TEACHING OF THE CONCEPT "DIFFUSION" USING DEMONSTRATION AND EXPOSITORY METHODS AND ITS INFLUENCE ON THEIR ACADEMIC ACHIEVEMENT OF STUDENTS IN BIOLOGY IN URUAN LOCAL GOVERNMENT AREA

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ABSTRACT

This study examined teaching of the concept "diffusion" using demonstration and expository methods and its influence on their academic achievement of students in biology in Uruan Local Government Area. The population of the study consisted of all the senior secondary two students in Uruan Local Government Area in Akwa Ibom State. The study adopted a quasi-experimental type research design while simple random sampling technique was used in selecting the respondents. Data was obtained using an instrument tagged ""Biology Achievement Test Inventory (BATI)." Data obtained from respondents was analysed using descriptive statistics (mean and standard deviation), hypotheses were tested with independent t-test analysis and Pearson Product Moment Correlation analysis was used to test the hypotheses at 0.05 alpha levels. It was concluded that Biology students taught with demonstration method perform significantly better than their counterparts taught with expository methods. Also, male students perform significantly better than their female counterparts. The concept diffusion and other topics in Biology should be taught most times using demonstration methods. Expository method is also highly recommendable.

INTRODUCTION

Science is an essential tool for any nations' progress and development (Akinbobola, 2009). Students should actually be given opportunity to discover, invent and get caught up in the rapid expansion in science and technology. This is because, biology has made great impact in the development of nations and its importance warrants the need to expose biology students to innovative methods like guided-inquiry method in the secondary schools. Chukwuneke (2006) asserts that if biology students are exposed to appropriate method of teaching in the secondary schools, students will be able to apply knowledge, communicate effectively, and be analytical, critical thinkers, inquisitive and imaginative. Biology as one of the science subjects, when properly taught, will help the students to solve personal and societal problems such as health wise and socio-economic

problems. The knowledge of Biology helps to question superstition, know the function of the various parts of the body, enables one to understand oneself, maintain good health practices such as the use of clean water, good sanitation, balanced diet, the need to vaccinate, among others (Maduabum, 1998).

The inculcation of scientific skills and attitudes in students can only be achieved through the proper teaching of the various science subjects; these include Biology, Chemistry, Physics, Mathematics, Health Science, Agriculture, etc. Biology as one of the science subjects, when properly taught, will help the students to solve personal and societal problems. In addition to other topics is biology diffusion which is prominently taught in our schools. Diffusion is the net movement of molecules or atoms from a region of high concentration (or high chemical potential) to a region of low concentration (or low chemical potential). This is also referred to as the movement of a substance down a concentration gradient. A gradient is the change in the value of a quantity (e.g., concentration, pressure, temperature) with the change in another variable (usually distance). For example, a change in concentration over a distance is called a concentration gradient, a change in pressure over a distance is called a pressure gradient, and a change in temperature over a distance is a called a temperature gradient (Agboghoroma, 2009). The word diffusion is derived from the Latin word, "diffundere", which means "to spread out" (if a substance is “spreading out”, it is moving from an area of high concentration to an area of low concentration). It has become necessary that appropriate teaching methods be used to teach the concept of diffusion. Many experts have recommended the use of demonstration and expository methods. Others have also seen other teaching methods as their preference.

Statement of the Problem

It is quite true that every learner is expected to enjoy effective learning for the purpose of promoting good academic performance on the part of the students. This has made it true that no good academic performance can be obtained without good teaching strategies, which motivate students to learn, especially, biology.

It is quite certain that in most cases, teachers do not exhibit appropriate teaching strategies that motivate students to perform well in their examinations. This may be due to the fact that they are not familiar with the right teaching method to use. For instance, it is not uncommon to find some teachers teaching students with demonstration and expository methods most times, especially when it is not necessary and rather deprive them of the needed knowledge which are interesting and motivational to the students. At times, teachers do not use the right teaching methods in teaching biology. It is for this purpose that this study is carried out in order to explore each of the aforementioned teaching methods in order to find out their level of influence on the academic performance of secondary school students in biology in Uruan Local Government Area.

Purpose of the study

The main objective of the study is to examine the teaching of the concept “diffusion” using demonstration and expository methods and its influence on the academic achievement of students in biology in Uruan Local Government Area: The objectives are as follows:

1. To find out the difference in the academic performance of secondary school students in biology taught with demonstration and expository methods.
2. To determine the difference in the academic performance of secondary school male and female students in biology taught with demonstration method.

Research Question

The following research questions were raised to guide the study:

1. What is the difference between the mean score of secondary school students in biology taught with demonstration and expository methods?
2. What is the difference between the mean score of male and female secondary school students in biology taught with demonstration method?

Research Hypotheses

The following hypotheses were raised to guide the study:

1. There is no significant difference between the academic performance of secondary school students in biology taught with demonstration and expository methods.
2. There is no significant difference between the academic performance of male and female secondary school students in biology taught with demonstration method.

Literature Review

Teaching and learning of diffusion

In the context of current reforms oriented science that values the idea of "science as a process," the description of approaches to science teaching must encompass both content ("what is taught") and pedagogy ("how it is taught") (Barko, 2006). Regarding the content, conceptual knowledge involves, for example, identifying the main ideas associated with the concepts of diffusion in a given class; the relationship between diffusion and molecules' random motion; the relationship between concentrations on each side of the membrane. However, Hasni & Bousadra (2015) assert that the teaching of diffusion should not be limited to acquiring decontextualized and unrelated fact or learning these concepts for their own sake. Instead, it should strive for students' acquisition of the broad ideas that characterize the field of biology. Two of these ideas are worth mentioning here:

1) Associating diffusion with transport through the cell membrane and with cellular exchanges, while also clarifying the role of the cytoplasmic membrane. Because of the selectivity of exchanges it enables, the membrane plays an important role in maintaining

a cell's internal equilibrium and consequently its survival. Selective permeability allows certain crucial molecules (glucose, amino acids, etc.) to penetrate into the cell, intermediate metabolites to be retained, and metabolic waste to be evacuated (Lodish et al., 2005).

2) Understanding the resulting dynamic equilibrium that is needed for certain biological functions. Aside from these characteristics that allow substances to be exchanged through diffusion, through facilitated passive transport or through active transport, it is important to underline the dynamic equilibrium that results from the membrane's features and that in some cases prevents the achievement of equal concentrations on each side of it. A number of biological phenomena, including those associated with the production of ATP (in mitochondria, for example) or the transmission of nerve impulses (in neurons), require that the cells concerned be able to maintain a concentration gradient on each side of biological membranes, namely by spending energy.

The osmotic gradient between root cells helps enable plants to absorb water. These are only examples. Along with conceptual knowledge, it is important to consider the moments when students acquire the methodological skills associated more specifically with scientific investigation processes (microscopic observations that illustrate studied phenomena; experiments on diffusion; etc.). These are all types of scientific learning targeted by programs in numerous education systems. To give a few examples, one of the four foundations of the Common Framework of Science Learning Outcomes published by the Council of Ministers of Education, Canada (CMEC, 1997), is that students will develop the skills required for scientific and technological inquiry, for solving problems and for making informed decisions. Hasni (2011) assert that once students have been exposed to the concepts of diffusion, osmosis, insect, etc, with the help of specific situations, they can then be presented with cases that have not been seen in class to verify whether they are able to understand them or not. From a perspective that could be described as constructivist, the idea is to draw on approaches that enable students to be engaged in the conceptual learning and development process. These approaches, when they are adopted by the students, involve more than solving the problems that are proposed or formulated by others.

Demonstration and Expository Teaching Method on Students Achievement

According to Hadim and Esche (2002), demonstration strategy has emerged to become an instructional approach that is gaining growing interest within the biology education community Duch (2002) described demonstration strategy as an instructional strategy that challenges students to "learn how to learn," working cooperatively in groups to seek solutions to real world problems. Prpic and Hadgraft (2009) addressed the key ingredients of demonstration strategy and postulated that it should not be confused with design projects or case studies where the focus is predominantly on the application of existing knowledge and integration of what is already known. Research has found that diverse students benefit immensely when they have the opportunity to interact with materials, participate in activities, and manipulate objects and equipment (Carrier, 2005; Prpric and Hadgraft, 2009). Through laboratories, demonstrations, educational games,

simulations, field trips, and other interesting activities, students in secondary school classes have many opportunities to be engaged actively in the learning process (Blair, Schwartz, Biswas, and Leelawong, 2007).

Demonstration strategy goes beyond this, students encounter some concepts for the first time and therefore they need strategies for acquiring this new knowledge (Prpic and Hadgraft, 2009). No one can deny that schools are becoming diverse in terms of student backgrounds and abilities, and teachers are being ever more challenged to find effective ways to meet diverse needs of their students. Educators confront classrooms in which students exhibit assorted academic and behavioral characteristics and they are increasingly looking for successful instructional and classroom management techniques (Tournaki and Criscitiello, 2003). Nnadi (2002) investigated the influence of level of resource utilization on students' achievement and attitudes towards science. The result showed that out of the nine resource utilization variables, only six made significant contribution to biology achievement. Although the work focused on the relationship between some resource utilization variables, achievement and attitudes in Biology, it did not concern itself with the effect of specific resource materials on the students learning.

Expository approach is the oldest approach employed in our schools for teaching both Science and Arts subjects (Agbulu, 2002). It involves verbal presentation of ideas, concepts, principles, generalization and facts. The objective is to impart or inculcate information to the students. The teacher does much of the activity in form of talking while, the pupils are either passive or slightly involved. Expository approach habours two basic skills which every teacher must endeavour to explore for effective dissemination of information to the students. These skills include: clear and good command of language and ability to write clearly and boldly on the chalk-board. In expository approach, the teacher knows every thing and that the learner is almost blank. It is the teacher's role to impart his knowledge merely by telling his students. The expository approach derives from the commonly held notion that in the teacher–student relationship, the teacher, as an embodiment of knowledge, gives out what he knows to his students. The teacher talks with the students. The teacher talks with the students by means of reading his notes (Snowman and Biehler, 2000).

Teachers make practically all the decisions; the mode of instruction; organization of learning experiences and materials; sequence; pacing and style of information dissemination. The teacher is therefore, the expositor and actor, while students are listeners, speaking only when called upon to answer questions, ask questions or demonstrate a procedure. The relevance of this study borders on the fact that education is the most important instrument for change especially in a fast changing world, the educational process needs to be put under constant focus so as to make it responsive to emerging challenges (Tournaki and Criscitiello 2003).

Effective teaching and learning can only be ascertained through proper assessment. Assessment according to Hornby, (2001) means appraise; fix or value of a speech at its true worth. It could be inferred from this definition that assessment deals with testing to know whether learning experiences are perfectly taught to students. It is carried out through formative and summative phases. Formatively, students are asked

questions when the lesson is on-going. This acts as check and balance in correcting the teaching learning style and repositioning the teacher at the course of delivering lectures/ tutorials in the classroom.

Methods

Research Design

The research design for this study is a quasi-experimental type. This design is found fit for this study as it attempts to find out the effect of the independent variables (teaching methods) on the dependent variable (performance of students).

Area of the Study

The area of study is Uruan local government area of Akwa Ibom State.

Population of the Study

The population of the study consisted of all the senior secondary two students in Uruan Local Government Area in Akwa Ibom State. They are 5993 in number (Ofonime, 2012).

Sample and Sampling Technique

The respondents in the study consisted of 10 teachers and 200 students. These were obtained through the simple random sampling method. Hence, the sample size of 200 respondents was used for the study.

Research Instrument

The researcher developed one instrument tagged "Biology Achievement Test Inventory (BATI). The instrument was made up of two sections, sections A and B. The Teaching Method Inventory (TMI) was used to test students on biology as a subject and Diffusion as a topic. The total number of items in the BATI was 20 in objective questions which measured 100% in all

Validation of the Research Instrument

The instrument was face and content validated by the researcher's supervisor. An expert from test, measurement and evaluation also helped in validating the instrument. The corrections and comments were incorporated into the final form of the instrument.

Reliability of the Instrument

Pearson product correlation was used to determine the reliability of the instrument (BATI), using 30 respondents who were not part of the main study but possess the character of the population. The reliability co-efficient was 0.88 showing that the instrument is reliable.

Experimental procedure

The researcher selected 50 male students and 50 female students for group X_1 (students taught with demonstration method). Then the next 50 male students and 50 female students made up group X_2 (students taught with expository method). The researcher taught the two groups of respondents before administering the instruments. This helped her derive scores used for data analysis.

Data analysis technique

Each research question was answered here with descriptive analysis while the hypotheses were tested with independent t-test analysis. The results of the statistical analysis for the hypotheses were tested for significance at 0.05 alpha level. Each result is considered

significant if the calculated value is greater than the critical value, but non-significant if the calculated value is less than the critical value.

Results and Discussion

Research Question One

The research question sought to find out the difference between the mean score of secondary school students in biology taught with demonstration method and those taught with expository method. To answer the research question, descriptive analysis was performed on the data (see table 1)

Table 1

Descriptive analysis of the difference between the mean score of secondary school students in biology taught with demonstration and expository methods.

Variables	N	X	Mean Difference	Remarks
Demonstration Method	100	74.05**		
			11.83***	***Remarkable Difference
Expository Method	100	62.67*		

**** The highest mean score**

*** The least mean score**

Source: Field Survey

The result of the above table 1 presents the descriptive analysis of the difference between the mean score of secondary school students in biology taught with demonstration method and those taught with expository method. From the result of the analysis it was observed that the mean score of secondary school students in biology taught with demonstration method (74.05) were remarkably higher than that of their counterparts taught with expository method (62.67) with remarkable mean difference of (11.83). The result therefore means that there is remarkable difference between the mean score of secondary school students in biology taught with demonstration method and those taught with expository method.

Research Question Two

The research question sought to find out difference between the mean score of male and female secondary school students in biology taught with demonstration method. To answer the research question, descriptive analysis was performed on the data (see table 2)

Table 2

Descriptive analysis of the difference between the mean score of male and female secondary school students in biology taught with demonstration method.

Variables	N	X	Mean Difference	Remarks
Male	50	76.84**	5.58***	***Remarkable Difference
Female	50	71.26*		

**** The highest mean score**
*** The least mean score**
Source: Field Survey

The result of the above table 2 presents the descriptive analysis of the difference between the mean score of male and female secondary school students in biology taught with demonstration method. From the result of the analysis it was observed that the mean score of male secondary school students (76.84) were remarkably higher than that of their female counterparts (71.26) with remarkable mean difference of (5.58). The result therefore means that there is remarkable difference between the mean score of male and female secondary school students in biology taught with demonstration method.

Hypotheses testing

Hypothesis one

The null hypothesis states that there is no significant difference between the mean score of secondary school students in biology taught with demonstration and expository methods. In order to test the hypothesis, two variables were identified as follows:-

1. Teaching methods as the independent variable
2. Performance of students in biology as the dependent variable

Independent t-test analysis was used to analyze the data in order to determine the difference between the mean score of secondary school students in biology taught with demonstration and expository methods. (See table 3).

Table 3

Independent t-test analysis of the difference between the mean score of secondary school students in biology taught with demonstration and expository methods.

Variable	N	$\bar{X}$	SD	t
Demonstration Method	100	74.05	9.97	

				7.58*
Expository Method	100	62.67	11.23	

***Significant at 0.05 level; df = 198; N= 200; critical t-value 1.960**

Table 3 presents the obtained t-test-value as 7.58. This value was tested for significance by comparing it with the critical t-value (1.960) at 0.05 level with 198 degree of freedom. The obtained t-value (7.58) was greater than the critical t-value (1.960). Hence, the result was significant. The result therefore means that there is significant difference between the mean score of secondary school students in biology taught with demonstration method and those taught with expository method.

Hypothesis Two

The null hypothesis states that there is no significant difference between the mean score of male and female secondary school students in biology taught with demonstration method. In order to test the hypothesis, two variables were identified as follows:-

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1. Gender as the independent variable
2. Performance of students in biology as the dependent variable

Independent t-test analysis was used to analyze the data in order to determine the difference between the mean score of male and female secondary school students in biology taught with demonstration method. (See table 4).

Table 4

Independent t-test analysis of the difference between the mean score of male and female secondary school students in biology taught with demonstration method.

Variable	N	$\bar{X}$	SD	t
Male	50	76.84	7.88	
				10.85*
Female	50	71.26	11.09	

***Significant at 0.05 level; df = 198; N= 200; critical t-value 1.960**

Table 4 presents the obtained t-test-value as 10.85. This value was tested for significance by comparing it with the critical t-value (1.960) at 0.05 level with 198 degree of freedom. The obtained t-value (10.85) was greater than the critical t-value (1.960). Hence, the result was significant. The result therefore means that there is significant difference between the mean score of male and female secondary school students in biology taught with demonstration method.

Discussion of findings

The result of the data analysis in tables 1 and 3 were significant due to the fact that the calculated obtained t-value (7.58) was greater than the critical t-value (1.960) at 0.05

level with 198 degree of freedom. This result implies that there is significant difference between the mean score of secondary school students in biology taught with demonstration and expository methods. The result is in agreement with the research findings of Martin (2003) who proposed that the teacher should involve the pupils when demonstrating in classrooms. Involvement can be through asking questions for clarity or through demonstrating figures. The result was also in agreement with the findings of Moore, (2000), who suggest that, teachers need to redemonstrate where pupils are failing to reproduce the skills shown before. The result of the analysis caused the null hypotheses to be rejected while the alternative one was retained.

The result of the data analysis in Tables 2 and 4 were significant due to the fact that the calculated obtained t-value (10.85) was greater than the critical t-value (1.960) at 0.05 level with 198 degree of freedom. This result implies that there is significant difference between the mean score of male and female secondary school students in biology taught with demonstration method. The result is in agreement with the research findings of (Carrier, 2005). The result of the analysis caused the null hypotheses to be rejected while the alternative one was retained.

Conclusion

Based on the findings of the research work the following conclusions are deemed necessary: Biology teachers in secondary schools in Uruan Local Government Area have exposed their male and female students to different teaching methods up to a high extent. Biology students taught with demonstration method perform significantly better than their counterparts taught with expository methods. Finally, male students perform significantly better than their female counterparts.

Recommendation

Based on the findings of this study, it was recommended that:

1. The concept diffusion and other topics in Biology should be taught most times using demonstration methods. Expository method is also highly recommendable.
2. It is advisable that female students should endeavour to compete with their male counterparts while the male folk should not also relent in their studies.
3. Schools should endeavour to introduce biology students to laboratory tests in order to prepare them effectively not only for examination but also for the future.

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