Effectiveness of Computer-Assisted Stad Cooperative Learning Strategy on Physics Problem Solving, Achievement and Retention

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ABSTRACT

This study investigated the effectiveness of computer-assisted Students' Team Achievement Division (STAD) cooperative learning strategy on physics problem solving, students' achievement and retention. It also examined if the student performance would vary with gender. Purposive sampling technique was used to select two senior secondary schools year two physics students (SS II). The schools were assigned into computer-assisted STAD and Individualized Computer Instruction (ICI) groups. 84 students from two intact classes participated in the study. The Computer-Assisted Learning Package (CALP) on physics and the Physics Achievement Test (PAT) were used as treatment and test instruments respectively. Analysis of Covariance and Scheffe test were used for data analysis. Findings indicated that students taught physics with computer-supported STAD performed better than their counterparts in ICI group. In addition, they had better retention than those in ICI group. However, gender has no influence on students' performance. Based on the findings, it was recommended among others that physics teachers should be encouraged to use computer-assisted cooperative instruction to enhance students' performance.

Keywords: *STAD, Cooperative Learning, Problem Solving, Achievement, Retention, Physics*

INTRODUCTION

IN the history of modern civilization, Physics occupies the central position among the science subjects. Thus, science and technology would be incomplete without physics (Micheal, 2006). Therefore, the inclusion of physics in the Nigeria senior secondary school curriculum for science-oriented students cannot be overemphasized (FRN, 2004). In spite of its importance to other disciplines such as medicine, engineering, computer science, and many others, students' poor performance in the subject in national examinations is not encouraging (WAEC, 2011, 2012). Some of the reasons attributed to this poor performance in the subject include: inability of students to understand the physics contents while studying independently, poor teaching methods, lack of integrating computer technology into teaching and learning, poor mathematical ability of the students, lack of problem-solving skills, and many others (Ajaja, 2002; Jegede, 2007; Yusuf & Afolabi, 2010; Zakaria, Solfitri, Daud, & Abidin, 2013).

The recognition of the educational importance of group problem-solving has resulted in groups working together around computers (Neufeld & Haggerty, 2001; Stahl Koschmann, & Suthers, 2006). The computer is a medium through which groups can communicate their understanding and provides a way to represent and store shared knowledge (Sharan, 1995; Sherman, 1991). Small groups interacting around and through the computer promotes productive cooperative learning (Littleton & Light, 1999). Interacting around

computers refers to using the computer as a shared reference for a group while interaction through computers refers to the use of a computer network.

The use of problem-solving groups is increasing both in work and education fields (Beatty & Barker, 2004; Salas & Fiore, 2004). Therefore, in order to provide better learning opportunities, it is important that learners work in problem-solving groups in physics classrooms (Light, 2004; Lesh & English, 2003). Cooperative learning improves students' mathematical understanding as well as their communication and group skills (Weldon & Felder, 2000). Physics and mathematics are interrelated; thus understanding the mathematical concepts will enhance physics knowledge. It is easier for groups to master physics problems that are too complex than for individuals to solve them alone (Jonassen & Kwon, 2001). While problem solving in cooperative learning, students have opportunities to ask questions, explain their reasoning, build upon their knowledge, and discuss and develop problem-solving strategies (Gillies & Asman, 2000).

A shift in focus from the individual learner to cooperative learning is necessary for two reasons. First, the use of group problem solving is increasing both in education and work fields (Beatty & Barker, 2004; Salas & Fiore, 2004). Second, the proliferation of computer supported collaborative learning (CSCL) and computer supported collaborative work (CSCW) environments in education and work fields is increasing due to the wide use of computers (Stahl et al., 2006).

Working in a group gives students access to a wide range of thinking strategies, contributes to understanding of the problem, and provides alternative solutions (Gillies, 2000; Jonassen & Kwon, 2001). However, while several studies have shown that groups are more productive than individuals in complex problem solving, not all groups work together cooperatively (Van-Wyk, 2010). In order to work effectively in a cooperative setting, students need to think about their group work by planning, monitoring, and evaluating their learning processes within a group context (Salas & Fiore, 2004).

Some researchers have suggested that computer settings can increase the possibility of successful group learning and problem solving, as students are more likely to work together when working on computer based tasks (Kreijns, Kirschner & Jockems, 2002; Light, 2004). Computers provide a medium for group problem solving by encouraging discussion and sharing both within- and between- groups (Beamish & Au, 1995).

Therefore, the present study investigated the effects of Students' Team Achievement Division (STAD) with that of Individualized Computer Instruction strategy in physics. STAD is a cooperative learning technique that has been extensively researched and assessed specifically on academic achievements, attitudes, social interactions and interpersonal relationships (Balfakih, 2003; Bernaus & Gardner, 2008; Slavin 1990; Kagan, 1994; Johnson & Johnson, 1998, 1999; Tarim & Akdeniz, 2008). STAD is one of the simplest and most extensively researched forms of all cooperative learning techniques and it could be an effective instrument to begin with for teachers who are new to the cooperative learning technique (Slavin, 1990). STAD as a teaching technique was designed and researched by Johns Hopkins University and is known as student team learning (Sharan, 1995).

Research studies show that STAD as a teaching technique has been applied with great success in various science research projects. For instance, Adesoji (2009) and Balfakih (2003) in chemistry, Ho and Boo (2007) in physics, Pei-wen (2001), Van-Wyk (2010), and Keramati (2010) in Mathematics, reported that STAD is more effective than individualistic instructional strategy, discussion method and conventional classroom instruction respectively. Fajola (2000), Pandian (2004), Yusuf and Afolabi (2010) reported that students exposed to cooperative computer-assisted instruction group outperformed their counterparts who learned the same biology concepts through traditional method. Similarly, Taiwo, (2008) reported that students taught mathematics using computer-assisted cooperative learning strategy performed better than those taught with individualized computer instruction and traditional method respectively. However, Rosini and Jim (1997), Armstrong (1998), Glassman (1989) and Khan and Inamullah (2011) found no significant difference between chemistry students exposed to cooperative learning and those taught using the traditional method.

Gender has been identified as one of the factors influencing students' achievement in sciences at senior secondary school level. Balfakih (2003), Adeyemi (2008) Kost, Pollock and Finkelstein (2009) and Oludipe (2012) reported no significant difference between male and female students' performance when

taught using cooperative learning strategy. Similarly, Pandian (2004), Yusuf and Afolabi (2010) and Yusuf, Gambari and Olumorin (2012) reported that gender did not have any significant influence on biology achievement using computer-assisted STAD cooperative learning strategy. However, Fajola (2000), Ghaith (2001), Aguele and Uhumniah (2007), Kolawole (2007) and Khairulanuar, Nazre, Sairabanu, and Norasikin, (2010) in their studies found that male students performed better than female students in the cognitive, affective and psychomotor skill achievements. In contrast, Olson (2002) reported female students taught mathematics using cooperative learning outperformed their male counterparts. Obviously, there is a strong association between gender and academic achievement in science education. The likely influence of gender on students' academic achievement in physics when taught using cooperative learning and individualized computer instructional method was examined by this study.

The extent of computer-assisted STAD cooperative settings on physics problem-solving on Nigerian students' performance is yet to be fully explored. Literature showed the inconclusiveness of the findings on STAD cooperative learning, gender, and retention on learner performance. Therefore, the effects of computer-assisted STAD cooperative learning strategy on students' achievement in physics were investigated in this study.

RESEARCH QUESTIONS

The study addressed the following research questions:

1. Is there any difference in the performance of students taught physics using computer-assisted STAD cooperative setting and those taught with individualized computer instructional method?
2. Is there any difference in the performance of male and female students taught physics using computer-assisted STAD cooperative setting?
3. Is there any difference in retention of students taught physics using computer-assisted STAD cooperative settings and individualized computer instructional method?
4. Is there any difference in the retention of male and female students taught physics using computer-assisted STAD cooperative setting?

RESEARCH HYPOTHESES

The following null hypotheses were tested in the study:

1. There is no significant difference in the performance of students taught physics using computer-assisted STAD cooperative setting and those taught using individualized computer instruction.
2. There is no significant difference exist in the performance of male and female students taught physics using computer-assisted STAD cooperative setting.
3. There is no significant difference in the retention mean scores of students taught physics using computer-assisted STAD cooperative setting and individualized computer instructional method.
4. There is no significant difference in the retention of male and female students taught physics using computer-assisted STAD cooperative setting.

METHODOLOGY

Design of the Study

The study employed pre-test, post-test control group design. This design consisted of two instructional groups (cooperative group and individualized computer instruction group) gender (male and female), ability (high, medium and low) and repeated testing (pre-test and post- test). The main independent variables were exposure to cooperative learning strategy, gender and ability while the dependent variables were achievement and attitude.

Sample of the Study

Multi-stage sampling procedures were employed in this study. Firstly, purposive random sampling was used to select two secondary schools in Minna, Niger State, Nigeria. The schools were selected based on the following criteria: equivalence (laboratories, facilities and manpower), school ownership (public schools), gender composition (mixed schools), ICT facilities (computer laboratories under the SchoolNet programme), and candidates' enrolment (Senior Secondary School Certificate in Education in physics for a minimum of ten years). Secondly, an intact class from each of the two schools were selected and randomly assigned to experimental (computer-assisted STAD) and control (ICI) groups using simple random sampling technique. Thirdly, the researcher arranged the list of students in the class into different strata based on gender (male & female) and achievement level (high, medium, & low). Students were stratified into academic levels (high, medium and low) based on their performance in the last promotion examination in physics. 84 students participated in the study, 46 students were in computer-assisted STAD cooperative learning strategy (Exp. Group) and 38 students in ICI strategy, the control group.

Instruments

Three research instruments were employed: treatment instrument {computer-assisted learning package (CALP)}, test instrument {physics achievement test (PAT)} and attitude test {physics attitude scale (PAS)}.

Treatment instrument: CALP was a researcher developed package used at two different instructional settings (cooperative and individualized). The computer package was written in html format using "Macromedia Dreamweaver 8" as the overall platform. Other computer programs and applications also utilized during the development process are Microsoft Word, Macromedia Fireworks, and Macromedia Flash 8. Macromedia Fireworks was used for specific texts, graphics and buttons, while Macromedia Flash was used for simulation. The package was validated by computer programmers and educational technology experts; subject content (physics) specialists; and finally field tested on a sample representative of the students involved in the final study. The package contained two topics subdivided into sixteen lessons. The main menu of the package consisted of introduction, students' registration, list of lessons as in lesson 1, 2, 3, 4, … 16 and exit. It adopted the drill and practice modes of CAI. The main difference between the group-based program and the individualized program were the adjustments made in terms of entries of number of the individuals who reacted to the computer. The package was produced by a team of professionals and specialists including the system programmer, operator and the instructional designers (the researchers).

***Test Instrument*:** Physics Achievement Test (PAT) was used in collecting data for this study. The PAT consisted of 100 multiple choice objective items adopted from past examination of West African Examination Council (WAEC, May/June, 1988-2008) and National Examination Council (NECO, June/July, 2000-2007). The Test (PAT) was based on the contents of the CALP. Each of the stems of the PAT had five options (A - E) as possible answers to the question. Students were required to indicate their correct answers by ticking one of the letters (A - E) corresponding to the correct option in each item. This instrument (PAT) was administered to the experimental and control groups as pre-test, posttest and again as delayed posttest (retention test) after it had been reshuffled. The scoring of the multiple-choice items was: '1' was awarded for each correct answer and '0' for each wrong answer. The items were validated and tested for reliability using 40 randomly selected SSII students within the population but outside the sampled schools. A reliability coefficient of 0.90 was obtained using the Kuder Richardson (KR-21).

Treatment Procedure

During the treatment, Physics teachers were trained as research assistants in using the computer-assisted learning package and cooperative learning strategy. The teacher in the cooperative-learning group incorporated the basic elements of cooperative learning into the group's experience: positive interdependence, face-to-face interaction, individual accountability, social skill development, and group processing, as recommended by Johnson, Johnson, and Holubec (1990). In addition, the teacher specified both the academic and social skill objective, explained the tasks and goal structures, assigned roles within the groups and described the procedure for the learning activities, as demonstrated by Trowbridge and Bybee (1996).

The Computer Assisted Learning Package (CALP) was installed on standalone computer systems. The physics contents were presented through the computer and the learners interact and respond to the computer prompts. The computer presents information and displays animation to the learner on each unit after which the students attempted some multiple-choice questions. The students could only proceed further in a lesson on the condition that the questions were satisfactorily answered. The students must have had at least 100% mastery of one topic before moving on to the next. If after three attempts they do not get the answer correctly, the package immediately logs them out and the instructor had to be called before they could continue through another log-in.

The students in the experimental groups trained on the principles and practice of cooperative learning. They were heterogeneously divided into groups with three members each, composed of students of different gender and different academic achievement levels. After the formation of heterogeneous groups and the process of teambuilding, each member in the group was given a role to play. The designation and rotation of role assignment for each student led to avoidance of free riders or potential complaint of overloading from high achievers.

The experimental group (computer-assisted STAD cooperative learning) was exposed to the following activities:

1. Each team consists of three members assigned to one computer. Team-mates complete the reading of the materials and complete the tasks as a team using CALP package;
2. Individually, students take a quiz on the assigned reading;
3. Each team takes the same quiz and reaches consensus with respect to the correct answers for test questions because only one answer sheet must be submitted by the team for which all teammates receive the same 'team score';
4. Student's individual quiz score and team quiz score are counted equally toward the student's final course grade.
5. High scoring teams are recognized and rewarded in the class.

The control group taught with the individualized computer instruction were exposed to the physics concepts using CALP only. The computer presented the instruction on human-to-computer basis. Students proceeded with the physics contents and study at their own rate without help from their colleagues.

The study covered twelve weeks but the treatment lasted for six weeks. At the commencement of the study, the Physics Achievement Test (PAT) was administered as pre-test. Immediately after the treatment, PAT was administered as post-test. Then, after four weeks the post-test, the PAT was reshuffled and re-administered as retention test.

Students answered the PAT test at pre-test and post-test individually. The data obtained were analyzed using Analysis of Covariance (ANCOVA) and Scheffe's test using SPSS version 16 at .05 alpha level.

RESULTS

The results are presented based on the research hypotheses.

Hypothesis One: There is no significant difference in the performance of students taught physics using computer-assisted STAD cooperative setting and those taught using individualized computer instruction (ICI) method.

To determine whether there was significant difference in the post-test mean scores of the experimental (computer-assisted STAD) and control groups (ICI), data were analyzed using the analysis of covariance (ANCOVA). Table 2 shows the analysis of results.

Table 1: ANCOVA post-test on experimental (STAD) and control (ICI) groups

Source of Variation	Sum of Square	df	Mean Square	F	Significance of F
Covariate (Pre-test)	280.386	1	280.386	5.047	0.027
Main Effect (Treatment)	282.912	1	282.912	5.092	0.027
Model	820.038	2	310.019	5.580	0.005
Residual	4499.997	81	55.556		
Total	344973.000	84			

Table 1 reveals that an F (1, 81) = 5.092, p = .027 for the main effect (treatment) was significant; this indicates that the method of instruction produced a significant effect on the post-test achievement scores of students when covariate effect (pre-test) was controlled. The result indicates that the treatment, using computer assisted STAD and ICI accounted for the difference in the post-test achievement scores of the students.

Student performance in the two groups was further compared based on the mean gain scores between the pre-test and post-test for each group and the results are shown in Table 2 and graphically illustrated in Figure 1.

Table 2: Mean gain scores of students in STAD and ICI groups

Group	Pre-test	Post-test	Mean Gain Score
STAD	20.72	65.43	44.71
ICI	19.82	61.39	41.57

Table 2 shows that both groups had improved performance in post-test. STAD had mean gain scores of 44.71 while ICI had mean gain scores of 41.57. This indicates that both groups benefited from the treatments with STAD having higher performance.

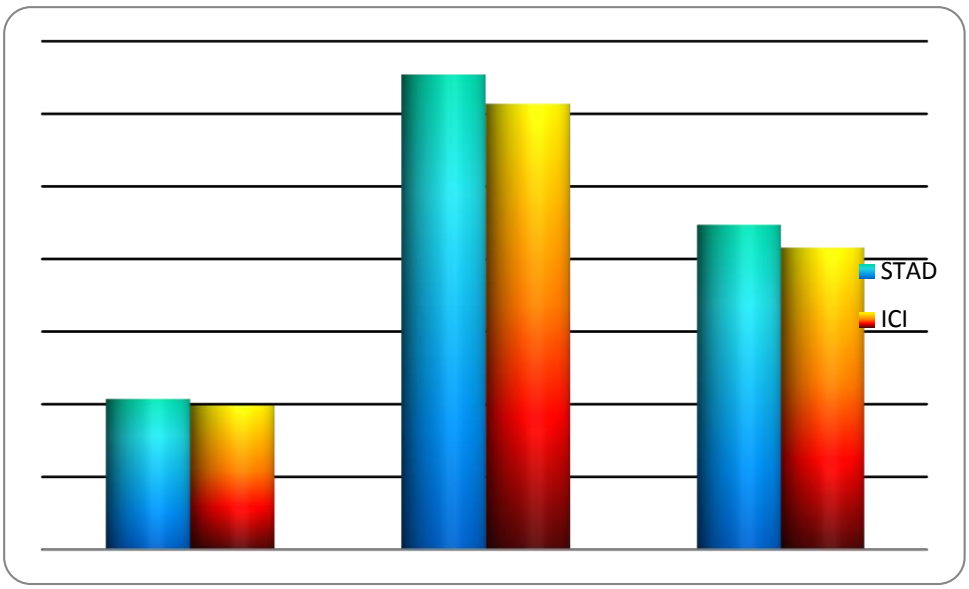

Fig. 1. Performance of students in STAD and ICI groups.

Hypothesis Two: There is no significant difference in the performance of male and female students taught physics using computer-assisted STAD cooperative setting.

To determine whether there was significant difference in the posttest mean scores of the male and

female students using computer-assisted STAD, data were analyzed using the analysis of covariance (ANCOVA). Table 3 shows the result of the analysis.

Table 3: ANCOVA posttest on male and female students in computer-assisted STAD group

Source of Variation	Sum of Square	df	Mean Square	F	Significance of F
Covariate (Pretest)	47.639	1	47.639	0.915	0.344
Main Effect (Gender)	44.359	1	44.359	0.852	0.361
Model	84.785	2	42.392	0.814	0.450
Residual	2238.520	43	52.059		
Total	199282.000	46			

The analysis in Table 3 shows the main effect of treatment group (computer-assisted STAD) on gender produced an F (1, 43) = 0.852, p = 0.361. This result was not significant at the .05 alpha level. This implies that there was no significant difference in the performance of male and female students taught using computer-assisted STAD. The hypothesis two is therefore not rejected. This signifies that male students' achievement did not differ significantly from that of female students when both groups were exposed to the computer-assisted STAD cooperative setting.

The mean gain scores between the pretest and posttest among male and female in the computer-assisted STAD group were further tabulated and graphically illustrated as shown in Table 4 and Figure 2 respectively.

Table 4: Mean gain scores of male and female exposed to computer-assisted STAD

Group	Pretest	Posttest	Mean Gain Score
Male	20.13	60.63	40.50
Female	21.46	57.39	35.93

Table 4 shows that male students had higher mean gain scores of 46.39 while the female students had mean gain scores of 43.64. This indicates that both groups benefited from the treatment, with male students having better posttest performance than female students. However, male students had better mean gain scores than female students. The comparison of the mean scores between their pretest and posttest is shown in Figure 2.

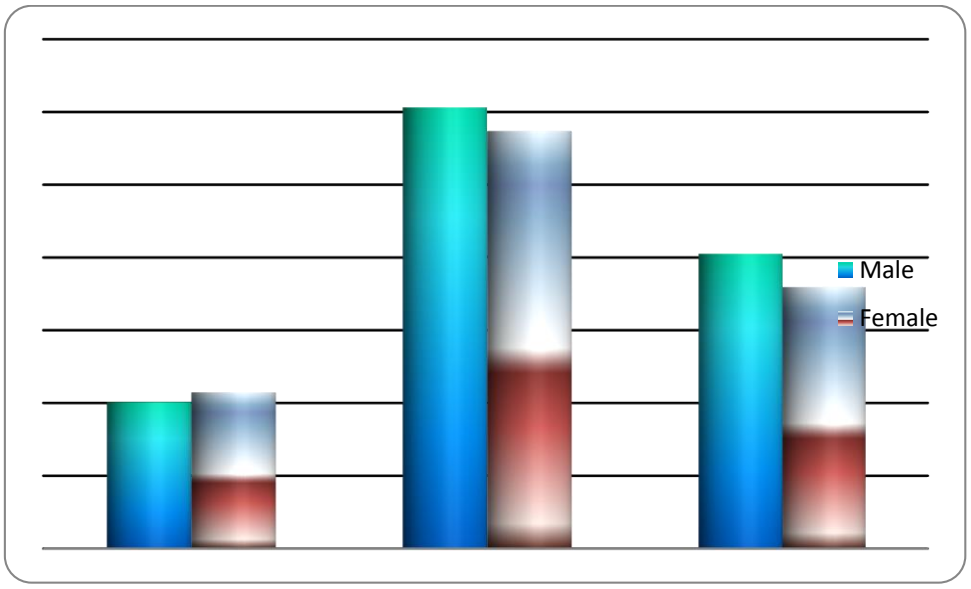

Fig. 2. Performance of the male and female students in STAD group.

Hypothesis Three: There is no significant difference in the retention of students taught physics using computer-assisted STAD cooperative setting and ICI method.

To determine whether there was significant difference in the posttest mean scores of the computer-assisted STAD and control groups (ICI), data were analyzed using the analysis of covariance (ANCOVA). Table 5 shows the analysis of the result.

Table 5: ANCOVA retention test on students in computer-assisted STAD and ICI groups

Source of Variation	Sum of Square	df	Mean Square	*F*	Significance of *F*
Covariate (Pretest)	244.128	1	244.128	4.549	0.036
Main Effect (Retention)	207.709	1	207.709	3.870	0.053
Model	497.215	2	248.607	4.632	0.012
Residual	4347.071	81	53.668		
Total	295834.000	84			

Table 5 shows that the main effect of treatment group (computer-assisted STAD) and ICI groups produced an F (1, 81) = 3.870, p = 0.053. This result was significant at the .05 alpha level. This indicates that there was significant difference in the performance of retention test of students taught physics using computer-assisted STAD. The hypothesis three is therefore rejected. This implied that students in computer-assisted STAD group achieved significantly higher scores than those in ICI group.

The mean gain scores between the pretest and posttest retention of computer-assisted STAD and ICI group were tabulated and graphically illustrated as shown in Table 6 and Figure 3 respectively.

Table 6: Mean gain scores of students' retention in computer-assisted STAD and ICI groups

Group	Pretest	Posttest	Mean Gain Score
STAD	20.72	60.43	39.71
ICI	19.82	59.95	40.13

Table 6 shows that both STAD and ICI had high retention from the treatment. The students in computer-assisted STAD group had higher mean gain scores of 1.40 while those in ICI group had a mean gain scores of 0.81. This indicates that both groups benefited from the treatment and retained some physics concepts after four weeks of treatment. Furthermore, the comparison of the mean scores between their pretest and posttest is shown in Figure 3.

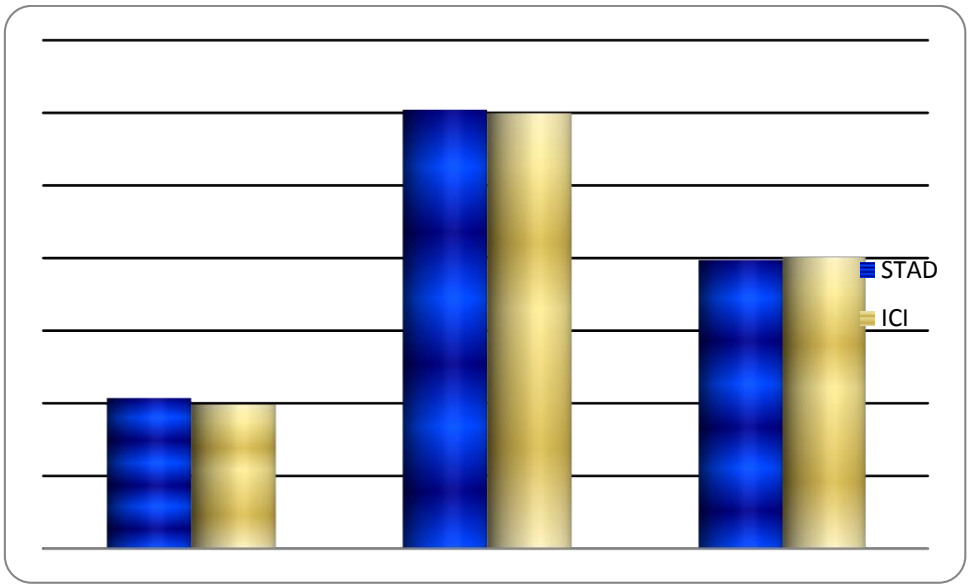

Fig. 3. Graphical illustration of students retention in STAD and ICI groups.

Hypothesis Four: There is no significant difference in the retention of male and female students taught physics using computer-assisted STAD cooperative setting.

To determine whether there was significant difference in the retention mean scores of the male and female students using computer-assisted STAD, data were analyzed using the analysis of covariance (ANCOVA). Table 7 shows analysis of the results.

Table 7: ANCOVA retention test on male and female students in computer-assisted STAD group

Source of Variation	Sum of Square	Df	Mean Square	*F*	Significance of *F*
Covariate (Pretest)	47.639	1	47.639	0.915	0.344
Main Effect (Gender)	44.359	1	44.359	0.852	0.361
Model	84.785	2	42.392	0.814	0.450
Residual	2238.520	43	52.059		
Total	170332.000	46			

The analysis in Table 7 shows the main effect of treatment group (computer-assisted STAD) on gender produced an F (1, 43) = 0.852, p = 0.361. This result was not significant at the .05 alpha level. This indicates that there was no significant difference in the performance of male and female students taught using computer-assisted STAD. Therefore, hypothesis three was not rejected. This implies that male students' achievement did not differ significantly from that of their female counterparts when both were taught using computer-assisted STAD.

The mean gain scores between the pretest and posttest among male and female in the computer-assisted STAD group was tabulated and graphically illustrated as shown in Table 8 and Figure 4 respectively.

Table 8: Mean gain scores of male and female students in computer-assisted STAD group

Group	Pretest	Posttest	Mean Gain Score
Male	20.17	61.56	41.39
Female	21.07	59.71	38.64

Table 8 shows that male students had higher mean gain scores of 41.39 while the female students had mean gain scores of 38.64. This indicates that both groups benefited from the treatment, with male students having higher retention than female students. However, male students had better mean gain scores than female students. Furthermore, the comparison in the mean scores between their pretest and posttest is shown in Figure 4.

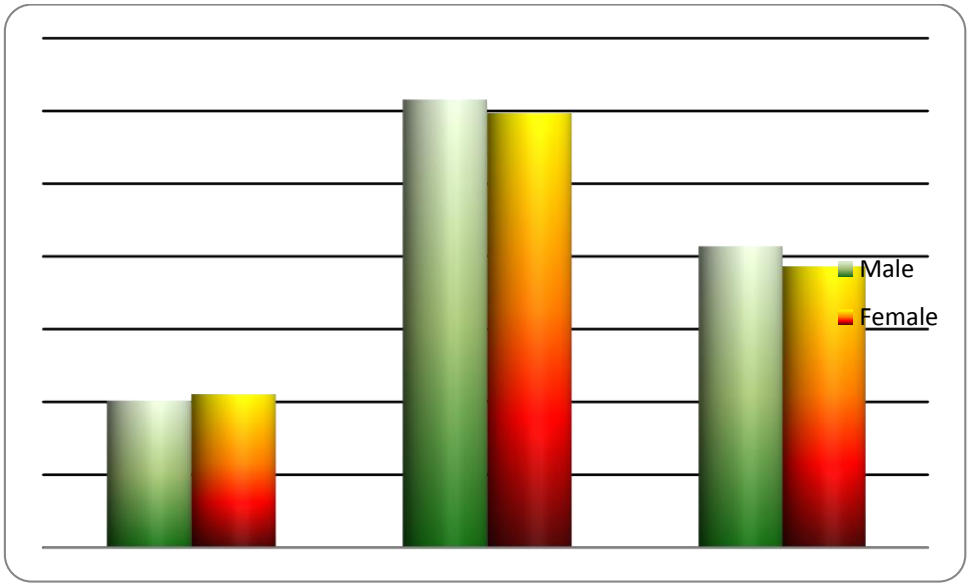

Fig 4. Graphical illustration of retention of male and female students in computer-assisted STAD group

DISCUSSION

The results of the analyses related to hypothesis one indicated a significant difference in students' performance of in favor of those in the experimental group (STAD). The findings regarding better performance of students in the STAD as compared to the ICI agree with earlier findings of Adesoji (2009), Balfakih (2003), Zuheer (2008), Ho and Boo (2007), Pei-wen (2001), van Wyk 2010, Keramati (2010), Liang (2002), Ghaith (2001), Dikici and Yavuzer (2006). Ayhan and Yasemin (2006) reported that STAD is more effective than individualistic instructional strategy, discussion method and conventional classroom instruction respectively. Findings of this study also support the findings of Fajola (2000), Pandian (2004), Taiwo (2008) and Yusuf and Afolabi (2010) stating that students taught using computer-assisted STAD cooperative instruction performed better than their counterparts who were taught the same biology concepts with individualized instruction and traditional method respectively. However, Rosini and Jim (1997), Armstrong (1998), Glassman (1989) and Khan and Inamullah (2011) found no significant difference in the achievement of students taught using STAD and those taught with conventional methods.

The results of the analyses for hypothesis two indicated no significant difference in the performance of male and female students taught physics using computer-assisted STAD cooperative setting. The findings regarding the performance of male and female students in the STAD group agree with the earlier findings of Balfakih (2003), Adeyemi (2008) and Kost, Pollock and Finkelstein (2009) who found no significant difference between male and female students' performance when taught using cooperative learning strategy. Furthermore, the findings support that of Pandian (2004) and Yusuf and Afolabi (2010) showing gender did not have any significant influence on biology achievement using computer-assisted STAD cooperative learning strategy. However, the findings disagree with that of Fajola (2000), Ghaith (2001), Aguele and Uhumniah (2007), Kolawole (2007) and Khairulanuar, Nazre, Sairabanu, and Norasikin (2010) that male students performed better than female students in the cognitive, affective and psychomotor skill achievements. They also disagree with the findings of Olson (2002) showing that female students taught mathematics using cooperative learning outperformed their male counterparts.

The results of the analyses related to hypothesis three indicated no significant difference in retention of students taught physics using computer-assisted STAD cooperative learning and those taught using ICI. Similarly, hypothesis four revealed no significant difference in the retention of male and female students in the computer-assisted STAD cooperative setting. The findings agree with the earlier findings of Tarim and Akdeniz (2008), Majoka, Dad and Mahmood (2010), Zakaria, Chin and Daud (2010) and Gupta and Pasrija (2011) revealing the encouraging effects of co-operative learning (STAD) on students' achievement, retention and attitude toward Mathematics.

These findings have strong implications for teaching and learning of physics in secondary schools in Nigeria using computer-assisted cooperative learning strategies. Major implication of these findings is that computer-assisted instruction is better in cooperative setting than individualized setting. Furthermore, the findings provide sound empirical basis which indicate that student performance in physics and other science related subjects would be improved if students were exposed to computer-assisted STAD cooperative setting.

RECOMMENDATIONS

Based on the major findings of this study, it is recommended that:

1. Physics teachers should expose their students to computer-assisted STAD cooperative instructional strategy so as to improve their performance in physics.
2. Federal and State ministries of education and other educational agencies and other education stakeholders should organize workshops on the use of computer-assisted cooperative learning strategy to enhance better performance of secondary school students.
3. The teacher education program in Nigerian tertiary institutions should be improved upon to prepare teachers who can apply innovative teaching strategies such computer-assisted STAD cooperative learning, which will promote effective teaching and learning.
4. Instructional designers, computer programmers, textbook writers, material developers should develop relevant computer assisted instructional packages for use within the Nigerian school systems.

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