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EFFECT OF PRACTICAL ACTIVITIES ON STUDENTS' SCIENCE PROCESS SKILL ACQUISITION IN FEDERAL CAPITAL TERRITORY, ABUJA NIGERIA

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Abstract

This study investigated the effect of practical activities on students' science process skill acquisition. Two research questions and two null hypotheses, tested at 0.05 level of significance, guided the study. The study was carried out in Federal Capital Territory (FCT), Abuja. The treatment consisted of teaching a selected biology concept "Cell and its environment" to an experimental group using practical activities and a control group using the teacher demonstration method. The study adopted a quasi-experimental design; specifically, the non-equivalent control group design. The population for the study comprised 7,158 senior secondary one (SS1) biology students in FCT, Abuja. The Sampling was Multistage involving purposive and simple random sampling techniques, to draw 131 SS1 biology students from two co-educational public senior secondary schools in the area. The instrument, Science Process Skill Acquisition Test (SPSAT), was used for data collection. The reliability coefficient of SPSAT was established using Kuder Richardson formula-KR20 was found to be 0.74. The data collected were analyzed using mean and standard deviation to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The result of the study revealed that practical activities had significant effect on students' Science Process Skills Acquisition scores with ($F=15.175$, $p=0.000<0.05$) in favour of practical activity group when taught cell and its environment. The result also revealed that gender has no significant effect on students' Science Process Skills acquisition scores with ($F=0.086$, $p=0.770>\alpha = 0.05$) when students were taught cell and its environment using practical activities. In line with the findings of the study, it was recommended, among others, that Biology teachers should be encouraged to adopt practical activities in teaching Biology concepts in order to promote science process skill acquisition necessary for enhancing 21st century skills. Also, the curriculum planners should incorporate more practical activities in Biology curriculum in order to promote students' interest and achievement in Biology.

Keywords: Practical Activities, Science process skill acquisition, Classification, Prediction, Inference, Manipulative skills.

Introduction

Science is a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe. Science is receiving much emphasis in education because of its significance and relevance to life and society. According to Enaiyeju and Tanko (2012)

educational systems of the world are emphasizing science and technology education because of its significance in technological advancement which is invariably tied to national development. The Federal Government of Nigeria has, in order to fully realize the goal of education in Nigeria, stated in the National Policy on Education that special provisions and incentive shall be made for the study of the sciences at each level of the education system (Federal Republic of Nigeria (FRN), 2014). According to Agbo, Aminu and Mukulu (2016) there could be no real development technologically without a corresponding development in science, of which Biology is one.

Biology is a branch of science that deals with the study of living things. It is the science subject offered in all the senior secondary schools in Nigeria, that attracts both science inclined and art based students. The importance of biology education in Nigeria's educational system and national technological development is unquestionable. The major objective of Biology Education at the senior secondary school level is that the students at the end of their study acquire adequate laboratory and field skills as well as be useful citizens within the society. However, in order to fully achieve the objectives of science education, government has taken meaningful and consistent measures regarding science education in general and Biology Education in particular. Some of these measures are, special interventions like building of science laboratories in schools, giving priority to the training of science and technology teachers, supplying of science textbooks, equipment / materials organizing workshops, conferences and seminars, projects such as step - B project (to improve federal post-basic science and technology education and to support the research subsector in Nigeria), Schlumberger Excellent in Education Development (SEED), education programs to ignite a passion for science in youth within the ages of 10 to 18 years, Strengthening Mathematics and Science Education (SMASE) and Exxon Mobil Education initiatives (to increase secondary school students' interest and tertiary students' access to science). In spite of all these, there is still persistent poor performance of students in biology in FCT. Although attempts have been made to improve students' achievement and the quality of Biology teaching and learning in schools, students' performance in FCT, Abuja is consistently low.

The information from statistics department of Education Resource Centre (ERC) Federal Capital Territory Abuja (2019) revealed the performance for Biology WAEC results of students, 42.44% for 2016, 40.95% for 2017

and 48.99% for 2018. This is below average. In view of this, the (WASSCE) Chief Examiners report for 2010, 2011 and 2012 listed some of the weaknesses that were observed generally in the scripts of the candidates responsible for their poor performance amongst which are: lack of practical skills; Production of poor diagram as a result of using blunt pencils with broken lines; Freehand guidelines and non-horizontal label; Not giving tills of diagrams; Poor spelling of labels and techniques; Not conforming to size specification of diagrams. This is in line with the WASSCE Chief Examiner's report of 2015 and 2017. If these factors identified as responsible for students' poor achievement in biology are to be addressed, students will achieve highly in Biology.

However, several other reasons had been identified for the poor performance of students in biology among which are the poor teaching method adopted by most biology teachers (Nwagbo & Chukelu, 2011 & Chukelu, 2021). Also failure by most biology teachers to teach the practical aspects of biology (Okoli 2011; Hafsatu, Akami & Abubakar 2016; Agbo, Aminu & Mukulu, 2016; Alimi, Mohammed & Nafisatu, 2016). According to Etuk (2011), continuous use of the ineffective teaching methods to teach in secondary schools reduces the ability of students to grasp relevant concepts than when exposed to lessons involving hands on experience. The above reports also indicated that biology teachers do not use appropriate teaching methods, they rather prefer the conventional method, which may not enhance students' achievement. These teachers shy away from innovative activity-oriented teaching methods (such as inquiry method, discovery method, concept mapping, investigative laboratory approach and cooperative learning method). In this study, the relative efficacy of practical activities and teacher demonstration method on students' science process skill acquisition was investigated.

The teacher demonstration method is a teacher- centered method of teaching designed to illustrate certain phenomena. According to Coffey (2015), the teacher demonstration method of teaching shows learners how to do a task using sequential instructions with the end goal of having learners perform the tasks independently. Teachers do not try for more experiments than those given in the prescribed text book; it is teacher dominated and proves to be one of the prevalent methods for teaching science to students of secondary schools. There is therefore, need for a paradigm shift from the old teaching of teacher know-all to the 21st century learner-centered method. For a meaningful science education and for science to serve the needs of development in Nigeria,

especially in Federal Capital Territory, the implementation of practical work (activity-based learning) in the school science is necessary. The practical activities that are involved in sciences distinguish it from other disciplines.

Practical activities refer to a learning approach that engages the students in hands-on, minds- on activities; it makes the task of a teacher (teaching) more real to the students as opposed to abstract or theoretical presentation of facts and concepts. According to Hafsatu, Akami and Abubakar (2016), practical activities involve those exercises that will enable students develop the processes of observing, classifying, identifying, measuring, hypothesizing, interpreting data, recording, controlling variables, predicting, inference using differentiated instructions. The Federal Government of Nigeria stated in the National Policy on Education that, modern science teaching requires that there should be less talk on the part of the teachers and more activities on the part of the students. That is, teaching shall be practical and activity based (FRN, 2014). Emenyi (2016) is of the opinion that most biology teachers shy away from conducting practical on biology topics because of lack of requisite practical skills/techniques by teachers or due to lack of equipment or facilities in the laboratories. Uzoechi (2009) observed that the poor performance of students in Biology examinations is as a result of the failure of most Biology teachers to teach the practical aspect of Biology that many Biology teachers shy away from practical classes because they lack the competence, skills and creativity to organize practical classes. Uzoechi therefore, emphasized that Biology teachers of 21st century should as a matter of urgency make a paradigm shift from being instructors, facts givers and verifiers to facilitators and stimulators. However, Biology being an experimental subject demands the use of science process skills which includes; observation, identification, communication, inference, predicting, collecting and interpreting data, reasoning and critical thinking among others (Ajewole, 2011).

According to Anaekwe (2010), science process skills refer to those basic tools, tactics or techniques which are utilized in the study of science. The acquisition of science process skills helps the child to explore his environment and solve certain scientific problems; it enhances students' achievement of science subjects. Agu and Samuel (2018) emphasized that if children are properly introduced early to science through process skill acquisition, they will find the skills useful throughout their lives. According to Safaah, Muslim and Liliawati (2017), science process skill acquisition have added value to students' abilities to explore their

environment, answer questions and solve challenging problems individually due to its' applicability. Educators and workforce experts alike emphasized that our children need improved 21st century skills. Without these skills they will not be able to participate in the global economy. They won't be adequately prepared for college and work. 21st century skills refer to the knowledge, life skills, career skills, habits, and traits that are critically important to students' success in today's world, particularly as students move on to college, the workforce, and adult life.

The search for a more effective approach for the teaching and learning of biology that will enhance the acquisition of science process skills has persisted over the years. Realizing the importance of science process skills in solution to scientific problems the Federal Government among other things, states as one of the national goals of education in Nigeria; that education should aim at helping the child in the acquisition of appropriate skills, abilities and competences, both mental and physical as equipment for the individual to live in and contribute to the development of the society (Federal Republic of Nigeria (FRN, 2014). To train students to become practicing scientists therefore, they need to learn and practice science process skills. This is because, the acquisitions of science process skills are the bases for scientific inquiry and development of intellectual skills and attitudes that are needed to learn concepts (Nwagbo & Chukelu, 2011). These intellectual skills and competences are developed through appropriate science teaching and learning. The science teacher's role is implicated since he/she is the major driver in the educational system.

The American Association for the Advancement of Science classified the process skills into basic and integrated process skills. The basic process skills are observing, classifying, measuring, inferring, predicting, quantification, relationships and communicating while the integrated skills are interpreting data, identifying and controlling variables, defining operationally, formulating and testing hypotheses and experimenting. Basic process skills are vital for science learning and concept formation at the primary and Junior Secondary Schools levels. Integrated (higher) skills are skills used in combination of the basic skills at senior secondary school level of education. It requires more of critical thinking. They are also used in the institutions of higher learning in the area of chemistry, physics, biology, integrated science. Since the American Association for the Advancement of Science published its list of science process skills, the science educators and curriculum experts have modified them by either expanding or condensing them to suit their special needs or expectations. Sequel to this, the Nigerian

Educational Research and Development Council (NERDC) adopted and modified the Science Education Programme for Africa (SEPA) schemes as basis for building Nigerian school science curriculum with a list of fifteen (15) science process skills derived from the scheme (Nwagbo & Chukelu, 2011).

In view of this, the Nigerian Educational Research Council (NERDC), in 1990 modified and came up with the following fifteen items as science process skills:-

i. Observation
ii. Classification
iii. Communicating
iv. Counting Number Relationship
v. Measurement
vi. Raising Questions
vii. Prediction
viii. Inference
ix. Formulating Hypothesis
x. Making Operational definitions
xi. Controlling or manipulating variables
xii. Experimentation
xiii. Formulating Mental Models
xiv. Interpreting Data
xv. Manipulative skills.

Acquisition of these skills in secondary schools has implications for the science teacher whose responsibility it is to teach effectively and meaningfully, for students to appreciate and further develop the 21st century skills.

Statement of the Problem

Several reasons had been identified for the poor performance of students in biology among which are the poor teaching method adopted by most biology teachers; failure by most biology teachers to teach the practical aspects of biology. However, studies have tried to identify the causes of students' poor performance as well as poor science process skill acquisition in Biology. Research reports attributed this to a number of factors of which the major factor is the teachers' method of teaching. The WAEC Chief Examiner's Report also confirmed this problem as could be observed in the background of the study. Teaching and learning of Biology in Nigeria especially in FCT are largely not satisfactory as could be observed in the background of this study. This therefore calls for reconsideration of instructional methods and strategies used in teaching Biology in senior secondary schools, ways to improve all these are the focus of research of which this study is one. Therefore, the problem of this study posed as a question is: what are the effects of practical activities on students' science process skill acquisition in cell and its environment in Abuja? The present study sought plausible answers to this question.

Research Questions

The following research questions guided the study:

1. What are the mean scores on science process skill acquisition test of students, taught cell and its

environment using practical activities and those taught using teacher demonstration method?

2. What are the mean scores on science process skill acquisition test of male and female students taught cell and its' environment using practical activities?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance

H_{01}: There is no significant difference in the mean scores on science process skill acquisition test of students taught cell and its environment using practical activities and those taught using teacher demonstration method.

H_{02}: There is no significant difference in the mean scores on science process skill acquisition test of male and students taught cell and its environment using practical activities.

Method

The Design of this study was quasi-experimental, specifically, the non-equivalent control Group design. The population for this study comprised all Senior Secondary One (SS1) Biology students in the Federal Capital Territory (FCT), Abuja. The sampling was done in stages; therefore multistage sampling technique was employed to draw the sample of 131 Senior Secondary one (SS1) students for this study. Firstly, purposive sampling technique was used to draw one Area Council from the six (6) area councils of FCT Abuja from which 2 schools were selected for experimental and control group respectively. The instrument used for data collection was Science Process Skill Acquisition Test (SPSAT) developed by the researcher based on the topic: cell and its' environment from SS1 Biology curriculum. The validity of SPSAT was established by the opinions of three experts. The reliability of SPSAT was determined using Kuder Richardson formula 20 (KR_{20}) and the reliability coefficient of 0.74 was obtained.

At the beginning of the experiment, the research assistants administered the pre-test on SPSAT to both groups (Experimental and Control Groups). The treatment was done twice a week using one double period of 80 minutes and one single period of 40 minutes. After the treatment one week later, the post SPSAT (after reshuffling) was administered to the subjects in the two groups. Data collected from both pre-test and post-test were used to answer the research questions and test the hypotheses stated for the study. Mean and standard deviation were used to answer the research questions while analysis of covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

Result

The results of the data analysis are presented in the tables 1- 4 in line with the research questions and hypotheses.

Research Question 1

What are the mean scores on science process skill acquisition test of students taught cell and its' environment using practical activities and those taught using teacher demonstration method?

Table 1: Mean and Standard Deviation for Practical Activities and Teacher Demonstration Groups

		Pre-test		**Post-test**		
Group	N	**Mean**	**SD**	**Mean**	**SD**	Mean Gain
Practical Activities	50	21.64	4.90	36.90	7.79	15.26
Teacher Demonstration	81	20.84	5.49	32.91	6.57	12.07

Table 1 shows the mean scores on science process skill acquisition test of students who were taught cell and its' environment using practical activities and those taught using teacher demonstration method. It shows that students who were taught cell and its' environment using practical activities had mean science process skill scores of 36.90 with a standard deviation of 7.79 at the post test while those who were taught using teacher demonstration method had post- test mean science process skill score of 32.91 with a standard deviation of 6.57. Mean gain scores of 15.26 and 12.07 shows that the practical activity group acquired more process skill than the teacher demonstration method group.

H_{01}: There is no significant difference in the mean scores on science process skill acquisition test of students taught cell and its environment using the practical activities and those taught using teacher demonstration method.

Table 2 ANCOVA Result on Students' Mean Science Process Skill Acquisition Scores of Practical Activities and Teacher Demonstration Groups

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4327.728[a]	2	2163.864	107.169	.000
Intercept	1237.759	1	1237.759	61.302	.000
Pretestps	3836.424	1	3836.424	190.005	.000
Group	306.406	1	306.406	15.175	.000
Error	2584.471	128	20.191		
Total	162249.000	131			
Corrected Total	6912.198	130			

Table 2 reveals a significant difference in science process skill acquisition of students taught cell and its environment using practical activities and those taught using teacher demonstration method. F = ratio of 15.175 was obtained with associated exact probability value of 0.000. Since the associated probability (0.000) is less than 0.05 set as level of significance, the null hypothesis was rejected. The result implies that practical activities enhance students' acquisition of science process skill in cell and its environment than teacher demonstration method.

Research Question 2

What are the mean scores on science process skill acquisition test of male and female students taught cell and its' environment using practical activities?

Table 3: Mean and Standard Deviation for Practical Activity Group across Sex

	Gender		Pre-test		Post-test		
Group		N	**Mean**	**SD**	**Mean**	**SD**	Mean Gain
Practical Activities	Male	27	22.89	4.89	38.37	8.07	15.48
	Female	23	20.17	4.58	35.17	7.24	15.00

Table 3 reveals that male students in the practical activity group had mean scores on science process skill acquisition test of 38.37 with a standard deviation of 8.07 at the post test while their female counterparts had mean scores on science process skill acquisition test of 35.17 with a standard deviation of 7.24. Mean gain scores of 15.48 and 15.00 for male and female students respectively indicate that male students acquired more science process skill than their female counterparts in the practical activity group when taught cell and its' environment using practical activities.

H_{02}: There is no significant difference in the mean scores on science process skill acquisition test of male and female students taught cell and its environment using practical activities.

The test for this hypothesis is provided in Table 4

Table 4: Results of Analysis of Covariance on Students' Science Process Skill Acquisition Test Using SPSAT Based on Gender and Practical Activities

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2019.767[a]	2	1009.884	49.819	.000
Intercept	154.556	1	154.556	7.625	.008
Pretestps	1892.868	1	1892.868	93.379	.000
Gender Exp	1.753	1	1.753	.086	.770
Error	952.733	47	20.271		
Total	71053.000	50			
Corrected Total	2972.500	49			

Table 4 shows an F = Ratio 0.086 with associated exact probability value of 0.770 which is greater than the bench mark probability value of 0.05. The null hypothesis was not rejected because there was no significant difference in the mean scores on science process skill acquisition test of male and female students taught cell and its environment using practical activities.

Discussion of Findings

The findings of this study revealed that practical activities affected students' acquisition of science process skill more positively than the teacher demonstration method. This implies that practical activities was more positive and effective in fostering and facilitating students' acquisition of science process skill in cell and its environment than the teacher demonstration method. The findings of this study is in agreement with that of Nwagbo and Chukelu (2011), Lawal and Usman (2018), Ajayi and Osoko (2013), Chukelu (2021) who reported that practical activities enhances biology students' acquisition of science process skills.

The practical activities expose the practical and applicability of biology in concrete situation, making the concept "cell and its environment" easy and faster to understand thereby resulting in higher science process skill acquisition. This means that instructional method helped the students to acquire the necessary science process skills better. The active involvement of students in practical activity group (Experimental group) therefore, may have given rise to efficient and effective learning which contributed to the

significant effect in the students' acquisition of science process skills.

The findings of this study showed that there is statistically no significant difference in the acquisition of science process skills among male and female students taught cell and its environment using practical activities. This result agrees with the findings of Nwagbo and Chukelu (2011), Jack (2013), Usman, Ahmadand Tijjani (2014), Etiubon Udoh (2017) and (Chukelu, 2021) that reported that there is no significant difference in the mean science process skills acquisition scores of male and female biology students taught using the practical activities. This is contrary to the findings of Ejimonu (2018) who discovered that male students acquired science process skills more than the female students when taught using computer simulated experiment.

These findings are in line with the popular saying that what a man can do a woman can also do it. The result is of no significant difference in terms of gender and acquisition of science process skills. This could be as a result of the instructional method used by the researcher who believed that differences in the performance of male and female students could be eliminated by using good methods, materials and appropriate strategies. Based on this therefore, practical activities had comparatively equal effects irrespective of gender of the students. This finding gives a ray of hope that breaks gender barriers in biology and science in general.

Conclusion

The results of this study provided the empirical evidence that the utilization of practical activities enhances students' science process skill acquisition in cell and its environment. The results also revealed that gender has no significant effect on students' science process skill acquisition when taught cell and its environment using practical activities. These findings imply that the use of ineffective instructional strategies by biology teachers in biology delivery might have contributed to the consistent poor science process skill acquisition of students in biology. The implications of this study therefore hinges on the development of more effective, students centered and activity oriented strategies in teaching of biological concepts in senior secondary schools.

Recommendations

Based on the findings, the following recommendations were made:

i. Biology teachers should adopt practical activities and instructional resources that will enhance students' acquisition of science process skill and promote active learning among students.

ii. Curriculum planners should incorporate practical activities in biology curriculum, because this will help to promote students' acquisition of science process skills.

iii. Biology teachers should make biology teaching and learning gender friendly by the utilization of practical activities that will promote social interaction and learning by doing.

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