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Experimenting the Effect of Class Size on Mathematics Based Performance: A Case Study of Selected Public Secondary School in Akure, Nigeria

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Abstract

Background: The spate of overcrowding numbers of students in public secondary schools in Nigeria is significantly on the increase and there has been paucity of literatures that had examined the effect of class size in the enhancement of students' academic performance, especially on mathematics. Mathematics is one of the compulsory subjects to be offered by every students in secondary schools across the nation. Therefore, this study examined the effects of class size on mathematics based performance in Akure, Ondo State-Nigeria.

Method: Quasi experimental research design was adopted in the study. Cluster random sampling technique was adopted to engage one hundred and fifteen (115) public secondary school students. The study participants were randomly assigned from the cluster of IQ categories and affiliated departments into three groups, under-crowded, standard and over-crowded class before exposure to intervention. Three research questions hypotheses were formulated to guide the study.

Results: Finding revealed that class size had significant effects on students' mathematics based performance, holding constant, the influence of affiliated departments ($F(3, 111) = 197.79$, $p < .001$; $\eta_p^2 = .842$). The phi eta coefficient revealed that 84.2% of the variance observed in students' performance in mathematics was strictly accounted for by the size of class. The post-hoc result presented in the table above shows that with a total mean of 58.03, the class size with under-crowded (n=15) reported better performance in mathematics when compared to performances of students in standard class size with a total adjusted mean of 48.66, and students in over-crowded class size with a total adjusted mean of 24.14.

Conclusion: From the results of this findings, it was concluded that the number of students in a class had strong implication on mathematics learning and performances. Based on the findings, this study therefore recommends that government and concern authorities should ensure less or standard class size in public secondary schools to further enhance students' performances, especially in mathematics.

Key words: Class size; Learning; Students Academic performance; Standard class; Overcrowded class

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INTRODUCTION

One of the biggest indices that determines quality of secondary school education in the world is students' academic 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 inspection of teachers have been put in place, yet the system shows no improvement. Also the increasing numbers of students per class is 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 (2010), 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.

Mathematics was considered in the study, because it remain one of the challenging subject to students in Nigeria (Agberotimi, Olaseni & Oladele, 2015). The prevalence of math anxiety appears to be high. For instance, Jones (2001) found that 25.9% of over 9,000 American students had a moderate to high need of help with maths anxiety. Investigating the prevalence of math anxiety among college students in Wichita state university, Zettle and Raines (2000) also found that majority of students who enrolled in college algebra and courses preparatory to it rated themselves to be math anxious (Zettle & Raines, 2000). Math anxiety has been reported more among the female gender than the male.

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 (Yelkpieri, 2009). Teaching and learning in an overcrowded classroom can be frustrating, overwhelming and stressful. An overcrowded classroom presents challenges that can feel nearly impossible to overcome, even to the most effective teachers; the challenges restrain teachers' effectiveness and make teachers less productive in dishing out what they have for the students. Conversely, students in overcrowded classrooms faces similar challenges; making 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, sound education and the academic performance of students become issues to consider.

Therefore, in order to put sound education on ground 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. Effective teaching and learning has a direct effect on the academic performances of the students, and can be categorized under the implementation stage in curriculum planning (Shah & Inamullah, 2012). Effective teaching and learning play a significant role under the implementation stage (in curriculum planning) in order to achieve the educational goals which includes improvement in the quality of education and the students' academic performance.

Furthermore, effective teaching and learning 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, (2015), 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. We can further say 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 NPE (2004).

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 study therefore focuses on the effects of class size on students' mathematics based performance in senior secondary schools in Akure, Ondo State.

RESEARCH HYPOTHESES

i. Class size will have no significant effect on students' mathematics based performances.

ii. There will be no significant different the mathematics based performances of students in under-crowded class, standard class and over-crowded class in the study.

iii. Students in under-crowded and standard class size will not significantly report better mathematics based performance after intervention than before intervention

METHODS

Study Design

The study adopted the quasi experimental design involving one way with three groups. Participants in group 1, group 2 and group 3 are subjects in the under-crowed class, standard class and over-crowded class respectively.

Setting

The study was conducted in a public secondary school, Akure, Ondo State Nigeria. Akure is the capital city of Ondo State that is located in the south west of Nigeria. The city had a population of 484,798 as at the 2006 population census. Akure lies about 7°25' north of the equator and 5°19' east of the Meridian. The town is situated in the tropic rainforest zone in Nigeria.

Participants

One hundred and fifteen public secondary school students were screened based on average and above average

general academic performance on three consecutive sessions and departments of affiliation (sciences, arts, and commercial). To ensure homogeneous characteristics across group, participants were randomly assigned into the study groups based on the stratum of brilliancy and departments of affiliation. Fifteen (n=15) students were assigned to under-crowded class, forty (n=40) students were assigned into standard class, while sixty (n=60) students were assigned into over-crowded class. Participants' ages ranged between 13 and 18 years with mean 14.87 and standard deviation 01.09.

Instrument

A structured question booklet format was used to collect data in the present study. The questionnaire is made up of two sections. Section obtained information on demographic data of the participants. Section two entails mathematics based questions and answer space to measure students' level of assimilation and performance after exposure to intervention (mathematics class on subject not previously exposed to).

Study Procedure

The study experiment was done in three phases which include (a) pre-test, during which students were assessed on knowledge of mathematics topic to be taught and informed the baseline basis for the study, (b) intervention, during which students were well taught the maths topic proposed, and (c) post-test, the final phase at which students were re-assessed on level of assimilation of the intervention. An approval and consent was sorted from the school principal, while no student was coerced into participation in the study, they all voluntarily participated. The researchers and other two trained research assistants participated for proper coordination of the research subject and ensure adherence to the proposed research methods. Confidentiality in respondents' performance was assured by the researcher.

Statistical Analysis

The data collected were analyzed using inferential statistics. Hypothesis one was tested using One-Way Analysis of Covariance (ANCOVA). Hypothesis two on the other way, was tested using the post hoc analysis of the ANCOVA. While, hypothesis three was tested using t-test of dependent sample.

RESULTS

Hypothesis 1

The study hypothesis one which stated that class size will have no significant effect on students' mathematics based performance, was tested using One-Way Analysis of Covariance (ANCOVA) as presented in the Table 1.

Table 1
showing the summary of ANCOVA revealing the effect of class sizes on students mathematics based assimilation and performances

Source	SS	df	MS	F	p	η_p^2
Affiliated Department	135300.17	01	135300.167	180.747	< .001	.942
Class Sizes	44582.78	03	14860.928	197.788	< .001	.842
Error	8340.05	111	75.136			
Total	188223.00	115				

Result from the table above showed that students affiliated departments (i.e. Science, Arts, and Commercial, co-founding variable) plays significant role in determining students' level of performance in mathematics ($F(1, 111) = 180.75$, $p < .001$; $\eta_p^2 = .942$). Furthermore, it was revealed that class sizes had significant effects on students' mathematics based performance, holding constant, the influence of affiliated departments ($F(3, 111) = 197.79$, $p < .001$; $\eta_p^2 = .842$). The phi eta coefficient revealed that 84.2% of the variance observed in students' mathematics performance was strictly accounted for by the size of the class. This finding was not in support with the stated null hypothesis, therefore, the alternate hypothesis one is accepted, while null hypothesis is rejected.

Hypothesis 2

The study hypothesis two which stated that there will be no significant different the mathematics based performances of students assigned to under-crowded class, standard class and over-crowded class in the study was reflected the post hoc analysis in Table 2.

Table 2
Showing the summary of scheffe analysis of the efficacy of class sizes on students' mathematics based Performance

Groups	N	$\overline{X}$	SD	1	2	3
Under-crowded Class	15	58.03	02.26	1		
Standard Class	40	48.66	01.37	09.37	1	
Over-crowded Class	60	24.14	01.12	33.89*	22.52*	1

Note: ** $p < .05$.

In order to ascertain the magnitude significant determinant of F Value, a multiple group comparison test was conducted. Consequently, scheffe post hoc test was used to compare the three groups since unequal number of participants represented the groups. The results are shown in the table below.

The post-hoc result presented in the table above shows that there was no significant difference in the

performances of students in under-crowded class and standard class (MD = 09.37; $p > 0.05$). Further, there was significant difference in the performances of students in the over-crowded class and standard class (MD = 22.52; $p < 0.05$) and under-crowded class size (MD = 33.89; $p < 0.05$). However, with a total adjusted mean of 58.03 and adjusted mean of 48.66, the class size with under-crowded and standard class reported significant better performance in mathematics when compared to performances of students in over-crowded class with a total adjusted mean of 24.14.

Hypothesis 3

Study hypothesis three which proposed that participants in under-crowded and standard class size will not significantly report better mathematics based performance after intervention than before intervention was tested using t-test of repeated measures.

Table 3
Showing the significant difference of the Pre and Post-test scores of students in the Experimental Group

Intervention	N	$\overline{X}$	SD	df	T	p
Pre-Test Score	55	33.35	02.15			
Maths Performance				54	115.29	< .001
Post-Test Score	55	51.06	12.79			

The table above presented the result showing the significant difference in students' maths based performance before and after intervention ($t(54) = 115.29$; $p < .001$). It was found that there was a significant increase in the participants' scores in math assessments from pretest score ($\overline{X} = 33.35$, SD = 02.15) to posttest score ($\overline{X} = 51.06$, SD = 12.79). This outcome was not in support with the stated null hypothesis three, therefore, alternate hypothesis is accepted, while the null hypothesis is rejected.

DISCUSSION

The purpose of this study was to examine the effects of class size on students' mathematics based performances in public secondary schools in Akure, Ondo State-Nigeria. The findings showed that class size had strong impact on student' performances in mathematics. Further findings revealed that students in under-crowded class and standard class had better mathematics based performances when compared to the students in over-crowded class. Therefore, overcrowded class size has negative effects on students' academic performance. This finding is in agreement with the position of the National Policy on Education which stipulates that the maximum teacher per student ratio is one teacher to forty students i.e. 1:40 (NPE, 2004).

The study further revealed that there was significant improvement in students' mathematics based knowledge after the intervention than before intervention among those in experimental group (i.e. under-crowded and standard class). This serves as a pointer to the essentiality of class size in ensuring effective teaching and learning, and having excellent students' academic performance (NPE, 2004).

CONCLUSION

Based on the findings of this study, it is clear students in overcrowded class face some unavoidable challenges which invariably causes problems for teaching and learning process. Hence, negatively affect effective teaching and learning. It is therefore concluded that class size had significant effect in students' mathematics based performance.

LIMITATION OF THE STUDY AND RECOMMENDATIONS

The study did not involve larger numbers of public schools to ascertain the generalizability of the study findings and concept. It is also possible that outcomes would vary if measured over a thousand or more participants. Therefore, outcomes should be interpreted with caution. In view of the findings of this study, the following recommendations were made:

- Class size reduction approach should be adopted by schools where students are more than forty (40) in a class to enhance better academic performances in students, especially in mathematics.
- Building of more classrooms with provisions of adequate facilities for teaching and learning in schools with increasing population, so as to segment classes of same level.
- Government should give adequate priority attention to the education industry, particularly, the public secondary schools to improve the status quo of public secondary schools.

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