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Effects of Peer-Assisted Learning Strategies as Pedagogical Approaches on Students' Academic Performance in Basic Science

Etobro, A. Benjamin[1*] and Fabinu, O. Emmanuel[1]

[1]Department of Science and Technology Education, Faculty of Education, Lagos State University, Ojo, Lagos, Nigeria.

Authors' contributions

This work was carried out in collaboration between both authors. Author EAB designed the study, performed the statistical analysis, wrote the first draft of the manuscript and managed the analyses of the study. Author FOE managed the literature searches. Both researchers read and approved the final manuscript for publication.

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ABSTRACT

Instruction involves the art of impacting knowledge unto students in order to bring about a change in behaviour as a result of experiences from the impacted knowledge. The art of impacting knowledge requires the teacher selecting appropriate pedagogical strategies that would bring about appreciable academic achievement among the students. This study was carried out to examine the effects of peer-assisted learning strategies as pedagogical approaches on students' academic performance in basic science. The study involved 213 students randomly sampled from eight junior secondary schools in education district iii of lagos state. Basic science achievement test on (bsat) was used for data collection. Data collected were analyzed with the use of mean scores and analysis of covariance (ancova). Findings revealed that students exposed to peer-assisted learning strategies generally outperformed those in the traditional lecture group with average mean sores of 10.92 and 7.44, respectively. Furthermore, results showed that there was a significant effect of treatment on students' achievement scores in basic science, $f_{(3, 204)} = 24.23$, $p<0.05$, partial $\eta^2 = .263$, $r^2 = .272$.

**Corresponding author: E-mail: benjamin.etobro@lasu.edu.ng;*

There is no significant interaction effect between teaching strategies and gender on students mean achievement score in basic science, $f_{(3, 204)} = 0.296$; $p > 0.05$, partial $\eta^2 = .004$, $r^2 = .272$. Inferentially, peer-assisted learning strategies can help to enhance students' academic performance. Consequently, education stakeholders particularly teachers, school authorities and educational administrators should ensure that peer-assisted learning strategies are integrated into the teaching-learning process.

Keywords: Peer-assisted learning strategies; academic performance; same-level peer tutoring; cross-level peer tutoring.

1. INTRODUCTION

Instruction involves the art of impacting knowledge unto students in order to bring about a change in behaviour as a result of experiences. Learning process requires the holistic development of the students in the three domains (cognitive, affective and psychomotor). Acquisition of these experiences requires the concerted efforts of all the players of the education industry. Factors relating to students, teachers, parents and government policies are vital in achieving quality education. Among the students and teachers' factors is the type of pedagogical strategies employed in the delivery of the content. The achievement of universal participation in education fundamentally depends on these factors, [1]. For example, how well students are taught and how much they learn, can have a crucial impact on how long they stay in school and how regularly they attend. The focal point expectedly, is the achievement of quality education which requires the collective effort of various stakeholders.

Pedagogical strategies that foster effective learning include supplemental instruction, cooperative learning, hands-on-minds-on, guided discovery, field trips, computer assisted instruction among others. Supplemental Instruction (SI) is a programme designed to improve students' academic success and increase retention. The SI program initially targeted traditionally difficult courses and provided regularly scheduled, peer-led learning sessions [2]. Supplemental instruction is a peer-assisted learning model for enhancing students' understanding of their subject, and for improving students' overall learning skills.

Education legislation such as Universal Basic Education (UBE) Act 2004; Child's Right Act 2003; National Economic Empowerment Development Strategy (NEEDS); National Child Policy 2007; National Policy for Integrated Early Childhood Development in Nigeria (2007) and National Minimum Standard for Early Child Care Centres in Nigeria; require schools to utilize empirically supported interventions and regular assessments to enhancing the learning experiences for all students. Kelly suggested the utilization of a tiered system of support and instruction delivery [3]. The first tier addresses the whole classroom, while the second tier includes students who are struggling in the classroom, while the third tier provides the most intensive intervention for those students who require individualized, high frequency, instruction. These types of intervention require regular formative assessment throughout the Tiers that would allow educators to identify whether students are responding accordingly, and subsequently allows educators better monitor the instruction and interventions to meet the students' needs.

Best practices imply that educators selecting interventions that are effective for all categories of students and that these interventions address both academics and behaviours as well as acquisition of required skills. Anyone who has ever had cause to teach knows that the best way to learn a concept is to have to teach it to someone else. This fundamental principle underpins the concept of peer-assisted learning, where peers are generally regarded as being individuals of the same or similar intellectual status and/or social standing [4].

Peer-Assisted Learning Strategy (PALS) is a supplemental instruction which is an evidence-based intervention that was typically used for tier 1 (Johns Hopkins University, 2012) cited in [2]. Peer-assisted learning (PAL) represents one of a variety of peer tutoring schemes currently operating within UK Higher Education (HE) institutions (Peer-assisted Learning, 2007) as in [5], in which students, normally within the same class or cohort and at a comparable level of academic development, learn with and from one another [6]. Peer tutoring approach to student learning has been adopted by a wide diversity of

academic disciplines within HE, ranging from history, law, music, and business studies to chemistry, mathematics and engineering. Peer tutoring is underpinned by some principles [4].

Peer tutoring generally includes some or all of the following principles:

a) Students are trained to use a highly structured tutoring model;
b) Students are divided into teams;
c) Students are assigned a partner;
d) Students follow a tutoring protocol and switch roles halfway through each session; and
e) The teacher acts as supervisor and awards points based on performance, [7] [3].

PALS follows this model and allow for the efficient and effective implementation of peer tutoring. Peer-assisted learning is a well-established method for promoting students' learning, and has a long tradition in higher education around the world [8,9]. A variety of different peer-assisted learning methods have previously been described [10], a certain hierarchy of educational levels, where a senior student tutors a group of junior students. A vast number of studies has been conducted demonstrating the efficacy of peer tutoring for students of all ages and across all levels of achievement in mathematics, reading and spelling, [3,7]. Most studies have been conducted using peer-learning models of instruction with the focus on students with disabilities and have found positive results [11]. The use of reciprocal peer-tutoring in mathematics instruction was more effective than non-reciprocal peer tutoring, but both methods of tutoring were significantly more effective than no peer-tutoring at all, [12]. In reciprocal peer-tutoring, each student acts as coach and player for equal amounts of time; and in non-reciprocal peer-tutoring, one student is the coach for the entire lesson [12]. When the contingencies for reinforcement were altered to include the entire class's performance (a large deviation from traditional peer-tutoring models), it was found that this method resulted in a significant improvement between pre- and post-test scores in mathematics [13]. This finding is important because it demonstrated that traditional models of peer learning can be adapted to better suit the needs of entire classrooms and that peer-based learning in and of itself was a critical element to the success of students in mathematics.

Regardless of the variations in tutoring style, the theoretical framework underlying peer-assisted learning is constructivism, where the tutors take on the role of facilitators to help students process and understand information and construct their own knowledge, rather than the role of information givers [14,10] who provide knowledge for the students to assimilate. This type of learning environment is designed to support and challenge the learner's thinking [15] when the learner plays an active role in the learning process. PAL is known to assist students in maximizing their ability to organize and use study materials, as well as clarify assessment tasks and requirements of the course. Contextual activities encourage students to discuss their learning in an informal atmosphere with their peers. PAL encourages students' participation and further equips students with the tools to become excellent problem solvers. Peer leaders use cues and prompt that may lower anxiety and increase ownership of learning.

Peer tutoring in this study also refers to as peer-teaching. Peer-teaching is an instructional strategy in which groups of children under the guidance of the teacher work together through a given instructional assignment with brilliant child, the peer teacher; providing assistance and instruction to others, the peer students.

1.1 Purpose of the Study

The main purpose of this study was to empirically investigate the effect of peer-assisted learning strategies on student's academic achievement in Basic Science**.** Specifically, the study sought to determine:

1. The effects of peer-assisted learning strategies and traditional lecture method on student's academic achievement in Basic Science**.**
2. The academic achievement of male and female students when exposed to the teaching strategies.
3. The interaction effect between the teaching strategies and gender on students' academic achievement in Basic Science**.**

1.2 Research Questions

This study was guided by the following research questions:

1. What is the performance of students exposed to treatment groups?

2. What is the performance of students in Basic Science achievement test on the basis of gender?
3. What is the performance of male and female students exposed to treatment groups?

1.3 Hypotheses

The following null hypotheses were tested at 0.05 level of significance guided the study.

$H0_1$ There would be no significant difference in the mean achievement scores of students in the teaching strategies [Same-Level Peer Tutoring with Equal Status (SPTES), Same-Level Peer Tutoring with Unequal Status (SPTUS), and Cross-Level Peer Tutoring (CLPT) and Control Group (CG)].

$H0_2$ There would be no significant difference between the mean achievement score of male and female students in Basic Science.

$H0_3$ There is no significant interaction effect between teaching strategies and gender on students mean achievement score in basic science.

2. METHODOLOGY

This study adopted a pre-post test, quasi-experimental, control-group comparison design. A pre-test assessment in the form of baseline data was collected to verify the reliability of subject responses. Multistage sampling technique was employed in the study. Education District III was selected by balloting from the six Education Districts in Lagos State. Four junior secondary schools were selected using convenience sampling technique from Ibeju-Lekki local government area of Education District III of Lagos State. Adopting simple random sampling technique by balloting, the four schools were assigned to four groups consisting of three experimental groups and a control group. Treatments administered included three experimental conditions - Same-Level Peer Tutoring with Equal Status (SPTES), Same-Level Peer Tutoring with Unequal Status (SPTUS), and Cross-Level Peer Tutoring (CLPT) and one control group. A total of 213 students took part in the experiment. From the first school, in which SPTES was adopted, 54 students in the top 25% were purposively selected from 168 students in three intact classes; SPTUS had 54 students in an intact class; CLPT with an intact class of 51 students and the control group with 54 students also in an intact class.

Conditions were randomly assigned to intact Basic 8 (JSS II) classes. In Same-Level Peer Tutoring with Equal Status (SPTES), students in this group were of equal status – with respect to their experiences, skills and attainment levels. One of the students was randomly selected to assume the role of a tutor. While in Same-Level Peer Tutoring with Unequal Status (SPTUS), students in this group were not of equal status – with respect to their experiences, skills and attainment levels. Here the researchers purposively selected a pupil with the higher level of skills and academic attainments to assume the role of a tutor. But in Cross-Level Peer Tutoring (CLPT) group, students were not of equal status – with respect to their experiences, skills and attainment levels, with respect to their grade levels. A pupil from Basic Nine (JSS III) was purposively selected to tutor those in Basic eight. Purposive sampling technique was adopted to select students with best academic performance to assume the role of a teacher. However, the students in the control group were taught by the researcher with traditional lecture method.

The Basic Science Achievement Test (BSAT) was administered to a sample of 35 students in a school that was not involved in the study in order to determine its reliability. The reliability of BSAT was established through the use of split-half (Spearman-Brown Prophesy Formula). Spearman-Brown Prophesy was used because it accommodates the dichotomous (i.e., right-wrong) answers that characterise the test and it yielded a reliability index of 0.79. All the groups completed the Basic Science Achievement Test (BSAT) as baseline, pre-test, and post-test measures. In the SPTES, SPTUS and CLPT conditions, the teachers implemented the intervention for 5 weeks while in the control condition; the teacher implemented the state-adopted Basic Science curriculum according to the regular school schedule using conventional traditional lecture method. In the SPTES condition, students completed the standards basic 8 SPTES programme. In the SPTUS Condition, students completed the task with a peer who was academically better than the members of the group. In the CLPT condition, students completed the task with a peer from the higher class.

2.1 Instrument for Data Collection

The instrument for data collection in the study was the Basic Science Achievement Test (BSAT). The BSAT is a 50-item, four-optioned A-D multiple choice test which was developed by the researchers from the two content areas in the Basic Science curriculum – You and energy as well as Science and development.

3. RESULTS AND DISCUSSION

3.1 Results

1. What is the performance of students exposed to treatment groups?

Table 1. Performance of students exposed to treatment groups

Treatment	Mean	N	Std. Deviation
SPTES	10.87	54	2.788
SPTUS	11	54	2.656
CLPT	10.88	51	2.605
CG	7.44	54	2.221
Total	10.04	213	2.973

Table 1 showing the performance of students exposed to treatment groups revealed that students in the Same-Level Peer Tutoring with Unequal Status (SPTUS) had the best mean score of 11 (SD = 2.66); followed by those in the Cross-Level Peer Tutoring (CLPT) with mean score of 10.88 (SD = 2.61); while students in the Same-Level Peer Tutoring with Equal Status (SPTES) and control group (CG) had means scores of 10.87 (SD = 2.79) and 7.44 (SD = 2.22) respectively.

2. What is the performance of students in Basic Science achievement test on the basis of gender?

Table 2. Performance of students in the achievement test on the basis of gender

Gender	Mean	N	Std. Deviation
Male	9.78	102	3.069
Female	10.27	111	2.876
Total	10.04	213	2.973

Table 2 showed that female students performed better than their male counterparts with mean achievement scores and standard deviation of 10.27 (SD = 2.88) and 9.78 (SD = 3.07) respectively.

3. What is the performance of male and female students exposed to treatment groups?

Table 3 shows the mean achievement scores of male students in the three experimental groups in the post-test were SPTES10.29 (SD=3.043); SPTUS 10.9 (SD = 2.54) and CLPT 10.75 (SD = 2.85) respectively whereas those of the female students were SPTES 11.33 (SD = 2.52); SPTUS 11.12 (SD = 2.83) and CLPT 11 (SD = 2.42) respectively. Generally, female students outperformed the male counterparts with average mean scores and standard deviations of 10.27 (SD = 2.88) and 9.78 (SD = 3.07). For the control group, the mean achievement scores of male and female students were 7.08 (SD = 2.27) and 7.76 (SD = 2.17) respectively. The female students in the control group performed slightly better than their male counterpart.

3.2 Hypotheses Testing

$H0_1$: There would be no significant difference in the mean achievement scores of students in the treatment groups [Same-Level Peer Tutoring with Equal Status (SPTES), Same-Level Peer Tutoring with Unequal Status (SPTUS), and Cross-Level Peer Tutoring (CLPT) and Control Group (CG)].

Table 4 revealed that after adjusting for pre-test scores, there was a significant effect of treatment on students' achievement scores in Basic Science, $F_{(3, 204)} = 24.23$, P =.000, Partial $\eta^2 = .263$, $R^2 = .272$. The implication of this is that since p-value (.000) of the F-ratio was significant, the null hypothesis on the main effect of treatment was rejected. The R Squared shows that the independent variables accounted for 27.7% of the variation in the students' achievement in Basic Science. The partial Eta squared estimated indicates that the treatment accounted for 26.3% of the variance observed in the post-test on students' achievement in Basic Science.

$H0_2$: There would be no significant difference between the mean achievement score of male and female students in Basic Science.

Table 4 revealed that after adjusting for pre-test scores, there was no significant difference between the mean achievement score of male and female students in Basic Science, $F_{(1, 204)} = 2.309$, P =.130, Partial $\eta^2 = .011$, $R^2 = .272$. The

implication of this is that since p-value (.130) of the F-ratio was not significant, the null hypothesis which stated that there would be no significant difference between the mean achievement score of male and female students in Basic Science was rejected. The R Squared shows that the independent variables accounted for 27.7% of the variation in the students' achievement Basic Science. The partial Eta squared estimated indicates that gender accounted for 1.1% of the variance observed in the post-test on students' achievement in Basic Science.

$H0_3$: There is no significant interaction effect between teaching strategies and gender on students mean achievement score in Basic Science.

Table 4 showed that there is no significant interaction effect between teaching strategies and gender on students mean achievement score in Basic Science, $F_{(3, 204)} = 0.296$; p = .828, Partial $\eta^2 = .004$, $R^2 = .272$. Since p-value (.828) of the F-ratio is greater than .05, the hypothesis which states that there is no significant interaction effect between teaching strategies and gender on students mean achievement score in Basic Science is rejected. This means that the teaching strategies and gender combined did not contribute to their achievement in Basic Science. The R Squared shows that the independent variables accounted for 27.7% of the variation in the students' achievement in Basic Science. The partial Eta squared estimated indicates that teaching strategies and gender accounted for 0.4% of the variance observed in the post-test on students' achievement in Basic Science.

Table 3. Performance of male and female students exposed to treatment groups

Gender	Treatment	Mean	N	Std. Deviation
Male	SPTES	10.29	24	3.043
	SPTUS	10.9	29	2.54
	CLPT	10.75	24	2.848
	CG	7.08	25	2.272
	Total	9.78	102	3.069
Female	SPTES	11.33	30	2.523
	SPTUS	11.12	25	2.833
	CLPT	11	27	2.418
	CG	7.76	29	2.166
	Total	10.27	111	2.876
Total	SPTES	10.87	54	2.788
	SPTUS	11	54	2.656
	CLPT	10.88	51	2.605
	CG	7.44	54	2.221
	Total	10.04	213	2.973

Table 4. Summary of analysis of covariance for the treatment and gender on students' achievement

Source	Type III sum of squares	Df	Mean square	F	Sig.	Partial Eta squared
Corrected Model	509.220[a]	8	63.652	9.517	.000	.272
Intercept	2161.354	1	2161.354	323.14	.000	.613
Preachivsco	0.125	1	0.125	0.019	.891	.000
Treatment	486.333	3	162.111	24.237	.000	.263
Gender	15.442	1	15.442	2.309	.130	.011
Treatment * Gender	5.948	3	1.983	0.296	.828	.004
Error	1364.48	204	6.689			
Total	23334	213				
Corrected Total	1873.7	212				

a. R Squared = .272 (Adjusted R Squared = .243)

3.3 Discussion

Results in this study revealed that students in the Peer-Assisted Learning strategies outperformed their counterparts in the control group. The difference in the performance was found to be statistically significant. This shows the efficacy of the peer-assisted learning strategies over the traditional approach. The excellent performance in the peer-assisted learning strategies could be attributed to the fact that they give students the opportunity to express their thought processes in such a way that the fellow students will understand. The peer-assisted learning strategies could have created an active and collaborative atmosphere where students freely expressed the views among their peers. From the result of this study, it could be inferred that students' achievement to a large extent depends on the instructional strategy adopted by the teachers. The finding in this study is consistent with that of Ezeugwu who reported that teachers' teaching methods to a greater extent have facilitative effects on student's academic achievement in Biology [16]. Furthermore, the finding is in agreement with Spencer, who reported in a study titled peer tutoring and students with emotional or behavioral disorders, reported that peer tutoring is an effective instructional strategy [17]. More so, the finding in this study concurs with Menesses and Gresham who found that the use of reciprocal peer-tutoring in mathematics instruction was more effective than non-reciprocal peer tutoring, but both methods of tutoring were significantly more effective than no peer-tutoring at all, [12]. This finding also agrees with Philip and Council and Romano and Walker who reported that peer tutoring has an effect on students' performance, [18] & [19]. The finding on this study also supports Lilly and Goergen, who examined academic outcomes for PAL participants in college algebra and pre-calculus in the 2009, 2010, and 2011 academic years, focusing on the variable of PAL session attendance; reported that the PAL participants earned a higher final course grade that was statistically significant ($p < .05$), [20].

4. CONCLUSION

The study investigated the effectiveness of supplemental instruction – peer-assisted learning strategies on students' performance. Findings in this study revealed that the strategies significantly improved students' academic performance. This could have been due to peer interaction. There was no statistically significant difference in the performance of students on the basis of gender. This further confirmed the efficacy of peer-assisted learning strategies on students' performance, irrespective of their gender and the strategies employed. The implication of this is that peer-assisted learning strategies can help to achieve the objectives of the new Universal Basic Education Basic Science curriculum. From the foregoing discussion, it is recommended that education stakeholders particularly teachers, school authorities and educational administrators should ensure that peer-assisted learning strategies are integrated into the teaching-learning process.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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