# Effects of Computer-Assisted STAD, LTM and ICI Cooperative Learning Strategies on Nigerian Secondary School Students' Achievement, Gender and Motivation in Physics

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## ABSTRACT

This study examined the effectiveness of computer-assisted instruction on Student Team Achievement Division (STAD) and Learning Together (LT) cooperative learning strategies on Nigerian secondary students' achievement and motivation in physics. The effectiveness of computer assisted instructional package (CAI) for teaching physics concepts in cooperative settings was determined using Pretest-Posttest Experimental group design. The reliability coefficient of the research instruments were .71 and .82 using Kuder-Richardson KR-20 and 21 respectively. Some 90 (45 male and 45 female) students from three secondary schools in Minna, Nigeria made-up the sample. The schools were randomly assigned to experimental group I (STAD), experimental group II (LTM) and control group (Individualized Computer Instruction, ICI). Results revealed that the students taught with STAD and LTM performed significantly better than their counterparts taught using individualized computer instruction (ICI). The cooperative learning strategies were found to be gender friendly. Based on the findings, physics teachers should be encouraged to use computer-assisted STAD cooperative teaching strategy to enhance students' academic achievement, retention and motivation in physics.

**Keywords:** *Computer-Assisted Instruction Package; Physics, Achievement, Motivation, Gender.*

## INTRODUCTION

Education is a prerequisite for meaningful and sustained national economy. No nation can rise above the quality of its educated citizenry. The purpose of education is to assist individuals to maximize their potentials for optimal self and national development. The teacher at any level of education is the pivot of learning. Therefore, the teacher's instructional method plays an important role in skill acquisition and meaningful learning (Ezenwa & Yaki, 2013).

In Nigerian schools, classroom teachers mostly prefer a teacher-centered approach to student-centered teaching strategy. This is a one-way process in which the teacher directly presents information and skills dictated by a textbook. Students generally remain passive throughout the lesson. Adegoke (2011) reported that students are not actively involved in developing knowledge; they receive information passively and are less motivated. When students are not encouraged to contribute to class discussions by voicing their opinions and supporting their answers because of persistent use of a didactic teaching method in which acquisition of factual knowledge and memorization are over emphasized, school becomes a tedious chore. Schooling becomes suffused with anxiety and boredom, destructive of curiosity and imagination, producing cramming machines (Gambari, 2004; Gupta & Pasrija, 2012; Thomas 1990).

The teacher-centered approach has been has identified as one of the causes of poor performance in science subjects especially in physics at senior secondary education level in Nigeria. According to the West African Examination Council (WAEC) Chief examiners' reports, students' performance in physics in the Senior Secondary School Certificate Examinations (SSSCE) in Nigeria from 2003 to 2012 has been poor. The percentage of students passing physics at credit level (A1 - C6) had consistently been less than 50% (West African Examination Council, WAEC, 2003-2012). Researchers have identified teacher-centered and poor teaching methods as a major cause of poor student performance in science subjects (Adegoke, 2011; Bajah, 2000; Chukwu, 2000; Gambari, 2010; Jegede, 2007, Olorukooba, 2007). To overcome this problem, students must be actively involved in the teaching and learning process.

Cooperative learning allows students to be actively involved in learning, communicate their ideas with each other, brainstorm, provide immediate feedback, work to solve problems together and fostering their learning outcomes. The importance of students becoming more involved with the learning process has been emphasized and needs to be implemented in classrooms around the world (Slavin, 2005; Leikin & Zaslavsky, 1997). Compared to traditional instructions, cooperative learning strategies improve students' achievements both on teacher-made and standardized tests (Slavin, 1990). Johnson and Johnson (2008) recognized these improvements to increased student motivation, greater time on-task, and especially active student involvement. Students working together are engaged in the learning process, instead of being passive listeners in the classroom. Slavin (1990) also found that students' self-esteem increased by working together. They felt more in control of their academic success and they began to link their success to their effort, an important factor in motivation. Low achievers tend to attribute their success or failure to luck or other forces outside their control, and cooperative learning helps them to change this perception. Now they can believe in themselves and be more confident.

Cooperative learning strategies promote student learning and academic achievement, increase student retention, enhance student satisfaction with their learning experience, help students to develop skills in oral communication, develop their social skills (Johnson & Johnson, 2000).

Different cooperative learning strategies are suitable for different objectives. Student Team Achievement Division (STAD) and Learning Together (LT) strategies of cooperative learning were specifically chosen because they allow more active involvement of students in the teaching and learning process in line with the design of science curriculum than other cooperative learning strategies (Bilesanmi-Awoderu & Oludipe, 2012).

STAD techniques were developed and researched at Johns Hopkins University in the United States in 1987. In STAD, the teacher presents the content or skill in a large group activity in a regular manner with opening, development and guided practice. Then as opposed to individual study, students are provided with learning materials (i.e., worksheets developed for STAD) that they use in groups to master the content. As students are provided with worksheets that they use in groups, the teacher circulates around the room to monitor group progress and interaction. When students are ready, they are administered formative test. The teacher scores this test and uses this information to compute improvement points. These are added up for each team, and teams earning a specific number of improvement points are recognized (e.g., award, free time, or certificate of achievement). Chen (2004) investigated the positive effect of Student Teams-Achievement Division (STAD) in teaching English as a foreign language; Tarim and Akdeniz (2007) found positive effects of STAD on Mathematics achievement and retention whereas Majoka, Dad, and Mahmood (2010) reported STAD as active co-operative learning strategy for teaching Mathematics. Zakaria, Chin and Daud (2010) and Gupta and Pasrija (2011) also revealed the encouraging effects of co-operative Learning (STAD) on students' Mathematics achievement, retention and attitude towards Mathematics.

Learning together model of co-operative learning (developed by Johnson & Johnson 1986) involves students working in four-or-five member heterogeneous groups on assignments. The groups complete a single assignment and receive praise and rewards based on the group product as this method emphasizes team building activities before students begin working together and regular discussions within groups about how well they are working together. Ghaith (2003) reported the upbeat effects of learning together model of co-operative learning on English achievement, academic self-esteem and feelings of school alienation while Keramati (2009) and Kaul (2010) found that learning together technique of co-operative learning is more effective than traditional teaching methods.

Adesanya (2000) stated that student performance in any subject could be enhanced by the quality of technology employed by the teachers. A number of researchers (Abimbade, 1997; Gambari & Mogbo, 2006; Yusuf & Afolabi, 2010) have attested to the effectiveness of computer-assisted instruction (CAI). It can also offer educators a new approach to learning. CAI is designed for individual learning, but, it is more effective and cost effective when implemented with small groups rather than alone (Cher, 1988; Yusuf & Afolabi, 2010).

Researchers in non-computer learning settings had indicated that cooperative learning groups are positively effective in improving students' academic achievement. Similarly, studies revealed that students learning with computer-based instruction in cooperative groups performed better than those taught using traditional teaching method and individualized instructional setting respectively (Gambari, 2010; Mohammad, 2004; Pandian, 2004; Yusuf & Afolabi, 2010; Yusuf, Gambari & Olumorin, 2012).

The uses of computer as a medium or resource for cooperative learning have been embraced by earlier researchers. For instance, in a research project, Johnson and Johnson (1986) concluded that computer assisted cooperative instruction promotes "greater quantity and quality of daily achievement, more successful problem solving, more task related student-student interaction and increases the perceived status of female students". Their results also indicated that putting students in groups at a computer is not enough, but that groups of students may need a clear cooperative goal structure.

Gender has been identified as one of the factors influencing students' achievement in sciences at senior secondary school level. Research on gender in cooperative learning has been conflicting; for instance, Olson (2002) reported females performed better than male students when taught mathematics using cooperative learning. In contrast, Aguele and Agwugah (2007), Adeyemi (2008), Kolawole (2007) and Khairulanuar, Nazre, Sairabanu, and Norasikin (2010) found gender differences in favor of male students. On the other hand, Annetta, Mangrum, Holmes, Collazo and Cheng (2009), Ajaja and Eravwoke (2010), Kost, Pollock and Finkelstein (2009), Oludipe (2010) and Yusuf and Afolabi (2010) Yusuf, Gambari and Olumorin (2012) reported that gender had no effect on academic performance of students in cooperative learning. These contradictory findings have prompted the inclusion of gender as one of the moderating variables for this study.

While empirical evidence supports the use of cooperative learning strategies with a variety of subject areas and age groups within and outside Nigeria, the extent to which these strategies are beneficial to science in general and physics in particular in Nigeria, to the best of our knowledge, is unknown. In addition, many of the research studies on the effects of cooperative learning teaching strategy, most especially in Nigeria, were limited to students' academic achievement and computers were not used as a medium of instruction. If the Learning-Together and STAD cooperative learning strategies of teaching are used to teach physics concepts, what would be their effects on students' academic achievement and gender in physics? In view of this, the effects of two cooperative learning strategies (Learning Together and STAD) on Nigerian senior secondary students' academic achievement, gender and motivation in physics were investigated in this study.

**Research Questions**

The following research questions were raised to guide the study:

(i) What are the differences in the achievement of students taught physics using computer-assisted STAD, LTM and ICI?

(ii) Is there any difference in the achievement of male and female students taught physics using computer-assisted STAD cooperative strategy?

(iii) Is there any difference in the achievement of male and female students taught physics using computer-assisted Learning Together cooperative strategy?

(iv) What are the differences in the motivation of students taught physics using cooperative computer-assisted STAD, LTM and ICI?

**Research Hypotheses**

The following null hypotheses were formulated and tested at the 0.05 level of significance:

(i) There is no significant difference in the achievement of students taught physics using computer-assisted STAD, LTM and ICI.

(ii) There is no significant difference in the achievement of male and female students taught physics using computer-assisted STAD cooperative strategy.

(iii) There is no significant difference in the achievement of male and female students taught physics using computer-assisted Learning Together Model cooperative strategy.

(iv) There is no significant difference in the motivation of students taught physics using cooperative computer-assisted STAD, LTM and ICI.

## METHODOLOGY

### *Research Design*

The research design adopted for the study is a pre-test-post-test experimental and control group design. Two levels of independent primary variable (one treatment and a control), two levels of gender (male and female) were investigated on students' performance in Mathematics. The research design is illustrated in Table 1.

**Table 1: Research design layout**

| Groups | Pre-test | Treatment | Post-test |
|---|---|---|---|
| Experimental (Group 1) | $O_1$ | STAD | $O_2$ |
| Experimental (Group 2) | $O_3$ | LT | $O_4$ |
| Control (Group 3) | $O_5$ | ICI | $O_6$ |

### *Sampling Procedure*

Purposive sampling procedure was adopted to obtain three secondary schools in Minna metropolis, Niger State, Nigeria. These schools were sampled based on facilities, school type, gender composition and year of experience in external examination. The three schools were randomly assigned to experimental group I (STAD group) (n = 30), experimental group II (LT) (n = 30) and control group (ICI) (n =30) respectively. Some 90 SSII students were selected from three schools using stratified random sampling techniques. Each school has equal number of male (n = 15) and female (n = 15) students as participants.

### *Research Instruments*

Three research instruments were employed in this study: Test instrument (Physics Achievement Test), Questionnaire (Physics Motivation Scale), and a treatment instrument (Physics Computer-Assisted Instructional Package).

Physics Achievement Test (PAT) was used as a test instrument for collecting data on students' achievement in the study. It consists of 50 multiple choice objective items with four options (A–D). The PAT was based on SS II physics curriculum on concepts of Structure of Matter (Molecule, Atom, Osmosis and

Diffusion). The selected contents correspond to the SSII physics syllabus and scheme of work and correspond to what the students would be taught in the school at the time of the study. The researchers developed PAT and subjected it to facility and discriminating indices. The ideal ranges of the facility and discrimination indices are taken to be between 30% - 70%. The 50 questions that met the facility and discriminating indices criteria were validated by physics experts (secondary school physics teachers; physics lecturers from university; physics subject officers; and test and measurement specialists from the National Examination Council) and its reliability coefficient was determined as .79 using Kuder Richardson (KR-21).

The Physics Motivational Scale (PMS) was developed by the researchers to measure the students' level of motivation toward physics before and after exposure to computer-supported STAD, LT and ICI learning strategies respectively. Section A of the PMS focused on demographic information of physics students while section B focused on students' motivation towards physics subject. This section contained a 23-item four point response mode of Strongly Agree (coded 4), Agree (coded 3), Disagree (coded 2) and Strongly Disagree (coded 1) that reflect their degree of response to each question asked. To test the instrument validity and reliability, the initial draft of 28-item of PMS was validated by experts. The observations, comments, and suggestions were used to modify the final instrument. PAM was subjected to pilot test and the reliability coefficient of .82 was obtained using Kuder Richardson (KR-20). Some 90 copies of the questionnaire were distributed to physics students before and after the commencement of study; a 100% return rate was achieved and responses were found suitable for data analysis.

Treatment instrument, Physics Computer Assisted Instructional Package (PCAIP) was developed by researchers and programmers. PCAIP was used for cooperative learning and individualized instruction respectively. The PCAIP consists of four topics in mechanics (Structure of Matter) in the Nigeria Senior Secondary School curriculum. These concepts were identified as one of the difficult concepts to understand (WAEC Chief Examiners' report, 2012). PCAIP incorporated computer animated illustration to aid the understanding of the concepts; it allows students to interact, navigate, explore the contents, and listen to the audio narration. Tutorial mode of CAI was employed in this study.

***Experimental Procedure***

The teachers and students participating in the study were trained for two weeks. During the training objectives and the modalities of the experiments were specified and an operational guide was provided. The Physics Computer Assisted Instructional Package (PCAIP) with the physics content was installed in the system. The computer presents information and displays animation to the learner on each of the units after which the students assessed themselves with objective questions at the end of each unit. Immediate feedback is provided before students proceed to the next unit.

We administered the Physics Achievement Test (PAT) on sample students as pretest to ascertain the cognitive achievement of the students before the treatment. During the four weeks treatment, the (STAD) and (LT) groups were exposed to the use of cooperative computer instruction as treatments, while students in control group were exposed to ICI. Each of the lessons in each school lasted for forty minutes duration (160 minutes per week) with four lessons per week. The following are the specific procedures for each group:

*(i) The cooperative computer instruction using Students Team Achievement Division (STAD) cooperative learning strategy*: In this strategy, students were assigned into three member heterogeneous groups. Each member was assigned with different responsibilities (e.g, group leader, time-keeper, scribe/quiet captain). The groups were exposed to CAIP where members complete the reading of the materials and perform the tasks together. To ascertain that there was no free rider, students were given an individual task which was marked and recorded against group scores. After the completion of a lesson, students take a quiz as a team and reach consensus with respect to the correct answers after which one answer sheet was submitted by the team for which all teammates receive the same 'team score'. The scoring was done based on individual quiz score and team quiz score which were counted equally toward the student's final course grade. High scoring teams are recognized and rewarded in the class. The group

processing form was completed after each lesson to determine the group behavior and correct any irregularity within the teammates.

*(ii) The cooperative computer instruction using Learning Together strategy:* In this strategy, students work in three heterogeneous groups on a group assignment sheet. During discussion, if students ask the teacher a question, the teacher will refer such students to their groups to find the answer. After the group discussion, a leader is chosen to present the group's result to the entire class, and groups receive reward together. Scores are based on both individual performance and the success of the group, but individuals do not compete with one another.

*(iii) Individualized Computer Instruction method:* In this method, students were taught the mathematics concepts using CAIP only. The computer presented the instruction on human-to-computer basis. Students proceeded with the physics contents and study at their own rate without any assistance from their colleagues. Students answered the PAT at pre-test and post-test individually.

Immediately after four weeks of treatment, PAT was administered as posttest to measure the achievement of different groups. The scores obtained were subjected to data analysis based on the stated hypotheses using One-way Analysis of Variance and Scheffe's post-hoc analysis. The significance of the various statistical analyses was ascertained at the 0.05 alpha level.

## RESULTS

To test the hypotheses, the data were analyzed using Analysis of Covariance (ANCOVA) and Scheffe's test using the Statistical Package for the Social Sciences (SPSS) version 17 at the 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-assisted STAD, LTM and individualized computer instruction (ICI).*

To determine whether there was significant difference in the posttest mean scores of the experimental (computer-assisted STAD), Learning Together Model (LTM), and control groups (ICI), data were analyzed using the analysis of covariance (ANCOVA). Table 2 shows the result of the analysis.

**Table 2: ANCOVA post-test on experimental STAD, LTM and control (ICI) groups**

| Source of Variation | Sum of Square | df | Mean Square | *F* | Significance of *F* |
|---|---|---|---|---|---|
| Covariate (Pre-test) | 58.310 | 1 | 58.310 | 2.580 | 0.112 |
| Main Effect (Treatment) | 2354.489 | 2 | 1177.245 | 52.084 | 0.000 |
| Model | 2546.577 | 3 | 848.859 | 37.556 | 0.000 |
| Residual | 1943.823 | 86 | 22.603 | | |
| Total | 521598.000 | 90 | | | |

Table 2 revealed that an $F(1, 90) = 52.084$, $p = 0.000$ 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 results indicate that using computer assisted STAD, LTM and ICI accounted for the difference in the posttest achievement scores.

Based on the established significant difference in the post-test achievement scores of the groups, Scheffe's test was used for post-hoc analysis. The results are as shown in Table 3.

**Table 3: Scheffe's post-hoc analyses of the groups mean scores**

| Groups | Mean Scores | Group I (STAD) | Group II (LT) | Group III (ICI) |
|---|---|---|---|---|
| Group I (STAD) | 82.40 | | 0.000 | *0.000 |
| Group II (LTM) | 75.47 | 0.000 | | *0.000 |
| Group III (ICI) | 69.53 | *0.000 | *0.000 | |

* The mean is significant at the .05 level.

The result in Table 3 indicates that there was significant difference in the post-test mean scores of students exposed to STAD (X = 82.40) and those exposed to LTM (X = 75.47). It also indicates significant difference in the post-test mean scores of students exposed to LTM (X = 75.47) and those exposed to ICI (69.53). Significant difference was also established in the post-test mean scores of students exposed to STAD (X = 82.40) and those exposed to ICI (X = 69.53).

The performance of students in both groups were further compared based on the mean gain scores between the pretest and posttest for each group and the results are shown in Table 4 and graphically illustrated in Figure 1.

**Table 4: Mean gain scores of students taught physics using STAD, LTM and ICI**

| Group | Pretest | Posttest | Mean Gain Score |
|---|---|---|---|
| STAD | 21.70 | 82.40 | 60.70 |
| LTM | 21.13 | 75.46 | 54.33 |
| ICI | 20.16 | 69.53 | 49.37 |

Table 4 shows that both groups had improved performance in posttest. For instance, STAD had the mean gain scores of 60.70, LTM had 54.33 mean gain scores, while ICI had the mean gain scores of 49.37. This indicates that all the groups benefited from the treatment, with STAD having higher performance.

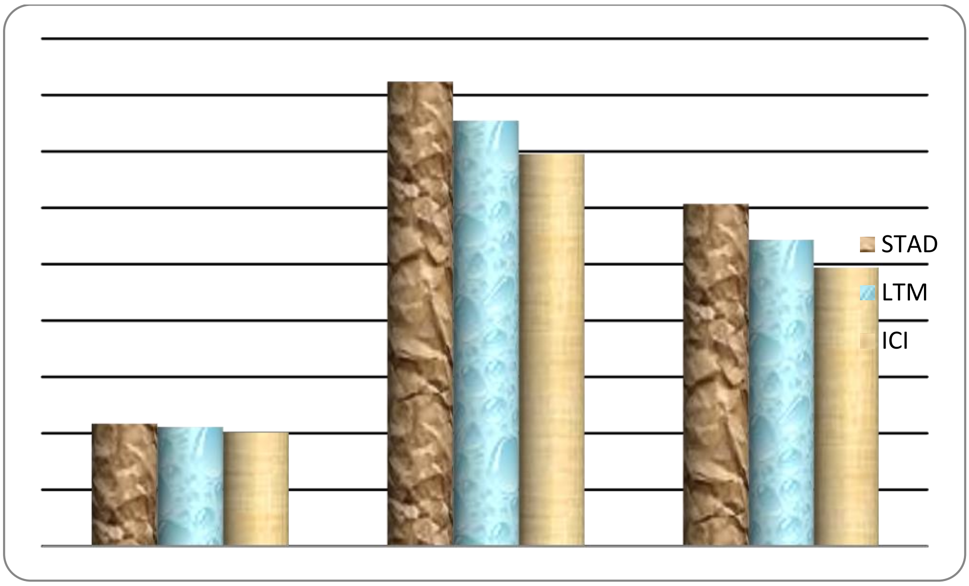


**Fig. 1: Graphical illustration of students in STAD, LTM and ICI groups at pretest and posttest**

**Hypothesis Two:** *There is no significant difference in the mean achievement scores of male and female students exposed to computer-assisted STAD cooperative instruction.*

To determine whether there was significant difference between male and female using computer-assisted STAD, data were analyzed using the analysis of covariance (ANCOVA). Table 5 shows the result of the analysis.

**Table 5: ANCOVA result on male and female students in computer-assisted STAD**

| Source of Variation | Type III Sum of Square | df | Mean Square | *F* | Significance of *F* |
|---|---|---|---|---|---|
| Covariate (Pre-test) | 80.618 | 1 | 80.618 | 3.189 | 0.085 |
| Main Effect (Treatment) | 12.098 | 1 | 12.098 | 0.479 | 0.495 |
| Model | 110.618 | 2 | 55.309 | 2.188 | 0.132 |
| Residual | 682.582 | 27 | 25.281 | | |
| Total | 204486.000 | 30 | | | |

Table 5 indicates that the main effect of treatment (group 1 – computer-assisted STAD on gender produced an $F$ (1, 27) = 0.479, $p$ = 0.495 which was not significant at the 0.05 alpha level. This shows that there was no significant difference between the mean achievement scores of male and female students. Male students' scores did not differ significantly from their female counterparts when both were taught using computer-assisted STAD cooperative learning strategy. Therefore, hypothesis two was not rejected.

The mean gain scores between the pretest and posttest among male and female in the computer-assisted STAD group were tabulated and graphically illustrated as shown in Table 6 and Figure 2 respectively.

**Table 6: Mean gain scores of male and female students taught physics using computer-assisted STAD**

| Group | Pretest | Posttest | Mean Gain Score |
|---|---|---|---|
| Male | 20.66 | 81.40 | 60.74 |
| Female | 22.73 | 83.40 | 60.67 |

From Table 6, it was observed that both male and female benefited from the treatment. The male students had higher mean gain score of 60.74 while the female students had a mean gain score of 60.67. This indicates that all the groups benefited from the treatment. Furthermore, the comparison in the mean scores between their pretest and posttest is shown in Figure 2.

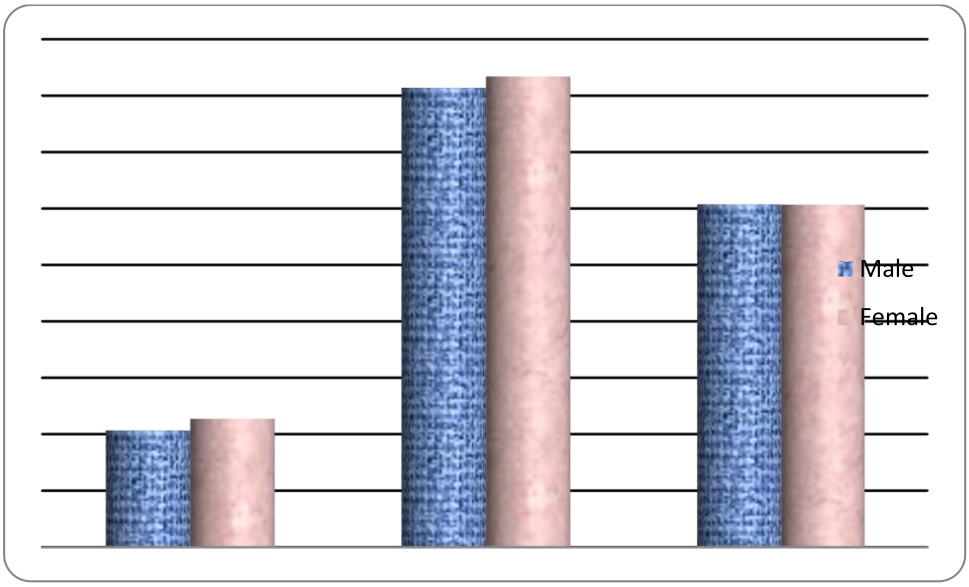


**Fig. 2: Graphical illustration of male and female students in STAD groups at pretest and posttest**

**Hypothesis Three:** *There is no significant difference in the mean scores of male and female students exposed to computer-assisted LT cooperative instruction.*

To determine whether there was significant difference between male and female using computer-assisted STAD, data were analyzed using the analysis of covariance (ANCOVA). Table 7 shows the result of the analysis.

**Table 7: ANCOVA result on male and female students in computer-assisted LTM**

| Source of Variation | Type III Sum of Square | df | Mean Square | *F* | Significance of *F* |
|---|---|---|---|---|---|
| Covariate (Pre-test) | 14.069 | 1 | 14.069 | 0.544 | 0.467 |
| Main Effect (Treatment) | 20.152 | 1 | 20.152 | 0.779 | 0.385 |
| Model | 33.269 | 2 | 16.635 | 0.643 | 0.533 |
| Residual | 698.198 | 27 | 25.859 | | |
| Total | 171588.000 | 30 | | | |

Table 7 indicates that the main effect of treatment (group 1 – computer-assisted LTM on gender produced an $F$ (1, 27) = 0.479, $p$ = 0.495 which was not significant at the 0.05 alpha level. This shows that there was no significant difference between the mean achievement scores of male and female students. Male students' scores did not differ significantly from their female counterparts when both were taught using computer-assisted LTM cooperative learning strategy. Therefore, hypothesis two was not rejected.

The mean gain scores between the pretest and posttest among male and female in the computer-assisted LTM group were tabulated and graphically illustrated as shown in Table 8 and Figure 3 respectively.

**Table 8: Mean gain scores of male and female students taught physics using computer-assisted LTM**

| Group | Pretest | Posttest | Mean Gain Score |
|---|---|---|---|
| Male | 21.26 | 76.26 | 55.00 |
| Female | 21.00 | 74.66 | 53.66 |

From Table 8, it was observed that both male and female benefited from the treatment. The male students had higher mean gain score of 55.00 while the female students had a mean gain score of 53.66. This indicates that the two groups benefited from the treatment. Furthermore, the comparison in the mean scores between their pretest and posttest is shown in Figure 3.

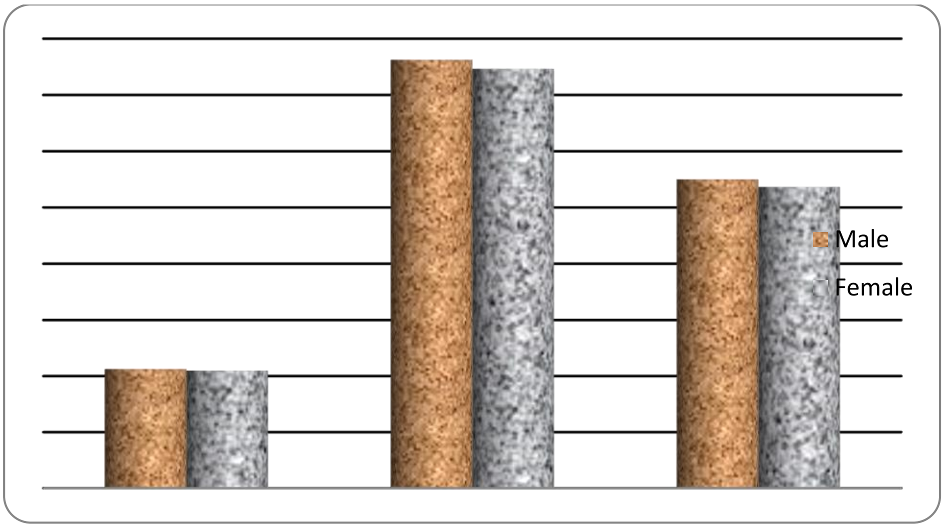


**Fig. 3: Graphical illustration of male and female students in LTM groups at pretest and posttest**

**Hypothesis Four:** *There is no significant difference in the motivation of students taught physics using computer-assisted STAD, LTM and ICI instructional strategies.*

To determine whether there was significant difference in the posttest mean scores of the experimental (computer-assisted STAD), Learning Together Model (LTM), and control groups (ICI), data were analyzed using the analysis of covariance (ANCOVA). Table 9 contains the result of the analysis.

**Table 9: ANCOVA post-survey on experimental STAD, LTM and control (ICI) groups**

| Source of Variation | Sum of Squares | df | Mean Square | *F* | Significance of *F* |
|---|---|---|---|---|---|
| Covariate (Pre-test) | 0.002 | 1 | 0.002 | 0.014 | 0.905 |
| Main Effect (Motivation) | 22.345 | 2 | 11.173 | 64.627 | 0.000 |
| Model | 23.498 | 3 | 7.833 | 45.308 | 0.000 |
| Residual | 14.867 | 86 | 0.173 | | |
| Total | 1161.895 | 90 | | | |

Table 9 revealed that an $F(1, 90) = 64.627$, $p = 0.000$ for the main effect (motivation) was significant, this indicates that the method of instruction produced motivation among the three groups. This implies that instructional strategy produced a significant effect on the students' motivation when covariate effect (pretest) was controlled. The results indicate that using computer assisted STAD, LTM and ICI accounted for the difference in the students' motivation toward learning.

Based on the established significant difference in the motivation mean scores of the groups, Scheffe's test was used for post-hoc analysis. The results are as shown in Table 10.

**Table 10: Scheffe's post-hoc analyses of the groups mean scores**

| Groups | Mean Scores | Group I (STAD) | Group II (LTM) | Group III (ICI) |
|---|---|---|---|---|
| Group I (STAD) | 4.068 | | 0.003 | *0.000 |
| Group II (LTM) | 3.686 | 0.003 | | *0.000 |
| Group III (ICI) | 2.845 | *0.000 | *0.000 | |

* The mean is significant at the .05 level.

The result in Table 10 indicates that there was significant difference in the post-test mean scores of students exposed to STAD (X = 4.068) and those exposed to LTM (X = 3.686). It also indicates significant difference in the post-test mean scores of students exposed to LTM (X = 3.686) and those exposed to ICI (2.845). Significant difference was also established in the post-test mean scores of students exposed to STAD (X = 4.068) and those exposed to ICI (X = 2.845).

The performance of students in both groups were further compared based on the mean gain values between the pre-motivation and post-motivation for each group and the results are shown in Table 11 and graphically illustrated in Figure 4.

**Table 11: Mean gain values of students taught physics using STAD, LTM and ICI**

| *Group* | *Pre-motivation* | *Post-motivation* | **Mean Gain Value** |
|---|---|---|---|
| STAD | 1.618 | 4.068 | 2.450 |
| LTM | 1.511 | 3.686 | 2.175 |
| **ICI** | 1.364 | 2.845 | 1.481 |

Table 11 shows that both groups had improved performance in the posttest. For instance, STAD had the mean gain scores of 60.70, LTM had 54.33 mean gain scores, while ICI had the mean gain scores of 49.37. This indicates that all the groups benefited from the treatment, with STAD having higher performance.

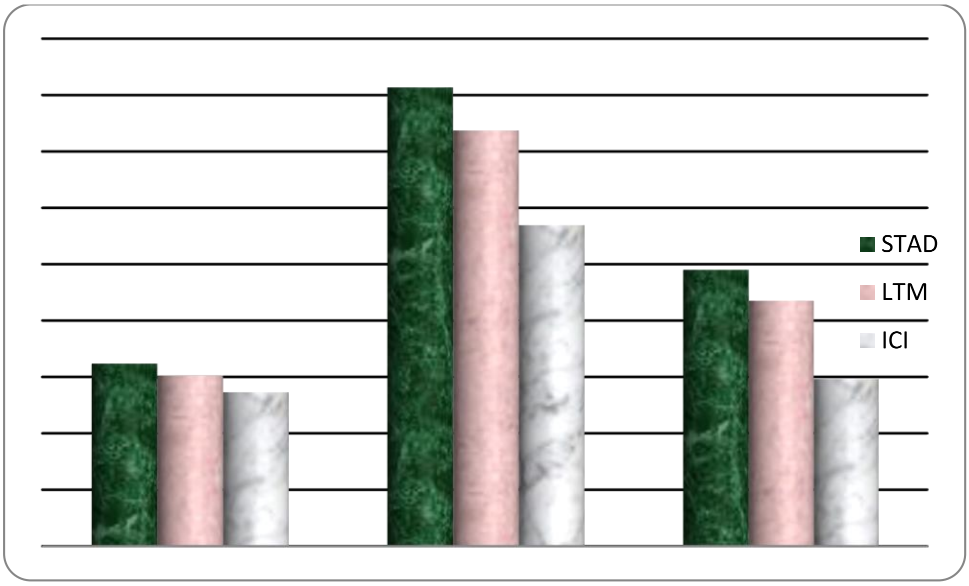


**Fig. 1: Graphical illustration of students in STAD, LTM and ICI groups at Pre-motivation and post-motivation**

## DISCUSSION OF THE FINDINGS

The result of the ANCOVA on performance of students taught physics using computer-assisted STAD, LTM cooperative settings and individualized computer instruction (ICI) indicated a significant difference in favor of the students in the experimental groups (STAD and LT). Scheffe test was used as post hoc to locate the observed significant difference. It indicated that there was significant difference between the performances of students exposed to STAD and ICI, LTM, and ICI. However, there was no significant difference between the performance of those exposed to STAD and LTM.

These findings agree with earlier findings of Chen (2004), Fajola (2000), Yusuf and Afolabi (2010), Majoka, Dad and Mahmood (2010) and Tarim and Akdeniz (2007) who reported that STAD enhanced students' performance and retention than conventional methods in English language, Mathematics and biology respectively. Specifically, the findings agree with that in Mohammad (2004), Yusuf and Afolabi (2010), Gambari (2010), Pandian (2004), Yusuf, Gambari and Olumorin (2012) who found that students learning with computer based instruction in cooperative groups performed better than those taught using traditional teaching method and individualized computer instructional setting respectively. They also agree with the findings of Ghaith (2003), Keramati (2009) and Kaul (2010) who reported that Learning Together Model of cooperative learning technique of cooperative learning method is more effective than traditional teaching methods. The superiority of STAD and LTM cooperative strategies over ICI could be attributed to the fact that cooperative learning encourages students to be active participants in construction of their own knowledge, positive interdependence, group processing, face-to-face interaction, among others.

Hypotheses two and three examined the influence of gender on computer-assisted STAD and LTM cooperative learning strategy respectively. The *t*-test analyses showed no significant difference between male and female students in STAD and LT respectively. The findings agree with the earlier findings of Annetta, Mangrum, Holmes, Collazo and Cheng (2009), Ajaja and Eravwoke (2010), Kost, Pollock and Finkelstein (2009), Oludipe (2010) and Yusuf and Afolabi (2010) Yusuf, Gambari and Olumorin (2012) who reported that gender had no effect on academic performance of students in cooperative learning. However, the findings disagree with the earlier findings of Olson (2002) who reported that female performed better than male students when taught mathematics using cooperative learning, while Aguele and Agwugah (2007), Adeyemi (2008), Kolawole (2007) and Khairulanuar, Nazre, Sairabanu, and Norasikin (2010) found gender differences in favor of male students.

The influence of STAD, LTM cooperative settings and ICI on students' motivation in physics was examined using hypotheses four. The result of ANCOVA showed significant difference for learners exposed to computer-assisted STAD, LTM and ICI. Scheffe post-hoc test shows significant difference in favor of computer-assisted STAD and LTM cooperative settings. The findings agree with the earlier findings of Zakaria, Chin and Daud (2010) and Gupta and Pasrija (2011a) who reported the encouraging effects of cooperative learning on students' Mathematics achievement, retention and attitude toward Mathematics. It also agreed with the findings of Slavin (1990) who found that cooperative learning increased students' self-esteem while Johnson and Johnson (2008) reported that cooperative learning increased student motivation, greater time on-task, and especially active student involvement.

## CONCLUSION

This study has very important contributions and high implication for the educational practices in Nigeria. The study revealed that students in the two cooperative learning strategies (STAD and Learning Together) groups had higher academic achievement mean scores than the students in the individualized computer instruction group. STAD and Learning together cooperative teaching strategies were found to be more effective in enhancing students' academic achievement, retention and motivation in physics more than the individualized computer instruction. When friendliness is established, students are motivated to learn and are more confident to ask questions from one another for better understanding of the tasks being learnt.

## RECOMMENDATIONS

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

Physics teachers should be encouraged to use computer-assisted STAD cooperative teaching strategy to enhance students' academic achievement, retention and motivation in physics. To implement this recommendation:

(i) The Ministry of Education, educational agencies, curriculum planners and other education stakeholders should create awareness by organizing seminars and workshops on the use of STAD cooperative learning strategy in schools.

(ii) At teacher training (pre-service) level, the use of STAD cooperative learning strategy in the classrooms should be included in the school curriculum. This could be achieved by practical demonstration of STAD cooperative learning strategy in the classroom, during micro-teaching and teaching practice exercise.

## REFERENCES

Abimbade, A. (1997). *Principle and practice of educational technology.* Ibadan, Nigeria: International Publishers.

Adegoke, B. A. (2011). Effect of multimedia instruction on senior secondary school students' achievement in Physics**.** *European Journal of Educational Studies, 3*(3)*,* 537-541.

Adesanya, L. (2000). The effect of learning environment factors on students' motivation and achievement. *International Journal of Science Education, 18*(3)*,* 204-215.

Adeyemi, B. A. (2008). Effects of cooperative learning and problem-solving strategies on junior secondary school students' achievement in social studies. *Electronic Journal of Research in Educational Psychology, 6*(3), 691-708. Retrieved from http://www.springerlink.com/content/c19u25816754q5j5/

Aguele, L. I., & Agwugah, N.V. (2007). Female participation in science, technology and mathematics (STM) education in Nigeria and national development. *Journal of Social Science, 15*(2), 121-126.

Ajaja, O. P., & Eravwoke, O. U. (2010). Effects of cooperative learning strategy on junior secondary school students achievement in integrated science. *Electronic Journal of Science Education, 14*(1). Retrieved from http://ejse.southwestern.edu

Annetta, L., Mangrum, J., Holmes, S., Collazo, K. & Cheng, M. (2009). Bridging reality to virtual reality: Investigating gender effect and students' engagement on learning through video game play in an elementary school classroom. *International Journal of Science Education, 31*(8), 1091-1113.

Artut, P. D., & Tarim, K. (2007). The effectiveness of jigsaw II on prospective elementary school teachers. *Asia-Pacific Journal of Teacher Education, 35*(2), 129-141.

Bajah, S. T. (2000). The state of science technology and mathematics education in Africa. *UNESCO,* (925) 3 - 4.

Bilesanmi-Awoderu, J. B. & Oludipe, D. I. (2012). Effectiveness of cooperative learning strategies on Nigerian junior secondary students' academic achievement in basic science. *British Journal of Education, Society & Behavioural Science, 2*(3), 307-325. Retrieved from www.sciencedomain.org

Cher, P. L. (1998). The effect of a Computer-Based Learning (CBL) support package on the learning outcomes of low performance economic students. *Cheer, 12*(1).

Gambari, I. A. (2010). *Effect of computer-supported cooperative learning strategies on the performance of senior secondary students in physics, in Minna, Nigeria*. (Unpublished Ph.D thesis, University of Ilorin, Nigeria).

Gambari, A. I., & Mogbo, I. N. (2006). Effect of computer-assisted instruction software for individualized physics instruction in secondary schools: Implication for counselling. *Book of Proceedings, 1st Annual SSSE, FUT, Minna,* (pp. 155-164).

Ghaith, G. (2003). Effects of the learning together model of cooperative learning on English as a Foreign Language reading achievement, academic self-esteem, and feelings of school alienation, American University of Beirut. *Bilingual Research Journal, 27*(3 ).

Gupta, M., & Pasrija, P. (2011). Cooperative learning versus traditional learning: Effect on achievement in mathematics. *New Frontiers in Education, 44*(4), 427-436.

Gupta, M., & Pasrija, P. (2011a). Team Assisted Individualisation (TAI): Impact on achievement and retention in mathematics learning community. *An International Journal of Education and Psychology, 3*(2), 387-396.

Gupta, M., & Pasrija, P. (2012). Effect of cooperative learning on high school students' mathematical achievement and retention using TAI and STAD methods. *Indian Journal of Psychology and Education, 2*(1), 75-86.

Jegede, S. A. (2007). Student's anxiety towards the learning of Chemistry in some Nigerian secondary schools. *Educational Research and Review, 2*(7), 193-197. Retrieved from http://www.academicjournals.org/ERR.2011.2.10

Johnson, D. W., Johnson, R. T., Holubec, E. J. (1986). *Circles of learning: Cooperation in the classroom.* Edina, MN: Interaction Book Company.

Kaul, P. (2010, August). The effect of learning together techniques of co-operative learning method on students achievement in mathematics. *Edutracks, 9*(12).

Khairulanuar, S., Nazre, A. R., Sairabanu, O. K., & Norasikin, F. (2010). Effects of training method and gender on learning 2D/3D geometry. *Journal of Computers in Mathematics and Science Teaching, 29*(2), *175 - 188.* Retrieved from http://www.editlib.org/p/33188

Keramati, M. (2009). Effect of co-operative learning (learning together technique) on academic achievement of physics course. In T. Bastiaens et al. (Eds.), *Proceedings of World Conference on ELearning in Corporate, Government, Healthcare, and Higher Education 2009* (pp. 2751-2756). Chesapeake, VA: AACE. Retrieved from http://www.editlib.org/p/32875

Kolawole, E. B. (2007). Effects of competitive and cooperative learning strategies on academic performance of Nigerian students in mathematics. *Educational Research Review, 3*(1), 33-37.

Kost, L. E., Pollock, S. J., & Finkelstein, N. D. (2009). Characterizing the gender gap in introductory physics. *Physics Education Research, 5*(1), 1-14.

Leikin, R., & Zaslavsky, O. (1997). Facilitating student interactions in mathematics in a cooperative learning setting. *Journal for Research in Mathematics Education, 28, 331-354.* Retrieved from http://www.nctm.org/eresources/journal_home.asp?journal_id=1

Majoka, M. I., Dad, M. H., & Mahmood, T. (2010, December). Student team achievement division (STAD) as an active learning strategy: Empirical evidence from mathematics classroom. *Journal of Education and Sociology,* p. 16.

Mohammad, I. (2004). *Effect of cooperative learning on academic achievement of secondary school students in mathematics.* (Unpublished Ph.D thesis, University of Arid Agriculture, Rawalpindi, Pakistan).

Olorukooba, S. B. (2007). Science, technology and mathematics (STM) education is for all students: Promoting effective teaching of STM subjects in our schools through teacher preparation. *Proceedings of the 50th Anniversary Conference of Science Teachers Association of Nigeria* (pp. 3-6).

Olson, V. E. (2002). *Gender differences and the effects of cooperative learning in college level mathematics.* (Unpublished Ph.D thesis, Curtin University of Technology, Perth, Western Australia).

Oludipe, D. I. (2012). Gender difference in Nigerian junior secondary students' academic achievement in basic science. *Journal of Educational and Social Research, 2*(1), 93-99.

Pandian, S. S. (2004). *Cooperative learning in biology: The effect of computers*. (Unpublished thesis, Department of Education, Arunachi University, India).

Slavin, R. (1990). *Cooperative learning: Theory, research, and practice*. Englewood Cliffs, NJ: Prentice-Hall.

Tarim, K., & Akdeniz, F. (2007). *The effects of cooperative learning on Turkish elementary students' mathematics achievement and attitude towards mathematics using TAI and STAD methods.* Springer Science + Business Media B.V.

Thomas. (1990). *International comparative education.* New York, NY: Pergamon Press.

Yusuf, M. O., & Afolabi, A. O. (2010). Effects of computer assisted instruction (CAI) on secondary school students' performance in biology. *The Turkish Online Journal of Educational Technology, 9*(1). Retrieved from http://www.tojet.edu.com

Yusuf, M. O., Gambari, A. I., & Olumorin, C. O. (2012). Effectiveness of computer-supported cooperative learning strategies in learning physics. *International J. Soc. Sci. & Education, 2*(2), 94-109.

WAEC (2012). *West African Examination Council, Chief Examiners' reports*. Lagos, Nigeria: Author.

Zakaria, E., Chin, L. C., & Daud, Y. (2010). The effects of co-operative learning (STAD) on students' mathematics achievement and attitude towards mathematics. *Journal of Social Sciences, 6*(2), 272-275.