International Journal of Mathematics and Statistics Invention (IJMSI)
E-ISSN: 2321- 4767 P-ISSN: 2321-4759
www.ijmsi.org Volume 8 Issue 7 || July, 2020 || PP 01-07

Effect of Class Size on the Performance of Mathematics Students in Makurdi Metropolis, Benue State, Nigeria

ADAMU Garba
Department of Science Technology and Mathematics, Nasarawa State University, Keffi, Nasarawa State, Nigeria.

ABSTRACT
The study investigated the effect of class size on the performance of mathematics students in Makurdi Metropolis, Benue State, Nigeria. The researcher used both primary and secondary sources from a sample of 1,715 respondents obtained by the use of a structured questionnaire. The data collected were analyzed using inferential statistics. The nexus between the variables of the model was examined using multiple linear regression analysis. The probability value of the regression estimates were used to test the hypotheses of the study. The result of the regression analysis indicates that Large Class Size (LCS) has a positive effect on Performance of Mathematics (STP) students in selected Secondary Schools in Makurdi Metropolis of Benue State, Nigeria and the effect is statistically significant ($p<0.05$) and not in line with a priori expectation. This means that a unit increases in Large Class Size (LCS) will result to a corresponding increase in Students' Mathematics Performance in selected Secondary Schools in Makurdi Metropolis of Benue State, Nigeria by margin of 13.8 percent. Small Class Size (SCS) has a positive effect on Performance of Mathematics students (STP) in selected Secondary Schools in Makurdi Metropolis of Benue State, Nigeria and the effect is statistically significant ($p<0.05$) and the effect is in line with a priori expectation. This means that a unit increases in Small Class Size (SCS) will result to a corresponding increase in Students' Mathematics Performance in selected Secondary Schools in Makurdi Metropolis of Benue State, Nigeria by margin of 44.1 percent. It was concluded that when the class size is smaller, the positive effect it has on students' achievement and performance is more compared to a larger class size. It was recommended among others that manager of schools in the study area should employ more Mathematics teachers so that the large class size found in the school can be reduced.

KEYWORDS*: Class size, Students, Performance, Mathematics, Benue, Nigeria.*

Date of Submission: 09-08-2020 Date of Acceptance: 21-08-2020

I. INTRODUCTION

Mathematics has an important role to play in the task of national development. It is an instrument for effecting economical, social, political, scientific and technological changes. In order to achieve these goals of education, the teachers are required to perform their duties efficiently and part of the solution to this is adequate and controllable class size of students to teach for effective learning in mathematics. The history of development of knowledge and much of the development in science and technology has been greatly facilitated by applications of mathematical knowledge and procedures. This study attempts to expose some of the numerous problems facing mathematics that prevents the effective teaching and learning of mathematics in Nigerian secondary schools. The issue of class size is one important area of this study as it relates to teaching and learning of mathematics in secondary school level. Some researchers such as Alio (2003) attributes students' development of negative attitude towards mathematics teachers to what is called "idiosyncrasy" of mathematics instruction. Class size encourages or discourages students active participation in the learning of Mathematics in secondary schools in Nigeria. The need to identify suitable class size by which students, especially with medium and low ability can be made to receive teachers' attention to grasp the content of the subject easily and intelligibly is the focus of this study. There are several literature on the adequate class size which will bring about effective learning of Mathematics in secondary schools. Some experts recommends that an average class size of thirty (30) is adequate. Anikweze (2004) recommends teachers/pupils ratio to be 1:35 in order to be more effective to, cope with an over-crowded classroom in our schools. The Nigerian National Policy on Education recommends an average class size of forty (40) students to a teacher, but hardly is this attained in Nigerian schools. In most Nigerian schools what exists in the class ranges from fifty (50) to a large number of one hundred and twenty (120) students to a teacher in many secondary schools.

High ability or gifted students are needed in all classrooms in order to stimulate, motivate and inspire other students. The achievement profile of high achievers declines as the class size becomes larger. This means that increase in class size tends to reduce the performance of students generally, despite the level. The researcher is of the view that the use of heterogeneous class could be of more advantage since low and average groups would gain more knowledge from their interactions and sharing with the high achievers whether the class is large or small (Adeyemi, 2008). 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 student's failure in Mathematics. It is often assumed that class sizes need to fall below a certain number (the figure of twenty (20) is often mentioned) before they can have an impact on educational outcomes.

There is a large body of research on the relationship between class size and student learning. The vast majority of these studies simply examine the association between variation in class size and student achievement. The primary difficulty in interpreting this research is that schools with different class sizes likely differ in many other, difficult-to-observe ways. For example, more affluent schools are more likely to have the resources needed to provide smaller classes, which would create the illusion that smaller classes are better when in fact family characteristics were the real reason. Alternatively, a school that serves many students with behaviour problems may find it easier to manage these students in smaller classes (Olatunde, 2010). A comparison of such schools to other schools might give the appearance that small classes produce less learning when in fact the behaviour problems were the main factor. The most credible studies of class size research have utilized either randomized experiments, in which students and teachers are randomly assigned to smaller or larger classes; natural experiments in which, for example, a sudden change in class size policy allows a before-and-after analysis of its effects; or sophisticated mathematical models for estimating effects that take advantage of longitudinal data on individual students, teachers, and schools.

Many studies have been conducted to find out the causes of this poor performance in Mathematics among secondary school students. Fabunmi, Brai-Abu and Adeniji (2007) investigated the extent to which factors like class size, student classroom space and class utilization rate would determine the performance of secondary school students in Senior Certificate Examinations (SSCE) conducted by the West Africa Examinations Council (WAEC) in Oyo State, Nigeria between 1997 and 2002 school years. The study was ex-post factor under a descriptive survey research design, 200 out of the 336 secondary schools in the state were randomly selected for the study. The multiple regression analysis and one-way analysis of variance were used to analyze the data. Findings revealed that the factors class size, student classroom space and class utilization rate, when taken together, determined significantly, students' academic performance in Oyo state between 1997 and 2002.

In a meta-analysis of class-size studies, Glass and Smith (1979); Smith and Glass (1980), argue that for elementary school children the benefit of small classes is a logarithmic function of size, with the marginal benefit of reducing class size being most significant for classes of size 20 and fewer. Moreover, the marginal benefit is very small when classes are larger than 25 or 30 students; that is, there is little, if any, benefit to reducing class size if the small class has more than 25 or 30 students. In 1996, California enacted a K-3 class size research program designed to reduce class size by ten students per class, from 30 to 20, throughout the state. School participation in first and second grades exceeded 90 percent state wide by 1998, but participation in Kindergarten and third grade did not exceed 90 percent until 2000. This staggered introduction of class size research provided opportunities for researchers to study its effects.

Adeyela (2000) found in her study that large class size is not conducive for serious academic work. In the same vein, Afolabi (2002) found no significant relationship among class size and students' learning outcomes. Yara (2010) in his study on class size and academic achievement of students in mathematics in South Western Nigeria found out that the performance of students in large classes was very low (23 percent) compared to those students in smaller classes (64 percent). There was difference in the performance of male and female students in either group. However, Aluko (1992) observed that many schools nowadays are more than 20 per cent short of staff and at the mercy of Parents Teachers Association (PTA) to hire teachers even in the sensitive subject areas like English Language, Mathematics and some of the science subjects. He concluded that with a crowd of 70 per cent in a class, records of continuous assessment are often unreliable.

Several reasons have been given on the poor performance of students in Mathematics in secondary schools. Reasons ranging from quality of teachers, lack of utilization of instructional materials as a result of shortage of funds, lack of workshops and seminars for Mathematics teachers, over-crowded classrooms, lack of Mathematics textbooks, lack of Mathematics laboratory to mention a few have been advanced (Osim, 2011). On

the part of the students themselves, reasons given range from lack of interest, poor attitude to learning, and effects of peer groups influence and many others. These variables make teaching/learning of Mathematics in secondary schools difficult for government to achieve the main stated objectives. It is on this bases that this study examines class size as one of the factors affecting the learning of Mathematics in selected secondary schools in the study area. The specific objectives of the study are to; examine the effect of large class size on the performance of students in selected Secondary Schools in Makurdi Metropolis, Benue State Nigeria; determine the effect of small class size on the performance of students in selected Secondary Schools in Makurdi Metropolis, Benue State Nigeria and proffer solutions to the problem affecting class size in the study area. It is hypothesized that large class size has no significant effect on the performance of students in selected Secondary Schools in Makurdi Metropolis, Benue State, Nigeria and small class size has no significant effect on the performance of students in selected Secondary Schools in Makurdi Metropolis, Benue State, Nigeria.

II. RESEARCH METHODOLOGY

This study used a survey research design. The population of the study is seven (7) secondary schools in Makurdi Metropolis purposively chosen from selected secondary schools. They are made up of only senior secondary school students of;

i) Tilley Gyado College Makurdi, Benue State Nigeria.
ii) Government Secondary School North Bank Makurdi, Benue State, Nigeria.
iii) Government Girls Secondary Schools Makurdi, Benue State, Nigeria.
iv) Government College Makurdi, Benue State, Nigeria.
v) Government Model College Makurdi, Benue State, Nigeria.
vi) Special Science Senior Secondary School North Bank Makurdi Benue State, Nigeria.
vii) Command Secondary School Makurdi Benue State, Nigeria.

The selected schools have a population of one thousand seven hundred and fifteen (1,715) students purposively chosen from the five purposively selected schools. The schools were selected because of they are schools with high and low students population which is suitable for the nature of study currently undertaken. The data for the study was collected using questionnaire, coded and analyzed using computer-based Statistical Package for Social Sciences (SPSS version 20.0 for Microsoft Windows). The validity and the reliability of the instrument was established using the factor analysis.

Table 1: Kaiser-Meyer-Olkin and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.950
Bartlett's Test of Sphericity	Approx. Chi-Square	3.706
	df	3
	Sig.	.029

a. Based on correlations

***Source**: SPSS Result, 2020*

A pilot test was conducted. The input variable factors used for this study were subjected to exploratory factor analysis to investigate whether the constructs as described in the literature fits the factors derived from the factor analysis. From Table 1, factor analysis indicates that the KMO (Kaiser-Meyer-Olkin) measure for the study's three independent variable items is 0.950 with Barlett's Test of Sphericity (BTS) value to be 3 at a level of significance *p*=0.029. Our KMO result in this analysis surpasses the threshold value of 0.50. Therefore, we are confident that our sample and data are adequate for this study.

Table 2: Total Variance

Total Variance Explained

	Component	Initial Eigenvalues[a]			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
		Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Raw	1	124.059	43.939	43.939	124.059	43.939	43.939	120.704	42.751	42.751
	2	111.358	39.441	83.380	111.358	39.441	83.380	114.713	40.629	83.380
	3	46.925	16.620	100.000						
Rescaled	1	124.059	43.939	43.939	1.370	45.658	45.658	1.435	47.822	47.822
	2	111.358	39.441	83.380	1.067	35.579	81.237	1.002	33.415	81.237
	3	46.925	16.620	100.000						

Extraction Method: Principal Component Analysis.

a. When analyzing a covariance matrix, the initial eigenvalues are the same across the raw and rescaled solution.

***Source**: SPSS Result, 2020.*

The Total Variance Explained table shows how the variance is divided among the three (3) possible factors. Three (3) factors have Eigenvalues (a measure of explained variance) greater than 1.0, which is a common criterion for a factor to be useful. When the Eigenvalue is less than 1.0 the factor explains less information than a single item would have explained. Table 2 shows that the Eigenvalues for the raw data 124.059, 111.358 and 124.059 are all greater than 1. Component one gave a variance of 43.939, Component 2 gave the variance of 39.441 while component three produced a variance of 16.620. The cumulative loadings indicates that three components i.e component 1, 2 and 3 accounts for 100 percent of the variance of the whole variables of the study. This shows that the instrument has a very strong construct validity.

Table 3: Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.810	.983	3

Source: SPSS Result, 2020

As shown by the individual Cronbach Alpha Coefficient the entire construct above falls within an acceptable range for a reliable research instrument of 0.70. The Cronbach Alpha for the individual variables is 0.810 and is found to be above the limit of acceptable degree of reliability for research instrument.

Table 4: Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
STP	73.9500	214.892	.829	.191	.609
LCS	70.3500	197.292	.546	.194	.704
SCS	72.9000	241.042	.606	.004	.608

***Source**: SPSS Result, 2020*

As shown in Table 4, an item-total correlation test is performed to check if any item in the set of tests is inconsistent with the averaged behaviour of the others, and thus can be discarded. A reliability analysis was carried out on the variables of the study values scale comprising three (3) items. Cronbach's Alpha showed the questionnaire to reach acceptable reliability, $\alpha = 0.810$. All items appeared to be worthy of retention, resulting in a decrease in the alpha if deleted. There is no exception to this in all the variables of the study as none of the items if deleted will improve the overall Cronbach alpha statistics. As such, none of the variables was removed. A correlation value less than 0.2 or 0.3 indicates that the corresponding item does not correlate very well with the scale overall and, thus, it may be dropped.

Models Specification

The functional relationship between the variables of the study, the model is expressed in implicit and explicit function as shown below:

$STP = f(LCS, SCS)$ - - - - - - - (1)

Where,

STP = Student's Performance

LCS = Large Class Size

SCS = Small Class Size

In explicit form, the functional relationship between the variables of the study can be shown below:

$STP = b_0 + b_1LCS + b_2SCS + U_t$ - - - - - - (2)

Where,

b_0 = Regression constant

b_1 - b_2 = Coefficients of independent variables.

U_t is the error term

A priori expectations

($\boldsymbol{X_1}$) = Large class Size; *a priori* expected to have a negative effect on students' performance

($\boldsymbol{X_2}$) = Small class size; *a priori* expected to have a positive effect on effect on student' performance.

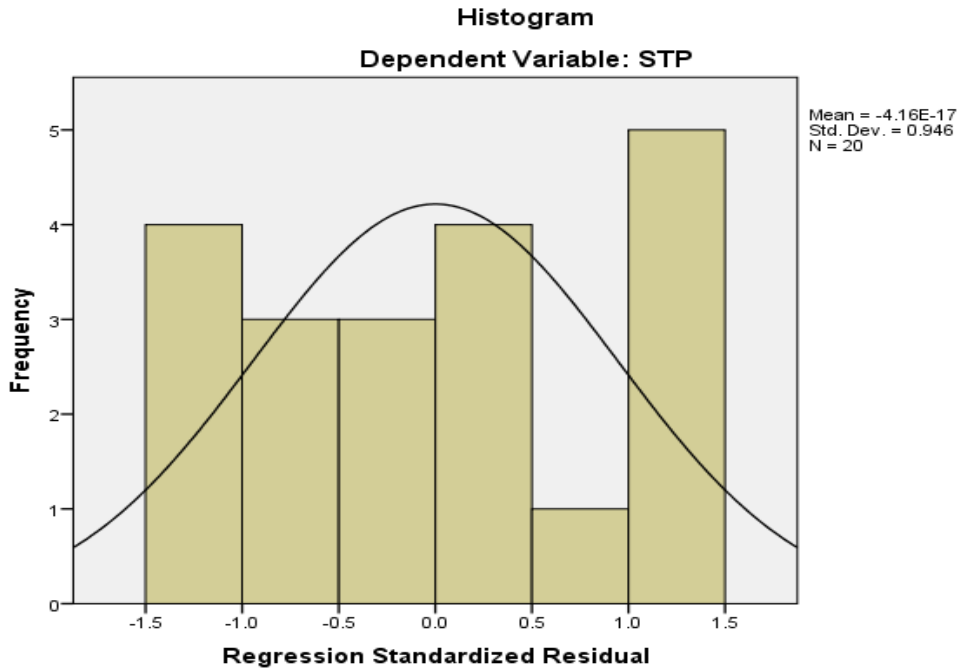
Multiple regression analysis was used to assess the nature and degree of effect of the independent variables on the dependent variable of the study. However, the probability value of the regression estimates was used to test the two hypotheses of the study.

Decision rule: The following decision rules were adopted for accepting or rejecting hypotheses: *If the probability value of* b_i [p (b_i) > critical value] we accept the null hypothesis, that is, we accept that the estimate b_i

is not statistically significant at the 5 percent level of significance. *If the probability value of* b_i [*p* (b_i) < critical value] we reject the null hypothesis, in other words, that is, we accept that the estimate b_1 is statistically significant at the 5 percent level of significance.

III. RESULTS AND DISCUSSION

Figure 1: Regression Standardized Residual



***Source**: SPSS Result, 2020*

Figure 1 above shows a histogram of the residuals with a normal curve superimposed. The residuals look close to normal, implying a normal distribution of data. Here is a plot of the residuals versus predicted dependent variable of Students' Performance (MTP). The pattern shown above indicates no problems with the assumption that the residuals are normally distributed at each level of the dependent variable and constant in variance across levels of Y.

Table 5: Statistical Significance of the model

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	290.138	2	145.069	2.008	.016[b]
	Residual	1228.412	17	72.260		
	Total	1518.550	19			

a. Dependent Variable: STP
b. Predictors: (Constant), SCS, LCS

***Source**: SPSS 20.0 Result Output, 2020*

The result of the statistical significance of the model is presented in Table 5. The F-ratio in the ANOVA table above tests whether the overall regression model is a good fit for the data. The table shows that the independent variables statistically significantly predicts the dependent variable F (2, 17) = 2.008, p =0.016[b] (i.e., the regression model is a good fit of the data).

Table 6: Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.944[a]	.891	.796	8.50056

a. Predictors: (Constant), SCS, LCS
b. Dependent Variable: STP

***Source**: SPSS 20.0 Result Output, 2020*

Table 6 shows the model summary. The coefficient of determination R^2 for the study is 0.891 or 89.1 percent. This indicates that 89.1 percent of the variations in the model can be explained by the explanatory variables of the model while 10.9 percent of the variation can be attributed to unexplained variation captured by the stochastic term. The Adjusted R Square and R^2 show a negligible penalty (79.6 percent) for the explanatory variables introduced by the researcher.

Table 7: Regression coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	19.054	9.159		2.081	.018		
	LCS	.417	.208	.138	2.003	.014	.996	1.004
	SCS	.368	.183	.441	2.011	.055	.996	1.004

a. Dependent Variable: STP

***Source**: SPSS 20.0 Result Output, 2020*

As shown by the result of the multiple regression in Table 7, Large Class Size (LCS) has a positive effect on Performance of Mathematics (STP) students in selected Secondary Schools in Makurdi Metropolis of Benue State, Nigeria and the effect is statistically significant (*p<0.05)* and not in line with *a priori expectation*. This means that a unit increases in Large Class Size (LCS) will result to a corresponding increase in Students' Mathematics Performance in selected Secondary Schools in Makurdi Metropolis of Benue State, Nigeria by margin of 13.8 percent. Using the probability value of the estimate, p (b_1) < critical value at 0.05 confidence level. Thus, we reject the null hypothesis. That is, we accept that the estimate b_1 is statistically significant at the 5 percent level of significance. This implies that large class size has a significant effect on student's Performance in selected Secondary Schools in Makurdi Metropolis of Benue State, Nigeria.

This finding is contrary to that of Adeyela (2000) who found in her study that large class size is not conducive for serious academic work. In the same vein, 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 percent) compared to those students in smaller classes (64 percent). However, Afolabi (2002) found no significant relationship among class size and students' learning outcomes. The positive effect of large class size on the performance of Mathematics students in the study area could be attributed to several factors ranging from quality teachers, use of effective teaching methods, high students' interest in Mathematics among several factors.

Small Class Size (SCS) has a positive effect on Performance of Mathematics students (STP) in selected Secondary Schools in Makurdi Metropolis of Benue State, Nigeria and the effect is statistically significant (*p<0.05)* and the effect is in line with *a priori expectation*. This means that a unit increases in Small Class Size (SCS) will result to a corresponding increase in Students' Mathematics Performance in selected Secondary Schools in Makurdi Metropolis of Benue State, Nigeria by margin of 44.1 percent. Using the probability value of the estimate, p (b_2) < critical value at 0.05 confidence level. Thus, we reject the null hypothesis. That is, we accept that the estimate b_2 is statistically significant at the 5 percent level of significance. This implies that small class size has a significant effect on student's Mathematics Performance in selected Secondary Schools in Makurdi Metropolis of Benue State, Nigeria. This finding is in line with that of Fabunmi, Brai-Abu and Adeniji (2007) who investigated the extent to which factors like class size, student classroom space and class utilization rate would determine the performance of secondary school students in Senior Certificate Examinations (SSCE) conducted by the West Africa Examinations Council (WAEC) in Oyo State, Nigeria between 1997 and 2002 school years and found similar results which indicates that factors such as class size, student classroom space and class utilization rate, when taken together, determined significantly, students' academic performance in Oyo state between 1997 and 2002.

IV. CONCLUSION AND RECOMMENDATIONS

This study examine effect of class size on the performance of mathematics students in Makurdi Metropolis, Benue State, Nigeria. The study shows that class size surely influences students teaching and learning. The study have revealed that that large class-size has a positive and significant effect on student's academic performance in the study area. This was attributed to school specific factors such as quality of teachers, students interest and quality of teaching. Small class size was found to have a more positive and significant effect on student's academic performance in the study area. This shows that when the class size is smaller, the positive effect it has on students' achievement and performance is more compared to a larger class size. Based on the result of this empirical study, it was recommended that the managers of the schools in the

study area should employ more Mathematics teachers so that the large class size found in the school can be reduced. Also, the number of students admitted into the schools should be based on the available teachers and infrastructure to accommodate the students. Policymakers in education in Benue State and Nigeria at large should bring about policy that puts the class size to twenty five students per teacher, so that the results of assignments, tests and examinations can be a reliable reflection of students achievement and not a hasty appraisal of students' effort by an overwhelmed teacher struggling to cope with a large student's population.

REFERENCE

[1]. Adeyela, J. (2000). Problems of teaching science in large classes at the Junior secondary school level. Implications for learning outcomes. Unpublished M.Ed thesis University of Ibadan,

[2]. Adeyemi, T.O. (2008). The influence of class size on the quality of output In secondary schools, In Ekiti State in Nigeria. American – Eurasian Journal of Scientific Research 3.1, 7 – 14.P566.

[3]. Afolabi, F. (2002). School factors and learner variables as correlates of senior secondary Physics achievement in Ibadan. Unpublished Ph.D thesis, University of Ibadan, Ibadan

[4]. Alio, B. C. (2003). Obstacles to effective secondary school secondary school mathematics education; the challenges of mathematics education. Multidisciplinary journal of research development NARD Publishers.

[5]. Aluko, S. (1992). Nigeria: The Way Forward Lecture Obafemi Awolowo Foundation Dialogue, pp 73-74.

[6]. Anikweze, C.M. (2004). Achieving Improved Teacher Capacities in Nigeria: Impact and Policy reforms and social dialogue. May, 2004.

[7]. Fabunmi M, Brai-Abu P, Adeniji I. A. (2007). Class Factors as Determinants of Secondary School Student's Academic Performance in Oyo State, Nigeria. *Kamla-Raj: Journal of social Sciences*. 14(3): 243-247.

[8]. Glass, G.V and smith, M. L. (1979). Meta-analysis of Research on Class Size and Achievement. Educational Evaluation and Policy Analysis, 1, 2-16.

[9]. Olatunde Y.P (2010). Class size and students' mathematics achievement of senior secondary schools in South-western Nigeria. The Social Sciences, 5 (2), 108-112.

[10]. Osim, R.O (2011). Teacher quality: It's implication for task performance among secondary school teachers in Cross River State Nigeria. International J.Edu. Admin. Planning and Res. 4 (2), 30-37.

[11]. Smith, M.L. and Glass, G.V. (1980). Meta-Analysis on class size and its relationship to attitude and instruction. American Educational Research Journal, 17, 419 – 433.

[12]. Yara, P.O. (2010). Class size and students' Mathematics Achievement of senior secondary schools in Southwestern Nigeria. The Social Sciences Journal (TSS), 5(2), 108 – 112.

Zaib-un-nisa. "Effect of Class Size on the Performance of Mathematics Students in Makurdi Metropolis, Benue State, Nigeria." *International Journal of Mathematics and Statistics Invention (IJMSI)*, vol. 08(07), 2020, pp. 01-07.