EFFECTS OF COMPUTER ASSISTED INSTRUCTIONAL PACKAGE AND SUBJECT DISCIPLINE ON SECONDARY SCHOOL STUDENTS PERFORMANCE IN BIOLOGY

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ABSTRACT...

This study investigated the effects of computer assisted instruction (CAI) package on secondary school students' performance in biology, in Oyo, Nigeria. The research was quasi experimental involving 3x2 factorial designs. The sample for the study comprised 120 first year senior Secondary school students (SSSI) selected from the three private secondary schools. The three schools used for the study were randomly assigned to Experimental Group I (20 males and 20 females), Experimental Group II (19 males and 21 females) and Control group (19 males and 21 females). Each of the groups contained science and non-science students. The students' pretest and post test scores were subjected to Analysis of Covariance (ANCOVA). Post hoc analysis was done using scheffe test. The findings of the study showed that the performance of students exposed to CAI either individually or cooperatively were better than their counterparts exposed to the conventional classroom instruction on the selected biology topics. The students exposed to CAI in individual setting performed lower than those exposed to it in cooperative CAI in cooperative setting. There was, however, no significant difference in the performance of male and female students exposed to CAI in either individual setting or cooperative setting. Subject discipline did not affect the students' performance whether they were exposed to CAI in either individual setting or cooperative setting, as there was no significant difference in the performance of the science and non-science students. Based on the research findings, recommendations were made on the use of CAI for the teaching of biology in secondary schools

BACKGROUND TO THE STUDY

Technology has turned the whole world into a global village where geographical distance no longer hinders free and fast flow of information. The use of mobile phones, e-mail and internet facilities make it possible for anyone to communicate with another person anywhere in the world within a short time. Nigeria too is not left out in this technology awareness.

Information and communication process has shifted base from the paper form that it used to be. Offices now use electronic devices to keep records and process data. Record keeping is fast becoming paperless because documents that were put in paper files before are now saved in electronic devices (Afolabi, 2001). In Nigerian context, the application of computer-assisted instruction will hopefully be of advantage to the teaching learning process, particularly in biology.

Individuality of every single child in the classroom is important in the teaching - learning process. Psychologists and educationists have opined that no two children are ever equal in all aspects, not even identical twins. Child (1986), for example, counseled teachers to give first priority to the knowledge of history of the individual child in the class before determining whatever academic treatment will be relevant to him/her. This is what he called the child's "entry characteristics", which he said could be cognitive or affective.

The students' subject discipline cannot be left out in the consideration of the factors that affect students' academic performance. Seymour and Hewitt (1994) did not make it clear whether the science students really perform better than non-science students in academic tasks. However, Idowu (1999) was more specific in her own study. She conducted a study on the effects of three instructional methods on the learning outcome of students in ecology. She found that the science students performed better than non-science students in all the three treatments given on ecological concepts. It has also been opined by those who have studied the learning of science that students learn best if they are engaged in active learning involving observation and concepts before terms and facts (Fraser, 1986, Chickering & Gamson, 1987; Mc Dermott, et al, 1994, Mc Keachine, 1994; Tobin, et al, 1994). In a study conducted by Idowu (1999), on the effects of three instructional methods on the learning outcome of students in ecology, 169 senior secondary students were involved. ANCOVA was used to analysis the data collected. She found that science students performed better than non-science students in all the three treatments given on ecological concepts.

Purpose of the Study

The study investigated the effect of computer-assisted instruction on the performance of secondary school students in biology. Specifically, the study examined:

(1)   The difference in performance in biology, if any, of secondary school students exposed to individualized computer assisted instruction, cooperative computer assisted instruction, and those exposed to conventional instruction.

(2)   The influence of subject based (whether science or non-science) on students' performance in biology when they are exposed to individualized Computer Assisted Instruction or Cooperative Computer Assisted Instruction.

Research Questions

1.   Will there be any difference in the performance of biology students exposed to individualized computer assisted instruction, cooperative computer assisted instruction, and those taught using conventional method?
2.   Do the science students perform better than non-science students in biology when they are exposed to individualized CAI?
3.   Do the science students perform better than non-science students in biology when they are exposed to cooperative CAI?

Research Hypotheses

The following research hypotheses were generated for the study:

Ho1   There is no significant difference in the performance of students in biology when they are exposed to (i) individualized computer assisted instruction, (ii) Cooperative computer assisted instruction, and (iii) Conventional instruction.

Ho2   There is no significant difference in performance in biology of science and non-science students when they are exposed to individualized computer assisted instruction.

Ho3   There is no significant difference in performance in biology of science and non-science students when they are taught using cooperative computer assisted instruction

Scope of the Study

This study was conducted in three secondary schools, namely Nesto College Oyo, St. Francis Catholic College Oyo and Ise Oluwa Montessori College Ibadan, located in Oyo State. The SSS 1 students were used since they had not studied the topics used in this research before. The researcher did not use the SSS 3 student because at that level, students' attention is usually focused on the final SSCE (WAEC/NECO) examinations and as such, any interruption in their studies may be injurious to them. The SS2 students too were not used because they had already studied the topics used in this research.

Research Design

This study is a quasi-experimental type, of the pre-test, post-test, non-equivalents, non- randomized, control group design. The design is a 3x2 factorial design. This paradigm represents three levels of treatment: the individualized Computer Assisted Instruction (experimental group 1), Cooperative Computer Assisted Instruction (experimental group 2) and the Conventional Instruction (control

group) and two levels of subject discipline (science and non- science). The dependent variable is the post-test scores.

Sample and Sampling Technique

The target population of this research was the first year senior secondary biology students in Oyo and Ibadan towns. The nature of the study, however, required that the research sample was purposively selected. This is because a research on CAI must necessarily be conducted in schools where computers are available for students' use and where the students are computer literate. This is why the NESTO College, Oyo, and Ise-Oluwa Montessori Secondary School, Ibadan were purposely sampled for the study. These two schools were selected as the experimental groups. A third school, St. Francis Catholic College, Oyo was also sampled as the control group, as the school is believed to be more or less equivalent in standard.

In each of the three schools, the senior secondary class 1 students were used for the study. The reason why SS1 students were used for the study is because SS111 students who will be preparing for their final Senior Secondary Certificate Examination (SSCE) might have their programme disrupted by the research. The SS11 students too were not used because they have already treated the topics used in this research.

Initially, sixty students randomly sampled were involved in the study in each of the schools. The sample selected was later stratified along subject discipline (science and non-science). Forty students were eventually selected for the study from each school. The three schools were randomly assigned to Experimental group I, Experimental group II, and the control group.

Research Instruments

The instruments for this research were the treatment instrument, Computer Assisted Instructional Package (CAIP) and the test instrument, Biology Performance Test (BIOPET). The treatment instrument, Computer Assisted Instructional Package (CAIP) on Biology, was developed by the researcher, with the assistance of a professional computer programmer.

The test instrument, Biology Performance Test (BIOPET) is a 30 item multiple-choice objective test with five options each which were selected from past WAEC/SSCE biology paper II questions. The test items were selected to cover the content of CAIP and the content for the control group.

DATA ANALYSES AND RESULTS

The students' post-test scores were analysed using the Analysis of covariance (ANCOVA), with the pretest used as covariate. A level of 0.05 probability was adopted for all analyses and the criterion for significance. A follow-up Scheffee test was used to identify the actual mean scores that were significantly different from one another for more than two groups.

Hypothesis One

There is no significant difference in the performance of students in biology when they are exposed to (i) Individualized Computer Assisted Instruction (ICAI), (ii) Cooperative Computer Assisted Instruction (CCAI), and (iii) Conventional Instruction (CI).

To determine the relative effectiveness of the three instructional treatment (ICAI, CCAI and CI), the students scores were analysed through ANCOVA and the result is as shown in Table 1.

Table 1: Analysis of Covariance of Mean Score of students Exposed to ICAI, CCAI, and, CCI.

Source of Variation	Sum of Squares		Mean square	F	Significance of F
Covariates (Pretest)	981.571	1	981.571	433.589	.000
Main effect (treatment)	167.160	2	83.580	36.920	.000
Explained	1148.731	3	382.910		
Residual	262.604	116	2.264		
Total	197.465	119	11.8599		

* denotes F is significant at 0.05 alpha level.

An examination of table 1 reveals that an $F_{(2, 117)} = 36.920$, $\alpha = 0.000$ for the main effect (treatment) was significant. This is because the significance of $F = 0.000$ is less than the 0.05 alpha level. This result shows that different CAI modes (ICAI and CCAI) as well as the conventional method of instruction (CCI) produced significant difference on the post test performance of students when the covariate effect (pretest) was statistically controlled. Hypothesis one was therefore rejected. A follow up scheffe test was conducted to locate where the significant difference existed among the three treatments' mean scores of the three treatment groups as indicated in Table 2.

Table 2: Scheffee Test of Significance on the Mean Scores of students Exposed to ICAL, CCAI and CCI

Groups	Mean Scores	Group I (CAI)	Group II (CCAI)	Group III (CCI)
Group I (ICAI)	17.8750		*0.014	*0.000
Group II (CCAI)	20.0500	* 0.014		* 0.000
Group III (CCI)	14.0500	*0.000	*0.000	

* The mean difference is significant at the 0.05 level.

The data in Table 2 indicate that there was significant difference in the post test mean scores of students exposed to ICAI (X=17.8750) and those exposed to

CCAI (X =20.0500) in favour of experimental group II, that is those exposed to cooperative computer assisted instruction. It also indicates that significant difference exists in the post test scores of students exposed to CCAI (X = 20.0500) and those exposed to CCI (X = 14.0500) in favour of students exposed to CCAI. Significant difference was established in the posttest scores of students exposed to ICAI (X=17.8750) and those exposed to CCI (X=14.0500) in favour of ICAI group.

The result in Table 2 is explained further with a graphical representation which shows that the mean gain scores made by the ICAI and CCAI groups were higher than the gain made by the CCI. This means that the ICAI and CCAI enhanced the performances of students when they are taught ecology concepts in biology than those taught using the conventional method.

Table 3: The mean scores of ICAI, CCAI, and CCI groups.

Groups	Pre test $\bar{x}$	Post test $\bar{x}$	$\bar{x}$ Gain Score
Group I ((ICAI)	10.3000	17.875	7.575
Group 11(CCAI)	14.275	20.0500	5.775
Group 111(CCI)	9.275	14.0500	4.775

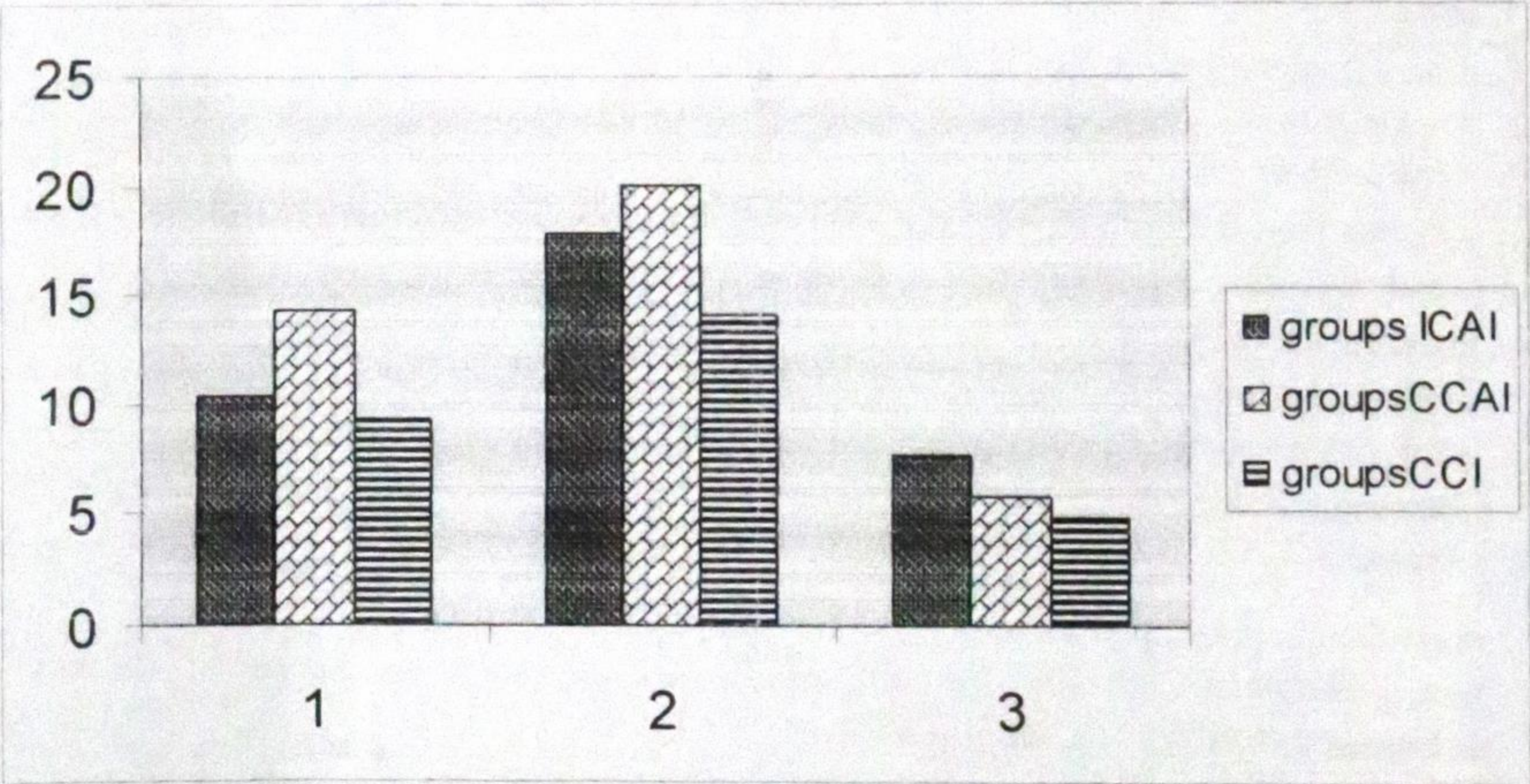Pretest Mean   Post test Mean   Mean Gain Score
Figure 1 Graphical Comparison of Mean Score by ICAI, CCAI, CCI

Hypothesis Two

> *There is no significant difference in performance in biology of science and non-science students when they are exposed to individual Computer Assisted Instruction (ICAI).*

In order to find out whether ICAI will have any effect on the performance of science and non science students in biology, an Analysis of Covariance (ANCOVA) was used and the pretest of the students served as Covariates. The result obtained is presented in Table 4.

Table 4: Analysis of Covariance for the Performance of Science and Non-Science Students Exposed to ICAI

Source of Variation	Sum of Squares	df	Mean Square	F	Significance
Covariate (Pretest)	211.419	1	211.419	84.080	.000
Main Effect (Subj Treatment)	.166	1	.166	** .066	* .799
Explained	211.585	2	105.793		
Residual	93.037	37	2.515		
Total	304.622	39	7.811		

** denotes F is not significant at 0.05 level.

The result shown in Table 4 indicates that an $F_{(1,37)} = 0.661$, $\alpha = .799$ is not significant at 0.05 level. This shows that ICAI had no influence on the performance of either science based or non-science based students. Furthermore, the data collected from the study is represented in Figure 2 to show the mean gain score.

Table 5: Mean score for science and non-science students exposed to ICAI.

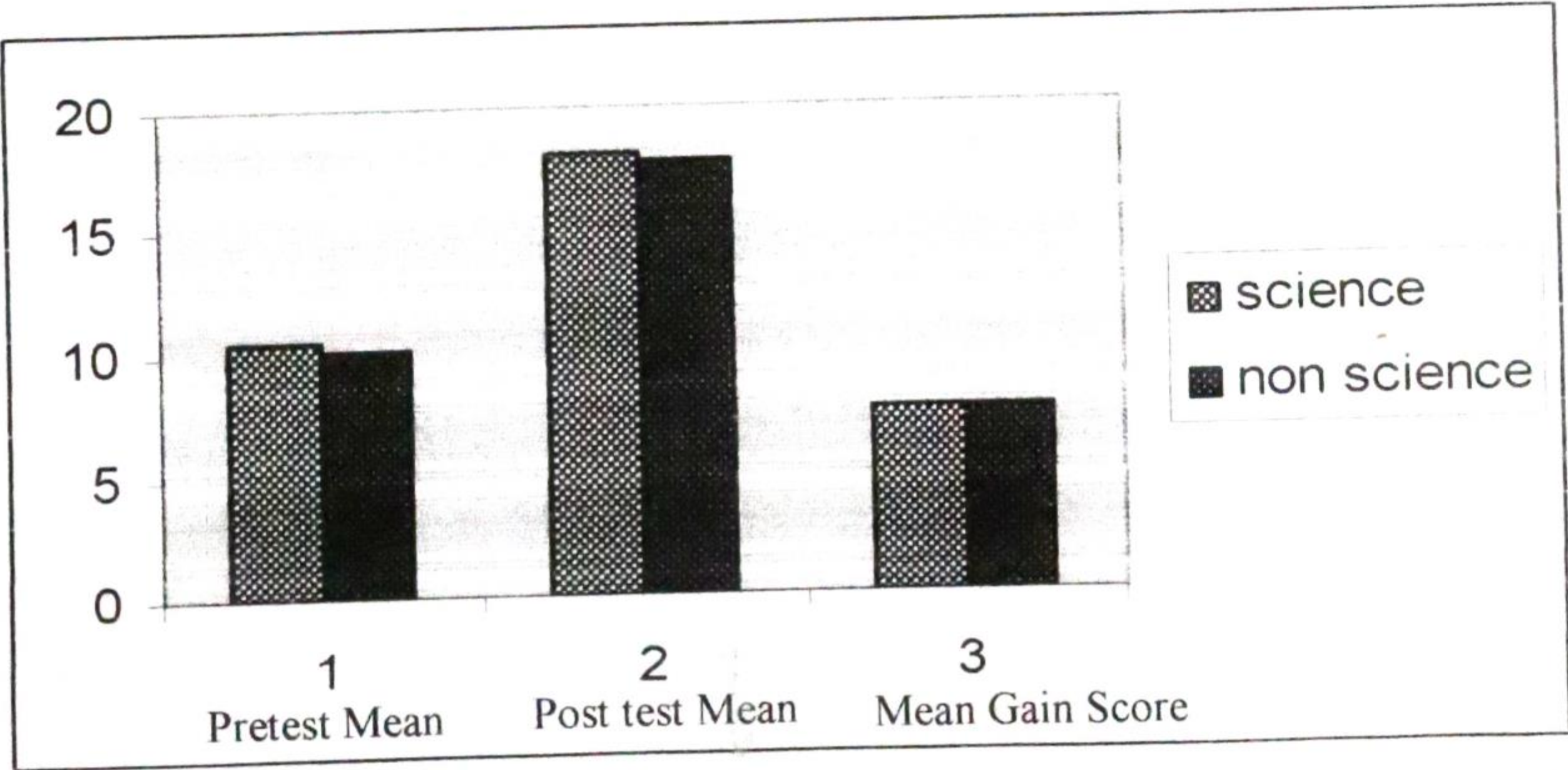|	Pretest x	Post Test x	x Gain Score
Science	10.53	18.105	7.58
Non Sc.	10.095	17.667	7.57

Figure 2: A Graphical Representation of the Analysis of Covariance for Science and Non-Science Students Exposed to ICAI.

The graph in Figure 2 shows that the mean gain score (X= 7.58) for science based students is slightly higher than that of the non-science based students (X=7.57). The difference between the two means is however very marginal.

Hypothesis Three

There is no significant difference in the performance of science and non-science students in biology when they are exposed to cooperative computer Assisted instruction (CCAI).

Analysis of Covariance (ANCOVA) was employed to identify the difference in performance of the science and non-science based students when they are exposed to CCAI. This result is contained in Table 6.

Table 6: Analysis of Covariance for the Performance of Science and Non-science Students Exposed to CCAI.

Source of Variation	Sum of Squares	Df	Mean Square	F	Significance
Covariates (Pretest)	498.088	1	498.088	230.907	.000
Main Effect (treatment Subj.)	.585	1	.585	** .271	.606
Explained	498.673	2	249.337		
Residual	79.812	37	2.157		
Total	578.485	39	14.833		

** denotes F is not significant at 0.05 level.

When their pretests are used as covariates and statistically controlled, the post test score shows that an $F_{(1,37)} = 0.271$, X= 0.606 is not significant at 0.05 alpha level. This result shows that the exposure of science and non-science students to CCAI does not produce any significant difference in the performance between the two groups. Furthermore, a graphical representation is produced to show the amount of gain score of the science (X= 5.65) and non-science (X=5.90) groups (Figure 3).

Table 7: Mean score of science and non-science students exposed to CCAI.

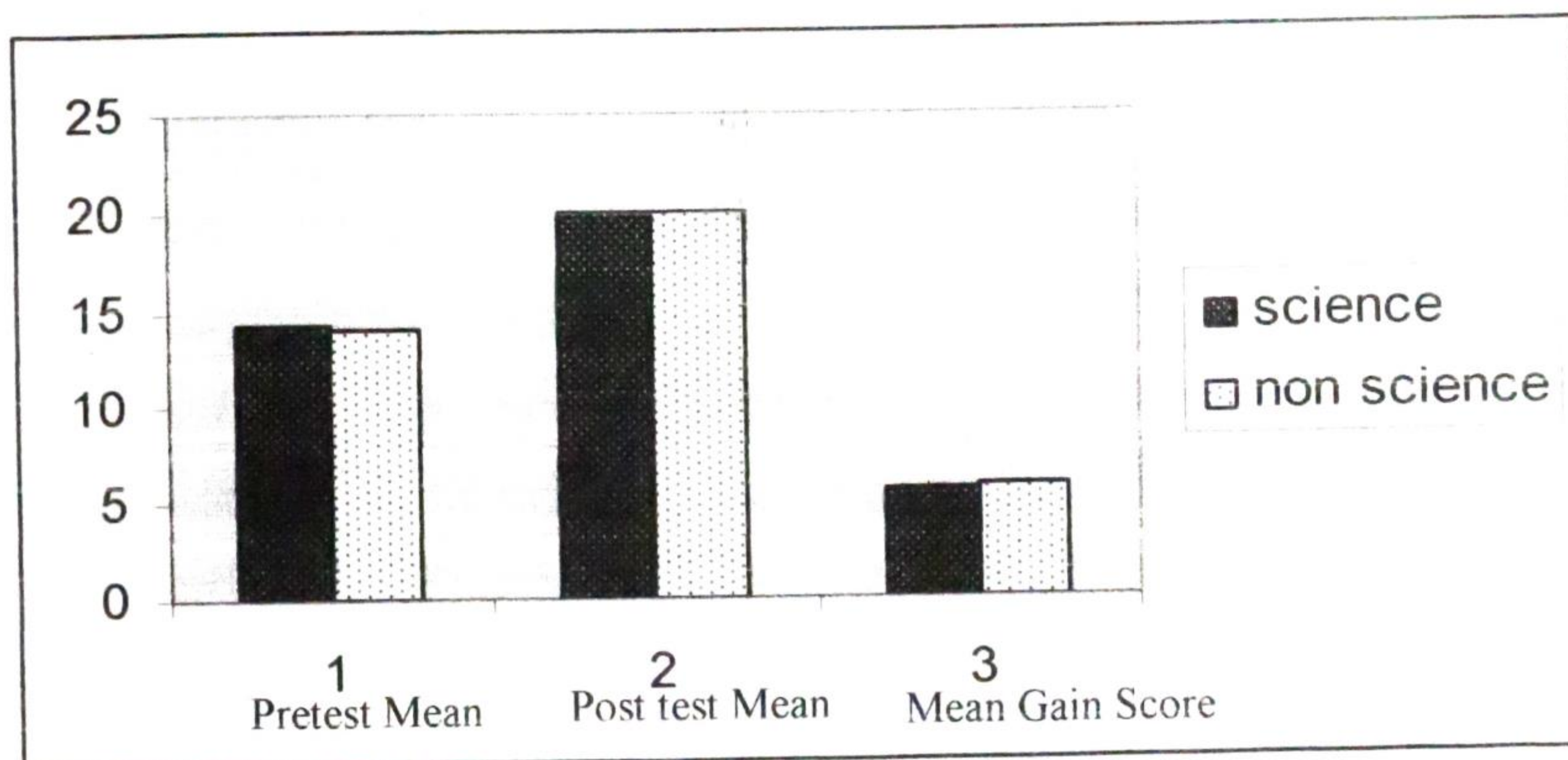|	Pretest x	Post test x	X Gain Score
Science	14.40	20.0500	5.65
Non science	14.15	20.0500	5.90

Figure 3: A Graphical Representation of the mean Gain Scores of Science and Non science Students Exposed to CCAI.

The mean gain score difference is found to be very small confirming the earlier revelation that the treatment of the two groups did not produce any significant difference in their mean scores.

Summary of Findings, Conclusion and Recommendation

The major findings of this study based on the formulated hypotheses are summarized as follows:

1. The students exposed to Individual Computer Assisted Instruction (ICAI) and Cooperative Computer Assisted Instruction (CCAI) performed significantly better than their counterparts exposed to Conventional Classroom Instruction (CCI). This implies that ICAI and CCAI are effective for teaching the biology concepts selected for this study. However the CCAI group also performed better than ICAI group.

2. The students expose to ICAI performed slightly lower than the students exposed to CCAI, although the difference was not significant This shows that cooperative work (group study) should be encouraged, as it will enhance student's performance.

3. There was no significant difference in the performance of science and non-science students when exposed to ICAI and CCAI.

Findings on the Efficacy of CAI on Students' Performance in Biology

Hypothesis one was used to investigate the effect of computer assisted instructional packages on students' performance in biology. The result of the analysis of covariance and scheffee (post hoc) tests showed that students who were taught with computer assisted instructional package performed significantly better than those taught with conventional classroom instruction.

Findings on the Effect of ICAI and CCAI on Students Performance in biology

The results of the analysis of covariance and post hoc tests (Scheffee) showed non-significant difference between the performances of students exposed to ICAI and CCAI. It was however observed that the two experimental groups (ICAI and CCAI) made significant learning gains after receiving their respective instructional treatments. This finding was corroborated in the studies of Phillip and Moss (1993) and Jegede, et al (1992). They both saw that students' learning are better enhanced when they work on CAI packages than when they learn through traditional method.

It is to be noted however, that students exposed to CCAI did better than those exposed to ICAI. This implies that some CAI modes could be more efficacious than the other. This is probably because the students in the CCAI group had the opportunity of putting heads together before deciding on a line of action. Johnson, Maruvama et al (1981) and Ojo (1992) found that learning in small groups (as we have in the CCAI of the present study) enhances students' performance. (Jenks 2002, Springer 2002).

Findings on the effect of students' subject discipline on their performance in relation to the treatments of ICAI and CCAI.

The effect on the subject discipline on the students' performance in biology was tested with Hypothesis 2 and 3. The findings revealed that the effect of subject discipline on students' performance is not significant for ICAI. This shows that the non- science students' performance in biology was very close to the science students' performance when treated with ICAI. This result is also repeated with CCAI.

The comparison of performances under the two modes of CAI also follows the pattern of the previous results where the CCAI has always showed a better performance than ICAI. The finding of this study further showed that CAIP enhanced students' performance in biology better when it was used cooperatively with four students working on one system than when it was used individually. This makes it important for students to work in group. It encourages team spirit and interpersonal relations among the students. Such an atmosphere is usually conducive to effective learning.

Disparity in students' subject discipline surprisingly did not affect the students' performance in biology significantly. If the non-science based students could compete favourably with the science-based students with the use of CAIP, it implies that with CAIP as a teaching strategy, the phobia for science could be reduced in the non-science biology students.

Recommendation

The following are the recommendations made based on the findings of this study:

1. The necessary attention should be accorded computer literacy and operation in the secondary schools.

2. West African Examinations Council (WAEC) and National Examination Council (NECO) should convert the subjects in the secondary schools into CAIP programmes for students to run. One or two subjects may be used as test cases to start with. Secondary schools should adopt the CCAI mode since it will require fewer computers than the ICAI mode.

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