EFFECT OF COMPUTER-ASSISTED-INSTRUCTION ON ACHIEVEMENT IN GEOMETRIC OPTICS IN THE SENIOR SECONDARY SCHOOL PHYSICS

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Abstract

The study investigated whether Computer-Assisted instruction (CAI) enhances student's achievement in geometric optics (ray optics) than the conventional chalk-talk method of instruction at the senior secondary school. It adopted a quasi-experimental research design. A total of fifty students with twenty-five (25) in each of experimental and control groups was used. Specifically, a non-randomized control group pretest post-test design was adopted. Two intact classes of SSII in the selected secondary school were assigned into the two groups. The experimental group was exposed to the concept of geometric optics using CAI while the control group was taught geometric optics by conventional method of instruction. The instrument used for pretest and post-test was the Teacher Made Geometric Optic formula was established at 0.73. The formulated research questions were answered by the use of the mean and standard derivation while the hypothesis, generated was tested using analysis of covariance (ANCOVA). Findings revealed that the mean score of students in the experimental (CAI) groups was higher than those obtained for students in the conventional group at posttest. Study also revealed that there was no significant difference in the mean score of male and female in the CAI (experimental group) and the conventional (control) group. This implies that the instructional strategy of CAI enhanced students' performance in geometric optics. Conclusions and recommendations such as provision software, and computer facilities for teaching and learning geometric optics and other difficult concepts in physics at the senior secondary school were made.

Keywords: Computer-Assisted Instruction, Geometric Optics, Physics, Achievemet

Introduction

It is observed in Nigerians schools today that face-to-face instructional (conventional)method is the commonly used instructional practice for teaching physics and other science based subjects such as Chemistry and Biology. But rapid scientific and technological developments along with changes in the structure of the society has influence the educational systems in general and instructional methods so that new attempt in the use of computers in instructional delivery is today considered a necessary and effective tools for learning and communicating science concepts.

Kara & Kahraman (2008) defined computer-assisted-instruction (CAI) as the use of computer in educational and instructional activities. According to them, the use of computers has brought positive effect on learning over a broad range of study feature variables and this in turn raised the achievement of students. Optics is the geometry of paths of light rays and their imagery through optical systems (Mc Grawhill encyclopedia of science & technology , 1993) while geometric optics is the branch of optics dealing with light as rays, especially in the study of the effects of lenses and mirrors or light beam and of their combination in optical instrument (Dictionary Com. 2003).

Kadhivaran and Suresh (2003) asserted, that the use of different media in science instruction has continued to grow as educators have been able to identify and understand the process of the

usefulness of the media for better understanding of science phenomena among students. Akgun (2002) in Bayrak (2008) observed that rapid scientific and technological development along has influenced the education systems in general and instructional method in particular so that such trends bring about new attempts and needs in terms of teaching and learning processes. Among those new attempts is the use of computers in instructional processes known as computer-assisted-instruction(CAI).

Mahmood(2004) in his study on CAI on students achievements in General Science as a comparison to traditional method of instruction, obtain a result that the experimental group outperformed the control group in all achievement areas by level of cognitive dimension and by type of contents. Besides, in a study by Chang (2001) on exploring the effects of a problem-based computer-assisted instruction (PBCAI) on students' earth science achievement in Taiwan, students in the experimental group had significantly higher achievement scores than did students in the control group especially on the knowledge and comprehension test items but not on the application test items. Basaran (2005) in Gonen, Kocakaya and Innan (2006) reported that computer-assisted-teaching affects positively on the level of success in all educational levels in the study of comparative effect of Computer Assisted Teaching and the 7E model of constructivist learning methods on attitudes and achievements of students in the physics classes.

The field of optics is a complex area for student and many studies have shown students' difficulties in learning optics (Anderson, 2007). Besides, the WAEC(West African Examination Council)Chief Examiners 'report as published by the Daily Independent Newspaper(2013)observed that students' performance in Physics is below average and that this due to lack of in-depth understanding of concepts. Adelaja (2005) also observed that physics posses more difficult and challenging tasks to learners. Pearce and Roux (2006) expressed worry that the decline in physics achievement is below the conceptual threshold. Moreover, Mayer (2003) in Kera and Kahraman (2008) observed that experimental evidences had found that verbal-only method is not working so well and that increasing visual content makes instruction lasting and effective. In view of the above, it becomes imperative to provide an alternative instructional strategy such as the CAI for teaching geometrics optics for better understanding and achievement in senior secondary school physics.

This study therefore intends to investigate whether CAI when it is used in teaching geometric optics as a difficult concept will increase students' achievement in physics at the senior secondary school physics compared to the conventional talk-chalk method.

Objectives of the Study

The study which investigated the effect of computer-assisted instruction on student achievement on the concept of geometrical optics in the senior secondary school has the following objectives:

(i) find out if the achievement of senior secondary school physics students taught geometric optics by means of computer-assisted instruction differs from those taught by conventional method of instruction

(ii) find out if male and female senior secondary school physics students taught geometric optics by means of the computer-assisted instruction performed alike or differ in performance when taught by the conventional method.

(iii) find out if the means score of students taught geometric optics using the computer-assisted-instruction is the same with those taught using the conventional method of instruction.

Research Questions

The following research question were formulated in the study:

(i) What is the mean score of students taught geometric optics using CAI and mean score of students taught by conventional method of instruction at pretest.

(ii) What is the mean score of students taught geometric optics using CAI and the mean score of students using the conventional method of instruction at post-test.

Research Hypothesis

(i) There is no significant difference between the post-test achievement of students taught geometric optics using CAI and conventional methods

(ii) There is no significant difference between the mean achievement scores of male and female students taught geometric optics using the CAI and conventional method of instruction.

Methodology

The quasi-experimental design was adopted in the study. Quasi- experimental design are used where true experimental designs are not feasible. Quasi-experimental design does not provide full control although it is expected that the researcher reach a reasonable conclusions by been aware of the threats to both internal and external validity (Ary, Jacobs and Razavieh, 2002).

A non-randomized control group, pretest-posttest design was adopted so that school schedules would not being disrupted nor school classes reorganized to accommodate the study. Two classes in the selected senior secondary school which offers physics were used as pre-existing intact groups. The design is shown as follows:

Table 1: Research design layout

Group	Pretest	Independent Variable (Treatment)	Post-test
CAI group	0_1	X	0_2
Conventional group	0_1	Y	0_2

Where 0_1 represent the pre-test
0_2 represent the post-test
X represent teaching geometric optics with CAI
Y represent teaching geometric optics using the conventional Method

The population of the study consists of all secondary school in the Federal Capital Territory, Abuja. The sample comprises of fifty(50) senior secondary school (SSII) physics students. Two classes each of twenty-five(25) students were selected by systematic sampling into the CAI group and conventional method group .

A Teacher Made Geometric Optics Test (TEMGOT) was used for the data collection. Its contents were based on the concept of geometric optics. The test consists of twenty (20) test items, the content validity of the instrument was established by two experienced university and subject teachers in the selected school. A reliability coefficient of 0.73 was established for the instrument using the Kuder Richardson-20 formula.

The two intact classes for the study were assigned experimental and control groups. Both groups were exposed to pre-test using the teacher made test (TEMGOT) to establish their equivalence level. The experimental group were then subjected to treatment (teaching) on the concept of geometric optics using the computer program software called looking glass (which is an interactive physics package that helps students visualize and understand the effect of optic components on light rays),

Data collected at pretest and posttest for both control and experimental groups were analyzed using the analysis of covariance (ANCOVA) at 0.05 significant levels in order to proffer answer to the research hypothesis.

Results

Research Question 1

What is the mean score of students taught geometric optics using CAI and the mean score of students taught by conventional method of instruction at the pre-test?

Table 2: Mean scores of students in geometric optics using the CAI and conventional method of instruction at pre-test

Group	N	Mean	S.D
CAI	25	25.68	7.50
Conventional	25	24.68	5.79

Table 2 shows that the mean scores of physics at pretest were 25.68 and 24.68 for both the CAI and conventional method group respectively. The scores of the experimental and control groups on the pretest are illustrated in figure 1 . This implies that although the subjects in the two groups scored low before treatment but had equivalence in their level of achievement in the TEMGOT scores. This means that both groups were at comparable level before treatment was administered.

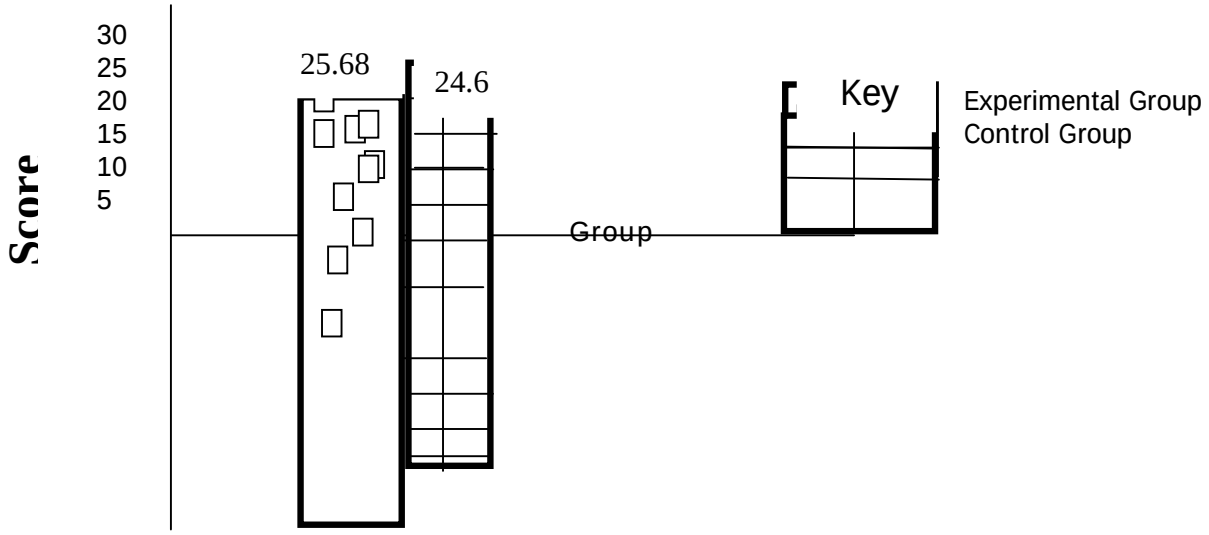

Fig 1: Bar Chart showing the means of the experimental and control groups on the pretest

Research Question 2:

What is the mean score of students taught geometric optics using CAI and the conventional method of instruction at posttest?

Table 3: Mean scores of students in geometric optics using the CAI and conventional method of instruction at posttest

Group	N	Mean	S.D
CAI	25	74.12	7.32
Conventional	25	50.20	9.27

From table 3, the mean score of students for the CAI group (experimental group) was 74.12 as against 50.20 for the conventional method group (control). The score of the experimental control group on the posttest are illustrated in figure 2 . Since that of the CAI was much higher than the conventional group, the difference could have resulted from the treatment using the CAI.

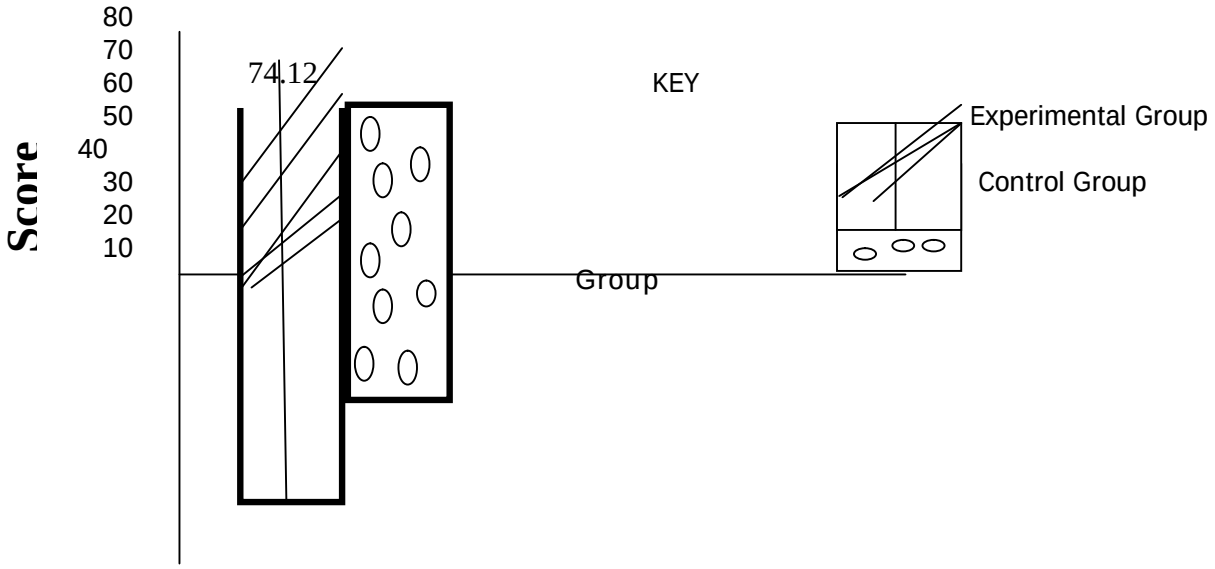

Fig 2: Bar chart of mean scores of the experimental and control groups on the post test

Research Hypothesis 1:

(i). There is no significant difference between the post-test achievement of students taught geometric optics using CAI and conventional methods .

Table 4: Showing the t-test statistics for significant test achievement in geometric difference between students post- optics using CAI and conventional method

Method	N	X	SD	df	t_{cal}	t_{cri}	P	Decision
CAI	25	74.12	7.32	24	-38.7	2.06	0.05	Not
Conventional	25	50.20	9.27					Significant

From table 4, $t_{cal}(-38.7) <$, $t_{cil}(2.06)$at p=0.05 for a two-tailed directional test with df = 24. Thus implying that the null hypothesis HO_1 was accepted .This means that the achievement of students in the two groups were the same.

Research Hypothesis 2

There is no significant difference between the mean achievement of male and female physics students taught geometric optics with CAI method and those taught with conventional method of teaching.

Table 5: Result of two-way ANCOVA for students' achievement in geometric optics using CAI and conventional group with respect to gender in the post-test

Source Square	Sum of Square	df	Mean Square	F	Significance
Covariate (S)	742,052	1	74.552	8.023	0.09
Main effect	15919.269	19	837.856	20.456	0.01
Method	65.019	6	10.837	0.026	0.45
Sex	65.019	2	27.797	0.037	0.42
Method	172.507	5	34.507	0.842	0.565
Error	694.662	23	30.203		
TOTAL	16165.00	25			

R squared = 0.098 (Adjusted R squared = 0.094)

Result shown on table 5 indicates that at F(2,23)=0.037,P=0.042,was not significant at 0.05 level of significant. This shows no significant difference on the main effect when gender was considered. The use of CAI accounted for no difference between male and female students achievement scores . Therefore hypothesis was not rejected.

Discussions

Findings in the study revealed that mean the score of students taught geometric optics. Using the computer-assisted-instruction (CAI) was significantly higher than the mean score achievement of students taught geometric optics using conventional method of instruction.

This is in line with the findings of Chang (2001) that students performance using CAI was better than their performance using the conventional method. Although result of t- test statistics shows no significance difference in achievement.

Also, there is no significant difference between the achievement of male and female students taught geometric optics using CAI and conventional method in the selected senior secondary school implying that gender has no effect on achievement in geometric physics.

The CAI as a method of instruction therefore should be adopted for teaching geometric optics in school for optimal achievement in physics.

Recommendations

In view of the findings in the study, the following recommendations are hereby made:

(i) Computers should be provided in schools for used in teaching of geometric optics as a difficult concept in the senior secondary school physics in Nigeria especially as most teaching done are by conventional methods.

(ii) Relevant software for teaching physics especially for difficult concepts such as geometric optics should be made available in Nigeria schools.

(iii) Physics teachers should be trained on the use of physics software and interactive physics especially for optional teaching and learning of different concepts.

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