

POSSESSION AND UTILIZATION OF SCIENCE PROCESS SKILLS IN TEACHING BIOLOGY IN SECONDARY SCHOOLS IN NKANU WEST LOCAL GOVERNMENT AREA OF ENUGU STATE

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Abstract

The study investigated the possession and utilization of science process skills in teaching Biology in secondary schools in Nkanu West Local Government Area of Enugu State. The study was guided by two research questions. A descriptive survey research design was adopted for the study. The population for the study was 33 Biology teachers within the 12 public secondary schools in the study area. The sample size comprised all the 33 Biology teachers hence, there was no sampling. The instrument for data collection was a structured questionnaire titled “Biology Teachers’ Possession and Utilization of Science Process Skills Questionnaire” (BTPUSPSQ), which was designed by the researcher. The instrument was divided into two sections namely: A and B. Sections A was based on the respondents’ biodata while B comprised of 16 item statements structured to elicit information from the respondents. The instrument was validated by three experts. The instrument was subjected to internal reliability test by administering it to 15 Biology teachers in public secondary schools in Nkanu East Local Government Area of Enugu State, to determine the overall reliability index of the instrument. Using Cronbach alpha, and an overall reliability coefficient of .84 was established. To distribute the instrument, the research visited the schools with two research assistants. At spot delivery method was used in data distribution, this was to ensure 100% return rate of the distributed instrument. A simple mean was used to analyze the data collected for the study. The decision rule for interpreting the results was based on the calculated means. Responses on each of the research questions were considered high and accepted when the mean is 2.50 and above, and low and rejected when less than 2.50. Findings from the analysis made revealed that Biology teachers’ possession of basic science process skills was of a high extent; Biology teachers utilized the basic science skills in teaching Biology. Based on the findings of the study, it was recommended among others that: training should be given to teachers for proper orientation on how to use science process skills in teaching Biology and other science subjects in secondary schools.

Keywords: Science, Science Process Skills, Biology, Biology Teaching

Introduction

Education is an instrument “par excellence” for effective national development. The development of any nation depends largely on the level of education attained by her citizens especially in the area of science and technology. It is highly rated as the most important instrument of change since any definite change in the intellectual and social outlook of the people must be preceded by an educational revolution. In cognizance with the importance of science and technology in national development, science subjects-Biology, Physics and Chemistry are taught in secondary schools to prepare a base for any science and technological development (Ababio, 2013). This according to Idoko (2010), is important because the knowledge of science in general helps man to understand himself, his environment and how his environment influences him.

Therefore, science according to Idoko (2010) is the application of man's acquired knowledge to influence and manipulate his environment to achieve better living condition for himself. In another report, Mbajorgu (2018) stated that science is the study of natural occurrence or way of making sense of the natural physical world. Mbajorgu further revealed that there cannot be any meaningful development without science. This is in agreement with the notion of Nwachukwu (2015) which reported that the development of the nation depends on the level of scientific teaching and knowledge received by individuals. According to Neboh (2019), science is a systematic process of carefully investigating and obtaining knowledge about nature and its phenomena.

However, science as an academic discipline involves learning the key concepts, as well as the processes of science. The increasing importance of science in the present diverse population of students poses a serious challenge of finding ways to improve teaching as a means of elevating these educational outcomes. Recent revival of interest in developing thinking skills has encouraged added emphasis on science process skills instruction. To achieve these learning goals, science educators and researchers are looking for key factors, innovations and ways to improve, modify, augment or replace prevailing methods of delivering effective and meaningful learning on given sets of educational climates.

Okeke (2017), defined science as a systematic process of obtaining verifiable knowledge and experimentation. Nwosu (2017), defined science as both an organized body of knowledge and a process of finding out knowledge. Science is a discipline, a body of knowledge about the universe, the structure and reactions of matter, the conservation and transfer of energy, the interaction between living things and their environment (Ezeudu, 2011). Therefore, all the definitions above center on science as systematic study of the environment or nature through observation and experimentation leading to accumulation of an organized body of knowledge useful for problem solving in the environment.

According to Mbah and Leghara (2018), science is a two-way activity that involves “product” (the knowledge and outcomes of science) and “process” (the skills and scientific procedures of investigation). Science can be categorized into two dimensions; the process and the product dimensions. The process of science involves the methods of approach employed and activities engaged in by scientists in order to arrive at a product. Ozgelen (2012) defined science process skills as abilities, potentials as well as all the technical “know how” which can be developed in a child and which can be employed in carrying out mental and physical operation in science. Nwosu (2011) described science process skills as mental and physical abilities and competencies which serve as tools needed for the effective study of science and technology as well as problem solving for individual and societal development. Ugwu (2017) observed that science process skills present science as a way of investigating and a way of thinking.

Baiyelo (2017) opined that science process skills are logically linked series of activities that can easily be learnt. Science process skills enable individuals and society at large to tackle their problems in a systematic and orderly way; developing an approach to problems that are not only scientific but social as well. Science process skills also encourage the active involvement of children in learning process (NTI, 2012). The process skills are the basic strategies of science. According to Russell (2015), scientific processes are “*truly culture free, a genuine international language of science, one which would remain relevant at all times, everywhere.*” In supporting this view, Baez (2013) in Russell (2015) had this to say:
It is more important that students acquire the frame of mind associated with discovery and enquiry than it is for them to memorize facts whose value may be transitory.

Science process skills are tools for gathering information, problem solving, decision making and adaptation (Chukwuemeka & Nwosu, 2018). Acquisition of these skills is enhanced by the use of experimental method of teaching which requires a child's active involvement in activities.

Science process skill according to American Association for the Advancement of Science (AAAS, 2015) include: observation, classification, measurement, inferring, communication, predicting, controlling variables, formulating models, formulation of hypothesis, manipulating, interpretation of data, counting/number relations, experimenting, recording of data and making operational definitions. Ango (2011) classified these science process skills into two categories which is basic and integrated process skills. The basic (simpler) process skills provide a foundation for learning the integrated (more complex) skills. The basic science process skills form the foundation for scientific methods. There are six basic science process skills: observation, communication, classification, measurement, inference and prediction. On the other hand, integrated science process skills include controlling variables, formulation models, formulating hypothesis, defining operationally, experimenting and interpreting data. Basic science processes are vital for science learning and concept formation at the primary and junior secondary school levels. More difficult and integrated science process skills are more appropriate at the senior secondary and tertiary school levels for the formation of models, experimenting and inferring. Hence, both basic and integrated science process skills are relevant and appropriate at the senior secondary school level in Nigeria. However, the basic science focuses on fundamental scientific principles and knowledge, while integrated science applies knowledge from various scientific disciplines to solve real-world problems. Additionally, the basic process skill provides a foundation for learning the integrated process skill.

Pearson (2015) identified the following steps as basic in a scientific process or method, these include:

- Identify the problem
- Gathering observation pertinent to the problem
- Developing and stating a hypothesis based on the observation
- Developing testable predictions of other related observation and observable phenomena from the hypothesis
- Testing the hypothesis through observation
- Supporting, rejecting or modification of hypothesis on the basis of empirical observation.

It is important to know that the skills in Biology practical activities cannot be completed without creativity. Practical work is not just putting the apparatuses together when seen, but it needs planning, designing a problem, creating new approach and procedure and also putting familiar things together in the new arrangement. According to Gliddings and Fraser (2018), achieving the objectives of science practical work depends a lot on the mode of assessment of laboratory work depends a lot on the mode of assessment of laboratory work adopted by the teachers and examination bodies. They further stressed that the mode of assessment directly influences teacher's teaching methods, students' learning styles and attitudes towards practical activities. This means that the Biology teacher needs to process and utilize science process skills.

Biology teachers' possession and utilization of science process skill approach method in teaching science is meant to foster inquiry and manipulative skills in students and discourage rote learning. This method embraces other methods of science teaching and is mainly activity

based, superior to those in which the students are not actively involved in learning process (Akinbobola, 2018). This reason has made WAEC and other examination bodies that conduct senior secondary school certificate exams (SSCE) to stipulate the practical work which should form the basis of teaching sciences. During examination the practical work is also assessed separately. Currently, biology being one of the sciences taught in senior secondary schools is taught both in theory and practical. In both internal and external examinations, practical Biology is assessed separately as an integral part of the subject.

The use of science process skills makes it possible to shift teaching from the teacher centered method to student center method. This shift from the teacher-centered method of teaching science to student-centered activity-based method, encourages and develops in the students the spirit of inquiry and also attempt to make students fully aware as well as understand the ways scientist work; also equipping and preparing students for their possible careers in science and technology (Akinbobola, 2018).

Problem Statement

Science process skills are cognitive and psychomotor skills employed in problem solving. They are the skills which scientists use in problem identification, objective inquiry, data gathering, transformation, interpretation and communication. Science process skills can be acquired and developed through training which is involved in science practical activities. They are the aspect of science learning which is retained after cognitive knowledge has been forgotten. Using science process skills in teaching Biology by Biology teachers are an important indicator or transfer of knowledge which is necessary for problem solving and functional living. The knowledge of process skills in science is very important for proper understanding of concepts in science. Ajaja stated that process skills are fundamental to science, which allows everyone to conduct investigation and reach conclusions; Ajaja observed that there is a serious educational gap in this area, both in bringing these skills into the classroom and in the training of teachers to use them effectively.

Teacher's acquisition and utilization of science process skills has significance influence on students' practical activities at senior secondary school level where students are required to be evaluated on practical activities as one aspect of the nine papers written in the final examination. This practical test is designed to develop and test the three aspect of the students' intellectual development; cognitive, affective and psychomotor skills. This practical is introduced late and students have to acquire these practical skills in few months to write WAEC and NECO examinations. The late introduction of training in the psychomotor skills at the SS III may be the cause of poor students' achievement in Biology practical at SS III as reported by WAEC Chief Examiner's Report 2015 and 201. Biology students have problem of acquiring these practical skills in short period to write the final examination. This definitely affects the overall achievement of students in O' level Biology practical. However, the late introduction might be due to so many reasons which may include the fact that the teachers do not possess these skills and when they do not possess it, there is no way they can impact it on the students. Hence, the need to ascertain the level of acquisition and utilization of science process skills by Biology teachers in teaching Biology in Nkanu West LGA of Enugu State.

Research Questions

The following research questions guided the study:

1. What is the extent of possession of basic science process skills by Biology teachers in secondary schools in Nkanu West LGA of Enugu State?
2. What is the extent of utilization of basic science process skills possessed by Biology teachers in secondary schools in Nkanu West LGA of Enugu State?

Methodology

A survey design was adopted for the study. A survey design, according to Nworgu (2015) is a design where peculiar characteristics of a known or identified population are studied through a sample, which is deemed to be representative of the population. Such study is only interested in describing certain variables in relation to the population. Ojo (2019) opined that survey is the best technique for obtaining the necessary data from a group in which the sample drawn from the population and their opinion will be used to generalize the opinion of the entire population. This design was appropriate for the study because; it collected data and described in a systematic manner, the science process skills possessed and utilized by Biology teachers in secondary schools. The study was carried out in public senior secondary schools in Agbani LGA of Enugu State. The population of the study consisted all the thirty-three (33) Biology teachers in the twelve (12) government secondary school in the study area. Because of the manageable size however, all the entire 33 (thirty-three) Biology teachers in the twelve secondary schools in the ten communities in Nkanu West LGA were used for the study. Hence, there was no sampling.

A 16-item questionnaire titled “Biology Teachers’ Possession and Utilization of Science Process Skills Questionnaire” (BTPUSPSQ), which was designed by the researcher in line with research questions that guided the study, and was used for the data collection. The questionnaire consisted of two parts. Part A contained the respondent’s personal data while part B encompassed a list of the items raised to answer the research questions. The items of the questionnaire were structured to have four points’ scales of: Very High Extent (VHE), High Extent (HE), Low Extent (LE) and Very Low Extent (VLE). Numerical values of 4, 3, 2 and 1 were given to the options respectively in each line of scale. The Instrument was subjected to face and content validation. The instrument was validated by three experts, two from Science Education Department, and one from Mathematics and Computer who majors in Measurement and Evaluation, all from Faculty of Education, Enugu State University of Science and Technology, ESUT). The validators made some constructive comments which formed the basis for the modification of the items before using it. The instrument was subjected to internal consistency reliability test by administering it to 15 Biology teachers in public secondary schools in Nkanu East Local Government Area of Enugu State, to determine the overall reliability index of the instrument. Cronbach alpha reliability coefficient formula was used to estimate the reliability of the instrument, and a reliability coefficient of .84 was established. The data were collected by the researchers and were analyzed using mean scores and standard deviation. Therefore, the decision rule for interpreting the results was based on the values of the calculated means. Responses on each of the research questions were considered high and accepted when the mean is 2.50 and above, and low and rejected when less than 2.50.

Results

Research Question 1: What is the extent of possession of basic science process skills by Biology teachers in secondary schools in Nkanu West LGA of Enugu State?

Table 1: Mean Responses of teachers on the extent they possess basic science process skills

S/N	Extent biology teachers possess basic science process skills:	VHE 4	HE 3	LE 2	VLE 1	$\bar{X}$	SD	DEC
1	Observation	17	8	5	3	3.18	1.01	High
2	Measuring	15	9	7	2	3.12	0.96	High
3	Classifying	18	7	6	2	3.24	0.97	High
4	Inference	16	8	5	4	3.01	1.07	High
5	Predicting	3	6	9	15	1.91	1.01	Low
6	Recording	17	8	5	3	3.18	1.01	High
7	Communication	16	8	5	4	3.01	1.07	High
8	Questioning	15	9	7	2	3.12	0.96	High
GRAND MEAN						3.10	0.44	High

The data in Table 1 above shows that high mean scores of 3.18, 3.12, 3.24, 3.01, 3.18, 3.01, and 3.12 were obtained in items 1, 2, 3, 4, 6, 7 and 8. By interpretation this means that the extent of Biology teachers possess of basic science process skills in items 1, 2, 3, 4, 6, 7 and 8 are high to some extent because the calculated mean scores are higher than the 2.50 mean benchmark score set for the study. The table also shows that low mean score of 1.91 was obtained in item 5, which means that the extent of Biology teachers possess of basic science process skill in item 5 is of low. The grand mean obtained was 3.10, which indicates that the level of Biology teachers' possession of basic science process skills is of high extent secondary schools in Nkanu West Local Government Area of Enugu State.

Research Question 2: What is the extent of utilization of basic science process skills possessed by biology teachers by Biology teachers in secondary schools in Nkanu West LGA of Enugu State?

Table 2: Mean Responses of teachers on the extent they utilize basic science process skills

S/N	Extent of utilization of basic science process skills by biology teachers	VHE 4	HE 3	LE 2	VLE 1	$\bar{X}$	STD	DEC
16	Observation	16	9	6	2	3.18	0.96	Utilized
17	Measuring	17	7	5	4	3.12	1.08	Utilized
18	Classifying	14	11	7	1	3.15	0.9	Utilized

19	Inference	15	10	6	2	3.15	0.94	Utilized
20	Predicting	3	6	9	15	1.91	1.01	Not Utilized
21	Recording	16	9	6	2	3.18	0.95	Utilized
22	Communication	17	7	5	4	3.12	1.08	Utilized
23	Questioning	4	5	8	16	1.91	1.07	Not Utilized
GRAND MEAN						2.84	0.57	Utilized

The data in Table 2 above shows that high mean scores of 3.18, 3.12, 3.15, 3.15, 3.18 and 3.12 were obtained in items 16, 17, 18, 19, 21, and 22. This means that the level of Biology teachers' utilization of basic science process skills in items 16, 17, 18, 19, 21 and 22 are of high extent. The Table further shows that low mean score of 1.91 and 1.91 was obtained in items 20 and 23 which means that the level of Biology teachers' utilization of basic science process skills is of low extent. The grand mean obtained was 2.67, which indicates that the level of Biology teachers' utilization of basic science process skills is of high extent in secondary schools in Nkanu West Local Government Area.

Discussion of Findings

Extent of Possession of Basic Science Process Skills

Research question one sought to determine the extent of possession of basic science process skills by Biology teachers as presented in Table 1. From the analyzed data in Table 1 above, it was revealed that: observation, measuring, classifying, inference, recording, communication and questioning skills had mean scores above 2.50, this implied that Biology teachers in secondary schools in Nkanu West LGA possess these basics science process skills to high extents. This result is in line with the findings of Mbah (2015), which indicated that teachers possess basic science skills to high extent. In the same vein, result computed in the Table above showed that predicting skills had mean score less than 2.50. This indicates that the teachers possess predicting skills to a low extent, about 59% of the respondents accepted that the extent of teachers' possession of predicting skills are low and 32% strongly agreed to this. This could be much attributed to the fact that teachers lack the opportunities to develop their professionalism.

The Extent of Utilization of Basic Science Process Skills

Research question three determined the extent of utilization of basic science process skills possessed by Biology teachers, the data were presented and analyzed in Table 2. From the result of the data computed in Table 2, it was observed that skills such as observation, classifying, inference, recording, communication and questioning were utilized by the teachers in teaching Biology. Hence, the teachers utilized the outlined basic science process skills. On the contrary, items statement such as predicting and questioning had mean score less than 2.50, which showed that teachers do not utilize this skill in Biology teaching. This may be attributed to the fact that they do not possess this skill and hence they do not possess it, they cannot utilize it in teaching biology in secondary school.

Conclusion

This study investigated Biology teachers' possession and utilization of science process skills in teaching Biology in Nkanu West Local Government Area of Enugu State. Findings from the study indicated that Biology teachers' possession of basic science process skills is high. In Furtherance, the findings from the study showed that their utilization of basic science process skill is high in secondary schools in Nkanu West LGA of Enugu State.

Recommendations

Based on the findings of the study, the researcher made the following recommendations:

1. Training should be given to teachers for proper orientation on how to use science process skills in teaching Biology and other science related subjects in secondary schools.
2. The laboratory should be adequately equipped for effective practical Biology to enhance teachers' possession and utilization of science process skills.
3. Adequate time should be allocated more to Biology teaching, and there should be separated time for Biology practical.
4. Teachers should be well and promptly paid to encourage them in utilizing science process skills.

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