

Effect of Class Size on Academic Achievement of Chemistry Students in Ikere Local Government Area of Ekiti State, Nigeria

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ABSTRACT: *This research investigated the effect of class size on academic achievement of chemistry students secondary schools in public in Ikere local government area of Ekiti State. The study was guided by four (4) objectives which were raised into three (3) research questions and formulated into four (4) hypotheses. The study adopted quasi – experimental research design. The sample size of eighty (80) respondents were used for the study using purposive sampling technique to select a school that practices co-educational school with at least 100 Chemistry students in the SS2 classes. The class was grouped into two. Group 1 named large class consisted of 50 students while the second group, Group 2 was named small class with 30 Chemistry students. The instrument for data collection in the study was a student Chemistry Achievement Test (SCAT). The test retest method of reliability was used to ascertain the reliability index of the instrument using Pearson's Product Moment Correlation (PPMC). A coefficient of 0.85 was obtained. Frequency counts and percentage were used to analyse the demographic data of respondents while the hypotheses were tested using inferential statistics of t-test. Based on the findings of the study, the researcher concluded that Chemistry class size either small or large class size had no effects on students' academic achievement but students' achievement in either small or large class size could be affected by factors like teachers' effectiveness, teaching method, instructional materials available for use etc. Students' treatment in either large or small class size had no effects on Chemistry achievement scores of students taught in small class and those in large class in the post-test. Class size did not affect Chemistry achievement scores of male and female students taught in small class in the post-test. Gender Chemistry achievement is independent of large class in the post-test. Therefore, based on the findings, appropriate recommendations were made.*

Key Words: *Class size, academic achievement, chemistry student, school discipline.*

Introduction

Globally, science has been embraced as driver of the new world and catalyst of civilization of any country. Science has been described as a discipline that is unique with beautiful qualities that branded it with systematic approach through which knowledge is sought after and collected. For every nation to benefit immensely and effectively from the abundant opportunity of science, there is need for substantial level of scientific literacy among the citizen. Pember & Humbe (2009) defined science as a process of teaching or training especially, in school to improve one's knowledge about environment and to develop one's skill of systematic inquiry as well as natural attitudinal characteristics.

Science plays important roles in the society because it relates to our daily life and career. Both the process and product of science are acquired through education and this is specialized type of education such as science education. No country can be globally recognized without talking about its scientific advancements. The importance of science in our society made the Federal Government of Nigeria, through the Federal Ministry of Education to introduce science subjects in the nation's secondary school curriculum. Chemistry is one of such subjects introduced.

Chemistry occupies a unique position among various science subjects offered at the senior secondary school level. The study of Chemistry involves pursuit of truth, a process that instills diligence, patience and objectivity in learners (Opara & Waswa, 2013). Chemistry learning develops the scientific habits in students, which are transferable to other areas of life. Such habits involve non-reliance on superstition, use of critical thinking and respect for other people's opinion (Yunus & Ali, 2012). Chemistry as a science is a fundamental requirement for most core science based courses (Oloyede, 2010). Improving students' academic achievement in Chemistry has been the concern and the reason for most educational research and programmes. In addition to the students' qualities, other determinants such as home factors, school variables, and teacher qualities have been found to impact on students' academic achievement, either positively or negatively. Class size is one of the school variables that determine how effectively students learn.

There is therefore the need to adopt efficient teaching and learning strategies that will enhance better achievement and retention of the subject matter by students. Michael (2010) defined class size as the number of students for whom a teacher is primarily responsible for during a school year. The class size could be large or small. Class size is akin to the administrative element of 'span of control', which is the number of subordinates a manager can effectively supervise. It is an administrative measure signifying the number of students for whom a teacher is responsible during the school year. Adeyemi (2008) described class size as an educational tool that can be used to describe the average number of students per class in a school.

The teacher who is the classroom manager should therefore, have the number of students he/she can effectively control, supervise and teach at any given period. It is often perceived that smaller classes have less number of disruptions thereby engendering better student/teacher engagement and better student learning than larger classes. Adding more students to a class increases the number of disruptions and decreases the amount of time during which learning can take place because the teacher spends time dealing with these students that cause disruptions. Meanwhile, Hattie (2009) argued that not all interactions between student and teacher will result in improved learning; rather effective interaction is what is needed.

However, Sparks (2010) noted that class can be said to be large when the student number is more than 25. As the world population continues to increase, the class sizes are also affected. Class size is often mentioned by experts in the educational literature as having effect on student's feelings and performance, quality of school budgets and on administration as well (Owoeye & Yara, 2011). It is considered as one of the important determinants of academic achievement over which teachers in schools have little or no control. Mokobia & Okoye (2011) explained that educators universally have identified class size as important and desirable attribute of effective educational system.

According to Doyle (2014), in modern day education, the focus is on the needs, interest and comfort of the students. Thus, managing class size allows students to learn effectively without disturbing one another (Garret, 2008). While a number of studies have found support for the importance of class size on student achievement, others strongly disprove this claim concluding that class size has little or no impact on objective student outcomes. The orthodox wisdom among parents, teachers, school administrators, and policy makers is that, smaller class size translates to improvements in student learning and outcomes. This orthodox wisdom, however, has not been universally supported by realistic evidence (Aturupane, Glewwe & Wisniewski, 2013). It has been argued that increasing the intake of senior secondary school students in a large class has numerous benefits for the schools and the country as a whole. It helps to reduce the cost of building additional classrooms of which few schools as well as the country have the resources to fund additional classrooms and teachers.

Determining the ideal class size continues to generate a lot of discussion, especially in this present period of school population explosion, financial hardship, shortage of teachers and students' poor academic achievement. Opinions differ among educationists and different people/ nations have varying perceptions of what constitutes a small, large or ideal class size. Whether a class is perceived as large or small depends on factors such as teacher factors, school environment, educational theories and philosophies. Several factors such as inadequate school building, population explosion, inadequate number of subject teachers, give rise to larger class sizes. In a normal classroom, the teacher is expected to cater for/ deal with diverse personalities with divergent backgrounds, ideas, interests, attitudes and abilities (Eboatu & Ehirim, 2018).

Academic achievement is the educational outcome that indicates the extent to which the specific goal of education has been accomplished in an instructional environment. This is normally shown in terms of students' scores and grades in test examinations or assignments. Maguson (2007) describes academic achievement as commonly measured by examination or continuous assessment but maintains that there is no general agreement on how academic achievement is best tested. Though the relationship between class size and academic achievement has been a perplexing one, many educationists believe that small class sizes engender better student achievement and that it helps students get sufficient feedback. Proponents of small class sizes posited that it enables students to get adequate attention from teachers which invariably lead to better academic achievement and eliminates frustration. Bruhwiler & Blatchford (2011) believes that students who were taught in smaller classes in their early elementary grades continue to have enhanced academic achievement even if they are in larger classes in upper elementary or middle school.

In Ekiti State, inadequate classrooms are coupled with insufficient numbers of chemistry teachers due to no immediate replacement of teachers, as many retire from the teaching profession each year. This leads to increases in teacher-students ratios in schools and lack of specialist teachers to handle some subjects. More often than not, two or more classes are combined to be taught chemistry because of these deficiencies. It brings about large class formation in schools which may hinder academic achievement of

students in chemistry. It was observed by the researcher that in some secondary schools within Ikere local government, the class size is large because of insufficient chemistry teachers. Some of the problems that are associated with large chemistry classes are congestion, noisy classes, little or no interpersonal relationships between teacher and students, etc.

In a chemistry class of 50:1 students-teacher ratio, some of the students will not be able to hear the teacher audibly while teaching and learning process are ongoing. Therefore, this leading to poor dissemination of instructions from chemistry teachers to students and resulting into low impact of knowledge of the topic under discussion. Hence, this study intends to investigate the effect of class size on academic achievement of chemistry students in Ikere local government area of Ekiti State.

Hypotheses

The following hypotheses were tested at 0.05 level of significance in the study:

1. There is no significant difference between the Chemistry achievement scores of students taught in small class and those in large class in the pre-test.
2. There is no significant difference between the chemistry achievement scores of students taught in small class and those in large class in the post-test.
3. There is no significant difference between the chemistry achievement scores of male and female students taught in small class in the post-test.
4. There is no significant difference between the chemistry achievement scores of male and female students taught in large class in the post-test.

LITERATURE REVIEW

Concept of School Environment

According to Mick (2011), school environment means the extent to which school settings promote student safety and student health, which may include topics such as the physical plant, the academic environment, available physical and mental health supports and services, and the fairness and adequacy of disciplinary procedures, as supported by relevant research and an assessment of validity. Environment is a place where the child functions. This includes home, the school, the peer group, the classroom, the totality of the child's upbringing including his spiritual life, tissue needs, social needs, psychological needs it is defined not to mean only the place in which the child lives (physical) but also the people with which he comes in contact with (social) (Akem, 2008).

Students' academic success is greatly influenced by the type of school they attend. School factors include school structure, school composition and school climate. The school that one attends is the institutional environment that sets the parameters of a students' learning experience. As schools are faced with more public accountability for student academic performance, school level characteristics are being studied to discover methods of improving achievement for all students. Depending on the environment, schools can either open or close the doors that lead to academic performance (Barry, 2005).

Crosnoe (2004) suggested that school sector (public or private) and class size are two important structural components of the school. Private schools tend to have both better funding and smaller sizes than public schools. The additional funding for private schools leads to a better academic performance and more access to resources. Research shows that students who trust their teachers are more motivated and as a result perform better in school (Eamon, 2005). School policies and programmes often dictate the school climate. Furthermore, if a school is able to accomplish a feeling of safety, students can have success regardless of their family or neighbourhood backgrounds (Crosnoe, 2004). According to Muleyi (2008), teachers do influence students' academic performance. School variables that affect students' academic performance include the kind of treatment which teachers accord the students. Teachers cannot be dissociated from the schools they teach and academic results of their schools.

Teacher's experience is another indicator of student academic performance. School climate is closely linked to the interpersonal relations between students and teachers. According to Crosnoe (2004), school climate is the general atmosphere of school. Trust between students and teachers increases if the school encourages teamwork. Quite a bit of research has been done to identify the influence of classroom and school characteristics on academic performance. Student achievement variables aggregated to the school level have been used a great deal to describe school output but variables describing aggregation of properties of classrooms within schools have been studied somewhat less often in school analyses.

Concept of Class Size

The concept of class size refers to the number of students undertaking a particular course/ subject or the number of students taught by a teacher in a classroom in a given period. It is the number of students a

teacher attends to during a given period of instruction (Eboatu & Ehirim, 2018). Class size is thus different from the student-teacher ratio, which is expressed as the relationship between the student population and the number of teachers available in the school. The schoolteacher-to-student ratio may be low but conceals the existence of a dearth of teachers in some subject areas that lack teachers, thereby giving rise to few teachers teaching large numbers of students in these subjects. Class size may be defined as the number of students per teacher in a given class or the population of a class (Ajayi, Audu & Ajayi, 2017).

Several factors such as inadequate school building, population explosion, inadequate number of subject teachers, give rise to larger class sizes. In a normal classroom, the teacher is expected to cater for/deal with diverse personalities with divergent backgrounds, ideas, interests, attitudes and abilities. In large classes and overpopulated classes, the result is student disengagement (Eboatu & Ehirim, 2018). The teacher in such a situation may not be able to give individual students the attention they need and this may lead to poor academic achievement. FRN (2013) therefore prescribes a student-teacher ratio of 1:25 for pre-primary classes; 1:35 for primary and 1:40 for secondary schools. Some researchers have maintained that class size is a tool which can be adopted in measuring performance of educational system (Kedney, 2013). Class size is refers to as students to teacher ratio per class (Ali, 2012).

In the view of Ikolo (2011), class size equally means group which is a set of persons among whom there exist a definable or observable set of relations. The word group then can refer not only to a set of persons but to a place where the interaction occurs. According to Imoke (2006) optimum class size implies rational coordination of educational infrastructures, subject to available number of students in order to attain high level of productivity. The class size is becoming increasingly unmanageable, putting teachers in an impossible position of giving individual student required attention. In Nigeria public schools, the teachers' eye contact with the students in class has become so reduced that some of the poorly motivated students can form number of committees at the back of the class while teaching is going on to engage in non-school discussion. Regular assignments and home works are dreaded by teachers considering the staggering number of books to mark and to record (Adimonyemma, Akachukwu & Igboabuchi, 2018).

Class Size, School Discipline and Performance

Discipline is a variable that impact and influence either way the students' academic performance in the school. Discipline according to Animashaun (2009), is the control of the class by the teachers as applicable to a feature of school life. Discipline is the training which produces cooperation from the students. Classroom discipline is the business of enforcing classroom standards and building patterns of corporation to maximize learning and minimize disruption. Makinde (2011) opined that to build positive classroom discipline, teachers should model appropriate behaviour and use appropriate classroom management methods. It is often argued that many notable problems that are militating against students' academic performance in Chemistry originated from the class.

A lot of indiscipline acts in the classroom are born of out of the fact that the class is too large for the teacher to manage (Mcintyre, 2005). The over population of the classroom and the prevalent acts of indiscipline is a thing of concern for educators and this researcher. Several factors have been incriminated as being responsible for the conducive teaching and learning environment. Among such factors are class size and discipline (Tobih, Akintaro & Osunlana, 2013). On one side, classroom congestion in terms of large class is blamed and on the other hand, low utilization of classrooms in the sense of small class size have been identified as a common feature of secondary schools in Nigeria. Conflicts has often appeared on the ideal class size. Zyngier (2014) stated that the relationship between class size and academic achievement is an approach that has been tried, debated and analysed for many decades. Some educators have long argued that students do better in small class sizes and there is a logic that small class size increase students' academic achievement.

Despite large amount of research on the debate on relationship between class size and student academic performance, there exist sharp disagreements about the findings. The divergent views have made it difficult to pin down the precise relationship among class size, discipline and students' academic performance. Although, most studies in Nigeria revealed significant relationship between class size and students' academic performance such as, Fabunmi, Brai-Abu & Adeniji (2007) who found out that class size alongside classroom space and classroom utilization rate determines significantly secondary school students' academic performance in Oyo State. Tobih, *et. al.* (2013) revealed that there is significant relationship between class size and students' academic performance in mathematics in JSSCE examination.

Status of Class Size in Senior Secondary Schools Chemistry Class

Education is the systematic training of individual in order to bring about positive change in his or her behaviour so as to become fulfilled citizen (Angelo, 2008). Across the globe, trends in education have

reflected significant increase in students' enrolment (Ademola, 2014). This is very evident in Nigeria with an upward trend in school enrolment at all levels of education including science (chemistry) after the civil war in 1970. Nigeria, like most of the countries across the globe has adopted and implemented to a large extent the Education For All (EFA) policy of the United Nations (UN), which has in no small measure resulted in the increased students population at all levels of education. The increased numbers in enrolment have led to another educational problem which piqued the interest of educators, particularly when this increased number is juxtaposed with students' classroom management and engagement. The increased figure in enrolment has led to increased number of students in a chemistry classroom.

According to Yusuf (2015), classrooms are used as appropriate places for seeking and acquiring education usually from a teacher to the learners. Classroom size is the population of a given class in terms of number of students per teacher. The FRN (2013) recommended an average of 40 students per class as the standard class size in Nigeria. Two class sizes are normally distinguishable in the educational sector. A large class size falls within 41 and above learners to one teacher while small class size is within 15-40 learners to one teacher (Aliu, 2015). Many scholars including Yusuf (2015) all support this classification of class sizes. Therefore, class size with 1 - 40 students per teacher will be categorized as small class size while class size with 41 and above students per teacher will be categorized as large class size.

Dror (2009) noted that class size (in chemistry) has become a phenomenon often mentioned in the educational literature as an influence on students' socializing pattern and academic performance, quality of instruction, administration and school budgets. The scholar added that class size is an administrative decision which teachers have little or no control. Ogunyemi & Hassan (2011) maintained that the issue of small or large class size can be counter-productive. In remote and even local areas, classes are found to be over-congested which is indeed an indication of the dearth of educational facilities in schools. The issue of large class sizes and the associated consequences is paramount. The phenomenon of large classes is fast becoming the vogue of senior secondary schools in Nigeria and in most developing countries.

The large class syndrome has been attributed to the expansion in annual students' enrolment. Sesugh (2012) discovered that there is tremendous increase in the enrolment of students and in the average size of classrooms in Nigeria senior secondary schools these days from 30 - 40 students to 60 - 75 or even more. Though, open enrolment in schools is laudable, yet, the deficiency is in the corresponding provision of adequate infrastructures, inadequate classrooms, short supply of teachers, dilapidated structures and classrooms which look like poultry in some schools. Seats and desks which are basic classroom requirements are insufficient and in some senior secondary schools, students are sitting on ransacked furniture and some even sit on bare floor (Omwirhiren & Anderson, 2016).

The size of classes has become increasingly unmanageable, leaving the chemistry teachers with the impossible task of giving individual attention to the learner's needs. The chemistry teachers' eye contact with the learner in class becomes so dissipated that a number of poorly motivated learners can form small committees at the back of the class to engage in non-school discussion, while the teacher is busy teaching. Continuous assessments are dreaded by teachers when they consider the staggering number of scripts to be marked and recorded. In modern education, attention is centered on the needs and comfort of the learner, how the learning is distributed by social background and may be influenced by the structural and organizational properties of the school. Thus, attention is centered on class size which allows (chemistry) students to learn effectively without disturbing one another (Ajayi, Audu & Ajayi, 2017).

Large Class Size and Academic Achievement of Chemistry Students

Teaching large classes is particularly challenging. The challenge to schools to provide a high quality education comes when secondary schools are also facing budget crises. A solution that many schools have turned to is large classes. Besides, the literature has argued that pedagogies specifically designed for teaching smaller classes sometimes overlap with pedagogies employed when teaching larger classes but have distinct characteristics that differentiate them from those employed when teaching larger class (Aturupaneet *et al.*, 2013; Azigwe, Kyriakides, Panayiotou & Creemers, 2016).

Although no consensus exist as to the exert size of the large class, the term generally applied to classes with more than 50 pupils. Some regard a large class as one with more than 100 pupils. According to Amadahe (2016), one of the most essential parts of the teaching and learning process is assessment and evaluation of students. Large classes call for large volumes of marking to be done and feedback given to students. This is a major challenge, especially in Nigeria public senior secondary schools. In the face of large classes, instructors are upset with the workload and resort to traditional teaching and assessment methods. Teachers are unable to finish marking assignments, exercises and examinations on time, and this delays the feedback given to students. Kasumi (2014) stated that large classes are less likely to make compositions and

oral presentations and are more likely to mark students with multiple-choice-exams involving multiple solutions.

Large classes may be a cost effective solution to budget crises at some schools, but they have been criticized by teachers and education stakeholders. Instructors frequently feel that teaching large classes is an unrewarded, ineffective or, at the very least challenging situation. Olatunde (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%). And for many schools, regardless of experience, teaching a large class seems difficult to do well. The large class experience also challenges pupils. Most large- class courses are introductory and intended for first and second year pupils for whom learning in a large class is a new experience. They must learn to get by with less individual attention than they may have received in primary schools. As a result, some chemistry students may feel anonymous in the class and this anonymity may make it harder for them to become motivated to keep up.

Another obstacle is that with so many of their peers listening, many pupils in large classes feel too intimidated to ask questions or too overwhelmed by the material to approach instruction or others for help. Larger classes needed fewer teachers and classrooms, hence the per-pupil cost was less (Tomlinson, 1998). The response of educators and school reformers to this practice was the same then as now. They believed that larger classes would increase the teachers' work burden and reduce the efficacy of instruction. Seats and desks which are basic classroom requirements are insufficient and in some secondary schools, students are sitting on ransacked furniture and some even sit on bare floor (Oyeniran, 2014). The size of the classes has become increasingly unmanageable, leaving the teachers with the impossible task of giving individual attention to the learner's needs. The teachers' eye contact with the learner in class becomes so dissipated that a number of poorly motivated learners can form small committees at the back of the class to engage in non-school discussion, while the teacher is busy teaching.

Small Class Size and Academic Achievement of Chemistry Students

Class with a smaller number of students is often perceived to allow teachers to focus more on the individual needs of students and shorten the amount of time in the classroom that teachers dedicate such as discipline, or disruption among students. Factors that affect the interaction between teachers and students in the class are: courses subjects, teachers' sharing time between teaching and other duties, students' grouping within the classroom and teaching practice in groups or teams (Kasumi, 2014). Resnick (2018) stressed that class size must be reduced substantially to achieve the benefits. There is no experimental research suggestions that any benefits are realized by subtracting only a few children from a larger class, for example, transitioning from 28 to 25 pupils.

Muraina & Muraina (2014) revealed that comfortable classroom temperature and smaller classes enhance teachers' effectiveness and provide opportunities for students to receive individual attention, ask more questions, participate fully in discussion, reduce discipline problems and perform better than students in schools with larger classes. Filges, Sonne-Schmidt & Bjørn (2018) concluded that reducing class size from 40 or more to 20 pupils led to almost no increase in achievement. Not until class size is being dropped to 15 pupils or lower will there be larger effects on achievement. In light of the varying definitions and methodologies for defining school and class size, a procedure had to be established for on the effect of class size on pupil achievement. Identifying large and small schools, then calculating the class size in those schools, was the most logical way to define class size.

Filgesset *al* (2018) emphasized the importance of investigating underlying motivations for teachers and parents and the need to examine teaching practices. Disruptive students are reasons why some promote small classes. Improving classroom management skills, providing alternative settings or additional support for disruptive pupils, or changing the curriculum might have more of an effect on pupil achievement performance than universally reducing class size.

Normore & Ilon (2006) concluded that smaller class size had a positive impact in several areas like having time to cover school curriculum, higher levels of pupil- pupil and pupil-teacher relationship and safer schools with fewer discipline problems.

At the same time, the evaluation of small class sizes is better, where teacher has an idea, prediction and keeps complete records for each student, for their achievements or their full performance (Kasumi, 2014). Teachers and students shall be provided with appropriate classroom conditions and limited number of students per classroom in order to organize and develop work in groups and course related practical activities. The class size could also affect the teacher's allocation of time and, hence, effectiveness, in other ways, too. According to Johnson (2010), classes that require active participation of the students are small.

Small classes tend to be effective, since students actively process the material rather than just listen and read.

Olatunde (2010) investigated the class size and the students' mathematics achievement of senior secondary schools in Southwestern Nigeria. The results showed that the performance of students in large classes was very low (23%) compared to those students in smaller classes (64%). It was then recommended that policymakers and the government should ensure that more classrooms are built and the number of students in a class should not be greater than 30.

Bakasa (2012) also investigated the effect of class size on academic achievement at a selected institution of higher learning in South Africa. Descriptive findings, which were a triangulation of the data gathered from the various instruments of data collection, pointed towards a conclusion that class size and school factors such as teacher effectiveness can influence student achievement.

Cho, Glewwe & Whitley (2012) analyzed the Minnesota Comprehensive Assessment test of all third and fifth grade students in Minnesota. They found that reducing class size had a positive impact on student performance in reading and mathematics. However, the researchers' analysis of the data showed only a minimal increase with a 10-student decrease in class size, resulting in a 0.04 to 0.05 standard deviation increase in the distribution of student standardized test scores.

Kassile (2014) conducted a study to look at the effects of various resources on student achievement. The study analyzed the effect of student-teacher ratio on pass rates on the Primary School Leaving Examination in Mainland Tanzania. It was found out that student-teacher ratio had a statistically negative effect on student achievement with a Pearson correlation coefficient of 0.74176 and $p=.0001$.

Mahlo (2015) in his study compared class size (learner-teacher ratio) between boarding and non-boarding schools, along with the correlation between them and academic achievement of Grade 12 learners of the Capricorn District in the Limpopo Province of South Africa. A simple random sample was drawn from the population of 339 schools, comprising of 51 principals, 158 teachers and 290 learners from 51 schools. The School Environmental Questionnaire (SEQ) collected data on the school environment, while the Capricorn District Academic Summary Report of the Grade 12 collected data on academic achievement. The data analysis technique used was the t-test. The results showed no significant difference in learner-teacher ratio between boarding and non-boarding schools. It also revealed no significant difference in class size exists between low and high achieving schools indicating that the class has no significant relationship with academic achievement.

McKee, Sims & Rivkin (2015) investigated patterns of heterogeneity in the effects of class size on student achievement in the Project STAR classes that showed improvement. They found out that students in higher poverty schools and academically gifted students both benefitted from smaller class size. It was conjectured that in higher poverty classrooms, there are a larger number of interruptions and classroom management issues that can be minimized with smaller class sizes. In academically gifted classrooms, smaller classes can result in more individualized and challenging instruction.

Methodology

The design of this study was quasi – experimental research design. It utilized the null randomized pre-test and post-test design.

The target population for the study consisted of the students in senior secondary school class 2 (SSS 2) studying Chemistry in Ikere Local Government Area of Ekiti State. The choice of Senior Secondary School II Chemistry students was borne out of the researcher decision that this is the class in which organic chemistry was being introduced to students in secondary schools and also it is a class preparing for Ekiti State unifying mock examination for senior secondary school students.

The sample for the study consisted of seventy five (25) SS2 Chemistry students in a selected secondary schools in Ikere Local Government Area. Purposive random sampling was used to select a school that has practice co-educational school programme with at least 100 Chemistry students in the SS2 classes. The students were randomly selected into two groups. Group 1 named large class consisted of 50 students while the second group, Group 2 was named small class with 30 Chemistry students.

The only instrument for the study was a Students' Chemistry Achievement Test (SCAT). The SCAT was a 50 – item multiple choice test developed by the researcher based on the Chemistry concepts organic chemistry. The SCAT consisted of two sections A and B. Section A was used to elicit demographic data of the respondents like name of school, gender and age while section B consisted of fifty multiple choice questions with four options labeled A – D.

The SCAT was used as pretest and posttest. The pretest was used to establish the baseline of all the selected students before the commencement of the treatment. The posttest was used to determine the effect of class size on students' achievement in chemistry.

The Students Chemistry Achievement Test (SCAT) was subjected to both content and face validity. The content validity was accomplished by ensuring that the test reflected the test blue print. Face validity was established by evaluation of the test items by the researcher's supervisor and one lecturer in Department of Chemistry in University of Nigeria, Nsukka, Ikere-Ekiti Campus. The validators were given the research topic, research questions and hypotheses to enable them validate the instruments.

Reliability of the Instrument

To ensure that the items are consistent, test retest reliability method was used. A pilot study was carried out in a school which involved 50 SS2 students in Ikere Ekiti, Ekiti State. The school selected was not part of the school selected for the study. The data collected were subjected to item analysis using Pearson Product Moment Correlation Statistics. This was used to obtain the reliability index of the instrument. The reliability index obtained was 0.85.

The researchers personally visited the selected secondary schools and get the consent of the school management before administering the same pre and post achievement test i.e. SCAT for the students. The study lasted for six weeks. In the first week the researchers divided the student into 2 classes' i.e. large class and pre-tests was administrated on the participating students after the researcher has brief the student on the importance of the study. On the second week, the researchers taught each days on different hour based on the chemistry concept (Organic chemistry). The researchers had prepared the lesson notes for the lesson and this lasted for two hours a week. On the last week which is the sixth week. The SCAT was re-administered to the students as post-test so as to determine their level of achievement.

Frequency counts and percentage were used in analyzing the demographic data of the respondents. While the research hypotheses were tested using the t-test at 0.05 level of significance.

Results and Discussion

Test of Hypotheses

Hypothesis 1: There is no significant difference between the Chemistry achievement scores of students taught in small class and those taught in large class in the pre-test.

Table 1: t-test analysis of performance of students in chemistry pre-test.

Variable	N	Mean	SD	df	t _{cal.}	t _{tab.}	Decision
Small class	30	19.80	3.66	78	0.37	1.96	Not significant
Large class	50	19.50	3.39				

P < 0.05 significance level

Table 1 shows the result of analysis of performance of students in chemistry pre-test. The table revealed that mean score for students taught in small class (19.80) was greater than the mean score of students taught large class (19.50) with a mean difference of (0.30). The t-test revealed that t-calculated (0.37) was less than the critical t-value (1.96) at the 0.05 significance level. Hence, the null hypothesis was upheld. This means that there is no significant difference between Chemistry achievement scores of students taught in small class and those in large class in the pre-test.

Hypothesis 2: There is no significant difference between the chemistry achievement scores of students taught in small class and those taught in large class in the post-test.

Table 2: t-test analysis of performance of students in chemistry post-test.

Variable	N	Mean	SD	df	t _{cal.}	t _{tab.}	Decision
Small class	30	44.20	4.01	78	0.13	1.96	Not significant
Large class	50	44.08	3.93				

P < 0.05 significance level

Table 2 shows the result of analysis of performance of students in chemistry post-test. The table revealed that mean score for students taught in small class (44.20) was greater than the mean score of students taught in large class (44.08) with a mean difference of (0.60). The t-test revealed that t-calculated (0.13) was less than the critical t-value (1.96) at the 0.05 significance level. Hence, the null hypothesis was upheld. This means that there is no significant difference between Chemistry achievement scores of students taught in small class and those in large class in the post-test.

Hypothesis 3: There is no significant difference between the chemistry achievement scores of male and female students taught in small class in the post-test.

Table 3: t-test analysis of performance of students in chemistry post-test.

Variable	N	Mean	SD	df	t _{cal.}	t _{tab.}	Decision
Male small class	16	43.75	4.00	28	0.65	2.00	Not significant
Female small class	14	44.71	4.10				

P < 0.05 significance level

Table 3 shows the result of analysis of performance of students in chemistry post-test. The table revealed that mean score for students taught in male small class (43.75) was less than the mean score of students taught in female small class (44.71) with a mean difference of (0.96). The t-test revealed that t-calculated (0.65) was less than the critical t-value (2.00) at the 0.05 significance level. Hence, the null hypothesis was upheld. This means that there is no significant difference between Chemistry achievement scores of male and female students taught in small class in the post-test.

Hypothesis 4: There is no significant difference between the chemistry achievement scores of male and female students taught in large class in the post-test.

Table 4: t-test analysis of performance of students in chemistry post-test.

Variable	N	Mean	SD	df	t _{cal.}	t _{tab.}	Decision
Male large class	22	43.05	4.38	48	1.68	2.00	Not significant
Female large class	28	44.89	3.39				

P < 0.05 significance level

Table 4 shows the result of analysis of performance of students in chemistry post-test. The table revealed that mean score for students taught in male large class (43.05) was less than the mean score of students taught in female large class (44.89) with a mean difference of (1.84). The t-test revealed that t-calculated (0.65) was less than the critical t-value (2.00) at the 0.05 significance level. Hence, the null hypothesis was upheld. This means that there is no significant difference between Chemistry achievement scores of male and female students taught in large class in the post-test.

Discussion of Results

The results of finding revealed that there is no significant difference between Chemistry achievement scores of students taught in small class and those in large class in the pre-test. The findings agreed with the findings of Olatunde (2010) that the performance of students in large classes was very low (23%) compared to those students in smaller classes (64%). And for many schools, regardless of experience, teaching a large class seems difficult to do well. The large class experience also challenges students. The size of classes has become increasingly unmanageable, leaving the chemistry teachers with the impossible task of giving individual attention to the learner's needs. The chemistry teachers' eye contact with the learner in class becomes so dissipated that a number of poorly motivated learners can form small committees at the back of the class to engage in non-school discussion, while the teacher is busy teaching.

Also, the findings from hypothesis 2 revealed that there is no significant difference between Chemistry achievement scores of students taught in small class and those in large class in the post-test. The findings is in line with the assertion of Resnick (2018) that class size must be reduced substantially to

achieve the benefits and further stated that there is no experimental research suggestions that any benefits are realized by subtracting only a few children from a larger class, for example, transitioning from 28 to 25 pupils. Not until class size is being dropped to 15 students or lower will there be larger effects on achievement. The findings also agreed with the finding of Muraina & Muraina (2014) that comfortable classroom temperature and smaller classes enhance teachers' effectiveness and provide opportunities for students to receive individual attention, ask more questions, participate fully in discussion, reduce discipline problems and perform better than students in schools with larger classes. In light of the varying definitions and methodologies for defining school and class size, a procedure had to be established for on the effect of class size on student achievement. Identifying large and small schools, then calculating the class size in those schools, was the most logical way to define class size.

The findings in hypothesis 3 revealed that there is no significant difference between Chemistry achievement scores of male and female students taught in small class in the post-test. This supported the findings of Bruhwiler (2011) that students who were taught in smaller classes in their early elementary grades continue to have enhanced academic achievement even if they are in larger classes in upper elementary or middle school. This implies that irrespective of gender, students' performance is guaranteed when taught in smaller class size. This established the fact that students taught in class size have improved academic performance whether male or female students. Chemistry students who are taught in small class size have access to sufficient learning materials, teachers' attention, enough instructional materials for enhancing learning and improved academic performance. Smaller class size had a positive impact in several areas like having time to cover school curriculum, higher levels of student - student and student -teacher relationship and safer schools with fewer discipline problems. Teachers and students shall be provided with appropriate classroom conditions and limited number of students per classroom in order to organize and develop work in groups and course related practical activities. The class size could also affect the teacher's allocation of time and, hence, effectiveness, in other ways, too and this will all have their effects on students' performance in chemistry.

Hypothesis 4 revealed that there is no significant difference between Chemistry achievement scores of male and female students taught in large class in the post-test. This is in line with the statement of Kasumi (2014) that large classes are less likely to make compositions and oral presentations and are more likely to mark students with multiple-choice-exams involving multiple solutions. Large classes may be a cost effective solution to budget crises at some schools, but they have been criticized by teachers and education stakeholders for less effective academic performance of students in subject like chemistry. Even, teachers frequently feel that teaching large classes is an unrewarded, ineffective or, at the very least challenging situation. Just as Johnson (2010) stated that classes that require active participation of the students are small. Small classes tend to be effective, since students actively process the material rather than just listen and read.

Conclusions

Based on the findings of the study, the researcher made the following conclusions:

Chemistry class size either small or large class size had no effects on students' academic achievement but students' achievement in either small or large class size could be affected by factors like teachers' effectiveness, teaching method, instructional materials available for use etc. Students' treatment in either large or small class size had no effects on Chemistry achievement scores of students taught in small class and those in large class in the post-test. The implication of this is that teacher's methodology and mode of instruction could be main determining factors that affects the academic achievement of students in chemistry. Class size did not affect Chemistry achievement scores of male and female students taught in small class in the post-test. This implied that class size could have influence on students' performance but students' achievement in chemistry in small class size is independent of gender of students. This is because if students either male or female are exposed to chemistry teaching that is experimental in nature, they are likely to perform well and achieve better than those taught using traditional method of teaching. Gender Chemistry achievement is independent of large class in the post-test. That is male and female students in large class can perform at the same level if other factors such as environment and other learning materials are available.

Recommendations

The following recommendations are suggested based on the outcome of the findings:

1. In spite of the amazing results of the influence of class size on the academic performance of secondary school students, and the facts that large classes has some advantages it is still

recommended that schools should stick to the 40:1 student –teacher ratio as stipulated by the National Policy on education. Class management and control is easier to achieve in a smaller class which goes a long way to determine the outcome of the learning experience.

2. Restructuration of class size in chemistry require more facilities, therefore stakeholders should endeavour to provide required facilities and instructional materials for the teaching and learning of chemistry in senior secondary schools.
3. Recruitment of chemistry teachers in senior secondary schools should be commensurate with the number of students in schools today so that the student-teacher ratio will not be so wide. This will reduce the possibility of taking more number of chemistry students by teachers in a particular class.
4. Where class size is inevitably large, chemistry teachers should devise a means of dichotomizing students into segments so that instructional and pedagogical strategies to be applied by the teacher will enable the students to effectively harness the lesson very well.
5. Ekiti State government should build more classrooms and provide adequate learning facilities so that chemistry students and teacher have enabling teaching-learning environment.
6. More instructional materials should be provided to include public address system so that the students in a large class could be instructed as appropriate.
7. Chemistry teachers should direct more attention particularly to female students to make them improve on their academic achievement.
8. Parents as well as chemistry teachers should encourage the students to develop positive attitude towards chemistry. Also, parents should provide equal learning opportunities to their children and should not discourage the girls from studying chemistry.

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