FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION

5th INTERNATIONAL CONFERENCE

THEME

ENHANCING SCIENCE AND TECHNOLOGY EDUCATION IN A DWINDLING ECONOMY

Conference *Proceedings*

DATE: 3rd - 6 th October, 2017

VENUE: CPES COMPLEX, BOSSO CAMPUS, MINNA

IMPACT OF LABORATORY INSTRUCTIONAL STRATEGY ON SECONDARY SCHOOL BIOLOGY STUDENTS' ACHIEVEMENT ON THE CONCEPT OF DIFFUSION IN MINNA METROPOLIS, NIGER STATE

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Abstract

This research study examined the impact of Laboratory Instructional Strategy on secondary school biology students' achievement on the concept of diffusion in Minna metropolis of Niger State. Two Hypotheses guided the study. Random sampling technique was used to assign the sampled schools to experimental and control groups. One hundred and sixty students (160) (80 from each School) were randomly selected and used for the study. The experimental group students were taught the concept of diffusion using Laboratory Instructional Strategy while control group students were taught the same topic using conventional lecture method. The instrument used for data collection was Biology Achievement Test (BAT) questions consisting of 20-Multiple Choice Test Items on the concept of diffusion. It was found that Laboratory Instructional Strategy enhanced students' achievement on the concept of diffusion in biology. It was also found to be gender friendly. It was recommend that teachers should be encourage to employ the use of the strategy in teaching biology concepts and Niger State government should organize Professional Career Development programs for secondary school teachers in form of workshops, conferences and seminars in order to make them well equipped for effective utilization of Laboratory Instructional Strategy during teaching.

Introduction

Biology is among the basic science subjects related to plant, humans and animal life. Biology is referred to as a branch of science concerned with the study of life (Tela, 2003). Biology could also be defined as the science of life (Lawal, 2011), Biology studies the composition, structure, function, origin, growth, evolution and distribution of living things through series scientific research methods (Alina, 2015). Biology consists of two major branches namely Botany and Zoology. Other sub branches of biology include Anatomy, Cytology, Ecology, Evolution, Genetics, Microbiology, (Daniela (2014), Alina (2015) Ajayi (2008) and Bennet (2005).

Most important concepts of biology are better understood when they are taught through practical exercise (Laboratory Instructional Strategy). Laboratory Instructional Strategy is an instructional strategy that permits students to practice and acquire knowledge, skills, and altitudes necessary to successfully perform one or more learning objectives on their own (Millar, 1999). Practical exercise (Laboratory exercise) is therefore an essential technique of teaching and learning of biology as biology is basically concerned with the study of life (Woodley, 2009).

Laboratory Instructional Strategy involves experiments that demonstrate a wide range of biological concepts and processes practically to the students (Hodson, 2001). These experiments are placed within real-life contexts of the students so that it can easily link the skills they learnt in the laboratory to what they read from textbooks (Gummer & Chmpagne, 2006).

Diffusion is one of the biology concepts that could be taught theoretically but need to be demonstrated practically for easy understanding by the students. Diffusion is referred to as the movement of particles from a region of high concentration of the particles to that of low concentration (Millar, 2004). Diffusion is important as it the process of transportation of necessary materials such as amino acids, digested food substances, waste product of metabolism from one part of the body to anther or from a cell to its surrounding environment. It is also important for osmo-regulation as well as the proper functioning of the body systems of living organisms. Despite of the importance of the concept of diffusion to living organisms, WAEC examiners' reports shows that most students performs poorly on diffusion related questions at Senior School Certificate Examination (WAEC, 2012, 2013 & 2014). Many factors identified to be responsible for this includes: ill-equipped laboratories, unskilled science teachers, teacher's attitude, insufficient practical materials, and unskilled laboratory technologists amongst others (Odogwu, 1998 & 2004)

Woodley (2009) on the other hand pointed out that, biology students' poor performance in practical related concepts are caused by lack of well-equipped laboratory, inadequate qualified biology teachers, limited timetable hours, poor observation, poor drawing and labeling techniques, poor identification and comparative skills of students on the examination specimens. During laboratory classes, students only watche the teacher demonstrating the concept but are not active participants. In most cases, the laboratory attendants lack technical skills to operate, maintain, repair or service the only few available equipment. Ogunleye (2002) reported that in 2002, 2003 and 2004, the percentages of candidates who passed West African School Certificate Examination (WASCE) at credit level and above (A1-C6) in biology were 30.3%, 42.1% and 30.2% respectively. Similarly, Egbunonu and Ugbaja reported that only 30.29% of the biology student who sat for the WASCE between 2000 and 2005 passed at credit level and above (A1-C6), WAEC Chief Examiners reported a decline in performance in biology especially the practical aspect (WAEC, 2000, 2001, 2002, 2003, 2004 & 2005). Also, a four years analysis of biology students' result (2009 – 2012) as shown in table 1 reveals that their performance was not up to 39%

Table 1: Statistic of Biology Students' May/June SSCE WAEC Results (2009 – 2012)

		Numbers & percentage of different grades		
Year	Total no. of Candidates that Sat for the exams	Credit (1-6)	Pass (7-8)	Fail (9)
2009	1036,520 (95.46%)	322,310 (31.39%)	365,140 (35.57%)	339,070 (33.03%)
2010	1203,028 (99.41%)	466.115 (38.75%)	354,108 (29.43%)	349,060 (26.89%)
2011	1347,050 (96.34%)	492,422 (36.56%)	409,584 (30.41%)	362,238 (26.89%)
2012	5135,283 (97.63%)	4488,308 (31.81%)	478,840 (43.19%)	509,849 (33.21%)

SOURCE: WAEC Annual Report 2009-2012

The decline in performance still prevails in spite of the various reforms and intervention from the government. This phenomenon has remained a source of concern to science educators and educational experts. They tried many instructional strategies but yet, biology students' performances in some practical related concepts have not been improved. This might be because teaching of these concepts especially diffusion are normally done theoretically and not by practical. This study therefore, was aimed at determining the Impact of Laboratory Instructional Strategy on Secondary School Biology Students' Achievement on the Concept of Diffusion in Minna Metropolis of Niger State.

Purpose of the Study

The aim of this study was to determine the Impact of Laboratory Instructional Strategy on Secondary School Biology Students' Achievement on the Concept of Diffusion in Minna Metropolis of Niger State. Specifically, the study strived to achieve the following objectives:

Objectives of the Study

(1) To determine the differences in biology students' achievement on the concept of diffusion when taught using Laboratory Instructional Strategy

(2) To determine gender difference among biology students' achievement on the concept of diffusion when taught using Laboratory Instructional Strategy

Research Questions

(1) Will the use of Laboratory Instructional Strategy in teaching secondary school biology students the concept of diffusion result in higher achievement than when convectional method is used□

(2) Will the use of Laboratory Instructional Strategy in teaching secondary school biology students the concept of diffusion result in gender differences□

Null Hypotheses

The following null hypothesis were formulated and tested at 0.05 level of significance

Ho_1: There is no significant difference in the mean achievement scores of secondary school biology

students taught the concept of diffusion using Laboratory Instructional Strategy and those taught using Conventional Teaching Method

HO_2: There is no significant difference in achievement mean score of male and female secondary school biology students taught the concept of diffusion using Laboratory Instructional Strategy.

Methodology

The design adopted for this research was a Pretest-Posttest- Experimental and Control group design. Both groups were first pretested and thereafter the experimental group was taught the concept of diffusion using Laboratory Instructional Strategy while the control group was taught the same topic using Convectional Teaching Method. After a period of two weeks a posttest (same as pretest) was administered to both groups.

Target population of this study was of all Senior Secondary two (SSII) biology students in all the Secondary Schools in Minna Metropolis of Niger State. The sample size consist of eighty (80) students (40 boys and 40 girls) randomly selected from two sampled Secondary Schools used for this study.

Sample and Sampling techniques

Two secondary schools were randomly selected by simple balloting from the pool of secondary schools in Minna metropolis. The two selected schools were later assigned to experimental and control groups randomly. From each schools, a total of 40 (20 boys and 20 girls) biology students were randomly selected for study, SS two students were used because the study biology concept (diffusion) is part of their syllabus. The experimental group was taught the concept of diffusion using Laboratory Instructional Strategy while the control group was taught the same topic using Conventional Teaching Method.

Research Instrumentation

The instruments used for the study are Treatment instrument and the Test instrument. The treatment instrument used on experimental group was Laboratory Instructional Strategy while Conventional Teaching Method was used on control group. The test instrument used for data collection was Biology Achievement Test (BAT). BAT consist of 20 - Multiple Choice Test Items on diffusion (MCTI) drawn from past question papers of Senior School Certificate Examination (SSCE) conducted by the West African Examination Council (WAEC) and National Examination Council (NECO). Each test item had four options (A-D) and only one of the options is correct. Each correct answer (option) carries two (2) marks.

Validity of the Instrument

The instruments were validated by biology experts from the Department of science education, Federal University of Technology Minna Niger State.

Reliability of the Test Instrument

Government Day Secondary School Minna was used for establishing the reliability of the test instrument (pilot test) using test – retest method at an interval of two week. The scores of the two sets were correlated using PPMCC formula (PPMC) and r = 0.85 was obtained. This indicated that the instrument is reliable and also suitable for the purpose of this study.

Method of Data Collection

The schools selected were visited by the researchers for permission from the school authorities. Thereafter, the researchers were introduced to both the biology teachers and the SSII biology students. After orientation and administration of pretest, the researchers taught both the experimental and control groups the concept of diffusion in biology. Experimental group was taught using Laboratory Instructional Strategy while Conventional Teaching Method was used on control group. Treatment was followed by one week of revision after which posttest was administered to both groups. The contact period was (6) Six weeks was used.

Method of Data Analysis

Mean, Standard deviation and t – test were the statistics used to analyze the data collected for the study.

Results and Discussion

Pre-Test Result

Table 2: t-test Analysis for the Pre-Test Scores of Experimental and control groups.

Group	N	Df	□	S.D	t-value	p-value
Exp	40	78	9.52	2.55	1.53^{Ns}	0.13
Control	40		10.48	2.97		

Ns: P>0.05

Table 2: indicates the t-test analysis of the pre-test mean score of experimental and control groups. The experimental group had a mean score of 9.52 and standard deviation of 2.55 while the control group had a mean score of 10.48 and standard deviation of 2.97. t-test of 1.53 with df of 78 and p-value of 0.13 was also obtained at P>0.05, it implies that there was no significant different in the mean scores of experimental and control groups.

Hypothesis One

HO_1 There is no significant difference in the mean achievement scores of secondary school biology students taught the concept of diffusion using Laboratory Instructional Strategy and those taught using Conventional Teaching Method

Table 3: t-test Analysis of Achievement Score for Experimental and Control Group.

Group	N	Df	Mean(□)	S.D	t-test	p-value
Exp	40	78	14.30	3.02	4.31^{Ns}	0.000
Control	40		11.65	2.45		

Significant at P<0.05

Table 3: indicates the t-test analysis of the achievement score for experimental and control groups. The experimental group had a mean score of 14.30 and standard deviation of 3.023, while the control groups had a means core of 11.65 and standard deviation of 2.45, at $p < 0.05$, Therefore this result indicates that there was a significant difference in the mean achievement scores of students taught the concept of diffusion using Laboratory Instructional Strategy and those taught using Conventional Teaching Method. HO_1 is therefore rejected.

Table 4: Summary t-test Analysis of Mean Achievement Score of Male and Female biology students in Experimental Group.

Group	N	Df	□ (□)	S.D	t-value	p-value
Exp	20	38	14.25	3.01	0.37^{Ns}	0.72
Control	20		13.90	3.06		

Ns at P>0.05.

Table 4: indicates the t-test analysis of mean achievement score of male and female students. The male and female of experimental group has mean score of 14.25 and standard deviation of 3.01, while the male and female control group has mean score of 13.90 and standard deviation of 3.06 with t = 0.37, df = 38. Since 0.05, this result indicates that there was no significant difference in the achievement score of male and female students taught the concept of diffusion using Laboratory Instructional Strategy

Discussion of Results

The result of this study showed that the achievement level of the biology students on the concept of diffusion was improved significantly in the experimental groups after treatment. The table 2 shows the t-test analysis of hypothesis one. The table showed that Focal Calculation (0.13) is greater than the p-value of 0.000 at 0.05 level of significance (P>0.05). The null hypothesis was rejected. This showed that Laboratory Instructional Strategy has a significant effect on the achievement of students. This finding is in agreement with the previous works of Gott & Mashita (1994); Abraham and Miller (2008); Chukwuneke and Nwakwukwu (2005) who reported students' high achievement when taught with laboratory instructional strategy.

Table 3 showed the t-test analysis of male and female students in experimental group exposed to practical exercise lesson plan. The result showed that focal calculation (0.50) is less than (0.72) at 0.05 level of significance (P>0.05). The null hypothesis two (2) was retained, which shows that there is no significant difference in the mean achievement score of male and female students in the experimental group when exposed to Laboratory Instructional Strategy. Hence, the result showed that both male and female have equal opportunity to achieve better when taught in the same condition for learning. This finding is thus, in agreement with the findings of Fakorele (1999); Tella (2003), Wickman (2002) and Willington (2002) who observed that the male and female when exposed to practical exercise lesson plan did not show only significance in their performance.

However, the finding is in agreement with the findings by Umar (2011), Abimbola (2013) who notated that there was a significant difference in the performance of male and female students exposed to laboratory practical exercise.

Major Findings of the Study

The following were the major findings of the research study:

- Laboratory Instructional Strategy enhances students' achievement and had significant effect on their learning outcomes as students taught with the strategy achieved significantly better than those taught with Conventional Teaching Method.
- Males and females students taught with Laboratory Instructional Strategy achieved equally on the concept of diffusion. This means that Laboratory Instructional Strategy is gender friendly

Conclusion

Based on the research findings as related to the hypotheses formulated and tested, the following conclusions were made:

Exposing Students to Laboratory Instructional Strategy has helped to improve the students' achievement on the concept of diffusion in biology. In addition, no gender difference in achievement was observed but both male and female biology students achieved equally better.

Recommendations

On the basis of the above findings, the following recommendations were made:

The government should establish service training, symposia, workshops, conferences and seminars for the secondary school teachers on the use of laboratory instructional strategy as part of career development programmers

(i) Government should encourage the biology teachers giving them financial assistance to go for career development programs in the area of laboratory instructional strategy.

(ii) Since Laboratory Instructional Strategy is found to be gender friendly, Curriculum planners should encourage the biology teachers to use Laboratory Instructional Strategy while teaching by making adequate provisions in the curriculum to achieve such aim

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