

Effects of Class Size and Gender on Students' Achievement in Mathematics in Ogbomoso South Local Government Area of Oyo State, Nigeria

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ABSTRACT

It has been observed that students' achievement in mathematics still remains low and Class size had been identified as one of the important factors of academic success. A pretest-posttest quazi experimental control group design was employed to determine the effects of class size on the academic achievement of Senior Secondary Schools students using 135 SS II students randomly selected from the three (3) geo-educational zones of Ogbomoso-South Local Government Area of Oyo State. There were two treatment groups and a control group. One treatment group was taught Mathematics using a class size of 25, the other was taught using a class size of 65 and the control group was taught using a class size of 45. Reliably validated objective and essay achievement test ($r=0.86$) was the main instrument in the study. Three research hypotheses were tested ($p<0.05$) using mean, standard deviation and Analysis of Covariance (ANCOVA) and the results showed a significant main effect of treatment on the students' achievement ($F_{(2,128)}=560.35$; $p<0.05$), the class size of 25 treatment group performed significantly better than the other two groups, and male students performed significantly better than the female students ($F_{(1,128)}=111.10$; $p<0.05$). The implications to mathematics teaching were discussed, provision of more conducive classrooms in Nigerian schools, recruitment of commensurate mathematics teachers and a class size of not more than 25 students for teaching of mathematics were recommended.

KEYWORDS: Class size, Achievement in Mathematics, Secondary School Students

INTRODUCTION

All through the history of humankind, and down to our present time, Mathematics has been tremendously useful in many aspects of human activities. Teaching and Learning of Mathematics all over the world, most particularly in the developing countries like Nigeria, has been of great concern to the generality of the people. This is not far from the fact that a number of events in the educational world have made people to realize the indispensable role that the knowledge of Mathematics could play in the life of every individual in the world today. Salawu (2001) maintained that Mathematics is indispensable because it has substantial application in all subjects, more especially in science and Technology and that, the depth of Mathematical knowledge of an individual dictates the post-secondary educational and career options one would take. This is responsible for the status of the subject as a core and compulsory

subject for students of primary and secondary schools in Nigeria. Mathematics is a necessary tool needed to be able to function effectively in the present technological age. Fajemidagba (1991) stated that the teaching of Mathematics is very important to all human existence because Mathematics is all about finding solutions to problems. Olowojaiye, (1998) indicated the role that Mathematics could play in the study of other school subjects. The study of Mathematics is very important in virtually all aspects of human endeavors. In fact none of human endeavors could dissociate itself from Mathematical inclination. In the context of Science Education, Mathematics has been identified as an important school subject whose importance in the scientific and technological development of any nation has been reported in various studies (Adedayo, 2007; Adeniran, 2006; Akinsola and Tella, 2001). Consequently, efforts have continuously been made to improve on its teaching and learning especially at the post basic level so as to ensure a sound foundation for later studies.

Despite these efforts, it has been observed that students' achievement in this subject in Nigeria still remains below average as shown from figure 1 below:

Year (A1- C6)	Total No of Candidates	No with Credit (A1-C6)	%
2006 41.73	1,181,515	482,123	
2007 46.75	1,249,028	583,921	
2008 52.27	1,292,890	726,398	
2009 47.04	1,373,009	634,382	
2010 41.95	1,306,535	548,065	
2011 40.40	1,508,965	608,866	
2012 38.81	1,672,224	649,156	
2013 36.57	1,689,188	617,736	
2014 31.28	1,692,435	529,425	
2015 38.68	1,593,442	616,370	

Figure 1: Students Performance in Mathematics in Nigeria: May/June SSCE (WAEC) 2000-2014 (Source: Statistics Section, West African Examinations Council. (WAEC), National Head Office, Lagos, 2015)

Various studies have recommended chains of instructional strategies of teaching Mathematics in order to solve the problem of low achievement in public examinations (Awofala and Nneji, 2012; Abimbade, 2011; Awolola, 2009; Adesoji and Ifamuyiwa, 2007), yet the problem still persist. However, Akinsola (2002) and Alexa (2013) claimed that, improvement of

students' achievement in mathematics is not only limited to the improvement of instructional strategy, this means that, instructional strategy is only a component of the factors that could influence the teaching and learning of Mathematics. The review of studies carried out to improve students' achievement in Mathematics shows that most of the studies carried out focused largely on the instructional strategies with little attention to other pedagogical factors like class size among others.

Various studies (Adeyegbe, 2005; Bajah, 1999; Okegbile, 1996; Oshokoya, 1998 and Osuafor, 1999) have identified such factors as: class size, school location, teacher exposure, among others as some of the factors that contribute to students' low achievement in mathematics, however, the effects of the class size on students' achievement in mathematics has not been well researched in to in this part of the world.

Mathematics, being the science of logical thinking and systematic reasoning, pupils' and students' education programmes should include a classroom environment that will help to develop Mathematics skills in learners.

Conducive classroom environment for the teaching and learning of mathematics lies largely on the number of students a mathematics teacher has to face at a time; this is referred to as the class size.

A classroom is a place where one or more groups of people usually referred to as pupils or learners gather together for the purpose of acquiring knowledge from the teacher. (Adeyinka, 2006). This acquisition of knowledge is made possible through the help of a teacher following some prescribed curriculum, usually approved by the government or an educational agency so designated or empowered to do so. Classroom may vary, depending on the size of the students, the categories of the student to be taught and the purpose for which instruction is to be given. It is for this reason that teachers are charged with the responsibility of effectively managing the classroom in order to promote academic excellence within their classroom environment.

Although class size is almost always an administrative decision over which teachers have little or no control, (Adedoyin, 2001), most studies start from the postulation that the size of the class would be a significant determinant of the degree of success, with the exception of a few studies that reported that under ideal situations, class size in itself appears not to be an important factor. Muraina and Muraina (2014) reported that, class size is an important factor with respect to academic performance of students. Oguntoye (2011) concluded that class-size had negative coefficient with student's academic performance in examination. Fafunwa (2010) postulated that there is a gap in the quality of students in crowded classrooms, using inadequate and absolute equipment, disillusioned teachers. These combined deficiencies perhaps affected the student's academic performance. Adeyemi (2008) discovered that schools having an average class size of 35 and below obtained better results in the secondary school certificate examination (SSCE) than schools having more than 35 students per class. Yara (2010) found out that the performance of students in large classes was very low (23%) compared to those students in smaller classes (64%). Afolabi (2002) investigating school factors and learner variables as correlates of senior secondary physics achievement in Ibadan found no significant relationship among class size and students' learning outcomes. Asadullah (2005) concluded that reduction in class size in secondary grades is not efficient in a developing country like Bangladesh. Thus the divergent view on the effect of class size on achievement continues. One great problem that comes to mind now is 'what number of students should constitute a large class and what should be number of students in a small one'? Answers to this question vary from time to time, place-to-place, country to country and from one experiment to another. In Nigeria for instance, the revised

National policy on Education (NPE) of 1989, section 3.7 and Blue print of 1978-79, chapter 4, sections 4.3 and 4.4 submitted to the Hon. Federal Commissioner for Education recommended that the highest number of students in a class is officially put at 20 in the pre-primary, 30-40 in the primary, and maximum of 40 in the secondary schools.

In reality, and especially in the densely populated urban area of the country, this is becoming practically impossible due to population explosion and lack of instructional and human resources. Class sizes of between 45 and 120 are common in big towns and cities, and to reduce class size for better academic achievement is fast becoming difficult. From various studies conducted in the so-called advanced countries of the world, the size of the large classes ranged from 30-300 and small classes from 8-30 (Kole, 1991). The number of students that should constitute a 'large' or 'small' class varies greatly. However, it was concluded from early studies that class size should not exceed 30-35 pupils. This standard was discarded with the invention of newer instructional materials, (Tella, 1990). The above explains the fact that 'large classes phenomenon has been recognized for quite a long time, while it has been considered a great problem at one time or the other, there has been difficult in determining what number constitutes a class.

It is obvious that the problem of large class size is a general problem in recent time most especially in Nigeria, hence, mathematics education cannot and will not be an exemption, since mathematics is a compulsory subject both in basic and post basic schools, the problem of large class sizes is highly inevitable. It is now a 'culture' in Nigerian secondary schools to be merging two or more classes together for the purpose of teaching mathematics.

However, classroom organization and management in mathematics education poses greater challenges to all teachers. This is because the teacher ensured that tasks are appropriate for the learners and that the interest and attention of the learners are guaranteed during the process of teaching. Due to the place of mathematics in Nigerian primary and post primary education where every learner has to study mathematics, most of the Nigerian mathematics classrooms are being crowded beyond teacher's control. The purpose of this investigation is to add to the existing knowledge by specifically examining the effect of class size on the teaching and learning of mathematics in public senior secondary schools in Oyo State, Nigeria.

Besides, mixed reports abound from fields of research on gender issues. Some researchers reported a decline in gender differences in science achievement (Afuwape and Oludipe, 2008; Martin, Mullis, Gonzales, Gregory, Smith and Chrostowski, 2004; O'Connor, 2000; Yuwen, 2008). Others found significant main effect of gender on subjects' learning outcomes in science. Aguele and Agwugah (2007); Becker (2006); Kolawole (2007); Olaniyi (2009); Ugwungwu (2002); Ugwungwu (2006); found in their studies that male students achieved significantly better than female students in science subjects while in the studies carried out by Raimi (2002); Soltani and Nasrl (2010); girls performed better than boys in science subjects. Research reports from different dimension, Ajila (2003), Aremu and Sangodoyin (2010), Oduwaiye (2009), Raimi and Adeoye (2002) found no significant gender difference in students' achievement in science. Since there are conflicting reports from various studies, gender as a variable attracted further investigation in this study. Therefore this study determined effect of class size on secondary school students' achievement in mathematics in Ogbomosho South Local Government Area of Oyo State with gender as a moderator variable.

Statement of Problem

In this present study, one great problem that comes to mind is what number of students should constitute a 'large' class and what should be described as a 'small' class in mathematics teaching? Answers to this question vary from country to country. In Nigeria, the national Policy on Education (1977) stipulated maximum of 40 in the secondary schools. Population explosion especially in the urban area has made the directives unrealistic. Class sizes of 55, 60, 70 etc are prevalent in our secondary schools, and to reduce class size for better academic performance is now difficult.

This research work therefore determined the effects of class size and gender on senior secondary school students' achievement in Mathematics in Ogbomoso-South Local Government Area of Oyo State.

Scope of the Study:

This research work analyses the effect(s) of class size and gender on students' performances toward the improvement of teaching and learning processes in mathematics in public senior secondary schools in Ogbomoso South Local Government Area of Oyo State.

Hypotheses: The following null hypotheses were tested at 0.05 level of significance.

Ho₁: There is no significant main effect of treatment on students' achievement in mathematics.

Ho₂: There is no significant main effect of gender on students' achievement in mathematics.

Ho₃: There is no significant interaction effect of treatment and gender on students' achievement in mathematics.

Methodology:

Research Design:

A pretest-posttest, quazi experimental control group design was adopted in this study which involved one hundred and thirty five (135) S.S.2 students which were randomly selected from three (3) Secondary Schools in the three (3) geo-educational zones of Ogbomoso-South Local Government (a school from each zone).

Population, Sample and Sampling Technique:

The study investigated the entire students in the public secondary schools in Oyo state, however, the sample of the study comprised one hundred and thirty five (135) students randomly selected from Senior Secondary Two (S.S. 2) in the three geo-educational zones of Ogbomoso-South Local Government Area of Oyo State. These schools are, The Apostolic Church Grammar School, Baptist High School and Baptist Secondary Grammar School all in Ogbomoso South Local Government Area of Oyo State. In the study, there are two experimental and one control groups. The sampling consists of 135 Students (60 males and 75 females), 25 (10 males and 15 females) of whom are in the experimental group one, while 45 (20 males and 25 females) are in the control and the remaining 65 (30 males and 35 females) are in the experimental group two to form three classrooms of equal environmental dimensions and conditions.

Instrumentation and Method of Data Collection:

Mathematics Teaching Program Based on modified conventional teaching method was developed in the study to teach the concept of quadratic equation for four weeks in each class. A set of thirty (30) multiple choice objective achievement test was developed by the researcher and given to experts in Science and Mathematics Education for review in terms of content, relevance, scope of coverage, language of presentation, clarity of expression and overall adequacy. Based on their comments, some of the items were modified while some were removed; twenty (20)

multiple choice objective items survived the experts' scrutiny. The achievement test was then pilot tested at a school in Ibadan. The reliability coefficient of the instrument was calculated using Kuder Richardson (20) method and the instrument yielded a reliability index of 0.86, which resulted in 20 multiple choice objective items with $r = 0.86$ and this indicates that it is reliable.

The first set of the instrument was presented as a pre-test to these groups in their classes. Their answer scripts were collected for marking and recording after the stipulated time. The students were informed to report at their different classrooms for lessons that lasted for four weeks (a class of 40 minutes every school day). With the help of the prepared lesson plan and well trained research assistants, lessons were delivered to each group accordingly.

The post-test was administered on these students a week after the teachings. Their answer scripts were marked and recorded accordingly. It is believed that whatever finding that comes out of this study can be generalized as implying a reflection of the effect of the class size on teaching and learning of mathematics.

To be able to make meaningful deductions, the data obtained were statistically analyzed using mean, standard deviation and ANCOVA statistics at 0.05 level of significance.

RESULTS

Table 1: Descriptive Statistics

SEX	CLASS SIZE	Mean (\bar{X})	Std. Deviation	N
Male	Experimental Group 1	17.80	1.23	10
	Control Group	13.20	1.20	20
	Experimental Group 2	9.40	1.04	30
	Total	12.07	3.29	60
Female	Experimental Group 1	15.00	.65	15
	Control Group	11.00	.91	25
	Experimental Group 2	9.00	.54	35
	Total	10.87	2.37	75
Total	Experimental Group 1	16.12	1.67	25
	Control Group	11.98	1.51	45
	Experimental Group 2	9.18	.83	65
	Total	11.40	2.87	135

Table 2: Analysis of Covariance (ANCOVA)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Decision
Corrected Model	995.79	6	165.97	199.26	.00	
Intercept	421.57	1	421.57	506.14	.00	
PRETEST	1.39	1	1.39	1.67	.20	
GENDER	92.53	1	92.53	111.10	.00	Reject
TREATMENT	933.43	2	466.72	560.35	.00	Reject
GENDER * TREATMENT	34.16	2	17.08	20.50	.00	Reject
Error	106.61	128	.83			
Total	18647.00	135				
Corrected Total	1102.40	134				

$P < 0.05$

From tables 1 and 2, there is significant effect of the treatment (class size) on secondary school students' achievement in mathematics ($F_{(2,128)} = 560.35; p < 0.05$). Therefore, H_{01} was not accepted. Moreover, the tables show that the students in Experimental Group 1 performed ($\Pi=16.12$) better than those in the Control Group ($\Pi=11.98$) while those in Control Group performed better than those in the Experimental Group 2 ($\Pi=9.18$). Besides, the tables also show that gender has significant main effect on secondary school students' achievement in mathematics ($F_{(1,128)} = 111.10; p < 0.05$). Therefore, H_{02} was not accepted. Table 1 reveals that male students ($\Pi=12.07$) performed significantly better than the female students ($\Pi=10.87$). Thus, there is significant interaction effect of treatment and gender on secondary school students' achievement in mathematics ($F_{(2,128)} = 20.50; p < 0.05$). Therefore, H_{03} was not accepted. The study reveals an ordinal interaction effect of treatment and gender on secondary school students' achievement in mathematics across the groups.

Discussion, Recommendation and Conclusion:

Discussion:

Tables 1 and 2 have clearly indicated an acquisition of knowledge in the treatment groups; this has shown that there is significant main effect of the treatment on students' achievement in mathematics, besides, there is significant interaction effect of the treatment and gender on students' achievement in mathematics. There is more effect of the treatment in favour of male students to the female students, the male students performed better than the female students, based on this fact, hypotheses 1 and 2 are therefore rejected and conclude that, there is significant main effect of the treatment on students' achievement in mathematics and there is significant interaction effect of the treatment and gender on students' achievement in mathematics. Besides, tables 1 has revealed that, the mean and standard deviation scores of the treatment groups have indicated deterioration in the achievement of the groups as the class size increases, that is, the achievement of the students varies inversely as the class size, and the posttest mean and standard deviation scores of male students are higher than that of the female students, this shows that, there is significant difference in the posttest scores of the control and the experimental groups, also, there is significant difference in the posttest scores of the control and the experimental groups based on gender.

Moreover, table 1 has shown that, there is significant difference in the posttest scores of the experimental groups in favour of the experimental group 1, students in this group performed significantly better than their counterparts in the experimental group 2, though, exposed to a similar treatment. From the foregoing, it has been factually shown that, the size of a class will have effect on the academic achievement of students and that, there is an inverse relationship between the class size and students' achievement in mathematics.

This result agrees with the earlier findings of Adeyegbe, (2005); Bajah, (1999); Okegbile, (1996); Oshokoya, (1998) and Osuafor, (1999) who have identified such factors as class size as one of the factors that contributed to students' low achievement in mathematics. This result agrees with the earlier findings of Mokobia and Okoye, (2011) who reported that, achievement in mathematics in senior secondary schools is higher in small sized classes than in large sized classes. The findings also supported the reports of Adeyemi (2008) that schools having an average class size of less than 35 obtained better results than those having greater than 35. It also agree with the results reported by Aguele and Agwugah (2007); Becker (2006); Kolawole (2007); Olaniyi (2009); Ugwungwu (2002; 2006) who found in their studies that male students achieved significantly better than female students in science subjects.

It does not, however, agree with the result reported by Afolabi (2002) and Asadullah (2005) who concluded from their findings that, there is no significant relationship among class size and students' learning outcomes and that reduction in class size in secondary grades is not efficient in a developing country like Bangladesh. It does not also agree with the result reported by Raimi (2002); Soltani and Nasrl (2010) where girls performed better than boys in science subjects.

Recommendation:

Mathematics (and Science) teaching aims at inculcating the spirit of science in students. In addition, it is expected that students who learn Mathematics (and Science) should perform well when tested. Hence, Mathematics (and Science) teaching and learning should be done in a friendly atmosphere where the class size will be manageable enough so as to present minimum difficulty to the students. This study seems to support the idea that, Mathematics (and sciences) should be taught in a small class size in order to enhance achievement. Besides, based on the findings of this study, the researcher is recommending the provision of more conducive classrooms in Nigerian schools and recruitment of commensurate mathematics teachers to meet the demand of the use of not more than 25 students for the teaching and learning of Mathematics (and sciences). At best class size of 25 should be used in our secondary schools across the country. If done it is hoped that it will enhance the performance of the students in the subject.

Conclusion:

From the findings, it is concluded that senior secondary school students in small sized classes show higher achievement in mathematics relative to their colleagues in large sized classes, there is an inverse relationship between the class size and students' achievement in mathematics. Furthermore, there is interaction effect of gender and class size in students' achievement in Senior Secondary School Mathematics. Therefore secondary school students should be taught mathematics in small class size.

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