Analysis Of Senior Secondary School Students Difficulties In Ecology, Biology Ogun State Nigeria

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ABSTRACT

The study investigated difficult concepts in ecology and examined school factors influencing difficulties in learning ecological aspects of biology as perceived by students.The research adopted a descriptive survey with a mixed method approach. The population consists of senior secondary school students offering biology in both public and private schools in Obafemi Owode Local Government area of Ogun State, Nigeria. A sample of 739 students, including 376 from public schools and 363 from private schools, was selected using purposive sampling techniques. Data was collected through a self-designed structured questionnaire and analyzed using statistical methods including percentages, means, standard deviation, and t-test of significance.Findings indicate that while students generally find basic ecological definitions easy and straightforward, they encounter challenges with complex processes, interrelationships, and detailed examples. Students' learning was influenced by school factors including the use of audio-visual aids and teacher-student relationships, government policies, funding support, and environmental factors.To suffice, a holistic approach considering student characteristics, school environments, government policies, and local ecological contexts are crucial for fostering a deeper understanding of ecological concepts and principles among senior secondary school students. In addition, comprehensive support frameworks, enhanced school factors, and integration of environmental education to improve ecological education outcomes for all students is necessary.

Keywords: Evolution; Metabolism; Adaptation; Genetics.

INTRODUCTION

Biology as a scientific discipline holds immense importance in understanding of life and the natural world. It serves as the cornerstone for comprehending the complexities of living organisms, their interactions, and the intricate mechanisms that govern life processes. Its applications extend across various scientific, medical, and societal domains, making it an indispensable field of knowledge with far-reaching implications for the benefit of humanity and the planet (1). As important as biology is, learning outcomes in this subject over the year was below expectation.

Furthermore, a meticulous examination of the Federal Ministry of Education (FME) senior secondary school curriculum for biology reveals an intriguing emphasis on ecological aspects. Among the ten biology themes, three are dedicated to ecology, spanning across the different tiers of classes—SS1, SS2, and SS3. This deliberate allocation underscores the significance accorded to ecological knowledge in the overall biology curriculum in Nigeria, surpassing the attention given to other themes such as Genetics and Cell Biology (2).

Ecology has a great influence on other aspects of Biology. For example, in evolution, ecology plays a role of natural selection and adaptation, influencing the evolution of species based on their interaction with the environment. In Genetics, ecological factors like habitats, resources, and competition contribute to genetic variation with population, influencing the gene pool themselves. In cell biology, ecological factors can affect the structure, function and behaviour of cell, it can also impact nutrient availability, affecting cellular process like metabolism. Cell may undergo changes based on the availability of essential nutrients in their environment. Also in reproduction, nutrition and other fundamental aspects of biology (3).

Analysis of ecology questions posed by the West African Examinations Council (WAEC) from 2010 to 2018, provides compelling evidence of the subject's pivotal role. A scrutiny of the theory questions reveals a consistent pattern, with ecology questions appearing more than twice in every single year except for 2012. This sustained presence reinforces the notion that ecological understanding is a recurring and integral component of the examination as shown in tables 1 and 2 below.

Table 1. Ecology Questions set by WAEC between 2010 and 2018 in Nigeria

Year of Examination	Theory Questions	Objective Questions
2010	3 & 8	Questions 32-43 (12 Items)
2011	3 & 7	Questions 36-49 (14 Items)
2012	3	Questions 37-49 (11 Items)
2013	3, 4 & 7	Questions 35-47 (13 Items)
2014	3 & 6	Questions 27-39 (13 Items)
2015	2,3 & 6	Questions 27-39 (13 Items)
2016	3 & 4	Questions 30-39 (10 Items)
2017	2, 3 & 6	Questions 29-42 (14 Items)
2018	3 & 6	Questions 27-37 (11 Items)

Source: Anyale (2019). *Unique Senior Secondary School Certificate Examination Past Questions and Answers for SSCE, GCE and NECO – Biology Series*. Lagos: A. Johnson Publishers Limited.

Table 2. Ecology Questions set by WAEC between 2019 and 2022

2019	3 & 5	Questions 28-37, 40,49 (12 Items)
2020	5	Questions 31-40, 50 (10 Items)
2021	4 & 6	Questions 26, 28-39 (113 Items)
2022	3 & 4	Questions 28-41 (13 Items)

Source: WAEC questions from 2019 to 2022.

These statistical insight underscores the substantial weight and significance attributed to ecology in the assessment framework. Consequently, it becomes apparent that students cannot afford to underestimate the importance of ecological knowledge if they aspire to achieve commendable grades in biology. To this effect, the study will investigate the difficult concepts in ecological aspects of biology and examine school factors that causes difficulties in learning the ecological aspects of biology as perceived by students in public and private secondary schools in Ogun State of Nigeria. Moving beyond curriculum considerations, the educational landscape in Nigeria encompasses public and private schools. In some countries of the world, among these two categories, the formal education depends largely on private schools while in other countries, public schools take a major responsibility for basic education (4).

METHODS

This study adopted the descriptive survey research design of mixed method type. The population in this study consist of all senior secondary school biology students in the existing sixteen (16) public and nineteen (19) private secondary school in Obafemi Owode Local Government area of Ogun State. In this regard, the total population is fifteen thousand five hundred and twenty-two (15, 522) comprising of 8884 from public school and 6638 from private school. In this study, a sample of seven hundred and thirteen (713) comprising of 363 students from public school and 350 from private school form the sample for the study. The total school used for this study were selected based on equal proportion, where eight (8) public schools as well as eight (08) private schools which are equivalent to a total of sixteen (16) were selected as the sample within the study area using simple random sampling techniques. Similarly, purposive sampling techniques was adopted in selecting SSS2 and SSS3 students in the selected school to participate in the study. The instrument that was employed for data collection in this study was a self-designed structured questionnaire. The questionnaire consisted of five sections: sections A sought for the Bio data of the respondents and this contains 4 items including class, age, gender and school type. Section B contain 62 items question on areas of students' difficulties in learning the ecological aspects of biology. The item in this section consisted of closed-ended questions for the students to complete in four point Liker type scale of: ED = Extremely Difficult; JD = Just Difficult; D = Difficult; ND = Not Difficult. The next was structured based on school factors on learning ecology as a topic in biology. This section contains six (06) items in a 4-point Likert type scale of Strongly Agree (SA), Agree (A) Disagree (D) and Strongly Disagree (SD).

The data was primarily sourced and the research questions were formulated according to the dimensions of the variables, which include: a difficulty in the ecological aspect of Biology, school factors and the instrument was validated. It yielded a Cronbach coefficient alpha value of 0.76.

RESULTS

Research Question One: What are the students perceived difficult concepts in Ecological aspects of biology in public and private secondary school in Ogun State of Nigeria?

Table 3. Descriptive statistics showing the students perceived difficult concepts in ecological aspect of biology in public and private secondary school in Ogun State.

Ecology Concept	Not Difficult	Difficult	Just Difficult	Extremely Difficult
Meaning of ecology	339	219	124	31
	47.5%	30.7%	17.4%	4.3%
Branches of Ecology	379	225	81	28
	53.2%	31.6%	11.4%	3.9%
Ecological concept	248	288	94	83
	34.8%	40.4%	13.2%	11.6%
Meaning of ecosystem	309	185	172	47
	43.3%	25.9%	24.1%	6.6%
Examples of ecosystem	353	159	153	48
	49.5%	22.3%	21.5%	6.7%
components of ecosystem	304	217	124	68
	42.6%	30.4%	17.4%	9.5%
Food chain	377	180	99	57
	52.9%	25.2%	13.9%	8.0%
Food web	325	209	85	94
	45.6%	29.3%	11.9%	13.2%
Ecological pyramids	235	304	56	118
	33.0%	42.6%	7.9%	16.5%
Meaning of energy	507	142	41	23
	71.1%	19.9%	5.8%	3.2%
Forms of energy	460	157	86	10
	64.5%	22.0%	12.1%	1.4%
Meaning of energy transformation	324	271	80	38
	45.4%	38.0%	11.2%	5.3%
Examples of energy transformation	299	281	71	62
	41.9%	39.4%	10.0%	8.7%
Laws of conservation of energy	238	319	76	80
	33.4%	44.7%	10.7%	11.2%
Meaning of nutrient	351	122	112	128
	49.2%	17.1%	15.7%	18.0%
Examples of nutrients	287	153	212	61
	40.3%	21.5%	29.7%	8.6%
Carbon/oxygen cycle	269	279	108	57
	37.7%	39.1%	15.1%	8.0%

Ecology Concept	Not Difficult	Difficult	Just Difficult	Extremely Difficult
Nitrogen cycle	193	331	86	103
	27.1%	46.4%	12.1%	14.4%
Water cycle	247	268	107	91
	34.6%	37.6%	15.0%	12.8%
Meaning of biotic community	182	273	165	93
	25.5%	38.3%	23.1%	13.0%
Local biotic communities in Nigeria	157	231	184	141
	22.0%	32.4%	25.8%	19.8%
World biotic communities	165	263	137	148
	23.1%	36.9%	19.2%	20.8%
Location and characteristics of the biotic communities mentioned above	117	324	148	124
	16.4%	45.4%	20.8%	17.4%
Meaning of population	339	142	127	105
	47.5%	19.9%	17.8%	14.7%
Characteristics of population	380	156	118	59
	53.3%	21.9%	16.5%	8.3%
Factors affecting population size	318	225	59	111
	44.6%	31.6%	8.3%	15.6%
Measurement of population size	316	165	148	84
	44.3%	23.1%	20.8%	11.8%
Meaning of habitat	507	98	72	36
	71.1%	13.7%	10.1%	5.0%
Types of habitats	449	94	129	41
	63.0%	13.2%	18.1%	5.8%
Characteristics of each type of habitat	393	153	67	100
	55.1%	21.5%	9.4%	14.0%
Plant and animal species adapted to each type of habitat	366	174	82	91
	51.3%	24.4%	11.5%	12.8%
Meaning of soil	611	52	19	31
	85.7%	7.3%	2.7%	4.3%
Types of soil	541	99	73	0
	75.9%	13.9%	10.2%	0.0%
Characteristics of each type of soil	499	143	61	10
	70.0%	20.1%	8.6%	1.4%
Measurement of soil porosity and water holding capacity	227	364	80	42
	31.8%	51.1%	11.2%	5.9%
Components of the soil	417	140	67	89
	58.5%	19.6%	9.4%	12.5%

Ecology Concept	Not Difficult	Difficult	Just Difficult	Extremely Difficult
Meaning of conservation of natural resources	231	279	91	112
	32.4%	39.1%	12.8%	15.7%
Types of natural resources	274	227	122	90
	38.4%	31.8%	17.1%	12.6%
Reasons for conservation	217	293	97	106
	30.4%	41.1%	13.6%	14.9%
Methods of conservation	240	215	133	125
	33.7%	30.2%	18.7%	17.5%
Benefits of conservation	215	259	124	115
	30.2%	36.3%	17.4%	16.1%
Ways of ensuring conservation	217	233	116	147
	30.4%	32.7%	16.3%	20.6%
Problems associated with conservation	206	208	145	154
	28.9%	29.2%	20.3%	21.6%
Meaning of pollution	583	52	47	31
	81.8%	7.3%	6.6%	4.3%
Meaning of pollutants	590	67	47	9
	82.7%	9.4%	6.6%	1.3%
Types of pollution	604	27	44	38
	84.7%	3.8%	6.2%	5.3%
Effects of pollution	523	69	52	69
	73.4%	9.7%	7.3%	9.7%
Control of pollution	526	82	45	60
	73.8%	11.5%	6.3%	8.4%
Meaning of biological association	214	247	129	123
	30.0%	34.6%	18.1%	17.3%
Types of biological association with examples	188	263	135	127
	26.4%	36.9%	18.9%	17.8%
Principles underlying each type of biological association	151	298	156	108
	21.2%	41.8%	21.9%	15.1%
Important features of organisms of each association	129	307	108	169
	18.1%	43.1%	15.1%	23.7%
Meaning of biological association	176	260	100	177
	24.7%	36.5%	14.0%	24.8%
Meaning of tolerance	266	245	103	99
	37.3%	34.4%	14.4%	13.9%
Meaning of tolerance range	217	299	72	125
	30.4%	41.9%	10.1%	17.5%
	246	241	141	85

Ecology Concept	Not Difficult	Difficult	Just Difficult	Extremely Difficult
Meaning of geographic range	34.5%	33.8%	19.8%	11.9%
Factors affecting population	362	152	60	139
	50.8%	21.3%	8.4%	19.5%
Meaning of limiting factor	248	227	84	154
	34.8%	31.8%	11.8%	21.6%
Meaning of environmental resistance	299	183	106	125
	41.9%	25.7%	14.9%	17.5%
Meaning of balance in nature	295	199	86	133
	41.4%	27.9%	12.1%	18.7%
Meaning of Family planning	364	159	83	107
	51.1%	22.3%	11.6%	15.0%
Birth control devices	344	203	59	107
	48.2%	28.5%	8.3%	15.0%

Table 3 present the descriptive statistics showing the students perceived difficult concepts in Ecological aspects of biology in public and private secondary school in Ogun State of Nigeria. According to the findings, students generally find basic definitions such as the meaning of ecology relatively straightforward, with 47.5% indicating it as not difficult. However, a significant portion still finds it challenging, with 30.7% marking it as difficult. Similarly, branches of ecology are not difficult for 53.2% of students, though 31.6% find them difficult. Understanding the meaning of an ecosystem is not difficult for 43.3% of students, but 25.9% find it difficult, and a notable 24.1% find it just difficult. When it comes to examples of ecosystems, almost half of the students (49.5%) do not find this difficult, but 22.3% do, and 21.5% find it just difficult. The food chain is one of the less difficult concepts, with 52.9% of students finding it not difficult. However, 25.2% find it difficult, and 13.9% find it just difficult. The food web is slightly more challenging, with 29.3% of students finding it difficult and 13.2% finding it extremely difficult.

Likewise, a significant majority of students (71.1%) do not find the meaning of energy difficult. The forms of energy are also not difficult for 64.5% of students, but 22.0% find them difficult. Energy transformation presents more of a challenge, with 38.0% of students finding it difficult. Also, nutrient cycles pose notable difficulties. For instance, the carbon/oxygen cycle is difficult for 39.1% of students, and the nitrogen cycle is particularly challenging, with 46.4% finding it difficult and 14.4% finding it extremely difficult. The meaning of population is not difficult for 47.5% of students, though 19.9% find it difficult. The characteristics of population are slightly easier, with 53.3% finding them not difficult. However, understanding the factors affecting population size is difficult for 31.6% of students. Moreso, the meaning of habitat is one of the least difficult concepts, with 71.1% of students finding it not difficult. Similarly, the types of soil are not difficult for 75.9% of students. However, the measurement of soil porosity and water holding capacity is difficult for 51.1% of students. In addition, conservation concepts are relatively challenging. The meaning of conservation of natural resources is difficult for

39.1% of students, and reasons for conservation are difficult for 41.1%. In contrast, pollution concepts are generally easier; 81.8% of students find the meaning of pollution not difficult.

Equally, understanding biological associations is challenging. The meaning of biological association is difficult for 34.6% of students, and the types of biological association with examples are difficult for 36.9%. The principles underlying each type of biological association are difficult for 41.8% of students, and the important features of organisms of each association are extremely difficult for 23.7%. Other ecological concepts such as the meaning of limiting factor and environmental resistance also pose difficulties, with 31.8% and 25.7% of students finding them difficult, respectively. Concepts related to population dynamics, such as the factors affecting population and meaning of balance in nature, are also challenging for significant proportions of students. In essence, the study highlights that while basic definitions and straightforward concepts are generally easier for students, complex processes, interrelationships, and detailed examples pose significant challenges. This suggests that educational strategies should focus more on these difficult areas to improve overall understanding and performance in the ecological aspects of biology.

Research Question Two: To what extent does school factors affect learning of ecological aspects of biology in Ogun State?

Table 4. Descriptive statistics showing the extent at which school factors affect learning of ecological aspects of biology in Ogun State

Statements	Strongly Disagree	Disagree	Agree	Strongly Agree
The use of audio-visual gadget as a mode of teaching by my teacher in my school enhance my love for learning ecology.	184	138	250	141
	25.8%	19.4%	35.1%	19.8%
The placement of biology periods in the time table helps me to learn better.	37	132	291	253
	5.2%	18.5%	40.8%	35.5%
Positive teacher-student relationships contribute to a conducive learning environment for the study of ecology.	59	48	370	236
	8.3%	6.7%	51.9%	33.1%
The accessibility of natural environments and field trips affects students' comprehension of ecological concepts	266	109	161	177
	37.3%	15.3%	22.6%	24.8%
There are adequate instructional materials for teaching ecology in my schools.	260	223	151	79
	36.5%	31.3%	21.2%	11.1%
The location of my school helps in learning ecology better.	209	153	212	139
	29.3%	21.5%	29.7%	19.5%

Table 4 present the descriptive statistics showing the extent to which various school factors influence students' learning of ecological aspects of biology in secondary schools in Ogun State, Nigeria, using both frequency counts and percentages. Findings revealed that the use of audio-visual gadgets as a teaching method shows a mixed impact on students'

engagement with ecology. While 25.8% of students strongly disagree and 19.4% disagree that these tools enhance their love for learning ecology, a significant portion of students, 35.1%, agree, and 19.8% strongly agree, indicating that audio-visual aids are effective for a notable number of students. Similarly, the scheduling of biology periods in the timetable is perceived positively by most students. Only 5.2% strongly disagree and 18.5% disagree that the timetable helps them learn better. In contrast, a substantial majority, 40.8%, agree, and 35.5% strongly agree, suggesting that the timing of biology classes plays a crucial role in facilitating better learning outcomes. In addition, positive teacher-student relationships are overwhelmingly seen as beneficial. A small percentage of students, 8.3%, strongly disagree and 6.7% disagree that such relationships contribute to a conducive learning environment for studying ecology. However, a significant majority, 51.9%, agree, and 33.1% strongly agree, underscoring the importance of healthy interpersonal dynamics in education.

Moreso, the accessibility of natural environments and field trips is another critical factor. A large proportion of students, 37.3%, strongly disagree and 15.3% disagree that these experiences enhance their comprehension of ecological concepts. Conversely, 22.6% agree, and 24.8% strongly agree, indicating that while field trips are beneficial for many, they are not universally accessible or impactful. Furthermore, regarding the adequacy of instructional materials for teaching ecology, many students report deficiencies. A notable 36.5% strongly disagree and 31.3% disagree that their schools have adequate materials. Only 21.2% agree and a mere 11.1% strongly agree, highlighting a significant area for improvement in resource provision. Consequently, the location of schools also influences students' learning experiences. Approximately 29.3% strongly disagree and 21.5% disagree that their school's location helps them learn ecology better, whereas 29.7% agree and 19.5% strongly agree. This suggests that the geographical and environmental context of a school can significantly affect ecological education. In essence, study above indicates that while certain school factors such as the use of audio-visual aids, scheduling, and teacher-student relationships have a positive impact on learning ecology, there are considerable challenges related to the accessibility of natural environments, adequacy of instructional materials, and school location. Addressing these issues could enhance students' comprehension and engagement with ecological concepts in biology.

DISCUSSION

Based on research question one, findings revealed that students in both public and private secondary schools in Ogun State find basic ecological definitions relatively straightforward, but encounter difficulties with complex processes, interrelationships, and detailed examples in ecological biology. This aligns with the findings of a study by Olaniyan and Iwuchukwu (2018), which highlighted that students often struggle with abstract ecological concepts and the application of ecological principles in real-world contexts. Similarly, students commonly face challenges in understanding ecological dynamics and ecosystem interactions due to the abstract nature of these concepts. Additionally the need for instructional strategies that promote active learning and conceptual understanding to address students' difficulties with complex ecological topics (5,6).

In accordance with research question two, findings of this study indicated that school-related factors such as the use of audio-visual aids, scheduling of biology classes, and teacher-student relationships significantly influence students' learning experiences in ecological biology. This finding is consistent with the research findings, who reported positive

associations between instructional practices, classroom management strategies, and students' academic performance in biology. Additionally, Ogunleye and Okeke (2017) emphasized the importance of supportive teacher-student interactions and well-structured learning environments in promoting students' understanding and interest in ecological concepts. However, challenges related to the accessibility of natural environments and adequacy of instructional materials remain prevalent, as noted by Olusakin and Oyeneye (2018), underscoring the need for resource allocation and infrastructure development in schools to enhance ecological biology education (7).

CONCLUSION

In line with the findings of this study, several conclusions were drawn in accordance with the students difficult concepts and school factors influencing difficulties in the learning of ecological aspects of biology among senior secondary school students in Ogun State of Nigeria. Firstly, students demonstrate a solid grasp of basic ecological concepts but encounter notable difficulties with more intricate topics. This underscores the importance of tailored educational approaches to address these complexities effectively. In consequence, the study recommend Tailored Instructional Strategies to develop and implement instructional strategies that address the challenges students face with complex ecological processes, interrelationships, and detailed examples. Incorporate interactive and hands-on learning activities to make these concepts more accessible and engaging.

Secondly, students' learning experiences are deeply influenced by a myriad of factors, encompassing their individual attributes, school environments, and government policies. Factors such as school-related factors like the use of audio-visual aids and teacher-student relationships. This unique fact recommends invest in improving school factors that positively impact ecological learning, such as the use of audio-visual aids, scheduling of biology classes, and fostering positive teacher-student relationships. Additionally, address challenges related to the accessibility of natural environments and adequacy of instructional materials by allocating resources and implementing supportive policies.

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