

EFFECTS OF PEER SQUARE AND COOPERATIVE LEARNING MODES ON SENIOR SECONDARY SCHOOL STUDENTS' PERFORMANCE IN MATHEMATICS

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Abstract

The major concern of this study was to investigate the effects of peer square and cooperative learning modes on students' performance in mathematics at the senior secondary school level. The study in addition examined the influence of gender and achievement levels on students performance in mathematics. Eighty seven (87) Senior Secondary School 3 Students comprising of 48 males and 39 females from two selected public schools in Ejigbo, Osun State, Nigeria constituted the sample of the study. The research was a quasi-experimental one which involved $2 \times 2 \times 3$ factorial design. Three research questions were raised and answered; three null hypotheses were also tested. Hypotheses one and two were tested using t-Test statistics while hypothesis three was tested using analysis of covariance (ANCOVA).

Findings of the study showed that students exposed to peer square and cooperative learning modes performed better than their counterparts exposed to the conventional method only. It also revealed that both male and female students performed equally well when taught using peer square and cooperative learning modes. Also, no significant difference existed among low, medium and high achieving students when taught using peer square and cooperative learning modes. It was recommended that peer square and cooperative learning mode can be adopted to teach different concepts in mathematics because the peer square and cooperative learning modes benefitted all the students exposed to it.

Key words: *Peer Square, Cooperative, Learning, Modes, Mathematics, Performance*

Introduction

The influence of mathematics upon the society, the economy, international politics and so forth has become obvious. Indeed, this era could be most accurately described by its scientific and technological advancement. This is because, Science, Mathematics and Technology (STM) form the bedrock for technological progress, sustained development and further extension of the frontier of knowledge of the developed nations. Advancement in Information Technology (IT) has revolutionized the world into a global unit and the developed nations firmly rooted in STM are the major participants and beneficiaries (Asim, Bassey & Essien, 2005).

Mathematics, apart from being an intellectually stimulating discipline, is also the cornerstone of all fields of studies. Olorundare (1989) opined that Nigeria may lag behind in scientific and technological development if adequate commitment is not made to the teaching of science and mathematics. However, as important as mathematics is, the concern of the public on poor performance of students in the West African Examination Certificate and National Examination Council and other public examinations is alarming (Akinsola, 2002).

Between 2000 and 2005, percentage pass at credit level in West African Senior School Certificate Examinations was not up to 50 percent (WASSCE, Examination and Records Report, 2007). This situation is not likely to promote the goal of developing necessary mathematical background for strong technological breakthrough. Specifically, research effort of the past in an attempt to check the current trends in the achievement of students in mathematics have been linked to mathematical procedures and methods of teaching. Ale (1989) reported that students blamed their poor performance on three broad areas, which are, teaching problems, negative attitudes towards the subject and examination difficulty. The degree of blame on these areas as reported is given as teaching problem / method, 42%; negative attitude, 37%; and examination difficulties, 21%. This agrees with the study of Fajemidagba (1986) who had earlier identified problems of mathematics learning being students' perception of mathematics to be highly theoretical and meaningless to everyday activities and submitted also that mathematics teachers often said that mathematics is useful but failed to show its usefulness. Hence, most students could not see the reason for studying mathematics. Since Mathematics plays a vital role in scientific, industrial, technological and social progress of any nation and is needed in all works of life, it is essential that teachers, educators, parents and general public work together to make students' performance in mathematics better than it is now with special attention on modes of instruction / methods of teaching considering Nigeria's eagerness to advance scientifically and technologically.

The panacea may lie in the use of peer square and cooperative learning modes which aims at enhancing teaching and learning through a structured process of classroom observation, reflection and discussion (leading to a plan for revitalization of teaching-learning process). A square is formed by four students who interact with each other over the topic taught. The interaction are preceded by a teaching and followed by an assignment where learners share their experiences or knowledge (the positive aspects of what they have learned and how they might improve their own learning ability). The total time commitment over a week is half of the total time allotted for the classroom activities. The interaction generate curiosity in the students, imbibe in them right from the start as tentative and re-visionary rather than a bundle of factorial knowledge.

Hence, this study investigated the effects of peer square and cooperative learning modes of teaching on students' performance in mathematics at the senior secondary school level. The study in addition examined the influence of gender and achievement levels on students performance in mathematics.

Research Questions:

1. what is the effects of peer square and cooperative learning modes on students' performance in mathematics?
2. is there a difference in the students' performance on the basis of gender when they are taught using peer square and cooperative learning modes?
3. is there any difference in the students' performance on the basis of their achievement levels when they are taught using peer square and cooperative learning modes?

Hypotheses:

1. there is no significant difference in the mean gain scores of students taught using peer square and cooperative learning modes and those taught using only the conventional method of teaching.
2. there is no significant difference in the mean gain scores of male and female students in mathematics when taught using peer square and cooperative learning modes.
3. there are no significant differences in the mean gain scores of students with high, medium and low achievement levels when they are taught using peer square and cooperative learning modes.

Methodology

This was a quasi-experimental research with $2 \times 2 \times 3$ factorial design. Therefore the pre-test and post-test control group design was considered appropriate for this study. The target population consisted of all students in Senior Secondary School III in

Ejigbo, Osun State offering mathematics. The choice of SSS III was informed by the fact that they had been taught most of the mathematics topics in the syllabus and making them well prepared for the chosen concept (Algebraic Process). Two co-educational public schools were purposively sampled. The two schools were then randomized into experimental (peer square and cooperative learning modes) and control (conventional) groups using simple random sampling technique. It was also ensured that both schools had treated the selected concept previously.

The students were then stratified into the three achievement levels (Low, average and high) using the student's scores in the previous term in mathematics with high (Upper 25%), average (Middle 50%) and low (Lower 25%). One instrument, Mathematics Achievement Test (MAT) was used and classroom activities was based on peer square and cooperative learning modes for the experimental group. These activities were students-centered involving a lot of interaction among students peered. The control group was taught using the conventional method only, that is, instruction was verbalized with minimum interaction among students. The researcher personally taught the experimental group while the regular mathematics teacher taught the control group.

Five periods of 40 minutes each was spent each week throughout the treatment period. The study lasted for six weeks. One (1) week was used for testing the students. Apart from the content validation being ensured by sampling the topics covered in the selected schools, a concurrent validation test was established. That is, the test was administered to an intact class of two non-participating schools. The test items were given to three experienced S.S.S mathematics teachers in three secondary schools in Ilorin. Their comments regarding contents appropriateness, whether the items were too difficult or not, relevant to what the students would come across in public examinations and future applications were considered before final selection of the questions. For reliability purpose, the test was administered to an intact class of a non-participating school comprising 28 students (12 male and 16 female). After 3 weeks, the same test was re-administered to same set of students. Their scores were correlated using Pearson Product moment correlation formula and a coefficient of 0.82 was obtained.

After six weeks of teaching, both the experimental and control groups, were post-tested with the same test items but they were reshuffled so that the test items might not look the same. Statistical package for Social Science version 21.0 was used for data analysis.

Results

Research Question One

What is the effects of peer square and cooperative learning modes on students' performance in mathematics?

Table 1:

Means Gain Scores Of Experimental And Control Groups

Group	Number	Mean	Std
Experimental	48	13.89	2.98
Control	39	9.15	3.52

Table 1 shows that the mean gain score of the experimental group is higher than that of the control group ($13.89 > 9.15$). This implies that students in the experimental group performed better than those in the control group.

Research Question Two

Is there a difference in the students' performance on the basis of gender when they are taught using peer square and cooperative learning modes?

Table 2:

Mean Gain Scores of Male And Female Students In Experimental Groups

Gender	Number	Mean	Std
Male	29	14.14	2.99
Female	19	13.5	3.03

From table 2, it can be deduced that the mean gain score of male students in the experimental group is higher than those of their female counterparts. The mean gain score of male students is slightly higher with 0.64 than that of the female students.

Research Question Three

Is there any difference in the students' performance on the basis of their achievement levels when they are taught using peer square and cooperative learning modes?

Table 3:
Students' Means Gain Scores (Pretest And Posttest Scores) In Experimental Group

Test	Low	Medium	High
Pretest	15.3	12.6	13.8
Posttest	20.1	23.6	30.2
Mean gain	4.8	11.0	16.4

Table 3 shows that the posttest means gain score of the high achieving students was higher than those classified as medium and low achieving students. Hence, it could be said that the peer square and cooperative learning modes in this study benefited the high scorers most.

Hypothesis One:

There is no significant difference in the mean gain scores of students taught using peer square and cooperative learning modes and those taught using only the conventional method of teaching.

Table 4:
t-Test Analysis showing the difference in the Mean Gain Scores Of Students In The Experimental And Control Groups

Variable	No	Mean Score	Std	Df	t-value	Sig.(2-tailed)
Experimental	48	13.896	2.991	85	6.792*	.000
Control	39	9.154	3.521			

*significant at 0.05 alpha level.

Table 4 shows that the calculated t-value = 6.792 with p-value of .000 at 0.05 alpha level of significance. Since the p-value is less than 0.05; Hypothesis one is therefore rejected. This implies that mathematics students taught using peer square and cooperative learning modes performed better than those taught using only the conventional mode.

Hypothesis Two

There is no significant difference in the mean gain scores of male and female students in mathematics when taught using peer square and cooperative learning modes.

Table 5:

t-Test Analysis showing the difference in the mean gain scores of male and female students in the experimental group

Variable	No	Mean Score	Std	df	t-value	Sig.(p-value)
Male	28	14.14	2.99	46	0.689*	2.021
Female	20	13.53	3.03			

*Not significant at 0.05

Table 5 shows that the calculated t-value is less than the p-value ($0.689 < 2.021$) at 0.05 alpha level of significance. Therefore, hypothesis two was not rejected. Even though the mean score of male students was higher than that of the female students, the difference was not significant. Thus, both males and females benefitted when taught using the peer square and cooperative learning modes.

Hypothesis Three:

There are no significant differences in the mean gain scores of students with high, medium and low achievement levels when they are taught using peer square and cooperative learning modes.

Table 6:

Analysis Of Covariance (ANCOVA) Of Low, Medium And High Achieving Students

Source of Variation	Sum of Square	df	Mean square	F	Sig
Covariates (pretest)	13.292	1	13.292	1.461	.233
Main effect (posttest)	7.967	2	3.983	0.438	0.648
Model	20.171	3	6.724	0.739	0.534
Residual	400.308	44	9.098		
Total	420.479	47			

Table 6 indicates that there are no significance differences in the performance of low, medium and high achieving students exposed to peer square and cooperative learning modes of teaching ($F_{calc} = 0.438 < p\text{-value} = 0.648$). The difference is not significant. Hence, the null hypothesis is not rejected at 0.05 level of significance. The peer square and cooperative learning modes favours the high achieving followed by medium achieving. Low achieving students benefitted least from the modes

Summary of findings

The following are the major findings from this study:

1. The group of students taught using peer square and cooperative learning modes performed better than the group of students taught using conventional method only.
2. Though male students performed better than their female counterparts when taught mathematics using the peer square and cooperative learning modes, the difference was not significant.
3. The low, medium and high achieving students in the experimental group gained when taught using the peer square and cooperative modes.

Summary and Recommendations

Findings from the t-Test of the mean gain scores of hypothesis one shows that the experimental group students exposed to peer square and cooperative learning modes performed significantly better than the control group who were only exposed to conventional mode. The findings of this study agrees with those of Martins and Oyebanji's (2000), Bajah and Asim (2002) and Akanmu and Fajemidagba (2013) where they found that demonstration, inquiry and guided-discovery modes of teaching respectively are more effective than the conventional method.

This study also shows that gender does not influence the performance of students when taught using peer square and cooperative learning modes. This agrees with those of Daramola (1983) and Bello (2002). High achieving students benefitted most when taught using peer square and cooperative learning modes in this study. This finding agrees with those of Aiyedun (1995) and Mankilik (2005). This study shows that both males and females could benefit from guided discovery and cooperative learning approach. This study also reveals that high achievers prefer the modes. This implies that if low and medium achievers are in the majority in a class, the method may not be appropriate.

The following recommendations are proffered:

A mathematics teacher should make use of more than one method of teaching; adoption of peer square and cooperative learning modes is high proposed. This is to allow all categories of students to benefit. The Ministries of Education at the Federal and State levels should organize workshops / seminars for mathematics teachers on different methods of teaching. Efforts should be made to encourage both male and female students in the mathematics classrooms since this study shows that males and females could perform equally.

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