

**CORRELATION BETWEEN STUDENTS' ACHIEVEMENT IN THE THEORETICAL AND
EMPIRICAL ASPECTS OF BIOLOGY IN SENIOR SECONDARY SCHOOLS IN EDU
EDUCATIONAL ZONE OF KWARA STATE**

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Abstract

In this study an attempt was made to find the comparison between students' achievement in theoretical and empirical aspects in Biology. The study adopted a correlational research design which specifically, compared recorded scores of students in theoretical and empirical aspects of Biology. Two research questions and two hypotheses guided the study. A total of 90 SSIII students drawn from two secondary schools (urban and rural) within Edu educational zone of Kwara state were used. The students were drawn through simple random sampling technique. Mean and standard deviation of scores were used to answer the two research questions while Pearson Product-Moment Correlation analysis was used to test the two null hypotheses at $p < 0.05$. The result showed that students achieved better in the theoretical aspect than in the practical in biology in Edu Educational Zone of Kwara State. It also indicated that Gender and Location had differential effects on achievement of students in Biology Examination. The female students achieved more significantly better than their male counterparts in both theoretical and practical aspects. Therefore it was recommended that Biology teachers should pave way for more improvisation method in rural areas where there is lack of laboratories and give more priority to practical experiments as part of instruction in order to improve students' understanding of practically related concepts.

Keywords: Students' achievement, Theoretical, Empirical and Biology

Introduction

Education is one of the most powerful instruments known for reducing poverty and inequality and for laying the basis for sustained economic growth. It raises the productivity and efficiency of individuals and produces skilled manpower that is capable of leading economic development. Education is a process through which the intellectual, moral capacities, proper conduct, and technical competency of individuals are developed to make them scientific members of their societies (Dorleku, 2013). Science in general and Biology in particular plays a significant role in the economic development of a nation. This underscores the reasons for emphasizing the promotion of Science as the means for achieving technological development in many countries. Striving for development in science and technology becomes imperative as it serves as a driving wheel for economic empowerment of the countries. Therefore, for a country to be economically viable, it must strengthen its science and technology programmes in content as well as in teaching and learning at secondary schools level (Gero, 2011). In Nigeria, in order to achieve this economic objective, impetus have been given to the implementation of the ratio 60:40 admission policy in favour of science subjects in institutions of higher learning.

Most of the educational objectives in Nigeria can be achieved through effective science education. Hence, science education is given priority because it will help in providing the essential manpower for the development of the country in areas such as Agriculture, extraction and processing of mineral resources, industrial production of consumer goods, Medicine and Pharmacy. Of all the science subjects, Biology is vital for preparing scientists and technologists both at middle and upper manpower levels. Biology is one of the basic sciences which are essentially the pre-requisites for technological breakthrough such as biotech. Hence, the need for effective Biology education in Nigeria appears very

crucial and therefore, demands considerable attention. In the higher manpower requirement, experts are needed in Biotechnology engineering. These fields cannot be effectively studied without Biology as it serves as pre-requisite to them. This implies that Biology is an important science subject needed for higher education in virtually all the science related professions such as Medicine, Pharmacy, Agriculture, Engineering, food and nutrition. So these aspects of the importance of Biology explain why schools, governments, students and parents are worried over students' poor achievement in Biology in senior school certificate examination.

Abonyi (2014) asserted that Biology is a science subject from which all science and technology disciplines draw sustenance". However, students do not perform well in Biology (Nwagbo, 2012; Eze, 2011). In fact (Njoku (2014); Balogun (2014) and Akinyele (2015) also observed that Biology as a subject, suffers poor academic performance by students especially at the Senior School Certificate Examination level. For instance, Biology results, at the SSCE level between 2016 and 2017, in terms of passes at credit levels has been very low. In 2015 the performance was 38.68% rate of passes out of 1,052,758 Candidates sat for the May/June examination and sat for Biology representing 31.60% who had credits and above, in 2017, Mr Olu Adenipekun said out of 1,345,102 candidates who registered 623,486 had credit in Biology which is representing 42.57% passed. These percentages were the only candidates who could be admitted into institutions of higher learning to read Biology and other courses that require Biology.

The implication of a student failing Biology at the ordinary level is that he/she will not be enrolled for science based courses at institutions of higher learning. The WAEC Chief Examiner's Reports between 2015 and 2017 also showed that the percentage of passes in Biology is low particularly in practical aspects across Nigeria, thereby affecting the general performance of most candidates who sat for Senior School Certificate Examination over the years. The chief Examiner's reports (2018) also indicated that "the poor performance of students in science subjects has assumed a dangerous dimension. In the light of this, science educators need to seek suitable ways of tackling the current mass failure if they are to halt the drifts of students to arts and social science subjects". Particularly, in Biology paper 1 (practical), WAEC Chief Examiner's reports (2018) again showed that Biology students' poor performance in this aspect over the years arises from students' poor knowledge of fundamental principles and procedures especially in practical and lack of exposure to laboratory techniques. It is indicated that the poor performance of the candidates was due to among others: - inability to adhere strictly to instructions; improvisation skills to agree with that of Supervisor; inability to link theoretical knowledge with actual practical work.

From the above discussion it is understood that the Biology examination constitutes two aspects; the theory aspect and the empirical aspect. It is also understood that students do fail in Biology examination, but it is not yet clearly understood in which of the two aspects of the examination do they have serious problems? Is it in theoretical aspect or in practical aspect? Or, will it be in both aspects of the examination? These are some of the questions this study is proposing to address.

Biology is offered at the senior secondary school level, from senior secondary one (SS1) to senior secondary three (SS3) classes, as a single subject. The senior secondary school students had done Integrated Science which is to prepare them for offering Biology at SS level. However, the above assertions have shown that the SS students' achievement in Biology has not been encouraging. This might have been partly responsible for the slow pace of scientific and technological development in Nigeria.

Statement of Problem

The teaching of Biology has two components. The abstract component is meant to train the students properly in the concepts, theories and principles of Biology. There is also the empirical laboratory

based component, which is intended to enable students undertake laboratory work necessary for explaining practically their understanding of the theories, ideas, principles and concepts of Biology they were taught theoretically. Both the abstract and the empirical work are important in the overall study and assessment of students in Biology because no one component is more important than the other. This is why it is important to compare and document the correlation between abstract and empirical aspects in the overall achievement of senior secondary school students in the study of Biology in Nigeria with particular emphasis on Edu Educational Zone of Kwara State. An extensive review of literature on the study of the abstract and empirical laboratory components of achievement in Biology showed that such literature is scanty and none have been reported for Edu Educational Zone, in Kwara State. The literature also indicated that students do fail in Biology, but it is not understood in which aspect (abstract or empirical) they fail worst. The literature also indicated that practical works are mostly delayed until SS III. Hence the study filled the gap of paucity of empirical data by comparing the scores of students in theoretical and practical aspects to find their relationship as they affect students' achievement in Biology in Kwara

Purpose of the Study

This study compared and found the relationship between students' achievement in theoretical and empirical aspects of Senior Secondary School Examinations in Biology. Specifically, attention was paid to comparing and finding the relationship of male and female, rural and urban area students' achievement in theoretical and empirical aspects of Biology in Kwara State. This was with the aim of finding out in which one of the components the students perform better and which one do they find difficult.

Research Questions

The following research questions guide this study;

1. What is the correlation between the achievement mean scores of students in urban and rural area in the theoretical (TH) and the empirical (ER) aspects of Biology Concept?
2. What is the correlation between achievement mean scores of male and female students in urban and rural area in the theoretical and empirical aspect of Biology Concept?

Null Hypotheses

The following null hypotheses were formulated to guide the study and they will be tested at 0.05 level of significance.

Ho1. There is no significant correlation between students' achievement mean scores of urban and rural area in theoretical and empirical aspects of Biology Concept.

Ho2. There is no significant correlation between males and females students' achievement mean scores of urban and rural area in theoretical and empirical aspects of Biology Concept.

Literature Review

The State of Biology Education in Nigeria

Biology is one of the core science subjects in the national education curriculum. It is studied alongside other related basic science subjects such as Chemistry, Physics and Mathematics. This is to prepare students for the pursuance of Biology academically as well as professionally to acquire appropriate and adequate foundation knowledge for such fields of studies like Engineering, Pharmacy, Medicine and Veterinary Medicine etc, to mention but a few. These fields cannot be studied without Biology as it serves as pre-requisite to them.

The Biology curriculum places more emphasis on guided inquiry method which is activity oriented than the traditional lecture method for the teaching of Biology empirical work has been described as a process of learning which demands activity rather than receptivity which is characteristics of theoretical work. Sola and Ojo (2014) noted that science teachers have always recognized the

importance of practical work as a means of introducing learners to the scientific process of experimentation. In relation to this, the United Nations Educational Scientific and Cultural Organization (UNESCO) and the International Union of Pure and Applied Chemistry (IUPAC) have participated in numerous international meetings to promote inexpensive experimental based teaching in Biology.

Akalonu (2015) opined that Biology students failed to acquire the necessary practical skills needed for success in external examination. This view is in line with the WAEC Chief Examiner's reports (2016) which indicated among other things, that students' major weaknesses in practical Biology examination were in the areas of: poor identification and description of specimen, poor drawing of specimen, poor interpretation of scientific data or poor deductive reasoning, inability to read or measure accurately e.g. burette reading and inability to relate theoretical knowledge to empirical observations.etc.

The Biology curriculum places more emphasis on guided inquiry method than the traditional lecture method. This implies that each science-based secondary school should have a well-equipped laboratory for effective Biology instruction and realization of the objectives in view. Here the Biology teacher is advised to manage the laboratory resources very well. Provision of adequate physical facilities such as well equipped laboratories, and classrooms will therefore go a long way in promoting effective teaching and learning of science. The present bad condition of science laboratories is quite alarming. Very few laboratories exist and even where they exist, they are virtually either empty or haphazardly filled. This situation is unhealthy for the effective teaching of Biology and related subjects. In connection with this, Ali (2016) stresses that basic laboratory facilities in Nigerian schools are lacking. He believes that in an ideal situation, different science subjects such as Biology, Chemistry, and Physics should have separate laboratories. In reality, however, the condition is very unpleasing. In some schools where science and technology are taught, not even a single laboratory or workshop is available. Students that learn under this condition are exposed to only the theory of science rather than scientific skills. They do not acquire knowledge about discovery method, which will assist them in developing their investigative skills, which could later be applied whenever the need arises.

Methods of Teaching of Biology

Method of teaching is a technique adopted by a teacher which enables him to achieve the stated objectives of an instruction. Many science education researchers reported that poor facilities for teaching and teachers' poor presentation of instructional materials in the teaching of Biology may be responsible for students lost of interest in the subject and eventually resulting in their failure in both internal and external examinations. Studies on variables of teaching compared different methods of teaching on ability grouping, cooperative learning and enhancement strategies and found poor performances of students to be as a result of poor classroom teaching and students' attitude to school (Okebukola, 2015).

There are many methods of teaching that can be adopted for teaching biology. Effiong and Eukoha (2013) found that both inquiry-based and refined traditional approach could be employed as viable alternatives in science teaching. Ette (2014) indicated that a major defect in our science education is that science is presented dogmatically in most schools as a series of disjointed facts and concepts which students find it difficult to relate to real world. He further continued that most of our secondary schools' laboratories are ill-equipped and as a result, students are denied that feeling of participation and reality which practical classes and demonstration provide.

The term gender is often used to indicate the distinction between human beings on the basis of masculinity and femininity in relation to their expected roles. Keller (2014) sees gender as a cultural construct which; distinguishes the roles, behaviour, mental and emotional characteristics between the

male and the female. To Shettima (2013), gender is a socially defined status as roles and actions ascribed to women and men so as to distinguish who they are, what is expected of them by the society and how they relate to each other for meaningful coexistence. This meaningful coexistence is influenced by the education of both men and women because education is believed to “play a great role in furthering social solidarity and integration in the society” as noted by Eriba and Ande (2016).

Methodology

The design of the study is a correlation research, which compares recorded scores of students in theoretical and practical aspects of Biology. The design is called “ex-post facto” in which the researcher cannot manipulate the variables because their manifestation has already occurred, Kerlinger (1975). The students’ scores were recorded from their individual academic performance. The study was conducted in Edu educational zone of Kwara State. There are twenty two (22) senior secondary schools in Edu educational zone. Thirteen of these senior secondary schools are in urban area whereas the remaining nine are in rural areas. The whole 22 senior secondary schools in the urban and rural area are coeducational. The choice of Edu education zone was borne out of the fact that this problem of poor achievement in biology exist in the area (Dangana, 2015). There are two thousand six hundred and thirty six (2636) Students in these secondary schools in Edu Educational Zone. There are 1106 males and 1530 females respectively that formed the population of the study (Quality Assurance Bearue, 2018).

Edu educational zone was chosen by purposive sampling to satisfy the interest of the researcher. Two schools were randomly selected one from urban area which is Government Secondary School, Lafiagi (GSS) and the second from the rural area which is Efagi Secondary School, Efagi (ESS) out of 22 senior secondary schools in the zone. Ninety (90) out of the 824 Senior School three (SSIII) students of the twenty two senior secondary schools in the zone constituted the sample for the study. Forty five (45) students were drawn from the rural schools and forty five (45) from the urban totaling 90. The students’ scores in both theoretical and practical aspects were recorded from their aptitude test in their various secondary schools. There were two instruments used. The first is the Biology Theoretical Test (BTT) and the second is Biological Empirical Test (BET). The two instruments were administered to the students. This was done by the researchers.

The scores obtained from records of students’ raw scores in both empirical and theoretical aspect of biology was analyzed with SPSS version 16.0 statistical tools. Mean and standard deviation of scores were used to answer the research questions while correlation which essentially employed Pearson Product-Moment Correlation Coefficient analysis was used to test the hypotheses.

Results

Table 1: Mean and Standard Deviation of Scores of Students in Theoretical (TH) and Empirical (ER) in Biology

Aspect of examination	Variable	N	£ X	Mean	S.D
TH	All groups	90	388	32.42	09.91
ER	All groups	90	257	21.43	11.56
Theory	UST	45	210	35.10	09.19
	RST	45	194	32.50	10.95
Empirical	USP	45	132	22.10	11.24
	RSP	45	124	20.75	11.85
Theory	MST	54	227	37.86	08.78
	FST	36	178	29.73	09.88
Empirical	MSE	54	125	20.97	11.99
	FSE	36	109	18.23	11.54

p= 0.05*

NB: UT = Urban students' scores in theoretical aspects of the Test
 RST = Rural students' scores in theoretical aspects of the Test
 USE = Urban students' scores in Empirical aspects of the Test
 RSE = Rural students' scores in Empirical aspects of the Test
 MST = Male students' scores in theoretical aspects of the Test
 FST = Female students' scores in theoretical aspects of the Test
 MSP = Male students' scores in empirical aspects of the Test
 FSP = Female students' scores in empirical aspects of the Test

There is no statistically significant correlation between students' achievement mean scores of urban and rural school in theoretical and empirical aspects of biology. The achievement scores obtained in theoretical and empirical aspects in biology in Edu Educational Zone of Kwara State were subjected to Pearson Product-Moment correlation analysis and the result is presented in Table 2. From Table 2, $r = 0.145$, at $p = 0.05$. This implies that there is a significant positive correlation between the achievements means scores of students in theory and empirical aspects of biology. However, the strength of the correlation is small (0.145). Thus, poor performance in theory will lead to poor performance in empirical biology.

Table2: Pearson Product-Moment Correlation Analysis (r) of Students' Scores in Theoretical and Practical Aspects of in Biology

Aspect of Test	N	£ X	Mean	S.D	r	Sig.
TH	90	388	32.42	09.91		
ER	90	2572	1.43	11.56	0.145	.000
Theory	45	210	35.10	09.19		
	45	194	32.50	10.95	0.152	.000
Empirical	45	132	22.10	11.24		
	45	124	20.75	11.85	0.149	.000
Theory	45	227	37.86	08.78		
	45	178	29.73	09.88	0.330	.000
Empirical	45	125	20.97	11.99		
	45	109	18.23	11.54	0.373	.000

Correlation is significant at the 0.05 level (2-tailed)

There is no statistically significant correlation between male achievement and female achievement mean scores of urban and rural school in theory and empirical aspects of Biology. The achievement scores obtained in both theoretical and empirical aspects for male and female students in biology were subjected to Pearson Product-Moment correlation analysis and the result is presented in Table 2. From Table 2, $r = 0.330$, at $p = 0.05$. This implies that a significant correlation exists between the rural students' achievement scores in theory and empirical aspects of biology and the null hypothesis is not accepted.

Discussion

The analyses of Table 1 showed that students achieved better in theoretical aspect than in empirical aspect in Biology in Edu Educational Zone of Kwara State. This might be due to the much attention teachers give to the theoretical aspect of teaching Biology in the secondary schools than the practical aspect. Students receive much teaching and instructions in theoretical aspect of the syllabus than the empirical aspect and therefore are bound to achieve better in the theory than in the empirical. The fact that students achieve better in theory than empirical in this study appears to be supported by available literature. For example, Eze (2013) observed that in most senior secondary schools, Biology lessons are taught and completed without empirical work. He further observed that some students of Biology never experienced any form of empirical until second term of senior secondary year 3. Eze (2013) also

observed that for greater effectiveness in the teaching and learning of Biology theory and empirical aspects of the SSS biology should be taught side by side.

Aboaba (2015) listed inadequacy of practical work as one of the reasons behind students' poor performance in biology. Experimentation is a major process in the learning of biology. It is not an understatement, therefore, to say that "no experimentation, no biology." Besides, biology is an experimental subject and as such its implied learning approach should stimulate students, bridge the gap between theory and reality, promote scientific attitude and scientific knowledge, and lead to better understanding of abstract concepts (Onwu, 2016).

Conclusion

Critical analyses of the tables of results bring certain conclusions to the limelight. From the general achievement of the students in both the theoretical and the empirical aspects of Biology, it can be concluded that the main concern of evaluation in the school system is to assess the achievement of students and performance of teachers at different stages of educational processes and whose outcome could be used in decision making by the teachers, the students, the administrators and the parents for promotions, placements, certification, additional efforts etc. Students achieved significantly better in the Theoretical Aspect of evaluation in this work than in empirical aspect in Biology, thus it can be concluded that students do not have enough laboratory experience to cope with the demands and challenges of the practical examination in biology and hence, must fail the final Senior School Certificate Examination in Biology. It is therefore clear from the result of this research that the failure in Biology caused by the failure of the students in the empirical aspect of the examination in Biology. Boys achieved better than the female counterparts, therefore gender plays a significant role in biology achievement.

Recommendations

In view of the results of these findings and conclusions reached in this study, the following recommendations are hereby made:

1. It is recommended that biology teachers should be sensitized on gender issues to develop a gender-fair posture and to exhibit a gender-inclusive environment in the course of their class room interactions. They should avoid among others consistent usage of masculine pronouns in discussing biology concepts, unequal access for male/female students to participate in discussion/demonstration, higher achievement levels set out for boys than for girls, and female students being assisted most often in practical, projects and other assignment. Let them be encouraged to feel they can do anything the boys can do when it comes to understanding of biology concepts.
2. Biology teachers in the rural areas should be encouraged by giving them some special incentives so that they will teach well in order to breach the gap of difference in achievement between the urban and the rural students.
3. The findings of this study indicate that students performed better in theoretical aspects than empirical aspects. This in itself is a pointer to the fact that students do not have enough laboratory experience to cope with the demand of the external empirical examination in biology. Biology teachers should therefore balance their emphasis between the theoretical and the empirical lessons in their day to day teaching and learning processes in order to improve students' understanding of empirically related concepts as well as the theoretical. In-fact, theoretical and empirical instructions should go hand in hand together.
4. Since biology is an experimental subject, government and parents should work hand in hand to build appropriate laboratories for effective learning and these laboratories should be adequately equipped with necessary equipment and materials for instruction, so that empirically related concepts are better taught and better understood by the students.

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