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# EFFECTS OF PEER-TUTORING AND CONCEPT-MAPPING INSTRUCTIONAL STRATEGIES ON SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN SCIENCE AND TECHNOLOGY IN EKITI STATE NIGERIA

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**Abstract**

The study examined the effect of Peer-tutoring and concept-mapping instructional strategies on students' achievement in Physics. The study was a quasi-experimental of non-equivalent, pre-test, post-test control group design. The population for the study consists of all the Senior Secondary class two (SS2) Physics students in Ekiti-State. Through multi-stage sampling technique a sample size of 120 SS2 Physics students were selected in 12 Local Governments Area of Ekiti-State. The students were placed into three experimental groups and a control group. Experimental group 1 was taught with Peer-tutoring strategy, experimental group 2 was admonished with Concept-mapping technique; experimental group 3 was taught with both Peer-tutoring and Concept- strategies while the control group was taught using Lecture method. Physics Achievement Test (PAT)

developed by the researcher was used to for data collection. The items of this instrument were subjected to face and content validation. The reliability of the instrument was established through Test-retest method. The reliability Coefficient obtained was 0.75. Five null hypotheses were formulated and tested at 0.05 level of significant to guide the study. The research questions were answered using Mean and Standard deviation while the hypotheses were analysed using Analysis of Covariance(ANCOVA).The results from the study shows that students taught Physics with both Peer-tutoring and Concept-mapping strategies improved significantly with a Mean score of 30.70 as against 25.93 and 29.37 of individual strategy of Peer-tutoring and Concept-mapping respectively. However, results obtained from the study shows that there is no significant difference in achievement mean scores of male and female students taught with Peer-tutoring and Concept-mapping strategies .Based on the findings from the results, it is recommended that Peer-tutoring and Concept-mapping strategies should be adopted for teaching Physics and other Science related courses in secondary schools as it involves active participation of students in the learning process.

**Keywords: Peer-tutoring, Concept-Mapping, Students' Achievement, Physics, Strategy.**

## Introduction

Evidence abound in our society that science and technology are not just tools but also a vehicle for all round development of any nation. To a very great extent, the level of technological development of any nation may determine the standard of living of the nation`s citizen (Alokan 2010). Science and technology education is paramount for any nation that want to maintain authority, self-reliance and independence among the committee of nation (oludipe, 2014). It is largely recognized, that the survival of a nation`s scientifically and technologically depend on its scientific literacy which can only be achieved through science education.

However, the issue of students academic achieved for science especially in physics over the years has been of concern to educators in Nigeria and globally. The reports of both internal and external examinations in physics has revealed unimpressive performance. Physics being one of the core science subject has been introduced in Nigerian secondary curriculum to achieve the following objectives:

i) To provide a solid foundation for everyday living

ii) To develop computational skills and ability to be accurate to a degree relevant to the problem in hand

iii) To stimulate and enhance creativity (FGN 2013). Physics as a science based course in secondary school curriculum stands as pre-requisite to many science and technology related carriers in tertiary institutions.

The researcher carried out an analysis of students' performance in Physics from 2010 to 2019 in table below:

**Table 1: Summary of the Analysis of Students Performance in Physics (WAEC) in Ekiti State (2010-2019)**

| Year | No of Candidate | Grade (1-6) | % | No of Passes | % | No of Failure | % |
|---|---|---|---|---|---|---|---|
| 2010 | 5765 | 2869 | 49.80 | 1825 | 31.7 | 765 | 13.0 |
| 2011 | 7317 | 6050 | 83.2 | 664 | 9.07 | 105 | 1.43 |
| 2012 | 5155 | 2514 | 41.61 | 1179 | 22.87 | 388 | 7.32 |
| 2013 | 4964 | 2794 | 56.28 | 1401 | 28.22 | 678 | 13.68 |
| 2014 | 5862 | 3260 | 55.61 | 1733 | 29.56 | 869 | 14.82 |
| 2015 | 6069 | 2863 | 47.17 | 2025 | 33.36 | 1181 | 19.45 |
| 2016 | 5231 | 4173 | 79.77 | 671 | 12.82 | 387 | 7.39 |
| 2017 | 5250 | 2724 | 5189 | 1819 | 3464 | 707 | 1346 |
| 2018 | 4989 | 4312 | 86.43 | 341 | 6.83 | 326 | 6.53 |
| 2019 | 5014 | 3386 | 67.53 | 951 | 18.96 | 677 | 13.00 |

Source: WAEC Research and Statistics Units (2010)

Ministry of Education Science and Technology Ado-Ekiti, Ekiti State

The analysis of students performance in physics between 2010-2019 revealed that in 2010 out of 5,765 candidates examined for physics in MAY/JUNE WASSEC only 49.8% scored A1-C6 grade, 31% got pass while 13.0% failed the subject. In 2011,out of 7,317 examined,82.2% scored A1-C6 grade,9.07% got pass while1.43% failed. Also in 2012, out of 5155 candidates examined, 41.6% scored A1- C6 grade, 22.87% got pass while 7.32% failed.

In 2013, out of 4964 candidates that was examined 56.2% scored A1-C6 grade, 28.22% got pass while 14.82 failed the subject. Furthermore, in year 2015, out of 6,069 candidate examined, 17.17% scored A1-C6 grade, 33.36% got pass while 19.45% failed. In 2016, 5,231 candidate were examined, 79.77% scored A1-C6 grade, 12.82% got pass while 7.39% failed.

Also, In 2017 out of 5250 candidates examined, 51.89% scored A1-C6 grade, 34.64% got pass while 13.46% failed. In year 2018, out of 4489 candidates examined, 86.43% scored A1-C6 grade 6.83% got pass while 6.53% failed. Finally, in 2019, out of 5014 candidate examined, 67.53% scored A1-C6 grade, 18.96% got pass while 13.50% failed the course. The analysis of this result revealed that not very many of the candidates has credit pass in physics in the period under review.

According to Adeoluwa(2013), as an educational technologist, learning problems could only adjudged to have been solved when students achievement is 100% which is yet to be achieved with the analysis of result in the period under review. This situation is worrisome and not in the best interest of the science and technological development of the country(Asubiojo & Aladejana, 2018). A number of factors militating against students against students' achievement in science instructions have been identified ranging from poor environmental condition, inappropriate use of instructional materials, teachers qualification, lack of relevant supports from school management. However, the most prominent factor identified by researchers is the inappropriate and uninspiring teaching strategies adopted by most of the science teachers (Otor, 2013). A sizeable chuck of the blame goes to teacher's inability to use appropriate teaching method.

It is believed that students achievement in examination is partly a function of teachers effectiveness (Asubiojo & Aladejana 2019). Most teachers want to provide the best instruction and create the best learning environment for their students without taking into cognizance learners' previous knowledge and how they reasoned in order for to construct their knowledge. Therefore the need to inculcate in the learner activities based learning, improve their self-esteem, and eliminate difficulties while learning becomes very important.

Achufusi (2015) opined that certain learning materials are better understood than others when they are presented in meaningful manner. Also finding from a study conducted by the Curriculum Development centre, Ministry of Education, Malaysia (2002) cited in Missilidine, (2004) shows that student do not know how to interpret problems, that involves pictures, stories which requires students creativity. As a result of this, many approaches to teaching were introduced so that teaching would focus more on the student ability to learn how to learn. One of such approach or strategy is the use of peer-tutoring and concept-mapping instructional strategies. Peer-tutoring is a flexible, peer-mediated strategy that involves students serving as academic tutors and tutees (Adedeji 2013). It is a process by which a student with guidance from a teacher helps one or more students at the same grade level to learn a skill or concept usually a higher performing students is paired with a lower performing students to review critical academic concepts.

Neddenriep et al (2009) opined that peer-tutoring involves students' helpers or tutors assisting in the learning process and helping other peer to learn by teaching. Peer tutoring allows students to receive individual assistance. In peer-tutoring technique students have increased opportunities to interact in smaller groups. Spencer (2006) opined that peer-tutoring increases self-confidence and self-efficacy. There are many different ways to pair students', it can be by ability level, skills mastered or age. The following model description will assist in selecting the correct model based on certain criteria.

**Peer Tutoring Models**

a) **Cross Age Peer Tutoring** (CAPT) : In this model, younger students are paired with an older student. The older student is there to model good behavioural, functional, adaptive or social skills. The position of tutor and tutee do not change. The older student serves as the tutor while the younger students serve as the tutee. A second grade could be paired with a kindergarten student to show them how to walk to the cafeteria, get a lunch tray,

select foods and find a place to sit. The older student and younger student can have similar or differing skill levels with its relationship being one of a cooperative or expert interaction. This arrangement is also helpful for students with disabilities as they may serve as tutors for younger learners.

b) **Class Wide Peer Tutoring** (CWPT): This model involves dividing the whole class into pairs or small groups not larger than five students with different ability levels .This is one of the models in which all the students in the classroom are involved in the learning process by learning from one another for an extended period of time. Students acts as tutors, tutees or both tutors and tutees. Typically, classroom peer tutoring involves highly structural procedures, direct rehearsal, competitive learning and posting of scores (Mocheady et al, 2011). Also in (CWPT) the entire class participates in structured peer tutoring activities two or more times per week for not more than 30 minutes (Harper and Mahead, 2007).

**c) Reciprocal Peer-Tutoring** (RPT). In this type of peer tutoring the peer learn from each other by changing their status from tutor to tutotee and vice-visa. Two or more students alternate between acting as the tutor and tutee during each session, with equitable time in each role. This strategy provides very good opportunity to every students to act as a tutor which enhance his confidence level (Webb et al, 2006).

**d) Peer Assisted Learning Strategies** (PALS): This is a form of CWPT model in which students are paired with students around the same ability level. It involves a teacher pairing students who need additional instruction or help with a peer who can assist (Scott & Jennifer, 2005). Academic requirement are increasing & educational funding is decreasing. Thus school must develop creative meaning to accomplish these goals one of such could be the use of peer tutors. peer tutoring provides a low-cost, research-supported method to improves academics (Ali & Watif, 2014). In(PALS) cue cards, small pieces of cardstock upon which are printed a list tutoring steps, may be provide to help students remember PALS steps (Spencer, Cruggs & Mastropieri, 2003).

**Same Age Peer-Tutoring** (SAPT): This involves pairing students who are within the same age range to review key concepts. Student may have similar ability level or a more advanced student (tutor) can be paired with some less advanced students (tutee); students with similar abilities should have an equal understanding of the content material and concepts (Calhoon, el-al, 2007).

However, concepts mapping is a metacognitive strategy that empowers learners to take charge of their learning in highly meaningful fashion (Mayer, 2003). Concept mapping is a way of displaying graphically the relationship that exists among concepts. It helps to augment assimilation, retention and retrieval of learned knowledge as the learning activity demands; this is because knowledge acquired through meaningful learning is integrated into the existing cognitive structure and is retained longer (Novak, 2010).

Concept maps are graphical tools for organizing and representing knowledge. They include concepts usually enclosed in circles or boxes of some types and relationships between concepts indicated by a connecting line referred to as linking words or linking phrases, which specifies the relationship between the two concepts. Concepts are perceived regularity in events or objects of events designated by a label. The label for most concepts is a word, although sometimes symbols can be used. Therefore a concept map is a visual organizer that can enrich

students' understanding of a new concept.

It has its origin in David Ausubel's (1968) assimilation theory of cognitive learning. Concept mapping as a strategy provides a suitable learning environment where students learn individually and in groups to collaborate and support each other (Mandor, 2013). Concept mapping is a technique of visually organization of structures of information, concept, and their relationship. Previous studies have shown that concept maps are used to document conceptual change and develop critical thinking skill, move away from rote learning and strengthening hierarchical relationship among concepts (Hay, 2007), According to Aulf (1985) cited in Uchemna & Philomens (2012), the following steps are necessary when constructing a concept map:

- Select an item for mapping. This could be an important text message, lecture note for laboratory background materials.
- Choose and underline key words or phrases, including objects and events in the list.
- Rank the list of concepts from most abstract and inclusive to the most concrete and specific.
- Cluster the concepts according to two criteria; concept that function at a similar level of abstraction and concept that interrelate closely.
- Arrange the concept as a two dimensional array analogous to a road map.
- Links related concept with line and label each line in propositioned form.

It is necessary to understand that for any meaningful scientific literacy to be achieved, students need to have sufficient foundation and critical thinking about concept mapping and relationship that exist among concepts. Arokoyu & Obunwo (2014) stated that effective and meaningful teaching of abstract scientific concepts require active students' involvement in the teaching and learning process through meaningful and relevant hand-on activities so as to internalized learning among the learners using concept maps. It is against this background that this study was carried out to ascertain if concept mapping and peer-tutoring enhance students' academic achievement in science.

**Purpose of the Study**

This study is aimed at investigating the effect of peer-tutoring and concept mapping instructional strategies on secondary school students' achievement in science and technology in Ekiti-state. Specifically the study sought to:

1) determine the mean achievement scores of students taught with peer-tutoring strategy and conventional method in physics in Ekiti-state secondary schools.
2) determine the mean achievement scores of students taught with concept mapping and convectional teaching method in physics in Ekiti- state secondary schools.
3) determine the mean achievement scores of student taught with both concept mapping and peer tutoring and convectional teaching method in Ekiti-state secondary schools.
4) examine if there is any significant difference between the mean achievement scores of male and female

students in physics when taught with concept mapping instructional strategy in Ekiti-state secondary schools

5) determine if there is any significant difference between the mean achievement scores of male and female students in physics when exposed to peer tutoring instructional strategies in Ekiti-state secondary schools.

**Statement of Problem**

Relevant stakeholders and concerned individuals have continued to express concerns over poor academic achievement of Nigerian students in science and technology especially in physics (WAEC 2019). Physics as one of the core science subjects has seriously become problematic making it difficult for many students seeking admission into tertiary institution to study technological and science-based courses due to inability to obtain credit score in the subject. Therefore the poor achievement of students in the subject cannot be allowed to go unattended to.

The problems could have caused by many factors ranging from poor environmental condition, lack of relevant instructional materials, teacher's qualification to lack of relevant supports from the school management. But it seems that the instructional strategies adopted by teachers will go a long way to affects students achievement in the subject. Thus the study therefore seeks to investigate the effect of peer- tutoring and concept- mapping instructional strategies in improving students' achievement in Physics.

**Research Questions**

The following research questions were raised to guide the study:

1. What is the mean achievement scores of students taught with peer tutoring and convectional method in Physics in Ekiti-state secondary schools?
2. What is the mean achievement scores of students taught with concept mapping strategy and conventional method of teaching in physics in Ekiti-state secondary schools?
3. Would there be any significant different in the mean achievement score of students taught with both concept-mapping and peer-tutoring and individual strategy of peer-tutoring and concept mapping in Physics.
4. Would there be any significant different in the achievement mean scores of male and female students taught with peer-tutoring instructional strategies in physics.
5. Would there be any significant different in the achievement mean scores of male and female students taught with concept-mapping instructional strategies in physics.

**Research Hypotheses**

The following Null hypotheses were formulated to guide the study:

1. There is no significant different in the mean achievement scores of students exposed to peer-tutoring and those taught with conventional teaching method.
2. There is no significant different in the mean achievement scores of students exposed to concept mapping and those taught with conventional teaching method.
3. There is no significant relationship in the mean achievement scores of students exposed to both concept mapping and peer tutoring and individual strategy of peer-tutoring and concept-mapping in physics.
4. There is no significant different in the mean achievement scores of male and female students taught with peer- tutoring instructional strategy in physics.
5. There is no significant different in the mean achievement scores of male and female students taught with concept-mapping instructional strategy in physics.

**Research Method**

The study adopted a quasi-experimental design of non-randomized pre-test, post-test control group design. The pre-test was used to establish the knowledge baseline of the students as well as the academic homogeneity of the four groups before he commencement of the treatments.

The population of the study consists of all the senior secondary school two physics students in Ekiti-state secondary schools. The sample consisted of 120 senior secondary school II Physics students which were selected using multi-stage sampling technique.

The first stage involves the selection of four local governments each from the three senatorial districts of Ekiti state. The 2nd stage involved the selection of three schools from each of the selected local governments using simple random sampling techniques. This was followed by selection of 10 students from the selected schools using purposive random sampling technique. The samples were assigned randomly to experimental and control groups. The instruments used for the study was 40 items standardized Physics Achievement Test (PAT). The researcher developed the PAT which consist of 40-items with four options drawn from motion and optics concepts. The instrument was validated by three experts, one from Test, Measurement and Evaluation and two experienced Physics teacher from Science Education. The reliability of the instrument was determined by Test-retest method and a reliability coefficient of 0.75 was obtained.

The experimental groups were taught using peer-tutoring, concept-mapping and a combination of peer-tutoring and concept-mapping instructional strategies while the control group was taught using conventional method. The null hypotheses were tested at 0.05 level of significance. The data collected were analysed using descriptive and inferential statistics.

**Results and Discussion**

**Research Question 1:** Would there be any difference in the mean achievement scores of students taught with peer-tutoring and conventional method in Physics?

**Table 1:** Mean achievement scores of students taught with peer-tutoring and conventional method in Physics

| Teaching Method | N | Pretest | | Posttest | | Mean Difference |
|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | |
| Peer-tutoring | 30 | 14.33 | 1.92 | 25.93 | 2.29 | 11.60 |
| Conventional | 30 | 14.87 | 3.01 | 11.43 | 1.70 | -3.44 |
| Total | 60 | 14.60 | 2.52 | 18.68 | 7.58 | 4.08 |

Table 1 and Figure i present the mean achievement scores of students taught with peer-tutoring and conventional method in Physics. The result shows that students exposed to peer-tutoring had a mean achievement score of 14.33 while those in the conventional groups were 14.87 prior to treatment. On exposure to treatment, students in the peer-tutoring group had the higher mean achievement score of 25.93 than their counterparts in the conventional group (mean= 11.43). This implies that there is difference in the mean achievement scores of students taught with peer-tutoring and conventional method in Physics. The mean achievement scores of students taught with peer-tutoring and conventional method in Physics before and after treatment are further depicted in Figure 1.

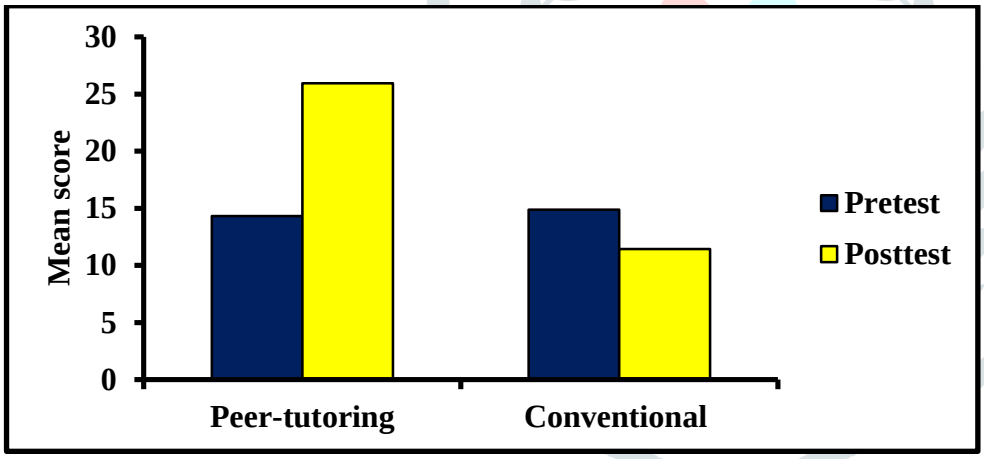


**Figure 1:** Mean achievement scores of students taught with peer-tutoring and conventional method in Physics

The study statistically revealed that the instructional techniques had a significant influence in the academic Achievement of physics students (Table 1). This work agree with the submissions of Ali and Awatif,(2014) and Neddenriep et al (2009) who documented volumes on effectiveness of peer-tutoring over teacher-centred method of instruction.

**Research Question 2:** Would there be any difference in the mean achievement scores of students taught with concept-mapping and conventional method in Physics?

**Table 2:** Mean achievement scores of students taught with concept-mapping and conventional method in Physics

| Teaching Method | N | Pretest | | Posttest | | Mean Difference |
|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | |
| Concept-mapping | 30 | 13.60 | 3.78 | 29.37 | 1.16 | 15.77 |
| Conventional | 30 | 14.87 | 3.01 | 11.43 | 1.70 | -3.44 |
| Total | 60 | 14.23 | 3.45 | 20.40 | 9.16 | 6.17 |

Table 2 and Figure II present the mean achievement scores of students taught with concept-mapping and conventional method in Physics. The result indicates that students exposed to concept-mapping had mean achievement score of 13.60 while those in the conventional group were 14.87 prior to treatment. On exposure to treatment, students in the concept mapping group had the higher mean achievement score 29.37 than their counterparts in the conventional group (mean= 11.43). This implies that there is difference in the mean achievement scores of students taught with concept mapping and conventional method in Physics. The mean achievement scores of students taught with concept mapping and conventional method in Physics before and after treatment is further depicted in Figure II.

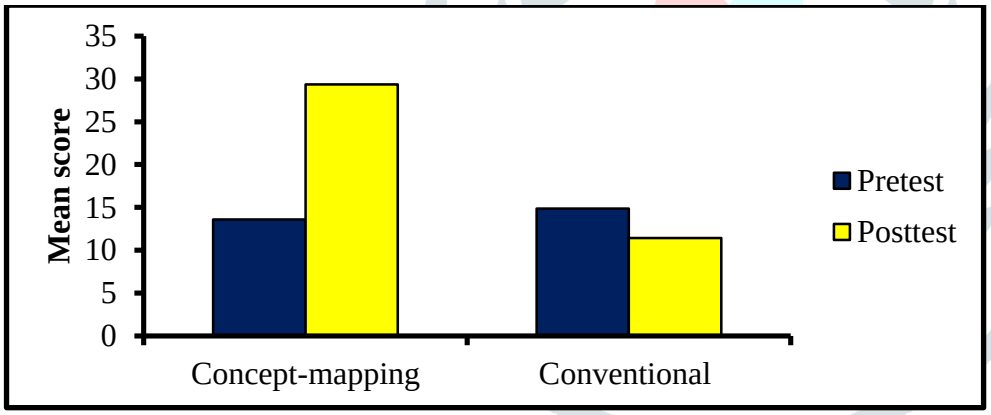


**Figure II:** Mean achievement scores of students taught with concept mapping and conventional method in Physics

The result of this study is in line with that of Fatokun and Eniayeju (2014) who in their submission found out that students taught with concept-mapping strategy retained better than those using conventional method. This is because concept-mapping strategy, enable concepts and their relationship to be organized in hierarchical order from most inclusive to more specific and less inclusive concepts which help the students to integrate new concepts with the previous concepts leading to better understanding of concepts.

**Research Question 3:** Would there be any difference in the mean achievement scores of students taught with both peer-tutoring and concept-mapping and individual strategy of peer-tutoring and concept-mapping in Physics?

**Table 3:** Mean achievement scores of students taught with both peer-tutoring and concept-mapping and individual strategy of peer-tutoring and concept-mapping in physics

| Teaching Method | N | Pretest | | Posttest | | Mean Difference |
|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | |
| Peer-tutoring | 30 | 14.33 | 1.92 | 25.93 | 2.29 | 11.60 |
| Concept-mapping | 30 | 13.60 | 3.78 | 29.37 | 1.16 | 15.77 |
| Peer tutoring + Concept mapping | 30 | 13.87 | 2.87 | 30.70 | 2.84 | 16.83 |
| Total | 90 | 13.93 | 2.94 | 28.67 | 2.98 | 14.74 |

Table 3 and Figure III present the mean achievement scores of students taught with both peer-tutoring and concept-mapping and individual strategy of peer-tutoring and concept-mapping in Physics. The result shows that students exposed to both peer tutoring and concept-mapping had a mean achievement score of 13.87 while those in the peer-tutoring and concept mapping groups were 14.33 and 13.60 respectively prior to treatment. On exposure to treatment, students taught with both peer-tutoring and concept mapping had the highest mean achievement score 30.70, closely followed by students in the concept mapping group (mean=29.37) while those in the peer-tutoring (mean=25.75) groups was the least. This implies that there is difference in the mean achievement scores of students taught with both peer-tutoring and concept-mapping and individual strategy of peer-tutoring and concept-mapping in Physics. The mean achievement scores of students taught with both peer-tutoring and concept-mapping and individual strategy of peer-tutoring and concept-mapping in Physics before and after treatment is further depicted in Figure III.

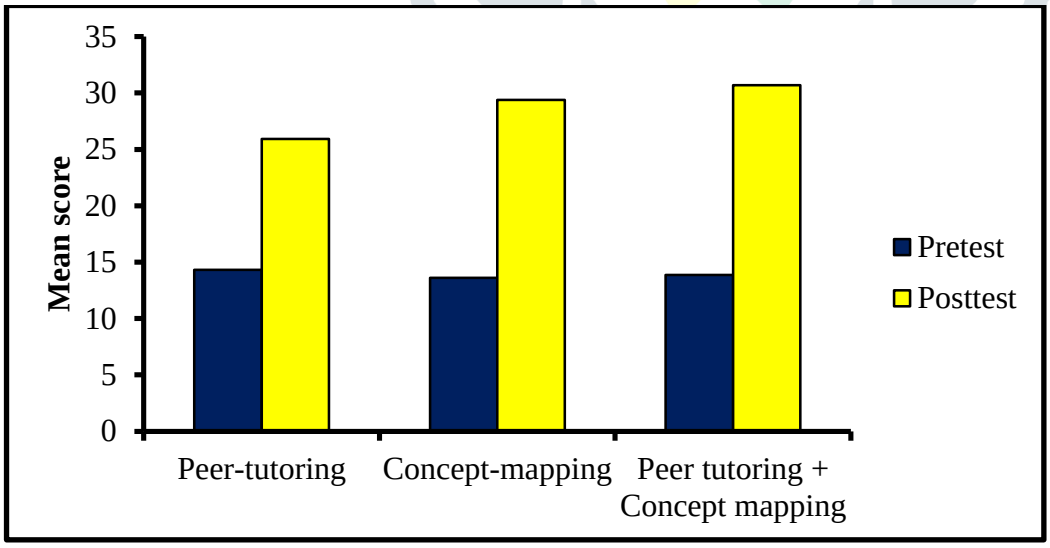


**Figure III:** Mean achievement scores of students taught both peer-tutoring and concept-mapping and individual strategy of peer-tutoring and concept-mapping in Physics

The results of this study in table 3 and figure III corroborates the proposition of Olatoye et al, (2011) who infers that the combination of individualized teaching strategy and co-operative leaning enhanced students'

achievement in Chemistry. The study equally agreed with Adedeji (2013) who investigated the effects of Explicit and Peer-tutoring instructional strategies and found out that learning outcomes were greatly improved.

**Research Question 4:** Would there be any difference in the mean achievement scores of male and female students taught with Peer-tutoring strategy in Physics?

**Table 4:** Mean achievement scores of students taught with peer-tutoring by gender

| Gender | N | Pretest | | Posttest | | Mean Difference |
|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | |
| Male | 20 | 13.90 | 2.02 | 26.15 | 2.35 | 12.25 |
| Female | 10 | 15.20 | 1.40 | 25.50 | 2.22 | 10.30 |
| Total | 30 | 14.33 | 1.92 | 25.93 | 2.29 | 11.60 |

Table 4 and Figure IV present the mean achievement scores of male and female students taught with Peer-tutoring strategy in Physics. The result indicates that male students exposed to peer-tutoring had mean achievement score of 13.90 while their female counterparts were 15.20 prior to treatment. On exposure to treatment, male students in the peer-tutoring group had slightly higher mean achievement score 26.15 than their female counterparts subjected to the same treatment (mean= 25.50). This implies that there is no difference in the mean achievement scores of male and female students taught with Peer-tutoring strategy in Physics. The mean achievement scores of male and female students taught with Peer-tutoring strategy in Physics before and after treatment is further depicted in Figure IV.

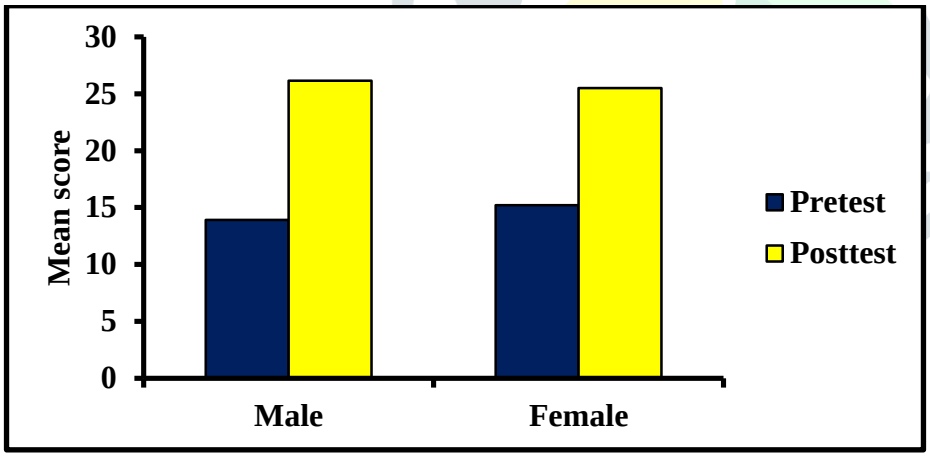


**Figure IV:** Mean achievement scores of students taught with peer tutoring strategy in Physics by gender

This finding agree with the works of Oviawe et al (2015), who reported that there is no significant interaction effects of gender and students' achievement. However, this work contradict the assertion of Nworgu and Ezenwosu (2013) who affirmed that male students performed better than their female counterparts

**Research Question 5:** Would there be any significant difference in the mean achievement scores of male and female students taught with concept-mapping strategy in Physics?

**Table 5:** Mean achievement scores of students taught with concept-mapping by gender

| Gender | N | Pretest | | Posttest | | Mean Difference |
|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | |
| Male | 18 | 13.00 | 3.80 | 29.72 | 1.13 | 16.72 |
| Female | 12 | 14.50 | 3.73 | 28.83 | 1.03 | 14.33 |
| Total | 30 | 13.60 | 3.78 | 29.37 | 1.16 | 15.77 |

Table 5 and Figure V present the mean achievement scores of male and female students taught with concept-mapping strategy in Physics. The result indicates that male students exposed to concept-mapping had a mean achievement score of 13.00 while their counterpart was 14.50 prior to treatment. On exposure to treatment, male students in the concept-mapping group had slightly higher mean achievement score 29.72 than their female counterparts subjected to the same treatment (mean= 28.83). This implies that there is no difference in the mean achievement scores of male and female students taught with concept-mapping strategy in Physics. The mean achievement scores of male and female students taught with concept-mapping strategy in Physics before and after treatment is further depicted in Figure V.

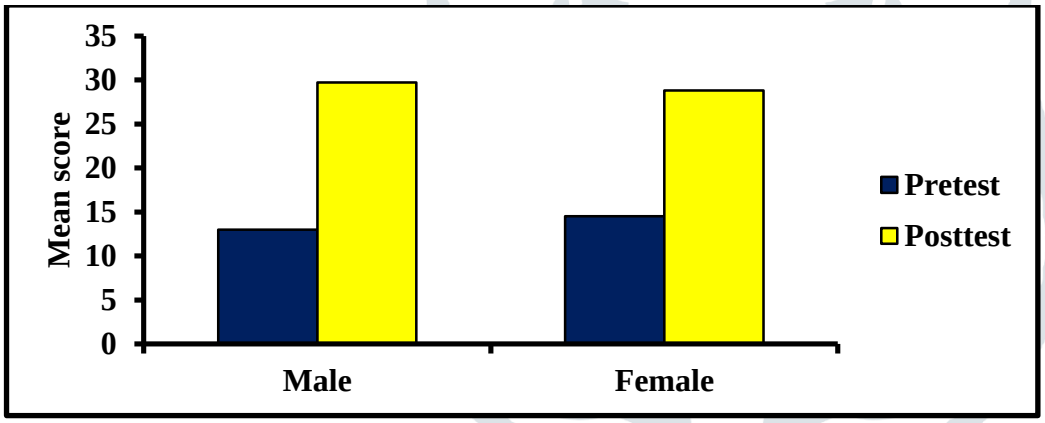


**Figure V:** Mean achievement scores of students taught with concept-mapping by gender

**Testing of Hypotheses**

**Hypothesis 1:** There is no significant difference in the mean achievement scores of students taught with peer-tutoring and conventional method in Physics?

**Table 6:** ANCOVA of students' achievement in peer-tutoring and conventional groups

| Source | SS | df | MS | F | p | Partial Eta$^2$ |
|---|---|---|---|---|---|---|
| Corrected Model | 3153.868 | 2 | 1576.934 | 382.302 | .000 | .931 |
| Intercept | 605.607 | 1 | 605.607 | 146.820 | .000 | .720 |
| Covariate (Pretest) | .118 | 1 | .118 | .029 | .866 | .001 |
| Group | 3113.721 | 1 | 3113.721 | 754.872 | .000 | .930 |
| Error | 235.116 | 57 | 4.125 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Total | 24333.000 | 60 | | | | |
| Corrected Total | 3388.983 | 59 | | | | |

*$p< 0.05$

Table 6 presents the difference in the mean achievement scores of students taught with peer-tutoring and conventional method in Physics. The result shows that computed F-value (754.872) with degrees of freedom 1 and 57 was statistically significant at p<0.05 level of significance for the groups. The null hypothesis was rejected. This implies that there is significant difference in the mean achievement scores of students taught with peer-tutoring and conventional method in Physics. The treatment accounted for about 93% ($Eta^2 = 0.93$) of the observed variance in the mean achievement scores of students taught with peer-tutoring and conventional method in Physics. The mean difference among the estimated marginal means descriptive statistics of the groups, after correcting for the other effects in the model is presented in Tables 7.

**Table 7:** Estimated Marginal Means for Treatment on achievement scores of students in Physics

| **Group** | **Mean** | **Std. Error** | **95% Confidence Interval** | |
|---|---|---|---|---|
| | | | **Lower Bound** | **Upper Bound** |
| Peer Tutoring | 25.929 | .372 | 25.184 | 26.673 |
| Control | 11.438 | .372 | 10.693 | 12.183 |

Table 7 shows that students exposed to peer-tutoring had higher estimated marginal means score on achievement in physics than their counterparts in the conventional group. The result further shows that there was significant mean difference between achievement mean score of students when subjected to peer-tutoring instructional strategy with (mean for peer-tutoring =25.929) and (mean for conventional = 11.438).

**Hypothesis 2:** There is no significant difference in the mean achievement scores of students taught with concept mapping and conventional method in Physics.

**Table 8:** ANCOVA of students' achievement in concept-mapping and conventional groups

| **Source** | **SS** | **df** | **MS** | **F** | **p** | **Partial Eta$^2$** |
|---|---|---|---|---|---|---|
| Corrected Model | 4824.218 | 2 | 2412.109 | 1125.290 | .000 | .975 |
| Intercept | 1293.041 | 1 | 1293.041 | 603.225 | .000 | .914 |
| Covariate (Pretest) | .151 | 1 | .151 | .071 | .791 | .001 |
| Group | 4668.688 | 1 | 4668.688 | 2178.022 | .000 | .974 |
| Error | 122.182 | 57 | 2.144 | | | |
| Total | 29916.000 | 60 | | | | |
| Corrected Total | 4946.400 | 59 | | | | |

*$p< 0.05$

Table 8 presents the difference in the mean achievement scores of students taught with concept-mapping and conventional method in Physics. The result shows that computed F-value (2178.022) with degrees of freedom 1 and 57 was statistically significant at p<0.05 level of significance for the groups. The null hypothesis was

rejected. This implies that there is significant difference in the mean achievement scores of students taught with concept mapping and conventional method in Physics. The treatment accounted for about 97.4% ($Eta^2 = 0.974$) of the observed variance in the mean achievement scores of students taught with concept-mapping and conventional method in Physics. The mean difference among the estimated marginal means descriptive statistics of the groups, after correcting for the other effects in the model is presented in Tables 9.

**Table 9:** Estimated Marginal Means for Treatment on achievement scores of students in Physics.

| Group | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| Concept mapping | 29.376 | .270 | 28.836 | 29.916 |
| Control | 11.424 | .270 | 10.884 | 11.964 |

The result on Table 9 shows that students exposed to concept-mapping had higher estimated marginal means score on achievement in physics than their counterparts in the conventional group. The result further shows that there was significant mean difference between achievement mean score of students when subjected to concept-mapping instructional strategy (mean =29.376) and conventional method (mean= 11.424).

**Hypothesis 3:** There is no significant difference in the mean achievement scores of students taught with both peer-tutoring and concept-mapping and individual strategy of peer-tutoring and concept-mapping in Physics.

**Table 10:** ANCOVA of students' achievement in peer-tutoring, concept-mapping and both groups

| Source | SS | Df | MS | F | p | Partial $Eta^2$ |
|---|---|---|---|---|---|---|
| Corrected Model | 362.976 | 3 | 120.992 | 24.482 | .000 | .461 |
| Intercept | 3124.252 | 1 | 3124.252 | 632.166 | .000 | .880 |
| Covariate (Pretest) | .110 | 1 | .110 | .022 | .882 | .000 |
| Group | 359.326 | 2 | 179.663 | 36.353 | .000 | .458 |
| Error | 425.024 | 86 | 4.942 | | | |
| Total | 74748.000 | 90 | | | | |
| Corrected Total | 788.000 | 89 | | | | |

$^{*}p< 0.05$

Table 10 presents the difference in the mean achievement scores of students taught with both peer-tutoring and concept-mapping and individual strategy of peer-tutoring and concept-mapping in Physics. The result shows that computed F-value (36.353) with degrees of freedom 2 and 86 was statistically significant at $p<0.05$ level of significance for the groups. The null hypothesis was rejected. This implies that there is significant difference in the mean achievement scores of students taught with both peer-tutoring and concept-mapping and individual strategy of peer-tutoring and concept-mapping in Physics. The treatment accounted for about 68.3% ($Eta^2$ = 0.68.3) of the observed variance in the mean achievement scores of students taught with both peer-tutoring and

concept-mapping and individual strategy of peer-tutoring and concept-mapping in Physics. The mean difference among the estimated marginal means descriptive statistics of the groups, after correcting for the other effects in the model is presented in Tables 11.

**Table 11:** Estimated Marginal Means for Treatment on achievement scores of students in Physics.

| Group | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| Peer Tutoring | 25.938 | .407 | 25.129 | 26.748 |
| Concept mapping | 29.363 | .407 | 28.554 | 30.171 |
| Peer tutoring + Concept mapping | 30.699 | .406 | 29.892 | 31.506 |

Cursory look at Table 11 shows that students taught with both peer-tutoring and concept-mapping had the highest estimated marginal means score on achievement in physics (mean=30.699), closely followed by those exposed to individual strategy of concept-mapping (mean=29.363) while the students subjected to Peer-tutoring (mean=25.938) was the least.

**Hypothesis 4:** There is no significant difference in the mean achievement scores of male and female students taught with Peer-tutoring strategy in Physics.

**Table 12:** ANCOVA of students' achievement in peer-tutoring group by gender

| Source | SS | df | MS | F | P | Partial Eta$^2$ |
|---|---|---|---|---|---|---|
| Corrected Model | 2.872 | 2 | 1.436 | .260 | .773 | .019 |
| Intercept | 287.572 | 1 | 287.572 | 52.112 | .000 | .659 |
| Covariate (Pretest) | .055 | 1 | .055 | .010 | .921 | .000 |
| Gender | 2.768 | 1 | 2.768 | .502 | .485 | .018 |
| Error | 148.995 | 27 | 5.518 | | | |
| Total | 20328.000 | 30 | | | | |
| Corrected Total | 151.867 | 29 | | | | |

***p> 0.05***

Table 12 presents the difference in the mean achievement scores of male and female students taught with Peer-tutoring strategy in Physics. The result shows that computed F-value (0.502) with degrees of freedom 1 and 27 was not statistically significant at p>0.05 level of significance for the groups. The null hypothesis was not rejected. This implies that there is no significant difference in the mean achievement scores of male and female students taught with Peer-tutoring strategy in Physics. Less than 5% (Eta$^2$ = 0.018) of the observed variance in the mean achievement scores of students taught with peer-tutoring in Physics can be attributed to gender.

**Hypothesis 5:** There is no significant difference in the mean achievement scores of male and female students taught with concept-mapping strategy in Physics.

**Table 13:** ANCOVA of students' achievement in concept-mapping group by gender

| Source | SS | df | MS | F | P | Partial Eta$^2$ |
|---|---|---|---|---|---|---|
| Corrected Model | 7.015[a] | 2 | 3.507 | 2.964 | .069 | .180 |
| Intercept | 1595.485 | 1 | 1595.485 | 1348.215 | .000 | .980 |
| Covariate (Pretest) | 1.326 | 1 | 1.326 | 1.120 | .299 | .040 |
| Gender | 6.582 | 1 | 6.582 | 5.562 | .026 | .171 |
| Error | 31.952 | 27 | 1.183 | | | |
| Total | 25911.000 | 30 | | | | |
| Corrected Total | 38.967 | 29 | | | | |

***p> 0.05***

Table 13 presents the difference in the mean achievement scores of male and female students taught with concept-mapping strategy in Physics. The result shows that computed F-value (5.562) with degrees of freedom 1 and 27 was statistically significant at $p<0.05$ level of significance for the groups. The null hypothesis was rejected. This implies that there is significant difference in the mean achievement scores of male and female students taught with Concept-mapping strategy in Physics. About 17.1% (Eta$^2$ = 0.171) of the observed variance in the mean achievement scores of students taught with concept-mapping in Physics was explained by gender. The mean difference among the estimated marginal means descriptive statistics of the groups, after correcting for the other effects in the model is presented in Tables 14.

**Table 14:** Estimated Marginal Means for Treatment on achievement scores of students in Physics

| Gender | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| Male | 29.757 | .258 | 29.226 | 30.287 |
| Female | 28.781 | .318 | 28.129 | 29.434 |

The result on 14 depicts that male students taught with concept-mapping had estimated marginal means score on achievement in Physics (mean=29.757 than their female counterparts (mean=28.781).

**Conclusion**

Inspite of efforts and concerns shown by stakeholders to enhance intellectual capability of the students in science, students' achievement in physics is not encouraging. One of the causes of this dwindling achievement is the adoption of inappropriate instructional strategies by physics teachers. Activity oriented strategies such as Peer-tutoring and Concept-mapping should be employed instead of conventional method. This study also provides empirical support that the exposure of students to both instructional strategies of peer-tutoring and concept-mapping improved students' achievement in Physics rather than a single strategy. However, the study found no significant difference between the academic achievements of male and female students in Physics when Concept-mapping and Peer-tutoring strategies are adopted.

**Recommendations**

Based on the findings of the study, the following recommendations were made:

1. Concept-mapping and Peer-tutoring instructional techniques should not only be incorporated into Physics syllabus by curriculum planners and developers but also should ensure implementation to facilitate students' achievement of learnt concepts.
2. Workshops, seminars and conferences should be organized by government and relevant professional bodies such as Science Teacher Association of Nigeria(STAN) to educate and encourage the teachers on the use of concept-mapping and peer-tutoring techniques for teaching Physics and other science subjects.
3. Authors of Physics textbooks and other science related subjects should present the contents and concepts with worked examples using Concept-mapping and Peer-tutoring techniques.
4. Government agencies and other professional bodies such as NERDC and STAN should sponsor further research work on the potency of Concept-mapping and Peer-tutoring strategies in promoting students' achievement in science.
5. Teachers should be on ground to supervise students during Peer-tutoring to limit unwarranted arguments.

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