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EFFECT OF COLLABORATIVE APPROACH OF LEARNING ON STUDENTS' ACADEMIC PERFORMANCE IN MATHEMATICS IN ANAMBRA STATE

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ABSTRACT

This study is on evaluation of the effect of collaborative approach of learning on students' academic performance in mathematics in Anambra State. The study was carried out in Onitsha Education zone of Anambra State. Four research questions and three null hypotheses tested at .05 level of significance guided the study. The study adopted a quasi-experimental design, in which pre-test and post test were administered to both experimental and control groups. This adoption was because of classroom grouping and rigid time table that made it impossible for the subjects to be randomly assigned to experimental and control groups. Subjects for the collaborative approach are 90 in number, (43 males & 47 females). The total number of subjects for lecture approach is 76 (40 males & 36 females). This brings the sample size to 166, 83 males & 83 females. Simple random sampling technique was used to select two secondary schools each from each stratum (Local Government Area) where this study was carried out. This brought the total number of schools for the study to six schools (three schools for collaborative approach and three schools for conventional approach) An intact class was selected from each school. In each stratum (each of the Local Government Areas- Onitsha North, Onitsha South and Ogbaru) the two selected schools had the selected intact classes assigned to experimental (collaborative approach) and control (conventional) groups respectively. The instruments for data collection were the Mathematics Performance Test (MPT). The Mathematics Performance Test items are forty in number drawn from Senior secondary school two (SSS2) first term Mathematics Scheme in the Senior Secondary Education Curriculum. Application of the Kuder-Richardson's formula K-R20 alpha yielded .76 for the Mathematics Performance Test items. Treatment lasted for six weeks. Pre-test and post-test were administered to both groups. Mean and standard

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deviation were used to answer the research questions while ANCOVA was used to test the hypotheses. Results of the research showed that students in the collaborative approach group achieved more than the conventional approach group. Gender had no significant interaction effect on performance of students based on any learning approach. Based on the findings of this study, recommendations were made. One of the recommendations is that collaborative approach to learning should be adopted as a more effective approach to teaching and learning of Mathematics in secondary schools.

Keywords: collaborative approach, learning, academic performance, Mathematics

Introduction

Mathematics is one of the core subjects that students are expected to have credit to further their studies in institutions of higher learning (Adejumo, Oluwole & Muraina, 2015). This makes Mathematics one of the essential subjects for student advancement. However, Mathematics is one of the subjects that is taken very seriously in the school system, irrespective of country or level of education. It has been described as a model of thinking which encourages learners to observe, reflect and reason logically about a problem and in communicating ideas, making it the central intellectual discipline and a vital tool in science, commerce and technology (Uwadiae, 2014). In the words of Oluwole and Muraina, (2016), Mathematics is compulsory at the secondary school level and a prerequisite for moving from the Junior Secondary School (JSS) to the Senior Secondary School (SSS); just as at the tertiary level of education, a sound background in Mathematics is a necessary condition for the study of all science, technology and social science based courses, as required by the Unified Tertiary and Matriculation Examination Board (UTME), therefore issues of learning and academic performance in mathematics is always a source of concern to educators and society at large.

Academic performance plays an important role in an individual placement, be it in the academic institutions or job placement. Due to this, many people are concerned with the ways they can enhance their academic performance. Academic Performance is defined as a key criterion to judge one's total potentialities and capacities which are frequently measured by the examination results (Micheal, 2016). According to Nwikina and Nwanekezi, (2020), academic performance is the knowledge gained which is assessed by marks by a teacher and/or educational goals set by pupils and teachers to be achieved over a specific period of time. Academic performance is the outcome of education, to the extent at which a student, teacher or institution has achieved their educational goals during and after teaching and learning process (Wang & Ye, 2015).

Effective learning requires the use and application of approaches or methods that can ensure proper assimilation of knowledge by the students for future use. Critically looking at the description of

effective learning, it would be noted that learning is not always the result of simple teaching or mere instruction. Proper learning takes place only when teaching- learning approaches or methods are applied in an environment that is open, participatory and encouraging (Umeh, 2012). A teacher not only ensures active learner participation, but also makes available his guidance to the learners where and when necessary. Based on the teacher's guidance of the learners, the learners begin to acquire problem-solving skills that can guide their core understanding of the subject matter. As observed by Kpolovie, Joe, and Okoto, (2014), effectiveness of a learning approach allows learners to not only get the requisite information but also develop and appreciate different views of looking at concepts, issues or ideas through collaboration.

Collaborative learning covers a broad territory of approaches with wide variability in the amount of in-class or out-of-class time built around group work. Collaborative activities ranged from classroom discussions interspersed with short lectures, through entire class periods, to study on research teams that last a whole term or year (Laal,2013). The goals and processes of collaborative activities also vary widely. Some teachers design small group work around specific sequential steps, or tightly structured tasks. Others prefer a more spontaneous agenda developing out of student interests or questions. In some collaborative learning settings, the students' task is to create a clearly delineated product; in others, the task is not to produce a product, but rather to participate in a process, an exercise of responding to each other's work or engaging in analysis and meaning-making.

Collaborative learning is an umbrella term for a variety of educational approaches involving joint intellectual effort (team work) by students, or students and teachers together. In this approach students work in groups of two or more, mutually searching for understanding, solutions, or meanings, or creating a product (Mitchelemore, & Kimamo 2011). This learning approach is learner centered with less or low teacher domination that is usually seen in the conventional (lecture) way of teaching.

Conventional approach refers to the traditional way of teaching where lecture method is used most of the time. This method of teaching is textbook centered, teacher dominated and, exam-oriented (Ghani, 2012). Conventional teaching or traditional teaching refers to a teaching method involving instructors and the students interacting in a face-to-face manner in the classroom. The emphasis here is mainly in remembering and reproducing facts, principles and theories of learning. Further on teacher-centered approaches in the classroom (Karatas, Alci, & Aydin, 2013), found out from their study that such approaches were inferior to approaches that involve active learning in which students solve problems, answer questions, debate or brainstorm collaboratively during classes.

The concept of collaborative learning is largely rooted in Vygotsky's sociocultural theory which view learning as inherently a social process activated through the zone of proximal development (ZPD) (Mitchelemore, & Kimamo 2011).

Vygotsky's sociocultural views have contributed significantly to social constructivist epistemology and highlight how learning is mediated in accordance with the context and experience with peers. This view illuminates the causal relationship between social interaction and an individual's cognitive development. Learning, from the socio-cultural perspective, is essentially a social term rather than individual in nature, where interaction constitutes the learning process (Paul, 2013). Collaborative learning in the aims at social interaction either among students or between students and a teacher, and essentially assists students in advancing through the Zone of Proximal Development (ZPD), which Vygotsky defined as: "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky 1978; Bukunola & Idowu, 2012).

Researchers like Uchendu, (2015) had shown that there are differences in learning styles, academic performance and social interaction patterns of male and female students. Kpolovie, and Obilor, (2013) reported in his study that gender had no significant effect on achievement. Approaches teaching and learning that will help in ensuring free interaction among boys and girls in classroom for maximal performance are needed. Therefore, it is necessary at this juncture to evaluate the effect of collaborative approach of learning on students' academic performance in Mathematics in Anambra state.

Research Questions

The following research questions guided the study

1. What is the effect of collaborative approach of learning on students' academic performance in Mathematics in Anambra state?
2. What is the effect of conventional approach on male and female students' academic performance in Mathematics in Anambra state?
3. What is the interaction effect of collaborative approach of learning and gender on students' academic performance in Mathematics in Anambra state?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 alpha levels.

1. There is no significant difference in the academic performance of Mathematics student's exposed to collaborative approach of learning and those exposed to conventional approaches.
2. There is no significant interaction effect of collaborative approach of learning and gender on Mathematics students' academic performance in secondary schools.

Method

The study adopted a quasi-experimental design, in which pre-test and post test will be administered to both experimental and control groups. The study was carried out in Anambra State. Anambra state. The population of the study comprise of all the year two senior secondary school (SSS2) students in the 262 public secondary schools in Anambra state. The sample of the study comprised of 166 senior secondary school students (SSII) drawn from the population of the study. Stratified sampling technique will be used to select subjects for this study. Simple random sampling technique will be used in selecting Onitsha Education zone from the six education zones in Anambra state and selection of two secondary schools each from each Local Government Area where this study was carried out. This will bring the total number of schools for the study to six schools. An intact class will be randomly selected from each school. In each Local Government Areas- Onitsha North, Onitsha South and Ogbaru) the two selected schools will have the selected intact classes randomly assigned to experimental (collaborative approach) and control (conventional) groups respectively. Consequently, six intact classes were used for this study. The instrument for data collection is the Mathematics Performance Test (MPT). The Mathematics Performance Test items are 40 in number drawn from Senior secondary school two (SSS2) first term Mathematics Scheme in the Senior Secondary Education Curriculum. The instrument was face and content validated by three experts from department of Educational Foundations, Nnamdi Azikiwe University, Awka. The subjects for reliability are 35 students drawn from a senior secondary school in Awka South Local Government Area in Awka Education Zone of Anambra State. The instruments for this reliability include the academic performance test items. Application of the Kuder-Richardson's formula K-R20 yielded .76 for the Mathematics Performance Test items. Some attempts are to be made to control extraneous variables such as non-randomization effect, experimenter bias, and Hawthorne effect. Non-randomization effect; given the fact that it is not possible to assign subjects to experimental and control groups, it become necessary to ensure similarity among the groups in terms of gender, background and organization. experimenter bias; the researcher minimized differences by ensuring that the objectives for each topic covered are the same for the groups. The only difference is that groups A are taught using collaboration approach while groups B are taught using lecture approach. These groups (collaborative and control) were taught by their class teachers in charge of Mathematics. The numbers of periods are the same for all the groups. Hawthorne effect; to minimize this, each group will be taught by their class teacher for Mathematics. The teaching will be during the normal school periods for Mathematics as obtained in each school time-table. Every activity will be done as part of normal class activity. The data collected for this study was analyzed thus: The research

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questions were answered using means and standard deviations, whereas the Analysis of Covariance (ANCOVA) was used to test the hypotheses at .05 level of significance. SPSS version 23.0 was used to analyze the data.

Research question 1: What is the effect of collaborative approach of learning on students' academic performance in Mathematics in Anambra state?

Table 1: Mean score of academic performance in Mathematics students exposed to collaborative approach.

Learning Approach	Pre-test	Post-test	Gain in Mean	Decision
Collaborative	68.33	86.01	17.68	Effective
Conventional	34.44	45.46	11.02	Effective

Data presented in Table 1 showed the results on the effect of conventional approaches on the mean academic performance in Mathematics students in secondary schools using their pre-test and post test scores. Form the result presented, the post-test for collaborative has a mean performance score of 86.01 while the pre-test has a mean performance score of 68.33. There is gain of 17.68 (86.01-68.33) in the mean performance score. For conventional approach the post-test has a mean performance score of 45.46 while the pre-test has a mean performance score of 34.44. There is gain of 11.02 in the mean performance score which was lesser than that of the collaborative approach of 17.68. This indicates that collaborative approach was more effective in enhancing students' performance in Mathematics.

Research Question 2: What is the effect of conventional approach on male and female students' academic performance in Mathematics in Anambra state?

Data relating to this research question is presented in Table 2.

Table 2: Mean academic performance scores of male and female Mathematics students exposed to conventional approach.

Gender	Pre-test	Post-test	Gain in Mean	Decision
Male	51.69	71.43	19.74	Effective
Female	53.93	72.61	18.68	

Data presented in Table 5 showed that the results on the effect of conventional approach on the mean academic performance of male and female Mathematics students in secondary schools using their pre-test and post test scores. Form the result presented, the gain in mean for male (19.74) is slightly greater than the gain in mean for female

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(18.68). This implies that the conventional approach is slightly effective for male than for female Mathematics students.

Research Question 3: is the interaction effect of collaborative approach of learning and gender on students' academic performance in Mathematics in Anambra state.

Data relating to this research question is presented in Table 4.

Table 3: Mean academic performance scores on the interaction effect of collaborative learning approach and gender on Mathematics student's academic performance scores

Sources of Variance	Pre-test	Post-test	Gain in Mean	Decision
Learning Approach	23.01	51.43	28.42	Ineffective
Gender	73.63	12.61	61.02	

Data presented in Table 6 shows the pre-test and post test scores on the interaction effect of collaborative learning approach and gender on Mathematics students' academic performance in secondary schools. From the analysis carried out, the gain in mean for learning approach is (28,42), while the gain in mean for gender is (61.02). However, the pre-test scores for gender tends to be higher than the post test scores, this indicates that there is no interaction effect of collaborative learning approach and gender on Mathematics students' academic performance.

Hypotheses 1: There is no significant difference in the academic performance of Mathematics student's exposed to collaborative approach of learning and those exposed to conventional approaches.

Table 4: ANCOVA summary table on the mean academic performance scores of Mathematics student's exposed to collaborative and conventional approaches

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	47323.152[a]	2	23661.576	394.141	.000
Intercept	6128.363	1	6128.363	102.083	.000
Post performance	9.363	1	9.363	.156	.693
learning approach	10983.569	1	10983.569	182.958	.000
Error	9785.427	163	60.033		
Total	520228.000	166			
Corrected Total	57108.578	165			

a. R Squared = .829 (Adjusted R Squared = .827)

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Data presented in Table 7 showed that the p-value (0.000) is less than the .05 alpha value. Based on this, the null hypothesis was rejected at .05 alpha level of significance, and a degree of freedom 1 and 163. This implies that there is a significant difference in the mean academic performance scores of Mathematics student's exposed to collaborative approach and those exposed to conventional approach.

Hypothesis 2: There is no significant interaction effect of collaborative approach and gender on Mathematics students' mean academic performance in secondary schools.

Data relating to hypotheses 4 is presented in Table 8.

Table 5: ANCOVA summary table on the interaction effect of Collaborative learning approach and gender on Mathematics student's mean academic performance scores

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	47353.006[a]	4	11838.252	195.371	.000
Intercept	6120.593	1	6120.593	101.011	.000
Post_performance	9.004	1	9.004	.149	.700
learning_approach	10934.825	1	10934.825	180.462	.000
Gender	17.466	1	17.466	.288	.592
learning_approach * gender	14.907	1	14.907	.246	.621
Error	9755.572	161	60.594		
Total	520228.000	166			
Corrected Total	57108.578	165			

a. R Squared = .829 (Adjusted R Squared = .825)

Data presented in Table 10 revealed that the p-value (0.621) is greater than .05 alpha value. Based on this, the null hypothesis was not rejected at .05 alpha level of significance, and a degree of freedom 1 and 161. This implies that there is no significant interaction effect of collaborative approach of learning approach and gender on Mathematics students' means academic performance scores.

Summary of Findings

Based on the results, the following findings emerged;

1. Collaborative approach is more effective on the mean academic performance scores of Mathematics students using their mean scores.
2. The conventional approach is slightly effective for male than for female Mathematics students using their mean scores.
3. There is no interaction effect of collaborative approach of learning and gender on Mathematics students' academic performance.
4. There is a significant difference in the mean academic performance scores of Mathematics students exposed to

collaborative and those exposed to conventional approaches.

5. There is no significant interaction effect of collaborative learning approach and gender on Mathematics students' mean academic performance scores.

Discussion of findings and Conclusion

This study sought to investigate the effect of collaborative approach of learning on students' academic performance in Mathematics in secondary schools in Anambra state. The results revealed that there is a significant difference in the mean academic performance scores of Mathematics student's exposed to collaborative and those exposed to conventional approaches. This then implies that collaborative approach was more effective in enhancing students' performance in Mathematics. This suggests that the use of collaborative approach enhances the performance of students in Mathematics. This finding is in consonance with Bukunola and Idowu (2012) who revealed that students exposed to collaborative learning tend to have higher academic test scores, as well as greater comprehension of the content and skills they are studying

This study also sought to find out the effect of collaborative approach of learning on male and female students' academic performance in Mathematics in secondary schools in Anambra state. Form the results revealed, the gain in mean for male is greater than the gain in mean for female for both collaborative and conventional approaches on gender. This implies that collaborative and conventional approaches are more effective for male than female. These findings are in consonance with Edgar, (2017) and Odagboyi, (2015), who asserted that men achieve more than females and that – not even the most dedicated feminist can deny this fact.

Another objective of this study was to find out the interaction effect of collaborative approach of learning and gender on students' academic performance in Mathematics in secondary schools in Anambra state. The result revealed that there is no significant interaction effect of collaborative learning approach and gender on Mathematics students' academic performance. This indicates that when collaborative learning approach and gender are considered together, it does not affect the students' academic performance. Hypothesis testing of research hypothesis showed that interaction effect of gender by group is not significant. The finding converged the finding of Telima and Doris (2016) on the effect of gender and collaborative learning approach on students' conceptual understanding of electromagnetic induction in Secondary Schools in Nigeria.

That collaborative approach is very effective in the teaching of Mathematics at the senior secondary school level. It enhanced students' academic performance and immerses students in challenging tasks. Rather than beginning ideas and then moving to applications, collaborative learning activities frequently begin with problems, for which students must marshal pertinent facts or ideas and then move to applications. The results of the study also led to the

conclusion that collaborative approach was more effective in enhancing students' performance in Mathematics. Despite the fact that there was mean indication that the female students achieved higher than the male students in the Mathematics using collaborative approach as an instructional approach, the ANCOVA revealed that the effectiveness of collaborative approach in enhancing mean performance scores of male and female students in Mathematics. The result also revealed that there is no significant interaction effect of collaborative learning approach and gender on Mathematics students' academic performance. This indicates that when collaborative learning approach and gender are considered together, it does not affect the students' academic performance. Finally, one can conclude that collaborative approach is a viable approach, in Mathematics lessons and as such teachers should use collaborative approach to boost learning in schools.

Recommendations

Based on the findings of this study and their implications the following recommendations are made:

1. Collaborative approach of learning should be adopted as one of the common modes of teaching and learning in secondary schools.
2. Since appropriate theories of learning within the Nigerian context is hinged on integration of the individuals into sound and effective citizens, who think for themselves, respect the views and feelings of others, collaborative approach should be adopted by teachers because it possesses the necessary ingredients for effective citizenship and harmonious co-existence.
3. Gender should not be place as criteria in selection of teaching approaches for lesson delivery since it has no effect in the academic performance of the learners.
4. Ministry of Education and other stake holders in education should help teachers acquire the skills of collaborative and transfer same to learners.

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