EFFICACY OF DEMONSTRATION AND PROBLEM-SOLVING TEACHING METHODS ON BIOLOGY STUDENTS' ACADEMIC PERFORMANCE IN ESAN-WEST L.G.A OF EDO STATE.

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Abstract

The paper investigated the efficacy of demonstration and problem-solving teaching methods on Biology students' academic achievement in Esan-West Local Government area of Edo State. A Quasi-Experimental pre-test, post-test control group was adopted for the study. A sample of one hundred (100) SS2 students were drawn for the study using the simple random sampling technique as well as non-proportional sampling technique. Two research questions and two corresponding hypotheses were tested in the study at 0.05 level of significance. Biology Achievement Test (BAT) constituted the source from which the students' academic achievements were measured. The BAT was developed by the researcher and reliability coefficient of 0.57 was established using Kuder Richardson Formula 20 (KR_{20}). Mean was used to answer the research questions and independent t-test was used to test the hypotheses. Results showed that demonstration method have a positive effect ($p = 0.003 < 0.05$) on students' achievement in Biology. On the other hand, problem- solving methods had a positive but insignificant effect ($p = 0.056 > 0.05$) on students' achievement in Biology. Based on these findings, it was recommended among others that demonstration method should be used more in Biology lessons in Esan-West Local Government Area in order to foster better retention and assimilation. Also, conclusions based on the findings were also made.

Keywords: *Demonstration Teaching Method, Problem Solving Teaching Method, Biology, Academic Performance.*

Introduction

Teaching is an act. The mastery of a subject is determined by the performance of the students in such a subject at a prescribed examination. Any in interactive activity between a teacher and the student is expected to produce learning outcomes in the learners. When such an activity failed to produce a change in behaviour (learning) in the learners, then, there is a problem. The impact of the teachers in the performance of the students is germane. The teachers are the facilitators who are to impact into the students the concepts expected to be learnt. One thing is to be well grounded in the conceptual understanding of a subject; another thing is to be well acquitted with the best method to pass the concepts across to the learners for proper comprehension. A professional teacher would be desirable in this regard. Scholars argued the necessity of skilled

teachers for effective learning. The success or failure of any educational programme rests majorly on the adequate availability of qualified, competent and dedicated teachers. The ability of a teacher to teach is not derived only from one's academic background but it is based upon understanding pedagogical skill acquired, Ngada in Fajonyomi (2014). To promote students performance in science, it is important to determine which factors influence students' science achievement in schools. Such an understanding will aid in the development of new intervention for influencing these factors, thus enhancing students' achievement in science. Among teachers behaviours that have been shown to lead to high students' achievement are efficient classroom management skills systematic teaching approaches, providing clear teaching goals, and using advance organizers. A teacher cannot be said to be qualified by checking his or her educational level, years of experience or teaching certificate. Teachers influence students through their interactions with them, especially in the classroom.

Science can be defined as a systematic way of acquiring knowledge based on scientific methods. Science is a necessity for every nation that wants to maintain its independence, sovereignty, self-reliance, ensure growth and have its head held high among civilized nations. Science and technology are important tools for development and productivity, this is because it provides the basic tools for industrialization, transport, energy, information, pollution and waste control among others. In Nigeria, the study of science is of great importance, that a lot of emphasis has been laid on the teaching and learning of science with the major aim of science education, as contained in the National Policy on Education, being to equip the students to live effectively in this modern age as stated in Federal Ministry of Education (FME, 2014).

Omosewo (2015) opined that teachers lack appropriate instructional strategies for teaching and often used lecture method. Science education in Nigerian school is faced with many challenges, one of such challenges is the out-of-field teaching. This is when a teacher is assigned to teach subjects for which he or she has not got adequate training. These categories of teachers need a change of teaching method as most of them teach by the lecture base instruction. This lecture method has been criticized for lack of effective interactive approach and caused poor academic performance in science education.

Biology is the study of nature involving living and non-living, plants and animals, terrestrial and acquatic beings. Biology is one of the major science subjects that every science students is expected to have adequate knowledge about. In secondary schools, it is totally impossible to excel in field of science without having a fair knowledge of Biology as a subject. (Obomanu & Akporehwe, 2011).

Despite the fact that Biology and other science related subjects are important to human progress; students still perform poorly in them. The low performance as reported in various science tests is evident in most science subjects in general. This is pointed out by the report of the Registrar, Joint Admission and Matriculation Board (2008) who indicated that the performance

of candidates in the University Matriculation Examination (UME) over the last three years has shown a steady decline. This is an indication of low retention of what is taught and subsequently poor academic achievement.

A statistical table of West African Senior School Certification Examination (May/June) from 2005-2007 illustrated the student low academic achievement in Biology for three consecutive years. The following are the percentage grade-(credit, passes and failure) obtained by the students. In 2005, the total number of candidates who sat for SSCE were seven hundred and twenty two thousand, and three (722, 003) candidates and out of this number one hundred and twenty thousand, four hundred and sixty (120, 460) candidates got credit and above represented by 16.71%. One hundred and eighty-eight thousand, six hundred and three (188, 603) candidates got passes represented by 26.16%. Four hundred and twelve thousand, nine hundred and forty (12, 940) candidates failed entirely and the above represented 57.27%. In 2006, the total number of candidates who sat for the examination were one million, and twenty five thousand, four hundred and fifty – six (1, 025, 456) candidates and out of this number, four hundred and forty one thousand six hundred and seventy two (44`, 672) candidates obtained passes and above represented 43.07 percent.

In 2007, the total number of candidates who sat for the examination were one million, two hundred thousand, and twenty eight (1, 200, 028) candidates, and out of this number two hundred and seventy-eight thousand, one hundred and fifty two (278, 152) candidates got credit and above represented 22.80%. Three hundred and seventy thousand, five hundred and one (370, 501) candidates got passes and the above represented 30. 37%, eight hundred and fifty thousand, six hundred and four (857, 604) candidates failed entirely and the above represented by 48.83% (WAEC, 2015).

This is also evident in the chief examiners report of the West African Examination Council (2015). There are indications that candidates who sat for the WAEC in most science subjects exhibited the following lapses.

- Inability to properly interpret questions
- Failure to write or answer their questions logically, systematically and convincingly.
- Poor drawing skills
- Shallow understanding of most concepts in Biology.
- Inability to relate features to functions.
- Inability of the candidates to correctly spell many Biological terms.

The aforementioned give an indication that there may be low desire to perform creditably in the area of Biology as one of the science subjects. This may lead to appreciable low/poor choice of Biology or other science subjects as a subject to offer in the secondary schools or tertiary institutions. This may also be an indication that meaningful learning had not taken place. The over all achievement and retention in Biology and other sciences are very much related to many other variables; the variables include: teaching methods, teachers ability to use the various methods and materials provided, students backgrounds, level of intelligence of the

students, students cognitive styles, among other variables (Moore, 2012).

Students vary in their academic abilities and this tends to be reflected in the extent to which they are affected by a particular teaching methods. For instance, Diamond and Onweegbuzie (2012) expressed concern over the influence of different teaching methods on learning benefits of students of different ability groups, stating that differences in intellectual functioning among learners necessitate variations in instructional strategies. Various teaching methods are used by teachers in the teaching of Biology aimed at bringing about meaningful learning. These include lecture method, demonstration method, project, discovery inquiry among many others. The most commonly used is the lecture method. It has been observed that effective teaching may facilitate learning and make it more meaningful. In line with this, Sander (2013) stated that effective teaching helps the learner to learn better, while poor teaching would naturally lead to poor learning and consequently poor achievement. This study investigated the effect of teachers teaching methodology on the academic performance of science students performance in science subjects.

Concepts of Teaching Method

Teaching is a continuous process that brings about desirable changes in learners behaviour through the use of appropriate methods. Adunola (2014) indicated that in order to bring desirable changes in students, teaching methods used by educators should be best for the subject matter. Basically, teaching methods should aim at prompting learning among the students and be adapted to competency goals of the curriculum, foster higher order skills such as "examine", "analyze', "discuss' and' explore," and provide guidelines on how the methods should be used (Repstad, 2016). Ogden (2014) opined that a prerequisite for effective teaching is that "teachers should master a broad range of teaching principles and know how they can be applied in different situations to promote learning. From a practical point of view no teaching method is better than another, though methods differ. In authentic educational settings, methods must be adapted to the students' and teachers' characteristics, interests and needs, as well as to the subject matter being taught and educational context were it is taught (Ogden, 2014).

The demonstration method is a process used to introduce some specific skills in the course of instruction. The teacher here is able to do some activities while the learners are watching. It could involve setting up some apparatus or showing how a reaction should be performed and their limitations. It is teacher centred and so it is economical as regards the resources used. So it can be used when the school only has a set of apparatus or when the activity involved is of high risk. Mckee, Williams and Revebush (2016).

A demonstration involves doing and telling the students the points of emphasis. It can be done by the teacher alone, teacher and students, student who is knowledgeable in the activity or by a guest demonstrator. (Nwanekezi & Arokoyu, 2014). Furthermore, it is the perception of the students that when they hear, they usually forget it and when they see they

start to believe in it but when they do; they understand more properly. Multimedia learning process is the mixture of audio and video into an application or presentation to communicate knowledge to listeners Adamu, (2013). Multimedia learning can be defined as a form of computer-aided instruction that uses two modalities concurrently. This means learning through the combined use of visuals (through pictures, animations, text and videos) and audio (through narrated voiceover). Examples of multimedia learning include watching a PowerPoint presentation, watching a pre-recorded lecture or reading a textbook.

Traditional chalk and talk method of teaching resulted in misbalance between what learning is given to the students in the classroom versus what is the need of organizations in the corporate world. As a result of this mismatch many educational institutions are using problem based teaching which can be explained as an innovative strategy, in which teacher often gives lectures on a particular topic with the help of a multimedia projector, in order to teach different skills and knowledge to an audience which is required in the job market. Problem-based learning is gradually being accepted in most of the institutions as an instrument to tackle the deficiencies of traditional chalk and talk method of teaching. Problem-based learning is proven as an effective method in order to teach students in a more appropriate manner, with the help of real-life problems and implement solutions. (Kenny, 2012)

The arguments that support the use of a variety of methods in teaching and learning encounter include:

i. not all students learn well through the same teaching strategies. There are students for example who prefer to learn using inquiry method, while there are others who prefer expository method (approach)
ii. certain methods are more applicable to particular teaching situation. No one strategy is appropriate to all learning contexts.
iii. no single method is superior to another in all situations, particular, in terms of students' performance. On the basis of this argument, strategies must be matched to instructional objectives so that the more effective and efficient one is selected. (Wayne and Young, 2013).

The following is one of the groupings of teaching methods:

i. Expository teaching where the flow of knowledge/ information is from source to learner.
ii. Interactive teaching, which incorporates the interchange between source and learner.
iii. Small group teaching whereby the emphasis is on group participation.
iv. Inquiry teaching whereby learners are actively engaged in solving problems
v. Individualization, which involve the completion of tasks appropriate to learners' level of ability.
vi. Models of reality; which involves learners in replication of the real world. (Ndukwe, 2012)

In the most general terms, there are four or five different models of teaching models. Having spent years in schools, you will

recognize each and probably have strong preferences for one or two models (Ali, 2014). These models cover a wide range of specialties and purposes, they include;

a) **Didactic – Directing teaching:** This involves the verbals and is typically in the form of a lecture or presentation.
b) **Modelling – directing teaching:** includes visual and typically in the form of demonstration and practice.
c) **Managerial- Indirect or interactive teaching:** Involves facilitation, individualization, and group management.
d) **Dialogic- indirect interactive teaching:** This is a Socratic technique of dialogue, questions and thought provocations.

In the direct instruction models, the teacher imparts knowledge or demonstrates a skill. In the indirect instruction models, the teacher sets up strategies, but does not teach directly, the students make meaning for themselves. In the interactive instruction models, the students interact with each other and with the information and materials; the teacher is organizer and facilitator.

In the words of (McGonigal, 2015), teaching is considered as a transformation process from learning theories to teaching strategies". Learning theories can be categorized as methods that promote behaviouristic, constructivist or socio-cultural learning.

The behviourist learning theory emphasizes external influence and the 1havior it causes stimulus and response are key concepts that define behaviourist learning. Behaviourism assumes that the human mind is a passive recipient of knowledge, and since it is not possible to observe or measure what is happening inside a human being researchers focus on external behavior that can be observed (Driscoll, 2012) teaching methods that promote behaviourist learning are those that focus on teacher-directed instruction, systematic training and repetition Behaviouristic methods are tailored to external stimulation of students. The following methods are typically associated with methods that foster behaviouris learning:

1. Demonstration method
2. Problem- solving method

The advantage of this method is that they are practicable and easy to use in classroom and ensure that the students "get through" the curriculum. The downside is that there is little personalization, and the students develop little understanding but only mimic or repeat the knowledge they are supposed to acquire, and that all must follow the same progression regardless of conditions, interests or needs.

Constructivist learning rejects the behaviouristic view that knowledge is an objective truth, which exists out there, which can be acquired by correcting the knowledge of new sensory data. Rather, the constructivist learning theory views knowledge as a constructed entity made by each learner through a learning process, constructivism frames learning less as the product of passive transmission than a process of active construction whereby the learners construct and reconstruct their own knowledge based upon prior knowledge (Piaget, 1971; Taber, 2014).
Constructivist learning requires learners to demonstrate their skills by constructing

their own knowledge when solving real world problems. The constructivist model calls for learner-centred instruction, because learners are assumed to learn better when they are forced to explore and discover things themselves: Constitivism as an educational philosophy has been introduced in computer science education (Ben-Ari, 2012). According to Ben-Ari the only teaching methods that encourage students to construct their own knowledge is the individual problem solving approaches.

1. Individual problem solving

In this method, there is a high degree of activity where students must make their own discoveries through problem solving. This fosters creativity and reflection. It is also easier to add up to differentiated tasks. A disadvantage may be that students cannot get an understanding of the problem if they do not identify the correct answer, or that they find the answer that they think is correct but is not in a specific situation.

The socio-cultural learning or situated learning, ties together the individual and the social context. It can be seen as a correction of constructivism. Whereas in the constructivist paradigm learning is assumed to occur as an individual learner interests with study material, learning in the socio-cultural perspective is understood as a social process in which individuals interact with the social environment (Ayeni, 2013). Learning occurs as learners construct their knowledge through discussion, dialogue, communication, information sharing and interaction with others.

In a problem solving method, Childan learn by working on problems. This enables the students to learn new knowledge by facing the problems to be solved. The students are expected to observe, understand, analyze, interpret, find solutions, and perform applications that lead to a holistic understanding of the concept. This method develops scientific process skills. This method helps in developing brainstorming approach to learning concepts. Problem-solving is a process- an ongoing activity in which we take what we know to discover what we don't know. It involves overcoming obstacles by generating hypo-theses, testing those predictions, and arriving at satisfactory solutions. Problem-solving involves three basic functions; seeking information, generating new knowledge and making decisions. (Swarnika, 2019).

Furthermore, Vygotsky argued that the guidance given by more capable others, allows the learner to engage in levels of activity that could not be managed alone. (Ben — Ari, 2014).

Typical methods that foster sociocultural learning are:

i. Group work under the teacher's guide
ii. Home work assignments and ask friends, or parents for help.
iii. Present solutions to problems in front of the class.

Also such methods foster dialogue, discussion, cooperation, and students' participation. Knowledge is acquired through collaboration, and it is engaging if the topic is interesting. Disadvantages of group and project work may be timeliness and efficiency. It can be difficult to

evaluate individual members, and it does not necessarily promote independent learning and being able to stand on its own.

As noted earlier, the persistent poor achievement of students in Biology as revealed by both research results and WAEC Chief Examiners' Reports calls for concern especially for teachers of Biology that enroll larger number of students. Students find sciences to be difficult, boring and not interesting. The problem has to a large extent been attributed to ineffective teaching method employed by the teachers- especially lecture teaching method which is teacher-centered.

Consequently, there is felt need to improve on the teaching and learning of Biology by exploring the use of some innovative learner centered teaching-learning methods, since it is believed that meaningful learning may be as a result of active participation by students. Among the factors responsible for students poor academic performance in the subject is large class sizes, inadequate funding, insufficient curriculum resources, poor teaching skills and lack of supports for teachers among other factors limit the quality of science teaching and learning in Nigerian school.

In secondary schools in Esan-West L.G.A of Edo state, the researches have been made and proving that have being poor academic achievement among students'. A whole lot of reason have been put up to explain these including lack of educational facilities, poor road network, lack of instructional materials as well as poor level of motivation on the part of both the teacher and students. As discussed earlier, teaching method is one of the most important factor that determine the outcome of academic achievement. In Esan-West which is majorly a rural area, teacher quality have been observed to be a major problem. Most qualified teacher have preferred more urban, areas to the present area. This means that, the less qualified teachers are left to oversee teaching activities in schools in the area. As a result, their incompetencies as well as in experiences have come to play when it comes to applying the best teaching method in teaching of students' in the area. On this note, the present researcher picks up interest in investigating the effect of demonstration and problem-solving teaching methods on science students' performance in Biology.

Aim and Objectives

The aim of this study is to determine the efficacy of demonstration and problem solving teaching methods on Biology Students' Academic Achievement in Esan – West LGA of Edo State.

The study specifically intended to;

1. Investigate the effect of demonstration method on students' achievement in Biology subject
2. Investigate the effect of problem-solving method on students' achievement in Biology subject.
3. Two research questions and two corresponding hypotheses were formulated for the study;

Research Questions

The following research questions will guide the researcher in the study.

1. What is the effect of demonstration method on students' academic achievement in Biology subject?
2. What is the effect of problem-solving method on students' academic achievement in Biology subject?

Hypotheses

1. Demonstration method has no significant effect on students' academic achievement in Biology subject.
2. Problem-solving method has no significant effect on students' academic achievement in Biology subject.

Methods

This study was conducted mainly to explore the academic effect of teaching students using the demonstration and problem-solving method. Non-equivalent-control – group design also known as the non-randomized – control-group-pretest-post-test – design was used in the study.

The design was used because the researcher gather data from two variables from the respondents. The two sets of data came from the teaching methods (demonstration and problem-solving) and students performance test (Biology) treatment were administered to the experimental groups (demonstration and problem-solving) while no treatment were administered on the control group.

The population for the study consisted of Senior Secondary School II students in Esan-West L.G.A. As at the time of the study, there are 750 SS2 students in the L.G.A as informed by the Edo State Secondary Education Board, 2019. This population were chosen because they were ready learners, and are exposed to various teaching methods and can as well detect easily which methods make more impact on them.

One hundred (100) SS2 students were drawn for the study from the population. Simple random sampling and non-proportionate sampling technique were used as methods of sampling. The researcher applied the initial technique in drawing 5 schools out of 12 secondary schools in Esan- West L.G.A of Edo State. All the schools were listed in a piece of paper, folded, and shuffled. With blindfold, the researcher hand picked five pieces which revealed the names of the schools used. This process ensured that all the schools had equal chance of being selected as well as being dropped.

Afterwards, non-proportionate sampling technique was used to draw twenty (20) students from each school irrespective of their number. This gave a total of 100 respondent in all.

Biology Achievement Test (BAT) was developed by the researcher for the study. It was designed using the multi-choice item format ranging from A-D. Only one option (key) was the correct answer and students were required to tick (√) the correct option. The researcher also ensured that the students were exposed to 2 months and one week teaching using the demonstration and the problem-based method. The test instrument contained 40, items in all.

Table of specification was used in determining validity of the test instrument, a total of 9 weeks was used. Content areas include, Osmosis, food testing, pollution and photosynthesis. The Bloom's lower cognitive level of knowledge

comprehension and application were used in drafting test contents. 22 items representing 60% of the test content contained. Items testing the students knowledge. Eleven (11) representing 25% comprehension questions while 7 items representing 15% contain application items.

The reliability of BAT was determined using Kuder Richardson Formular 20 (KR_{20}). Thirty students who were not part of the targeted sample but who shared similar characteristics were selected and administered with the instrument. After their responses, their scores were subjected to KR_{20} formular for determining reliability. A reliability coefficient of 0.57 was realized indicating that the instrument was reliable enough. The test was administered directly to the students with the help of research assistants who were mostly their class teachers.

Results

Data generated from the research instrument were analyzed using the –test to test the individual research question.

Research Question One: What is the effect of demonstration method on students' achievement in Biology?

Hypothesis One: Demonstration method does not have any significant effect on students academic achievement in Biology.

Groups	N	$\overline{X}$	S. D	t-cal	∝	Df	t-crit	Sig.	Result
Demonstration group	20	26.90	5.13						Significant
				3.212	0.05	38	1.960	0.003	Rejected
Control group	20	21.95	4.59						

From table 4.2 above, mean and standard deviation for those in demonstration and control group were 26.90, 5.13 and 21.95, 4.59 respectively. From the mean values, it could be seen that those in the experimental group scored higher than those in the control. Hence, the research question can be answered that the effect of demonstration method on students' performance in Biology is positive. The t-test also reveal a sig- value of 0.003. Hence, since sig ($p = 0.003 < 0.05$) is less than 0.05 alpha at 38 degrees of freedom, the null hypothesis is rejected meaning that demonstration method has a significant positive effect on students' achievement in Biology.

Research Question Two: What is the effect of problem solving method on students' academic performance in Biology?

Hypothesis Two: Problem solving method does not have any significant effect on students' academic performance in Biology.

Table 4.2: Shows t- test analysis of effect of problem solving teaching method on students' performance in Biology.

Groups	n	$\overline{X}$	S. D	t-cal	∝	df	t-crit	Sig.	Result
Problem-solving	20	24.90	4.86						Insignificant
				1.972	0.05	38	1.960	0.056	Failed to reject
Control group	20	21.95	4.59						

Table 4.2 reveals mean and standard deviation of 24.90, 4.86 and 21.95, 4.59 respectively for both the experimental and control group. The mean value here compared to the pretest scores as well as the control groups indicated that problem solving method has a positive effect on students performance in Biology. The t-test also reveals a sig-value of 0.056. Hence, since sig ($p = 0.056 > 0.05$) is greater than 0.05, the hypothesis is accepted indicating that the positive effect was not significant.

From the analysis in the table, it is revealed that;

1. Demonstration method has a significant positive effect ($P = 0.003 < 0.05$) on students' achievement in Biology.
2. Problem solving method has a positive but an insignificant effect ($p = 0.056 > 05$) on students' achievement in Biology.

Discussion of Results

From the analysis in table 4.1, it is revealed that demonstration method has a significant positive effect on students' academic performance in Biology. This findings mean that students understand better when their teachers adopt various forms of demonstration, examples and visible actions in teaching them. The result here may arise because most students seems to recall better what they hear and see others do. This finding however is not surprising at all to the researcher because she is quite aware of the fact that students will have a ful grasp of what is demonstrated. In other words when teachers fail to demonstrate their fact practically, this may limit the students ability to comprehend and remember.

This findings however is in line with that reported earlier by Daluba (2013) who noted that there is significant influence of demonstration method on students' achievement in Agricultural Science. Also, Ameh and Dantani (2012) noted that there is significant influence of demonstration method on academic achievement of students in chemistry.

From research findings two in table 4.2 it is revealed that problem solving method has an insignificant positive effect on students' academic performance in Biology. This findings mean that students would have understood better if the teacher had watch the situation before applying the problem-solving method, interpreting and formulating it. This finding however is not surprising as the researcher is quite aware that students no longer involve themselves in critical thinking. In other words when teachers fail to present problems that are within the reach and capacity of learners, this may limit their ability to reason and be creative.

This findings however is in line with (Ogunmade, 2015) who noted that there is no significant influence of problem solving on secondary school teaching and learning.

Conclusion

Based on the findings of the study, the demonstration method has a significant positive effect on students' academic achievement. This method is an effective method for promoting meaningful learning in science. This method will help students retain and apply knowledge thereby reducing students dislike for Biology subject, reducing forgetfulness in concepts and reducing examination malpractice.

On the contrary, though the problem-solving method show some high mean values, this method is not particularly effective. This may be because students at this level still need guidance and mentorship in their studies and teacher and other teachers should not use this method independently in teaching Biology as a subject.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Biology teachers should endeavor to use the demonstration method for Biology lessons in order to motivate and arouse the interest of students to meaningful and better achievement of course.
2. Biology teachers should also use problem-solving method to foster critical thinking in the minds of students, for this to be effective students should have knowledge of facts, materials and methods to be employed.

However, they should not use this method independently as it may still give the students problems in their course of study.

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