

Effect of Class-Wide Peer Tutoring on Students' Performance in Physics in Dekina, Nigeria

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Abstract

The study investigated the effect of Class-wide Peer Tutoring (CWPT) on students' performance in physics in Dekina, Nigeria. Two co-education public secondary schools were purposively selected. A total of 64 (male = 31, female = 33) senior school two (SSII) students were randomly selected from the sampled school. A quasi-experimental design was adopted for the study. The instrument used for this research was a 20-multiple-choice projective Motion Test (PMT) developed by the researcher. The treatment in the experimental group was the teaching of Projectile Motion using the CWPT strategy. Mean, standard deviation, and ANCOVA was used to analyze the data collected. The findings revealed that there was a significant difference between the performance of the experimental group and control group in the favour of the experimental group and no significant difference in the performance of male and female students when both are taught Projectile Motion using CWPT. It is recommended among others that teachers should be trained to adopt classwide peer-tutoring in schools since it facilitates the academic performance of students in physics.

Keywords: class-wide; peer tutoring; physics; performance

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INTRODUCTION

The relevance of physics to the technological growth of any nation is incontestable, many students have performed poorly in physics in the external examinations particularly, projectile motion. Projectile motion and simple harmonic motion are some of the topics in dynamics that students perceived as difficult in Nigerian secondary schools (Erinosho, 2013). The West African Examinations Council (WAEC) chief examiners' reports of 2015, 2016, and 2017 also identified projectile motion questions as those that candidates found difficult to answer. Many factors, ranging from teachers' qualifications, experience, and lack of enthusiasm, to ill-equipped physics laboratories and poor teaching methods, have been attributed to the persistent underperformance of students in physics (Michael, et al. 2022).

The poor recruitment of teachers from low achievers for physics teaching in secondary schools and the weak preparation programs in teacher education resulted in problematic physics teaching dominated by didactic teaching (Alemu, et al. 2017). Physics, however, requires the use of a suitable and efficient instructional approach to understand nature, the environment, and the application of scientific principles for everyday use. (Alemu, 2020; Hanč, et al. 2020; Pompea & Russo, 2020).

One of the ways to bring about a change in the teaching of physics is to change from the strictly teacher-directed approach to a teacher-facilitated approach such as jigsaw learning-teams, problem-based learning and peer-tutoring (Bigozzi, et al., 2018; Kalu-Uche & Alamina, 2014; Kalu-Uche & Emeka, 2018; Mumuni, Dike & Uzoma-Nwogu, 2017; and Ullah, Tabassum & Kaleem, 2018) among others. The success of the teaching is measured by the success of the students in the examination, so teachers must be flexible to teach the students the way the students will understand. According to Bamidele and Yoade (2017), the conventional chalk-and-talk method of teaching is still very predominant in Nigeria. Ayvazo and Aljadeff, (2014), state that teaching is still in such a way that teachers act as the warehouse of knowledge and students the passive receiver. The teacher-centered method entails teachers acting as guardians at all times thereby reducing the students to be the lazy receiver of knowledge and consequently restricting the knowledge

sources of the students. In an attempt to involve students actively in the teaching-learning process, many researchers such as (Kalu-Uche, & Ogbonna, 2020; Mkpanang, 2016; and Osei-Himah, Parker, & Naah, 2022) have advocated the adoption of Class-wide Peer Tutoring (CWPT). They all reported that the students taught using peer tutoring achieved better results than those exposed to using the lecture method. Class-wide peer tutoring is a teaching intervention strategy in which students alternate between the role of tutor and tutee, that is, students get to be the learner and the teacher. Lidon, et al. (2014) defined CWPT as “an instructional arrangement in which the teacher pairs two students in a tutor-tutee relationship to promote learning of academic skills or subject content” (p. 51). CWPT involves grouping two or more students together, and it can be used for any subject or age group. CWPT gives each student the chance to teach a review lesson, monitor other students in the group, and evaluate each other's work through observations or work samples. In a pair group or small group conditions, roles can be exchanged, and therefore, we call that kind of peer tutoring a reciprocal peer tutoring (Topping et al., 2013). In this model, students are a huge part of the whole process as they can prepare instructional materials as well as receive immediate feedback from their peers. Using ordinary peer tutoring, knowledge imbalance among peers may be created over time as tutors act as true knowledge providers and sources of the final answer while tutees gradually acknowledge the role of knowledge recipient (Miravet et al., 2014). However, exchanging roles in reciprocal peer tutoring tackles these problems and gives equal opportunity to all the group members of learning by teaching content (Kalu-Uche & Emeka, 2018). Furthermore, reciprocal peer tutoring maximizes the benefit for learners by providing the opportunity to benefit from both the tutor and tutee roles. Less knowledgeable learners were found motivated to engage in peer tutoring and showed better learning outcomes (Neugebauer et al., 2016). Even though more able tutors may feel at a disadvantage in engaging with less able tutees in heterogeneous groupings, careful structuring and implementation of principles of cooperative learning ensure equal benefits in reciprocal peer tutoring (Supanc et al., 2017).

Students learn in different ways and from a variety of people. Students can learn more from one teacher than from another, from their parents, siblings, and often, from their peers (Gazulaa et al. 2016) support the idea that students are more natural teachers for their peers as peers use age-appropriate language and are inclined to use helpful examples rather than just providing answers. In turn, a student may be more willing to listen to the ideas and explanations of a peer than those of an adult. Students often feel more comfortable admitting to their peers than to their teachers that they are confused or do not understand something. Abdulmalik and Torpev (2016) examined the effect of the Classwide peer tutoring instructional approach on secondary school slow learners' performance in chemistry in Funtua, Katsina State. There were 108 participants sampled from two secondary schools. The experimental group received treatment by being taught by peer tutors using CWPT while the teacher taught the control group using the lecture method. The data were analyzed using a t-test. Results showed that the experimental group taught by peer tutors via CWPT performed significantly better than the control group taught by using the lecture method.

Anggereini et al. (2018) studied the effect of ICT-based class-wide peer tutoring (CWPT) on the creativity of biology education students in Jambi, Indonesia. Descriptive data analysis and inferential statistics of 2-ways ANOVA were employed in the study. The results of the study show that there was no effect of the CWPT model on student creativity. Alemu (2020) tests the effect of reciprocal peer tutoring on students' achievement in secondary school physics teaching in Addis Ababa, Ethiopia. Data were gathered from three different intervention groups in a pre-test post-test multi-level quasi-experimental design. The three groups used reciprocal peer tutoring for 9 weeks in two physics units. Results revealed that reciprocal peer tutoring helped in improving physics achievement of low achievement secondary school students and female students when it was used as a unilateral pedagogy. The consideration of gender is substantial in science education research since most of the schools are coeducational. The studies conducted by (Ezenwosu, & Nworgu, 2013; Nwankwo, & Madu, 2014; Osei-Himah, *et al.*, 2022; Yusuf, *et al.*, 2016) indicated that there were many studies on gender as it influences students' performance in using peer tutoring strategy in sciences. For example, Ezenwosu and Nworgu (2013) reported that male students performed better than female students when taught biology using a peer tutoring strategy. Nwankwo & Madu (2014) indicated that female students

outperformed male students. The studies conducted by Abdulraheem, *et al* (2017); Adigun, *et al*, (2015); Osei-Himah, *et al*. (2022); and Yusuf, *et al* (2016) reported that no significant difference between male and female students taught using CWPT. Consequently, gender differentiations that exist in some science-related subjects, which lead to variation in the academic achievement of male and female students remain an issue of concern to researchers. Therefore, in this study, the effect of students' performance in Projectile Motion when taught using a class-wide peer-tutoring strategy was investigated.

Quite a few studies have proved that class-wide peer tutoring is an important factor that promotes students' academic achievement in subjects such as chemistry, biology, and physics in States other than Kogi. However, there has not been any study on the effects of class-wide peer tutoring strategy on senior secondary school students' performance in physics in Dekina, Kogi State. The need, therefore, arises for a study of the effect of class-wide peer tutoring as an instructional strategy on secondary school students' performance in physics in Dekina, Kogi State. It is based on antecedent that the study attempts to close the gap.

METHODS

This study adopted the pre-test post-test non-randomized and non-equivalent control group design of the quasi-experimental research design. The target population for this study was all 32,000 Senior Secondary school two students (SSII) in all the 24 senior secondary schools offering physics in Public Schools in Dekina, Kogi State. Senior school two (SS2) students were involved in the study because it is expected that they have covered a greater part of the curriculum, and are familiar with the previous knowledge needed for the selected topic. Two co-educational public secondary schools of the same characteristics and structure were randomly selected from Dekina Local Government in the study area. That is one for the experimental group and the other for the control group. The experimental group consisted of 36 students (including 16 males and 20 females) while the control group was made up of 28 students (having 15 males and 13 females). Thus, the total male and female students for this study were 31 and 33 respectively.

Twenty-multiple-choice Projectile Motion Test (PMT) was developed by the researchers for data collection. The instrument was validated by two professors in the Department of Science Education, Prince Abubakar Audu University, Anyigba, and three senior secondary school teachers, for clarity of instruction, vocabulary and sentence structures that might be too difficult, poorly constructed items, improper arrangement of items and ambiguous test items inappropriate for the outcomes being measured.

The researchers administered twenty (20) copies of the test instrument to the respondents outside the area of the study within two weeks. After two weeks another twenty (20) copies of the instrument were administered again to the same respondents. The results of the two administered test items were compared using Pearson's product-moment correlation Coefficient and the reliability coefficient of 0.67 was obtained using the Crombach Alpha method.

Afterward, the researchers visited the selected schools with permission from the appropriate authorities and conducted the study. The study covered four weeks. In the 1st week, a pre-test was administered by the school physics teachers (who double as research assistants) in the two selected intact classes before the commencement of the teaching sessions. The research assistants were trained for three days within the first week. The instructional packages (the lesson plan structured with Class-wide peer tutoring) was used to teach the experimental group projectile motion for two weeks in two lesson periods of 40 minutes each per week during the official school period allowed on the timetable for physics. The experimental group was divided into subgroups of mixed ability based on the pre-test score. The student in each group was to teach themselves. One student (tutor) explains the work to the students (tutee) of his/her group, asks the student (tutee) to answer questions, and tells the student (tutee) whether his or her answers are correct. The research assistant then provided more explanation to clarify misconceptions and corrects the tutor and tutee before they switch roles and practice new roles as the teacher moved around. While the lesson plan with the conventional method was used to teach the control group projectile motion for the same periods as allowed on the school timetable. During the 4th week, the post-test was administered to the two groups. The post-test lasted for 30 minutes.

After data collection, scoring, and coding (on SPSS version 20), mean and standard deviation were used to answer the research question while Analysis of Covariance (ANCOVA) was used to test the hypotheses at a 0.05 level of significance.

RESULTS AND DISCUSSION

Out of 64 (100%) students sampled for this study, 36 (56.2%) of the respondents constituted the experimental group (Class-wide peer tutoring) out of which 16 (25.0%) were males and 20 (31.2%) were females while 28 (20.0%) of the respondents formed the control group (Conventional method) from which 15(23.5%) were males and 13 (20.3%) were females

Research Question: What is the performance profile of senior school students taught Projectile Motion in Physics in Dekina?

As revealed in Table 1, the performance of students (both the experimental and control groups) in the post-test was higher than their performance in the pre-test. However, in the post-test, the performance (18.48) of students taught Projectile Motion using Class-wide peer tutoring was high when compared to those taught Projectile Motion using the conventional method with a mean score (11.73).

Table 1. Descriptive Statistics of Students Taught Projectile Motion (before and after the Treatment)

Groups		Mean	S.D.	Min	Max
Experimental Group (Class-wide peer tutoring)	Pre-test	8.90	4.41	4.00	11.00
	Post-test	17.48	6.99	9.00	20.00
Control Group (Conventional Method)	Pre-test	8.09	3.79	5.00	12.00
	Post-test	11.73	4.56	8.00	14.00

Table 2, therefore, shows the mean gain of the students in Projectile Motion after the treatment. Students taught with the Class-wide peer tutoring technique had a mean gain score of 8.58 while students that taught with the conventional method had a mean gains score of 3.64.

Table 2. Mean Gain Scores of the Students Taught Projectile Motion (before and after the Treatment)

Groups	Pre-test	Post-test	MeanGain Scores
Experimental (Class-wide peer tutoring)	8.90	17.48	8.58
Control (Conventional Method)	8.09	11.73	3.64

Hypotheses Testing

Hypothesis One: *There is no significant effect of Class-wide peer tutoring on senior school students' performance in Projectile Motion in Physics*

Table 3. Analysis of Covariance Results of the Effect of Class-wide Peer Tutoring on Senior School Students' Performance in Projectile Motion in Physics

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	756.689 ^a	2	378.344	168.384	.000
Intercept	1068.699	1	1068.699	475.631	.000
Pre-test	5.796	1	5.796	2.579	.113
Class-wide peer tutoring	747.000	1	747.000	332.457	.000
Error	137.061	61	2.247		
Total	14234.000	64			
Corrected Total	893.750	63			

a. R Squared = .847 (Adjusted R Squared = .842)

The result in Table 3 reveals that the *F*-value of 332.457 is obtained with a *p*-value of 0.000 computed at a 0.05 alpha level. Since the *p*-value (0.00) is less than the alpha level (0.05), the null hypothesis is rejected and

thus, there is a statistically significant effect of Class-wide peer tutoring on senior school students' performance in Projectile Motion in Physics ($F(1, 61) = 332.457, p < 0.05$).

The Multiple Comparison Analysis is depicted in Table 4 to show where the difference lies (i.e. the actual effect of the class-wide peer tutoring on students' performance). As shown in Table 4, students who taught Projectile Motion using a Class-wide peer tutoring strategy had a higher adjusted mean score of 17.29 than those students who taught Projectile Motion using the conventional teaching method with an adjusted mean score of 11.61. Thus, the actual effect of the Class-wide peer tutoring on students' performance in Projectile Motion is shown by the mean score difference of 5.68.

Table 4. Pair wise Comparisons Analysis Showing the Actual Effect of the Class-wide Peer Tutoring on Students' Performance

Treatment	Mean	Mean Difference (I-J)	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
					Lower Bound	Upper Bound
Experimental (I)	17.29 ^a	5.68*	.357	.000	2.331	3.742
Control (J)	11.61 ^a	-5.68*	.357	.000	-3.742	-2.331
Grand Mean = 15.105						

* the mean difference is significant at 0.05 level

b. Adjustment for Multiple Comparisons: Bonferroni

Hypothesis Two: *There is no significant interaction effect of the Class-wide peer tutoring and gender on senior school students' performance in Projectile Motion in Physics*

The result in Table 5 reveals that the F -value of 0.597 is obtained with a p -value of 0.507 computed at a 0.05 alpha level. Since the p -value (0.507) is greater than the alpha level (0.05), the null hypothesis two is not rejected and thus, there is no statistically significant interaction effect of Class-wide peer tutoring and gender on senior school students' performance in Projectile Motion in Physics ($F(1, 33) = 0.597, p > 0.05$).

Table 5. *Analysis of Covariance Results Showing the Interaction Effect of Class-wide peer tutoring and Gender on Senior School Students' Performance in Projectile Motion in Physics*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3.540 ^a	2	1.770	.842	.443
Intercept	652.968	1	652.968	310.539	.000
Pre-test	2.858	1	2.858	1.359	.255
Gender	.951	1	.951	.597	.507
Error	52.567	33	1.593		
Total	945.000	36			
Corrected Total	56.107	35			

a. R Squared = .063 (Adjusted R Squared = -.012)

It was revealed from the study that there is a statistically significant effect of Class-wide peer tutoring on senior school students' performance in Projectile Motion in Physics. The effectiveness of CWPT in enhancing the performance of students in physics is therefore established. It also creates more opportunities for students to practice specific skills, which leads to better retention. This agrees with the findings of (Kalu-Uche, & Ogbonna, 2020; Mkpanang, 2016; and Osei-Himah, Parker, & Naah, 2022). They all reported that the students taught using peer tutoring achieved better results than those exposed to using the lecture method. In the same vein, Abdulmalik and Torpev (2016) and Alemu (2020) of whom also agreed that CWPT could bring about improved performance of students. Similarly, it contradicts the findings of Anggereini, Budiarti, and Sanjaya (2018) who reported that there was no effect of the CWPT model on student creativity.

This study, however, pointed out that both male and female students had statistically equal performance when both are taught Projectile Motion using CWPT. Therefore, gender did not affect the performance of students in physics when both are taught using CWPT. This may be as a result of gaining a deeper understanding of a topic by teaching it to one another (tutor - tutee). this is in line with the studies conducted

by Osei-Himah, *et al* (2022) and Yusuf, *et al* (2016) reported that no significant difference between male and female students taught using CWPT. On the contrary, Ezenwosu and Nworgu (2013) found that male students performed better than female students when taught biology using a peer tutoring strategy. While Nwankwo and Madu (2014) found that female students outperformed male students.

CONCLUSION

This study revealed that CWPT is capable of improving the academic performance of students in physics. One can conclude that using the CWPT strategy can help address the generally poor performance of students in physics. The study also showed that male and female students did not have different performances in physics. Therefore, gender does not determine the performance of students in physics.

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