EFFECTS OF LABORATORY INSTRUCTION INCORPORATING ANNOTATED DRAWINGS ON SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN BIOLOGY

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Abstract
Over the years, performance of secondary school students in biology has been consistently poor, and exploring instructional strategies became necessary. Therefore this study investigated the effects of laboratory instruction incorporating annotated drawings on the understanding of reproductive system in flowering plants by senior secondary school biology students. 183 SS II secondary school students drawn from two intact classes, from two secondary schools purposively sampled in Uwie Local Government Area of Delta state, constituted the sample. The study employed a pre-test, post- test, non- equivalent control group design. Quantitative and qualitative methods were used to collect data in order to answer research questions and testing of hypothesis formulated at 0.05 alpha level. Two instruments were used, Flowering Plants Achievement Test (FPAT), a 30- item multiple choice test with options A-D and a reliability coefficient estimated at 0.80 by split- half was used to collect quantitative data. An Interview Schedule (IS) with open ended questions was used to collect qualitative data . Findings are annotated drawing had a positive effect on students understanding. Secondly male and female students equally benefited from annotated drawing, however, there was no significant difference between student taught reproductive system in flowering plants with annotated drawing and those taught without annotated drawing.

Key words: laboratory instruction, annotated drawing, achievement, flowering plants

Biology as a branch of science is the study of living things and their interactions with their environment. According to National Association of Biology Teachers (2005), biology is the study of life and its evolution, organisms and their structures, functions, processes, and interactions with one another and with their environment. According to Hodson (1993) science has three major categories which include learning science, learning about science, and doing science. Hence, the paradigm shift to social constructivism to bring about interactions and engagement of biology students in science processes, manipulating materials and objects to explore scientific concepts in the course of fieldwork or laboratory work which are doing science rather than learning about science. Therefore, the constructivist approach in teaching biology enables the teacher to build models of students' science knowledge, students participate actively determining their ability of constructions, and learning is more interactive, more cooperative and collaborative. This is very important at early stage since it has been established that academic achievement in biology at secondary school level of education plays a key role in enhancing performance at tertiary level of education and should be a source of concern to stakeholders in order to bring about adequate intervention to confront the dismal performance of secondary school students in biology.

One of the main objectives of teaching biology according to Ramalingam (2013) is to make students acquire laboratory skills, field skills, and scientific attitudes. This indicates that teaching biology requires both practical and theoretical approaches. According to Iloeje (1991) almost all practical work includes making labeled diagrams of specimen under study. He further explained that theories of biology come from practical study of specimens, and new ideas are also discovered as a result of practical work. In addition WAEC 2013-2015 biology practical question papers and marking schemes have confirmed that drawing is an important science process skill. According to Billiet (2003) scientific drawing is a very important skill in biology, it helps in data recording as well as highlights important features of a specimen, and probe mental models of biological concepts that students have, therefore, drawing is a necessary skill in passing biology. According to the Society of Biology (2010) practical is a key factor in engaging, enthusing and inspiring students and in turn leads to stimulating lifelong interest of students.

Taking into cognisance the consistent poor achievement of secondary school students in biology, teachers were enjoined to strategise methods of teaching biology to be student – centered using practical approach, yet the desired improvement is not achieved. Akanbi and Kolawole (2014) also attributed poor academic achievement to traditional instructional strategies employed by most biology teachers in teaching biology concepts. This position was also buttressed by Cimer (2004) that students' lack of interest and failure in biology is as

a result of teachers' methodology, and inadequate strategies.

According to Chief Examiners' Report WASSCE (2007), students' performance in 2007 was poorer than in 2006. The poor performance was attributed to students' inability to perform well in practical and most of students' weaknesses were related to drawing. Frequent exposure of students to practical classes was suggested as one of the remedies. According to Wakesa (2013), poor achievement of students in biology was as a result of teachers' inability to use strategies that can help students master biological drawings adequately. To teach biology concepts such as respiratory system, reproductive system, excretory system in living organisms, teachers need to explore different strategies that can make concrete the otherwise abstract subject matter for easy understanding. According to the study "Exploring Annotated Drawing for Improving Nigerian Secondary School Students Achievement in Genetics" Danmole and Lameed (2014) found that annotated drawing is superior to traditional method of teaching, and has the ability to aid students in identifying and establishing links with labeled parts of diagram and function, as well as establishing a relationship between structure and function. In addition, they further explained that drawing is an integral part of biology, and annotated drawing strategy provides medium for critical thinking during minds – on and practical experience of hands-on activities that can promote conceptual understanding as well as students' drawing skills. According to Koba and Tweed (2009) drawings and annotated drawing are nonlinguistic representations that aid learning. According to the Australian Academy of Science (2009), annotated drawing is a visual representation to illustrate an idea, scientific concept or object. It also indicated that it enhances the ability to spot differences in diagrams and infer the function of labeled parts and in turn facilitate the learning of scientific concepts because of its capacity to capture and retain interest, and also elicit students' ideas and development. This is also an indication that annotated drawing can reduce cognitive load by presenting only relevant features of a scientific process, concept, idea or object diagrammatically, however, not much has been done on the effects of annotated drawing on secondary school student's ability to understand reproductive system in flowering plants. Therefore, this study investigated the efficacy of annotated drawing in enhancing secondary school students' ability to understand reproductive system in flowering plants.

Laboratory instruction is seen as leading the learner through a sequence of statements and restatement of problem or body of knowledge that enhances learner's ability to grasp, transform, and transfer what is being learned. Literature in biology education has not given a precise definition of laboratory instruction however, it can be referred to as guided experiences in the laboratory where students manipulate real materials or specimens under direct supervision of a

teacher or manual. It is student-centered and a constructivist approach that involves manipulation of objects and specimens. According to Zoller (2001) teacher – centered or traditional lesson cannot be productive but detrimental and have less chances of promoting technical skills development and conceptual understanding. Jegede and Taylor (1998) also asserted that constructivist approach enables the teacher to build models of students' science knowledge. In addition Miller and Abrahams (2009) stated that practical work increases students' interest in learning. It is therefore, necessary to implement suitable laboratory instructional approaches in teaching reproductive system in flowering plants.

Statement of the Problem

The achievement of secondary school students in biology is consistently poor. According to Chief Examiner's Report WASSCE (2007), students' performance in 2007 was poorer than in 2006. The poor performance was attributed to students' inability to perform well in practical and most of students' weaknesses were related to drawing. Frequent exposure of students to practical classes was suggested as one of the remedies however, not much effort seems to have been directed towards finding out the effects of laboratory instruction incorporating annotated drawings on secondary school students' ability to understand reproductive system in flowering plants.

Purpose of the Study

This study explored the effects of laboratory instruction incorporating annotated drawings, in enhancing the understanding of reproductive system in flowering plants by senior secondary school students. The study answered the following research questions:

1. Will there be a difference in the performance of students taught flowering plants reproductive system with annotated drawing and those taught without annotated drawing?
2. What are the views of students on their teacher's instructional strategy in the experimental group?

Hypothesis

The study was guided by one hypothesis:

$H0_1$: There is no significant difference in the mean scores of students in the experimental group and control group.

Methodology

The study employed a pre-test, post-test non-equivalent control group design, two intact classes were used, one control group and one experimental group. This design became necessary due to the absence of randomisation. The independent variable is annotated drawing, and the dependent variables are students' achievement, and opinion.

Population

The population consists of all SS II biology students of all public secondary schools, in Uvwie Local Government Area of Delta State.

Sample and Sampling

Two secondary schools were purposively sampled for the study because of their poor performance in biology, the availability of biology laboratory facilities and qualified biology teachers. One intact SS II biology class was randomly sampled from the schools selected for the study. One intact class constituted the sample for the experimental group taught reproductive system in flowering plants with annotated drawing, while the other intact class was the control group taught the same concept without annotated drawing. The sample was made up of 183 students, 77 in the experimental group and 106 in the control group. The choice of SS II was made because the selected topic is from SS II in the curriculum.

Instrumentation

Two researcher designed instruments were used in the study, Flowering Plants Achievement Test (FPAT) and an Interview Schedule (IS).The FPAT has two sections, A and B. Section A consists of the personal data of the subjects and Section B consists of 30-item multiple choice test questions on flowering plants reproductive system with options A-D, administered as pre-test, restructured to have the same level of difficulty and administered as post-test. The Interview Schedule (IS) consists of open ended questions. Table of specification was drawn to show validity of content and to show that the concept of the matter was covered. The instruments were validated by two experts and the FPAT was pilot tested on 28 students outside the study area and, reliability coefficient of 0.80 was obtained by split-half.

Experimental Procedure

The study lasted for six weeks in Uvwie Local Government Area of Delta State. Flowering Plants Achievement Test (FPAT) was administered to experimental and control group in the first week as pre-test .Experimental group was given laboratory instruction on flowering plants reproductive system with annotated drawings that explained functions of labeled structures and relationships with objectives clearly stated in the lesson plan, from the second week to the fifth week, the control group was given the same instruction without annotated drawings within the same period. Restructured FPAT was administered to both groups in the sixth week as post-test, male and female students in the experimental group were randomly interviewed to find out their opinion about the teaching strategy.

Data Collection

Flowering Plants Achievement Test (FPAT) was administered to control and experimental groups as pre-test in the first week, followed by four weeks of treatment. The restructured FPAT was administered to control and experimental groups as post-test in the sixth week. All the tests were administered with the assistance of biology teachers in the sampled schools. The Interview Schedule (IS) was used to interview students (male and female) in the experimental group in

the sixth week to further buttress the quantitative data collected.

Data Analysis

Analysis of covariance (ANCOVA) was used to test the hypothesis at 0.05 level of significance using pre-test as covariate due to the significant difference found between the control and experimental group at pre-test. Responses elicited from the Interview Schedule (IS) were transcribed and extrapolated by qualitative analysis.

Results

The results of the study were discussed under two sections: Testing hypothesis and qualitative analysis.

Testing Hypothesis

Ho_1: There is no significant difference in the mean scores of students in the control group and experimental groups.

Table 1: ANCOVA – Post-test Achievement of Control Group and Experimental Groups' Difference

Source Variable	Type III Sum of Squares	Df	Mean Square	F-Value	Sig P-Value	Decision
Corrected Model	1104.908[a]	2	552.454	34.381	.000	Not Significant
Intercept	631.534	1	631.534	39.303	.000	
Pre-test	1002.893	1	1002.893	62.414	.000	
Group(Treatment)	17.201	1	17.201	1.070	.302	
Error	2892.316	180	16.068			
Total	47299.000	183				
Corrected Total	3997.224	182				

a. R-squared = .276 (Adjusted R-squared = .268).

As shown in table 1, P > .05, revealed that there is no significant difference between students taught flowering plants reproductive system with annotated drawing and students taught without annotated drawing. Therefore, the null hypothesis is retained.

Qualitative Analysis

What are the views of male and female students in the experimental group, on their teacher's instructional strategy?

The transcribed data from the interview schedule is shown below.

Researcher: What is your name?
Student: My name is Tamaraupreye.
Researcher: How did you feel about the just concluded lesson?
Student: The lesson was interesting.
Researcher: Why was the lesson interesting to you?
Student: Because I understood what you were saying, you brought flower, and taught us how to draw and label it. Our teachers don't teach us practical like this.
Researcher: What is your name?
Student: My name is Nneka
Researcher: How did you feel about the just concluded lesson?

Student: The teaching was very interesting.
Researcher: why was the teaching very interesting to you?
Student: Because I understood very well than other teachers' lesson, the language was simple and made me understood the use of flower.

Both male and female students in the annotated drawing group found the lesson interesting as a result of the teacher's instructional strategy, different from the way their teacher taught them, and easier to understand.

Discussion

The findings of the study showed that, there is no significant difference in the achievement of students taught flowering plants reproductive system with annotated drawing and those taught without annotated drawing ($P > .05$) as shown in table 1.Therefore, the null hypothesis is retained. This finding contradicted the earlier findings of Danmole and Lameed (2014) that students significantly benefited from annotated drawing strategy however this result could have been affected by other variables that are not within the scope of this study, especially the high rate of indiscipline observed in the experimental group. The qualitative analysis revealed that male and female students found the lesson interesting, and easier to understand as a result of annotated diagrams used by the teacher. This finding corroborates earlier findings of Danmole and Lameed (2014) that students found annotated drawing interesting.

Conclusion

Based on the findings of this study, some conclusions that could positively enhance the teaching of biology were made: Secondary School biology students found annotated drawing interesting making biology concepts easily understood. This is an indication that annotated laboratory instruction has positive effect on students even though there was no significant difference in the performance of those taught reproductive system in flowering plants with annotated drawing and those taught without annotated drawings. Secondly, Male and female biology students found the lessons interesting and easier to understand. This interest was probably generated by the mental models generated as a result of the teaching strategy.

Recommendations

Based on the findings of the study, the following recommendations were made:
Firstly, student-centered method of instruction such as annotated drawing should be adequately used to disseminate science knowledge, in secondary schools. Secondly, since secondary school students are interested in learning biology with annotated drawings, Biology teachers should try to appeal to students' interest in order to enhance learning.

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