

Impact of Audio-Visual Aids on Senior High School Students' Achievement in Physics

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Abstract

This study was aimed at finding out the impact audio-visual-aided instruction on students' achievement in physics at Cape Coast township of Cape Coast Metropolis, Ghana. The study was a non-randomized pretest-posttest group design. A total of 65 students in Senior High School (SHS) formed the sample for the study. The students were fourth year science students from two purposefully selected co-educational SHS. The two selected schools were randomly designated experimental and control groups respectively. A validated physics achievement test instrument of a reliability coefficient of 0.76 was administered. Analysis of Covariance (ANCOVA) and t-test statistics were used to test the two hypotheses formulated to guide the study at a significance level 0.05. The results showed that SHS students taught with audio-visual aided instruction performed better than those taught with traditional method. The mean achievement scores of both male and female students improved significantly by the use of the audio-visual aided instruction. It was therefore recommended that SHS physics teachers should explore the use of audio-visual-aided instruction to teach the subject, physics.

Keywords: Audio-Visual Aids, Senior High School, Physics Achievement, Traditional Method

Introduction

According to Nacino-Brown, Oke and Brown (1985), for effective teaching to take place, a good method must be adopted by a teacher. Teachers are aware that students learn in different ways and have different ways of absorbing information and of demonstrating their knowledge (Tamakloe, Atta, & Amedahe, 2005). Teachers employ a variety of teaching strategies and methods to ensure that learners have equal opportunities to learn. It must however be stated that teaching methodology in education is not a new concept in the teaching and learning process. New methods and techniques evolve almost every day to supplement existing ones in teaching. Notable among them is technology-supported ones.

Kochhar (2004) observes that more recently technology has been successfully introduced in the field of education to make education more productive and more individual. To Kochhar (2004), the most outstanding development in modern education is the increase in the use of supplementary devices by which the teacher through the use of one sensory channel

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helps to clarify, establish and correlate accuracy, concepts, interpretation and appreciation, increase knowledge, rouses interest and even evokes worthy emotions and enriches the imagination of students. Researchers (see for example, Dale, 1996; Fillmore, 2008) have also recommended that in education we should appeal to mind chiefly through the visual and auditory sense organs since it is possible that 85% of our learning is absorbed through these senses.

Science has been regarded as the bedrock of modern day technology. Countries all over the world especially the developing ones like Ghana are making a lot of efforts to develop technologically and scientifically. This has become necessary because the world is turning “scientific”. And the situation in schools is no exception. At the core, we can say science comprises three disciplines: Biology, Chemistry, and Physics. Oguneleye (2002), as cited in Oladajo, Olosunde, Ojebisi, & Isola (2011) stated that science, and for that matter physics, is a dynamic human activity concerned with understanding the workings of the world. This understanding, he says, helps people to know more about the universe. Without the application of the discipline (physics), it would have been difficult for man to explore the other planets of the universe. Investigations however, have shown that physics education is in crisis as the number of students studying physics at all levels is declining rapidly (Fillmore, 2008; Smithers & Robinson, 2007). It has also been found that of all the sciences, physics is the subject in which the increase in number involved has been particularly low (Barbosa, 2003; Donnellan, 2003). The reason may include lack of specialist physics teachers and the perception that physics is a difficult subject (Buabeng & Ntow, 2010; Fillmore, 2008; Isola, 2010). Other researchers (see for example, Paas, Renkl, & Sweller, 2004; Prow, 2003) have also reported that physics is a difficult subject to learn where maximum effort is required and the resulting grade may not always reflect the effort that students have expended.

Studies have also revealed that the performance of students in physics in most African countries was generally and consistently poor over the years (Oladajo, Olosunde, Ojebisi, & Isola 2011; Osmosewo, 1999; Wambugu & Changeiywo 2008). Tamakloe, Atta, and Amedahe (2005) observed that it is not all those who teach students that are considered in the traditional sense as teachers. In their opinion, the teacher is the one who understands what his or her students need to learn and their capabilities of learning. Thus the teacher must be able to judge just how much intervention students will require in their learning activities. The physics teacher is therefore supposed to be one who would facilitate the learning process of learners. He/she ought to be a professional who will make use of any available resources to enhance teaching and learning.

The use of audio-visual aids in education has been found to be an effective way of communicating ideas and concepts to students (Le Doux, 1996; Ouellette, 2004). Literature has also established that audio-visual-aided instruction has greatly improved the performance of students in physics especially those with special needs and slow learners abilities (Aremu, 1992; Mitchell & Surprise, 1994; Okwo, 1994; Osokoya, 2007). However, many teachers in Senior High Schools (SHS) in Ghana do not use audio-visual aids when teaching physics. Although there are a few notable exceptions, others either feel these materials are inappropriate for instruction or use them poorly. Some teachers find it quite complex to use audio-visual aids to complement the traditional lecture method while others perceive the use of it as waste of time.

With respect to instruction, students’ achievement and attitude towards learning, research has not only proven the efficacy of technology related materials but has also found the results to be overwhelmingly positive (Dabbagh, 2001). Teaching and learning with audio-visual resources play an important role in the teaching-learning process. Students often benefit from the visual/sound appeal of audio-visual material because it tends to focus their

attention on the topic. When teachers present materials in various manners such as providing students with both a summary statement and a chart on a given topic, the visual material enhances the written materials. King (1990) indicated that audio-visual resources, wisely selected and intelligently used, arouse and develop intense and beneficial interest and so motivate students to learn; and properly motivated learning means improved attitudes, permanency of impression and rich experience and ultimately more wholesome living.

Since most students consider physics as an abstract subject, the use of audio-visual resources should be a requirement for every physics teacher if the aim of the teacher is to guide the student to master concepts in the subject (physics). Quellette (2004) sums up tenaciously that words may easily be forgotten but mental pictures will long be remembered. It is therefore important to prepare illustrative materials and short demonstrations or other visual materials which are effective means of helping students to understand and thereby facilitating learning.

Objectives of the Study

The study sought to find out the impact of the use of audio-visual aids when it complements the traditional lecture method on the performance of Ghanaian SHS physics students compared to the use of only the traditional method. The following null hypotheses were formulated to guide the study:

- H₀₁: There is no significant difference between the mean posttest achievement scores of SHS students taught with audio-visual aided instruction and those taught through the traditional approach.
- H₀₂: There is no significant difference between the mean achievement scores of (a) male and (b) female students taught with audio-visual aids and those taught with traditional method.

Research Methodology

Design

Quasi-experimental research design was adopted for the study. Specifically, the study used non-randomized pretest-posttest group design. Quasi-experimental design was used because intact classes were used instead of randomly composed samples (Oladejo, Olosunde, Ojebisi, & Isola, 2011; Osokoya, 2007; Owusu, Money, Appiah, & Wilmot, 2010). The diagrammatic representation of the design is shown below:

O ₁ X ₁ O ₂	Experimental group
O ₃ X ₂ O ₄	Control group

where

O₁ and O₃ represent pretest
O₂ and O₄ represent posttest
X₁ represents treatment (audio-visual aided instruction)
X₂ represents treatment (traditional method)

Sample and Sampling Technique

A total of 65 physics students in SHS formed the sample for the study. The students were fourth year science students from two purposefully selected co-educational SHS in the Cape Coast town of the Cape Coast Metropolis, Ghana. The two schools were the only co-educational institutions in the Metropolis that offered physics as an elective subject at the time of the study. The two selected schools were randomly designated experimental and control

groups respectively. There were 35 students in the experimental group and 30 in the control group. The researchers chose the fourth year students because they had treated almost all major topics.

Instrument

The instrument used in this study was a self-designed Physics Achievement Test (PAT). The PAT consisted of 40 objective multiple choice items with four options on the units used in the study. Students were asked to choose the correct option from the four given options. Out of the 40 items, 15 were drawn from selected topics in mechanics, 10 from current electricity, eight from sound and waves and seven from atomic and nuclear physics. The achievement test (PAT) was used to measure the pretest and the posttest of the experimental and control groups.

The instrument was face-and content-validated by experts in the subject and Measurement and Evaluation by adhering to the table of specifications. Kuder-Richardson 21 reliability coefficient was used to establish the reliability of the instrument since items were scored dichotomously (correct/incorrect). The reliability of the test was found to be 0.76. According to Fraenkel and Wallen (2000), an alpha value of 0.7 and above is considered suitable to make group inferences that are accurate enough.

Procedure

In this text, audio-visual aided instruction refers to a type of teaching where teaching or learning aids that appear to the two most used senses – hearing and visual such as videos are used to complement the traditional lecture method.

The non-randomized pretest-posttest design was used to collect data for the study. The main treatment for the study was teaching using the traditional lecture and audio-visual aided methods. The experimental group was taught the units used in the study with audio-visual aids whereas the control group was taught the same units using the traditional lecture method. The physics teachers in the selected schools were used for the teaching. In the control group, the physics teacher delivered a pre-planned lesson to the students whereas in the experimental group, the teacher was trained by the researchers on how to use the audio-visual aids. The teaching of the topics lasted in each group for four weeks with three meetings per week for the normal two period teaching times (80 minutes).

The validated physics achievement test was administered as a pretest before treatment commenced. After teaching both groups the posttest was conducted with the same achievement test (except that the order and question numbers were altered) to avoid guessing. Intervening variables extraneous to the study such as group interaction and teacher effect were controlled through the use of two different schools for the experimental and control groups; and the presence of at least one of the researchers during instructional periods and days tests were conducted.

Data Analysis

Inferential statistics were conducted to analyze the data obtained from the study. Specifically, null hypothesis one was tested at $p \leq 0.05$ significance level using analysis of covariance (ANCOVA). The pretest achievement score was used as covariate. Null hypothesis two was tested using independent samples t-test.

Findings

Students' achievement based on instructional strategy – null hypothesis one

Analysis of covariance (ANCOVA) was employed to investigate the efficacy of the instructional strategies. Preliminary checks were conducted to investigate the assumptions of

linearity and homogeneity of regression slopes, as these assumptions are very important as far as the use of ANCOVA is concerned. Figure 1 is a simple scatter plot showing the general distribution of the scores. It can be seen from the figure that a linear relationship exists between the dependent variable (posttest) and the covariate (pretest). This means that the two variables are related hence the covariate can be controlled.

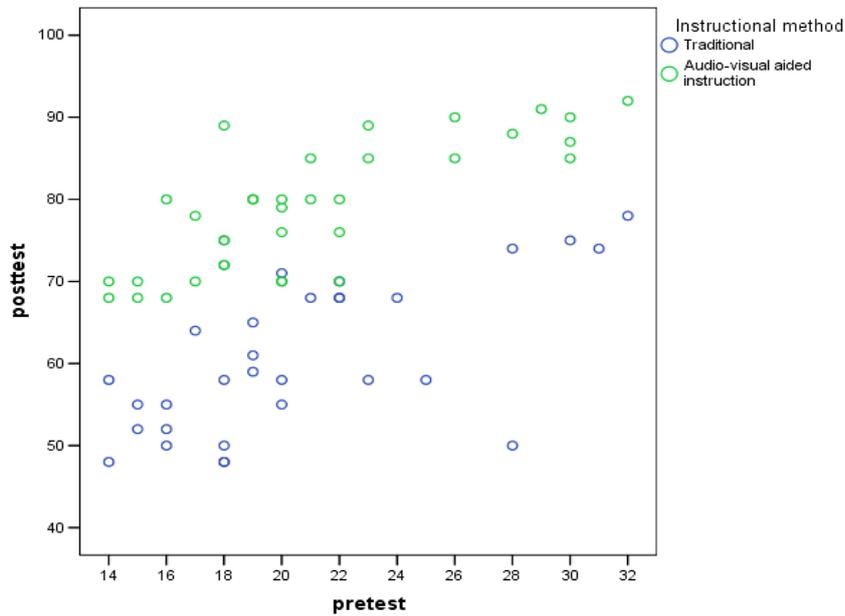


Figure 1. A scatter plot showing the relationship between the dependent variable (posttest) and the covariate (pretest)

The assumption of homogeneity of regression slopes was also investigated. The information presented in Table 1 was used to check this assumption.

Table 1. Test of Homogeneity of Regression Slopes

	Sum of Squares	df	Mean Square	F	p-value
Corrected model	7864.65	3	2621.55	77.43	0.000
Intercept	6710.37	1	6710.37	198	0.000
Instructional method	284.78	1	284.78	8.41	0.005
Pretest	2380.60	1	2380.60	70.31	0.000
Instr. method*pretest	0.060	1	0.060	0.002	0.967*
Error	2065.41	61	33.859		
Total	332503.00	65			
Corrected Total	9930.06	64			

* Not Significant, $p > 0.05$

As indicated in Table 1, the significant level of the interaction term, method*pretest is 0.967 which is greater than the cut-off point, 0.05. Hence, the assumption of the homogeneity of regression slopes is not violated. This supports the earlier conclusion obtained from the scatter plot.

The main ANCOVA results are presented in Table 2. The task here is to find out if the instructional strategies (treatments) are significantly different of their scores on the dependent variable (posttest). As shown in Table 2, the p-value for the predictor variable (instructional method) is 0.000 (which actually means $p < 0.0005$) which is less than 0.05; therefore the result is significant. It can be seen that the total variation to be explained (SS_T) was 9930.06 units (corrected total). Out of this figure, the amount of variation accounted for (SS_M) by the experimental manipulation was 7864.59 (corrected model) units of which the instructional strategy accounted for 5185.52 units, equivalent to 71.5% (eta square). About only 2065.47 units (SS_R) were unexplained (error).

Table 2. One-Way ANCOVA on Students Posttest Achievement Scores by Teaching Method

	Sum of Squares	df	Mean Square	F	p-value	Eta Square
Corrected model	7864.59	2	3932.29	118.02	0.000	0.792
Intercept	6734.21	1	6734.21	202.14	0.000	0.765
Pretest	2389.88	1	2389.88	71.74	0.000	0.536
Instr. method	5185.52	2	5185.52	155.66	0.000	0.715
Error	2065.47	62	33.31			
Total	332503.00	65				
Corrected Total	9930.06	64				

From the estimated marginal means (shown in Table 3), it is seen that the two instructional methods had different effects.

Table 3. Estimated Marginal Means

Instructional methods	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Traditional	60.79	1.054	58.684	62.899
Audio-visual aided instr.	78.72	1.273	76.771	80.673

We can therefore conclude that there is a significant difference between the mean posttest achievement scores of students taught with audio-visual aided instruction and those taught through the traditional approach. The null hypothesis one was therefore rejected.

Students' posttest achievement scores based on teaching method and gender – hypothesis two

The information presented in Table 4 and Table 5 were used to test the hypothesis that no significant difference exists between the mean posttest achievement scores of (a) male and (b) female students taught with audio-visual aids and those taught with traditional method.

Table 4. T-Test Comparison of Posttest Achievement Scores of Male Physics Students based on Teaching Method

Teaching method	N	Mean	Std. dev.	t	p-value
Traditional	17	62.06	9.69	-6.38	0.000*
Audio-visual aided	21	80.48	8.12		

*Significant, $p < 0.05$, df = 36

Table 4 shows an independent-samples t-test conducted to compare the posttest achievement scores for male physics students. The results show that there is indeed significant difference between the mean posttest scores of male physics students taught with audio-visual aided instruction ($M = 80.48$, $SD = 8.12$) and those taught with traditional method [$M = 62.06$, $SD = 9.69$]; $t(36) = -6.38$, $p < 0.05$]. The magnitude of the difference in the means (i.e. effect size) was large (eta squared computed = 0.53) (Cohen, 1988).

The post achievement scores for the female physics students were also compared using t-test. The results are shown in Table 5. The results in Table 5 show that there is significant difference between the mean posttest scores of female physics students taught with audio-visual aided instruction ($M = 76.64$, $SD = 6.82$) and those taught with traditional method [$M = 58.54$, $SD = 8.23$]; $t(25) = -6.24$, $p < 0.05$]. The magnitude of the difference in the means (i.e. effect size) was also large (eta squared computed = 0.61). Based on the results presented above null hypothesis two is rejected since there is a significant effect of teaching method on all the students.

Table 5. T-Test Comparison of Posttest Achievement Scores of Female Physics Students based on Teaching Method

Teaching method	N	Mean	Std. dev.	t	p-value
Traditional	13	58.54	8.23	-6.24	0.000*
Audio-visual aided	14	76.64	6.82		

*Significant, $p < 0.05$, $df = 25$

Discussion

The SHS students in the experimental group exhibited higher achievement than their counterparts in the control group. Thus the SHS students taught with audio-visual aids complementing the traditional method achieved better performance than the SHS students taught with only the traditional lecture method. The result has established that teaching methods were significant factors on students' achievement in physics. The higher performance by the students may be as a result of the audio-visual aids to provide more concrete representations of ideas and concepts which were normally taught in abstract form in the regular physics classes. The result of the study is in line with other studies (Mitchell & Surprise, 1994; Okwo, 1994; Oladajo, Olosunde, Ojebisi, & Isola 2011; Osokoya, 2007; Owusu, Money, Appiah, & Wilmot, 2010). Le Doux (1997) found that student learn better when audio visual-visual aids are used in the instructional segment to give reality to abstract thinking thereby making them more concrete. Evidence from the qualitative and quantitative analysis conducted by Fillmore (2008) also suggested that student learned physics better and performed well when taught with Tablet/Workbook Pedagogy than those taught with conventional method.

Conclusion and Recommendations

The study has shown that when appropriate media (e.g. audio-visuals) are integrated into the curriculum to complement the traditional method, higher learning outcomes in terms of achievement scores would probably result. SHS students taught with the audio-visual aided instruction achieved better than students taught with the traditional method. Performance was significantly improved by the use of audio-visual aided instructional approach in teaching

Physics. The mean achievement scores of both male and female students were significantly improved by the use of audio-visual aided instruction.

The study has shown that the use of audio-visual-aided instruction enhances student achievement in physics better than the use of the traditional method at the SHS level. SHS physics teachers should therefore be encouraged to adopt the method in their teaching. It is also suggested that researchers and SHS physics teachers should explore the use of audio-visual-aided instruction to teach other physics areas not covered by this study in order to determine its effectiveness and possible adoption as a major instructional strategy.

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