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Effect of Class Size on Students Academic Achievement and Retention in Mathematics in Umuahia North Local Government Area Abia State

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Abstract

The study investigated the effects of class size on students' academic achievement and retention in Mathematics in Umuahia North Local Government Area, Abia State. Three research questions and three corresponding hypotheses guided the study. A quasi-experimental, non-randomized pre-test–post-test design was adopted. The population comprised 1,753 Senior Secondary School One (SS1) students, while a sample of 102 students was selected using simple random sampling. Data were collected using the Mathematics Achievement Test (MAT), and the study lasted three weeks. Mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was employed to test the hypotheses. The findings revealed that teaching Mathematics in small classes was significantly more effective than teaching in large classes in improving students' academic achievement and retention. Both male and female students benefited from small-class instruction. Based on these findings, the study recommends that Mathematics teachers adopt smaller class sizes to promote meaningful learning, improve academic performance, and develop positive attitudes towards Mathematics. Furthermore, teacher-training programmes, seminars, workshops, and conferences should emphasize effective teaching strategies for small classes. The government and relevant professional bodies, including the Science Teachers Association of Nigeria (STAN), should promote manageable class sizes. Additionally, the Ministry of Education should establish appropriate student admission limits for schools to facilitate effective Mathematics teaching and learning.

Keywords: Class Size, Mathematics Achievement, Student Retention, Academic Performance, Secondary School Students

Introduction

Mathematics is the study of topics such as quantity (numbers), structure, space, and change. It is the science that studies and explains numbers, quantities, shapes and the relationship between them. It is also the systematic treatment of magnitude, relationships between figures and forms, and the relations between quantities expressed symbolically. Mathematics is very useful in the society, especially in this present science and technology age. A sound science curriculum cannot be spoken of realistically without considering the important role of mathematics [1].

Mathematics is one of the science subject that students offer in Nigeria Secondary Schools FRN, 2013. It can be seen as the study of quantity, structure, space and change [2]. It is the science of structure, order, and relation that has evolved from counting, measuring and describing the shapes of objects [3]. Hom [4] stated that mathematics is the science that deals with the logic of shapes, quantity and measurement. Thus, mathematics is the science of structure, order and relation that has evolved from elementary practices of counting measuring and describing the shapes of objects.

The importance of mathematics cannot be overemphasized. It is the building block for everything in people's lives daily, including mobile devices, architecture (ancient and modern), art, money, engineering and eve sports [4]. Hence, it is one of the subjects of study in the science Education Curriculum, and a core subject in Junior Secondary Nigeria. Mathematics is a very important science subject. It equips learners with the basic knowledge and skills required for further learning a number of professional courses like engineering, medicine, accounting, banking and finance, business administration, marketing and economics among others. In contemporary Nigeria, greater emphasis is placed on science and technological development. As a result, students are encouraged to take up science-related subjects. Today, mathematics pervades literally every field of human endeavor, and plays a fundamental role in educational advancement.

The national policy on Education stipulates that mathematics should be taught to students at primary and secondary school levels. In accordance with the policy, the National Examination Council Stated that the aims and objectives of teaching mathematics in secondary schools are as follows: To generate interest in mathematics and to provide a solid foundation for everyday living, to develop computational skills, to foster the desire and ability to be accurate to a degree relevant to the problem at hand, to develop and practice logical and abstract thinking, to develop the ability to recognize problem and to solve them with mathematical knowledge, to provide necessary mathematical background further education and to stimulate and encourage creativity. These aims and objectives can only be achieved if teaching as well as learning of mathematics are made effective in Nigeria Secondary Schools.

One of the biggest indices that determines quality of secondary school education in the world is students' academic achievement/outputs. The prevalence of failing rate, especially in mathematic performance is becoming too alarming. Various factors such as allocation of more funds to the sector, periodic supervision of teachers have been put in place, yet the system shows no improvement. Also the increasing numbers of students per class size in Nigeria is becoming worrisome. In context, class size refers to the number of students a teacher faces during a given period of instruction. Class size according to Yara and Otieno [5], means the number of students in a given course or classroom, specifically either the number of students being taught by individual teachers in a course or classroom or the average number of students being taught by teachers in a school, district, or education system.

In education system increasing class sizes is a sacrifice many schools have to make in order to keep their doors open in an era where schools are underfunded. A combination of an increasing population and a decrease in funding has caused class sizes to soar higher [6]. Teacher's effectiveness is the ability for a teacher to produce gain on student achievement scores, taking account of a base line measure of students' prior attainment and other characteristics of students intake, the teacher effect is identified in relation to students' progress measured by later attainment.

Furthermore, overcrowded classrooms makes learning uneasy and uninteresting to the students. Since teaching and learning become less effective, uninteresting and uneasy for both teachers and students in overcrowded classrooms, effective teaching and learning of mathematics and the academic performance of students become issues of concern. Therefore, in order to attain effect teaching and learning and improve the academic performance of the students in senior secondary schools, there is a need for effective teaching and learning within a control populated class.

Furthermore, effective teaching and learning of mathematics seem to be the function of the teacher understanding the individual differences of each of the students as this forms the basis for the appropriate teaching skill to be applied. However, understanding individual differences for effective teaching may require having a standard class size. Celik and Koc [7], properly states in this regard that the essence of having a manageable class size is to ensure that the understanding rate of the students, their respective general background is put into consideration by the teacher in the course of his or her teaching. It can be further said that "a class is standard in a situation where the number of students in a class is neither too much nor too small," hence, class size and adequate teaching aids have a long way to go in determining teacher's productivity, student learning input, as well as the student performance.

In clear terms, effectiveness of teaching and learning, among other factors, depend on class size, which invariably have effects on the academic performances of the students.

Learning is not independent of some factors, noticeable among them is the issue of class size which has become one of the major concerns of educational planners today. As a pointer to the essentiality of class size in ensuring effective teaching and learning, and having excellent students' academic performance, the National Policy on Education stipulates that the maximum teacher -student ratio is one teacher to forty students. Despite the stipulation of the National Policy on Education on teacher-student ratio, and the fact that class size among some other factors has a lot to do with effective teaching and learning as well as the students' academic performance in senior secondary schools, The population of students in the classroom have continued to be on a high number.

Retention is defined as a preservation factor of the mind. The mind acquires the materials of knowledge through sensation and perception. These acquired materials in the mind needs to be preserved inform of images for knowledge. To develop whenever a stimulation situation occurs retained image are revived or produced to make memorization possible not all academic achievement is accompanied by good retention but the best is that which is accompanied by retention. Although the teacher in most times are the initiator of knowledge, the students are not supposed to be passive recipients of knowledge. Students should participate actively in the teaching/learning processes as the activities the students embarked on in the teaching/learning process can enable the student in retention. When student become active in the teaching-learning encounter, greater academic achievement is bound to take place and hence, greater retention.

The ever-growing world population and the craze for education means that classes will continue to grow. A common feature in institutions of learning is the large number of students taught by a single teacher. With such a high teacher-student ratio, the teacher has no option but to adopt self-help measures, which are in no way ideal or adequate for appropriate learning. A critical issue that becomes a focus in the recent development is the issue of the ability of the regular classroom lessons to meet the learning requirements of the students in mathematics subject. It is now thought that organizing the classroom lessons with a small number of students may help in guiding them towards better performance.

Despite the emphasis placed on effective teaching and learning, most students still find it difficult to cope with the study of mathematics in school, and this leads to high failure rate in both internal and external examinations in mathematics [8-11], and this may have resulted from class size. Proper implementation of any curriculum is essentially a function of effective class size. Therefore, this study focuses on effect of class size on students' academic achievement and retention in mathematics among junior secondary students in Umuahia North Local Government Area of Abia State.The purpose of this study is to find out

the effect of class size on academic achievement of students and retention in mathematics among secondary schools in Umuahia North Local Government Area of Abia State.

Materials and Methods

Research method

This chapter describes the procedure that was used in carrying out this study. It describes the design of the study, area of the study, population for the study, sample and sampling technique, instrument for data collection, validity of the instrument, reliability of the instrument, method of data collection, and method of data analysis.

Design of the Study

The quasi-experimental research design was used for the study. According to Dinardo [12], quasi-experiment is an empirical study used to estimate the causal impact of an intervention on its target population without random assignment. It is an experiment that has treatment, outcome measures and experimental units but do not use random assignment to create the comparisons from which the treatment-caused change is inferred [13, 14].

A quasi-experiment is designed around an intervention. Typically, the main study goals are to estimate the size of the intervention effect on some outcome and to test whether it differs significantly from no effect where it is not possible to randomly assign the subjects to experimental and control groups. The design was considered appropriate because the researcher will use intact class as experimental and control group respectively. The design is illustrated as below:

Design of the experiment:

Group	Pre-test	Treatment	Post-test
A	O1	X1	O2
B	O1	-X	O2

Where:

A - Experimental group taught with cooperative learning strategy

B - Control group taught with conventional instructional strategy

O1 - Pre-test administered to all the groups

O2 - Post-test administered to all the groups

X1 - Treatment administered to group A

-X - Control Treatment.

Area of the Study

The area of the study was Umuahia North Local Government Area of Abia State. Umuahia North Local Government Area is one of the seventeen local government areas in Abia State. It is bounded to the North by Umuahia South Local Government Area, to the East by Ikwuano Local Government Area, to the South by Isiala Ngwa North Local Government Area and to the West by Bende Local Government Area. The occupation of the people of Umuahia North Local Government Area is farming; although, there are few public servants.

The choice of the local government area was based on the fact that the performance of senoir secondary school students in Mathematics has not been impressive [15]. The author stated that most senoir secondary school students find it difficult to cope with the study of Mathematics in secondary schools in Abia State, and this leads to high failure rate in both internal and external examinations in Mathematics.

Population for Study

The population for the study was 1753 consisting of 26 Mathematics teachers and 1727 SS1 students studying Mathematics in public secondary schools in Umuahia North Local Government Area. There are sixteen (14) public secondary schools in the local government area.

Sample and Sampling Technique

Purposive sampling procedure was used to select the two public secondary schools in the area of study. Purposive sampling technique was used because the researcher's discretion is needed to select the schools that are approximate for the study. The criteria for the selection are based on co-educational schools, availability of experienced Mathematics teachers with years of teaching, laboratory facilities in each school and the number of students. The researcher was considering the issue of gender and that is why coeducational secondary schools where boys and girls study together under the same learning environment was used. Once the school is selected, intact class was used. On the whole, there was 2 intact classes, one of the intact class was taught Mathematics in a small class (experimental group) while the other was taught Mathematics in a large class (control group).

Instrument for Data Collection

The instrument that was used for data collection is Mathematics Achievement Test (MAT). Mathematics Achievement Test (MAT) covers test items in the topic-Linear equation.

The topic gave twenty (20) multiple choice Mathematics achievement test items. The items were based on the behavioral objectives that were achieved by the end of the lessons, and were also developed from JSSCE and NECO examinations that were related to the topics that were treated. The 20 multiple choice questions have 4 options (A-D) and each correctly answered questions was awarded two and half marks. Incorrect answers shall attract no marks.

Validity of the Instrument

The validity of the instrument was established by giving the draft of the instrument to three experts - two experts in Mathematics Education and one measurement and Evaluation expert in Department of Education, Michael Okpara University of Agriculture, Umudike. The purpose of the study and research questions were accompanied the instrument was given to the experts. The experts shall be requested to critically examine the specific sections and items of the instrument and establish if the items are capable of achieving the objectives of the study. They were requested to determine the suitability, clarity, coverage, representativeness, appropriateness of the language and the ability of the instrument to elicit the desired information. The matching of the MAT items to the appropriate level of cognitive domain was examined by the validators. The comments and corrections made by the experts was reflected in the final copies of the instrument.

Reliability of the Instrument

To obtain the reliability of the instrument, a pilot study was

conducted. Twenty (20) students from a school, which is outside the area of study was used for the pilot study. Kuder- Richardson (K-Ro) formula was used to determine the reliability coefficient of MAT. The Kuder-Richardson formula (K-R20) was used because responses to the MAT shall entail right or wrong answers, that is, they are dichotomously scored.

Method of Data Collection

The Mathematics teachers in the schools to be sampled served as instructors for the students that took part in the study. The teachers was trained on how to administer the instrument, which is Mathematics Achievement Test (MAT). Three Mathematics concept (Linear Equation) was prepared and taught by the Mathematics teachers in the sampled schools (both the treatment and controlled group) for three weeks with the aid of lesson plan. The experimental group was taught in small classroom while the control group was taught in a normal conventional classroom. The instrument for data collection (Mathematics Achievement Test) was administered to the students before the experimental treatments. This served as pre-test. At the end of the study, the instrument was reshuffled and re-administered to the students as post-test. The reshuffling was done to make the students not to realize that they had responded to the items in the instrument previously and this was used to test for retention. Direct delivery and retrieval method was used in administering test instrument to the respondents, and both the treatment and control groups were not made to be aware that they would be involved in the study. The scripts of the students was marked, scored and recorded.

Control of Extraneous Variables

The researcher shall take into considerations the following variables in carrying out the study for effective result: Teacher variable, Hawthorne Effect, subject interaction, instructional situation variable, intergroup variable, testing effect and initial group difference. Teacher Variable: In order to reduce error due to teacher difference, the researcher was the teacher for the two groups. Hawthorne Effect: When the students become aware that they are being used for the study, they tend to adopt behavioural changes that could affect the outcome of the study. This is known as Hawthorne Effect. In order to control this effect, the researcher was introduced to the students as their new Mathematics teacher Subject Interaction: This variable was controlled by using ANCOVA in analysing the items. Testing Effect: This was controlled by reshuffling the position of items of the questions after pre-test before administering it again as the post-test. The researcher shall also ensure that the students' scripts after pre-test was kept under his custody and will not be distributed to the students.

Method of Data Analysis

Data generated from the field was analysed using descriptive and inferential statistical tools. Frequency, mean and standard deviation was used in answering the research questions while null hypothesis was tested using the ANCOVA at 0.05 level of significance.

Results

The results are presented in the manner research questions are raised and hypothesis are posed.

Research Question 1

What are the mean achievement scores of students taught mathematics in the small class and those in the large class?

Table 4.1.1

Variable Methods	N	Pre Test X	Pre Test SD	Post Test X	Post Test SD
Small Class	32	42.44	9.47	74.13	6.73
Large class	70	36.37	12.63	53.83	9.29

Table 4.1.1 shows the mean achievement scores of the small class and large class on student' achievement in mathematics. The results shows that student's taught mathematics in the small class performed higher than those taught in the large class.

Hypothesis 1

There is no significant difference in the mean achievement score of students taught mathematics using the small and those taught with the large class.

Table 4.1.2

Source of variation	Type III sum of square	Df	Mean square	F	Sig	Decision
Corrected model	97.156	2	48.578	1.078	.353	
Intercept	5871.753	1	5871.753	130.349	.000	
Small Pre-test	87.573	1	87.573	1.944	.174	
Large pre-test	50.436	1	50.436	1.120	.299	
Error	1306.344	29	45.046			
Total	177228.000	32				
Corrected total	1403.500	31				
a. R Squared = .069 (Adjusted R Squared = .005)						

Table 4.1.2 shows the F value of 1.078 at $p < 0.05$ level. This implies that there is significant difference in the mean achievement of achievement scores of students in small and large class in mathematics achievement test, thus the null hypothesis which states that there is no significant difference in the mean score of students in small and large class in mathematics achievement test is therefore rejected.

Research Questions 2

What are the mean achievement scores between the male and female students taught mathematics with the small class?

Table 4.1.3

Variables Gender	N	Pre Test X	Pre Test SD	Post Test X	Post Test SD
Male	15	47.93	8.49	78.60	5.67
Female	17	37.59	7.57	70.18	4.93

Table 4.1.3 shows that the mean pre-test and mean post-test, scores of male and female students taught mathematics with the small class. The result shows that female students taught mathematics in the small class performed higher than the male students.

Hypothesis 2

There is no significant difference in the mean achievement scores of male and female students taught mathematics

using the small class?

Table 4.1.4

Source of variation	Type III sum of square	Df	Mean square	F	Sig
Corrected model	8.809	1	8.809	.260	.619
Intercept	577.221	1	577.221	17.024	.001
Post-test female	8.809	1	8.809	.260	.619
Error	440.791	13	33.907		
Total	93119.000	15			
Corrected total	449.600	14			
a. R squared = .020 (Adjusted R squared = -.056)					

Table 4.1.4 shows that the F-ratio is 17.024 with 1 degree of freedom. However, since the alpha level of .001 is less than the p-value of 0.5 (p>0.05) the null hypothesis which states that there is no significant different in the mean achievement scores of male and female students taught mathematics using the small class is rejected. This indicated that there is a significant difference in the mean achievement scores of male and female students taught using the small class.

Research Question 3

What is the mean retention scores of students taught mathematics using the small class?

Table 4.1.5

Variables Method	N	Retention X	Retention SD	Post small X	Post small SD
Small class	32	77.91	10.46	74.13	6.73

Table 4.1.5 shows results of the mean pre-test, mean post-test and standard deviation pre, and standard deviation post scores of scores of student's retention taught mathematics using the small class. The result shows that student perform more in retention test more than the post small test.

Hypothesis 3

There is no significant different in the mean retention scores of students taught mathematics using the small class?

Table 4.1.6

Source of variation	Type III sum of square	Df	Mean square	F	Sig	Decision
Corrected model	20.080	1	20.080	.393	.015	
Intercept	1422.224	1	1422.224	27.825	.000	Reject H0
Smallpost	20.080	1	20.080	.393	.000	
Error	1533.389	30	1533.389			
Total	226171.000	32	226171.000			
Corrected total	1553.469	31				
a. R Squared = 013 (Adjusted R Squared = -.020)						

Table 4.1.6 shows that the F-ratio is 27.825 with degree of freedom. However, since the alpha level of .000 is less than the p-value of .05 (p>0.05). the null hypothesis which states that there is no significant difference in the mean retention scores of the students taught mathematics using the small class method is rejected. This indicates that there is a significant difference in the mean retention scores of student taught mathematics using the small class.

Discussions

The result from Table 4.1.1 indicates that the students taught mathematics using the small class performed higher than those taught using the large class. This was further confirmed by the result in able 4.1.2 which indicates that there is a significant difference between the mean achievement scores of students taught using the small class and those taught using the large class in favour of those taught using the small class. The findings of this study is in affirmation with the study conducted by (Zakasa, 2011) on effect of class size on academic achievement at a selected institution of higher training in class size had higher achievement implies that small or normal classes had significant effect on students' academic achievement in mathematic.

The results from Table 4.1.3 indicates that the male students performed higher than the female students taught using the small class. This was further confirmed by the result in Table 4.1.4 which indicates that there is a significant difference between the mean achievement scores of male students taught mathematics using the small class and those female students taught using the small class in favour of male students taught using the small class. The findings of this study is collaboration with Okereke (2011) who conducts a study on influence of gender on students" achievement in mathematics in Owerri Educational zone, the result of the study revealed that gender of student had significant effect on students' academic achievement in mathematics.

The result from Table 4.1.5 indicates that the mean retention test scores is better than the small class post-test scores of students taught mathematics using the small class. This was further confirmed by the result in Table 4.1.6 which indicates that there is a significant difference between the small post-test and the retention test. The findings of this study is upheld by Alazi he discovered that male students had higher retention of teaching and learning encounters in mathematics than their female counter parts. Hence a mean difference in retention scores of student based in gender does exist.

Conclusion

The result of this investigation has revealed the effect of class size on senior secondary school student' achievement in Umuahia North Local Government Area, Abia State. The study had revealed that the use of small class is more efficacious in student retention and it is more efficacious both to male and female students alike and also effective for the development of higher order thinking skill in the students in senior secondary school one (SS1).

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