Class Size and Academic Performance of Senior Secondary School Students in Mensuration in Ogbomoso Education Zone, Nigeria

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Abstract
This study investigated the influence of class size on the students' performance in mensuration in Ogbomoso Education Zone, Oyo State, Nigeria. The design of the study was ex-post-facto design. The target population in the geographical scope of this study is thirty-one thousand seven hundred and six (31,706) SS II students out of which a sample of two hundred and seventy four (274) students were selected using purposive sampling technique that form sample size for the study. Two research questions were asked to guide the study while two hypotheses were formulated and tested at 0.05 level of significance. Only one research instrument; Mathematics Performance Test on Mensuration (MPTM) was developed, validated by two experts in Mathematics Education and used to collect data for the study. The instrument yielded reliability coefficient of 0.85 using test retest method to ensure internal consistency of the instrument. Data collected were analysed using mean, standard deviation and t-test. Findings from the study revealed that there was a significant difference in the mean performance scores of students taught in large class size and in small class size. There is no significant difference in the mean performance scores of SS II students taught Mensuration in the rural and urban areas based on class size. Based on the findings, it was recommended, among others, that school principals and other stakeholders who are in charge of admission of students need to take into cognizance the resources available in the schools and the number of students to be given admission.

Keywords: *Class size, Mensuration, Rural School, Urban School, Students' Performance.*

Introduction

Mathematics as a school subject is a tool for scientific and technological advancement. It is a fundamental science that is needed for the understanding of most fields in science and technology education (Bolaji, 2008). Mathematics offers a large educational value apart from its technological relevance and variety of structures such as numbers, shapes, ratios and functions that are very useful in understanding our physical environment (Isa, 2011). Mathematics was viewed by Anaduaka and Hassan (2017) as the bedrock upon which scientific knowledge rests. Hence, the researchers stressed that for a modern existence, apart from rapid technological development, a good knowledge of Mathematics is unavoidable.

The subject helps students to develop a sense of critical thinking, observation and to acquire appropriate skills which in turn lead them to scientific solution of problems.

Due to the importance of Mathematics to everyday life, it was made one of the compulsory and core subjects in primary and post-primary school levels of Nigerian educational system (Federal Republic of Nigeria (FRN), 2014). Mathematics taught in primary and post-primary school levels deals with the study of numbers, shapes and space which involve problem-solving activities and very powerful way of communication (Ahmad, 2016). Seven aspects of Mathematics concepts taught at the secondary school level in Nigeria include: Number and Numeration, Algebra, Measurement, Geometry, Statistics, Trigonometry and Probability. Although, the performance of students in external examinations in the past years were very poor, but some topics in Mathematics as reported by the West Africa Examination Council Chief Examiners' reports of May/June (2019, 2020 and 2021) stated that questions on geometry were poorly attempted by candidates in which mensuration is an aspect.

Plane mensuration, according to Otumudia (2017) include: Problems on; Rectangle, Square, Circle, Triangle, Parallelogram, Trapezium, Rhombus, Length of an arc, Perimeter of a sector, Area of a sector, and Length of a chord. Others are; Perimeter of segment of a circle, Area of segment of a circle and Irregular plane shapes. Solid mensuration include: Cylinder, Surface area and volume of cylinder, Hollowed cylinder, pipes and rings, and Cone. Others are; problems on cones formed from a sector, Sphere and Hemisphere, Triangular Prism, Cube, Cuboid, Pyramid, Frustum, and Irregular solids (Otumudia, 2017). Both plane and solid mensuration help students to understand their environments better through analysis of some existing facts.

Class size, according to Michaelsen (2007) is the number of students for whom a teacher is primarily responsible for during a school year. Adeyemi (2008) defined class size as an educational tool that can be described as an average number of students per class in a school. In other words, class size is the number of students per teacher in a class, that is, student to teacher ratio. This ratio is defined as the tool that can be used to measure performance of the education system, and work productivity. The class size could be considered as large or small, but Sparks (2010) noted that class can be said to be large when the student number is more than 25. Study by Rivkin, Hanushek and Kain (2005) argue that even though numbers may be necessary for defining large classes, number alone is not sufficient to arrive at a shared definition, even within one country. Another study by Jepsen and Rivkin (2009) shown that class size is an important factor that affects the performance of students. This suggests that large class size cannot be defined only by the number of students but by several additional factors.

Large class size, according to Anderson (2000), is one of the major problems in the education sector that developing nations like Nigeria have been struggling with. Nigeria, as a developing country, is no exception and has its own fair share of this problem at the pre-tertiary and tertiary levels of education. Almost all schools, colleges and universities in Nigeria have large classes, which some educators have linked to lower test scores in Mathematics in particular and other subjects in general. Large classes in our secondary schools in Nigeria appear to be a serious challenge to teachers, school authorities and other stakeholders. The truth is that the student population is greater than the facilities, infrastructure and staff of the school.

On the definition of class size and argument on the student-teacher ratio; British Council (2010) explained that a large class in the United State (US) or United Kingdom (UK) may be considered small by both teachers and students in most teaching-learning contexts in Africa. The British Council explained further that large class can vary from twenty-two (22) in US elementary schools to one hundred and fifty (150) in an Africa classroom. United States Agency for International Development (USAID) reported that in the Western countries, class size of thirty (30) is considered large which needs to be reduced. The reduction should include physical conditions in the classroom such as number of space available and personnel resources. In Nigeria, there is appropriate class size in learning and has a policy that guides the ratio of teacher to student in classroom environment. According to the Nation Policy on Education (2013), the standard ratio of teachers to students in junior secondary school is 1: 35. Although, some schools observed it, but most schools do not observed the policy due to inadequate learning facilities.

Academic performance, according to Out-Danquah (2002), is what a student is capable of achieving when he or she is tested on what has been taught. The researcher explained further that it is how well a student meets standards set out to be attained in an educational institution. This indicates that academic performance can only be determined after the student has been taught a specified course of study. Adams and Hayes (2001) viewed academic performance as three things: (a). ability to study and remember facts, (b). ability to study effectively and see how facts are fit together to form larger patterns of knowledge and to think for oneself relationship among facts, (c). ability to communicate knowledge verbally or writing it down. In the same vein, Jae (2018) opined that performance can be measured in various ways; such as retention rates, graduation rates, standardized test scores and performance test scores. However, this research study used standardized test scores as a measure of students' achievement.

Empirical study on class size and performance by Fabunmi and Okore (2000) revealed that class size is a major factor of performance in Secondary School Certificate Examination (SSCE). The researchers observed that students in small class size recorded better test scores than those in the large class size. Another study revealed that teachers of smaller classes confront fewer disciplinary problems, cover subject matter in more depth, have more one-on-one contact with students and keep better track of student progress which eventually lead to higher academic performance than their colleagues in large classes. It was also discovered in the study by Brophy (2000) that the school principals reported that smaller classes have allowed them to establish and maintain better relationship with students, parents and families and resulted in better academic performance. Cotton (2001) in a study opined that specific benefit associated with smaller class sizes are higher student achievement especially in a test scores.

Robinson and Wittebols (1986) in In-Soo and Jae (2009) reviewed 100 class size research studies conducted between 1950 and 1985 using a related cluster analysis approach that grouped similar kind of studies together. The study concluded that the effects of smaller classes on student learning, attitudes and behaviour decreases as grade level increases and that clearest evidence of positive effects is in the primary grades, particularly kindergarten through third grade. The result of the study explained further that reducing class size is especially promising for disadvantaged and minority students. In addition, they explained that

if the teacher did not change their teaching methods and classroom management in the smaller classes, positive effects could be smaller. Nathan and Febey (2001) mentioned similar benefit outcomes that smaller class sizes can provide; such as, a safer place for students, a more positive environment, higher achievement, higher graduation rates, fewer discipline problems and greater satisfaction for families, students and teachers.

In the same vein, Hinneh and Hilda (2019) in their study concluded that large class size directly destroyed or damaged the quality of teaching and instruction delivery as well as students' learning outcomes. In other word, large class sizes increase the possibilities for mass failure and make students to lose interest in school. The researchers explained further that large class size do not allow individual students to get attention from teachers which can lead to low reading scores, frustration and poor academic performance. The study concluded that classroom size significantly influence academic performance of students at all levels. The relationship between classroom size and academic performance was found to be inversely related. Students in large classrooms performed poorly while students in small classroom size performed better academically. In the contrary, Hoxby (2000) found no statistically significant performance gains for students in smaller classes compared to students in larger classes. In a study carried out by Abdallah, Fuseini, Abudu and Nuhu (2014) on large class size and students' academic performance in basic, secondary and selected tertiary institutions in Central Region of Ghana, little or nothing is known about whether large class size influences students' academic performance.

Statement of the Problem

Despite the importance and usefulness to Mathematics for the technological development of any nation, the rate of failure has become so alarming and a great concern to stakeholders. Many studies have been carried out in several areas in order to improve students' academic performance in Mathematics. Some researchers have attributed the problems to some factors such as teachers' failure to adopt appropriate teaching methods in the teaching of some mathematical concepts (Nwoye, Okoye, Ugwuany, Odo, & Eze, 2019); influence of school location (Igboegwu & Okonkwo, 2012); lack of learning facilities such as instructional materials, laboratories and equipment (Kaniz, 2015); lack of enough physical facilities that lead to overcrowded classrooms or Large class size (Fabunmi & Okore, 2000). Study by Hoxby (2000) found no statistically significant performance gains for students in smaller classes compared to students in larger classes. Owoeye and Yara (2011) agreed that students performed better in large class size than in a small class. Discordant to the study of Owoeye and Yara (2011) is the study of Hinneh and Hilda (2019) which reported that students in large classrooms performed poorly while students in small classroom size performed better academically. Therefore, this situation of inconsistent findings of class size studies has left an empirical gap to be filled; whether class size has any effect on students' academic performance at senior secondary school level or not. This is due to the fact that available studies on effect of class size on students' performance are inconclusive.

Purpose of the Study

This study aimed at investigating the effects of class size on the academic performance in Plane Mensuration in Ogbomoso Education Zone, Oyo State, Nigeria. Specifically, the study is to determine:

1. the effect of class size on senior secondary school students' performance in Mensuration.

2. the effect of school location on senior secondary school students' performance in Mensuration based on class size.

Research Questions

In view of the purpose of the study, the following research questions were formulated to guide the conduct of the study:

1. What is the effect of class size on the students' mean performance scores in Mensuration?
2. What is the effect of school location on students' mean performance scores in Mensuration based on class size?

Research Hypotheses

The formulated hypotheses on this research to guide the study and tested at 0.05 levels of significance are as follow:

HO_1: There is no significant difference in the mean performance scores of students in Mensuration based on class size.

HO_2: There is no significant difference in the mean performance scores of students taught Mensuration in the rural and urban areas based on class size.

Scope of the Study

Geographically, the study is limited to senior secondary schools in Ogbomoso Education Zone I of Oyo State, Nigeria. The content scope is delimited to Mensuration and the sample scope is Senior Secondary two (SS II) students in Ogbomoso Education Zone I. Ogbomoso Education Zone I consists of Ogbomoso South, Ogbomoso North and Oriire Local Government Areas (LGAs) of Oyo State.

Research Type

The research type used in this study was ex-post-facto design, which is also known as quantitative research design. In this design the researcher does not have control over who experienced the treatment and who did not.

Population, Sample and Sampling Techniques

The target population for the study consists of SS II students in the thirty-seven (37), sixteen (16) and eighteen (18) public senior secondary schools in Ogbomoso North, Ogbomoso South and Oriire (LGAs) respectively. The students' population consists of twelve thousand four hundred and forty-one (12,441), eleven thousand nine hundred and ninety-nine (11,999) and seven thousand two hundred and sixty-six (7,266) from Ogbomoso North, Ogbomoso South and Oriire LGAs respectively. Therefore, students' populace in the geographical scope of this study is thirty-one thousand seven hundred and six (31,706). Purposive sampling technique was used to select four (4) schools; one school from Ogbomoso North and one from Ogbomoso South (Urban Areas) and two schools from Oriire LGA (Rural Area) based on their populace. Thereafter, purposive sampling technique was also used to select three (3) schools in the Education Zone: the most populous school, the least populous school in urban area and one least populous in the rural area. The sampling technique used for the study was considered appropriate because selections of schools for the study and students' populace in the three classes were done based on the location and class size respectively. Two hundred and seventy four (274) SS II students form sample size for the study: two hundred and two

(202) students from most populous school (urban), thirty seven (37) students from least populous school (urban) and thirty five (35) students from least populous school (rural).

Research Instrument

The main instrument used to collect data from the samples was Mathematics Performance Test on Mensuration (MPTM). The instrument consists of fifteen (15) questions on Plane mensuration and another fifteen (15) questions on solid mensuration, totaling thirty (30) items of multiple choice tests. The instrument also consists of demographic data of the respondents, which include the name of the school of respondent, gender and Local Government Area.

Validation of Research Instrument

Face and content validity of the instrument were determined by two experts in Mathematics Education at the Department of Science Education, University of Ilorin; and three experienced secondary school Mathematics teachers in Oyo State. The instrument was scrutinised to examine whether it could serve as a useful tool to measure what it is meant to measure regarding the content. A test-retest approach was used to determine the index of reliability of the instrument (MPTM). The instrument was administered to thirty (30) SS II students different from the selected schools for the study. The same test was re-administered on the sample after an interval of one week. Thereafter, Pearson's Product Moment Correlation formula was used to calculate the index of reliability of 0.85.

Procedure for Data Collection

The researcher visited the three sampled schools to seek the consent and cooperation of the school principals, Mathematics teachers and other teachers in the schools. The researcher also employed the service of Mathematics teachers as research assistant in the administration of the research instrument. Procedure for data collection was in phases; Phase 1: the researcher prepared two lesson notes, the first lesson note was on plane mensuration and the second was on solid mensuration. These lesson notes were used to teach the respondents in their respective schools. Each of the lessons lasted for one hour. In other words, it took the researcher six hours to teach the three schools, which were carried out after the school hours with the assistance of their Mathematics teachers. Due to long distance between the three schools, phase 1 for data collection lasted for one week.

Phase 2: this second phase was for the administration of the instrument. With the assistance of the respondents' Mathematics teachers, tests were conducted in the three schools. The second phase lasted for another one week. The third phase was for the marking of respondents' scripts, recording and grading. The third phase of the data collection also lasted for one week.

Data Analysis Techniques

The scores obtained from respondents' scripts were used to calculate the mean, standard deviation and the t-test analysis.

Answering Research Questions

Research Question 1

What is the effect of class size on the students' mean performance scores in Mensuration?

Table 1: Mean and standard deviation of Mathematics performance test (MPTM) for most populous school (urban) and least populous school (rural)

Variable	Groups	N	Mean (x)	S.d
Class size	Small class size	035	19.67	3.23
	Large class size	202	12.57	3.81

Table 1 displayed the mean of 19.67 and standard deviation of 3.23 for small class size while mean of `12.57 and standard deviation of 3.81 for large class size. It can be deduced from this result that the students in small class size performed better than the students in large class size. This signifies that class size may have effect on the performance of Mathematics students.

Research Question 2

What is the effect of school location on students' mean performance in Plane Mensuration based on class size?

Table 2: Mean and standard deviation of (MPTM) for urban and rural least populous Schools

Variable	Groups	N	Mean (x)	S.d
School location	Urban	37	20.06	3.30
	Rural	35	19.67	3.23

Table 2 revealed that students in urban area had a mean performance of 20.06 and standard deviation of 3.30 while students in rural area had a mean performance of 19.67 and standard deviation of 3.23. This result is an indication that students in the urban school performed slightly better than their counterpart in the rural school. In other words, the result shows that school location may have effect on students' performance in Mathematics.

Testing of Hypotheses

Hypothesis HO_1: There is no significant difference in the mean performance scores of students in Mensuration based on class size.

Table 3: t-test analysis of the difference between the mean performance scores of large and small class sizes of students in MPTM

Variable	Group	Number	Mean	S.d	df	t-cal.	t-tab.	Remark
Class size	Small class	35	19.67	3.23	235	7.10	2.60	Reject HO_1
	Large Class	202	12.57	3.81				

Table 3 shows that small class size of 35 students had mean performance of 19.67 and standard deviation of 3.23 while large class size of 202 students had mean performance of 12.57 with standard deviation of 3.81. The table also revealed t-value of 7.10 at a 235 degree of freedom and p-value of 0.000. Therefore, the null hypothesis was rejected since p-value (0.000) is less than the criterion value (0.05). Hence, there is significant difference in the mean performance scores of SS II students in Mensuration which is a topic in Mathematics based on class size.

Hypothesis HO_2: There is no significant difference in the mean performance scores of students taught Mensuration in the rural and urban areas based on class size.

Table 4: t-test analysis of the difference between the mean performance scores of students taught Mensuration in the rural and urban areas based on class size

Variable	Group	Number	Mean	S.d	df	t-cal.	t-tab.	Remark
School location	Rural	35	19.67	3.23	70	0.37	1.99	Accept HO_2
	Urban	37	20.06	3.30				

Table 4 revealed the mean performance score and standard deviation of 19.67 and 3.23 for rural school students respectively, while urban school students had mean performance score of 20.06 and standard deviation of 3.30. Table 4 also revealed that t-value of 0.37 at a70 degree of freedom and p-value of 0.000. Therefore, the null hypothesis is accepted because table value (1.99) is greater than t-calculated (0.37). Hence, there is no significant difference in the mean performance scores of SS II students taught Mensuration in the rural and urban areas based on class size.

Discussion of Findings

This study aimed at investigating the effect of class size on the academic performance in Mensuration on senior secondary school students and the findings from the t-test of the performance mean scores showed that there is significant difference in the mean performance scores of SS II students in Mensuration based on class size. This finding agrees with that of Owoeye and Yara (2011) who carried out a similar study in Ekiti State, Nigeria. The result of this study also agrees with the finding of Nwoye, Okereafor, Okeke and Odo (2020) that carried out research work on class size and students' achievement in junior secondary school in Nsukka Local Government Area of Enugu State. The researchers found a significant difference in the mean scores of students achievement based on class size. Small class size achieved better than large class size. Another study done on class size and students' performance by Hinneh and Hilda (2019) in Ghana is also in concord with the result of this study. The study revealed that relationship between classroom size and academic performance was found to be inversely related. That is, students in large classrooms performed poorly, while students in small classrooms size performed better academically.

Another finding of this study revealed that there is no significant difference in the mean performance scores of SS II students taught Mensuration in the rural and urban areas based on class size. This finding is in line with that of Igboegwu and Okonkwo (2012). The study investigated the influence of gender and location of students on achievement in Chemistry. This submission is also in agreement with that of Kissau (2006) who found no significant influence of school location on academic achievement. However, the finding of Obioma (1986) was in contrast with the present finding who found a significant influence of the school location of students in secondary school in favor of rural areas.

The researcher observed that the size of the class determined level of interaction between the teacher and the students. Small class size promotes better communication between the students and teacher. The teacher was able to address the learning difficulties of each student during teaching learning process. On the contrary, large class size reduces the interaction between the students and teacher and the teacher is unable to attend to each student's needs. These observations imply that large size of the class makes it difficult for the teacher to ascertain the challenges of the students and provide solutions to them. It was also observed

that teaching-learning process in large classes is difficult and ineffective, due to the fact that large class size is always noisy and difficult to control. Students at the back seats of the large class size hardly hear what the teacher is teaching. Some of the students stood throughout the lesson because of inadequate seats and note-taking becomes difficult for such students. The implication of these is poor performance of students in such a class.

Conclusion

The following conclusions were made based on the findings of this study:

There is significant difference in the mean performance scores of SS II students in Mensuration (Mathematics) based on class size. It can be deduced from this result that the students in small class size performed better than the students in large class size. This signifies that class size have effect on the performance of Mathematics students. The study also revealed that there is no significant difference in the mean performance scores of SS II students taught Mensuration in the rural and urban areas based on class size.

Recommendations

The researcher made the following recommendations based on the findings of the study:

1. Principals of schools and other stakeholders who are in charge of admissions of students need to take into cognizance the resources available in the schools and the number of students to be admitted into the schools. For example, number of teachers, furniture, and classrooms must be considered so that the required number of students is admitted to match these resources. If the number of students admitted outnumbers the available resources, it would lead to poor academic performance of students.
2. The management of the schools should seek support of the Parent Teacher Associations in the provision of resources to the schools in order to reduce the problem of large class size and to improve students' academic performance.
3. School management should find ways of managing their large class sizes for effective teaching and learning to enhance academic performance of students. This can be done by providing portable megaphone speakers in large classes.

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