EFFECT OF CLASS SIZE ON THE TEACHING AND LEARNING OF CHEMISTRY IN SECONDARY SCHOOLS IN DELTA STATE, NIGERIA

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ABSTRACT

An ex-post-factor design has been employed to investigate the effects of class size on the academic achievement of Senior Secondary Schools students using 681 SS II students selected from 16 Secondary Schools. Data collection was carried out using Chemistry Achievement Test (CAT). The study was guided by two research questions and the ensuing null hypotheses were tested at the 0.05 level of significance. The results showed that chemistry students in small sized classes perform better in relation to those in large sized classes. The results also show that there s no interaction effect of school location and class size on the achievement of the considered students.

Keywords: Class size, Achievement, Chemistry

INTRODUCTION

Class size refers to an educational tool that can be used to describe the average number of students per class in a school (Adeyemi, 2008). This varies from country to country. The values as have been used in 14 different countries are presented in Table 1(Adeyemi, 2008; Averett and McLennan, 2011). In the context of Science Education, Chemistry has been identified as a very important school subject whose importance in the scientific and technological development of any nation has been widely reported (Adesoji and Olatunbosun, 2008). Consequently efforts have continuously been made to improve on its teaching and learning especially at the post primary level so as to ensure a sound foundation for later/future studies. Despite these efforts, it has been painfully observed that students' achievement in this subject in Nigeria still remains low (Maduemezia, 1996; Okoye, 1997). Investigators (Osuafor, 1999; Okegbile, 1996; Bajah, 1999; Adeyegbe, 2005; Oshokoya, 1998 and Adesoji, 1999) have identified such factors as: class size, school location, teacher exposure, poor instructional methods, negative attitude of teachers, in adequate/ lack of laboratory facilities and poor student background.

Talking about class size, parents and educators universally identify it as a desirable attribute of successful school system hence the widely implementation of class size reduction initiatives. Despite this and the plethora of studies available, investigators remain divided on whether smaller classes actually have positive effects on student outcomes (Averett and McLennan, 2011). For instance, Afolabi (2002) investigating school factors and learner variables as correlates of senior secondary physics achievement in Ibadan found no significant relationship among class size and students' learning outcomes. On the other hand, Adeyemi (2008) working on the influence of class size on the quality of output in senior secondary schools in Ekiti State, Nigeria found that schools having an average class size of ≤ 35 obtained better results than those having > 35. Data from the Third International Mathematics and Science Study referred to in Averett and McLennan (2011) indicate that larger class size countries obtained higher

achievement scores. The same investigator also indicated that although class sizes have fallen dramatically in the United States, achievement has not simultaneously increased across all demographic groups. On investigating the effect of class size on student achievement: evidence from Bangladesh, Asadullah (2005) concluded that reduction in class size in secondary grades is not efficient in a developing country like Bangladesh. Thus the divergent view on the effect of class size on achievement continues. The purpose of this investigation is to add to this discuss by specifically examining the effect of class size on the teaching and learning of chemistry in senior secondary schools in Delta State Nigeria. The data to be generated in this preliminary study will serve as baseline information for not only future but a more detailed investigation on this contemporary issue.

METHOD

The ex-post-facto or causal comparative research design was employed. The population of the study consisted of all SS II students that offered Chemistry. These were drawn from 14,136 students in 144 public senior secondary schools available in the Eight Local Government Areas that make up the Delta Central Senatorial District. Stratified random sampling was used to select 681 students from 16 schools in the stratified educational zones (Table 1). The choice of SS II students was considered appropriate for this study because these set of students have been exposed to some vital basic chemistry concepts and skills for at least one year which is considered enough time for an adequate background for the purpose of this investigation. Data collection was carried out using the Chemistry Achievement Test (CAT). This consisted of a 25 item multiple choice objective questions having four options A to D that covered concepts in SS II first term Chemistry scheme of work. Each question examined students on the various cognitive domains so as to assess their level of acquisition of Chemistry concepts. The items in the instrument were drawn from validated instrument of the West African Examination Council (WAEC).

The test - retest method was used to establish its reliability ($r = 0.80$). In the administration of the instrument, the various Chemistry teachers in the sampled schools were used as research assistants, these were properly briefed on the mode of administration and retrieval so as to ensure maximum cooperation and high retrieval percentage (Mokobia, 2010). Three research questions guided this thus: "Is there any difference in the achievement in chemistry for senior secondary school students in small and large sized classes?, Is there any difference in the achievement in chemistry for senior secondary school students in small and large sized classes? and Is there any interaction effect between location of school and class size in the achievement in chemistry for senior secondary school students in small and large sized classes? " The two null hypotheses that were formulated are: "There is no significant difference between the achievement in chemistry of students in small and large sized classes of senior secondary schools and there is no interaction effect of School location and class size in students' achievement in senior secondary school chemistry. The former was tested using Chi-square statistics at 0.05 level of significance while the later was analyzed using F-test (ANOVA) at same level of significance. In this work, a small sized class was considered to be such having $\leq$ 40 students while a large sized class was considered to have > 40 students. In modelling class size and students' achievements, the conventional approach is to estimate an education production function

(Averett and McLennan, 2011). The standard education production function posits that student achievement outcomes such as test score or educational attainment is a function of individual characteristics such as innate ability, family background, classroom features etc thus: $A_i = f\{X_i, F_i, Z_{c,n,s,d}\}$ [1]

A_i is measure of the individual student's, i, achievement, X his/her innate characteristics, F the variables relating to his/her family background, Z the features of his/her class which may be c class size, n neighbourhood, s nature of the school and d distance/location of the school. In this work, this model was modified by the supposition that every other variable but students' innate capabilities is constant so that the equation [1] above is simply expressed as $A_i = f\{X_i\}$ [2]

To be able to make meaningful deductions, the data obtained were statistically analysed using frequency distribution , graph, mean, standard deviation and Chi-square χ^2 test. The interaction effect of school location and class size was investigated by plotting mean achievements of large and small sized classes against location (urban/rural).

RESULTS AND DISCUSSION

The frequency distribution of the students' achievement/score from retrieved instruments is given in Table 2 for both small and large sized classes. Data from this Table show that the mean student score for large sized classes is 6 while the corresponding value for small sized classes is 7. This indicates that achievement in chemistry in senior secondary schools is higher in small sized than in large sized classes. This is clearly illustrated in Figure 1 representing a bar chart showing the difference in the mean student achievement for the two differently sized classes. The respective standard deviations of 153.50 and 78.79 indicate that the scores/achievement of the students in large sized classes are more spread about the mean than those of the students in small sized classes.

The obtained $\chi^2 = 34$ is greater that the critical χ^2 (26.3) value for 16 degrees of freedom. This is indicative of the fact the mean achievements of senior secondary schools in chemistry (6 and 7) for small and large sized classes respectively are statistically different as opposed to the relevant earlier formulated hypothesis for this investigation. Thus there is a significant difference in the achievement in chemistry of students in large and small sized classes in senior secondary schools. The graph of frequency against achievement (Figure 2) shows the same achievement trend for both sized classes rising from unity with a greater number of students scoring between 4 and 8. In both cases too, this graph shows that very few students recorded the highest scores. In Table 3, the mean achievements of the students according to their school locations are presented. In either location (urban/rural), the small sized classes obtained a greater mean than the large sized classes. This finding which is also evident in Figure 2, agrees with the submission of Afolabi (2002).

CONCLUSION

From the finding it is concluded that senior secondary school students in small sized classes show higher achievement in chemistry relative to their colleagues in large sized classes. Furthermore, there is no interaction effect of location and class size in students' achievement in Senior Secondary School Chemistry.

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Table 1: Secondary School Class Size in some countries

Country	Class Size	Country	Class Size
Australia	27	Netherlands	≥20
Belgium	20	Norway	≥20
Canada	28	Romania	27
Czech Republic	26	Singapore	32
Hong Kong	41	Slovenia	24
Japan	36	Turkey	≥20
Korea	51	USA	26

(After Adeyemi, 2008; Averett and McLennan, 2011)

Table 2: Statistics of students' achievement in small and large sized classes

Score (X)/25	Frequency, f		Total Score, f X	
	Large Class	Small Class	Large Class	Small Class
1	5	1	5	1
2	25	12	50	24
3	41	15	123	45
4	48	19	192	76
5	75	32	375	160
6	56	32	336	192
7	56	28	392	196
8	61	28	488	224
9	29	14	261	126
10	18	19	180	190
11	16	9	176	99
12	6	15	72	180
13	5	1	65	13
14	3	4	42	56
15	2	0	30	0
16	2	2	32	32
17	0	2	0	34
Total	448	233	2819	1648
Mean			6	7
STDEV			153.50	78.79

Table 3: Mean students' achievement according to location and size

School Location	Mean Achievement according to Class Size	
	Large	Small
Urban	6.75	7.29
Rural	5.78	6.84

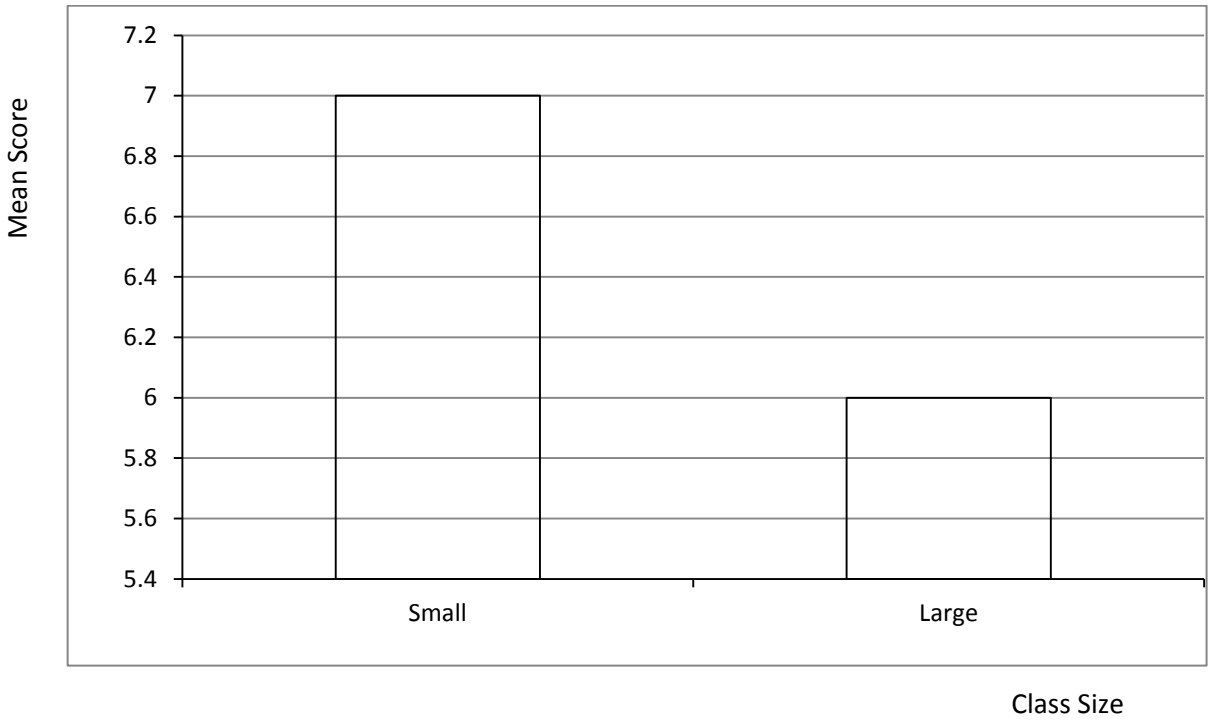

Fig. 1: Bar Chart showing the Difference in Mean Achievement for the Different Sized Classes

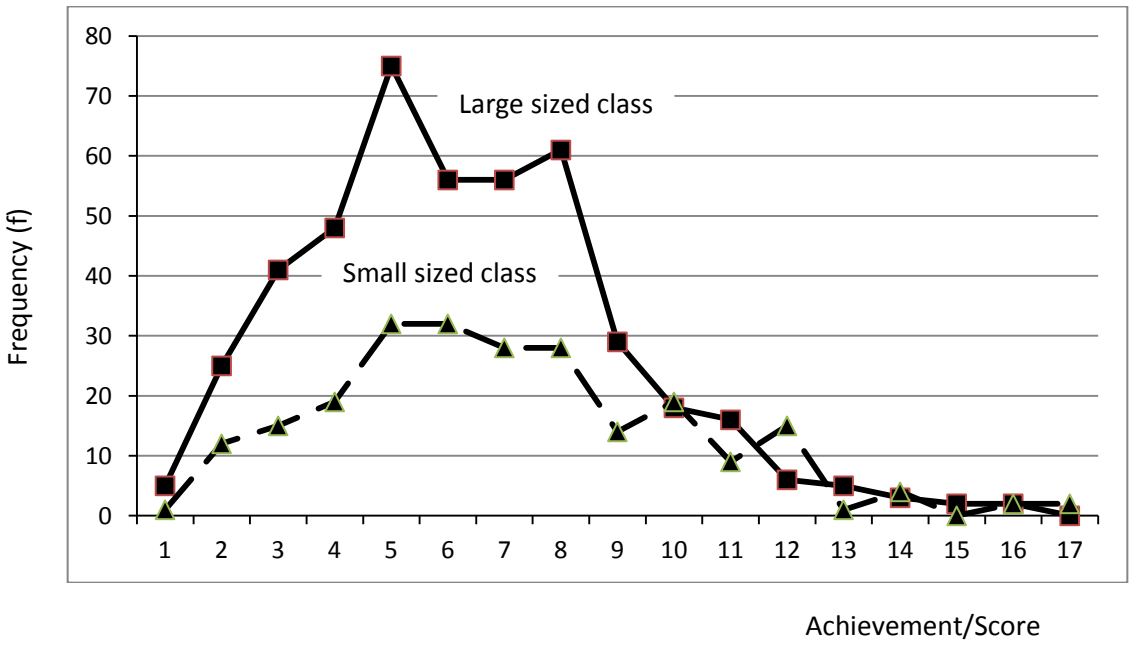

Fig. 2: Frequency Graph showing the Trend in Students' Achievement

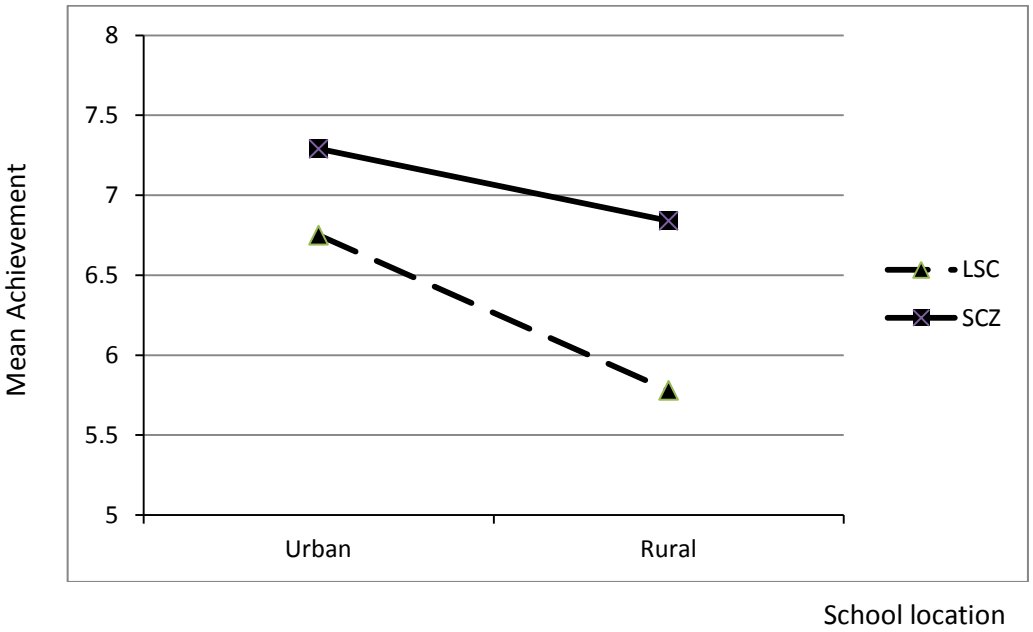

Fig. 3: Line Chart absence of Interaction Effect between class size and School Location