EFFECTS OF COMPUTER-BASED STAD COOPERATIVE LEARNING STRATEGY ON THE PERFORMANCE, ACHIEVEMENT LEVEL AND ATTITUDE OF SECONDARY SCHOOL PHYSICS STUDENTS IN MINNA, NIGERIA

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Abstract
This study determined the effects of computer-based STAD cooperative learning strategy on the performance, achievement level and attitude of secondary school physics students in Minna, Nigeria. A quasi-experimental study using a non-randomized, non-equivalent, pre-test, post-test, control group design was adopted. The target population for this study comprised all the senior secondary school class (SSSII) physics students in Niger State. Purposive sampling technique was used to select two senior secondary schools class two (SSS II). The schools were assigned into Computer-based STAD and Individualized Computer Instruction (ICI) groups. A sample size of 84 physics students from two intact classes participated in the study. Computer-Assisted Learning Package (CALP) on physics was used as treatment instrument. Physics Achievement Test (PAT) was used as test instrument, while Physics Attitude Scale (PAS) was used to elicit response on students' attitude towards physics. PAT and PAS were pilot tested, the reliability coefficient of 0.90 and 0.86 were obtained using Kuder Richardson (KR-20) and (KR-21) respectively. Analysis of Covariance and Scheffe test were used for data analysis. Findings indicated that students taught physics with computer-based STAD performed better than their counterparts in ICI. In addition, students in computer-based STAD group had positive attitude towards physics than those in ICI group. Furthermore, achievement levels had significant influence on their performance. Based on the findings, it was recommended among others that teachers should use computer-assisted STAD to improve students' performance in some difficult physics concepts. **Keywords:** STAD, Computer, Achievement Levels, Attitude, Physics

Introduction

Cooperative learning is a strategy which involves students working together in a small group to accomplish a common goal. Each member of a team is responsible not only for learning what is being taught but also for helping teammates learn, thus creating an atmosphere of achievement. Students work through the assignment until all group members successfully understand and complete it (Johnson & Johnson, 2008). Such a collaboration usually involves positive interdependence promoting mutuality among students, individual accountability as a measure of personal responsibility, peer interaction generating instructional support, social skills necessary for working effectively with others, and group processing as a way of improving team performance (Simsek, 1993; Alshammari, 2015). Cooperative learning can be employed for all teaching subjects including physics (Gambari, 2010).

Physics occupies the central position among the science subjects. It is a central subject in medicines, engineering, computer science, among others. In spite of its relevance in national development, students' poor performance in physics at secondary level in Nigeria over the years (2010 to 2014) is not encouraging (WAEC, 2015). Traditional method of teaching have been attributed to students' poor performance at national examinations conducted by West African Examination Council (WAEC), and National Examination Council (NECO) (Jegede, 2007, Olorundare, 2011). Nigerian government in the revised

national policy on education (Federal Republic of Nigeria, FRN, 2013) placed greater emphasis on teaching that emphasizes student-activity such as: inquiry, discovery, and cooperative and collaborative oriented modes of teaching. Zakaria, Chin and Daud (2010) asserted that effective teaching and learning occur when students-centered approach is employed in the teaching process.

There are various computer-based cooperative learning strategies which include: Learning Together (LT), Teams Games-Tournaments (TGT), Group Investigation (GI), Constructive Controversy (CC), Numbered Heads Together (NHT), Jigsaw Procedure (JP), Students Teams Achievement Divisions (STAD), Complex Instruction, Team Accelerated Instruction (TAI), Cooperative Learning Structures (CLS), Cooperative Integrated Reading and Composition (CIRC) (Sarah & Cassady, 2006; Yusuf, Gambari & Olumorin, 2012).

Students Team Achievement Division (STAD) mode of cooperative learning is simplest to implement by teachers because it allows more active involvement of students in learning process than other cooperative learning strategies (Zakaria, Solfitri, Daud & Abidin, 2013). STAD provides good interaction among students, improves positive attitude towards subject, better self-esteem, increased interpersonal skills among others (Rai & Samsuddin, 2007). STAD enables students to work with their colleagues competently and successfully (Balfakih, 2003).

Researches had proven that STAD cooperative learning setting has been effective in promoting students' achievement, encouraging students' interaction and developing positive attitude towards learning outcomes. For instance, Fajola (2000), Pandian (2004), and Yusuf and Afolabi (2010) reported that students exposed to cooperative computer-assisted instruction performed better than those exposed to the same biology concepts through traditional method. Similarly, Gambari (2010), Taiwo, (2008), Gambari and Yusuf (2015) and Zakaria, Solfitri, Daud and Abidin (2013) reported that students taught physics and 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) and Glassman (1989) found no significant difference in the achievement of students taught using STAD and those taught with conventional classroom.

The use of computer-assisted instruction with STAD is the affinity and links between technology and cooperative learning highlighted by Millis and Cottell (1998) in their assertion that cooperative learning and technology are natural partners, because the use of technology involves human dimensions of caring, community, and commitment. In addition, using technology in ways that promote sequenced learning within the groups can lead to in-depth processing of course content and, hence, more retention of information among students of different achievement levels (Gambari & Yusuf, 2015).

The issue of students' achievement level as a cause of differential learning outcome has attracted the attention of educational researchers. It is a common feature in the conventional classroom to find students of mixed achievement levels lumped together to be given the same treatment without considering their ability levels. Fajola (2000) found that students who are high achievers performed better than students who are low achievers on the three dependent variables (computer STAD, Individualized computer instruction & traditional method). Ghaith (2001) revealed that the high achievers felt that they had contributed to the learning of others more than their low-achieving counterparts. Balfakih (2003) reported significant difference between students of high, medium and low ability level in favour of high and medium respectively. Iqbal (2004) reported no significant difference between the mean scores of high achievers of the experimental and the control groups. The low achievers of experimental group performed significantly better than low achievers of the control group on posttest. However, Yusuf (2004) revealed that achievement levels had no influence on academic performance of the learners. Other studies have found that high, medium and low achievers were favoured in cooperative

learning settings irrespective of their interest and attitude to learning (Gambari & Yusuf, 2013).

Attitude was conceptualized as a learned predisposition to respond positively to certain objects, situations, institutions, concepts or persons (Aiken, 1996). Attitudes possess cognitive (beliefs, knowledge, and expectations), affective (motivational and emotional), and performance (behavior or actions) components. For instance, a person's attitude toward a computer is influenced by a variety of aspects, e.g., computer liking, computer confidence, computer anxiety or comfort.

Research by Johnson and Johnson (1991) found that cooperative learning enhanced more positive attitude towards subject matter. Furthermore, Armstrong (1998) reported that STAD technique had improved students' attitude toward social studies. In addition, Tarim and Akdeniz (2008), Majoka, Dad and Mahmood (2010), Zakaria, Chin and Daud (2010) and Gupta and Pasrija (2012) revealed the encouraging effects of co-operative learning (STAD) on students' achievement, retention and attitude towards Mathematics. However, Rosini and Jim (1997) reported no significant difference in the achievement, retention and attitude of those taught home economics using cooperative learning strategy and those taught with traditional method.

The extent of the impact of computer-assisted STAD cooperative settings on Nigerian students' performance in physics is yet to be fully explored. Previous studies focused on cooperative learning strategy and conventional classroom instruction without examining the effectiveness of computerassisted STAD cooperative learning strategy. In addition, there was limited studies on the effects of cooperative learning strategy in Nigeria in physics education and few available studies did not examine the influence of cooperative learning strategies on students' attitude, and achievement levels. Therefore, this study examined the effects of computer-based STAD cooperative learning strategy on the performance, achievement level and attitude of secondary school physics students in Minna, Nigeria.

Research Questions

The study addressed the following research questions.

1. What is the difference in the mean performance scores of students taught physics using computerbased STAD cooperative setting and those taught with individualized computer instructional (ICI) strategy?
2. What is the difference in the mean performance scores of high, medium and low achievement level students taught physics using computer-based STAD cooperative setting?
3. What is the difference in the mean attitude score of students taught physics using computer-based STAD cooperative setting and those taught with individualized computer instructional (ICI) strategy?

Research Hypotheses

The following null hypotheses were tested in the study:

Ho_1 There is no significant difference in the performance of students taught physics using computerbased STAD cooperative setting and those taught using individualized computer instruction (ICI) strategy.

Ho_2 There is no significant difference in the performance of high, medium and low achievement levels of students taught physics using computer-based STAD cooperative setting. There is no

Ho_3 significant difference in the attitude of students taught physics using computer-based STAD cooperative setting and individualized computer instructional strategy.

Methodology

Design of the Study: This study adopted a mixed method research combining qualitative and quantitative research methods. A quasi-experimental design of the pretest, posttest,

non-equivalent, non-randomized control group was used to compare the performance of physics students taught using computer-based STAD cooperative learning strategy and those taught using Individualized computer Instruction (ICI), while descriptive research of the survey type using the questionnaire was employed to elicit responses about the physics students' attitudes towards the use of STAD. The study employed two instructional groups (cooperative group and individualized computer instruction group), as independent variable, achievement level (high, medium and low) is the moderator variable, 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: equivalence (laboratories facilities and manpower), school ownership (public schools), gender composition (mixed schools), ICT facilities (computer laboratories under the SchoolNet programme). Secondly, an intact class from each of the two schools were selected and randomly assigned to experimental (computer-based STAD) and control (ICI) groups using simple random sampling technique. Thirdly, the researcher arranged the list of students in the class into different stratum 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. Last promotion examination results were used because, conventional measure of mental ability (Intelligent Quotient (IQ) and Verbal Quotient (VRQ) were not available in Nigerian Secondary Schools Yusuf (1997) and Fajola (2000). Eighty four (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 individualised). The package contained of two topics which were subdivided into sixteen lessons. It developed in html format using "Macromedia Dreamweaver 8" as the overall platform. The package was validated by computer programmers, educational technology experts, subject content (physics) specialists, and finally field tested on sample representative similar to the students used for the final study.

***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. PAT was validated and tested for reliability using 40 randomly selected SSII students within the population outside the sampled schools. PAT was administered once on the selected students, and a reliability coefficient of 0.90 was obtained using the Kuder Richardson (KR-20).

Physics Attitude Scale: A structured questionnaire was used to measure the students' attitude towards physics. Physics Attitude Scale (PAS) was developed to measure students' attitude towards physics before and after being exposed to computer-based STAD cooperative learning strategy. PAS contained two sections, Section A included four questions and it focused on demographic information of physics student while Section B focused on students' attitude towards physics subject. The section contained 20-item fourpoint response mode of Strongly Agree (coded 4), Agree (coded 3), Disagree (coded 2) and Strongly Disagree (coded 1) was used. To test the instrument's validity and reliability, the initial draft of 30-item of PAS was validated by experts. The final draft of

the instrument comprised of 20 items and was tested for reliability. PAS was administered once on the selected students and 0.86 reliability coefficient was obtained using Kuder Richardson (KR 21).

Treatment Procedure: During the treatment, Physics teachers were trained as research assistants in the use of the computer-assisted learning package and cooperative learning strategy. The Computer Assisted Learning Package (CALP) was installed on the computer systems. The physics contents were presented through the computer and the learners interacted and responded to the computer prompts. Students in experimental group were exposed to the following computer-based STAD activities:

(i) 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;

(ii) Individually, students take a quiz on the assigned reading;

(iii) Each team take the same quiz and reach consensus with respect to the correct answers for test questions because only one answer sheet should be submitted by the team for which all teammates receive the same 'team score';

(iv) Student's individual quiz score and team quiz score are counted equally towards the student's final course grade.

(v) High scoring teams is recognized and rewarded in the class.

Students in the control group (Individualized Computer Instruction) were exposed to physics concepts using CALP only. The computer presented the physics contents and the students study at their own rate without the help of their classmate.

The treatment lasted for six weeks for both experimental and control groups. At the commencement of the study, Physics Achievement Test (PAT) and Physics Attitude Scale (PAS) were administered as pretest.

Immediately after the treatment, PAT and PAS were administered as post-test.

Results

Data obtained were analysed using Analysis of Covariance (ANCOVA) and Scheffe's test using Statistical Package for Social Sciences (SPSS) version 16 at 0.05 alpha level. 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-based STAD cooperative strategy and those taught using individualized computer instruction (ICI).

To determine whether there was significant difference in the posttest mean scores of the experimental (computer-based STAD) and control groups (ICI), data were analyzed using the analysis of covariance (ANCOVA) as shown in Table 1.

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 revealed that an F (1, 81) = 5.092, p = 0.027 for the main effect (treatment) was significant, this indicates that the method of instruction produced a significant effect on the posttest achievement scores of students when covariate effect (pretest) was controlled. The result indicates that using computer-based STAD and ICI accounted for the difference in the posttest achievement scores of the students. The hypothesis one is thereby rejected.

The performance of students in both groups were further compared based on the mean gain scores between the pretest and posttest for each group to determine the direction of the difference. The results are shown in Table 2 and graphically illustrated in Figure 1.

Table 2:
Mean Gain Scores of Students taught Physics Using Computer-based STAD and ICI Groups

Group	Pretest	Posttest	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 posttest. For instance, computer-based STAD had the mean gain scores of 44.71 while ICI had the mean gain scores of 41.57. This indicates that all the groups benefited from the treatment, with computer-based STAD having higher performance.

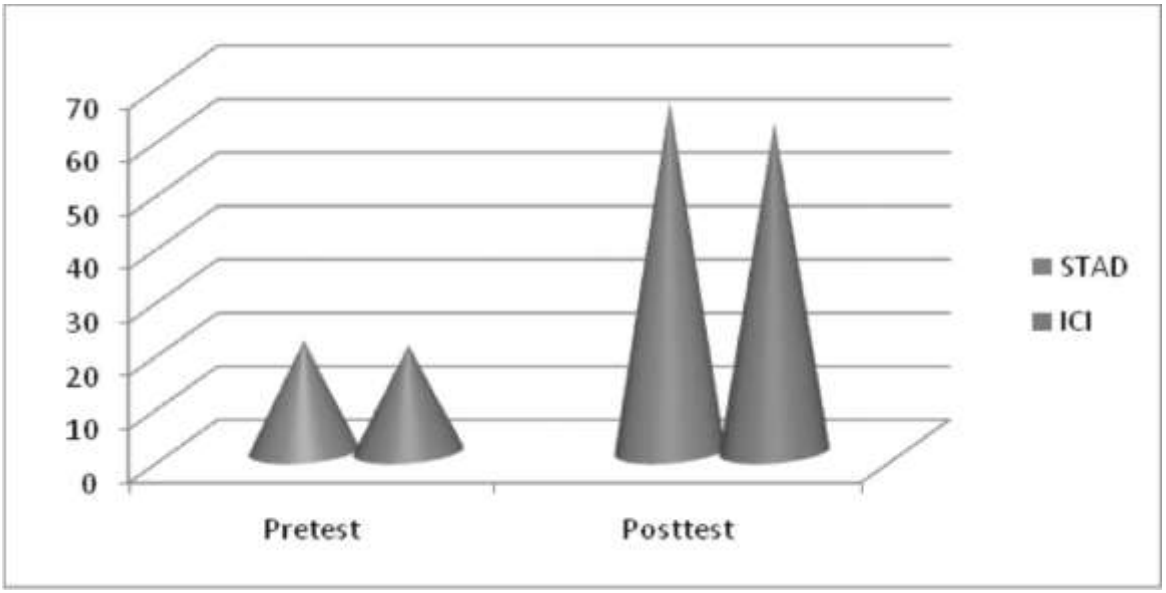

Fig. 1: Graphical Illustration of Students in STAD and ICI Groups at Pre-test and Post-test

Hypothesis Two: There is no significant difference in the performance of high, medium and low achievement levels of students taught physics using computer-based STAD cooperative strategy.

To determine whether there was significant difference in the posttest mean scores of the computer-based STAD and the control group (ICI), data were analyzed using the analysis of covariance (ANCOVA). Table 3 contains the result of the analysis.

To find out whether any significant difference existed in the posttest means scores of high, medium and low achiever students (Computer-based STAD group), the analysis of covariance (ANCOVA) was used. Table 3 presents the result of the analysis of covariance using the pretest scores of students in the three achievement levels as covariates.

Table 3:
ANCOVA Posttest on High, Medium and Low Students in Computer-based STAD Group

Source of Variation	Sum of Square	df	Mean Square	F	P-value
Covariate (Pretest)	35.475	1	35.475	2.276	0.139
Main Effect (Level)	1628.274	2	814.137	52.236	0.000
Model	1668.700	3	556.233	35.688	0.000
Residual	654.604	42	15.586		
Total	199282.000	46			

The result of the analysis in Table 3 indicates that an F (2, 42) = 52.236, p = 0.000 for the main effect was

significant at 0.05 alpha level. This shows that there was significant difference in the posttest mean scores of the high, medium and low achievers. This signifies that, the use of computer-based STAD was influenced by the achievement levels as the initial advantage at the pretest had been statistically controlled using ANCOVA. The hypothesis two is thereby rejected.

Based on the establishment of a significant difference, a post-hoc analysis using Scheffe test was conducted to determine the direction of difference among the three achievement levels. The result of the analysis is shown in Table 4.

Table 4:
Scheffe's Post-hoc Analyses of the Groups Mean Scores

Groups	Mean Scores	Group I (High)	Group II (Medium)	Group III (Low)
Group I (High)	75.00		*0.000	*0.000
Group II (Medium)	66.85	*0.000		*0.000
Group III (Low)	58.71	*0.000	*0.000	

* The mean difference is significant at the 0.05 level.

The data in Table 4 indicates significant difference in the posttest mean scores of high achievers (X = 75.00) and medium achievers (X = 66.85) in favour of high achievers. It also indicates significant difference in the posttest scores between medium achievers (X = 66.85) and low achievers (X = 58.71) in favour of medium achievers. Significant

differences were established in the posttest scores between high achievers (X = 75.00) and low achievers (X = 58.71) in favour of high achievers.

The mean gain in achievement scores between pretest and posttest for the three achievement levels (high, medium and low) are shown in Table 5 and Figure 2 respectively.

Table 5:
Mean Gain Scores of High, Medium and Low Students in STAD Group

Group	Pretest	Posttest	Mean Gain Score
High	22.38	75.00	52.62
Medium	19.81	66.85	47.04
Low	19.85	58.71	38.86

Table 5 revealed that high, medium and low achievers benefited from the treatment. However, there was a mean gain scores of students of different achievement levels taught using computer-based STAD strategy. The high achievers had mean gain scores of 52.62, followed by the medium achievers with mean gain scores of 47.04 and the low achievers with 38.86 as mean gain scores. This indicates that both groups benefited from the treatment, with high achievers having better posttest performance and mean gain scores than medium and low achievers. The mean gain scores of the three achievement levels are shown in Figure 2.

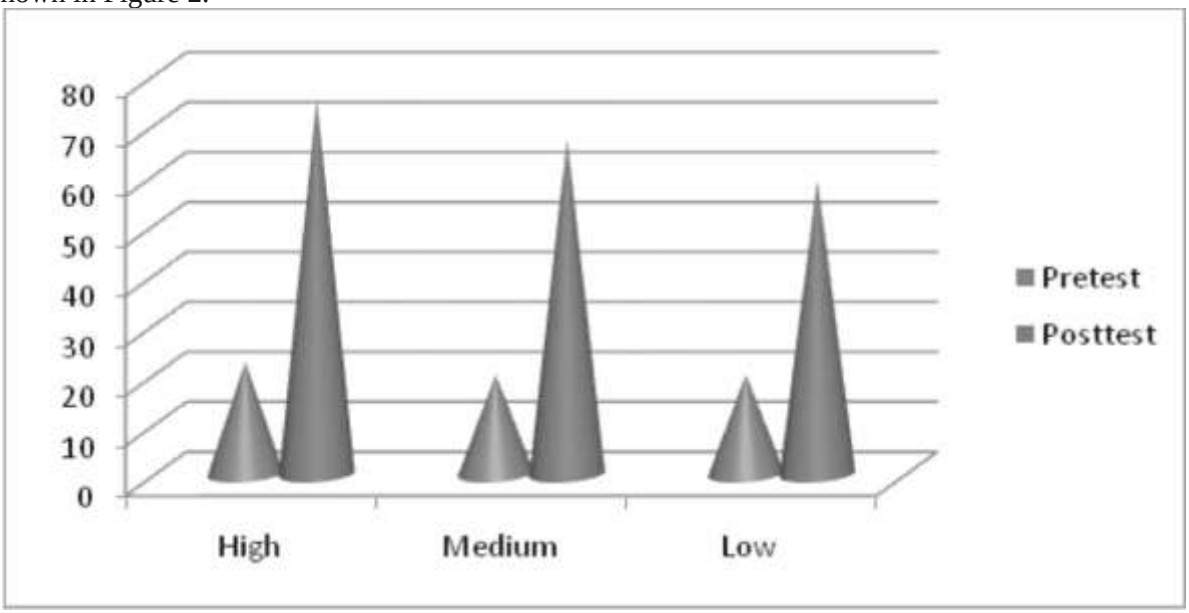

Fig. 2: Graphical Illustration of High, Medium and Low Students in STAD Group

Hypothesis Three: There is no significant difference in the attitude of students taught physics using computer-based STAD cooperative setting and individualized computer instructional (ICI) strategy. To determine whether there was significant difference in the posttest mean scores of the computer-based STAD and control group (ICI), data were analyzed using the analysis of covariance (ANCOVA). Table 6 shows analysis of the results.

Table 6:
ANCOVA on Attitude of Students in Computer-based STAD and ICI Groups

Source of Variation	Sum of Square	df	Mean Square	F	P-value
Covariate (Pretest)	2677.102	1	2677.102	24.328	0.000

Main Effect (Attitude)	1529.592	1	1529.592	13.900	0.000
Model	3392.390	2	1696.195	15.414	0.000
Residual	8913.569	81	110.044		
Total	263013.956	84			

Table 6 indicates significant difference in the attitude of students taught physics using computer-based
STAD and ICI. The main effect of treatment group (computer-based STAD) on attitude produced an F (1, 81) = 13.900, p = 0.000. This result was significant at the 0.05 alpha level. This hypothesis is therefore rejected. This implies that attitude of students in computer-based STAD group differ significantly from that of those in ICI group. The hypothesis three is thereby rejected.

The mean gain scores between the attitude of students in computer-based STAD and ICI groups were tabulated and graphically illustrated as shown in Table 7 and Figure 3 respectively.

Table 7:
Mean Gain Scores of Students' Attitude Using Computer-based STAD

Group	Pre-attitude	Post-attitude	Mean Gain Score
STAD	30.580	57.284	26.704
ICI	35.203	51.421	16.218

From Table 7, it was observed that both students' attitude differed. The attitude of students in computerbased STAD group had higher mean gain scores of 26.704 while the attitude of students in ICI had a mean gain score of 16.218 This indicates that students in computer-based STAD had better attitude towards physics than those in ICI group. Furthermore, the comparison in the mean scores between their pretest and posttest is shown in Figure 3.

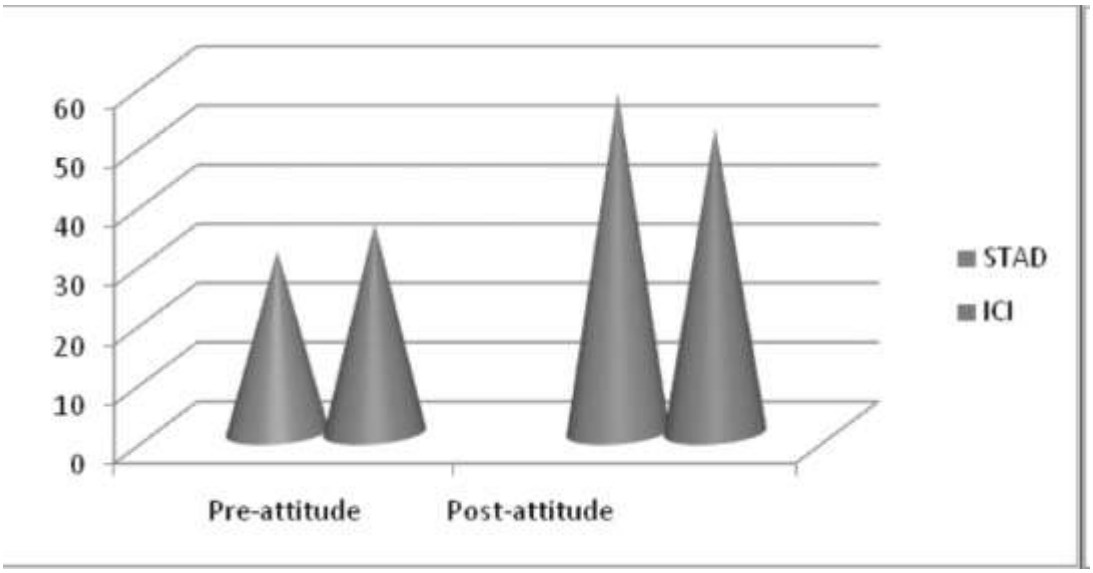

Fig. 3: Performance of Male and Female Students in Computer-based STAD and ICI Groups

Discussion

The results of the analyses related to the hypothesis one indicated a significant difference in students' performance of in favour of those in the experimental group (STAD). The

findings as regards better performance of students in the STAD as compared to the ICI agree with earlier findings of of Fajola (2000), Gambari (2010), Pandian (2004), Taiwo (2008), Yusuf and Afolabi (2010) and Gambari and Olumorin (2012) which found that students taught using computer-assisted STAD cooperative instruction performed better than their counterparts who taught the same biology concepts with individualized instruction and traditional method respectively. However, Rosini and Jim (1997), Armstrong (1998) and Glassman (1989) found no significant difference in the achievement of students taught using STAD and those taught with conventional classroom.

The results of the analyses related to the hypothesis two indicated significant difference in the performance of high, medium and low students taught physics using computer-assisted STAD cooperative learning. The findings agree with the earlier findings of Fajola (2000), **Ghaith** (2001) and Balfakih (2003) which found that the high scorer students performed better than the low scoring ability students. However, it contradicts the findings of Yusuf (2004) which revealed that achievement levels had no influence on academic performance of the learners.

The results of the analyses related to the hypothesis three indicated significant difference in the attitude of students taught physics using computer-assisted STAD cooperative learning and those taught using ICI. The findings agree with the earlier findings of Johnson and Johnson (1991), Armstrong (1998), Tarim and Akdeniz (2008), Majoka, Dad and Mahmood (2010), Zakaria, Chin and Daud (2010) and Gupta and Pasrija (2012) which revealed the encouraging effects of co-operative learning (STAD) on students' achievement, retention and attitude towards Mathematics. However, Rosini and Jim (1997) reported no significant difference in student attitudes toward the cooperative learning strategy and traditional teaching method.

The positive attitude towards physics exhibited by students in the cooperative learning classroom may have been attributed to immediate feedback, reinforcement, and support come from students' peers in the group. Again, students in cooperative learning performed better in test of attitude towards studies may perhaps be because of role expectation and sharing of responsibility, which are two important features of cooperative learning (Ajaja & Eravwoke, 2010).

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

Conclusion

This study examined the effects of computer-based STAD cooperative learning strategy as a way to overcome poor performance in physics at the senior secondary school level in Nigeria. Computer-based STAD cooperative learning strategy enhanced students' performance in physics, promote cooperation among students and improved their achievement levels. Students attitude towards physics were found to be positive in computer-based cooperative learning strategy than individualized computer instruction (ICI) strategy.

Recommendations

Based on the findings of this **study,** it is recommended that physics teachers should expose students to computer-assisted STAD cooperative instructional strategy so as to enhance their performance in the subject. In addition, education stakeholders such as government and non-governmental agencies should organize workshops on the use of computer-

assisted cooperative learning strategy to improve their teaching methodology. Also, teacher education programme 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.

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