EFFECTIVENESS OF STAD AND LT COOPERATIVE LEARNING STRATEGIES ON NIGERIAN SECONDARY SCHOOL STUDENTS’ ACHIEVEMENT AND MOTIVATION IN PHYSICS

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Abstract
This study investigated the effectiveness of computer-assisted instruction on Student Team Achievement Division (STAD) and Learning Together cooperative learning strategies on Nigerian senior secondary students’ achievement and motivation in physics. The study also examined the influence of gender and motivation on students’ achievement. 90 senior secondary school students were randomly drawn from three secondary schools. Stratified random sampling technique was used to select 30 students (15 male and 15 female) from each school. Four research questions and four hypotheses were formulated, and tested at 0.05 level significance. The Physics Achievement Test (PAT) made of 50 items of multiple-choice objective type and Physics Motivation Scale (PMS) consisted of 13-item were developed and validated for data collection. PAT was administered to students as pre-test and post-test, while PMS was administered as a pre-survey and post-survey. Data obtained were analyzed using one-way ANOVA and t-test statistics for testing the hypotheses. The result indicated that students taught using STAD and LT performed significantly better than their counterparts taught using individualized computer instruction (ICI). Students taught using cooperative learning strategies felt more motivated than those in control group (ICI). Also there was no significant difference in the post-test achievement scores of male and female students taught using STAD and LT cooperative learning strategies. Based on the findings it was recommended among others that teachers should be trained and encouraged to use computer-assisted cooperative strategies (STAD and LT) for effective teaching and learning of difficult concepts 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 instructional method employed by the teacher plays an important role in the acquisition of skills and meaningful learning (Ezenwa & Yaki, 2013).

In Nigerian schools, classroom teachers mostly prefer teacher-centred approach to student-centred 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 a 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 persistence use of a didactic method of teaching in which acquisitions of factual knowledge and memorization are over emphasized. All this could make schooling look tedious, suffused with anxiety and boredom, destructive of curiosity and imagination, produce cramming machines (Thomas 1990, Gambari, 2004 & Gupta & Pasrija, 2012).

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

Cooperative learning allows students to be actively involved in learning, communicates their ideas with each other, brainstorms, 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 globe (Skavin, 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 students' social skills (Johnson & Johnson, 2000).

There are various cooperative learning strategies 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 to master the content, 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. On the other hand Zakaria, Chin and Daud (2010) and Gupta and Pasrija (2011) 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 method is more effective than traditional teaching methods.

Adesanya (2000) stated that the performance of students 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 instructions (CAI). It can also offer to the educator 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 setting had indicated that cooperative learning groups are positively effective to improve students’ academy 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 (Mohammad, 2004; Yusuf & Afolabi, 2010; Gambari, 2010; Pandian, 2004; Yusuf, Gambari & Olumorin 2012).

The use of computer as a medium or resource for cooperative have been embraced by earlier researchers. For instance, in a research projects, 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”. These researchers 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 males students when taught mathematics using cooperative learning. Contrarily, Aguele and Agwugah (2007), Adeyemi (2008), Kolawole (2007) and Khairulanuar, Nazre, Sairabanu, and Norasikin (2010) found gender differences in favour 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 caused for inclusion of gender as one of the moderating variable or 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 researchers’ 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 computer 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 performance of students taught physics using computer-assisted STAD, LT and ICI?
(ii) Is there any difference in the performance of male and female students taught physics using computer-assisted STAD cooperative strategy?

(iii) Is there any difference in the performance 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, LT and ICI?

Research Hypotheses

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

(i) There are no significant differences in the performance of students taught physics using computer-assisted STAD, LT and ICI.

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

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

(iv) There are no significant differences in the motivation of students taught physics using cooperative computer-assisted STAD, LT 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 design layout is as shown in Table 1.

Table 1: Research design layout

<table>
<thead>
<tr>
<th>Groups</th>
<th>Pre-test</th>
<th>Treatment</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental (Group 1)</td>
<td>O₁</td>
<td>STAD</td>
<td>O₂</td>
</tr>
<tr>
<td>Experimental (Group 2)</td>
<td>O₃</td>
<td>LT</td>
<td>O₄</td>
</tr>
<tr>
<td>Control (Group 3)</td>
<td>O₅</td>
<td>ICI</td>
<td>O₆</td>
</tr>
</tbody>
</table>

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. 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). PAT was based on SS II physics curriculum on concepts of Structure of Matter (Molecule, Atom, Osmosis and Diffusion). The selected contents correspond to SSII physics syllabus and scheme of work and correspond to what they students would be taught in the school at the time of the study. The researchers developed PAT was subjected to facility and discriminating indices. The ideal range 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 National Examination Council) and its reliability coefficient was determined as 0.79 using Kuder Richardson (KR-21).

Physics Motivational Scale (PMS) was developed by the researchers to measure the students’ level of motivation towards physics before and after exposed to computer-supported STAD, LT and ICI learning strategies respectively. Section A of the PMS focused on demographic information of physics student while section B focused on students’ motivation towards physics subject. This section contained 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 being asked from them. To test the instrument’s 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 0.72 was obtained using Kuder Richardson (KR-20). 90 copies of the questionnaire were distributed to physics students before and after the commencement of study. 100% return rate was achieved and used 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 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 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 proceeding to the next unit.

The researcher 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 lesson 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:

1. The cooperative computer instruction using Students Team Achievement Division (STAD) cooperative learning strategy: In this strategy, students were assigned into three member heterogeneous group. 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 individual task which was marked and recorded against group scores. After the completion of a lesson, students take quiz as a team and reach consensus with respect to the correct answers after which one answer sheet were 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 towards the student’s final course grade. High scoring teams is recognized and rewarded in the class. Group processing form was completed after each lesson to determine the group behaviour 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 answer. After the group discussion, a leader is chosen to present 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 individual 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 MAT 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 0.05 alpha level.

Results

To test for the hypotheses, the data were analysed using Analysis of Variance (ANOVA) and Scheffe’s test using Statistical Package for Social Sciences (SPSS) version 11 at 0.05 alpha level. The results are presented based on the research hypotheses.
Table 1: ANOVA pre-test on STAD, LT and ICI groups

<table>
<thead>
<tr>
<th>Source of variables</th>
<th>Sums of square</th>
<th>df</th>
<th>Mean (x)</th>
<th>F-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3447.022</td>
<td>2</td>
<td>19.200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within Groups</td>
<td>2625.867</td>
<td>87</td>
<td>8.611</td>
<td>2.230 ns</td>
<td>0.114</td>
</tr>
<tr>
<td>Total</td>
<td>6072.889</td>
<td>89</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ns: Not Significant at 0.05 level

Table 1 shows the result of ANOVA comparison of the two experimental groups and control group. From the table, the F-value (2.230, p = 0.114) was not significant at 0.05 alpha level. This implies that there was no significant difference among the mean scores of the experimental group I; experimental group II and the control group at 0.05 level of significance. This results shows that students in the experimental groups and control group have the same entry level with regards to previous knowledge of the topic treated. Thus, they are comparable groups.

**Hypothesis One:** There are no significant differences in the performance of students taught physics using computer-assisted STAD, LT and individualized computer instruction (ICI).

To determine whether there were significant differences in the post-test mean scores of the STAD, LT and ICI, data were analyzed using the analysis of variance (ANOVA). Table 2 contains the result of the analysis.

Table 2: ANOVA post-test on STAD, LT and ICI groups

<table>
<thead>
<tr>
<th>Source of variables</th>
<th>Sums of square</th>
<th>df</th>
<th>Mean (x)</th>
<th>F-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3469.689</td>
<td>2</td>
<td>1884.844</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within Groups</td>
<td>2829.467</td>
<td>87</td>
<td>32.523</td>
<td>57.955*</td>
<td>0.000</td>
</tr>
<tr>
<td>Total</td>
<td>6599.156</td>
<td>89</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at 0.05 level

Table 2 presents the result of ANOVA comparison of the two experimental groups and control group. From the table, the F-calculated (57.955, p = 0.000) was significant at 0.05 alpha level. This indicates that statistically significant difference was established among the experimental groups and control group. Hence the null hypothesis one (HO₁) was rejected.

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 of this post-hoc analysis are as shown in Table 3.
Table 3: Scheffe’s post-hoc analyses of the groups mean scores

<table>
<thead>
<tr>
<th>Groups</th>
<th>Mean Scores</th>
<th>Group I (STAD)</th>
<th>Group II (LT)</th>
<th>Group III (ICI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (STAD)</td>
<td>77.47</td>
<td>0.200</td>
<td>*0.000</td>
<td></td>
</tr>
<tr>
<td>Group II (LT)</td>
<td>74.80</td>
<td>0.200</td>
<td>*0.000</td>
<td></td>
</tr>
<tr>
<td>Group III (ICI)</td>
<td>62.60</td>
<td>*0.000</td>
<td>*0.000</td>
<td></td>
</tr>
</tbody>
</table>

* The mean is significant at the 0.05 level.

The result in Table 3 indicates that there was no significant difference in the post-test mean scores of students exposed to STAD (X = 77.47) and those exposed to LT (X = 74.80). It indicates significant difference in the post-test mean scores of students exposed to LT (X = 74.80) and those exposed to ICI (62.60). Significant difference was also established in the post-test mean scores of students exposed to STAD (X = 77.47) and those exposed to ICI (X = 62.60).

**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 test this hypothesis, t-test statistic was used to analyze the mean scores. The summary of this analysis is shown on table 4.

Table 4: t-test analysis on achievement scores of male and female students exposed to STAD

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Df</th>
<th>Mean (x)</th>
<th>SD</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>15</td>
<td>28</td>
<td>78.13</td>
<td>6.906</td>
<td>0.583ns</td>
<td>0.565</td>
</tr>
<tr>
<td>Female</td>
<td>15</td>
<td></td>
<td>76.80</td>
<td>5.545</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ns: not Significant at 0.05 level

Table 4 presents the t-test of male and female students of experimental group I (STAD). The mean score of the male students was (78.13) and (76.80) for the females. The t-value of 0.583 was not significant at 0.05 level. This indicates that there is no significant difference between the male and female students taught with STAD, (t= 0.583,df = 28, P = 0.565). Hence, HO₂ was upheld. Therefore, there is no significant difference between male and female students taught with cooperative computer instructional package.

**Hypothesis Three:** There is no significant difference in the mean scores of male and female students exposed to computer-assisted LT cooperative instruction.
To test this hypothesis, t-test statistic was also used to analyze the mean scores. The summary of this analysis is shown on table 5.

### Table 5: t-test analysis on achievement scores of male and female students in LT group

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Df</th>
<th>Mean (X)</th>
<th>SD</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>15</td>
<td>28</td>
<td>77.07</td>
<td>6.497</td>
<td>1.989</td>
<td>0.057^ns</td>
</tr>
<tr>
<td>Female</td>
<td>15</td>
<td>28</td>
<td>72.53</td>
<td>5.975</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

^ns: not Significant at 0.05 level

Table 5 presents the t-test of male and female students of experimental group II (LT). The mean scores of the male students were 77.07 and male 72.53 for the female students. The calculated t-value of 1.989 was not significant at the 0.05 level. This indicates that there is statistically no significant difference between the male and female students taught with LT, (t = 1.989, df = 28, p = 0.057). Hence, HO\textsubscript{3} was upheld. Therefore, there is no significant difference between male and female students taught with computer-assisted learning together strategy.

**Hypothesis Four:** There are no significant differences in the motivation of students taught physics using cooperative computer-assisted STAD, LT and individualized computer-assisted instruction (ICI).

To determine whether there were significant differences in the post-test mean scores of the STAD, LT and ICI groups, data were analyzed using the analysis of variance (ANOVA). Table 2 shows the result of the analysis.

### Table 6: ANOVA pre-survey and post-survey on STAD, LT and ICI groups

**Pre-survey**

<table>
<thead>
<tr>
<th>Source of variables</th>
<th>Sums of square</th>
<th>df</th>
<th>Mean Square (x)</th>
<th>F-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>0.022</td>
<td>2</td>
<td>0.011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within Groups</td>
<td>18.645</td>
<td>87</td>
<td>0.214</td>
<td>0.051^ns</td>
<td>0.950</td>
</tr>
<tr>
<td>Total</td>
<td>18.667</td>
<td>89</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Post-survey**

<table>
<thead>
<tr>
<th>Source of variables</th>
<th>Sums of square</th>
<th>df</th>
<th>Mean Square (x)</th>
<th>F-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>10.803</td>
<td>2</td>
<td>5.401</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within Groups</td>
<td>5.523</td>
<td>87</td>
<td>0.063</td>
<td>85.088*</td>
<td>0.000</td>
</tr>
<tr>
<td>Total</td>
<td>16.325</td>
<td>89</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at 0.05 level
Table 6 shows the pre-survey result of ANOVA comparing two experimental groups and control group. From the table, the F-value (0.022, p = 0.950) was not significant at 0.05 alpha level. This implies that there was no significant difference among the mean scores of the experimental group I; experimental group II and the control group at 0.05 level of significance.

From table 6, post-survey result of ANOVA comparing two experimental groups and control group. From the table, the F-value (85.088, p = 0.000) was significant at 0.05 alpha level. This indicates that statistically significant difference was established among the experimental groups and control group. Hence the null hypothesis four \( (H_0) \) was rejected.

Based on the established significant difference in the post-survey scores of the groups, Scheffe’s test was used for post-hoc analysis. The results of this post-hoc analysis are as shown in Table 7.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Mean Scores</th>
<th>Group I (STAD)</th>
<th>Group II (LT)</th>
<th>Group III (ICI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (STAD)</td>
<td>3.470</td>
<td>*0.008</td>
<td>*0.000</td>
<td></td>
</tr>
<tr>
<td>Group II (LT)</td>
<td>3.262</td>
<td>*0.008</td>
<td></td>
<td>*0.000</td>
</tr>
<tr>
<td>Group III (ICI)</td>
<td>2.653</td>
<td>*0.000</td>
<td>*0.000</td>
<td></td>
</tr>
</tbody>
</table>

* The mean difference is significant at the 0.05 level.

The result in Table 7 indicates that there was significant difference in the post-survey mean scores of students exposed to STAD (\( X = 3.470 \)) and those exposed to LT (\( X = 3.262 \)). It indicates significant difference in the post-survey mean scores of students exposed to LT (\( X = 3.262 \)) and those exposed to ICI (2.653). Significant difference was also established in the post-survey mean scores of students exposed to STAD (\( X = 3.407 \)) and those exposed to ICI (\( X = 2.653 \)).

**Discussion of the Findings**

The result of the ANOVA on the performance of students taught physics using computer-assisted STAD, LT cooperative settings and individualized computer instruction (ICI) indicated a significant difference in favour 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, LT, and ICI. However, there was no significant difference between the performance of those exposed to STAD and LT.

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 the findings of Mohammad (2004), Yusuf and Afolabi (2010), Gambari (2010), Pandian (2004), Yusuf, Gambari and Olumorin (2012) who found that students learning with computer base instruction in cooperative groups performed better than those taught using traditional teaching method and individualized computer instructional setting respectively. It 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 LT cooperative strategies over the ICI could be attributed to the fact that cooperative learning encourages students to be active participants in the construction of their own knowledge, positive interdependent, group processing, face-to-face interaction, among others.

Hypotheses two and three examined the influence of gender on computer-assisted STAD and LT 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 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 favour of male students.

The influence of STAD, LT cooperative settings and ICI on students’ motivation in physics was examined using hypotheses four. The result of the ANOVA showed significant difference for learners exposed to computer-assisted STAD, LT and ICI. Scheffé post-hoc test
shows significant difference favour of computer-assisted STAD and LT cooperative settings. The
findings agree with the earlier findings of Zakaria, Chin and Daud (2010) and Gupta and Pasrija
(2011) who reported the encouraging effects of cooperative Learning (STAD) on students' Mathematics achievement, retention and attitude towards Mathematics. It also agreed with the findings of Slavin (1990) who found that cooperative learning increase 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

The following recommendations are made based on the findings:

(i) Physics teachers should be encouraged to adopt computer-assisted STAD and Learning Together cooperative teaching strategies and other various cooperative teaching strategies in order to enhance students’ academic achievement, retention and motivation in physics;

(ii) At the preservice level, the use and implementation of cooperative teaching strategies in the classrooms should be emphasized in the methodology courses being offered by the Student-teachers; and

(iii) At the in-service level, seminars and workshops should be organized by ministry officials, zonal educational authority, and local educational authority in order to educate practicing teachers on how to implement cooperative teaching strategy in schools at all levels.
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