EFFECT OF INNOVATIVE STRATEGIES ON STUDENTS' ACHIEVEMENT IN SECONDARY SCHOOL BIOLOGY

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Abstract

Innovative strategies are instructional procedures that have been adjudged to improve student's learning outcomes. The impact of innovative strategies was explored in this study- the 5E learning cycle and lecture method of teaching on students' achievement on the concept classification of plants (annuals, biennials, and perennials). The study used a pretest-posttest control group design. The sample consisted of 240 senior secondary two (SS2) pupils selected from a population of 4816 students in Bayelsa State's Yenagoa Local Government Area. In addition to lesson packages for the experimental (5E learning cycle) and lecture instructional methods established by the researchers, data was collected using an instrument called the Biology Achievement Test (BAT) depending on the topic under study. Experts reviewed both the content and the face validity of BAT. BAT yielded a reliability index of 0.81 using the test-retest method. The only research question was analyzed using mean, standard deviation, and multiple regression analysis while the hypothesis was tested at 0.05 level of significance using ANCOVA and multiple classification analysis (MCA). The results indicated that students taught with the 5E learning cycle performed significantly better than those exposed to lecture instructional strategy and the difference was significant. The use of the 5E learning cycle for teaching secondary school Biology was therefore recommended for its efficacy at improving students' learning.

Keywords: Innovative strategies, 5E learning cycle, Lecture method teaching, Achievement, and Biology.

Introduction

Biology is a required scientific subject in the secondary school curriculum in Nigeria. Biology is the study of living things involving the structure, functions, growth, origin and evolution, and distribution of living organisms. The National Policy on Education (FGN, 2013) recognized its importance when it outlined biology as one of its core subjects in senior secondary schools. This is premised upon its centrality to several science-related professional courses such as medicine, Dentistry, Micro Biology, Pharmacy, Agriculture, Laboratory Technology, Biochemistry, and allied courses.

Biology is therefore a prerequisite for students to be offered admission to the under-listed and other related courses. However, low success in biology is worrying, according to reports from the WAEC chief examiners report 2015-2018, a situation always attributed to the strategies adopted in the teaching-learning process.

The conventional approach, often known as the lecture method, has dominated the majority of science classroom education. The conventional teaching method according to intel (2007) entails learners memorizing facts and occasionally analyzing information critically. Lyop and Magnot (2013) in Omole (2017) also pointed out that the inherent setback of the lecture method is its inability to enhance meaningful learning as it only panders to the sense of hearing. Additionally, they stated that the lecture method fosters rote learning and repetition of material without necessarily promoting comprehension, a circumstance that contributes to students' poor performance. Improving students' achievement in science requires learners' friendly strategies that deepen their understanding and meaning of learning concepts. Innovative instructional strategy according to ogbu (2017) is a phrase that originates from the concepts of innovation which connote new methods, ideas, products. Innovative strategy is simply using new technologies in instruction delivery to enhance, transform and improve the educational process for better educational achievement for both teachers and students. The objective of an innovative

instructional strategy, as defined by Ogbu (2017), is to make learning more flexible, to accommodate learners' diverse learning styles, to motivate learners, to engage them in learning, to probe critical thinking skills, to keep learners on task, to foster sustained and beneficial classroom interaction, and to enable and enhance their content learning in general.

In scientific inquiry, the 5E learning cycle is a generic phrase that refers to any approach that enables students to create their knowledge of a scientific subject, investigate and expand their understanding, and then apply their understanding to new situations. Sadi and Cakiroglu cited in Jibril Babolola and Isaac(2019) Planning Technique is an established planning method in science education that is congruent with modern beliefs about individual and learning team and consists of five steps

1. Engagement
2. Exploration
3. Explanation
4. Elaborating and
5. Evaluation

At the engagement phase, the teacher introduces a task, pre-assess the knowledge of the learners, and connects past learning experiences by asking invocating questions. In the Exploration phase, students conduct activities that enable them to manipulate the teaching aids or work with materials that will guide their understanding of the content of instruction. In the explanation phase, the teacher interprets the activities of the previous phases. Learners are guided to put observations, questions, and experiences into simple understandable language i.e. to communicate their discoveries or findings. The knowledge or experiences gained by learners in the previous phases are extended to real situations at the elaboration phase. The teacher introduces new information that extends what the learners have learned during their activities. At the evaluation phase, the teacher assesses the progress of learners.

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As the name implies, there is no end in the process as there is overlap between elaboration and engagement while evaluation runs through all four stages.

The 5E learning cycle is a type of active learning technique that begins with the posing of questions, challenges, or situations rather than merely presenting existing facts or depicting a straight route to knowledge; the process is frequently aided by a facilitator. It is based on the constructivist principle where students learn best when they construct their meaning allow students to learn deeper and wider than ever before

Two theories upon which this work is anchored are Brunner"s (1961) theory of discovery learning and Vygotsky(1978) theory.

Brunner's theory holds true in problem-solving situations when the learner draws on prior experiences and knowledge to uncover facts and relationships and new truths to be learned.

Brunner's theory of discovery learning has been found to promote motivation, autonomy, responsibility, independence, develop creativity and problem-solving skills, and tailors learning experience.

According to Vygotsky's theory of learning, learning is an appropriation that occurs inside the learner but is aided by social contact with more sophisticated persons who give guidance throughout the learning process. The emphasis is on social interaction provided by the more experienced teachers and peers which help to evaluate students' thinking and learning.

Empirically, studies carried out by (Ajaja 2013;Aboli 2014;Egbollie and Keamu 2017) revealed the potency of innovative strategies on students' achievement in science. Jibril et al (2019) investigated the effect of the 5Elearning cycle and concept mapping strategies on secondary school students' achievement in ecology in Ilorin city. The study revealed that the 5Elearning cycle had a positive effect on students' achievement in ecology. Similarly, the studies of (

Balci, Caroglu, and Tekkkaya, Ajaja, and Eravwoke, 2012 cited in Jibril et al 2019) proved the efficacy of the 5Elearning cycle on students' achievement in science.

Researchers have demonstrated that scientific classes in Nigeria are controlled by the traditional lecture method, where the instructor dominates the whole process, denying pupils the chance to build their meaning. A situation where many researchers (Abimbola, Umar 2011; Ajaja, 2013 and Omole 2017) had adjudged to be responsible for the abysmal performance of students in biology. To stem down the downward trend of students' performance in biology, innovative instrumentation strategies ought to be utilized such as the 5E learning cycle. Available literature shows that only a few studies have been carried out in Nigeria and none in Bayelsa state. The purpose of the study is to investigate the effect of 5E learning cycle instructional strategy on students' achievement in biology in Yenagoa Local Government Area of Bayelsa State

Research Question: To guide the study only one research question was formulated.

What difference exists in students' achievement in biology when taught with a lecture and 5E learning instructional strategies?

Research Hypothesis: There is no significant difference in students' achievement in biology when taught with a lecture and 5E learning cycle instructional strategies.

Methodology

The research design employed in the study is the quasi-experimental design with pretest-posttest control groups. The population of this study comprised all the four thousand, eight hundred and

sixteen (4816) Senior Secondary Two (SS2) biology students in Yenagoa Local Government Area of Bayelsa State.

The sample comprised 240 senior secondary school students from four complete classes selected from schools in the Yenagoa Local Government Area. The four secondary schools in the research region were selected using a criterion sampling technique, with the requirement that each stream has a minimum of thirty pupils. There was an experimental group as well as a control group determined by random assignment.

The Biology Achievement Test (BAT), which the researchers designed, was used to collect data. BAT consisted of twenty topics pertaining to plant classification. The instruments are divided into two sections: A contains the students' biographical data, while B comprises four multiple-choice items. The researcher also prepared lesson packages for both the experimental and control groups on each of the concepts, which included procedural methods for teaching.

Experts in the assessment and evaluation of biology instructors gave the face and content validity of the instruments. Using the Pearson Product Moment correlation coefficient, a reliability coefficient of 0.81 was achieved, which demonstrates that the instrument has excellent reliability.

As a pre-test, both experimental and control groups were administered the Biology Achievement Test (BAT). Teachers of biology in schools were utilized as research assistants. They underwent one week of training on how to utilize the instructional packages.

The experimental groups were taught using the 5E learning cycle while the control groups were taught using the lecture instructional strategy. The two groups involved were taught the same content. The teaching in these groups lasted for six weeks at which Biology Achievement Test (BAT) was reshuffled and administered as a posttest to both groups.

Descriptive and inferential statistics were used to evaluate the research questions. Mean and standard deviation was adopted as descriptive statistics to evaluate research question 1.

Inferential statistics analysis involving analysis of (ANCOVA) using pre-test scores as covariates, multiple analysis (MCA) became necessary for the only hypothesis. The hypothesis was tested at the 0.05 alpha level.

Results

Research question:

What difference exists in students' achievement in biology when taught with lecture learning and 5E learning cycle instructional strategies?

Table 1: Summary of the mean and standard deviation of post-test scores students' achievement in biology when taught with a lecture and 5E learning cycle instructional strategies.

S/N	instructional strategies	N	pretest mean	SD	posttest mean	SD	Mean gain
1	Lecture	120	26.62	9.44	68.63	9.07	42.01
2	5E learning cycle	120	25.54	10.27	78.21	9.02	52.47

The data presented in Table 1 shows that the mean post-test scores of students taught with 5E learning cycle (78.21) were greater than the mean post-test score of students taught with lecture instructional strategy (68.63). The table further reveals that the mean gain score of students taught with 5E learning cycle instructional strategy (52.54) was also greater than the mean gain score of students taught with lecture instructional strategy (42.01). This implies that students

taught with 5E learning cycle instructional strategy achieved higher than those taught with lecture instructional strategy. Consequent to the difference, the analysis of (ANCOVA) was carried out to ascertain if the difference was significant.

Ho1: There is no significant difference in student's achievement in biology when taught with a lecture and 5E learning cycle instructional strategies.

Table 2

One-way analysis of covariance (ANCOVA) of achievement scores of students in biology when taught with lecture method and 5E learning cycle instructional strategies using pre-test scores as covaries.

Sources of variation	sum of Squares	df	Mean Square	F	sig Decision at p< 0.05
Covariates (pretest)	352.701	1	352.701	4.408	0.037
Main effects (instructional Strategies)	5682.269	1	5682.269	71.016	0.000
Model	6034.970	2	2017.465	37.712	0.000
Residual	18963.363	237	80.014		
Total	24998.333	239	104.596		

*=significant at p>0.05 value; critical F1,237=3.89 N= 240s

The results in Table 2 indicate that the main effect is statistically significant at the 0.05 alpha level since the estimated F-value of 71.016 is higher than the crucial F-value of 3.890 at o.5 with 1 and 237 degrees of freedom. As a result, the null hypothesis is discarded. As a result of the observed difference in the main effect, the alternative hypothesis states that there is a significant difference in students' achievement in biology when taught using lecture and instructional 5E learning instructional strategies. Multiple classification analysis (MCA) was used to determine the index of relationship and also the variance of the deviant.

Table 3: Multiple classification analysis of the achievement scores of students in biology when taught with a lecture and 5E learning instructional strategies.

			covariates	
variables =category	Devin	Eta	Devin	Beta
instructional strategy		0.470		0.477
lecture	120	-4.792		-4.873
5E learning cycle	120	4.792		4.873

Multiple R=0.491	
Multiple RSquared	
	0.241

The data presented in Table 3 above shows that instructional strategies (lecture and 5E learning cycle have an index of the relationship of 0.228 beta value of 0.477) with the achievement of students in biology. The data also indicates that the deviation of the adjusted post-test score of students taught with lecture instructional strategy from the grand mean of 73.52-4.873. alternatively, the deviation of the adjusted post-test score of students' 5E learning cycle from the grand mean of 73.42 was 4.873. This means that students taught with 5E learning cycle achievement biology are significantly better than their counterparts taught with lecture instructional strategy. Table 3 still shows that a multiple regression index (R) of 0.491 and multiple regression index squared (R^2) of 0.241. this implies that 24 percent of the total variance of students' achievement in biology is attributable to the effect of instructional strategies.

Discussion of findings

The findings in this study revealed that when students are exposed to science instructions using innovative instructional strategies which make learning flexible, engage and motivate learners, their achievement would be improved upon. This is evident in the result in Table 1 and that students taught with innovative strategy (5Elearning cycle) performed significantly better than their counterparts taught with lecture instructional strategy. This could be attributed to the active involvement and commitment on the part of the students when the 5E learning cycle was utilized. The multiple classification analysis (M.C.A) also indicates

that 24 of the total variances of students' achievement in biology are attributable to the effect of instructional strategies. The findings of this work agree with the findings of (Aboli, 2014; Ajaja and Eravwoke, 2012; and Jibril et al 2019) which proved the efficacy of 5E learning cycles in improving students' achievement in biology concepts. However, the findings contradict that of Ajaja (2014) who argued that the effectiveness of the 5E learning cycle instructional strategy is dependent on the availability of facilities for science teaching. This suggests that the utilization of the 5E learning cycle strategy in teaching must be supported with the requisite instructional materials and facilities for the improved achievement of students in science.

Recommendations

Based on the findings of the study the following recommendations were made

1. Biology teachers should strive to adopt the 5E learning cycle in teaching science to improve students' achievement
2. Workshop and seminars should be organized for Inservice biology teachers on the procedures for utilizing the 5E learning cycle in teaching.

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