The Impact of Laboratory Based Teaching Method on Secondary Schools Biology Students' Acquisition of Science Process Skills in Littoral Region of Cameroon

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Abstract
The study had as objective to investigate the impact of laboratory based teaching method on secondary schools biology students' acquisition of science process skills in Littoral Region of Cameroon. The design used for the study was Solomon Four Non-Equivalent Quasi Experimental Design. The target population of the study was made up of 20315 students of form three of forty one (41) Government Bilingual High Schools in Littoral Region who carry biology practical. A sample of four hundred and five (405) form three students was drawn from four Government Bilingual High Schools of three Divisions in Littoral Region through simple random and purposive random techniques. The instrument for data collection was Biology Science Process Skills Achievement Test formulated by the researcher and validated by some experts of test and measurement and secondary schools biology teachers. Kunder Richardson 20 (Kr-20) was used to determine the reliability coefficient. The reliability coefficient was 0.60 and 0.70 respectively for the test retest procedure and was considered favourable for the study. Data collected was analysed using mean, standard deviation and t-test to test the hypothesis stated at $P \leq .05$ level of significance. The results revealed that after the treatment; the experimental schools mean acquisition scores of science process skills were (9.37 to 18.64) and (17.70) for the pre-test and post- test and post-test only groups respectively These results were higher than the post-tests mean acquisition score of the mean acquisition score of science process acquisition skills of the control schools (8.25 to 10.19) and (16.21) pre-test and post-test and the post-test only respectively. Conclusively, based on the results, it was revealed that, laboratory based teaching method enhances the acquisition of the basic science process skills in secondary schools biology students more the conventional teaching method. It was recommended that laboratory based teaching method should be used by all biology teachers in secondary schools in the teaching of biology especially with those topics that requires practical activities to enhance the acquisition of science skills in secondary schools biology students.

Keywords: Laboratory Based Teaching Method, Conventional Teaching Method, Science Process Skills, and Government Bilingual High Schools.

1. INTRODUCTION

Tambo (2012) defines teaching method as a standard procedure for presenting subject matter and organizing teacher-student interaction during a lesson. Nekang (2016) on his part defined teaching method as a path followed in communicating knowledge with the view of securing the best individual results. This shows that the role of teaching methods in the teaching learning process cannot be overemphasized. However, there are many teaching methods. One of the teaching methods that puts the learners at the centre of learning is the laboratory based teaching method (LBTM) which is commonly known as "practicals". This method is very applicable to biology as it communicates knowledge to the students both theoretically and practically. Laboratory based teaching method is one of those teaching methods that can mould learners to contribute to Cameroon desire to achieve vision 2035 objectives because it equips the learners with science process skills in solving real life problems. Furthermore, this method is based on the competency based approach curriculum where the learners are put at the centre of teaching as opposed to the conventional teaching method.

However, the inadequate acquisition of science process skills, underachievement in sequence tests, poor academic performance of students at the Ordinary Level (O/L) General Certificate of Education (GCE), the inability of O/L biology graduates to apply biology knowledge at home, society and at the Advanced Level (A/L) practical paper three is fundamentally linked to the ineffective application of teaching methods by teachers to facilitate teaching learning process (Advanced level biology chief examiner's report, 2014). This simply shows that the conventional teaching method which is (teacher-centred) used in teaching biology in secondary schools nowadays has partially been attaining its objectives. Tchombe (2004) and Omiko (2015) opined that laboratory based teaching method provides the premise for first-hand knowledge whereby theory and practice are exploited, thus training a student holistically to meet today's challenges.

2. RELATED LITERATURE REVIEW

Laboratory Based Teaching Method (LBTM)

Talking about the laboratory based teaching method without knowing about a laboratory is baseless. However, a laboratory in the school setting has been defined by several authors in different ways. Ezeliora (2001) defined science laboratory as a workshop where science is done or where scientific activities are carried out in a conducive environment. According to Omiko (2007), "A laboratory is a room, or building or a special period of time equipped and

set apart for practicals or experimental studies to take place". He also sees the laboratory as the heart of a good scientific programme which allows students in the school to have experience which are consistent with the goals of scientific literacy. This implies that, science teaching and learning cannot effectively be done in a secondary school where there is no well-equipped laboratory were practicals can be done to equip the learners with science process skills.

Thus, laboratory based teaching method is a teaching method that deals with students experimentation, fieldwork and activity project. All of these culminate to practical activities in and out of the class room which involves an individual, group of students or the whole class practical activity as seen by this researcher. Some scholars have simply called this method of teaching "practicals". Tambo (2012) defined laboratory based teaching method as "a teaching learning interaction in which pupils, under the guidance of a teacher, investigate some aspect of a topic". He reiterated that, the purpose of laboratory based teaching method is to solve some problems or answer some questions. Nekang (2016) defined laboratory based teaching method as a teaching method that leads the students to carry out material experiments, observe, feel, touch, approximate, and estimate. In nutshell, LBTM can equip a learner with generic skills or science process skills that can help the learner to solve real life problems. This is because the learners are exposed to constructing knowledge for themselves in the teaching learning process.

Furthermore, Dienye and Gbamanja (1990) observed that, laboratory based teaching method is an activity involving a two-way approach, carried out by one or more persons through the exercise and experimental approaches both of which are useful in science teaching. The experimental approach provides an opportunity for students to seek information using experimental procedures. These procedures call for careful observations and interpretation of data which has the qualities of questioning, investigating and confronting the unknown during the process on the other hand favouring all types of learners.

Benefits of Laboratory Based Teaching Method in the Teaching of Biology in Secondary Schools

Udondu (2009) and Omiko (2015) observed that, the use of the laboratory based teaching method has the following benefits:

1. Laboratory based teaching method makes the students to learn about the nature of science and technology in order to foster the knowledge of human enterprise of science and thus enhance the aesthetic and intellectual understanding of the child. Dienye and Gbamanja

(1990) opined that, science is known to be a way of doing certain things by the observation of natural phenomena, quantifying the observed thing, integration of such quantities and interpretation of the results in order to make useful meaning out of the exercise. The students can identify cause effect relationships and in this process develop important scientific skills.

2. Learning scientific inquiry skills that can be transferred to other spheres of problem solving (that is, the acquisition of problem solving skills). One of the basic goals of science education is to help students learn skills that can be applicable to other life situations in future. It thus follows that, the exercise of transfer of such learning conditions must have something in common with the situation to which it will be applied.
3. Students learning to appreciate and in fact emulate the role of the scientist through acquisition of manipulative skills should be allowed to investigate phenomena by;

(a) Indirect observation of objects and materials for the acquisition of mental as well as manipulative skills, for example measuring substances, using weighing balances, measuring cylinder, pipette, and so on.

(b) Through multiple trials, students can in the process of fiddling with materials and activities without stated theories arrive at useful conclusions.

(c) Given a known theory, students can be guided to observe some phenomena selected by the teacher and from such observation make predictions that are likely to occur. This is as applicable in cognitive apprenticeship theory.

4. Developing interests, attitudes and values by considering what science entails, it is clear that a field experience has the best potential for stimulating a life time interest in science in the students when accorded the chance for personal experience by handling the real things. Students interest in science increases as they yearn to investigate and explore more about their environment.

According to (Blosser, 1990), laboratory based teaching method used as a primary means of instruction in science gives opportunities for students' to manipulate equipment and materials (Tobin, 1990); helps students to build confidence in their problem-solving abilities (Sundberg and Moncada, 1994); maximizes their conceptual development (Domin, 2007); maximizes students' learning achievement, preventing misconceptions, develop positive attitude towards practical activities, and build self confidence in the students (Tarhana and Sesen, 2010); and stimulates students to greater efforts of achievement (Hunt, Koender & Gynnild, 2012).

Based on the roles of the laboratory based teaching method in science teaching and learning, it implies that schools without laboratories, where students can carry out biology, chemistry and physics practical activities may end up producing or graduating students who will have no knowledge of science practical and science process skills required by the digital generation of the 21st century. Consequently, these students will lack the prerequisite requirement qualifications for professions like medicine, engineering, agricultural science and any of the science related careers.

How to Effectively Implement the Laboratory Based Teaching Method to Enhance Science Process Skills Acquisition

The steps involve in the implementation of laboratory based teaching method has been formulated by (Tambo, 2012). Tambo put it forwards that, the effective use of laboratory based teaching methods has four stages to follow for its implementation; (1) planning (2) introduction (3) the work period and (4) culminating activities. When this is done effectively, the method will serve time as many teachers always complaint that there is no time for the use of laboratory based teaching method or practicals in biology at the secondary level of education in Cameroon.

Planning

a) Know what materials are available and be sure that, the quantity is good enough in terms of the number of students in the class.

b) Pre-test material to ensure that it is in good condition. In case, there is equipment that needs assembling, decide if the equipment will be assembled beforehand by you or by you and students during the laboratory based teaching method session.

c) Ensure that the laboratory based teaching method session; project or field study lesson does not interfere with other school activities or other teachers' periods in school.

d) Try out the experiment/practical or manipulation of materials to be sure that they are workable, safe and can be completed within the time available. These steps are equally applicable to classroom used of laboratory based teaching method.

e) Determine the most effective size of student grouping for the work, if you want to do group work practicals. Some laboratory based teaching process may require that the class be divided into small groups.

This is simply to ensure effective teaching as elaborated by (Tambo, 2012) when he says; "effective teaching helps children to discover their potentials and creates in the children the desire to put them into good use. However, it ensures a relaxed, happy and respectful

atmosphere for the learners. It also shows signs of growth, thinking and experiencing on both students and teachers and only so can knowing become doing", Tambo concluded.

f) Determine the number and types of attendants you will need as helpers at a given stage and make appropriate contacts with them in case of field work and project outside the school building. Establish appropriate rules to be observed during the field, project or experimentation activities.

g) Decide on the safety precautions necessary to avoid accidents and to guarantee the safety of students as they do the practical either individually or in groups.

Introduction

a) The teacher introduces the problem or topic and explains the tasks or work to be accomplished step wise based on the theories they had learned in the previous lessons in class.

This is the first stage of lesson delivery which requires that the students should listen, observe and ponder on how the lesson objective shall be achieved or the problem is going to be solved. The teacher states the relationship of the experience to the past, present or future classroom work.

Tambo (2012) stresses on the previous knowledge which takes the students to the work that was done in the previous class theoretically. This reminds the teacher that when he is delivering the lesson to the students he must bear this in mind to arouse curiosity and interest in the students to think and ponder on the practical lesson and its out comes.

b) Clear directions have been given about the plan to follow. Farrant (2002) states that, the presentation should be a record of facts to be taught and the methods to be used during the process.

This is clear that, laboratory based teaching method follows directions as well as steps which must be instructed by the teacher. Abimbola (1996) says, "if students follow the steps given by the teacher in any lesson, they should be rest assured that they are going to succeed in their examination". In this case, the learners become apprentices to the teacher as they are out to construct and discover new knowledge for themselves. This is in line with the cognitive apprenticeship theory and Bruner's social constructivism theory of teaching and learning.

The work Period

a) If work takes several days, the class may meet as one group each day at the beginning of the period to discuss their progress and problems and then receive instructions and

clarification from the teacher. However in the case of this study, the practical is done on a single period and the result obtained at the end of the practical lesson.

b) The teacher keeps the record of students' progress in the case of several days' activities.

c) The teacher always makes provision to occupy students who complete their tasks earlier than the rest of the students to avoid noise and distraction.

Culmination Activities

These activities according to (Akon, 2014) refers to those activities that mark the end of the laboratory based teaching method. These activities are centred on evaluating what has been accomplished during the period of the practical activity. Here individual or groups reports are followed by a general discussion. Finally the teacher may collect individual or groups reports or give a test to ascertain the extent to which the students have achieved the desired objectives of the practical lesson.

Assessment of the Outcome of Practical Work

This involves the assessment of all the practical activities as well as the assessment of the science process skills acquisition. The process of assessment goes thus;

- Continuous assessment by the biology teacher based on systematic observations and records of the students.
- The evaluation of laboratory reports made by the students on the bases of their laboratory activities.
- The individual student projects based on practical skills, for instance production of yogurt, cultivation of tomatoes, piggery, and poultry just to name a few.
- Paper pencil test items pertaining to laboratory experience and related issues.
- Practical examination can be carried out. For instance biology paper three at the Advanced Level.

Conventional Teaching Method (CTM)

This is a teacher centred, student peripheral teaching method in which the teacher delivers a pre-planned lesson to the students with or without the use of instructional materials (Nwagbo, 1999). Some scholars call this method pure lecture method. Gbamanja (1991) observed that, in using this method, the teacher talks about science while the students only listen and read about science abstractly. According to Awotua-Efobo (2001), the teacher comes to class fully armed with a mass of facts, probably gathered from books and would start to pour out the facts to the students who are very passive in the teaching learning process. The teacher presents ideas or concepts, develops and evaluates them and summarizes the main points at

the end, while the students listen and take down notes. During the cause of the teaching and learning process, students' questions are not normally encouraged and in cases where questions arise, they are usually for clarification of important facts (Tchombe, 2004). Conventional teaching method of instruction can be useful in teaching some biological topics or in conjunction with other methods. It is therefore recommended that, conventional teaching method can become effective if used together with other teaching methods for instance demonstration and illustration. It is also effective in teach large body of students like in higher education (Tambo, 2012). However, some of its disadvantages are identified by (Eya and Igbokwe, 2000) as follows:

- It does not develop student's manipulative skills in science, as they are passive listeners.
- It does not cater for individual differences among the students, with the result that the slow learners and the academically weak students are dragged at the pace they cannot cope with. This may lead to underachievement and loss of interest.
- The method appeals only to the sense of hearing. This makes the method not suitable for teaching science in the secondary schools; however; it can be suitable in the University. Alio (2002) stated that, complete learning takes place when the child uses all his senses in the learning process.

The persistent use of conventional teaching method makes students passive rather than active learners. More so, it does not promote insightful learning and long term retention of any abstract concepts in biology and emphasizes on learning through the teacher's guidance at all times (Gambari, Yaki, Gana & Ughovwa, 2014). Despite these disadvantages, the innovation in the biology curriculum in Cameroon has shifted from New Pedagogic Approach (NPA) to the Competency Based Approach (CBA) in teaching and does not envisage the place of conventional teaching method as a tool to bring out competency or the acquisition science process skills in the learners of biology in secondary schools and stand little chance to contribute for Cameroon emergence by 2035.

Laboratory Based Teaching / Conventional Teaching Method and the Acquisition of Science Process Skills

Omiko (2015) investigated the role of the laboratory in students' academic achievement in chemistry in secondary schools in Ebonyi State of Nigeria. According to the study, the results showed that, the use of the laboratory helps to develop scientific attitudes in the students

towards the learning of chemistry especially practicals, and scientific skills for problem solving in students among others.

Chukelu (2009) investigated the effects of biology practical activities on students' process skills acquisition in the Abuja Municipal Council Area. The results revealed that practical activity method was more effective in fostering students' acquisition of science process skills than the lecture method. The interaction effect between teaching methods and gender of the subject was not significant.

Badri and Shri (2013) carried out a study on the topic; "The Impact of Laboratory Approach on Achievement and Process Skills in Science among Standard Students". The purpose of this study was to compare the effects of laboratory based teaching method on the 7E learning cycle model with verification of laboratory approach on university students' development of science process skills and conceptual achievement.

The achievement of student studied through laboratory approach was significantly higher than traditional approach. The development of process skill was higher in the students who were taught using laboratory approach. The students who studied through laboratory approach were better in the acquisition of science process skills, achievement and in practical test also. Therefore, they concluded that laboratory based approach should be used in teaching and learning biological sciences.

Burak (2009) made an investigation into the relationship between science process skills with efficient use of the laboratory and science achievement in chemistry education. He found out that, positively significant and linear relationships exist; a) between science process skills taught in laboratory applications and efficient laboratory use of the students; b) between their efficient laboratory use and their achievement in the course; and c) between their science process skills and achievement in the course taught. Empirically, it shows that laboratory based teaching method enhances the acquisition of science process skills in the learners.

Science Process Skills (SPS)

Science process skills are those learned potentials which a child develops as a result of his or her involvement in scientific investigations (Nworgu, 2009). Ajaja (2010) stated that science process skills are fundamental to science, which allows everyone to conduct investigation and reach conclusions. They 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 these skills effectively in the teaching learning process.

There are two types of science process skills; basic and integrated science process skills. The basic science process skills include; observing, measuring, classifying, inferring, predicting, use of number, recording, communication / reporting and questioning (Abruscato, 2000). According to the nature of this study, basic science process skills are discussed by this researcher because these are the skills frequently used by beginners in the learning of science and biology in particular and are use in day to day biological activities in secondary schools. According to Akinbobola and Afolabi (2010), basic science process skills are designed for primary and secondary schools. These skills are often combined with science content, enabling pupils/students to learn both science processes and content at the same time, in a teaching learning environment like schools. These basic science process skills are:

Observation

This is achieved by using the sense of sight, touch, smell and feel. A student cannot be said to be curious unless he has the ability to observe. Systems are first observed as a whole then analysed for sub team information. However, a microscope, hand lens and telescope can also aid in proper observation for better analysis.

Measurement

This process gives the scientist useful information based on accuracy in science processes. Measurement contains two parts, a number to tell how much or how many something is and a name of what is measured. The use of number makes a measurement a quantitative observation. An example is measuring the volume of a chemical (felling solution) in a pipette or burette to carry out food test.

Classification

Classifying object according to (Mari, 1994), involves sorting and arranging objects according to their similarities and differences. Objects that share a given characteristics can be said to belong to the same kingdom, Phylum, class and so on. For example, all insects are divided into the head, thorax and abdomen.

Inferring

This is a form of guess, a deduction made to explain an observation subjectively. It implies a cause effect relationship. An inference may be using what you observe to explain what has happened. An example is concluding that it rained this morning because there was the present of nimbus cloud in the atmosphere.

Predicting

This process deals with events of forecasting of the future occurrence based on past observations or to state the outcomes of a future event based on available information. Examples, a scientist predicting that some animal and plant species will become extinct like elephants simply because of pouching or hunting.

Communication/Reporting

This is the process skill of transmitting acquired information from one person or group to another which may result to a change in behaviour. A scientific experience in observation, data collection and discovery need to be communicated to other people (Eniayeju, 1994). This will give growth to knowledge, and it could be in written words, diagrams, graphs or models. For examples, draw a well labelled plant cell, an amoeba cell, describing an experiment to demonstrate osmosis.

Recording

This involves using a stop watch to time and record the time passed in an experiment. For example, measuring the rate of heart beat or rate of transpiration using a stop watch.

Generally the effective implementation of LBTM promotes the acquisition and application of the various basic science process skills. It is in this light that, the Federal Government of Nigeria, have made science process skills acquisition as one of the national goals of education that should be aimed at helping the child in the acquisition of appropriate skills, abilities and competencies, both mental and physical (Federal Republic of Nigeria (FRN), 2004). This is in line with the new Competency Based Approach syllabus for secondary schools as documented by the Ministry of Secondary Education in Cameroon which went operational since 2014/2015 academic year.

According to Nwagbo (2001), a number of factors have been identified as contributing to the non-acquisition of basic science process skills by secondary school students which invariably lead to poor performance and inability to solve real life problems. One of the factors is the teacher variable, that is, the teachers' method of teaching. Furthermore, Okoli (2006) indicated that, many science teachers prefer using the conventional teaching method in teaching and shy away from activity-oriented teaching methods which are student centred (such as inquiry method, discovery method and laboratory based teaching method). The teachers usually complaint that, the use of laboratory based teaching method is time consuming and tedious and requires a lot of resources, as observed by this researcher during the teaching of biology in secondary schools.

Biology

Biology is a natural science that deals with the living world; how the world is structured, how it functions and what these functions are, how it develops, how living things came into existence, and how they react to one another and with their environment (Umar, 2012). It is a prerequisite subject for many fields of learning that contributes immensely to the technological growth of a nation (Ahmed, 2008). This includes medicine, pharmacy, nursing, agriculture, forestry, biotechnology, nanotechnology, and many other areas (Ahmed and Abimbola, 2011). Biology is one of the core subjects in Cameroon secondary school curriculum as well as second cycle (A/L) subject combination (series). It is obvious that, no student aspiring to study these professional disciplines can do it without the use of laboratory based teaching method in learning because these are all practical fields (Kareem, 2003).

Shafack and Jitzi (2019) in their study found out that laboratory based teaching method enhance cognitive achievement in the teaching of biology in secondary school in the Littoral region of Cameroon.

However, Nwagbo (2008) stated that, "the use of laboratory based activities or practicals to the teaching of biological concepts should therefore be a rule rather than an option to biology teachers, if we hope to produce students that would be able to acquire the necessary knowledge, skills and competences needed to meet the scientific and technological demands of a nation". This simply means that practical activity in the teaching of biology cannot be overemphasized in the teaching learning process as it enhances cognitive achievement, acquisition of science process skills in the students, motivation, retention, application of knowledge, confidence in the handling of practical tools and develop interest in learning biology even after school (Tchombe, 2004, Tambo, 2012 and Akon, 2014).

Despite of the important role played by laboratory based teaching method in biology, there are still many questions asked by many biology educators concerning the poor performance of students, cognitive underachievement of students during biology sequence and public examinations especially at O/L and A/L in Cameroon as well as sufficient acquisition of science process skills. Abraham and Millar (2008) pointed out that, "despite the widespread use of practical activities as a teaching and learning method in schools sciences, they expressed views that, increasing its amount would improve quality of science education. However, some science educators have raised questions about its effectiveness". This simply means that if practical activities are given the weight theory is given in secondary, it might equip the learners with science process skills. The major worry according to them is that the

laboratory based teaching method has been relegated to the back rendering it ineffective in secondary schools.

Generally, the performances of O/L biology at the Cameroon General Certificate of Education (CGCE) for the past years have been below average as revealed by the (CGCE Result booklets from 2010-2016) and the (Chief of Service of Results and Archives (S.R.A), Sub Directorate of Examinations, Concourse and Certifications (S.D.E.C.C), Regional Delegation of Secondary Education (R.D.S.E) Buea, 2019/2010 Academic Year). This indirectly has contributed to the insufficient acquisition of science process skills in secondary schools. Several researchers have pointed out the different reasons for students' poor performance and inadequate acquision of science process skills in biology at the CGCE O/L. Some of which are due to the abstractness of certain aspects of biology, lack of basic science process skills acquisition, lack of understanding of certain biological concepts such as ecology, genetics and biotechnology by the students (Nzelum, 2010) as cited by Owoeye, (2016). Moreover, some of the reasons given by GCE O/L chief examiners reports of 2013, 2014, and 2015 about these phenomenon in O/L biology are; the poor usage of teaching methods, lack of didactic materials, students absenting from examination, overcrowded classrooms and so on. It is on this serious note that this researcher is worried about this phenomenon of inadequate acquisition of science process skills in secondary schools in Cameroon despite the effort made by the government, stakeholders of biology and the importance of these skills. The issue that this researcher is interested with is to find out whether laboratory based teaching method can ameliorate the acquisition of science process skills among biology students in secondary schools.

Statement of the Problem

Despite the effort made by the government, education stakeholders and biology educators to improve on the standard of education by enhancing the acquisition of science process skills to meet the 21st century learners, it has been observed that students and graduates of biology from secondary still finds it difficult to solve real life problems by applying the knowledge they have required in everyday life and to solve real life problems and to pursue their career in biological sciences. Many factors might be accounted for this insufficient acquisition of basic science process skills amongst biology students in secondary schools and upon graduation with biology ordinary level GCE paper. This involves both students and teachers factors. One of these factors might be the wrong usage of teaching methods. It is due to this back dropped that this study seeks to find out if laboratory based teaching method has an impact on

secondary schools biology students' acquisition of science process skills in Littoral Region of Cameroon.

Objective of the Study

To compare the mean acquisition scores of the basic science process skills of form three students that are taught biology using the laboratory based teaching method and the conventional teaching method.

Research Question

What is the difference in the mean acquisition scores of the basic science process skills of form three students in biology that are taught using the laboratory based teaching method and the conventional teaching method.

Research Hypothesis

This hypothesis is set at $p \leq 0.05$ thus:

Ho: There is no significant difference in the mean acquisition scores of the basic science process skills of form three students in biology that are exposed to the laboratory based teaching method and the conventional teaching method.

Ha: There is a significant difference in the mean acquisition scores of the basic science process skills of form three students in biology that are exposed to the laboratory based teaching method and the conventional teaching method.

3. METHODOLOGY

Research Design

Solomon Four Non-Equivalent Control Group Quasi Experimental Design that comprises of four schools (two experimental and two control schools) was adopted for this study. This design is employed where participants are assigned to different conditions, and there is manipulation of one or more independent variables by the experimenter. Furthermore, there is measurement of the effects of this manipulation on one or more dependent variables and there is control of all other variables. This type of experimental design is a strong design for a researcher to test hypotheses to reach valid conclusions between independent and dependent variables (Best and Kahn, 2003). Best and Kahn (2003) reiterated that, it is difficult to ensure equivalence of the experimental and control groups in a school by random assignment of students because classrooms in Cameroon are formed as intact classes that cannot be dismantled for the purpose of a study.

Methodologically, it was a quantitative study that made used of comparing the mean achievement scores of form three biology students between the schools involved in the mean acquisition scores of basic science process skills among the students with respect to the laboratory based teaching method and the traditional teaching method. Solomon Four Non Equivalent Control Group Quasi Experimental Design has been used successfully used in research studies to determine the effect of teaching approaches on students achievement scores in Kenya (Wambugu and Changeiywo, 2008; Wachanga and Mwangi, 2004). Form three students were used for this study because they were relatively of the same age as they occupy the same classes.

This study used the experimental design with figures and symbols as used by Wiersma (2000) as follows; groups 1, 2, 3 and 4 were assigned to the schools/classes of the English section of the government co-educational bilingual secondary high schools that were randomly assigned to the experimental and control groups. O1 and O3 schools were given the pre-test while O2, O4, O5 and O6 schools were all given the post-test as stipulated by the design. According to this design O1 and O3 suddenly became O2 and O4 for the post-test. O5 and O6 schools were given only the post-test. Both the pre-test and post-test were done using the BSPSAT, (X) is the treatment variable and (C) is the control variable. Groups/schools 1 and 3 were the experimental groups that received the treatment (X) and were taught using the laboratory based teaching method while groups/schools 2 and 4 were the control groups that were kept under the control condition (C) and were taught using the traditional teaching method. Groups 1 and 2 were pre-tested (O1 and O3) while groups 3 and 4 were not pre-tested as prescribed by the design. All the four schools (O2, O4, O5 and O6) were then post-tested at the end of the six weeks treatment period.

The control groups/schools were only taught using the conventional teaching method without the practical activities for the students. The teacher presented the topics as an exposition to the whole class while the students listen as they take down notes individually. When the lessons were fully taught by the two methods for the two groups of four schools, BSPSAT were administered by the researcher and the class teacher to the students. The scripts were marked by the researcher to measure their level of acquisition of the science process skills. Figure 1 below presents the Solomon Four Non-Equivalent Control Group Experiment Design for this study.

Group 1	O1	X	O2
Group 2	O3	C	O4
Group 3	----	X	O5
Group 4	----	C	O6

Figure 2: Solomon Four Non-Equivalent Control Group Design

Source; Best and Kahn (2003)

Key: Pre-tests 01 and 03, Post-tests 02, 04, 05and 06. Treatment X, Control C, --------- Dashed lines show that the experimental and control groups were not equated by randomization hence non equivalent

1, 2, 3, and **4=**Various schools

Population of the Study

The target population of this study was made up of all the Government Bilingual High Schools (41) of all the Divisions of Littoral Region that carry out biology practicals (having equipped biology laboratories). These Divisions are Wouri, Moungo, Sanaga Maritime and Nkam. The accessible population of this study was made up of all the form three biology students of the English section of the Government Bilingual Secondary High Schools with equipped biology laboratories in the three selected Divisions of the Littoral Region of Cameroon. The sample was 405 form three students. Table 1 below presents the divisions, parent, target, accessible and sample populations of the study respectively.

Table 1: Population and Sample

Division/Government Bilingual High Schools of Littoral Region	**Nº of Government Bilingual High Schools (population)**	**Nº of Bilingual High Schools with biology laboratories (target population)**	**Accessible population: All form three students of the English section of the G.B.H.S of the Littoral Region**	**Sample population/students/streams of the selected schools of the G.B.H.S of the Littoral Region**
Wouri	18	16	10060	253/2 streams
Nkam	2	2	2300	Not selected

Mungo	21	18	7723	81/ 1 stream
Sanaga-Maritime	7	5	3132	71/ 1 stream
Total	48	41	23215	405(4streams)

Source: MINESEC/RDL/SDGA/SSMGCSA: List of Schools Operating in the Littoral Region for 2017/2018, that have Laboratories and carry Biology Practicals in the Littoral Region.

Sampling

The optimum sample size required for each participating group in an experimental research as recommended by Coolican (1999), Gall, Borg and Gall (1996) is thirty respondents. Four hundred and five (405) participants provide a reasonable sample size whose findings may easily reproduce the salient characteristics of the accessible population to an acceptable level (Mugenda & Mugenda, 1999). Therefore, the sample size employed in this study was valid for this study.

Sampling Technique

Both purposive and simple random techniques were use in this study from the accessible to the sample population. The choosing of the divisions were done using the simple random technique as well as the assigning the schools to the experimental and control groups. The teachers and form three students were purposively chosen. There was no randomisation of the form students.

Instrument for Data Collection

The instrument that was used for data collection was Biology Science Process Skills Achievement Test (BSPSAT). These were coined to collect data for the cognitive achievement and the acquisition of basic science process skills. The data were collected from the students test only.

Validation and Reliability of Instrument

Experts test and measurement and curriculum studies and teaching in the university of Buea and some secondary schools teachers in Littoral Region validated the instrument. Reliability was ensured through a test re-test procedure on a model school.

The instrument was subjected to trial testing. The trial testing was carried out in form three at a Model Bilingual Secondary High School in Nyalla in Douala, in an English section of the school. The data obtained from the test scores of the students in the trial testing was used to

estimate the reliability coefficient of the instrument which was at 0.60 for the first test and 0.70 for the re-test in a range of 0 to1.

Control of Extraneous Variables

The control of extraneous variables in this study there controlled include; teacher variables, instructional situation variables, subject interaction.

Method of Data Analysis

The data obtained for this study was from biology science process skills achievement test. These data were analysed using the Statistical Package for Social Sciences (SPSS) version 17. The BSPSAT pre-test and post-test scores were keyed into SPSS version 17 for further analysis. The scores obtained from the pre-tests and post-tests were analysed using mean and standard deviation. The statistical test that was used for this analysis was the t-test, to test the statistical hypotheses for the study. The hypothesis was either rejected or accepted at the significant level of $p \leq 0.05$. T-test was used to determine the significance of any observed differences between the two groups tests mean scores of the acquisition of science process skills.

4. RESULTS

Four schools participated in the study. The students of two schools were given the pre-tests and post-tests (Government Bilingual High School Deido and Government Bilingual High School Edea) while the students of the other two schools (Government Bilingual High School Bonaberi and Government Bilingual High School Penja) were given only the post-tests. Each of the schools were exposed to either the laboratory based teaching method or conventional teaching method. The results obtained from the different schools are presented on the different tables below.

Table 2: Basic Science Process Skills Mean Scores Acquisition of Government Bilingual High School Deido (Experimental School)

Method	N	Sum	Mean	Std. Error	Std. Deviation	Mean Gain
Laboratory Based Teaching Method						

Pre-test scores for biology science process skills achievement test.	127	1236	**9.73**	0.34	**3.78**	
Post-test scores for biology science process skills achievement test.	122	2274	**18.64**	0.26	**2.90**	**8.91**

Table 2 and 3 below present the results of those schools that were given both the pre-tests and post-tests. Each of the schools was taught using a particular teaching method.

Table 2 presents the data for Government Bilingual High School Deido in response to research question two as stated above. This was an experimental school of the study and the students were taught using the laboratory based teaching method. The students of this school were given both the pre-test and the post-test. The result shows that the students scored 9.73 in their pre-test mean acquisition score for the basic science process skills with a standard deviation of 3.78. In the post-test after treatment, the students' mean acquisition score was 18.64 with a standard deviation of 2.90 and a mean gain of 8.91.

Table 3: Basic Science Process Skills Mean Scores Acquisition of Government Bilingual High School Edea (Control School)

Method	**N**	**Sum**	**Mean**	**Std. Error**	**Std. Deviation**	**Mean Gain**
Conventional Teaching Method						
Pre-test scores for biology science process skills achievement test.	71	586	**8.25**	0.48	**4.01**	
Post-test scores for biology science process skills achievement test.	71	683	**10.19**	0.54	**4.42**	**1. 94**

Table 4: Basic Science Process Skills Mean Scores Acquisition of Government Bilingual High School Penja (Experimental School)

Method	N	Sum	Mean	Std. Error	Std. Deviation	Mean Gain
Laboratory Based Teaching Method						
Post-test scores for biology science process skills achievement test.	81	1434	**17.70**	0.40	**3.58**	

The data on table 3 shows the results in response to research question two as stated above. The data shows that the students acquired a mean acquisition scored of 8.25 in their pre-test with a standard deviation of 4.01. After the treatment the student acquired a mean acquisition score of 10.19 with a standard deviation of 4.42 and a mean gain of 1.94.

The data on table 4 constitute results in response to research question two. Government Bilingual High School Penja was one of the experimental schools of the study whose students were given only the post-test with no pre-test as prescribed by the design. The mean acquisition score of the students was 17.70 with a standard deviation of 3.58. The students of this school were taught using the laboratory based teaching method.

Table 5: Basic Science Process Skills Mean Scores Acquisition of Government Bilingual High School Bonaberi (Control School)

Method	N	Sum	Mean	Std. Error	Std. Deviation	Mean Gain
Conventional Teaching Method						
Post-test scores for biology science process skills achievement test.	126	2042	**16.21**	0.35	**3.87**	

The data on table 5 were collected in response to research question two. Government Bilingual High School Bonaberi students were given only the post-test with no pre-test as prescribed by the design. The mean acquisition score of the students was 16.21 with a standard deviation of 3.87. The students were taught using the traditional teaching method.

The results presented on tables 2, 3, 4 and 5 were further used to test the hypothesis at $p \leq 0.05$ as stated below:

Ho: There is no significant difference in the mean acquisition scores of science process skills among form three students in biology that are exposed to laboratory based teaching method and the conventional teaching method.

Ha: There is a significant difference in the mean acquisition scores of science process skills among form three students in biology that are exposed to laboratory based teaching method and the conventional teaching method.

Table 6: T-Test Scores for the Basic Science Process Skills Acquisition for Laboratory Based Teaching Method and Traditional Teaching Method (Experimental and Control Schools).

Method	N	$\bar{x}$	Std	df	std error	t_{cal}	t_{crit}	Decision
Laboratory based teaching method	122	18.64	2.90					
				191	0.5866	**14.405**	**1.960**	**Reject Ho**
Conventional teaching method	71	10.19	4.42					

Table 6 presents results for testing the null hypothesis as stated above in relation to research question two. The table shows that, the $t_{calculated} = 14.405$ is greater than the $t_{critical} = 1.960$ with degrees of freedom 191 at $p \leq .05$ level of significance. Judging from the results, we reject the null hypothesis (Ho), retaining the alternative hypothesis (Ha).

5. DISCUSSION

The finding reveals that, the students of the experimental schools; Government Bilingual High School Deido and Government Bilingual High School Penja that were taught using the laboratory based teaching method acquired more in their mean acquisition scores when compared to the students of the control schools of Government Bilingual High School Bonaberi and Government Bilingual High School Edea that were taught using the conventional teaching method. Thus, there is a significance difference in the acquisition of science process skills between form three students who taught biology using laboratory based teaching method (experimental schools) and conventional teaching method (control schools).

This result is confirmed by the alternative hypothesis (Ha_1) of this study which states that, there is a significant difference in the mean acquisition scores of science process skills among form three students in biology that are exposed to laboratory based teaching method and the conventional teaching method. The results show that laboratory based teaching method promotes the acquisition of basic science process skills among biology students of form three better than the conventional teaching method which is teacher-centred and the students were passive in their lessons.

This result is in line with the results of the study carried out by Chukelu, 2009,; Burak, 2009,; Badri and Shri (2013) whose results of their studies revealed that practical activity method was more effective in fostering students' acquisition of science process skills than the lecture method.

However, the result is contrary to the view of (Ango, 2002) who argued that, practical work endangers not only the science process skills, scientific inquiry but practical work also inculcates attitudes and conceptual perspectives which are not necessary for skilled scientific inquiry.

This result can be attributed to the fact that, students who were taught via the laboratory based teaching method were more exposed to the acquisition of the basic science process skills through the laboratory activities. This is so because; practicals favour all the three cognitive domains of learning especially the cognitive and the psychomotor domains that develop basic science process skills in the learners. It also favours all the three types of learners (visual, auditory and kinaesthetic) during the teaching and learning process.

Conclusion

The finding of this study lead to the conclusion that, the use of laboratory based teaching method favoured students' acquisition of the basic science process skills when the students

are taught using the laboratory based teaching method as opposed to the conventional teaching method. Thus, laboratory based teaching method can therefore be used as a spring board to inculcate the acquisition of science process skills in biology students in secondary schools. This skill supplements the 21st century skills as well in general which are very essential in the teaching and learning of biology in this era.

Recommendations

- Regional and Divisional pedagogic inspectors for biology should organise more workshops, seminars, refresher courses and in-service training for biology teachers for the use of laboratory based method in teaching biology in secondary schools. This might keep teachers abreast with the use of laboratory based teaching method (practicals). This will also motivate and enable the teachers to plan and implement the practicals adequately during their lesson deliveries to their students.
- All biology concepts that requires practical should be taught practically using the laboratory based teaching method, using the necessary equipment, specimens, reagents and local materials available. By using the specimens, reagents and biological objects, the students would acquire the skills involved in studying and applying the knowledge in real life situations. If this is done students will do biology instead of learning about biology and become biology products producers instead of biology products consumers.

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