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FACTORS MILITATING AGAINST THE EFFECTIVE TEACHING AND LEARNING OF BIOLOGY EDUCATION IN SECONDARY SCHOOLS IN ONITSHA EDUCATION ZONE OF ANAMBRA STATE

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ABSTRACT

This study investigated the factors militating against the effective teaching and learning of biology education in Senior Secondary Schools in Onitsha Education Zone of Anambra State, Nigeria. The effective teaching and learning of biology hold a crucial position in equipping students with the prerequisite knowledge and skills necessary for careers in science and related disciplines like medicine, pharmacy, biotechnology, genetics, nursing and environmental science. Understanding the significance of the impacts of the factors militating against the effective teaching and learning of the subject Biology and how to overcome them is very important. The study used descriptive research design with well-constructed questionnaires to collect data from respondents. Forty (40) teachers were selected through purposive sampling techniques while four hundred and sixty, ,(460) students were selected through stratified random sampling technique .The data collected was analyzed using crombach and chi-square statistical methods. The research found out that the teaching of Biology plays a pivotal and significant role for students pursuing careers in science and healthcare related disciplines. The result of the research carried out showed some of the factors militating against the effective teaching and learning of biology education in senior secondary schools in Onitsha Education Zone, which are; insufficiency in the number of qualified teachers, bulky curriculum, lack of integration of ICT, inconducive learning environment, poor learning environment and lack of practical activities. Therefore, there is need for recruiting of sufficient qualified teachers and teachers training and professional development opportunities for effective biology teaching coupled with provision of conducive environment with well-equipped laboratory and instructional materials. Students need meaningful engagement and a keen interest in biology and biology teaching and learning process. It is important to pay attention to the classroom facilities, laboratory apparatus and incorporation of ICT (virtual laboratories) to facilitate effective teaching and learning of biology education in secondary schools in Onitsha Education Zone of Anambra State.

Keywords: Factors; Effective Teaching; Learning; Biology Education

Introduction

Science has to do with nature. It is derived from the Latin words Scientia which means knowledge. Science is a systematic enterprise that builds and organizes knowledge in the form of portable expectations and production about the universe. Science can equally be defined as the field of study which tries to describe and understand the nature of the universe in whole or part. Britannica (2026) defined science as any system of knowledge that is concerned with the physical world and

its phenomena that entails unbiased observations and systematic experimentation. According to Merriam-Webster (2026); Science is a knowledge or a system of knowledge covering general truths or the operation of general laws especially as obtained and tested through scientific methods. Science council (2017) stated that science is the pursuit and application of knowledge and understanding of the natural and social world, following a systematic methodology based on evidence. Igwe (2018) defined Science as a systematic study of nature of the behavior of material and social universe through observation, experimentation, measurement and recording. Science is aimed at understanding how the universe works and builds knowledge through evidence-based research, solve practical problems and improve human life. The key aspects of scientific goals are:
1) Describe: To observe and categorize events, behaviors or phenomena and to understand what is happening.
2) Explain: To determine the underlying causes of behaviors of natural occurrences.
3) Predict: To forecast future outcomes or behaviors based on established patterns and laws.
4)Control or Influence: To apply scientific knowledge to change, manage or influence conditions for practical purposes such as a medicine or engineering.
5) Builds: The main goal of science is to develop scientifically literate individuals that are concerned with high competence for rational thoughts and actions.

Kind V, Osborne J (2017): analyzed that the goal of science education and practice includes fostering and understanding of major explanatory ideas to help individuals make sense of the material and living world. Kahan and Corbin J (2018) opined that the goal of science education and practice includes enhancing public understanding and trust in scientific consensus particularly in making informed, evidence-based decisions noted in studies on the "science of science" Mantyre (2019) discussed the context of scientific philosophy that the goal of science is to distinguish itself from other ways of doing things through critical thinking. Veli Virmajoki (2021) focused on how science can better achieve the goals of enhancing understanding and challenging conventional thinking. Science is the bedrock on which modern day technological breakthrough is hinged. Science can exert a dominant, if not decisive influence on the life of individuals and as well as on the developmental efforts of a nation. The universal recognition of this is responsible for the prime position that has been awarded to science in particular worldwide. It was as a result of the recognition given to science in the development of the individual and the nation that science related subjects are made core courses in Nigerian educational system. It is chosen as a core subject in High school, therefore, the need to teach it effectively is non-negotiable. Effective science teaching can lead to the attainment of scientific and technological greatness. Igwe (2018) defined Science as a systematic study of the natural and the behavior of the material and physical universe through observation, experimentation, measurement and recording.

The purpose of teaching and learning any subject in science is to produce scientists with three levels of intellectual capital: scientists who will continue with research and development that is central to the economy growth of our country, to produce technologically proficient workers who are capable of dealing with the demands of a science-based high technology workforce and scientifically literate citizens who make intelligent decisions about public policies that will

influence the world around them. Science comprises the basic disciplines such as physics, chemistry, mathematics and biology.

Biology which is our main focus is derived from two Greek words "bio" and "logos" which means life and study respectively. Biology therefore means the study of life or the study of living things. It is also a natural science concerned with the study of life and living organisms, their function, growth, evolution, origin and taxonomy. Biology has several branches which are: Zoology; which is the study of animals, Botany which is the study of plants, Physiology which deals with the study of how living things function, Morphology which deals with the study of the external structure of living things, Anatomy deals with the study of the internal structure of living things, Ecology is the study of the relationship between living things and the environment, Genetics is the study of how living things inherit characters from their parents. Cell biology is the study of cell structure and functions. Biology is a very important subject in secondary school. It is a prerequisite for further studies in science and health related courses in higher institutions. Students who did well in biology could have prospects in being doctors, nurses, pharmacists, genetic engineers, microbiologists, biochemists, and other biology related disciplines.

Biology was originally introduced as a subject in federal government colleges in 1982 as an attempt to make it a case study and thereafter, state government implemented the system. Biology pervades literally every field of human endeavor and plays a fundamental role in educational advancement in the world today which is because of scientific investigations. Biology as a branch of science and a prerequisite subject for many fields of learning contributes immensely to the technological growth of the nation which includes medicine, nursing and biotechnology. Nwagbo (2025) opined that educating people in science especially biology has been widely acknowledged as a way of providing economic development, eliminating poverty, introducing social welfare etc.

The social economic importance of biology is therefore highlighted below:
1) Health and Medicine: It is a foundation for understanding diseases, developing treatment, enabling genetic medicine which increases life expectancy.
2) Agriculture and food security: Biology provides knowledge of crops, soil health and livestock management, leading to better harvests and sustainable, high yield farming practices.
3) Environmental management: It informs conservation efforts, waste management and understanding ecosystem interactions to combat pollution.
4) Economy development and industry: Biotechnology such as developing biofuel and the production of pharmaceuticals are major economic contributors.
5) Informed decision making: Basic biological knowledge allows individuals to make better decisions regarding nutrition, public health (e.g., vaccination) and environmental impact.
7) Understanding Human Biology and Genetics: It provides knowledge on how our body functions, grow and inherit traits which is crucial for personal health.

Biology is the most commonly chosen science subject of most secondary schools as confirmed by West African Examination Council (WAEC, 2018). The effective teaching of biology is the

process of accepting all the possible methods used in teaching in the classroom to make sure that students understand biology and are able to respond positively during assessment or to produce a good result, Ezeobi (2016). Effective teaching is imperative for attainment of student's educational goal outside the classroom setting.

Certain factors militate against effective teaching and learning of biology in secondary schools in Onitsha Education Zone, thus making students become passive towards the learning of biology. It became imperative to reappraise the extent of effective planning of instruction in the teaching and learning of biology in secondary schools. The most pressing problems carefully considered in this study are those factors militating effective teaching and learning of biology which includes:
1. Teacher-centred factors.
2. Student-centred factors.
3. Resource and facilities constraints.
4, Curriculum and Instructional issues.
5.Socio-economic and environmental factors.
6.School and administrative factors.
7.Policy and system-level issues.
8.Assessment and examination policies, to mention but a few.

This research intends to find out which of these factors and to which extent they really militate against the effective teaching and learning of biology education in senior secondary schools in Onitsha Education Zone of Anambra State.

Statement of the Problem

Biology as a science subject requires that trained technicians and laboratory attendants be employed. The reports of Shelter Right Initiative clearly stated that Nigeria trailed behind other West African countries for nine consecutive years in science especially subjects like Mathematics, Physics and Biology. Students do not only perform badly at the cognitive level, they also perform badly at the effective and psychomotor domains respectively. Biology is been taught in secondary schools in Onitsha Education Zone and it has been observed that students in public secondary schools perform poorly in both internal and external examinations such as WAEC and JAMB respectively to the extent that it is difficult to have a good number of candidates with enough credits to secure admission at higher levels of science, technology and health related disciplines. Pivoting the problem of biology is complex and can be solved when teachers and students change their attitudes towards teaching and learning in schools generally and to biology in particular. Eze (2022) observed that some secondary schools especially public schools have insufficient competent teachers as well as biological equipment in their different schools.

The role of biology education in the development of the scientific base of a country cannot be overemphasized. Moreover, The World Summit for Sustainable Development (WSSD) recommended that people should be empowered through education to achieve the three goals which are employment generation, poverty eradication and value orientation (Ajeyelemi 2016).

Yet with the increasing importance of biology education, to the unfolding world, the performance of Nigerian students and as well as those in Onitsha Education Zone remained a dismal failure. (Korall 2022) reported that several factors have been advanced to affect student's poor performance. Such factors include: The student factor, Teacher factor, Societal factor, Governmental infrastructure problems, Curriculum related variables, Test related variables, Textbook related variables and home related variables. Nigeria's current high rate of educational tourism is as a result of ineffective teaching of not only biology but also other disciplines, thus, students opt to get education from more developed nations. This has resulted in brain drain and has harmed Nigeria's socio-economic development (Kelly 2015). Brain drains from Nigeria which is usually nicknamed "Japa" syndrome is a situation where people flee from the country for "greener" pastures. A lot of people travel out of Nigeria to foreign countries, some even go to neighboring countries which they believe has higher standards of education than ours. Nigeria is experiencing a severe accelerating brain drain crises which over 1.4 million international migrants as of 2019. 58% of young people aspire to leave the country. The health sector and education sectors are the hardest hit.

Many of them travel to countries like United Kingdom, Canada, The United States, United Kingdom, Germany, Saudi Arabia, and African countries like South Africa, Ghana, Cameroon, Togo, Benin Republic, etc. The socio-economic impact of this is so alarming. The loss of prospective skilled labor has led to a decline in quality of healthcare and education, with over 40% poverty and 33% unemployment rate pushing people to seek better opportunities. The government loses over 366 million dollars in traveling costs for academia and doctors who emigrate.

Factors militating against effective teaching and learning of biology could be due to several reasons social as classroom management communication, teachers' qualification, lack of instructional materials, teacher's personality, negligence of seminars and workshop by teachers of biology, inadequate illustration and practical aspects of biology infrastructure and facilities and absence of laboratories etc. More so, high level of failure in biology could be due to lack of student's concentration in the classroom. All these are bane that poses a threat to productive output in biology and the context of the curriculum.

From the foregoing high tightest statement of the problem, it is pertinent to investigate some factors meditation against the effective teaching and learning of biology education in senior secondary schools in Onitsha Education Zone in order to improve the academic performance of students. In the light of the above, there is need to answer certain questions to reinforce the effectiveness of teaching and learning of biology in senior secondary schools in Onitsha Education Zone of Anambra state.

Purpose Of the Study

The main purpose of the study is to ascertain factors militating against effective teaching and learning of biology in secondary schools and prospective ways of investigating them. The specific objectives are to:

1. Investigate the extent to which insufficiency in the number of qualified teachers affect the effective teaching and learning of biology education in senior secondary schools in Onitsha Education Zone.
2. Assess the extent to which unavailability of instructional materials affect the effective teaching and learning of biology education in senior secondary schools in Onitsha Education Zone.
3. Determine the extent to which inconducive environment affect the teaching and learning of Biology education in senior secondary schools in Onitsha Education Zone.
4. Find out the extent to which negative attitudes of students towards biology affect the effective teaching and learning of biology education in senior secondary schools in Onitsha Education Zone.
5. Ascertain to which extent the bulkiness of the curriculum affects the effective teaching and learning of biology education in senior secondary schools in Onitsha Education Zone.

Research Questions

The relevant research questions related to this study includes the following:
In assessing the purpose of the study, the study will also answer the following questions:
1) Do insufficient numbers of qualified biology teachers affect the teaching and learning of Biology in senior secondary schools?
2) Does unavailability of instructional materials for teaching biology affects the teaching and learning of biology in senior secondary schools?
3) Does the negative attitude of students towards biology affects the effective teaching and learning of Biology in senior secondary schools?
4) Does inconducive learning environment affect the teaching and learning of Biology in senior secondary schools?
5)Does overloaded curriculum affect the effective teaching and learning of biology education in senior secondary schools in Onitsha Education Zone?

Research Hypotheses

Eight hypotheses we are formulated and tested at 0.05 alpha levels
H01) There is no significant relationship between insufficient numbers of qualified biology teachers and factors affecting the effective teaching and learning of Biology in senior secondary schools.
H02) There is no significant relationship between unavailability of instructional materials for teaching biology and factors militating against the effective teaching and learning of biology in senior secondary schools.
H03) There is no significant relationship between the negative attitude of students towards biology and factors militating against the effective teaching and learning of Biology in senior secondary schools.
H04) There is no significant relationship between inconducive learning environment and factors affecting the effective teaching and learning of Biology in senior secondary schools.

H05) There is no significant relationship between overloaded curriculum and factors affecting the effective teaching and learning of biology education in senior secondary schools.

Research Method

This study adopted descriptive survey research design to examine effective teaching and learning of biology in senior secondary schools. The study was based on Onitsha Education Zone in Anambra state. The population of the study comprised of thirty-four (34) public schools. One thousand, eight hundred and thirty- three (1833) biology students and forty-six (46) biology teachers are in public senior secondary schools Onitsha Education Zone giving a total of one thousand, eight hundred and seventy-nine (1879) people. The researcher made use of stratified random sampling techniques as the population was homogeneous. The schools were stratified based on location into 10 strata. Stratified random sampling techniques was used to obtain the samples for the study ensuring that all groups were uniformly represented. Sample size of 500 teachers and students was used. 46 students were selected from each stratum leading to a total of four hundred and sixty (460) students while forty (40)) teachers were selected using purposive sampling techniques. The instrument used for data collection was a well-constructed questionnaire to retrieve relevant information from respondents based on the study been carried out in order to seek their opinions. A well-structured questionnaire was used to collect data in this study. Two research assistants will be recruited as data collectors. The data collectors will be trained for a day on the process of data collection. The questionnaire was designed to collect data for academic research on factors affecting the effective teaching and learning of Biology in senior secondary schools. Your honest responses are important and will be treated with strict confidentiality. To ensure content and construct validity, the questions items were generated congruently with specific research questions A design is valid when it meets the validity with evidence and concerned with the intervention of factors that stimulates the dependents variable. The instrument was validated by two (2) experts from the department of Biology and one (1) from the department of measurement and evaluation for face and content validation. The comments of the validators formed the basis for either modifying or rejecting some of the items.

The reliability of the instrument was tested using test and re- test method to determine the reliability of the instrument. Twenty teachers (20) and thirty (30) students making a total of fifty (50) copies of the questionnaire were given to students outside the sample group after which the data collected was computed using Crombach Alpha statistical tool. It should show strong internal consistency especially at 0.75 and above. This confirmed the reliability of the instrument in the study setting.

Chi-square (X^2) test was performed to determine the statistical significance between the predators and outcome variable. Predictors with a p-value >0.5 was considered statistically significant with the outcome variable. Inferential analysis of mean and standard deviation was used in computing the data for study participant. The result of the findings was presented using text, tables and figures. The data collected was analysed based on the information obtained from the research questions using mean square and standard deviation while the null hypothesis was tested by $P < 0.5$ using Chi-square (X^2). The mean wad calculated by assigning nominal values to the response categories for all the research questions.

A) Strongly Agree. (SA) =4

B) Agree. (A)=3

C) Disagree. (D) =2

D) Strongly Disagree (SD) = 1
Mean= (4+3+2+1) ÷ 4 = 10 ÷ 4 = 2.5

For the mean (x) statistics, a criterion of (2.5) and above with an additional internal scale of (0.5) was added to the mean to give (3.00) which is the critical value. Any response of 3.0 and above is regarded as agree while any rating less than 3 is regarded as disagree.

1. Standard Deviation Formula:

$$SD2 = \frac{E(X-X)2}{N} \quad OR \quad \frac{E\,X2}{N}$$

2 Chi-square Formula:
Chi-square (x2)

$$X2 = \frac{E\,(Oi - Ei)}{Ei}$$

Where Oi = Observed frequency of the cell.
Ei = Expected frequency in the Ith cell

Presentation of Results

Table I: Perceptions of public school biology teachers and students on the factors militating against the teaching are learning of Biology education in secondary schools in Onitsha Educations Zone. The table is divided into six columns:
Column 1 (Items)= Questions
Column 2 (SD) = Strongly Disagree
Column 3 (D,) = Disagree
Column 4 (N)= Neutral
Column 5 (A) = Agree
Column 6 (SA) = Strongly Agree
Each subscale was tested and analyzed

S/N	Statement	SD 1	D 2	U 3.	A 4.	SA.5
**Subscale 1: Insufficient Number. of Qualified Teacher		.				
1.	Biology lessons are often combined or cancelled Because there are too few teachers.	2	2	26	20	

2. Unqualified or non-specialist teachers do not use appropriate methods like inquiry, discussion and demonstration methods when teaching.	3	2	24	21
3. The shortage of Biology teachers makes it difficult to complete the syllabus on time.	3	3	24	21
4. Biology lessons are mostly teacher talk with little student participation.	2	5	21	23
5. The teaching methods used make me memorize facts instead of understanding them. ≥				

Analysis _

1. Item 1: Internal consistency: 20+20÷50 =0.8 (high) since ≥ 70 is considered high
Mean =(2 × 1) +(2 ×2) +(26 ×3)+ (20×4) ÷50
2 + 4 + 78 + 80=164÷50
3.28 + 0.5 =3.78 (Agreed/ accepted)

For the mean (x) statistics, a criterion of (2.5) and above with an additional internal scale of (0.5) was added to the mean to give (3.00) which is the critical value. Any response of 3.0 and above is regarded as agree while any rating less than 3 is regarded as disagree.

2. Item 2: Internal consistency: 24+21÷50
45÷50= 0.9 (high)
Mean : [2 ×1]+ [2× 2]+ [24×3]+ [21×4]÷75
2 + 4 + 72 + 84 ÷ 50
162÷ 50= 3.24+0.5 =3.74 (agreed/ accepted)

3. Item 3: Internal consistency: 24+21÷50
45÷50= 0.9 (high)
Mean : [3 ×1]+ [3× 2]+ [24×3]+ [21×4]÷50
3 + 6 + 72 + 84 ÷ 50
165÷ 50= 3.3+0.5 =3.8 (agreed/accepted)
4. Item 4: Internal consistency: 18+3÷50
41÷50= 0.82 (high)
Mean : [2 ×1]+ [4× 2]+ [21×3]+ [23×4]÷50
2 + 8 + 63 + 92 ÷ 50
165÷ 50= 3.3+0.5 =3.8 (agreed/ accepted)
5. Item 5: Internal consistency: 24+22÷50
46÷50= 0.92 (high)

Mean : [3 ×1]+ [1× 2]+ [24×3]+ [22×4]÷50
3 + 2 + 72 + 88 ÷ 50
165÷50= 3.3+0.5 =3.8 (agreed/ accepted)

S/N 2. Subscale 2

** Subscale 2: Inadequate Teaching Resources

6. Lack of teaching aids like textbooks, charts, models, forces teachers to rely only on chalkboard explanations.	2	1	29	18
7. Lack of laboratory equipment, specimens, chemicals and reagents make biology lessons theoretical and not easy to understand.	3	4	27	16
8. Students share one Biology textbook among three or more learners in my class.	1	2	21	26
9. Lack of ICT tools means we cannot visualize processes like cell division or DNA replication.	2	3	24	21
10. My school does not use computer simulations or apps to teach difficult Biology topics.	0	1	23	26

Analysis

6. Item 6: Internal consistency: 29+18÷50
47÷50= 0.94 (high)
Mean : [2 ×1]+ [1× 2]+ [29×3]+ [18×4]÷50
2 + 2 + 87 + 72 ÷ 50
163÷50= 3.26+0.5 =3.76 (agreed/ accepted)

7. Item 7: Internal consistency: 27+16÷50
43÷50= 0.86 (high)
Mean : [3×1]+ [4× 2]+ [27×3]+ [16×4]÷50
3 + 8 + 81 + 64 ÷ 50
156÷50= 3.12+0.5 =3.62 (agreed/ accepted)

8. Item 8: Internal consistency: 21+26÷50
47÷50= 0.94 (high)
Mean : [1×1]+ [2× 2]+ [21×3]+ [26×4]÷50
1 + 4 + 63 + 104 ÷ 50
172÷50= 3.44+0.5 =3.94 (agreed/ accepted)

9. Item 9: Internal consistency: 24+21÷50
45÷50= 0.9 (high)
Mean : [2 × 1]+ [3× 2]+ [24×3]+ [21×4]÷50
2 + 6 + 72 + 84 ÷ 50
164÷50= 3.28+0.5 =3.78 (agreed/ accepted)

10. Item 10: Internal consistency: 23+26÷50

49÷50= 0.98 (high)
Mean : [0 ×1]+ [1× 2]+ [23×3]+ [26×4]÷50
0 + 2 + 69 + 104 ÷ 50
175÷50= 3.5+0.5 =4.0 (agreed/ accepted)

**Subscale 3: Lack of Conducive Environment and Poorly equipped lobotomy.

11. Overcrowding in the classroom does not affect class management or hinder everybody from being carried along.	3	2	25	20
12.. The poor condition of the laboratory and the physical condition of our classrooms prevent effective Biology practicals.	5	3	23	19
13. Insufficiency and bad conditions in the number of seats, desks and tables in me school do not encourage learning effectively.	2	4	24	20
14. Lack of water supply and electricity. do not encourage effective teaching and learning of biology.	3	1	24	22
15. The library in my school is in a poor. condition and have mostly outdated books	1	6	23	20

Analysis

11. Item 11: Internal consistency: 25+20÷50
45÷50= 0.9 (high)
Mean : [3 ×1]+ [2× 2]+ [25×3]+ [20×4]÷50
3 + 4 + 75 + 80 ÷ 50
162÷50= 3.24+0.5 =3.74 (agreed/ accepted)

12. Item 12: Internal consistency: 23+19÷50
42÷50= 0.84 (high)
Mean : [5 ×1]+ [3× 2]+ [23×3]+ [19×4]÷50
5 + 6 + 69 + 76 ÷ 50
156÷50= 3.12+0.5 =3.62 (agreed/ accepted)

13. Item 13: Internal consistency: 24+20÷50
44÷50= 0.88 (high)
Mean :[2×1]+ [4× 2]+ [24×3]+ [20×4]÷50
2 + 8 + 72 + 80 ÷ 50
162÷50= 3.24+0.5 =3.74 (agreed/ accepted)

14. Item 14: Internal consistency: 24+22÷50
46÷50= 0.92 (high)
Mean : [3 ×1]+ [1× 2]+ [24×3]+ [22×4]÷50
3 + 2 + 72 + 88 ÷ 50

165÷50= 3.3+0.5 =3.8 (agreed/ accepted)

15. Item 15: Internal consistency: 23+20÷50
43÷50= 0.86 (high)
Mean : [1 ×1]+ [6× 2]+ [23×3]+ [20×4]÷50
1 + 12 + 69 + 80 ÷ 50
162÷50= 3.24+0.5 =3.74 (agreed/ accepted)

16. Most students believe Biology is too difficult and avoid participating in lessons.	5.	3.	.	23. 19
17. Many students see Biology as irrelevant. to their future careers.	3	1.		24. 22
18. Students' lack of seriousness do not. affect the teaching and learning of Biology.	3.	2.		25. 20
19. Some students do not like to participate in hand-on activities Lack of practical activities makes				
20. Many students do not respond when. it comes to financial responsibility.	1.	6.	.	23. 20

Analysis

16. Item 16: Internal consistency: 23+19÷50
42÷50= 0.84 (high)
Mean : [5 ×1]+ [3× 2]+ [23×3]+ [19×4]÷50
5 + 6 + 69 + 76 ÷ 50
156÷50= 3.12+0.5 =3.62 (agreed/ accepted)

17. Item 17: Internal consistency: 24+22÷50
46÷50= 0.92 (high)
Mean : [3 ×1]+ [1× 2]+ [24×3]+ [22×4]÷50
3 + 2 + 72 + 88 ÷ 50
165÷50=3.3÷0.5=3.8

18. Item 18: Internal consistency: 25+20÷50
45÷50= 0.9 (high)
Mean : [3 ×1]+ [2× 2]+ [25×3]+ [20×4]÷50
3 + 4 + 75 + 80 ÷ 50
162÷50= 3.24+0.5 =3.74 (agreed/ accepted)

19. Item 19: Internal consistency: 23+19÷50
42÷50= 0.84 (high)
Mean : [5 ×1]+ [3× 2]+ [23×3]+ [19×4]÷50
5 + 6 + 69 + 76 ÷ 50
156÷50= 3.12+0.5 =3.62 (agreed/ accepted)

20. Item 20: Internal consistency: 23+20÷50
43÷50= 0.86 (high)
Mean : [1 ×1]+ [6× 2]+ [23×3]+ [20×4]÷50

1 + 12 + 69 + 80 ÷ 50
162÷50= 3.24+0.5 =3.74 (agreed/ accepted)

Subscale 5: Bulky Curriculuml

21. The overloaded curriculum leaves little. time for practical activities and revision.	2.	1.	19.	28
22. Due limited lesson periods, we often rush through Biology topics in order to complete the scheme of work.	0.	1.	23.	26
23. Some of the topics in the broad and complex therefore should be streamlined.	3.	4.	27.	16
24.The do not make it difficult for students to master key concepts.				
25. The curriculum should be reviewed. for better understanding of the topics	0	1.	22	27

Analysis

21. Item 21: Internal consistency: 19+28÷50
47÷50= 0.94 (high)
Mean : [2 ×1]+ [1× 2]+ [19×3]+ [28×4]÷50
2 + 2 + 57 + 112 ÷ 50
176÷50= 3.52+0.5 =4.02 (agreed/ accepted)

22. Item 22: Internal consistency: 23+26÷50
49÷50= 0.98 (high)
Mean : [0 ×1]+ [1× 2]+ [23×3]+ [26×4]÷50
0 + 2 + 69 + 104 ÷ 50
175÷50= 3.5+0.5 =4.0 (agreed/ accepted)

23. Item 23: Internal consistency: 27+16÷50
43÷50= 0.86 (high)
Mean : [3×1]+ [4× 2]+ [27×3]+ [16×4]÷50
3 + 8 + 81 + 64 ÷ 50
156÷50= 3.12+0.5 =3.62 (agreed/ accepted)

17. Item 17: Internal consistency: 24+22÷50
46÷50= 0.92 (high)
Mean : [3 ×1]+ [1× 2]+ [24×3]+ [22×4]÷50
3 + 2 + 72 + 88 ÷ 50

25. Item 25: Internal consistency: 22+16÷50
43÷50= 0.86 (high)
Mean : [0×1]+ [1× 2]+ [22×3]+ [27×4]÷50
0 + 2 + 66 + 108 ÷ 50

176÷50= 3.52+0.5 =4.02 (agreed/ accepted)

*** Since internal consistency of the items range from 0.77 -0.92 which is greater than 0.70[⅞ and mean values ranging from 3.11-3.23 which is above 3.00 which is the critical point, them the reliability of the Instrument is confirmed high.

Analysis of the Main Study

For the main study, forty (40) people which is 8% of the population study were teachers while four hundred and sixty (460) people which is (92 %) were students. Three hundred and four (304) people (60.8%) of the population were males while one hundred and ninety-six people (39.2%) were females. Three hundred and ninety-one (392) that is (78.2%,) were from the urban settlement while one hundred and eight (108) people which represents (21.8 %) were from the rural part of Onitsha education zone. Twenty (20) of the teachers which (50%) have taught SS1 class, twelve (12) teachers (30%) taught SS2 and eight (8) teachers (20%) of the teachers taught SS3. Regarding years of working experience; ten (10) that is (25%) have between one to five (1-5) years of working experience; twelve (15) teachers (37.5%) have between six to ten (6-10) years of working experience; eight (8) teachers representing (20%,) have between eleven to fifteen (11-15) years of working experience and seven (7) teachers which is (17.5%) have above fifteen years of working experience.

Concerning educational achievement or qualification: twenty (20) teachers, that is (50%) of the teachers were degree holders, eight (8) teachers (20%) had master's degree; four (4) teachers (10%) had doctorate degree (Ph.D.) and eight (8) teachers (20%) had other form of qualifications.

S/N	Statement	SD 1	D 2	U 3.	A 4.	SA.5
**Subscale 1: Insufficient Number. of Qualified Teachers		.				
1.	Biology lessons are often combined or cancelled Because there are too few teachers.	24	55	145	275	
2.	Unqualified or non-specialist teachers do not use appropriate methods like inquiry, discussion and demonstration methods when teaching.	30	38	173	259	
3.	The shortage of Biology teachers. makes it difficult to complete the syllabus on time.	50	57	223	170	
4.	Biology lessons are mostly teacher talk with little student participation.	50	57	140	253	
5.	The teaching methods used make. me memorize facts instead of under-standing them.	30.	35.	153.	262	

Analysis of the subscale

1. Item 1: Internal consistency: 145+275÷500
420÷500= 0.84 (high)
Mean : [24 ×1]+ [55× 2]+ [145×3]+ [275×4]÷500
24 + 110 + 435 + 1100 ÷ 500
1669÷500= 3.338+0.5 =3.838(agreed/ accepted)
2. Item 2: Internal consistency: 145+275÷500
420÷500= 0.84 (high)
Mean : [30 ×1]+ [38× 2]+ [173×3]+ [259×4]÷500
30 + 76 + 519 + 1036 ÷ 500
1661÷500= 3.322+0.5 =3.822(agreed/ accepted)
3. Item 3 Internal consistency: 223+170÷500
393÷500= 0.78 (high)
Mean : [50 ×1]+ [57× 2]+ [223×3]+ [170×4]÷500
50 + 114 + 669 + 680 ÷ 500
1513÷500= 3.026+0.5 =3.526(agreed/ accepted)
4. Item 4: Internal consistency: 140+253÷500
393÷500= 0.78 (high)
Mean : [50 ×1]+ [57× 2]+ [140×3]+ [253×4]÷500
50 + 114 + 420 + 1012 ÷ 500
1596÷500= 3.192+0.5 =3.692(agreed/ accepted)
5. Item 5: Internal consistency: 153+262÷500
415÷500= 0.83 (high)
Mean : [30 ×1]+ [34× 2]+ [153×3]+ [262×4]÷500
30 + 68 + 459 + 1048 ÷ 500
1605÷500= 3.21+0.5 =3.71(agreed/ accepted)
11. Item 11: Internal consistency: 214+228÷500
442÷500= 0.88 (high)
Mean : [24 ×1]+ [55× 2]+ [145×3]+ [275×4]÷500
24 + 110 + 435 + 1100 ÷ 500
1669÷500= 3.338+0.5 =3.838(agreed/ accepted)

The degree of acceptance is high since it ranges from 3.13- 3.25 which is greater than 3.0(the critical value). This also has high internal consistency ranging from 0.77-0.83 h

** Subscale 2: Inadequate Teaching Resources

6. Lack of teaching aids like textbooks, charts, models, forces teachers to rely only on chalkboard explanations.	55	29	187	229
7. Lack of laboratory equipment, specimens,. Chemicals and reagents make biology lessons	20	36	220	224

theoritical and not easy to understand.

8. Students share one Biology textbook among three or more learners in my class.	36	50	190.	224
9. Lack of ICT tools means we cannot visualize processes like cell division or DNA replication.	22	34	215.	229
10. My school does not use computer simulations or apps to teach difficult Biology topics.	23	42	209	226

Analysis

6. Item 6: Internal consistency: 187+229÷500
416÷500= 0.83 (high)
Mean : [55 ×1]+ [29× 2]+ [187×3]+ [229×4]÷500
55 + 58 + 561 + 916 ÷ 500
1590÷500= 3.18+0.5 =3.68(agreed/ accepted)
7. Item 7: Internal consistency: 220+224÷500
444÷500= 0.88 (high)
Mean : [20 ×1]+ [36× 2]+ [220×3]+ [224×4]÷500
20 + 72 + 660 + 896 ÷ 500
1648÷500= 3.296+0.5 =3.796(agreed/ accepted)
8. Item 8: Internal consistency: 190+224÷500
414÷500= 0.82 (high)
Mean : [36 ×1]+ [50× 2]+ [190×3]+ [224×4]÷500
36 + 100 + 570 + 896 ÷ 500
1602÷500= 3.204+0.5 =3.704(agreed/ accepted)
9. Item 9: Internal consistency: 215+229÷500
444÷500= 0.88 (high)
Mean : [22 ×1]+ [34× 2]+ [215×3]+ [229×4]÷500
22 + 68 + 645 + 916 ÷ 500
1651÷500= 3.302+0.5 =3.802(agreed/ accepted)
10. Item 10: Internal consistency: 209+226÷500
435÷500= 0.87 (high)
Mean : [23 ×1]+ [42× 2]+ [209×3]+ [226×4]÷500
23 + 84 + 627 + 904 ÷ 500
1638÷500= 3.276+0.5 =3.776(agreed/ accepted)
2068÷ 750= 2.75+0.5 =3.25 (agreed/ accepted)

The degree of acceptance is high since it ranges from 3.16- 3.26 which is greater than 3.0(the critical value). This also has high internal consistency ranging from 0.80-0.85

**Subscale 3: Lack of Conducive Environment and Poorly equipped lobotomy.

11. Overcrowding in the classroom does not.	20	38.	. 214	228

affect class management or hinder everybody from being carried along.				
12.. The poor condition of the laboratory and the physical condition of our classrooms prevent effective Biology practicals.	16.	32	191	261
13. Insufficiency and bad conditions in the number of seats, desks and tables in my school do not encourage learning effectively.	30	28	179	263
14. Lack of water supply and electricity. do not encourage effective teaching and learning of biology.	23	38	224	263
15. The library in my school is in a poor. condition and have mostly outdated books	36	20	195	249

11. Item 11: Internal consistency: 214+228÷500
442÷500= 0.88 (high)
Mean : [20 ×1]+ [38× 2]+ [214×3]+ [228×4]÷500
20 + 76 + 642 + 912 ÷ 500
1650÷500= 3.3+0.5 =3.8(agreed/ accepted)
12. Item 12: Internal consistency: 191+261÷500
452÷500= 0.90 (high)
Mean : [16 ×1]+ [32× 2]+ [191×3]+ [261×4]÷500
16 + 64 + 573 + 1044 ÷ 500
1697÷500= 3.394+0.5 =3.894(agreed/ accepted)
13. Item 13: Internal consistency: 179+263÷500
442÷500= 0.88 (high)
Mean : [30 ×1]+ [28× 2]+ [179×3]+ [263×4]÷500
30 + 56 + 537 + 1052 ÷ 500
1675÷500= 3.35+0.5 =3.85(agreed/ accepted)
14. Item 14: Internal consistency: 224+263÷500
487÷500= 0.97= (high)
Mean : [23 ×1]+ [38× 2]+ [224×3]+ [263×4]÷500
23 + 76 + 672 + 1052 ÷ 500
1823÷500= 3.646+0.5 =4.146(agreed/ accepted)
15. Item 15: Internal consistency: 195+249÷500
444÷500= 0.88 (high)
Mean : [36 ×1]+ [20× 2]+ [195×3]+ [249×4]÷500
36 + 40 + 585 + 996 ÷ 500
1657÷500= 3.314+0.5 =3.814(agreed/ accepted)

The degree of acceptance is high since it ranges from 3.20- 3.29 which is greater than 3.0(the critical value). It also has high internal consistency ranging from 0.80-0.87

Subscale 4: Negative Attitudes of Students

16. Most students believe Biology is too difficult and avoid participating in lessons. 23 36 237 204
17. Many students see Biology as irrelevant to their future careers. 40 48 196 216
18. Students' lack of seriousness do not affect the teaching and learning of Biology 50 47 178 225
19. Some students do not like to participate in hand-on activities Lack of practical activities makes 45 43 218 194
20. Many students do not respond when it comes to financial responsibility 38 48 238 176

16. Item 16: Internal consistency: 237+204÷500
441÷500= 0.88 (high)
Mean : [23 ×1]+ [36× 2]+ [237×3]+ [204×4]÷500
23 + 72 + 711 + 816 ÷ 500
1622÷500= 3.244+0.5 =3.744(agreed/ accepted)
17. Item 17: Internal consistency: 196+216÷500
412÷500= 0.82 (high)
Mean : [40 ×1]+ [48× 2]+ [196×3]+ [216×4]÷500
40 + 96 + 588 + 864 ÷ 500
1588÷500= 3.176+0.5 =3.676(agreed/ accepted)
18. Item 18: Internal consistency: 178+225÷500
403÷500= 0.80 (high)
Mean : [50 ×1]+ [47× 2]+ [178×3]+ [225×4]÷500
50 + 94 + 534 + 900 ÷ 500
1578÷500= 3.156+0.5 =3.656(agreed/ accepted)
19. Item 19: Internal consistency: 218+194÷500
412÷500= 0.82 (high)
Mean : [45 ×1]+ [43× 2]+ [218×3]+ [194×4]÷500
45 + 86 + 654 + 776 ÷ 500
1561÷500= 3.122+0.5 =3.622(agreed/ accepted)
20. Item 20: Internal consistency: 238+176÷500
414÷500= 0.82 (high)
Mean : [38 ×1]+ [48× 2]+ [238×3]+ [176×4]÷500
38 + 96 + 714 + 704 ÷ 500
1552÷500= 3.104+0.5 =3.604(agreed/ accepted)

The degree of acceptance is high since it ranges from 3.1- 3.29 which is greater than 3.0(the critical value). Ih also has high internal consistency ranging from 0.76-0.83

Subscale 5: Bulky Curriculuml

21. The overloaded curriculum leaves little time for practical activities and revision. 20 28 206 244
22. Due limited lesson periods, we often 15 27 241 217

rush through Biology topics in order to complete the scheme of work.				
23. Some of the topics in the broad and complex therefore should be streamlined.	24	32	224	220
24.The bulkiness of the curriculum makes it difficult for students to master key concepts.	16	24	230	230
25. The curriculum should be reviewed for better understanding of the topics	16	32	224	228

21. Item 21: Internal consistency: 206+244÷500
450÷500= 0.9 (high)
Mean : [20 ×1]+ [28× 2]+ [206×3]+ [244×4]÷500
20 + 56 + 618 + 976 ÷ 500
1670÷500= 3.34+0.5 =3.84(agreed/ accepted)
22. Item 22: Internal consistency: 241+217÷500
458÷500= 0.91 (high)
Mean : [15 ×1]+ [27× 2]+ [241×3]+ [217×4]÷500
15 + 54 + 723 + 868 ÷ 500
1660÷500= 3.32+0.5 =3.8(agreed/ accepted)
23. Item 23: Internal consistency: 224+220÷500
444÷500= 0.88 (high)
Mean : [24 ×1]+ [32× 2]+ [224×3]+ [220×4]÷500
24 + 64 + 672 + 880 ÷ 500
1640÷500= 3.28+0.5 =3.78(agreed/ accepted)
24. Item 24: Internal consistency: 230+230÷500
460÷500= 0.92 (high)
Mean : [16 ×1]+ [24× 2]+ [230×3]+ [230×4]÷500
16 + 48 + 690 + 920 ÷ 500
1674÷500= 3.348+0.5 =3.848(agreed/ accepted)
25. Item 25: Internal consistency: 224+228÷500
452÷500= 0.90 (high)
Mean : [16 ×1]+ [32× 2]+ [224×3]+ [228×4]÷500
16 + 64 + 672 + 912 ÷ 500
1664÷500= 3.328+0.5 =3.828(agreed/ accepted)

The degree of acceptance is high since it ranges from 3.2- 3.39 which is greater than 3.0(the critical value). This also has high internal consistency ranging from 0.82-0.98. Both the pilot and main study showed strong internal consistency and high level of acceptance, therefore, the reliability of the instrument is tested and accepted.

Research Hypotheses

Five hypotheses were formulated and tested at 0.05 alpha levels

HOI: There is no significant relationship between the numbers of qualified biology teachers and factors affecting the effective teaching and learning of biology in Onitsha Education Zone.

This table shows the mean values of respondents as follows:

Variables:	Figure	χ^2(critical)	χ^2(calculate fl)	dt.	P
Agreed .	85	3.84	262.08	1	>0.05
Disagreed	415				
Total:.	500				

From the table, 415 (83.0%) of respondents agreed. The degree of freedom is 1, P>0.5 and the calculated value is greater than the critical value (262.08> 3.84), The null hypothesis is therefore rejected.

HAI: There is significant relationship between the numbers of qualified biology teachers and factors affecting the effective teaching and learning of biology in Onitsha Education Zone.

HO2: There is no significant relationship between unavailability of instructional materials for teaching and factors affecting the effective teaching and learning of biology in Onitsha Education Zone.

Variables:	Figure	χ^2(critical)	χ^2(calculate fl)	dt.	P
Agreed .	69	3.84	262.08	1	>0.05
Disagreed	431				
Total:.	500				

The chi-square value above shows 431 (86.2%) respondents agreed. The table also shows the calculated value of 262.08 which is greater than of 3.84 with 1 degree of freedom. The calculated value is greater than 3.48 which is the critical value. Therefore the result shows that there is a significant relationship between lack of instructional resources and factors militating against the effective teaching and learning of biology education in senior secondary schools in Onitsha Education Zone of Anambra State. Hence the null hypothesis is rejected.

HA2: There is significant relationship between unavailability of instructional materials and factors affecting the effective teaching and learning of biology in Onitsha Education Zone.

HO3: There is no significant relationship between the attitude of students towards biology and factors affecting the effective teaching and learning of biology in Onitsha Education Zone.

Variables:	Figure	χ^2(critical)	χ^2(calculate fl)	dt.	P
Agreed	56	3.84	301.08	1	>,0.05
Disagreed	444				
Total:.	500				

The chi-square value above shows 444 (88.8% ,) respondents agreed. The table also shows the calculated value of 301.08 which is greater than 3.48 with 1 degree of freedom and. P >0.5 .Since the calculated value is greater than 3.84 which is the critical value, there is a significant relationship between attitude of students towards biology education and factors militating against

the effective teaching and learning of biology education in senior secondary schools in Onitsha Education Zone of Anambra State. Hence the null hypothesis is rejected.
HA3: There is significant relationship between the attitude of students towards biology and the factors affecting the teaching our learning of biology in Onitsha Education Zone.

HO4: There is no significant relationship between inconducive learning environment and the factors affecting the teaching and learning of biology in Onitsha Education Zone.

Variables:	Figure	χ^2(critical)	χ^2(calculate fl)	dt.	P
Agreed	54	3.84	301.08.	1	>,0.05
Disagreed:	446.				
Total:.	500				

According to the table, chi-square value above shows 446 (89.2%) respondents agreed. The table also shows the calculated value of 301.08 which is greater than 3.84 with 1 degree of freedom and P>3.84 of freedom. Since the calculated value is greater than 3.84(critical value). Therefore, there is a significant relationship between inconducive learning environment and factors militating against the effective teaching and learning of biology education in senior secondary schools in Onitsha Education Zone of Anambra State. Hence the null hypothesis is rejected.

H05,: There is no significant relationship between bulkiness of the curriculum and factors militating against the effective teaching and learning of biology in senior secondary schools in Senior Secondary Schools of Onitsha Education Zone

Variables:	Figure	χ^2(critical)	χ^2(calculate fl)	dt.	P
Agreed	44	3.84	339.48	1	>,0.05
Disagreed	456				
Total:.	500				

From the table, chi-square value above shows 456(91.2 %) agreed.. The table also shows the calculated value of 339.48 which is greater than 3.84(critical value) 1 degree of freedom and P>0.5. Since the calculated value is greater than(339.48>3.84) there is a significant relationship between the bulkiness of the curriculum and factors militating against the effective teaching and learning of biology education in senior secondary schools in Onitsha Education Zone of Anambra State. Therefore, the null hypothesis is rejected.
HA5:. There is significant relationship between bulkiness of the curriculum and factors affecting the effective teaching and learning of biology in senior secondary schools in Onitsha Education Zone.

Discussion of Findings
The demography of the respondents after computation showed that there is serious disparity between the males and the females meaning that there is still a wide gap male and female biology teachers and students. The number of the males is quite higher than that of the females. This calls for serious attention in the education sector. Factors like lack of awareness, socio-economic and socio-cultural factors could be largely responsible. Therefore, there should be creation of serious

awareness and collaboration by relevant stakeholders encouraging girls to pick interest in biology education. This will close the gap that is existing in the number of female students and teachers in biology education and biology related disciplines. Factors Militating against the effective teaching and learning of biology education in senior secondary schools of Onitsha Education Zone are going to be discussed as follows:

Insufficient Number of Qualified Teachers

A shortage of qualified biology teachers often leads to the employment of untrained or underqualified personnel, resulting in poor content delivery, misconceptions, and shallow explanations of complex biological concepts. This weakens students' conceptual understanding and scientific literacy. Qualified teachers are more likely to adopt student-centered approaches (e.g., inquiry-based learning). Their absence sustains traditional lecture. More so, few teachers handling large classes experience overload, which reduces lesson preparation quality, limits individualized instruction, and discourages innovative teaching strategies or methods reducing engagement and retention. Inadequate teacher expertise do not apply other teaching methods like demonstration, discussions, hands -on activities (practicals), field trips, etc. This results im low student performance, especially in cognitively demanding topics such as genetics, ecology, and physiology.

Qualified teachers are more likely to adopt student-centered approaches (e.g., inquiry-based learning). Their absence sustains traditional lecture methods, reducing engagement and retention. The overall effect is a decline in educational standards, reduced preparedness of students for higher education and science-related careers, poor development of scientific and practical skills, low student motivation and interest, inability to relate theories to real life experience and poor performance in both internal and external examinations.

Lack of Instructional Materials

The lack of instructional materials is a critical barrier to the effective teaching and learning of Biology, particularly in senior secondary schools where abstract concepts require concrete illustration and experimentation. Instructional materials include textbooks, charts, models, specimens, laboratory equipment, functional library, audiovisual aids, and digital tools. Biology involves complex and abstract concepts (e.g., genetics, cell structure, ecological systems). Without instructional materials such as models, diagrams, and charts, teachers rely heavily on verbal explanations, which limits students' comprehension. Consequently, there would be reduced student's comprehension, poor conceptual understanding, student engagement and and motivation, inadequate development of practical skills, poor reading or study habits, ineffective teaching methods, limited retention and recall. Increased teacher workload and frustration.

Lack of conducive Learning Environment

The learning environment is an important factor in effective teaching and learning of biology. Some school buildings are so dilapidated, with roofs, windows and doors falling off. Students and teachers do not have good seats. In some students' seat on the bare floor. Some others face the

challenge of overcrowded classrooms. Large class size gives rise to unclear personalized attention and effective class management. Students learn at different paces. Some are fast learners because others are slow learners. Having an overcrowded class will hinder transfer of knowledge according to individual needs while some may catch up, others may lag behind. There is also the challenge of well-equipped and functional libraries leading to limited access to information and reduction in reading and research skills. Some schools also lack basic amenities like electricity, water supply even toilet system which are essential in a conducive environment.

Negative Attitude of Students

Students may develop negative attitude towards biology which can lead to a lack of effort and poor performance. A lack of genuine interest in the subject can result to students not engaging with the material or putting in the necessary efforts to learn. Some do not like to participate in practical activities or be bothered with biological exercises like field trips or research activities. Some have phobia for biology education- they see biology as very difficult and demanding. Therefore, not putting in the required zeal and efforts. This will lead to low motivation and concentration, poor academic performance and achievement, low practical skills and at times, drop-out of school.

Bulky Curriculum

Overloaded Curriculum: The curriculum is sometimes seen as too extensive for the time allocated. The topics in biology are very complex and extensive therefore, enough time should be allocated for effective learning. Curriculum overload at times make teachers skip practicals to cover the syllabus, reducing Biology to memorization of diagrams and definitions instead of inquiry. The topics in the curriculum should align with students' needs. The bulkiness of the curriculum makes teachers stressed and at times deliver biology contents poorly while trying to meet up. This makes students loss motivation and interest leading to poor performance in both internal and external examinations like WAEC and JAMB.

Lack of Practical Activities

Biology is inherently experimental. Without laboratory activities, students fail to develop essential skills such as observation, hypothesis testing, data analysis, and scientific reasoning concepts such as cell division, enzyme activity, and ecological interactions remain abstract without hands-on experiences, leading to rote memorization rather than meaningful learning. Students struggle to apply biological knowledge to real-world issues (e.g., health, environment), limiting functional understanding. Lack of practical activities lead to abstract learning and misconceptions, low student motivation and interest, and inability to relate theory to real life.

Poor Teaching Methods

ii) Poor method of teaching: The primary aim of teaching at any level of education is to bring fundamental change in the learner (Kalhssay and Tebalal 2021) to facilitate the process or transmission, teachers should apply appropriate methods that best suit specific objectives and level of existing outcomes. A good biology teacher is expected to use scientific methods that use appropriate methods such as discovery, inquiry, activity, demonstration and projects which if

judiciously employed by the teachers will lead to effective teaching and learning of biology education. Some teachers still use lecture method of teaching instead which is teacher- centered leading to lack of job satisfaction and poor performance on the part of the students. Using appropriate method which is student-centered, promotes deep with lectures, motivation and proper engagement lecture. Consequently, this enhances job satisfaction on the part of the teacher and boost better performances and achievements.

Effects of Lack of Integration of ICT (Virtual Labs)

Biology involves microscopic and complex processes (e.g., DNA replication, cellular respiration). ICT tools like simulations and virtual labs enhance visualization; without them, understanding is limited. ICT promotes interactive and learner-centered environments. Without it, teaching remains teacher-dominated and less engaging. Students in ICT-deficient schools are disadvantaged compared to peers with access to digital tools, widening educational inequality. Inadequate Development of 21st-Century Skills. ICT integration fosters digital literacy, problem-solving, and independent learning. Its absence leaves students unprepared for modern scientific and technological environments.

Students in ICT-deficient schools are disadvantaged compared to peers with access to digital tools, widening educational inequality, Inadequate development of 21st-Century skills. ICT integration fosters digital literacy, problem-solving, and independent learning. Its absence leaves students unprepared for modern scientific and technological environments. Virtual labs can compensate for lack of physical laboratories by providing safe, cost-effective experimentation environments. Their absence deprives students of these benefits. Virtual labs can compensate for lack of physical laboratories by providing safe, cost-effective experimentation environments. Their absence deprives students of these benefits: ability to relate theory to real life, increased student engagement and interactivity, better performance in external and internal examinations.

The findings of the study show the factors militating against the teaching of biology in public secondary schools in Onitsha Education Zone. (See table ll and lll). Therefore, the need for more qualified teachers and adequate teacher training and development opportunities for effective teaching and learning of biology in Onitsha Education Zone cannot be overemphasized. Students need to show keen interest by engaging meaningfully in the teaching and learning process of biology. There is need to pay attention to classroom facilities, laboratory apparatus and equipment in facilitating effective teaching. This aligns with Olajide's (2022) study, which underscores the correlation between teacher's competency, academic resources, teaching methodologies and students performance. Similarly, Abidoye and Olajide (2023) examine the significance of instructional materials such as textbooks, charts, specimens and other resources in biology teaching as emphasized earlier. Lack of proper harmonization between integrated science and biology education for effective teaching and learning of biology is another militating factor. ISEAN have emphasized integrated science.

Conclusion

The research focused on assessing the public secondary schools, anchoring on the perspectives of biology teachers and students regarding factors militating against the effective teaching and learning of biology education in Onitsha Education Zone of Anambra State. Giving biology's current role in preparing students for diverse scientific fields like medicine, genetics, ecology, pharmacology and biotechnology, it remains the core subjects globally recognized across educational levels. Employing Albert Bandura's Social Cognitive Theory (SCT) which posits that learning occurs within a social context characterized by interactive influence among individuals, the environment and behaviors and Kolb's Experiential Learning Theory (ELT) which emphasized on the impact learning by experience have on effective teaching and learning of biology. Data was collected via questionnaires administered to 40 biology teachers and 460 biology students in public secondary schools in Onitsha Education Zone.

Analysis involving standard deviation and chi-square statistical methods were used. The findings underscored the significant importance of Biology education for students aspiring to pursue carriers in science and healthcare. Furthermore, factors such as availability of qualified teachers, access to updated teaching resources, teacher training and professional development, adequate classroom facilities, student's engagement and interest, curriculum harmonization, incorporation of ICT (virtual labs) were identified as crucial for effective Biology instruction in secondary schools in Onitsha Education Zone in Anambra State.

Recommendations

The study reveals that to ensure effective Biology education in secondary schools will necessitate several key actions. Hence, the following recommendations that put forward.
Firstly, it is imperative to employ more qualified biology teachers. Having sufficient number of qualified teachers will enhance the quality of biology education in senior secondary schools

Secondly, a strong emphasis must be placed on continuous training and professional development. This will encourage various forms of training: in-studying formal education, in-service programs and workshops. It is crucial to actively encourage teachers to participate in these opportunities to keep abreast of the latest educational development and instructional techniques, thus, enhancing their teaching effectively.

Thirdly, provision of an enabling and conducive teaching and learning environment. This involves the procurement of necessary resources such as laboratory equipment, ICT (virtual labs), teaching aids, and instructional materials, ensuring that biology teachers have access to the tools required for engaging and information lessons.

Furthermore, allocation of sufficient lesson periods for proper teaching and learning of biology education in other for impartation of adequate knowledge to students. It will also make the teachers to be well coordinated and have more time for the teacher to be carrying everyone along or design appropriate teaching methods according to students' specific needs.

More so, active student engagement is essential for fostering meaningful learning experiences. In Biology, students should be encouraged to develop a keen interest in biology, actively participating in the teaching-learning process. Emphasis should be placed on the fostering curiosity and exploration; encouraging students to interact with classroom and laboratory facilities and apparatus during lessons, practicals, fieldwork, projects etc., does deepening their understanding of biological concepts through hands-on experiences. There should be proper monitoring of the quantity and quality of biology practicals and activities carried out in secondary schools

Furthermore, incorporation of ICT (virtual labs and simulations) is very important. The role of technology cannot be overemphasized. Virtual labs will make materials that not accessible easily accessible.

Finally, there should be proper harmonization between the subject integrated science and biology. This will provide proper educational background and foundation as students Transit from JSS to SSS.

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