



Research Article

Optimizing Biology Education: Unpacking Influence of Class Size and School Environment on Student Performance

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Abstract. The study determined the influence of school environment and class size on senior secondary school students' biology performance in Ibadan North Local Government, Oyo State. Descriptive research design was adopted. All SS2 students in Ibadan North Local Government formed the population with a sample of 100 SS2 biology students randomly selected from public secondary schools in Ibadan North Local Government. Class Size Questionnaire-CSQ ($r=0.95$), School Environment Questionnaire-SEQ ($r = 0.72$), and Biology Achievement Test-BAT ($K-R_{20}=0.76$) were used to collect data. Data collected were analysed using multiple regression. A linear relationship was found between the independent variables (class size and school environment) and students' biology achievement in Ibadan North Local Government secondary schools. Class size and school environment jointly accounted for 71.1% of the variance in biology achievement among secondary school students in Ibadan North Local Government, with significance at $F(2,97)= 4.785$ $p < 0.01$. Class size and school environment significantly influence student achievement in biology within Ibadan North Local Government Area, Oyo State. Therefore, authorities should implement the teacher-student ratio policy

to reduce classroom overcrowding and government should invest more in education by increasing the facilities in schools to create a conducive learning environment for improve academic performance in biology as well as other school subjects.

Keywords: School Environment, Class Size, Student Performance, Biology and Ibadan

INTRODUCTION

Biology which is the study of different forms, their evolution, structures, functions, growth, distribution and taxonomy occupies a unique position in the secondary school science curriculum. It serves as a pre-requisite to the study of other lucrative and challenging professions like; Medicine, Nursing, Pharmacy, Pharmacology, Biochemistry, Agriculture, Microbiology, Geology, Geography, Technological and other applied sciences. The vital role of the study of this discipline in the economic, industrial and public life of the learners and the general humanity cannot be overstressed (Ibe and Ukpai 2013). Biology is a vast field of study that includes everything from the intricate interactions between small molecules inside living cells to the larger ideas of ecosystems and environmental change on a global scale. It is also related to the physical traits and behaviors of extant and extinct species, their origins, and their surroundings (Mamoni, 2021). Biology is a natural science in which life and living organisms are studied. Asogwa, Mohammed, and Ofoegbu (2016) defined it as a branch of science that involves the systematic study of living things that range from microbes to larger organisms. As a subject, biology is an exciting intellectual adventure whose importance to humans, just like science, cannot be overemphasized. It is primarily concerned with the nature of organisms and their relationships with each other and with the environment. In Biology, science plays a vital role in solving the intricacies of living organisms, their interactions, and the fundamental processes that govern life (Dinah, 2013). Biology deals with in-depth investigation of human brain anatomy, genetic makeup, and even the operation of the reproductive system (Mamoni, 2021).

According to Comer (2012), biology paves the way for scientific investigation and an understanding of the environment. Similarly, Ude and Onah (2017) highlighted that it helps in interesting hobbies such as gardening, insect collection and bird watching, environmental protection, and conservation, as well as understanding the basis of hereditary and its application in genetic engineering, crime detection, blood transfusion, banking, and the determination of children's paternity. As a scientific domain, biology consists of a comprehensive arrangement of subfields and uniqueness, each focusing on various aspects of living systems. Like other scientists, biologists strive to comprehend how life at multiple stages, from molecular and cellular processes to organismal behavior and ecological dynamics, is mechanized through scientific inquiry. Biology is an important part of education. Biology makes learners scientifically literate and helps them make informed decisions after analysis and engagement with scientific information (Daworiye, Alagoa, Enaregha & Eremasi, 2015). According to Nnorom and Erhabor (2019), a solid understanding of biology is required for anyone interested in studying medicine,

pharmacy, nursing, agriculture, or forestry. Biology also contributes to the development of future scientists in biotechnology, nanotechnology, and other fields.

The National Policy on Education (FRN, 2013) has made biology an elective for science students only in Nigerian senior secondary schools. Biology is central to many science-related courses such as Medicine, Nursing, Pharmacy, Agriculture, Biochemistry, and Microbiology. Biology is a practical-oriented subject that requires a conducive school environment, such as laboratories, textbooks, reference materials, specimens, aquariums, and botanical gardens, to enhance students' performance. This unequivocally demonstrates the importance of biology to every developing economy (Olajide, 2024). The school sector has witnessed a decrease in the academic performance of students in Science subjects in both internal and external examinations (Nja, & Kalu, 2013).

Despite the place of the subject in the comity of other science subjects, the performance in the subject remains worrisome. Literature suggested a number of factors to be responsible for the poor performance in biology ranging from teacher factors, students factors, facilities, instructional aids among others. Two other factors where further studies were suggested to be carried out are class size and school environment. For the purpose of this study, the focus will be on class size and school environment. Class size can be defined as the number of students per teacher in a given class or the population of a class (Ajayi et al., 2017). Class size is used to indicate the average number of students per class in a school. Student performance becomes a problem when student enrollment increases. (Owoeye & Yara, 2011) have frequently pointed out that class size has an impact on students' attitudes and academic performance, the quality of school funding, and administration. One of the significant factors that affect academic performance is that teachers in schools have little or no influence. They explained that educators have universally identified class size as an important and desirable attribute of an effective educational system. According to Adeyemi (2018), this is the typical number of students in a class. The Glossary of Education Reform (2015) defines class size as the total number of students in a classroom: (i) The total number of students taught in a classroom (ii) The average number of students taught by teachers in a school, district, or educational system.

One of the key factors influencing academic achievement is that teachers in schools have little to no influence on class size. Consequently, the debate has continued in the educational literature with stakeholders, such as academics, policymakers, and parents, over the educational consequences of class size. (Kedney, 2013) in his literature has maintained that class size can be adopted to measure the performance of an educational system. Amedahe (2016) also opined that class size permits students to study successfully, without causing a disturbance. Increased class size is crucial to teaching and learning because it can be challenging for teachers to interact with student individually. According to educators everywhere, class size is a crucial and desirable feature of the educational system. One factor hypothesized to affect students' academic achievement is class size. There are two aspects of the class size: large and small. When there are more students in a class than what the National Policy on Education specifies should be in a class, the condition is known as large class size. According to the Federal Republic of Nigeria (2014), for better

management, control, and effectiveness in teaching and learning, senior secondary teacher-to-student ratios should be set at 1:35. A large class size is defined as one in which there is a significant student population, which makes it difficult for teachers to instruct and manage. The size of the class makes it difficult for teachers to observe every student's behavior (Magdalene, 2014). A small class size is the number of students below the stipulated number of students in a class, which is 35. The increase in population over time has brought about an increase in the number of students admitted to schools, and consequently outweighs the available infrastructure. The teacher-student ratio of 1:35, as stipulated in the National Policy of Education, does not reflect class size in reality.

Increase in student enrollment can pose a problem when it comes to academic performance. According to the National Policy on Education, the ideal teacher-to-student ratio in Junior Secondary Schools is one teacher to thirty-five students, while in Senior Secondary Schools, it should be one teacher to 35 students per classroom (FRN, 2013). Bosworth (2014) conducted a study that found little correlation between class size and student achievement. Large class sizes pose a challenge for teachers, which could impact evaluation, teaching standards, and learning standards. Some of the issues that arise from large class sizes include the inability of teachers to apply various teaching methodologies, the inability of students to focus during class, and lack of resources for teaching and learning. Consequently, students' academic performance may be negatively affected. Academic performance refers to the outcome of educational activities achieved by students and teachers working together (Alalwan et al., 2019).

The school environment comprises all the components of the school system that contribute positively or negatively to effective teaching and learning (Songu, 2016). A good school environment, therefore, refers to all improved school conditions, such as the availability of the right functional and usable infrastructure, availability of the right quality and quantity of teaching materials and workforce, standard class size, proper location, good student-teacher relationship, and improved methodologies that combine to encourage teachers and students to teach and learn effectively (Songu, 2016). In addition, Usaini and Abubaker (2015) asserted that a supportive and favorable school environment enriched with enough learning facilities and a favorable climate makes students more comfortable and concentrated on their academic activities in high academic performance; thus, a proper and adequate environment is necessary for the fruitful learning of the child.

The school environment includes classroom ventilation, poor lighting in classrooms, school population, school facilities, school organization and teacher – student ratio. Teachers and students themselves are equally important in the teaching-learning process. A well-planned school will bring about the expected outcomes of education, such as good social, political, and economic emancipation; effective teaching and learning processes; and academic performance. As cited in Amedahe (2016), Usaini, Abubakar, and Bichi (2015) reported that a safe and orderly classroom environment (an aspect of instructional space) and school facilities (accessories) were significantly related to student's academic performance in schools. The physical characteristics of schools have a variety of effects on teachers, students,

and the learning process. Poor lighting, noise, high levels of carbon dioxide in classrooms, and inconsistent temperatures make teaching and learning difficult. These factors can adversely affect students' behavior and frustration among teachers and lead to poor learning attitudes among students (Doyle and Esu, 2014). Eschool News (2019) reported that students in small class exhibit advanced academic performance. The performance of students in their academics can be rewarding if the students perform well academically; however, if the reverse is the case, it becomes a thing to worry about, and due attention is accorded to the situation to address it as it affects their academic performance and society. Biology is an important subject because it enables us to understand ourselves and our immediate environment. It also enables us to be aware of the interactions between living and non-living things around us. However, in recent times, the academic performance of students on their external examination (Senior Secondary School Certificate Examination) has been very poor, as observed in secondary schools. This could be attributed to school environment, parents' background, school facilities, school location, instructional methods and materials, and class size. The academic performance of students in their external examinations (Senior Secondary School Certificate Examination and Joint Admissions and Matriculation Board) determines whether they will continue to a higher institution to further their studies in biology-related courses. Some have to deviate from their initial course of study because of their performance in science (biology) and humanities. The bone of contention in the educational system and society is the number of students a teacher is meant to teach to ensure that effective teaching and adequate learning takes place. In addition, to ensure improvement in the performance of students in their academics, especially in science subjects such as biology. This study investigated the influence of school environment and class size on biology students' academic performance in the Ibadan North Local Government Area of Oyo State.

Statement of the Problem

Despite the collective efforts of the government, parents, teacher associations, old student associations, and non-governmental organizations, as well as the administrators of public secondary schools in Oyo State, Nigeria, to create a suitable environment for teaching and learning that would improve students' academic performance, the problems associated with poor school environments continue to hinder and overwhelm these efforts. One reason for this could be the large number of students enrolled, leading to overcrowding in classrooms. Many schools lack basic furniture, such as seats, desks, and tables, resulting in students sitting on the floor or logs of wood. In addition, some classrooms lack ventilation, which can have negative health and academic consequences in school subjects, biology inclusive. Biology is considered important, students' performance on the subject has been consistently poor in both internal and external examination. The West African Examination Council (WAEC) records also show that a large number of students enroll in biology each year in the Senior School Certificate Examination, but the subject's performance fluctuates from year to year.

Also, the school environment is a critical component in promoting academic success. It encompasses various elements that directly or indirectly impact an institution's educational process. Apart from the physical structure and equipment, it includes the entire learning environment that fosters the teaching-learning process. The significance of adequate facilities and conducive learning environments cannot be overstated when supporting effective learning. A positive school environment is a vital aspect of a student's educational journey and it emphasizes the importance of a conducive school environment that is characterized by quality facilities and a positive atmosphere. Such an environment encourages students to actively participate in their academic pursuits and nurtures their enthusiasm and motivation. It also promotes a sense of comfort and concentration among students, which enhances their focus on learning. In light of this, there is a need to address the problem of class size and school environment on their effect on academic performance in biology, especially in the study area. Consequently, this study investigated the influence of class size and school environment on students' academic performance in biology in senior secondary schools in the Ibadan North Local Government Area of Oyo State.

Research Questions

- i. To what extent will class size and school environment jointly influence biology academic performance of students in secondary school?
- ii. To what extent will class size and school environment individually affect secondary students' achievement in biology?

RESEARCH METHODS

This study adopted a descriptive research design. The target population of this study comprises of all public senior secondary school SSS 2 students currently enrolled in biology classes in senior secondary schools in Ibadan North Local Government. The study targets both male and female students, covering a diverse range of backgrounds and academic abilities within the senior secondary schools in the Local Government. Multi-stage sampling technique was adopted for this study. There are thirty-three (33) Local Government Areas in Oyo State from which one Local Government Area (Ibadan North) was randomly selected. The sample size consist of one hundred (100) respondents/students from five (5) schools, which was selected using simple random sampling techniques. Twenty (20) students were selected from each of the five senior secondary schools in Ibadan North Local Government as stated above. Simple random sampling technique was employed to select participants from the list of senior secondary school students enrolled in biology classes. This is to enhance the likelihood of obtaining a representative sample, as every student has an equal chance of being selected.

Two (2) instruments were developed and used to generate data for this study. (i) The class size and school environment questionnaire (CSSEQ) was designed to generate information on class size and school environment. The instrument is meant for student to respond to. The questionnaire was divided into three (3) sections: Section A: to elicit information on students 'bio-data, section (B) seeks to test the

students' responses to various aspects of class size with twenty four items carefully drawn on class size, instructional strategies, psychological readiness, and social impact. The items in the questionnaire was based on 4 points Likert-type rating in which respondents were required to express their opinion by using the 4 rating scale. To validate the instrument, copies of the instruments was administered on small samples outside the main sample. The data collected was analyzed for internal consistency using Cronbach's Alpha which yielded 0.95. Section C is on school environment with nineteen items carefully drawn on school environment. To validate the instrument, copies of the instruments were administered on small samples outside the main sample. The data collected was analyzed for internal consistency using Cronbach's Alpha which yielded 0.72.

(ii) The researcher developed Biology Achievement Test (BAT) to measure students' academic performance in Biology. The instrument was divided into two sections. Section A is on the bio-data of students such as gender, class, age, name of school, department, and name of the respondent. Section B has thirty (30) biology test items. The total items were carefully drawn and did not go beyond what was taught in the public secondary school syllabus from the first term in SS1 to the first term in SSS2. Thirty (30) items which consist of four (4) options each letter A - D was adopted. To investigate the reliability, copies of the instruments were administered on a small sample outside the main sample. The data collected were analyzed for internal consistency using Kuder-Richardson₂₀ which yielded 0.76.

The researcher carried out a preliminary list of all sampled secondary schools, during the process, the school authorities were informed, and the participants were adequately briefed on the need to cooperate with the researcher. They were made to understand that the study was basically for research purposes, the result of which can go a long way in enhancing their academic achievements as students in senior secondary school. Respondents were assured of the confidentiality of their responses. The questionnaires were administered to the selected students in the sampled secondary schools. The data collection processes were administered within two weeks and the researcher was assisted by the subject teachers in each school in the collection of the instruments. This was done systematically. Adequate time to supply the required information was given to the respondents, after which the completed questionnaires were retrieved from them for analysis. The data collected were analyzed using multiple regression analysis

RESULTS AND DISCUSSION

Table 1: Model Summary of Predictors on academic performance in Biology

Model	R	R square	Adjusted R Square	Std. Error of the Estimate
	0.670	0.448	0.711	0.30317

Table 2: Regression ANOVA of predictors on academic performance in Biology

Model	Sum of Squares	Df	Mean Square	F-ratio	Sig.
Regression	0.880	2	0.440	4.785	0.010
Residual	8.915	97	0.092		

Total	9.795	99
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* Significant at $P < 0.05$ level

The model summary and regression ANOVA are presented in Tables 1 and 2, respectively. As shown in Table 1, the multiple regression correlation coefficient (R) indicates the linear relationship between the independent variables (class size and school environment) and the dependent variable (students' biology performance in Ibadan North Local Government secondary schools). The R value is 0.670, with R^2 at 0.448 (9%) and Adjusted R square at 0.711 (71.1%). This suggests that approximately 71.1% of the variation in students' biology performance can be attributed to class size and school environment, which is statistically significant at $p < 0.05$.

Table 2 displays the analysis of variance results for the multiple regression data, yielding an F-ratio of $F(2, 97) = 4.785$, significant at the 0.05 alpha level. The findings regarding the joint influence of class size and school environment on students' academic performance in Ibadan North Local Government secondary schools reveal a linear relationship between these independent variables and biology performance. The variation in students' biology performance explained by class size and school environment is substantial and statistically significant.

The study result indicates that class size and school environment significantly contribute to the prediction model for academic performance. While class size is an important component of the model, it is not significant in the study area. These findings align with research by Altinok and Kingdon (2012), Bosworth (2014), and Ruffin (2018). This supports the notion that certain small class pedagogies, such as project work with individual monitoring and continuous feedback on investigative tasks, are designed to cultivate higher-order thinking skills. These skills may be challenging to develop in larger classes. Smaller class sizes facilitate increased student collaboration and communication, provide beneficial learning opportunities, and promote metacognitive skills through the development of information discovery and help-seeking behaviours.

Table 3: Regression Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t-statistic	Significant level
	Beta	Std. Error	Beta		
Constant	2.227	0.679		3.278	0.001
Class Size	-0.108	0.171	-0.065	-0.630	0.530
School Environment	0.208	0.068	0.316	3.062	0.003

The impact of various explanatory factors on students' biology performance in Ibadan North Local Government secondary schools is illustrated in Table 3. Among these factors, only the school environment demonstrated a statistically significant contribution to the prediction model ($\beta = 0.316$; $t(97) = 3.062$; $p < 0.05$) at the 0.05 level. In contrast, class size was found to have no influence on predicting students' academic achievement in Biology within the secondary schools of Ibadan North Local

Government, Oyo State. The results presented in Table 3 demonstrate a negative relationship between class size and biology students' academic performance in the study area. This finding agrees with the earlier observation when examining the combined impact of class size and school environment on biology students' academic performance in Ibadan North Local Government. The outcome contradicts with Yusuf et al. (2016), who identified class size as a crucial factor directly influencing academic performance. However, conflicting views exist, as Adeyemo (2012) noted that large classes negatively affect academic tasks. Filges (2018) reported superior achievement levels in smaller classes, while Ruffina et al. (2018) found an inverse relationship between class size and student achievement, concluding that larger classes lead to lower student performance.

CONCLUSION

The study's findings suggest that class size and school environment significantly impact students' biology achievement. The research indicates a combined influence of these factors on academic performance in biology. Notably, while school environment demonstrated a relative contribution to student achievement, class size did not significantly affect biology performance in the study area. However, class size does play a considerable role in biology students' academic outcomes, with smaller classes generally yielding better results than larger ones. In smaller classes, teachers can more easily identify and address students' varying abilities, employing appropriate teaching strategies to enhance learning. Conversely, this becomes more challenging in larger classes. The study also reveals a direct correlation between school environment and Biology students' academic performance in the examined area. The researchers determined that the school environment is a crucial factor in students' academic success. The school's location can have long-lasting effects on its overall performance, serving as a strong predictor of students' academic achievement, significant at the 1% level. In summary, the research established significant relationships among the predictor variables (class size and school environment) and their predictive influence on student achievement in Biology.

Recommendations

Based on the findings on the impact of class size and school environment on Biology achievement is significant. The following recommendations are proposed:

Research shows that smaller class sizes lead to better academic performance in Biology. Therefore, the government should collaborate with school-based management committees (SBMC), NGOs, and other organizations to construct additional classrooms and hire more teachers. This will help align class sizes with the student-teacher ratio mandated by the National Policy on Education. It is crucial to implement the teacher-student ratio policy outlined in the National Policy on Education to reduce classroom overcrowding. Teachers should recognize individual student abilities and cater to all learners, including high-performing students. The government and educational stakeholders should provide study facilities like libraries and laboratories to enhance student academic performance. Schools should create

conducive classroom environments to promote learning. Both the government and affluent members of society should ensure adequate learning resources are available to support teaching and learning activities in schools. There is a need to equip schools with facilities such as libraries, science labs, and computer labs to promote higher academic achievement. Education stakeholders should continue to prioritize school facilities to boost student academic performance.

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