International Journal of Education & Social Sciences (IJESS)
ISSN: 2754-2793
Vol. 2 Issue 8, August - 2021

Effect Of Teaching Methods On The Acquisition Of Science Process Skills (SPS) By Biology Students In Port Harcourt Metropolis, Rivers State

WOKOCHA GIDEON A.
DEPARTMENT OF INTEGRATED SCIENCE
IGNATIUS AJURU UNIVERSITY OF EDUCATION PORT HARCOURT

***Abstract*—This study borders on the effect of teaching methods on the acquisition of Science Process Skills (SPS) by Biology students in Port Harcourt Metropolis. The effect of Demonstration method was weighed against Inquiry method in developing SPS in Biology students. The quasi-experimental design was employed in the study. The sample comprised of one hundred and eighty-two (182) SS1 students of four (4) intact classes. The SS 1 classes were randomly assigned to two experimental groups – 1 and 2. The study covered two topics namely: Cell and its Environment, and Classes of food and Food test. Questionnaire for Acquisition of Science Process Skills (QASPS) was used as instrument the subjects were Pretested, treated and post tested was estimated pretested, treated and post tested. The reliability coefficient of the instrument was estimated using Pearson Product Moment formula and was equal to 0.82. Three Research questions guided the study. The data was analyzed using mean and standard deviation. The results revealed that Demonstration method provoked the acquisition of SPS in Biology students than Inquiry method. It was therefore recommended that, teachers should endeavor to use Demonstration method in teaching practical- related topics in Biology, especially in the face of limited teaching/ practical resources. Science teachers were therefore encouraged to expand their knowledge of science process skills to enable them engage students with these skills in their lessons.**

Keywords—Effect, Demonstration, Inquiry, method, Teaching, Science Process Skills, Biology.

Introduction

Science is a systematic enterprise that builds and organizes knowledge in the form of testable explanations and prediction about the universe (Harper, 2014). This therefore means that scientific observations or discoveries are testable and predictable. In other words, to be able to define the problems around us and make meaning of situations, science process skills are of utmost importance. It is noteworthy that scientists use their creativity in every stage of scientific research. Science as a practical subject provides students with an opportunity to interact with science process skill that can be used to solve problems in everyday life and contribute to national developments.

Science process skills are activities, which students carry out in scientific investigations to enable the acquisition of scientific knowledge and skills. The importance of teaching science process skills is to allow students to describe objects and events, ask questions, construct explanation, test those explanations against current scientific knowledge and communicate their ideas to others (Opara, 2011). Science Process Skills are the underlying skills and premises which govern the scientific method. In other words, Science Process Skills are used to gather information about nature. Science Process Skills (SPS) include skills that every individual could use in each step of his/her daily life by being scientifically literate and increasing the quality and standard of life by comprehending the nature of science. Therefore, these skills affect the personal, social and global lives of individuals. The SPS(s) are necessary tool to produce and use scientific information, to perform scientific research and to solve problems. Little wonder, academia in the field of education often lay great emphasis on these skills. Science process skills are employed in observing, analyzing, hypothesizing, experimenting, concluding, generalizing, etc, Hill (2011). According to Padilla (2011), Science Process Skills are a set of broadly transferable abilities appropriate to science discipline and reflective of what scientists do.

Biology is the natural science that studies life (living organisms), including their physical structure, chemical processes, molecular interactions, physiological mechanism, development and evolution. In fact, Biology is the center of science; hence, it is difficult to properly teach Biology if the learners do not have these necessary skills. Therefore, teachers are required to develop and promote tasks that foster the acquisition of science process skills in students. These skills are likely to enhance the discovery and learning of new biological knowledge. It also helps student in developing important skill necessary in solving problems in the society.

The interaction with process-skills is evident throughout the student's daily lives and also in science lessons, when they engage in practical activities. The activities carried out by the students under this framework will enable them to practice and utilize process-skills. This set of intellectual abilities is referred to as science process skills, which scientist use (Bentley, Ebert & Ebert, 2007). Besides promoting the acquisition of the process-skills, practical work in science facilitate the necessary learning environments such as activities participation, integration of life and meaningful leaning. (Karamustafaoglu, 2011). However, despite the usefulness of the scientific knowledge acquired through science skills in solving societal problems, some teachers still follow the regular/conventional method (lecture) in teaching science subjects like biology.

Being able to conduct scientific inquiry to address a problem of personal and social importance in and out of school is accepted as an integral part of science education in many curriculum documents (Wu and Wu, 2011). Students need Science Process Skills as they use scientific reasoning and critical thinking to develop their understanding of science (Gilies and Nicholas, 2014). Students need to develop SPS to learn science with understanding. Acquisition of SPS is a great influence in developing mental processes such as higher order critical thinking and decision making as well (Tseng, Tuan and Chin, 2013).

Realizing the importance of SPS in helping students learn science, researchers have argued that students need to acquire these skill early on, from primary school onwards (Nevin and Mustafa, 2010) Consequently, SPS(s) are important components in the science curriculum in many countries. In Australia, for example, building science inquiry skills is one of the major components in the national science curriculum from primary to secondary education (ACARA, 2012). Competence in SPS should be viewed as a means that will help students to acquire knowledge and understan how the knowledge is obtained (Bati, Erturk and Kaplan, 2010). The teaching of SPS is considered to take place in science laboratories. Teachers have major roles in students' acquisition of SPS hence, they should attend seminars, courses that will equip them and build their knowledge of SPS in order to help students acquire these skills.

Statement of the Problem

One of the most important goals of schooling is to teach students to think. Science process skills are among the most frequently used thinking skills (Ayodgdu, et al., 2012). However, Prajoko et al, (2016) revealed in a study that student's acquisition of these skills is low. Subiantoro (2010) stated that through practicum, students have the opportunity to develop and apply the science process skills. The facing obstacle however, is the lack of laboratory equipment and space to support practical practicum facilities. Local materials are materials or equipment that are readily found in everyday life according to the person's location (Gustina, 2012), Reuse of plastic bottles can also be used as a local material for simple microscope (Tungall, 2011). According to Klarmustagaoglu (2011), the students' science process skills thrive in learning using Diagram models.

The interaction with process-skills is evident throughout the students' daily lives and also in science lessons, when they engage in practical activities. The activities carried out by the students under this framework will enable them to practice and utilize process-skills. This set of intellectual abilities is referred to as science process skills, which scientists use (Bentley, Ebert & Ebert, 2007). Besides promoting the acquisition of the process-skills, practical work in science facilitate the necessary learning environments such as active participation, integration of life and meaningful learning. (Karamustafaoglu, 2011). However, despite the usefulness of the scientific knowledge acquired through science skills in solving societal problems, some teachers still follow the regular/conventional method (lecture) in teaching science subjects like biology.

Students who could not sufficiently acquire SPS at desired levels cannot comprehend the world or establish necessary connections. For this reasons, teachers should develop their students SPS, content knowledge and questioning skills which are major factors for an efficient science teaching in primary and secondary schools (Miles, 2010). This is because the fact that having SPS and contents knowledge is highly important for the resolution of a problem. In other words, teachers should have the required knowledge, understanding and materials to teach and inculcate science process skills in their students, (Miles, 2010). To do this they need to adopt relevant teaching methodologies and pedagogical principles. Certain teaching methods/strategies are more adequate in developing SPS in learners than others. Hence this study was undertaken to compare the Demonstration and Inquiry methods, which of them promote the acquisition of SPS more, in Biology students?

Purpose of the Study

The main purpose of the study was to determine the effect of teaching methods on the acquisition of Science Process Skills (SPS) in Biology students in Port Harcout metropolis, Rivers State, Nigeria. Specifically, the study sought to determine:

1. The effect of Demonstration and Inquiry methods on the acquisition of SPS in Biology students.
2. The effect of Demonstration and Inquiry methods on the acquisition of SPS in male and female Biology students.
3. The effect of Demonstration and Inquiry methods on the acquisition of SPS in Biology students of different age range.

Research Questions

The following research questions guided the study:

1. What is the effect of Demonstration and Inquiry methods on the acquisition of SPS in Biology students?
2. What is the effect of Demonstration and Inquiry methods on the acquisition of SPS in male and female Biology students?
3. What is the effect of Demonstration and Inquiry methods on the acquisition of SPS in Biology students of different age range?

Research Methodology

The study adopted the quasi-experimental research design. This design was adopted in order to establish a cause – and- effect relationship that exist, if any, between the independent and dependent variables. This allows for pretest, treatment and posttest of the subject, (Wiersma and Jurs, 2005; Wali, 2002).

The population for the study consisted of all Biology students in SS 1 class in Port Harcourt metropolis. The sample consisted of 182 SS1 students drawn from two purposively selected schools. In Port Harcourt metropolis consists of Port Harcourt and Obio/Akpor Local Government. One school per Local Government area was randomly chosen. The two schools were located far apart from each other. Intact classes were used for the study. The schools were randomly assigned to each experimental group 1 and 2. Experimental group 1 was treated using Demonstration, while experimental group 2 was treated using Inquiry methods.

Administration of Instrument

The researcher went to the sampled schools to brief the principals and seek his permission, and also discussed with the Biology teachers who served as research assistants on the nature and purpose of the study. The researchers developed the lesson plans. Two-day induction course was also offered to the Biology teachers who administered treatment to the subjects in the experimental groups. The study was restricted to the study of the following SPS; observation, measurement, classification, controlling variables, experimentation and inference.

Table 1: **Number of Schools and Students that participated in each group**

Sch	Experimental Group 1			Experimental Group 2			Grand Total
	Male	Female	Total	Male	Female	Total	
A	19	27	46	22	26	48	**94**
B	23	24	47	22	19	41	**88**
Total	**42**	**51**	**93**	**44**	**45**	**89**	**182**

A total of 182 SS 1 students were selected as sample for the study. Two schools, A and B were used. Four intact classes were randomly chosen from two schools. Two classes of 46 and 48, respectively, were involved making a total of 94 students from school A. On the other hand, another two classes of 47 and 41 students, summing up to 88 students made up the respondents from school B. in each school one class was designated as Experimental group 1 (Exp 1) and the other or Experimental group 2 (Exp 2). Exp 1 consisted of 93 respondents – 42 males and 51 females. Exp 2 consisted of 89 subjects – 44 and 45 females. While Demonstration method was employed for treating Exp 1, Inquiry was used for Exp 2.

SS 1 Students' age were grouped into three categories; viz: 12-14, 15-17, and 18-20 years as shown below.

Table 2: **Sample showing Age range**

Sch	Age Range	Experimental Group 1			Experimental Group 2			Grand Total
		Male	Female	Total	Male	Female	Total	
A		**46**			**48**			
	12-14	5	4	9	5	4	9	**18**
	15-17	11	9	20	10	14	24	**44**
	18-20	3	14	17	7	8	15	**32**
B		**47**			**41**			
	12-14	6	6	12	2	3	5	**17**
	15-17	13	11	24	14	7	21	**45**
	18-20	4	7	11	6	9	15	**26**
Total		**42**	**51**	**93**	**44**	**45**	**89**	**182**

The two experimental groups received treatment conducted by the Biology teachers (who served as research Assistants), for a period of two weeks. Four contact periods were organized, two per week. Two topics were taught using both Demonstration and Inquiry methods of teaching. Experimental group 1 was taught using Demonstration, while group 2 was taught using Inquiry methods. The two topics were Cell and environment, and Classes of food and food tests.

Questionnaire for Acquisition of Science Process Skills (QASPS) was the main instrument used to

gather data for the study. The instrument was validated by two experts; one from the Department of Curriculum & Instructional Technology and another from Department of Science Education, and later its Reliability was established to be 0.82, using test – retest method. It was presented to the subjects before treatment to respond to. The information generated was used for pretest. After the instructional intervention (treatment), QASPS was also presented to the subjects and data generated used for posttest. Data were analyzed by descriptive and inferential statistics (ANOVA).

Result Presentation and Analysis

The result of the study were presented and analyzed below:

Research Question 1: What is the effect of Demonstration and Inquiry Methods on acquisition of SPS in Biology Student?

Table 3: **Mean Scores of Demonstration and Inquiry Methods for acquisitions of SPS in Biology students.**

Group	N	Mean	Pre-Test Std. Deviation	Mean	Post-Test Std. Deviation
Experimental Group 1	**93**	43.00	9.06	58.77	13.69
Experimental Group 2	**89**	42.60	7.52	51.59	11.19
Total	**182**				

Results showed that the Exp group 1 recorded a higher posttest mean score of 58.77 and standard deviation of 13.69, while Exp Group 2 has a posttest mean score of 51.59 and a standard deviation of 11.19. This meant that Exp 1 performed better than Exp 2. This implied that, Demonstration method promotes in students, the acquisition of the 6 SPS under investigation that Inquiry method.

Research Question 2: What is the effect of Demonstration and Inquiry Methods on the acquisition of SPS in male and female Biology Student?

Table 4: **Mean Scores of Demonstration and Inquiry Methods for acquisition of SPS in male and female Biology Students**

Group	N N	Mean	Pre-Test Std. Deviation	Mean	Post-Test Std. Deviation
Experimental Group 1	**93**	43.00	9.06	58.77	13.69
Male	42	19.62	4.00	28.75	6.64
Female	51	23.38	5.06	30.02	7.05
Experimental Group 2	**89**	42.60	7.52	51.59	11.19
Male	44	20.24	2.76	26.10	5.72
Female	45	22.36	4.76	25.49	5.47
Total	**182**				

From the results shown above, the mean posttest score of male students in Exp 1 was 28.75 and standard deviation of 6.64, while female was 30.02 and standard deviation of 7.05. Here, the female respondents/students acquired SPS better than their male counterparts.

Conversely, in Exp 2, the male has as a higher mean posttest score of 26.10 and standard deviation of 5.72, while the female has 25.49 and 5.47, for mean posttest score and standard deviation respectively. The male imbibed the skills better than females in this group.

Research Question 3: What is the effect of Demonstration and Inquiry Methods on the acquisition of SPS in Biology Students of Different Age range?

Table 5: **Mean Scores of Demonstration and Inquiry Methods for acquisition of SPS in Biology Students of different age range**

Group	N	Mean	Pre-Test Std. Deviation	Mean	Post-Test Std. Deviation
Experimental Group 1	**93**	43.00	9.06	58.77	13.69
Age 12-14	21	10.14	2.62	14.43	3.02
15-17	44	13.64	2.83	18.26	4.63
18-20	28	19.22	3.61	26.08	6.04
Experimental Group 2	**89**	42.60	7.52	51.59	11.19
Age: 12-14	14	10.41	1.81	15.17	3.59
15-17	45	14.41	2.01	15.36	3.78
18-20	30	17.78	3.70	21.06	3.82
Total	**182**				

Based on age distribution, age range of 18-20 years, in Exp 1, with a posttest mean score of 26.08 and standard deviation of 6.04 better acquired SPS than all other age ranges. This was followed by the same age range of Exp 2. It was observed that, age range of 15-17 and 18-20 later followed in that order. It appeared that, the older the learner the better skills they could acquire.

The high scores attained by respondents in the posttest (the gain in mean scores between posttest and pre-test), was due to treatment. This was an indication that the treatment had a greater effect on the acquisition of SPS in subjects.

Discussion

After two weeks of science process skills-based instructions, the researcher found that the students in the Experimental Group 1, who were taught using Demonstration method of teaching, acquired significantly, more science process skills than those students in Experimental group 2, who were taught using Inquiry method. It was observed that students in Exp group 1 did better when exposed to activities that need them to observe, measure, classify, control variables, experiment, and infer than their counterparts in Exp group 2, during the investigation activities.

Studies carried out by Khan et al. (2011); Opara (2011); Wanibugu & Changeiywo (2008) and Alexander (2001) showed that inquiry-based teaching approaches enhanced student's achievement in science subjects, which are in agreement with the findings of this study. Mandor (2002) indicated that active participation of the students in science lessons contributed to effective learning. Aktamis and Ergin (2008) earned out a study to investigate the effect of science process skills with elementary school students in Buc'a. District, Turkey, on scientific creativeness, academic achievement, and attitude towards science. The results were consistent with that of this study that science process skills teaching approach is most effective in enhancing learning of Biology than the regular/conventional teaching approach. Feyzioglu (2009) carried out a study at the university level and the outcome indicated a positive relationship between science process skills and university students' achievement. The study supports the fact that academic achievement of students in Biology could be greatly improved if they are exposed to science process skills teaching approach. However, it is important to note that the success of the approach may depend on the competence, enthusiasm and confidence of the Biology teacher and the ability of the students in making use of the opportunities provided.

Conclusion

Students need to reach many different types of information and Science Process Skills will help them get this information. This is because SPS engage students in hands-on-activities that make them very active. However, the skills obtained by students are merely memorizing skills.

This is in line with Bobadilla et al., (2016) who stated that at the moment, learning tends to be based on memorizing the theories without utilizing students' experiences. In contrast, the most important point in learning is improving wide range of skills that can be used to solve problems in the real-life situation, such as Science Process Skills (SPS). Learning models applied by teachers in secondary schools, both junior and senior high schools are 70% lecturing models (transfer of knowledge), and the rest are discussion, demonstration and experiment models with 10% for each model. (Crook et al., 2015). It is important that teachers should have sufficient Science Process Skills and teach these skills to students efficiently using appropriate methods, (Miles, 2010).

The study therefore revealed that there is significant difference in levels of acquisition of science process skills by students when taught with different teaching methods. For this study, Demonstration

method promotes acquisition of the six skills under investigation than Inquiry method.

Recommendations

The following recommendations were made:

1. The teachers should endeavour to use Demonstration method in teaching practical-related topics in Biology, especially in the face of limited teaching/practical resources.
2. Science teachers are encouraged to expand their knowledge of science process skills to enable them engage students with these sills in their lessons.
3. Training and retraining programmes should be organized periodically by the Government and private institutions to equip teachers on the appropriate utilization of Science Process Skills Teaching Approach (SPSTA).
1. Biology teachers are encouraged to use appropriate teaching methods in order to inculcate science process skills in students to enhance their overall academic performance in Biology; they should constantly engage students in tasks that will enable them practice the Science Process Skills to sustain their interest in science.
2. The institution offering Teacher Education Programmes should emphasize the use of appropriate pedagogical strategies and structure their learning environments in manners that can increase interaction among the learners and enable active participation in the learning process.
3. The government should reinforce the need to establish and equip science laboratories in all secondary schools to encourage students' involvement in practical related activities. This is because almost all the laboratory, activities employ science process skills.
4. Biology teachers should ensure active participation of secondary school students by organizing frequent practical sessions; utilize and improvise laboratory materials for doing experiments and creating opportunity for students to share ideas as these activities will engage them effectively in the lesson.
5. Biology teachers should structure lessons to provide hands-on-activities, with a hope to stimulate students' understanding of science as a process of discovering and acquiring scientific knowledge.

References

ACARA (2012). Australian Curriculum: *Science Sydney:* Australian Curriculum, *Assessment and Reporting Authority.*

AkiaiTiis, H. & Ergin O, (2008). The effect of scientific process skills education on students' scientific creativity, science attitudes and academic achievements. *Asia-Pacific Forum on Science Learning and Teaching,* 9(1), article 4.

Alexander, M. D. (2001). Inquiry-based methods of instruction in chemistry. *http://spacegranl nmsu.edu/NMSU/2QQl Id alesander.pdf.*

Aydogdu, B., Tatar, N., Yildiz-Feyzioglu, E. & Buldur, S. (2012). (Developing science process skills scale for elementary students) J. *Theoretical Educ. Sci.* 5(3); 292-311.

Basics of Research for the Health Profession, Retrieved June 6, 2018, @: www.pt.armsirong edu>3.4.depvarl.htm.

EBati, K., Erturk, G. & Kaplan, F. (2012). The awareness level of pre-school education teachers regarding science process skill. *Innovation and Creativity in Education,* 2(2), 1993-1999.

Bentley, M. L., Ebert E.S. & Ebert C. (2007). *Teaching constructivist science, K- 8: nurturing natural investigators in the standards-based classroom.* Crown Press-Sage publication Ltd. Company.

Bobadilla, C., Marina, Lorza, L. Ruben, Gonzalez, V., Eliseo, P. Gomez, S. & Fatima (2016). *International Journal on Advances in Education Research, 3(2)* 38.

Chabalengula, V.M. Mumba, F. & Mbewe (2012). How Preservice Teachers Understand and Perform Science Proess Skills. *Euroasia J. Math. Sci. Techno! .Educ*.8(3): 167-176

Crook. S.J. Sharma, M.D. & Wilson, R. (201 S). *Contemporary Issues in Technology and Teacher Education,* 15(2) 126.

Feyzioglu, B. (2009). An investigation of the relationship between science process skills with efficient laboratory use and science achievement in chemistry education. *Journal of Turkish Science Education, 6(3).*

Foley. B.J. & McPhee C. (2QQ&). *Students' attitudes towards science in classes using hands-or Textbook based curriculum*, America.

Gillies, R.M. & Nicholas, 1C (2014). How to support primary teachers' implementation of inquiry: Teachers' reflections on teaching cooperative inquiry-based science. *Research in science Education,* DOI10.1007/s11165-014-941'8-x.

Harper, (2014). Science Online Etymology Dictionary. Retrieved September 20, 2014.

Hill, A., (2011) *what is Science Process Skills*? Science Education. 56, 112-113

Hofstein, A. (2004). The laboratory in Chemistry Education: .0Thirty Years of Experience with developments. Implementation and Evaluation, Chemistry Education Research and Practice, 5, 247-264.

Hypothesize-Dictionary Definition: Vocabulary.com, Retrieved June 6, 2018, @: http//www/vocabulary.com>dictionary

Infer Meaning in the Cambridge English Dictionary, Retrieved June, 6 2018, @: http://dictionary.combridge.or>infer.

Karamustafaoglu, S. (2011). Improving the Science Process Skills Ability of Prospective Science Teachers Using I Diagrams. *Eurasian. I Phys. Chem. Educ.* 3(1): 26-38.

Karsli, F., Sahin, C. & Ayas, A. (2009). Determining Science Teachers' Ideas about the Science Process Skills: A Case Study. Procedia Social Behavioural Sci. 1:890-895. Doi:10.1016/j.sbspro.2009.01.158.

Lunette, V.N., Hofstein A. & Cloug M. (2007). Learning and teaching in the School science laboratory: An analysis of research, theory and practice. In N. Lederman and S. Abel (Eds.) Handbook of Research on Science Education (Pp. 393-441), Mahwah, NJ: Lawrence Erlbaum.

Mandor, A.K. (2002). Effects of Constructivist Model on Acquisition of Science Process Skills among Junior Secondary Students. Unpublished M.ED. Thesis. Department of Science Education, University of Nigeria, Nsuka.

Miles, E. (2010). In-service Elementary Teachers' Familiarity, Interest, Conceptual, Knowledge, and Performance on Science Process Skill. (Unpublished Master Thesis). Southern Illinois University Carbondale, U.S.A from ProQuest, UMI Dissertations Publishing (UMI No. 1482656).

Multlu. M. & Timiz, B.K. (2013). Science Process Skills of Students having Fild Dependent and Field Independent Cognitive Styles. Educ. Res. Rev. 8(11): 766-776.

Nevin, K.C. & Mustafa, S. (2010). An evaluation of Science process skills of the science teaching major procedia social and behavioural sciences, 9, 1592-1596.

Opera, J.A. (2011). Some considerations in achieving effective teaching and learning in science education. *Journal of Educational and social research, 1(4).*

Padilla. M.J. (2001). The science process skills. National Association for Research in Science Teaching Retrieved May 15, 2011.

Pongkun. T. (2015). Best Practice. Thai land Abstract.

Prajoko. S., Amin, M., Rohman, F. & Gipayana, M. (2016). *The profile and the understanding of science process skills. Indonesia: Surakarta Open University.*

Subiantoro, A.W. (2010). Pehtingnaya Praktikumdalam Pembelajaran IPA. Yogyakarta: UNY.

Tseng, C.H., Tauan, H.L. & Chin, C.C. (2013). How to help teachers develop inquiry teaching; Perspectives from experienced science teachers. *Research in Science Education, 43(2), 809-825.*

Tungall, N. (2011). Mikroskopdaribotol plastic. Retrieved from: http://sains.kompas.com/read/2011,10/08/23510669/mikroskop.dari.botol.plastik.

Wanbugu, P.W. & Changeiywo J. M. (2008). Effects of mastery learning approach on secondary school students' physics achievement.

Wiersma, W. & Jurs S.G. (2005). *Research methods in Education. An introduction, 8th edition, Boston; Pearson.*

Wu, H-K. & Wu, C-L. (2011). Exploring the development of fifth graders' practical epistemologies and explanation skills in inquiry-based learning classrooms. *Research in Science Education, 4 1(3), 309-340.*