International Journal of Innovative Research and Advanced Studies (IJIRAS)
Volume 8 Issue 1, January 2021

ISSN: 2394-4404

Effect Of Class Size On Students' Learning Achievement In Mathematics In Junior Secondary Schools: A Case Study Of Katagum Local Government Bauchi State

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Abstract: ***The reasons for large classes in developing countries can conveniently be placed at the doorsteps of government's free and compulsory basic education policy, which is in line with the global initiative for universal basic education coupled with the rapid population growth and awareness that a literate population is more productive than an illiterate one. However, experience has shown that overcrowded classrooms affect the quality of education delivered in the school system. Teachers find it difficult to manage and teach effectively in large classes. The aim of this study therefore was to examine the effect of class size on students' student's learning achievement in mathematics in junior secondary schools in Bauchi state. The study was quasi-experimental, the population for the study consisted of both students and teachers of mathematics in public schools in Katagum LGA Bauchi state and a sample of three schools were selected at random was involved in the study. Mathematics achievement test (MAT), teacher interview, classroom observation and video recording were the methodologies used to obtain information from students and teachers. Student t-test and ANOVA were used for analysis of the quantitative data while the qualitative data were analysed using content analysis. The research questions were investigated and hypothesis were duly tested at 5% level of significance. The results of the analyses showed that performance of students in mathematics is not dependent on class size. It was therefore recommended that government should provide enough learning materials and teachers should be provided with opportunity to attain teacher training programmes.***

I. 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 exacerbated by the fact that a number of events in the 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, most 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 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

ISSN: 2394-4404

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 & 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.

Various studies have recommended chains of instructional strategies of teaching Mathematics in order to solve the problem of low achievement in public examinations (Awofala & Nneji, 2012; Abimbade, 2011; Awolola, 2009; Adesoji & Ifamuyiwa, 2007), yet the problem still persists. 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 one of the many 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. Thus, some of the studies that revealed that large class size has a negative effect on students' academic performance include; Muraina and Muraina (2014), Oguntoye (2011), Fafunwa (2010), and Yara (2010) while specifically on mathematics achievement includes; Handal, Watson, and Maher (2015), Petrilli and Northern (2014), Tobih, Akintaro, Osunlana (2013) and Olubunmi (2016).

II. STATEMENT OF THE PROBLEM

The objective of secondary school education is to produce high quality students who would be able to face the challenges of the society and prepare them for higher education. Today, our secondary education is faced with high population of students since the inception of Universal Primary Education in Nigeria. Consequently, there has been high percentage of students' failure in Mathematics. Many studies have been conducted to find out the causes of this poor performance in mathematics which include: influence of instructional material on mathematics achievement by Bassey and Joshua (2010), quality and quantity of mathematics teachers by Bot (2014), effect of using mathematics laboratory in teaching mathematics on the achievement of student (Ebele & Abigail, 2008). This study focussed on the effect of class size on students learning achievement in mathematics. Three research questions were generated to guide the conduct of the study. The following research questions guided and give focus to the study:

- ✓ Is there any statistically significant relationship between class size and students' performance in mathematics in junior secondary schools?
- ✓ Is there any statistically significant relationship between class size and female students' performance in mathematics in junior secondary schools?
- ✓ To what extent are teachers aware of teaching strategies that help deal with large classes?

The main hypothesis postulated in the study states that there is no statistically significant relationship between class size and students' performance in mathematics. The hypothesis was tested at 0.05 level of significance.

III. METHODOLOGY

The research design used was quasi experimental design. According to Shadish, Cook and Cambell (2002), the term quasi experimental design efers to a type of research design that lacks the element of random assignment. And it's suitable for this research because the reactions of test subjects are more likely to be genuine because it is not an artificial research environment and also school authority may not allow the researcher to tamper with the student allocation. The population for this study comprised of all students and teachers in public junior secondary schools in katagum metropolis. The researcher chose Katagum metropolis for convenience purpose. There are 26 public junior secondary schools in katagum metroplis. The students' population at the time of the study was 13,288 and the number of teachers was 793. Three schools were selected at random, Intact classes of 93 students were involved in school A (group A), 60 students in school B (group B) and 45 students in school C (group C). The pre-test and post-test were conducted for the three groups. A pre-test was administered on the students in the three groups before the treatment. This was to determine the ability levels of the students.

The instruments that the researcher used for the collection of data for this study was Mathematics achievement test, which was designed based on the content of JSS 2 scheme of work. It consisted of 45 objective questions and 5 essay, the test items were adopted from the multiple choices in Junior Secondary Certificate Examination past questions. Other instruments used in the study were observation schedule and interview guide. Observation schedule was designed to see how the teachers control, manage, teach and achieve the stated objectives during the lesson. The instrument was divided into six sections which included; lesson presentation, classroom management, communication skills, evaluation and teacher's responsibilities. Unstructured Interview was conducted to find out how the teachers tackle the problems of large class and find out the strategies used in teaching large classes. Video recording of mathematics lessons also provided the researcher with other classroom data. Seven lessons were recorded in the sample schools and five were transcribed

IV. FINDINGS

The first research question asks that: *Is there any statistically significant relationship between class size and students' performances in mathematic in junior secondary schools?* To deal appropriately with this research question, the researcher generated a null hypothesis which states that: There is no statistically significant relationship between class size and students' performance in mathematics. In considering the

question and subsequent testing of the hypothesis, the data on students' performance in the treatment and control groups in both the pretest and the posttest were pulled together and subjected to analysis.

Table 1shows descriptive analyses of the scores in both pretest and posttest of students in the three groups. The analyses show that the group means (at pretest) are comparable.

Index	Performance of students in pretest			Performance of students in post test		
	Treatment group 1	Treatment group 2	Control group	Treatment group 1	Treatment group 2	Control group
Mean	21.6	22.1	22.6	53.5	58	53
SD	5.0	6.1	6.6	19.2	17.2	15.3

Table 1: Description of group performances in pretest and posttest

The table above revealed the performance of each of the three schools representing large, medium and small size classes. The mean score and standard deviation of the large class size were 53.5 and 19.2 respectively. For the medium class size the mean and standard deviation were 58 and 17.2 respectively; while 53 and 15.3 were the mean score and standard deviation, for the small class size. From this result, it can be seen that a better performance was obtained from the medium class size with mean score of 58 and standard deviation 17.2, to test the hypothesis, Analysis of Variance (ANOVA) statistics was used.

Description variation	Sum of squares	Degree of freedom	Mean squares	F-calculated	F-critical	Decision
between the group	31.47	2	15.735	0.2	3.06	Statistically not significant
within the group	6925.59	194	73.676			
Total	6957.06	196				
between the group	851.04	2	425.52	1.43	3.06	Statistically not significant
within the group	57881.86	194	298.36			
Total	58732.9	196	-			

Table 2: ANOVA of performance of students in pretest and post test

Results from both pre-test and post-test revealed no significant deference between the performances of the students in the three different class sizes, the table above shows that the calculated f-values for both pre-test and post-test were 0.2 and 1.43 respectively and were both are less than the table value of 3.06 at 5% level of significance. Therefore, we do not reject the null hypothesis, which state that there is no statistically significant difference between class size and student's performance in mathematics in junior secondary school.

The second research question asks that, *Is there any statistically significant relationship between class size and female students' performances in mathematics in junior secondary schools?* To deal properly with this research question, the research generated a null hypothesis which states that: There is no statistically significance relationship between class size and female student's performance in mathematics. In considering the question and subsequent testing of the hypothesis, the data on female students' performance in the treatment and control groups in posttest were pulled together and subjected to analysis.

Table 3 shows descriptive analyses of the scores in posttest of female students in the three different class sizes.

Index	Performance of treatment group		Performance of Female students in control group
	Female students (Gropu 1)	Female students (Gropu 2)	
N	28	36	46
Mean	50	63	53
SD	16.3	14.2	20.9

Table 3: Comparison of the Performance of Female Students in Three Different Class Sizes

The table above shows the performance of female students in posttest in large, medium and small class sizes. Whereas, it can be seen that a better performance was obtained from medium class size with the highest mean score of 63, with smaller standard deviation compared to the small and large class sizes, therefore female students perform better in medium class size. To test the hypothesis, t-test statistics was used.

large class	**N**	**Mean**	**SD**	**Df**	**t-cal**	**t-crit**	**comparison**	**Decision**
Male Female	49 46	54 53	17 21	93	0.25	2.000	t-cal < t-crit	not significant
medium class	**N**	**Mean**	**SD**	**Df**	**t-cal**	**t-crit**		
Male Female	23 36	48 63	17 14	57	3.53	2.021	t-cal > t-crit	statistically significant
small class	**N**	**Mean**	**SD**	**Df**	**t-cal**	**t-crit**		
Male Female	15 28	57 50	12 16	41	1.62	2.021	t-cal < t-crit	not significant

Table 4: t-test of Performance of Male and Female Students in Three Class Sizes

The above table compares the performance of male and female students in post-test in large, medium and small class sizes. The results revealed that in medium class size the calculated t-value was 3.53 and critical t-value was 2.02 at 5% level of significance with 57 degree of freedom, hence the calculated t-value is greater than critical t-value, these shows: there is significance relationship between class size and female students' performance in mathematics in medium class sizes; therefore, the null hypothesis is rejected

The third research question asks that: *To what extent are teachers aware of teaching strategies that help deal with large classes?* The interviews reported in this research sought to explore the awareness of teaching strategies that help deal with large classes, the following question was used to direct conversation between the researcher and participants to elicit responses about teaching strategies:

Interviewer: which teaching strategy do you prefer?

Out of the six teachers been interviewed, teacher 4 and 5 prefer group method and concept mapping respectively, one of the best ways to manage large classes is through the use of small groups, Juliana (2015). Concept mapping is said to be one of the teaching strategy that help in dealing with large classes, this was supported by Tomaswick(2018) , Sadler (2015), Jeffery (2010) Van Boxtel (2000), Ian Kinchin (2005), Xiong (2017), Chei-chang (2009), Ghorai (2018).

The result of observation checklist shows that lesson five was good, teacher-student interaction, use of instructional

material, mastery of subject matter and teachers' responsibility were well observed, but other lessons were not well presented, it shows that out of seven observed lessons only one lesson got 36 marks out of 55 marks in presentation, so also organization and evaluation Thus, assessment and evaluation play an important role in mathematics education as they often define the mathematics that is valued and worth knowing. Furthermore, sound assessment provides important feedback about students' mathematical thinking that prompts student and teacher actions to improve student learning, Neubrand (2015).

Seven mathematics lessons were recorded in the sampled schools, five lessons were transcribed which revealed the following: teacher-student interactions was not fully exploited, teaching was mainly teacher-centered, teachers mostly interact with the bright students while other students just sat and look, teaching materials are not enough, while material resources have a significant effect on student's' achievement in all subjects,

Momoh (Isola, 2010). No group work has been seen, while group work is one of the strategy that help in large classes, this was supported by (Bascia, Connelly, Flessa, &Mascall, 2010),and teacher-student interaction influence student's' achievement by (Blatchford, Baines, Kutnick& Martin 2001).

V. DISCUSSION OF FINDINGS

Class size is a subject that excites opinion especially from parents, teachers, researchers and governments. From a 'common sense' perspective, parents would claim that small class size directly influences children's learning because it increases personalized instruction (Watson, Handal, Maher & McGinty, 2013). Another study reveals that teachers with large class size spend significantly less time on task and significantly more time on discipline or organizational matters compared with teachers of small class size (Spark, 2010), upon all these, performance of students, as indicated by the results in this research has shown that medium class size, with a mean of 58, performed significantly better than small and large classes with mean score of 53 and 53.5 respectively.

The first hypothesis using ANOVA revealed no significant difference between the performances of students in the three different class sizes, it shows that the calculated f-values for both pre-test and post-test were 0.2 and 1.43 respectively and both are less than the table value of 3.06 at 5% level of significance. Therefore, we do not reject the null hypothesis. While in medium class size shows that the calculated t-value 3.53 is greater than the critical value of 2.0 which means there is statistically significant relationship between class size and female student's performance in mathematics

Contrary to the findings of this study christopher and steven (2009) in their study on class size reduction and student achievement: the potential tradeoff between teacher quality and class size, shows that smaller classes raised mathematics and reading achievement. Yara (2010) in his study on class size and academic achievement of students in mathematics in Southwestern Nigeria found out that the performance of students in large classes was very low (23%) compared to those students in smaller classes (64%). There was difference in the performance of male and female students in either group, Tobih, Akintaro, Osunlana (2013), and Olubunmi (2016) found significant difference between class size and academic performance of students in mathematics in which large classes has negative effect. Another study also shows that class size does have an effect on student achievement although not as significant as teacher ability, Petrilli and Northern (2014).

VI. CONCLUSION

In conclusion according to the findings of this study, performance of students in mathematics is not dependent on class size, this was supported by Owoeye and Yara (2011) who conducted a study of 50 secondary schools in Nigeria to determine if class size had an effect on students' achievement at secondary school level. They found that class size had no statistically significant effect on students' achievement, and there was no significant difference in achievement between small classes and large classes in both urban and rural communities. Hattie (2009) found that student's performance is influenced more by teacher quality than class size. He added that it is not the size of the class that enhances students' academic performance but the quality of the teaching that takes place, thisis supported by the assertion of Bascia and Fredua-Kwarteng (2008) that "class size does not influence students' achievement directly: it is what teachers and students do in smaller classes that matter". Afolabi (2002) also found no significant relationship between class size and students' learning outcomes.

VII. RECOMMENDATION

In view of the foregoing conclusions, the following recommendations were made. The study set out to access the effect of class size on students' learning achievement in mathematics in junior secondary schools, the over populated class rooms is a result of the free and compulsory education for every primary school age child by the federal government, who would otherwise missed a chance to access education and improve their lives. In view of this, shift systems should be used where teacher-pupil ratios are high.

The government should engage contract and part-time teachers who are cheaper to maintain especially the unemployed trained teachers; this would therefore ease the teachers' working load, and more class rooms should be created where possible, for effective teaching and achieving internal efficiency of the public schools' system in Nigeria and to meet government stipulations on student/pupil-teacher ratios as recommended by FGN (2013). Frequent training should be given to teachers to ensure confident and quality teachers that will be able to handle any given class sizes, teachers' remuneration should also be taken in to consideration as it increases motivation and dedication.

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