

STUDENTS' PERCEPTIONS OF DIFFICULT CONCEPTS IN BIOLOGY IN SENIOR SECONDARY SCHOOLS IN LAGOS STATE

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(Received 14, August 2017; Revision Accepted 5, September 2017)

ABSTRACT

The study sought to find out the biological topics in the National Curriculum that students in Senior Secondary School Two (SSII) have difficulties in learning, the reasons why students have difficulties in learning such topics in biology, and to suggest ways of improving the effectiveness of the teaching-learning process of biological topics. For these purposes, a questionnaire consisting of both closed and open-ended items was administered to the students in the data collection procedure. The instrument was administered to 400 SS II students in some selected secondary schools in Education District V of Lagos State. The data collected were analyzed both qualitatively and quantitatively. The result showed that there was no significant difference in the perception of students on difficult topics in Biology on the basis of their subject areas - Science, Commercial or Arts ($F_{(2, 397)} = 1.523, P > 0.05, \text{Partial } \eta^2 = .008, R^2 = .003$). Moreover, findings revealed that students usually have difficulties in five major topics. Among of which were nutrient cycling in nature, ecological management, conservation of natural resources, pests and diseases of crops as well as reproductive system in plants. However, teaching strategies, students' attitude, inadequate learning resources and students' learning habits were the reasons adduced by students of the perceived difficult topics. In remedying the problem, the students suggested the use of varied strategies that would involve appropriate instructional materials, use of hands-on and minds-on strategy, integrating biological concepts to daily life and provision of adequate and functional resources.

KEYWORDS: Perceptions of students, difficult biology topics, Biology learning, effective teaching, effective learning.

INTRODUCTION

The characters in current teaching appear to be discipline-centred, teacher-centred teaching, and the student learning is just passive surface learning. A wealth of evidence has been reported to support the concept that under the discipline-centred teaching, the needs, concerns, and requirements of teachers and students are not considered because the subject content is driven by, and depends mainly on the disciplinary content that must be presented. Science teaching requires attention to both the content of the

course and the process of moving students from their initial state of knowledge and understanding to the desired level. In fact, teaching is part of a whole that comprises the teacher, the learner, the disciplinary content, the teaching/learning process, and the evaluation of both the teacher and the learner. A shift from the traditional teacher-centred to a progressive mode of teaching-learning process had led to an increased interest in learners' individual differences. The new paradigm is student-centered, based on inclusiveness, cooperative learning and encouraged diversity. In spite of the

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new approach to the teaching-learning process, students' performance in examinations appears to be discouraging; prompting researchers to investigate the causes of the poor performance and how to improve on the teaching-learning process.

There has been consistent decline in the performance of students in public examinations conducted by the west African Examination Council (WAEC) and the National Examination Council (NECO) in sciences across the country over the years (Agogo, 2003; Samba & Eriba, 2012). Ahmed and Abimbola (2011) argue that because of its numerous importance, Biology is the most popular choice, among science subjects nationwide, offered by candidates sitting for the senior secondary school certificate examinations. According to WAEC Research Report (2008) and (2009), despite the popularity of Biology, results of research studies always revealed the poor performance of students in the subject. Results from findings revealed that a vast number of factors are responsible for the students' poor performance: difficult biological concepts (Tekkaya et al., 2001; Çimer, 2004; Zeidan, 2010); the nature of science itself and its teaching methods Lazarowitz and Penso (1992) as well as the biological level of organization and the abstract level of the concepts.

Çimer (2011) argued that many concepts or topics in biology, including water transport in plants, protein synthesis, respiration and photosynthesis, gaseous exchange, energy, cells, mitosis and meiosis, organs, physiological processes, hormonal regulation, oxygen transport, genetics, Mendelian genetics, genetic engineering, and the central nervous system can be perceived as difficult to learn by secondary school students. While Tekkaya et al. (2001) found that hormones, genes and chromosomes, mitosis and meiosis, the nervous system, and Mendelian genetics were considered difficult concepts by secondary school students. Özcan, (2003) stressed that experiencing difficulties in so many topics in biology negatively affects students' motivation and achievement. Students' difficulties with many topics in biology have stimulated researchers to investigate why students experience such difficulties and how to overcome these difficulties. Experiencing difficulty in Biology could be attributed to many factors such as classroom learning environment, lack of interest in learning science, overloaded curriculum content and delineation of science from society, among others.

Designing learning environments while ignoring students' interests and expectations causes several learning problems as well as decreasing their interest in biology (Yüzbaşılioğlu and Atav, 2004; Roth et al., 2006; Zeidan, 2010). Fraser (1998) in Çimer (2011) indicates that there is a close relationship between students' perceptions of their classroom learning environment and their success. Osborne and Collins (2001) also report that students' diminishing interest in learning science was due to the curriculum content being overloaded and not generally related to working life, the lack of discussion of topics of interest, the absence of creative expression opportunities, the alienation of science from society and the prevalence of isolated science subjects. Another reason reported by many researchers, specifically in Turkey, is that due to the nature of biological science, biology learning is generally based on memorization. Biological science includes many abstract concepts, events, topics and facts that students have to learn. This makes it hard for students to learn them (Çimer, 2004; Saka, 2006; Durmaz, 2007).

Also, in addition to determining the factors that negatively affect students' learning in biology, understanding students' views on what makes their biology learning effective is crucial, as many researchers suggest that in order to improve the quality of teaching and learning in school, students' views must be taken into consideration by researchers, teacher educators, schools and teachers (Macbeath and Mortimore, 2001; Çimer, 2004; Ekici, 2010). They argue that what students say about teaching, learning and schooling is not only worth listening to but provides an important perhaps the most important foundation for thinking about ways of improving teaching, learning and schools. For instance, Phoenix (2000) states that student views of teaching may reflect the ways that they learn best. Indeed, schools that acknowledge the significance of student views have found that these views can make a substantial contribution to classroom management, to learning and teaching, and to the school as a social and learning place (Macbeath et al., 2000). It is thought that how students perceive the learning environment in biology affects their attitudes towards biology and its learning (Çakıroğlu et al., 2003; Telli et al., 2009). Therefore, understanding secondary school students' perceptions of biology will help policymakers, teachers and teacher educators plan more effective teaching

activities that can help students learn biology better and have more positive attitudes towards it.

Gender differences may perhaps influence students' perception on, and achievement in biology difficult concepts. According to European Union (EU), gender differences in science achievement are the smallest (EU, 2010). It was further stressed that despite performing equally well as boys in most countries, girls tend to have a weaker self-concept in science, Biology inclusive than males, i.e., on average, girls had lower levels of belief in their science abilities than boys. Yet, both boys and girls are similarly interested in science; and there is no overall difference in boys' and girls' inclination to use science in future studies or jobs. The reason why boys perceive biological concepts easier than girls could be attributed to socialization factors and classroom experiences leading to low self-esteem and passive dependent behavior among girls.

Therefore, the aim of the current study is to determine the biology topics that SSII students have the most difficulties in learning and understanding, their views of the reasons they have difficulties learning some biological topics and the strategies or methods that can make biology learning more effective.

Purpose of the Study

The purpose of this study is to investigate into the students' perceived difficult topics in senior secondary school Biology in Lagos State. The study sought to:

- i. Identify the topics in SS II students perceive difficult to learn.
- ii. Find out if gender influences students' perception of difficult topics in SS II Biology.
- iii. Find out if the students in different subject areas differ in their perception of difficult Biology topics.
- iv. Find out the causes of topic difficulties by SS II Biology students in Education District V.
- v. Find out ways of improving the effectiveness of the teaching-learning process of biological topics.

Research questions

The following research questions were raised to guide the study.

- i. What Biology topics do SS II students perceive as difficult?

- ii. Is there any difference in the perception of male and female students of difficult Biology topics?
- iii. What are the sources of the difficulties experienced by the SS II students in biology?
- iv. What are the ways of improving the effectiveness of the teaching-learning process of biological topics?

Hypothesis 1

There is no significant difference in the perception of students on difficult topics in Biology on the basis of their subject areas - Science, Commercial or Arts.

Methodology

The study employed a survey design. The study was carried out in Education District V comprising of Badagry, Ojo, Amuwo-Odofin and Araromi-Ifelodun of Lagos State, Nigeria. Two schools were randomly selected from each of the local government areas. The population consisted of all the 138 senior secondary schools in the Education District V and about 16,221 Senior Secondary School Two (SSII) students in the study area, out of which 400 senior secondary II biology students were sampled using stratified random sampling method. Fifty (50) biology students were selected from each school. The four hundred students were selected from the Science, Commercial and Arts classes using proportionate to size sampling technique. The purpose was to guarantee that larger (i.e., more populated) subject areas have a proportionally greater probability of being chosen as part of the sample population.

The instrument used for data collection was the Biology Difficult Topics Questionnaire (BDTQ). It was constructed by the researchers and consisted of three sections: A, B and C. Section A contained the bio-data, while Section B consisted of senior secondary II (SSII) topics drawn from the National Curriculum. Section C consisted of open-ended items that sought the students' sources of difficulties as well as possible remedies. The instrument was validated by two experts in biology unit from the Department of Science and Technology Education, Lagos State University, Ojo, Nigeria. The instrument was then pilot-tested on one hundred SS II students that were not used in the study. The instrument was validated using Cronbach alpha, which gave an index of .77. The validated instrument was thereafter administered

to the respondents by the researcher, with the assistance of the biology teachers in the schools. The data obtained were scored and analyzed. The scoring was based on a four Likert Scale: 1 very difficult (VD); 2 difficult (D); 3 averagely difficult (AD) and 4 not difficult (ND).

RESULTS AND DISCUSSION

Research question 1

What Biology topics do SS II students perceive as difficult?

Table 1: Showing the frequency distribution of the perception of students on the level of difficulty of Biology topics in the National Curriculum

S/N	TOPICS	D	ND
1	Digestive system	137 (34.3%)	263 (65.8%)
2	Transport system	96 (26.1%)	304 (76.1%)
3	Respiratory system	93 (23.3%)	307 (76.8%)
4	Excretory system	101 (25.3%)	399 (74.8%)
5	Nutrient cycling in nature	263 (65.8%)*	137 (34.3%)
6	Ecological management	273 (68.3%)*	127 (31.8%)
7	Tolerance	65 (16.3%)	335 (83.8%)
8	Adaptation	134 (33.6%)	266 (66.6%)
9	Pollution	156 (39%)	244 (61%)
10	Conservation of natural resources	221 (55.3%)*	179 (44.8%)
11	Pests and diseases of crops	238 (59.5%)*	162 (40.6%)
12	Reproductive systems in vertebrates	75 (18.8%)	325 (81.3%)
13	Reproductive system in plants	201 (50.3%)*	199 (49.8%)
14	Classification of plants	165 (41.3%)	235 (58.8%)

*Perceived difficult topics

It should be noted that, in the scoring of the students' responses, the 4-Likert scale response format was collapsed into two categories: very difficult (VD) and difficult (D) were categorized into difficult (D) while averagely difficult (AD) and not difficult (ND) were categorized into not difficult (ND).

Table 1 showed the level of difficulties of Biology topics in the National Curriculum. Majority of the topics were perceived as not being

difficult by the students. However, nutrient cycling in nature, ecological management, conservation of natural resources, pests and diseases of crops as well as reproductive system in plants were perceived to be difficult by the students.

Research question 2

Is there any difference in the perception of male and female students of difficult Biology topics?

Table 2a: Showing the descriptive statistics of the perception of male and female students of difficult Biology topics

Gender	N	Mean	Std. Deviation	Std. Error Mean
Male	202	2.85	.494	.035
Female	198	2.86	.510	.036

Table 2b: Showing the Chi-Square Tests of the perception of male and female students of difficult Biology topics

Gender	N	df	χ^2	α
Male	202	34	44.382	0.11
Female	188			

Table 2a showed that the mean score of male students is 2.85 while that of the female students is 2.86. This implies that there is no difference in the perception of difficult Biology topics between the male and female students. Table 2b showed the Chi-Square Tests of the perception of male and female students of difficult Biology topics. The table revealed that there was no difference in the perception of male and female students of difficult Biology topics, χ^2 (34, N = 400) = 44.38, $p = .110$. This implies that male and female students perceived the Biology topics in the same way. This implies that, gender has no significant effect on students' perception

of difficult Biology topics. This result could be an indication that biology topics pose same level of difficulty to both male and female students. This shows that the students' performance in Biology is not a function of their sex. The insignificant difference between the male and female students may be due to their exposure to similar socialization factors and classroom experiences as well as less emphasis on gender inequalities.

Research question 3

What are the sources of the difficulties experienced by the senior secondary II students in biology?

Table 3a: Students' sources of the perceived Biology difficult topics

S/N	Students' sources	No of students	%
1	Abstractness	321	80.25
2	Complexity	305	76.25
3	Misconception of topics	298	74.5
4	Unavailable instructional materials	250	62.5
5	Poor attitude of teachers to teaching	250	62.5
6	Lack of practical classes	245	61.25
7	Poor students study habits	97	24.25

Table 3 shows the different reasons adduced by the students for their perception on biology difficult topics. The highest commonly advanced sources was abstractness of topics indicated by 321 (80.25%) students, while the least commonly source was lack of practical classes indicated by 97 (24.25%) students. other sources included complexity, misconception of topics, unavailable instructional materials, poor attitude of teachers to teaching, lack of practical classes and poor students study habits.

Research question 4

What are the ways of improving the

effectiveness of the teaching-learning process of biological topics?

In remedying the problem, the students suggested the use of varied strategies that would involve appropriate instructional materials, use of hands-on and minds-on strategy, integrating biological concepts to daily life and provision of adequate and functional resources.

Hypothesis 1

There is no significant difference in their perception of students on difficult topics in Biology on the basis of their subject areas - Science, Commercial or Arts.

Table 4a: Showing the adjusted means of students on their perception of difficult topics in Biology on the basis of their subject areas - Science, Commercial or Arts

Dependent Variable: Level of difficulty

Subject Choice	Mean	Std. Deviation	N
Science class	2.90	.523	95
Commercial class	2.87	.515	142
Art class	2.80	.472	163
Total	2.86	.501	400

Table 4a shows that there is slight difference in the perception of students based on their subject choice. Students in the Science class have the highest mean score of 2.90, followed by those in

Commercial class (2.87) while those in the Art class had the least mean score of 2.80; however, the difference was not statistically significant.

Table 4b: Summary of ANOVA on the difference in the perception of students on difficult topics in Biology on the basis of their subject areas - Science, Commercial or Arts

Dependent Variable: Level of difficulty

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	.764 ^a	2	.382	1.523	.219	.008
Intercept	3105.057	1	3105.057	12381.969	.000	.969
Subject Choice	.764	2	.382	1.523	.219	.008
Error	99.557	397	.251			
Total	3361.954	400				
Corrected Total	100.320	399				

a. R Squared = .008 (Adjusted R Squared = .003)

Table 4b revealed that, there was no significant difference in the perception of students on difficult topics in Biology on the basis of their subject areas - Science, Commercial or Arts ($F_{(2, 397)} = 1.523$, $P > 0.05$, Partial $\eta^2 = .008$, $R^2 = .003$). The implication of this is that since p-value (.219) of the F-ratio was not significant, as it is greater than the .05 p-value; the null hypothesis on the difference in the perception of difficult topics in Biology on the basis of their subject areas - Science, Commercial or Arts was not rejected. The R Squared shows that the independent variables accounted for 0.8% of the variation in the perception of difficult topics in Biology. The partial Eta squared estimated indicates that the subject choices accounted for only 0.3% of the variance observed in the difference on the perception of difficult topics in Biology on the

basis of their subject areas - Science, Commercial or Arts.

DISCUSSION

The findings of this study showed that, SS II students perceived five Biology topics out of the fourteen topics in SS II as contained in the National Curriculum to be difficult. These are nutrient cycling in nature, ecological management, conservation of natural resources, pests and diseases of crops as well as reproductive system in plants. This finding is in line with Tekkaya et al. (2001) who earlier reported that secondary school students generally find hormones, genes and chromosomes, mitosis and meiosis, the nervous system, and Mendelian genetics difficult to learn. Çimer (2011) identified many concepts or topics

in biology, which include water transport in plants, protein synthesis, respiration and photosynthesis, gaseous exchange, energy, cells, mitosis and meiosis, organs, physiological processes, hormonal regulation, oxygen transport, genetics, Mendelian genetics, genetic engineering, and the central nervous system perceived as difficult to learn by secondary school students.

The study revealed that gender has no significant difference on students' perception of difficult Biology topics. This result could be an indication that biology topics pose same level of difficulty to both male and female students. This shows that the students' perception of difficult topics in Biology is not a function of their gender. This finding agrees with Areola (1995) who holds that the effect of sex in the difference in performance between male and female is not statistically significant. The finding also supports Ivowi (1999) who found out that sex was not significant factor in the understanding of physics concepts. The result of this study therefore contrasts with that of Njoku (2004), Nworgu (2005) and Isa (2005) as cited in Achor and Agbidye (2014) who revealed that there exist gender differences in science achievement in the schools.

The study furthermore, revealed that students' choice of subjects had no effect on their perception of difficult topics in Biology. This result could also be an indication that biology topics pose same level of difficulty to all students irrespective of their subject choice. Although, one would have expected the science students to experience less difficulty in learning the perceived difficult topics, since Biology forms one of the basic science subjects in pursuance of science-based courses in tertiary institutions.

The study revealed that students adduced some reasons for their perception of difficult Biology topics. They attributed their sources of difficulty of the perceived difficult topics to abstractness, complexity, misconception of topics, unavailable instructional materials, poor attitude of teachers to teaching, lack of practical classes and poor students study habits. This finding is in consonance with the findings of Çimer, 2004; Zeidan, 2010; Tekkaya et al., 2001; Çimer, 2004 and Zeidan, 2010; who identified the nature of science itself and its teaching methods as well as the biological level of organization and the abstract level of the concepts as reasons for encountering difficulty in learning biology. Other sources included overloaded biology curricula,

the abstract and interdisciplinary nature of biological concepts, and difficulties with the textbooks.

Finally, the students suggested some ways by which the difficulties could be remedied to include: the use of varied strategies that would involve appropriate instructional materials, use of hands-on and minds-on strategy, integrating biological concepts to daily life and provision of adequate and functional resources.

CONCLUSION AND RECOMMENDATIONS

It can be concluded from the study that SS II students perceived some topics as difficult and some as not difficult in Biology. However, the study revealed that gender has no significant difference on students' perception of difficult Biology topics. Similarly, the study revealed that students' choice of subjects had no effect on their perception of difficult topics in Biology. Furthermore, the students attributed their sources of difficulty of the perceived difficult topics to abstractness, complexity, misconception of topics, unavailable instructional materials, poor attitude of teachers to teaching, lack of practical classes and poor students study habits. Therefore, there is a need to make the subject content of senior secondary school biology curriculum more contemporary, meaningful and interesting for the students, reflecting the current developments in the field and relating teaching-learning process with daily life issues. However, biology instruction should be supported by qualified textbooks, instructional materials, hands-on, mind-on sessions and observations as well as experiments that actively engage students in learning processes. This calls for the there is need to teach biology dynamically, not as a static subject in textbooks, emphasizing inquiry instruction that would allow students to pursue areas of personal interest.

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