Extent of Use of Practical Works by Biology Teachers in Public Secondary Schools in Anambra State, Nigeria

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Abstract

The extent of use of practical work by secondary school biology teachers in public schools in Anambra State of Nigeria was investigated. The design adopted was descriptive survey. The population of the study comprised all the biology teachers in Anambra State. The sample for the study was made up of 221 biology teachers selected through multi-stage sampling. The instrument for data collection was researcher constructed questionnaire titled Practical Work Questionnaire. The instrument was subjected to validation by three experts while reliability index of 0.86 using Cronbach Alpha coefficient was obtained. The data collected were analysed using mean. The findings of the study showed that among others that the ways by which the use of practical work by biology teachers in teaching biology can be enhanced include continuous supply of materials, inspection of laboratories, use of alternatives to practical, project work, outdoor practical, field trips/excursions, improvisations, use of simulations, invitation to experts in subject area, and alternative power supply. The findings also showed that schools have materials and equipment for practical works which are used by biology teachers to a moderate extent. The study recommended that government should also create a separate department under the minister of education, charged with the responsibility of carrying out occasional and routine check of school practical works to ensure they are used for teaching biology.

Keywords: Practical works, biology, laboratory, teachers, technicians

Introduction

The importance of education in the overall development of an individual and the society is sometimes underestimated. Since no nation can develop and advance beyond the provisions of her educational system, what should be taught and how it should be taught at all levels of the educational system, becomes the concern for all. In order to restructure the formal education bequeathed to Nigeria at independence in 1960 by the British Colonial masters and make education relevant to present needs, an indigenous National Curriculum Conference was held in 1969. The conference resulted in the Federal government publication of white paper entitled National Policy on Education (NPE) in 1977. In 2004, 2008, 2012 and 2013 respectively; the policy has been revised in order to reflect the nation's philosophy on education.

The NPE deals with all aspects of education from philosophy, different levels and structure, financing, types of education to educational services, administration and planning. Although, the curriculum materials have been revised, the system of education remains six-year primary education, three-year junior and three-year senior secondary school and four-year tertiary education (6-3-3-4 system of education). The national educational goals to which the philosophy of education is linked include the training of the mind in the understanding of the world around# (FRN, 2013). The broad goals of secondary school education as spelt out in the NPE are to prepare the individual for useful living in the society and higher education (FRN, 2013).

In 1986, the Federal Government of Nigeria in another policy document 'National Policy on Science and Technology' expressed well-defined philosophy and objectives of science and technology. The philosophy stipulates that scientific and technological activities should be planned to achieve their acculturation and use through mass science education, technology transfer and acquisition, copy creativity, design and fabrication (Federal Ministry of Science and Technology, (FMST), 1986). Among the objectives of the policy is emphasis on increasing and strengthening theoretical and practical scientific base of the society. The policy also emphasizes that educational system shall focus on science at all levels.

Science is the study of the nature around us. Biology being a branch of science is the study of life and encompasses the study of living things in the context of influences exerted by non-living things (Kwan, Lam & Ofofuna, 2011). At the senior secondary school level, biology is one of the basic science subjects required in Senior Secondary School Certificate Examination (SSCE). It is common knowledge that virtually all students opt for Biology as they enroll for senior secondary class. This may be because the study of Biology is fundamental to the development of the human mind and good living environment, hence, Eze (2009) observed that Biology class is usually very large compared to other basic sciences. To achieve

the objectives and meet up with the usefulness of science in general and Biology in particular, the teaching of Biology must involve practical works.

Practical works are very essential to the effective teaching and learning of sciences in schools. Those who are properly grounded in the knowledge of Biology are better equipped to tackle health challenges. Such knowledge will not come from mere theories, but from practical application of the instructional materials/equipment learnt in real life situations. According to Dan-ologe and Shittu (2012), most school subjects can be taught with ordinary tools such as pencil, paper, chalkboard, textbooks and some other teaching aids. For effective science teaching, well equipped laboratories are needed as science cannot be taught only theoretically. Teaching of biology without adequate practical work makes teaching teacher-centered and the student passive learners during lessons. This makes students prone to rote learning and do not develop in the student the attitude of scientific enquiry.

Practical work in biology entails the acquisition of laboratory and field skills in the scientific study of life and structure of plants and animals in relation to their environment (Opuh, 2013.) In the preamble to their syllabi, the National Examinations Council, (NECO) (2014), West African Examinations Council (WAEC), (2014), buttressed the need for practical work in teaching and learning of biology in senior secondary schools. Both syllabi were designed to assess candidates in understanding of the structure and function of living organisms as well as appreciation of nature; acquisition of adequate laboratory and field skills in order to carry out and evaluate experiments and projects in biology; acquisition of Science Process Skills (SPS); observing, classifying and interpreting data. According to the 2014 edition of WAEC syllabus, great importance should be attached to experimental works. It was recommended that whenever possible throughout the whole course, candidates should be aware of practical applications of what is being studied.

From the foregoing, one can infer that practical work is very essential for effective teaching and learning of biology. Practical works however, is rarely used by science teachers and biology teachers in particular. The reasons for the seldom use of practical work in most public schools are often reasonable. For instance, some biology teachers argue that sometimes, the lack of practical resources and equipment for practical works makes it difficult to conduct practical work for students. It is a common occurrence in most public secondary schools that it is during external examinations like WAEC and NECO that schools acquire most resources. The acquisition of resources for practical works at this time is often limited to the ones specified in the white papers and which will be used in the examinations. Most other resources which are available in public schools are either not useful or expired.

The problem of unavailability of instructional materials and resources for practical works in teaching and learning biology is often linked to the expensive nature of the resources. There is also the problem of preservation. Degradable resources such as leaves, flowers, animals such as toads, fish, rats, lizard and such other resources cannot be preserved for a very long time. At some instance, they become useless as some of their useful parts either fall off or dissolve in the chemical used in preserving them. At such times, their physical characteristics become hard to determine. These problems in listed did not end the list of the problems of the use of practical works on the part of the biology teacher. One peculiar problem relative to the biology teacher is that of time allocated for biology instruction.

The school timetable often contained a well-planned duration for all subjects which teachers must adhere to. The timing is to ensure smooth operation of the school system. However, there is barely any time specifically allocated for practical works by students or demonstration on the part of the teacher. This has made biology teachers to focus more on finishing the content of the scheme of work which is believed to be slightly overloaded. Given that biology is nearly offered by all students, the biology teachers' classes are often filled

beyond the number of students that can be effectively handled by a single teacher. Class exercises and assignments, marking of scripts and other academic functions further eat into the time which in any case could have been used for practical works. This being the case, the extent of biology teachers' use of practical works has continued to reduce and have become an area of research interest.

Research in the problems of practical works has shown that the concept of practical works can be re-conceptualized to include cognitive approach to laboratory experiments. This is the concept used in most external examinations such as WAEC and NECO where alternatives to practicals are used. Whereas the term 'practical work' refers to any teaching and learning activity which at some point involves the students in observing or manipulating the objects and materials they are studying, the observation or manipulation of objects might take place in a school laboratory, but could also occur in an out-of-school setting, such as the students' home or in the field (example when studying aspects of biology or Earth science).

Following this line of reasoning, it then follows that, cognitively, there is nothing uniquely distinctive about practical work which marks it off from other kinds of science learning activity. The same kind of discussion as might follow a practical activity/work can take place in a lesson where there is no data collection, observation or manipulation because the phenomena which the teacher wants to explore with the class are ones that the teacher can assume are already well-known to pupils from their everyday experiences. For example, imagine a teacher beginning a lesson on the idea of inertia in Newtonian mechanics. The teacher might ask the class if they have ever found themselves having to stand in a bus or train, because it was crowded – and to say what they remember happening (and feeling) as the vehicle started off, or when it stopped. From their shared experiences, the teacher might then draw out the idea that objects are somewhat resistant to changes in their motion.

There has been no practical work in the sense of in-class data collection, observation or manipulation. But the cognitive processes involved are the same as when data collected or observed and manipulated by the students are discussed and reviewed. The aim is to draw students' attention to a phenomenon, to isolate parts of it for particular scrutiny, and to talk of a way of thinking about it. The aim is to develop a link between an observation and a way of thinking about it – between the world and a mental representation of the world. This is at the centre of all science learning – and practical work plays a critical role in it. Practical work is used in science classes when students are unlikely to have observed the phenomenon one is interested in, or to have observed it in sufficient detail, in their everyday lives. In such situations, practical works is essential and irreplaceable, hence the investigation on the extent of use of practical work by biology teachers in public secondary schools in Anambra State.

Purpose of the Study

The purpose of this study was to determine the extent of use of practical work by Biology teachers in Anambra State. Specifically, the study determined:

1. Instructional materials/equipment that is available for teaching biology practical.
2. The extent to which biology teachers use practical works in the teaching of biology in senior secondary school level.
3. The strategies for enhancing the use of practical works in senior secondary schools.

Research Questions

1. What are the instructional materials/equipment available for practical works in secondary schools?
2. To what extent do biology teachers use practical works in teaching biology in senior secondary schools?
3. What strategies can be used for enhancing the use of practical works in senior secondary schools?

Method

Descriptive survey design was used in the study. The population of this study comprised all biology teachers in the six Education Zones of Anambra State, namely: Nnewi Education Zone, Onitsha Education Zone, Otuocha Education Zone, Ogidi Education, Aguata Education Zone and Awka Education Zone. Data obtained from the Post Primary School Service Commission (PPSSC) indicated that there are 457 biology teachers in the 21 Local Government Areas (LGAs) in the state. The sample size was 221 biology teachers in 11 LGAs within three (3) education zones. Simple random sampling technique was used to select three out of six (6) education zones. The entire biology teachers in the three selected zones were involved in the study.

The instrument for data collection was a researcher-constructed questionnaire titled Practical Work Questionnaire (PWQ). The data collection instrument was structured on a four-point response option ranging from Always Available (AA), Occasionally Available (OA), Rarely Available (RA) and Never Available (NA). A mean of these weighted responses which met the criteria/decision for acceptance was used to judge the availability of the materials and equipment for practical work in the school. Section B which sought to obtain information on the extent of practical works by biology teachers was designed on four-point rating scale Very Regularly in use (VR), Moderately in use (MU), Rarely in use (RU), Never in use (NU) and Sections C as modified four (4) point response scales from Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). PWQ was validated by three experts in science education and one in measurement and evaluation all in Nnamdi Azikiwe University, Awka. The reliability of the instrument was established using Cronbach Alpha. The instrument was administered once to 20 biology teachers from secondary schools in Onitsha Education Zone. The data obtained was used to compute the reliability of the instrument by applying Cronbach Alpha which yielded a reliability coefficient of 0.86.

The researcher with the help of research assistants administered the PWQ to the respondents. Before administering the PWQ, the researcher instructed the research assistants on what to do. The PWQ was administered to the biology teachers during their biology teachers' workshop. The data collected were analysed using weighted response average and grand mean with respect to research questions. The based criteria mean were used for questions 1, 3 and 4. The decision was that the weighted response average score of 2.50 and above for the all sections indicated acceptability while the items with mean score below 2.50 were not accepted. For the second research questions, the grand mean was used. The decision was that grand mean ranging from 3.01- 4.00 indicated that extent of use of practical works by biology teachers was very regularly in use, 2.01-3.00 was moderately in use, 1.01-2.00 was rarely in use, and 0.01 – 1.00 was never in use.

Results

Table 1: Availability of the Instructional Materials/Equipment for Practical Works

S/N	Questionnaire item	$\bar{X}$	Remark
1	Real objects	2.45	Not available
2.	Improvised material	2.37	Not Available
3.	Microscope	2.56	Available
4	Dissecting kit	2.67	Available
5.	Reagent	2.66	Available
6.	Projector for films	2.64	Available
7.	Bone/skeleton	2.79	Available
8.	Chart	3.41	Available
9.	Pictures/diagram	3.48	Available
10.	Test tube	2.71	Available
11.	Bunsen burner	2.62	Available
12.	Aquarium	2.32	Not available
13.	Audio/visual set	2.39	Not available
14.	Laptop	2.62	Available
15.	Rain-gauge	2.67	Available
16.	Wind-vane	2.58	Available
17.	Anemometer	2.93	Available
18.	Quadrant	3.25	Available
19.	Insect net	2.81	Available
20.	Petri dish	2.57	Available
21.	Measuring cylinder	2.54	Available
22	Beaker	2.62	Available

Cut off mean = 2.5 (Available)

From Table 1, it can be seen that all the items achieved mean scores above the cut-off mean except items 1, 2, 12 and 13. The respondents rating of materials/equipment available for practical work is that microscope, dissecting kit, reagent, projector for films, bone/skeleton, chart, pictures/diagram, test tube, bunsen burner, laptop, rain-gauge, wind-vane, anemometer, quadrant, insect net, Petri dish, measuring cylinder, beaker are available for practical works while real objects, improvised material, aquarium, audio/visual set are not available.

Table 2: Mean Responses on the Extent of use of Practical Work in Teaching Biology

S/N	Practical work (item)	$\bar{X}$	Remarks
1.	Collecting specimen	2.91	Moderately in use
2.	Biological drawing	1.55	Rarely in use
3.	Identify	1.86	Rarely in use
4.	Sample measurement	1.74	Rarely in use
5.	Investigating of specimen	1.00	Never in use
6.	Specimen preservation	1.32	Rarely in use
7.	Specimen storage	1.95	Rarely in use
8.	Observing specimen	2.44	Moderately in use
9.	Recording	2.67	Moderately in use
10.	Testing food substance	1.00	Never in use
11.	Drawing and labelling specimen	2.19	Moderately in use
12.	Classifying objects	1.00	Never in use
13.	Interpreting results	1.00	Never in use
14.	Analysing results	1.00	Never in use
	Grand mean	**1.69**	**Rarely in use**

Table 2 reveals that the respondents are in agreement that items 1, 8, 9 and 11 with mean score of 2.91, 2.44, 2.67 and 2.19 are moderately in use, while items 2, 3, 4, 6, 7, 10, with the mean scores of 1.55, 1.86, 1.74, 1.32, 1.95, were rarely in use, other items with mean scores of 1.00 are never in use. The grand mean scores of 1.69 indicates that practical works are rarely used by biology teachers.

Table 3: The mean Reponses of the strategies for enhancing the use of practical work in teaching Biology

S/N	Strategies (Items)	$\bar{X}$	Decision
1	Continuous supply of materials	2.63	Agree
2	Inspection of laboratories	2.57	Agree
3	Use of alternative to practical	2.54	Agree
4	Project work	3.01	Agree
5	Outdoor practical	2.60	Agree
6	Field trip/excursion	3.06	Agree
7	Improvisation	2.82	Agree
8	Use of simulations	2.76	Agree
9	Invitation to field workers	2.71	Agree
10	Alternative power supply	3.03	Agree

Cut off mean = 2.5 (Agree)

Data in Table 3 show that all the items in the table are accepted as ways by which biology teachers' use of practical work in secondary school can be enhanced

Discussion

The findings of the study revealed that the materials available for teaching practical works in secondary schools included microscope, dissecting kit, reagent, projector for films, bone/skeleton, chart, pictures/diagram, test tube, bunsen burner, laptop, rain-gauge, wind-vane, anemometer, quadrant, insect net, Petri dish, measuring cylinder, beaker. The availability of these materials could be because they are the basic apparatus required in biology laboratories. However, the absence of audio-visuals and computers are rather appalling. Aquarium which is one the most important tools that could give students an insight about the natural environment and real world are not available in schools. One possible cause of this may be because they are quite expensive and requires a lot of effort to maintain.

The findings of the study contrast that of Egbuonu (2005) who reported that schools do not have the needed instructional resources for teaching and learning of practical biology. The findings of the study however support that of Ukaegbu (2012) that 88% of biology laboratory resources are available in biology laboratories such as interactive white boards, prepared slides, chemicals, textbooks, beakers, flasks of different types, microscopes, first aid box, hand lens,

maps, models, computers, dissecting kits, fire extinguishers, thermometers, insect nets, bell jars, incubator, water baths, freezers and lecturers. The findings of the study further supported that of Nwafor and Eze (2014) that only two dimensional instructional materials are available in schools and those other instructional materials example audio materials, audio-visual materials are lacking in most schools.

The finding of the study showed that practical work is rarely used by biology teachers in teaching biology. This observation of the study could be because secondary school biology teachers often reserve most practical work for the examination class. Quite often, practical works are conducted only in preparation for external examinations. This is done to save material wastage and the cost of acquisition of more materials. The teachers may also not conduct practical work due to the class size. Most public secondary schools are over-loaded. Conducting practical works for large number of students is often problematic and requires a lot of time to involve all the students. Pairing or grouping students often result in some students taking over the exercise to the disadvantage of others. In such cases, students who were not able to interact directly with the materials/equipment for learning may not grow interest for another practical work.

The findings of the study support that of Egbuonu (2005) that biology teachers have not been using most of the science equipment for practical activities. The findings of the study is in line with that of Nwafor and Eze (2014) that teachers do not use instructional materials or improvise instructional materials to facilitate their teaching. The findings of the study also support that of Tolessa, Baressa, Bula and Itefa (2016) who reported that the frequency of practical work was 8.8%. Rabi (2017) finding is in line with that of this study. The findings show that teachers indicated reluctance and inability in conducting practical works using the few available laboratory facilities.

The findings of the study showed that the strategies through which the use of practical work by biology teachers in teaching biology can be enhanced include among others the continuous supply of materials, inspection of laboratories, outdoor practical, project work, field trip/excursion, improvisation, use of simulations, invitation to field workers, and alternative power supply, use of alternative to practical. The continuous supply of practical work materials ensures the availability of the materials for usage. When such materials are in continuous supply, the teachers can have enough to conduct practical exercises. The supply of materials often warrants inspection for usage and for malfunctional materials. Through such inspection, teachers are made to use the materials. Also, through the inspections, faulty materials are replaced and adequacy for the number of the students who are going to use the materials is ensured.

Another way to enhance the use of practical works is through the use of alternative to practical by the biology teacher. Here, the perquisite knowledge and skills is acquired through cognitive activities. This approach to practical activity does not require too much time and can be achieved within the time frame stipulated in the school timetable. Also, great number of students can be handled with ease and it is less expensive. Another alternative could be through the use of outdoor practical, field works and excursions. Visits can be made to companies, laboratories, workshops and factories to see the practical applications, procedure, skills used by the scientists.

The field workers or experts may otherwise be invited to the school to teach the students. In case of any difficulty, the teacher has as a final alternative, the use of simulation. Here, the practical work can be simulated and shown to the students. The benefit associated with the use of simulation is that it involves more senses of the learner and can facilitate easy recall. Moreso, the use of simulation can be used for large number of students. However, constant power supply is needed. This is why it is important to provide alternative power

supply. The findings of the study lend credence to the study of Opuh (2013) who noted that the teachers' mastery of the subject area is important for good practical work. Opuh noted also that if the practical equipment and experience is accessible, it plays a major role in influencing student attitude and academic achievement.

Conclusion

It can be concluded from the findings of the study that biology teachers' use of practical work is to a rare extent. Strategies that can help to improve the use of practical works include among others the use of improvisation, field trip and outdoor practical.

Recommendations

Based on the findings of the study, the following recommendations are put forward:

1. Government should provide more laboratory equipment/materials to ensure availability of those materials needed for practical work and to adequately meet up with the increasing population of students in schools.
2. There should be inclusion of outdoor practical, field trip/excursion in the secondary school curriculum according to seasons, festivals or occasions, for students to link studies with their daily experiences in the locality.

References

Dan-Ologe, I. A. & Shittu, A. O. (2012). Improving the standard of teaching and learning of practical in our secondary schools, emphasis on biology and chemistry practical. *Journal of Education*, *6*, 231-236.

Egbuonu, R.U. (2005). *Availability and utilization of instructional resources for teaching and learning of practical skills in biology.* Retrieved from: https://globalacademicgroup.com/journals/nard/Egbunonu.pdf

Eze, S. O. (2009). *Perception of biology teachers on the competencies possessed by the biology laboratory assistants in Nsukka and Obollo education zones*. Unpublished M.Sc. Thesis, University of Nigeria, Nsukka

Federal Republic of Nigeria (2013). *National policy on education*. Lagos: Nigerian Educational Research and Development Council (NERDC).

Kwan L. P, Lam, E. Y. K, & Olofuna J. O. (2011) *Biology for senior secondary school.* Ondo: Africana Feb publishers.

Nwafor, C.E, & Eze, S.O. (2014). Availability and utilization of instructional materials in teaching basic science in selected secondary schools in Abakiliki Education Zone of Ebonyi state. *Global Journal of Bio-science and Biotechnology, 3*(3), 492-295.

Opuh S.O (2013). *Problem of teaching practical work in biology, Igbo-Etiti local government. area of Enugu state*. Unpublished MSc thesis, University of Nigeria, Nsukka

Rabi, M. (2017). A survey of availability, utilization and maintenance of biology laboratory equipment and facilities in secondary schools in Sokoto state, Nigeria. *International Journal of Science and Technology, 6*(1), 662- 668.

Tolessa, M.D., Baressa, A., Bula, K.O., & Itefa, D. (2016). Status of biology laboratory and practical activities in some selected secondary and preparatory schools of Borenza Zone, South Ethiopia. *Educational Research and Reviews, 11*(1), 1709-1718.

Ukaegbu, C.G. (2012). *Provision and management of biology laboratory resources in colleges of education in South-Eastern Nigeria.* (Unpublished thesis), University of Nigeria Nsukka.