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VIDEOTAPE INSTRUCTIONAL PACKAGE AND ITS EFFECT ON STUDENTS' ACHIEVEMENT AND RETENTION OF CONCEPTS IN CHEMISTRY AT SECONDARY SCHOOLS

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Abstract
This study examined videotape instructional package and its effect on students' achievement and retention of concepts in chemistry. One hundred (100) SSII chemistry students in Abakaliki Local Government Area of Ebonyi state southeast Nigeria made up the sample for this study. The sample was divided into two groups; one formed the experimental group taught with videotape instructional package while the other formed the control group taught with traditional method. The instrument for data collection was 60 items multiple choice questions in chemistry. Analysis of data was done using mean, standard deviation, and t-test statistics. The results revealed that videotape instructional package for teaching chemistry significantly improved achievement and retention of concepts capability of students than the traditional method. It was then recommended that videotape instructional package be used for instruction among students in Ebonyi state southeast Nigeria.

Introduction

Background of the study
Chemistry is one of the science subjects offered at the senior secondary school levels in Nigerian secondary schools, [1]. Chemistry is a very important science subject and a requirement for higher learning in a number of science-related professional courses like medicine, agriculture, pharmacy, engineering, etc. Ofoegbu, [2] opined that chemistry is a science subject done in secondary schools by a reasonable number of the students and in most schools, as it is optional for students. It is therefore a science subject that enables students to acquire the knowledge to live effectively in the modern age of science and technology. In contemporary Nigeria, greater emphasis is placed on science and technological development and as a result students are being encouraged to take up science subjects like chemistry.

The major goal of science education is to develop scientifically literate individuals who are concerned with high competence for rational thoughts and actions. The objectives of science education in Nigeria according to Maduekwe, [3] include the need to prepare students to; observe and explore the environment, explain simple natural phenomena, develop scientific attitudes including curiosity, critical reflection and objectivity, apply the skills and knowledge gained through science to solve everyday problems in the environment and develop self-confidence and self-reliance through problem solving activities in science.

The poor performances of secondary school students in chemistry over the years may not be unconnected with the method of teaching used in our various secondary schools. Education is a powerful instrument of self and national development. The work of Onyegegbu, [4] indicated that videotape films enhanced the level of performance in understanding schistomiasis. She carried out the studies with three schools and found out that the performance of those that used videotape recordings was higher than that of those that did not use videotape recordings. She concluded that this could be because of the ability of videotape films to motivate and as well as heighten reality.

Frank, [5] stated with evidence that there is hardly any object matter which could not be taught effectively through films and videos. According to him, films and videos help to arouse the students' interest to learn. Interest provides a strong motivation to learn especially when individual considers the subject interesting. This in turn bears more on retention level of students.

A good instruction would improve students' information retention capacity. According to Adedapo, Salawu and Afolabi, [6] audiovisual material when used effectively can stimulate interest among learners. Audiovisual

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materials usually induce longer retention of concepts as the learners come into contact with what is being described. This is in line with Onyegegbu, [4] who stated that videotape films can be used to transform classroom instruction into a series of rich memorable experiences thereby reducing forgetfulness.

On the whole, audiovisual materials are valuable for various age-groups and for those with varied learning abilities. They provide integrated experience, which may vary from the concrete to the abstract, and they have the ability to hold the attention of almost all students.

Statement of the problem

As teachers, the challenge is to understand how to use videotape accordingly to its benefit to the students. Apart from this, there is the need to make a personal professional commitment to supporting students' well being through the effective use of classroom instructional methods. Students should be conditioned to understand that confidence in oneself as a learner leads to maximum learning experience generally.

Lack of appropriate instructional media in our secondary schools has been a major setback to students' performances. More so, the low level of performance has been observed to be due to the type of instructional materials used and the method of teaching employed, [7]. In most cases the instructional materials used lack motivation due poor usage, and thereby denying students the all-important weapon for learning. Benedict, [8] reported that though videotape films have a strong influence on learning most teachers seldom use them because they are not aware of their effectiveness.

The trend of poor performance in most secondary school subjects including chemistry has been a disturbing phenomenon to all stakeholders and this trend has been suggested and investigated as being associated with the said lack of appropriate instructional media in our secondary schools [9]. Students' poor performances in the school subjects may not be on unrelated to their retention capabilities. Moreover, retention cannot be totally separated from the teaching and instructional materials adopted by the instructors. In view of this, skilled teachers continually breach for effective instructional procedures so that the tendency for students to "cram" for the purpose of passing the examinations is reduced. To actually advance in the above aim, motivational rather than intimidation approaches would be the use of suitable instructional media.

This research is therefore geared towards unravelling the effects of videotape instructional package on the achievement and retention of concepts in chemistry among secondary school students in Abakaliki Local Government Area Ebonyi State, Southeast Nigeria.

Purpose of the study

The purpose of this research work is to investigate videotape instructional package and its effect on students' achievement and retention of concepts in chemistry at secondary schools in Ebonyi state southeast Nigeria. In specific term, the work seeks investigate how the use of videotape instructional package would improve the learning of chemistry and improve the retention capabilities of chemistry.

Significance/Justification of the Study

The findings of this study would reveal the need to adopt or otherwise of videotape instructional package in teaching chemistry in particular and other subjects in general at secondary schools in Ebonyi state southeast Nigeria. This will be achieved through the application of recommendations of this study. Achieving this feat through this study will make students' achievement in chemistry to improve for better as the abstract nature of subject contents would be reduced. This would go a long way improving the science and technology status of the country.

The result of the study will be beneficial to the teachers, curriculum planners and other stakeholders in science education. This is in the area of helping them to develop a realizable educational goal in the subject.

The theoretical significance of this study is that, it will provide opportunities for a better understanding, elaboration or refinement of the Stimulus-Response Associationist's behavioral theory. S-R theory proposes that learning occurs due to the influence of the environment on an organism which makes the organism respond. If the study shows that the use of VTI instructional delivery approach helps in enhancing students' achievement and retention of chemistry concepts, the result will validate the S-R theory. Otherwise, it questions the S-R theory.

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The findings of this study will be beneficial to stakeholders in the educational sector. These stakeholders include educational policy makers, curriculum planners, government agencies, teachers and students. If the use of VTI instructional delivery approach is found valuable, curriculum planners will be provided with information that may be used in recommending effective innovations in teaching strategies. Findings could provide information which could inform the government and policy makers on the need for workshops, seminars and conferences on the use of VTI instructional delivery approach for teaching chemistry. The study might provide an insight into other school subjects on whether to use VTI to enhance students' achievement and retention.

The study could be useful to classroom teachers who decide what instructional delivery approach to deploy when teaching. Results of this study if found valuable, could provide a guide for choosing VTI as innovative instructional delivery approach.

The study could be beneficial to students if found effective. VTI could be used to enhance students' achievement as well as help them retain what they have learnt. Finally, the results of this study could provide empirical information to researchers interested in the use of VTI in education.

Scope of the study

This study focuses on one independent variable; videotaped instruction, and two dependent variables; achievement and retention. The content scope of this study is "Acids, Bases and Salts". Senior Secondary II (S.S.2) students will be used for this study. The geographical scope of this study is delimited to two public secondary schools in each of the three senatorial zones of the Ebonyi State.

Research Questions

The following research questions guided the study;

1. What is the effect of VTI on the mean achievement scores of students taught Chemistry as measured by a Chemistry Achievement Test (CAT)?
2. What is the effect of VTI on the mean retention scores of students taught Chemistry as measured by a Chemistry Retention Test (CRT)?

Hypotheses

Two null hypotheses were formulated for this tested and tested at 0.05 level of significance.

1. There is no significant difference in the mean achievement scores of students taught chemistry with videotape instructional package and those taught without the package.
2. There is no significant difference in mean retention scores of students taught chemistry with videotape instructional package and those taught without the package.

Literature review

In the conceptual framework, the concept of instructional materials revealed that they are the pivot on which the wheel of teaching and learning rotates. This is because, teaching and learning are complex processes composed of interaction among teachers, students, instructional content and the environment, [10],[11]. Therefore, in order to achieve the set out instructional objectives, the teacher must adopt a proper instructional delivery approach. The traditional instructional delivery approaches in vogue have not really being able to achieve these objectives fully because they make students understand chemistry concepts at knowledge level without understanding the real meanings. As a result, it is therefore important that alternative instructional delivery approaches be adopted to teach the difficult concepts in chemistry. From studies, it is discovered that there is a high rate of failure in chemistry and in order to address this issue, teachers need to be exposed to appropriate teaching and learning approaches which require the use of instructional materials, [4], [12], [13]. This is because it has been observed that retention of concepts can be improved by explicitly creating memorable events involving visual or auditory images,[5].

In the theoretical background, two theories were discussed namely; Stimulus-Response (S-R) Learning Theory and Social Cognitive Theory. The S-R learning theory is also known as the behavioural theory, [5],[14]. For the behaviourist, the quality of what is learnt depends on the strength and nature of the links between the stimulus and the response. For this study, students will be instructed using VTI containing chemistry instructions. The instruction here is the stimulus because it contains visual and sound sensations. The responses of students to these will then be assessed. The social cognitive theory believes that the learner plays a prominent role in cognitively selecting, organizing and transforming stimuli from the environment in which he is found.

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Accordingly, learning occurs by watching the events of the environment. For this study, the students watched (observed) biology instructions as presented using VTI (stimulus). The study assessed if the students were able to cognitively organize and transform the stimuli. The assessment was done using their answers (responses) to the questions posed on the instructional content, [2], [14]. Acquisition of skills (learning) indicates ability to transform stimuli from the environment.

The empirical studies were categorized under studies on the use of VTI and students' achievement in science and studies on retention. From the review of related literature on VTI, it is evident that studies are very scanty in the area of chemistry.

Therefore, this study intends to find out the effects of VTI instructional delivery approach on students' achievement and retention in chemistry.

From the studies related to retention, it is noted that meaningfulness, direction and motivation are the key ingredients which help to enhance retention. Also, the use of proper instructional delivery approach like VTI would probably enable students retain the concepts in chemistry more than using the traditional instructional delivery approaches, [14], [15], [16]. It would appear that VTI has been effective for students utilizing them to direct their independent study. However, additional knowledge and experience might be gained from an investigation into their effect on achievement in chemistry instruction as well as their effect on students' retentive ability. This study will hopefully assist in providing evidence about the effectiveness of VTI to instructions and learning and on achievement and retention ability.

Methodology

Research Design

The design of this study is a quasi-experimental design, specifically, the pretest-post-test non-equivalent group design. It investigated the effects of video-taped instructions (VTI) on achievement and retention. Control group was instructed with Traditional Teaching Method (TTM). It is a quasi-experimental design because the two treatment groups were randomly assigned to two intact classes. The use of intact classes was to avoid disrupting normal class activities in the schools involved in the study. Symbolically, this design is represented thus:

Group 1 O X1 O1 O2

Group 2 O X2 O1 O2

The symbols are explained thus:
O = Pretest observations
X1 = Treatment 1 using VTI
X2 = Treatment 2 using Traditional Teaching Method (Control)
O1 = Posttest observations
O2 = Retention test
--- = Non-equivalent of the two groups

Area of the Study

The study was conducted in Ebonyi state, an inland south-eastern state of Nigeria. The state shares boundaries with Benue state to the north, Enugu state to the north-west, Abia state to the south-east and Cross River State to the east. It has an area of 5,533 square kilometers and lies 6º15'N8º05'E, 6.250ºN,8.083ºE, [17]. Most urban towns in Ebonyi State like Abakaliki, Onueke, Afikpo, Uburu, etc enjoy relatively stable electricity supply and schools located in such areas can boost of basic infrastructures like laboratories which are prerequisite for the experiment.

Population of the Study

The population for this study comprises all the chemistry students in senior secondary class two (SS II) in Ebonyi state. This is because the topic chosen for the study is taught in first term of SSII according to chemistry core curriculum. Ebonyi state has about 93 public secondary schools with an estimated number of 5,130 students offering chemistry.

Sample and Sampling Technique

The sample for this study was drawn from two schools from each of the three senatorial zones of the state. The sample size for this study was 180 students drawn from six public secondary schools in Ebonyi state. The sampling technique used is multi-stage sampling technique. Purposive sampling technique was first used to select two schools with similar characteristics (in terms of facilities, staffing, poor performance in chemistry and location). Secondly, random sampling was used to select one intact class from each school. Finally, treatment was randomly assigned to each intact class, that is, one class was assigned VTI and the other, Traditional Teaching Method (TTM).

Instrument for Data Collection

Two instruments were used for data collection in this study. They are the Chemistry Achievement Test (CAT) and Chemistry Retention Test (CRT). Specifically, the questions were drawn from "Acids, Bases and Salts" of chemistry content. The CAT was used for both pre-test and post-test. It consists of 30 items of multiple choice objective tests. Each objective question has 4 options A, B, C, and D, scored 1 mark each with a total of 30 marks. This test is designed to measure students' cognitive achievement in the "Acids, Bases and Salts" lesson. The CRT was used to determine the extent to which the experimental groups differed in remembering the contents taught and it was administered two weeks after the achievement test. The retention test is the same as the achievement test, except for the fact that, the items in the achievement test were re-organized and printed on a coloured paper.

Development of Instructional Materials

The instructional delivery approaches that were used are VTI and TTM. The VTI containing these instructions on the "Acids, Bases and Salts" were used as instructional materials in delivering the lesson. The VTI was developed by the combined efforts of the researcher and a Computer Programmer using the lesson script. The lesson scripts were prepared by the researcher and it comprised of three lessons of 40 minutes duration each on the topic "Acids, Bases and Salts". The VTI and was designed to help students know the definitions of acids, bases and salts, their properties and uses. The topic was selected from SS II Chemistry curriculum.

Validation of Instrument for Data Collection and Instructional Materials

The CAT, CRT, a table of specification which guided the development of the test items, VTI containing Chemistry instructions and lesson scripts were made available to the validators. The researcher asked the validators to; examine the structure of the items, determine the extent to which the items will help to achieve the objectives of the topic, determine the extent the table of specification is correct with respect to the topic covered. Two experts from Science Education and one expert from Educational Technology validated the instruments and instructional material. Comments and corrections were noted and affected by the researcher.

Reliability of the Instrument

The CAT was trial-tested by administering the test to a sample of 40 students in one intact chemistry class of SS 2 students at Enyigba Comprehensive Secondary School, Eketube, Abakaliki Local Government Area. These subjects were not involved in the main study but were equivalent samples of the group for which the instrument was developed and had covered the lessons on the topic chosen. Trial testing was done in order to determine the reliability of the instrument. The scripts were marked and the scores recorded.

To estimate the reliability of the instrument, the data collected from the CAT was subjected to a reliability test and analyzed using Kudder–Richardson Formula 20 (KR20) reliability coefficient. The Kudder–Richardson Formula 20 was used because the test items were dichotomously scored and administered only once. A reliability index of 0.88 was determined.

Experimental Procedure

This study involved two groups. The VTI group was the experimental group 1 while the TTM group was the experimental group 2. On the first day of the experiment, the test instrument CAT was administered as pre-test to all the students in the sample schools. After this, the VTI group was taught the "Acids, Bases and Salts" for a period of two weeks using the VTI played in a laptop and projected on a screen using a projector for better and clearer view, while traditional teaching method was used for the control TTM group. A total of 5 lesson periods were taught each group and the lesson period lasted for 40 minutes. At the end of the lessons, post-test was administered to the students. The researcher evaluated and recorded the scores. The retention test was administered to the students 2 weeks after the experiment. The retention test is necessary to determine how the two treatment groups differ in remembering the contents learnt. The teachers helped in distributing the instrument and answer sheets to the students. They also supervised the students and collected the answer sheets at the end of the test.

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Control of extraneous variables

The following measures were adopted to control some of the extraneous variables in the study:

(i) Experimental Bias: When a researcher involves external teachers in experiments, the students become sensitized that they were being used for a study. Consequently, they tend to behave mechanically, faking most of their actions. This introduces bias. In order to avoid bias in this study, the regular chemistry teachers in each of the schools used for the study were trained on how to use the media. The researcher monitored these teachers to ensure that they effectively adhered to instructions.

(ii) School Variables: Public schools were used in order to ensure that the students have the same learning standard and share similar classroom conditions.

(iii) Initial Group Differences: Randomization is one of the procedures of controlling initial group differences in an experimental study. However, this was not done in the present research since the process would disrupt normal school administration. Instead, intact classes were used. Thus, to control initial differences of subjects in these intact classes, Analysis of Covariance (ANCOVA) was used in data analysis as post-hoc control.

(iv) Variability of Instructional Situation: Homogeneity of instruction across groups was ensured as follows;

- The researcher trained all the teachers on instructional procedures involved.
- Teachers were directed to strictly follow the detailed lesson note provided.
- The VTI and TTM groups were taught the same topics within the regular periods allocated to chemistry in the school time table.

(v) Teacher Variable: In other to control the teacher variable, the researcher prepared the lesson notes on the topic in chemistry which were used to instruct the students. The researcher trained the teachers on how to effectively handle the lesson. The training package involved showing the teachers how to effectively operate the projector.

Method of data collection

Students' scores in the first administration of test items served as the pre-test scores of the study. The topic "Acids, Bases and Salts" was taught for two weeks after which the test items were re-arranged and re-administered to the students as post-test. The scores that were obtained from second administration served as post test scores in the study. After 2 weeks, the items were re-arranged and printed on a coloured paper and re-administered. The scores that were obtained from the third administration served as retention test scores in the study.

Method of data analysis

The research questions were analyzed using mean and standard deviation. The hypotheses were tested at 0.05 level of significance using t-test statistics.

Results and discussion

Data analysis

Hypothesis one: There is no significant difference in the mean achievement scores of students taught chemistry with videotape instructional package and those taught without the package.

The data collected were then analyzed using t-test statistics

Table I: Result of pre-test scores for experimental and control groups

Groups	N	df	$\bar{x}$	SD	Calculated t-value	Critical t-value	p
Experimental		48	23.86	7.03	0.521	1.68	0.605
Control	50		24.38	6.13			

Table I indicated the result of analysis of the pretest scores of the experimental and control groups. The pretest analyses were to determine whether the means and standard deviations of the two groups differed significantly. The results indicated that the groups were equivalent before the treatment ($t = 0.521$, $df = 48$, $p > 0.05$)

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Table 2: Post-test results of experimental and control groups

Groups	N	df	$\bar{x}$	SD	Calculated t-value	Critical t-value	p
Experimental	50	48	71.36	13.23	12.38	1.68	0.001
Control	50		44.16	8.73			

Significant at $p > 0.05$

Table 2 presents the t-test to compare the post mean scores of the experimental and control groups

The mean scores for experimental and control groups, was 71.36 and 44.18 respectively. The t-test value calculated is 12.38 and the t-test value critical is 1.68. In view of this, since t-value calculated is greater than t-value critical it indicates that there is statistically significant difference between the mean scores of the experimental group (71.36) and control group (44.18) at the 0.05 level of significance ($t = 12.38$, $df = 48$, $p < 0.05$). In this view, $H0_1$ is rejected.

The experimental group exposed to videotape instructional package on chemistry performed significantly better than the control group that was taught without the package.
From the result it showed that the use of videotape instructional package as instructional material had a positive effect on the achievement of students. This result is in line with the findings of Onyegegbu, [4] that the use of videotape recording in teaching enhanced students academic achievement.

Hypothesis Two: There is no significant difference in the mean retention scores of students taught chemistry with videotape instructional package and those taught without the package

Table 3: post-test results of experimental and control groups

Groups	N	df	$\bar{x}$	SD	Calculated t-value	Critical t-value	p
Experimental	50	68.18	8.04	5.90	19.417	1.68	0.001
Control	50	48	38.88				

Significant at the 0.05 level

Table 3: indicates the t-test comparison of the post-test mean scores of the experimental group is 68.18 as compared to that of the control group which is 38.88.

Since the t-value calculated of 19.417 is greater that the t-value critical of 1.68, it indicates that there is significant difference between the mean scores of the post-test of the experimental group (68.18) and the post-test of the control group (38.88) at the 0.05 level of significance ($t = 19.417$, $df = 49$, $p < 0.05$). The mean post-test score of student dropped by a mean of 2.18 for the experimental group and 5.30 for the control group, however greater proportion of the concept of chemistry was retained by the experimental group taught with videotape instructional package. The result shows that the videotape instructional package enhanced retention of the concepts of chemistry. On this note hypothesis two is rejected.

Conclusion

This study aimed to investigate the effects of videotape instructional package on students' achievement and retention of chemistry concepts, two hypotheses were tested. A total of 100 chemistry students from randomly selected schools divided into two groups were taught some concepts of chemistry using videotape package and traditional teaching methods. One of the groups formed the experimental group and the other formed the control group. The experimental group was taught chemistry using videotape package while the control group was taught the same concepts in chemistry using the traditional teaching method. The treatment lasted for four weeks for both groups. Pretest, post-test experimental- control group design was employed in carrying out the study. Pretest was first administered to determine, the level of equivalence of the two groups with respect to their prior knowledge of the concepts of chemistry and were found to be equivalent. After the treatment, a post-test was administered to

both groups to evaluate the effect of treatment on students' performance. A post-test was administered, after four weeks to determine the retention of the concept of chemistry by experimental group. Data gathered were analyzed and tested at 0.05 level of significance.

Findings

i. The use of videotape instructional package for learning chemistry significantly improved achievement of students compared to the traditional method.
ii. The use of videotape instructional package enhanced retention of the concepts of chemistry among the students.
iii. When videotape instructional package is used in chemistry teaching, students learn faster and retain more concepts.

Educational Implications

The findings of this study have far reaching implications for not only teaching and learning of chemistry but other subjects especially the sciences. When relevant stakeholders in educational sector are made to be fully aware of the benefits derivable from the use of VTI package in the teaching and learning process and appropriate actions taken for its domestication there is every likelihood that the performances of the students would improve greatly.

Limitations of the Study

(i) The research work focused on chemistry only but can be generalized to other subjects especially the sciences.
(ii) It took the researcher extra time and effort to reach the respondents due to their tight schedules of activities and to get the students in the frame of mind.

Recommendations

In the light of the findings of this study the following recommendations are made for the improvement of teaching, learning and retention of chemistry concepts.

i. Educational authorities should motivate and encourage teachers generally with respect of the use of videotape instructional package through in-service training and necessary teaching skill acquisition.
ii. Professional associations should organize work shops and seminars to acquaint teachers with the current development in education and the use of technological instructional materials such as videotape instructional package.

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