

Biology Teachers' Views on Practical Work in Senior Secondary Schools of South Western Nigeria

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Abstract: The study investigated biology teachers' views on practical work in the Nigerian senior secondary schools. Four teacher variables investigated were sex, qualification, years of experience in teaching biology and marking experience as (WAEC/NECO) biology examiner. Five research questions and five main hypotheses were answered and tested, respectively. The method employed was a descriptive one of the survey type. Fifty schools were randomly selected from two towns in Oyo State South Western Nigeria. The towns were selected by purposive sampling technique: forty schools from Ibadan metropolis an urban town and state capital and ten from Saki a rural town North of the state. All the ninety six biology teachers participated in the study. Data was collected using a researcher-designed questionnaire which was validated. A reliability coefficient of 0.85 was obtained using the Pearson Product Moment Correlation Formula. Results indicated that all the biology teachers viewed practical work as very important in the teaching of biology. In addition that biology could not be taught effectively without practical work and that learning and retention of biology concepts by students would not be possible without exposure to practical work. About >80% of the teachers did not agree that practical examination should be replaced with the alternative to practical examination, a theoretical examination on practical work. There was no significant difference in the views of biology teachers on all the research questions. However, Chi-square analysis revealed a significant difference in the views of biology teachers with marking experience and those without on the replacement of the practical examination paper with the alternative to practical. A Chi-square value of 6.38 at 0.05 level of significance. The recommendations made included that shortage of biology teachers be addressed urgently and class size be reduced for adequate teacher-student ratio to ensure conduct of quality practical work in biology.

Key words: Biology, sex qualification, hypotheses, urban town, Nigeria

INTRODUCTION

Several studies have documented the status of practical work in the teaching of science for more than a century (Lazarowitz and Tamir, 1994; Hoftein and Lunetta, 2004). Practical work experience has long been recognized as distinctive and central in the science curriculum. It is an Activity-Oriented Method of teaching carried out by an individual or group of students for the purpose of engaging in personal observation of products, processes or events through actual experience.

According to Dikmenli (2009), the main purpose of laboratory work in science education is to provide students with conceptual and theoretical knowledge to assist them learn specific concepts and scientific methods to understand the nature of science.

Biology, a science subject is accorded an important position in the Nigerian National Policy on Education. Biology has remained the most popular subject in the

Senior Secondary School System in Nigeria. It is a life science concerned with the knowledge of live plants and animals, their forms, characteristics, functions, biodiversity and relationship with the environment. It covets a high enrolment figure annually relative to chemistry and physics other science subjects. Its present position is not surprising because it is a pre-requisite to entry into courses such as medicine, physiotherapy, microbiology, biotechnology, agricultural science and others.

Practical work in biology is regarded as any learning experience which involves student participation in activities such as observing, counting, measuring, experimenting, recording and carrying out fieldwork (Ndu, 1980). Practical work in biology is considered according to Ileoje as part of the study of biology and involves fieldwork, collection and laboratory study of specimens, drawing diagrams and conducting experiments. He asserted that practical work is important in the study of biology.

The justification for practical work in biology at the senior secondary school level is supported by the aims of practical biology in the West African Examination Council syllabus as follows:

- To acquire the power of observation
- To develop the ability to related observation by illustration
- To develop the ability to recognize general characteristics of plants and animals
- To be able to interpret and illustrate knowledge of biology principles and to develop the ability to perform simple experiments and make inferences from the results established

In addition, the score or mark allotted to the practical examination paper in biology in the West African Certificate Examination in Nigeria is higher than those of the objective test (multiple choice) and the essay papers. Many research studies have established that despite the high enrolment of biology in the Nigerian secondary schools, the low outcomes of students in the school certificate examination in the subject annually is often at variance with the enrolment figure. Some research findings have confirmed this submission and attributed the phenomenon to several factors (Oguniyi, 1977). Some of which include the problem of large classes and inadequate number of periods for teaching the subject. The assumption by students that biology is easy as documented by Soyibo (1982). In their reports, Akusoba (1985) and Tobin (1990) indicated inadequate quantity and quality of biology teachers in studies on the conduct of biology practical in some Nigerian secondary schools. Other researchers reported lack of adequate laboratories and apparatus for practical work and difficulties experienced by teachers in conducting practical work in biology.

While many researchers consider practical work experience in science biology as indispensable and integral part of the discipline (Ndu, 1980; Idris, 1981). Similarly, Okebukola and Ogunniyi (1984) educators have suggested that many benefits are derived from engaging students in science laboratory activities (Hofstein and Lunetta, 1982; Hoftein and Lunetta, 2004; Tobin, 1990).

Others however, expressed concerns on the value of laboratory type experience since practical has not been shown to produce significant cognitive gains for science students (Bates, 1978; Gayne and White, 1978). Skepticism has been expressed about the effectiveness of laboratory work in helping students understand the various aspect of scientific investigation (Lazarowitz and Tamir, 1994).

The preceding justification for practical work in biology and the inconclusive evidence by researchers on the value of practical work in science provided the impetus for this study. Okebukola (1990) recorded the poor attitude of biology teachers in the involvement of students in practical work.

Purpose of the study: The main purpose of the study was to investigate biology teachers' views on practical work in the Nigerian senior secondary school. Four variables investigated were sex, qualification, years of experience in teaching biology and marking experience as examiners of West African Examination Council (WAEC) and National Examination Council (NECO).

Research questions: The following five research questions were answered in the study:

- Do biology teachers view practical work as important in the teaching of biology?
- Can a teacher teach biology topics effectively without the conduct of practical work?
- Can a student obtain a credit pass in senior school certificate examination in biology without passing the practical examination paper?
- Is the conduct of practical work essential for the understanding of biology concepts by students?
- Should practical examination be cancelled and replaced with alternative to practical, a test of practical work the type conducted in the November/December examination?

Research hypotheses:

H01: There is no significant difference in the views of biology teachers on question 1 according to the following four variables: sex, qualification, years of teaching experience and marking experience.

H02: There is no significant difference in the views of biology teachers on questions 2 according to the four variables.

H03: There is no significant difference in the views of biology teachers on question 3 according to the four variables.

H04: There is no significant difference in the views of biology teachers on question 4 according to the four variables.

H05: There is no significant difference in the views of biology teachers on question 5 according to the four variables.

MATERIALS AND METHODS

The study was descriptive and questionnaire was employed to collect information from biology teachers on their views on practical work in fifty schools. The rationale was to find out and report results as they were found.

Sample and sampling techniques: The target population was biology teachers in senior secondary school in Oyo State, the South Western Zone of Nigeria. Fifty schools were selected by stratified and simple random sampling techniques. Forty schools from Ibadan metropolis an urban town, the second largest city in West Africa and the Oyo State capital. Ten schools were selected from Saki, a rural town in the Northern part of Oyo State. The two towns were selected by purposive sampling technique. All the biology teachers in the selected schools participated in the study. These schools had enrolled students for the school certificate examination consistently for at least 5 years. A total of eighty four biology teachers from schools in Ibadan and twelve biology teachers from Saki participated in the study. Three teachers were expected to be selected from each school but some schools had less than three biology teachers. A total of ninety six biology teachers participated in the study. That is 64% of the total number of biology teachers' expected to be employed in the selected schools.

Instrument: A researcher-designed questionnaire with two sections; A and B, respectively was utilized in the collection of data. Section A consisted of questions used to collect information on biology teachers' profiles such as sex, qualification, year of experience in teaching biology, West African Examination Council (WAEC) or National Examination Council (NECO) examiner (marker) which are the two major examination bodies in Nigeria. Section B contained five different Yes or No questions which constituted the five research questions on practical work in biology. In addition, spaces were provided for teachers to give two reasons for their responses for each question. The questionnaire was administered to ten biology teachers from six senior secondary schools of comparable status in Ilorin, Kwara State as trial test in a pilot study to ascertain its validity. The Split-Half Method employing the Pearson Product Moment Correlation formula to determine the reliability of the instrument yielded a reliability coefficient of 0.85. This value was considered as an indication that the instrument was reliable as the coefficient obtained was >0.5 . The content validity had earlier been ensured by incorporating

suggestions from two senior colleagues. One from biology education in the Department of Science Education and the other from Department of Biological Sciences, University of Ilorin, respectively.

Procedure for data collection: A total of 150 questionnaires was administered to secondary school biology teachers by the researcher and two post graduate students as research assistants in Ibadan and one assistant in Saki. All 84 biology teachers in the forty schools in Ibadan and 12 teachers in ten schools in Saki completed the questionnaire. Descriptive statistics was utilized in the analysis of responses of biology teachers. Percentages were calculated for biology teachers responses to the research questions. Frequency counts were made and data collected were subjected to Chi-square statistical analysis to test the hypotheses.

A Chi-square value of 6.38 was obtained which was greater than the table value of 5.91. This showed that the hypothesis was rejected as a significant difference was observed in the responses of biology teachers who were markers and non-markers.

RESULTS

The distribution of respondents as shown in Table 1 shows that most of the biology teachers in the study were males (70%) and qualified teachers constituted 81%. Biology teachers with 6 years and above experience in teaching biology were 67% and biology teachers who were markers (examiner) for WAEC and NECO also constituted 67% of the total number of biology teachers in the study. Responses of biology teachers to question 1-5 are shown in Table 2.

Research question 1: Do biology teachers view practical work as important in the teaching of biology topics? All the biology teachers (100%) without exception irrespective of their sex, qualification, years of experience and marking experience agreed on the importance of practical work in biology. The reasons proffered included

Table 1: Distribution of biology teachers according to sex, qualification, years of experience in teaching biology and marking experience in WAEC/NECO

Variables	Group distribution	Total number	Percentage
Sex	Female	30	30
	Male	66	70
Qualification	Qualified	70	81
	Unqualified	26	19
Years of teaching experience of biology	1-5 years	32	33
	6 years and above	64	67
Marking experience	WAEC/NECO markers	64	67
	Non markers	32	33

Table 2: Analysis of biology teachers' responses to question 1-5

Variable groups	Q1 (%)		Q2 (%)		Q3 (%)		Q4 (%)		Q5 (%)	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Sex										
Female	30 (100)	0 (0)	0	30 (100)	0	30 (100)	30 (100)	0 (0)	10 (33)	20 (67)
Male	66 (100)	0 (0)	11 (17)	56 (83)	17 (25)	59 (75)	66 (100)	0 (0)	11 (17)	55 (83)
Qualification										
Qualified	70 (100)	0 (0)	7 (10)	63 (90)	21 (30)	49 (70)	70 (100%)	0 (0%)	14 (20)	56 (80)
Unqualified	26 (100)	0 (0)	0 (0)	26 (100)	0 (0)	26 (100)	26 (100%)	0 (0%)	0 (0)	26 (100)
Years of teaching experience of biology										
Experience	64 (100)	0 (0)	5 (8)	59 (92)	9 (14)	55 (86)	64 (100%)	0 (0%)	8 (14)	56 (86)
Less experience	32 (100)	0 (0)	0 (0)	32 (100)	0 (0)	32 (100)	32 (100%)	0 (0%)	8 (25)	24 (75)
Marking experience										
Marker	64 (100)	0 (0)	12 (20)	52 (80)	13 (20)	51 (80)	64 (100%)	0 (0%)	7 (100)	57 (82)
Non-marker	32 (100)	0 (0)	4 (12)	28 (88)	60 (20)	24 (80)	32 (100%)	0 (0%)	12 (38)	20 (62)

that biology like physics and chemistry is a practical-oriented subject. Most teachers' reason was that biology is the study of life organisms and their activities must be observed through practical work. Individual experience is required for student to ensure retention of the knowledge acquired. Other teachers stated that scientific processes such as observation, classification, drawing and fieldwork are essential in the teaching of biology to ensure that students acquire practical skills.

Research question 2: Can a biology teacher teach biology topic effectively without the conduct of practical work? Responses of biology teachers to this question showed that 100% female and 83% male teachers indicated No, 90% qualified and 100% unqualified, 92% experience and 100% less experienced, 80% markers and 88% non-markers all disagreed that biology could be taught effectively without the conduct of practical work.

Research question 3: Can a student obtain a credit in the senior school certificate examination in biology without passing the practical examination paper? Biology teachers' responses on this question revealed 100% male and 75% female teachers responded that it was not possible and indicated No. Similarly, 70% qualified and 100% (all) of the unqualified biology teachers also ticked No for the question, 86% of the experienced and 100% of those less experienced indicated No, 80% markers (examiners) and 80% non-markers (non-examiners) also indicated No that it was not possible for a student to obtain a credit in biology without passing the practical examination paper. One of the reasons most biology teachers gave was that the mark (score) for the practical examination is higher than those of the objectives and essay papers, consequently failing the practical paper would result in overall poor achievement.

Research question 4: Is the conduct of practical work essential for the understanding of biology concepts by

students? All biology teachers indicated Yes 100% males, 100% females; 100% qualified and unqualified; 100% experienced and less experienced and 100% markers and non-markers all agreed that conduct of practical work was essential for students understanding of biology concepts. One of the reasons teachers gave for their responses was that concepts such as ecology and genetics would be difficult to teach and would not be understood without engaging students in practical work, field work inclusive.

Research question 5: Should the practical examination be cancelled and replaced with alternative to practical similar to that conducted in the November/December examination. Biology teachers responded as follows: 67% females and 83% males; 80% qualified and 100% unqualified, 86% experienced and 75% less experienced; 82% markers and 62% non-markers indicated No to the question they all disagreed that practical examination should be replaced with the alternative to practical. One reason given by majority of biology teachers among others is that the alternative to practical is a theory of practical examination and would not examine practical skills of students in actual observation and drawing.

A total of twenty hypotheses were formulated using the four teacher variables for each question and were tested as shown in Table 3 and 4. Results of the hypotheses tested revealed no significant difference based on all the five questions according to gender, years of teaching experience, qualification and marking experience. Only one hypothesis indicated a significant difference in the views of biology teachers who were markers and non-markers with respect to question 5, on the replacement of the practical examination with the alternative to practical examination. A Chi-square value of 6.38 which was greater than the table value of 5.91 was obtained. Hence, the hypothesis was rejected.

Table 3: Chi-square analysis of the views of biology teachers on questions 1-5 according to the variable

Research question	Variable	χ^2 -value	Remark
Do teachers perceive practical work as important in the teaching of Biology?	Sex	0.01	-
	Qualification	1.01	NS
	Years of teaching	-	NS
	Experience	1.00	NS
	Marking experience	1.10	NS
Can a teacher teach biology topic effectively without the conduct of practical lessons?	Sex	2.11	-
	Qualification	0.03	NS
	Years of teaching	-	NS
	Experience	0.12	NS
	Marking experience	1.29	NS
Could a student obtain a credit pass in senior school certificate examination in biology without passing the practical examination paper?	Sex	0.25	-
	Qualification	0.61	NS
	Years of teaching	-	NS
	Experience	0.72	NS
	Marking experience	0.45	NS
Is the conduct of practical work essential for students understanding of Biology concepts?	Sex	0.01	-
	Qualification	0.10	NS
	Years of teaching	-	NS
	Experience	0.13	NS
	Marking experience	1.05	NS
Should practical examination be cancelled and replaced with alternative to practical, the type conducted in the Nov./Dec.?	Sex	2.49	-
	Qualification	2.61	NS
	Years of teaching	-	NS
	Experience	2.46	NS
	Marking experience	6.38	*S

*S = Significant at 0.05 level; NS = Not Significant, χ^2 (Chi-square); Table value is 5.91

Table 4: Chi-square analysis of the views of biology teachers on the replacement of the practical examination with alternative to practical according to marking experience (question 5)

Variables	Yes	No	Total	χ^2 -value	Remark
Marker (WAEC/NECO)	07	57	64	6.38	*S
Examiner					
Non marker (WAEC/NECO)	12	20	32	-	-
(Non Examiner)					
Total	19	77	96	-	-

*S = Significant at 0.05 level. Table value of χ^2 is 5.91

DISCUSSION

Only 64% of the total number of qualified biology teachers expected to have been employed was found in the schools. This indicates that there is still inadequate number of qualified biology teachers in Nigerian secondary schools. The average class size of the schools was eighty students except schools in Saki where the average class size was fifty as at the time the study was carried out. This finding is in agreement with those of Uzoma (1980) who also recorded large class size as being a problem in Nigerian schools. In this study 70% of the biology teachers were males and 81% of them were qualified teachers. It is surprising that only 30% of biology teachers were females. One would have thought that biology the least abstract of the three science subjects would attract more females as teachers. It is also encouraging to note that 81% of the biology teachers in the schools were qualified teachers. Total 67% of them had experience in teaching biology and 67% were also

WAEC and NECO markers (examiners). Hence, the teachers were qualified and competent to answer the five research questions in the study.

The biology teachers' views on research question one on the importance of practical work in biology was total. All biology teachers (100%) were in agreement that practical work in biology was very important. The finding corroborates that of Fraser *et al.* (1992) who highlighted the importance of practical work in biology from their study despite the chronological difference of about two decades from the previous studies and the present one. The reasons biology teachers gave were also identical with those proffered by previous researchers (Hofstein and Lunetta, 1982). The result indicated that majority of the biology teachers irrespective of sex, qualification, years of teaching and years of marking experience did not agree that biology could be taught effectively without practical work. Similarly, the responses to research question three showed that majority of biology teachers expressed the view that it is impossible for any student to obtain a credit in the subject without passing the practical examination.

Biology teachers perceived that the conduct of practical work was essential for the understanding of biology concepts and all teachers indicated Yes in response to research question four. Indeed 100% of the respondents according to sex, qualification, year of teaching of biology and marking experience had identical views without any exception. The reasons given by biology teachers notwithstanding in addition is that it would be difficult for biology students to understand certain essential cellular processes such as osmosis, photosynthesis, diffusion and several others without students participation in practical work. Furthermore, it would be difficult for biology teachers to teach and explain form and function of parts of organisms without the opportunity for students to interact with specimens of plants and animals of various types and experience fieldwork as required in the school certificate biology syllabus. Besides, characteristics of animals and plants should be demonstrated during practical lessons for students to experience and observe the features for themselves.

Biology teachers' views on the importance of practical work in biology resulted in the overwhelming responses that practical examination should not be replaced with alternative to practical. In line with biology teachers' responses all the nineteen hypotheses were upheld by biology teachers: all agreed that practical examination should not be replaced. However, a significant difference was found between teachers with marking experience who also did not want the practical

examination replaced and biology teachers without marking experience who wanted the practical examination replaced.

Apart from the reasons given by the teachers for not replacing practical examination with the alternative to practical, this researcher submits that biology students would also lack scientific process skills such as recording measuring, collecting of specimens and proficiency in handling and making use of biology apparatus and reagents if practical examination is cancelled. The findings of this study interestingly is indicative of the views of biology teachers themselves on the importance they attach to practical work in biology. Although, their poor attitude towards the conduct of practical work in secondary schools has not improved significantly. Indeed, it is at variance with the strong views expressed on the importance of practical work in biology. Teachers strongly view practical work in biology as important and indispensable. Therefore, it seems logical to discuss the need to improve the quality of practical work in biology in the Nigerian secondary schools since most teachers view it as indispensable.

However, teachers find conduct of practical work in biology difficult. The need to reduce the class size in most of Nigerian secondary schools to the teacher: student ratio of 1:40 as stipulated in the National Policy on Education has become inevitable. Since, large class size has been reported in research literature to hinder effective teaching of biology and by extension the conduct of practical work. Ango and Silo (1986) and Illig (1996) also, reported that a large class size makes it difficult for students to interact with the available apparatus, specimens and materials individually.

This researcher is also of the opinion that perhaps there is need for comprehensiveness with respect to any biology content in terms of processes, practical skills to be acquired by students and the need for procedures to be enumerated step by step to facilitate easy conduct of practical work by biology teachers. Teachers should identify and map out objectives for any given practical work which corresponds with the particular practical skills students are required to acquire during each practical lesson.

Furthermore, biology teachers should incorporate different minds-on and hands-on scientific activities such as problem-solving, inquiry, fieldwork and cooperative learning into the procedures for practical work in the different content areas. These are activities that have been established through research to enhance instruction. Also, students should be exposed and engaged in many and varied scientific activities also to motivate them and

make the subject more interesting. Consequently, the performance of students in biology would greatly improve and retention of knowledge ensured.

CONCLUSION

The findings on the analysis of biology teachers' views on practical work have further buttressed previous studies in support of the importance and indispensability of practical work in biology. Knowledge acquisition in biology commences with the collection and assimilation of data from the environment and students learn more meaningfully when given the opportunity to observe and interact with biology specimens. Indeed, the growth of the subject is ensured by the repeated and consistent practical study of specimens which enrich the body of knowledge in biology. However, biology teachers must demonstrate vividly their commitment to the strongly expressed views on the importance of practical work in biology through the effective conduct of practical work in the teaching of the subject. There has to be priority shift towards procedures which would expose students to many and varied activities during the conduct of practical work in the subject. Biology educators should now pay more attention to the specific types of skills students should acquire in their practical work experience. It has become necessary for students to be exposed to more hands-on activities such as surveying, collecting specimens from different habitats, individual projects such as making plant and insect albums and plotting of graphs in addition to the usual practical skills of observing, classifying and drawing in biology. Furthermore, intra and inter-group co-operative learning should be encouraged among students' groupings during the conduct of practical work in biology. This would encourage knowledge and information sharing in addition and also promote the acquisition of social skills which enhance retention of knowledge.

It is important that biology teachers purposes of practical work is well understood to ensure that the expected outcomes are derived from the practical work experience. It is therefore imperative that more qualified teachers are employed, class size reduced, inspection and supervision of science instruction intensified by the relevant units of the ministry of education to meet up with the challenge of quality practical work in biology in Nigerian senior secondary schools.

RECOMMENDATIONS

- Practical work in biology in the senior secondary school should be made to commence and enforced by the school authority from SS1 before the workload becomes overwhelming for biology teachers

- Shortage of biology teachers should be addressed urgently as only 64% of the total number of biology teachers expected were found in the schools sampled
- The Ministry of Education should re-introduce laboratory assistants into secondary schools for effective conduct of practical work in biology
- More schools and classrooms should be built to reduce the class size to the teacher-student ratio of 1:40 as stipulated in the Nigerian National Policy on Education. This will improve the quality of instruction and conduct of practical work in biology less stressful and cumbersome to organize
- Ministry of Education should provide school biology laboratories with adequate number and quality apparatus to ensure that each student develops practical and manipulative skills
- Practical work experiences should not be confined only to the biology laboratory or classroom in order to enable students acquire field skills and to arouse their interest in the subject
- Biology teachers should be trained in the use of inquiry and problem-solving strategies to improve the quality of practical work and inculcate critical thinking ability into students
- The monitoring of biology teaching and practical classes by the Federal and State Ministries Supervisory and Inspectorate Divisions of Education should be intensified as major components of the proposed reforms in the education sector
- Science teachers allowance should be reviewed to encourage biology teachers' commitments to conduct of quality practical work
- Periodic training programmes on practical work and acquisition of scientific process skills for in-service secondary school biology teachers is highly recommended
- Biology teachers must register with the Teachers' Registration Council to qualify for Science Teachers allowance and opportunity to attend training workshops

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