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EFFECTIVENESS OF EXPEDITIONARY AND 5E MODEL TEACHING METHODS ON BIOLOGY STUDENTS' ACADEMIC ACHIEVEMENT ON PLANT CLASSIFICATION IN ABAK MUNICIPALITY, NIGERIA

By

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Abstract

The study was on plant classification using expeditionary, 5E and didactic teaching methods. Three research questions and three null hypotheses were formulated and tested at 0.05 level of significant using quasi-experimental design. The population was 3,786 and the sample size was 138 SS2 Biology students. Students were assigned into experimental and control groups using simple random technique. Researchers made test, Biology Achievement Test in plant classification (BATIPC) with a reliability coefficient of 0.86 was used after validation using Kuder- Richardson formula-20. Data generated were analyzed using descriptive analysis and ANCOVA. The findings showed that students taught plant classification using expeditionary and 5E teaching methods achieved significantly better than those taught with didactic teaching method. The findings also showed no significant difference between the mean achievement scores of male and female Biology students. It was recommended among others, that Biology teachers should make use of expeditionary and 5E teaching methods in the teaching of plant classification.

KEYWORDS: Expeditionary And 5e Model, Teaching Methods, Biology Students, Academic Achievement, Plant, Classification, Abak Municipality, Nigeria

Introduction

Science is an innovative activity of man that has to do with the understanding of the working of the world, which helps man to know more about the world. Therefore, science is said to be a systematic observation of natural events and condition. In order to discover facts about science, an organized body of knowledge is verified and tested for further investigation. Udoh, Anidu, and Ekon (2024) added that science is an activity which is systematically observed, tested and verified body of knowledge, which is very important to human existence and development in life. Science helps in the explanation of events in nature and identifying beliefs that are superstitious. One of the science subjects taught in secondary schools is Biology.

Biology is the study of life for both plants and animals. It is the scientific study of living organisms including their structures, functions, growth, evolution and distribution. Edet (2024) opined that the study of Biology provides the platform for students to apply science concepts and principles in solving everyday life's problems. Anidu and Udoh (2021) added that Biology serves as one of the tools that open research door in understanding the process of life development in living things from elementary level; and encourages students to apply scientific knowledge in all situations. Edet (2024) also noted some difficult concepts in Biology amongst others to include; digestion, respiration, genetics and plant classification.

Plant classification is the systematic arrangement of plants into categories to show their relationship and importance. The plants are classified based on botanical names, agricultural classification, based on life cycle or span. Classification of plant is a very broad concept in biology and it requires practical aspect of teaching for easy understanding. However, it remains that there is high failure in the subject, in most secondary schools. Sheetal and Grishma (2021) added that secondary school students who have interest in study achieve any science concept taught better than those with little or no interest which could determine students' academic achievement.

Academic achievement is the degree or level of success gained at the conclusion of educational endeavours. It is the extent to which students have achieved educational goals. Sambo and Sunday (2024) described academic achievement as the scholastic standing of a student at a given moment, which states individual abilities. Students' academic achievement can be explained in the form of grades obtained from tests or examinations on subjects taken. Dinah (2022) ascertain that numerous factors contribute or militate against improved academic achievement of students in schools and some of these factors include lack of appropriate or suitable teaching methods.

Teaching methods are approaches used by teachers to facilitate learning of a concept in the classroom. Udoh, Umoh and Udo (2020); Ekon and Udoh (2021) stated that teaching methods are strategies, techniques, styles and principles use in carrying out teaching and learning process for easy assimilation by the learners or used by the teacher to enable easy learning. The type of teaching method adopted determines to a greater extent what the students assimilates. Attah (2023) opined that if suitable and appropriate teaching methods are used for a particular concept, the knowledge acquired will be accelerated and can be applied in solving problems for human existence. Anidu and Udoh (2021) added that some teaching methods are teacher-centered and it is based on the assumption that students are passive subjects that store what they learnt as a result of repeated practice and reinforcement as didactic teaching method.

The didactic teaching method is a teaching method where the teacher presents information in a direct, plain, clear and often lecture-style method which is authoritarian. Ana and Jasete (2020) opined that didactic teaching method is based on the speculation that students are inactive subjects that store what they learnt as a result of repeated practice and reinforcement. Umida (2021) added that the teacher is the primary authority and source of information. The goal is to transmit knowledge and information from the teacher to the student and students have limited opportunities for discussion, questioning, or hands-on activities. The didactic teaching method can lead to limited student engagement and motivation and may not provide opportunities for critical thinking and problem-solving. This method can lead to teacher dominance, where the teacher is the sole authority and source of information and that fails to account for individual students' needs and learning styles (Anidu & Udoh, 2021). In order to achieve positive impact on the academic achievement of Biology students in plant classification, innovative teaching methods should be used such as expeditionary and 5E models.

Expeditionary teaching method is student- centered, practical oriented that combines hands-on learning, real world application and community engagement. It encourages students to take active role in planning, executing and reflecting on their learning experience. Abonyi (2024) opined that expeditionary teaching method is an approach to education that seeks to engage students in a way that excites them not only on the subject they are studying but also in the process of education and in life in general. Okuakaji (2020) stated that expeditionary

method of teaching is a physical activity and real life/world work paired with traditional and intellectual classroom activities. This makes the students to develop interest and can understand the concept by developing holistic approach. Sheetal and Grishma (2021) added that the expedition of plant classification can take place in the school farm and the students' plant what they would be able to see, touch, feel base on botanical classification, agricultural and life cycle. Plants in the farm can be identify base on major criteria. Expeditionary teaching method gives solutions to challenging situation in schools. It brings to reality those things in the textbook for easy understanding and make teaching and learning process more innovative (Sunday & Moses, 2019). This discovery helps the students to perform certain mental processes such as observation, measurement and description which fosters the improvement of biology students' academic achievement.

The 5E model is another student-centered teaching method that promotes interactive and inquiry-based learning. Richard (2024) opined that 5E model is an instructional design framework that promotes active learning by sequencing teaching and learning experiences into five phases, named engage, explore, explain, elaborate, and evaluate. This model is widely used in science teaching but can be adapted for various subjects. Yusuf (2018) opined that, 5E model allows student to think critically and creatively in the act of unraveling hidden information for effective learning. Throughout the process, students work collaboratively to observe, investigate, analyze, and draw conclusions. Meanwhile, the teacher serves as a facilitator, guiding students in the learning process. Richard (2024) stated that this framework can be used to teach Biology concepts and science new concepts. According to Yusuf (2018) the 5E model provides students the opportunity to explore new concepts critically and retain information through meaningful learning experiences which can benefits both gender (male and female) students.

Gender is a range of physical, mental and behavioral characteristic between male and female.
Sambo and Sunday (2024) stated that gender is often associated with the physical and genetic differences between males and females, primarily determined by chromosomes (XX for females and XY for males), reproductive organs, and secondary sexual characteristics that develop during puberty. Some studies suggest that hormonal influences can affect brain structure and function, potentially leading to different patterns in behaviour and cognition between males and females. Some studies suggest that there are no significant differences in academic achievement between genders in science subjects. However, Udoh, Umoh and Udo (2020) indicates that gender can influence academic achievement with factors such as societal expectations, stereotypes, and differing levels of motivation.

Statement of the Problem

Biology being one of the important subjects in science, makes it needful for students to pass the subject in both internal and external examinations such as West African Senior Secondary Certificate Examination (WASSCE) and National Examination Council (NECO). Therefore, there is need for industrious creativeness in teaching, as this will lead to meaningful and effective learning outcome. The teacher must innovate creative methods of presenting their lessons so as to capture and motivate learners, as well as inculcation of basic concept to learners understanding to improve their academic performance. Hence the problem of this study is therefore post as a question. What is the effect of expeditionary learning and textbook method on biology students' academic performance in plant classification in Abak municipality. The reason is ascribed to the fact that there are topics in biology that post serious problems of comprehension to students, because they are not well taught. The use of appropriate and

suitable teaching methods, instructional materials and exposing the students to first-hand experience will help eliminate the obstacles and abstractness of concepts in biology.

Research Questions

The following research questions were raised to guide this study.

1. What is the difference in the mean achievement scores of Biology students taught plant classification using expeditionary, 5E and didactic teaching methods?
2. What is the difference in the mean achievement scores of male and female Biology students taught plant classification using expeditionary teaching method?
3 What is the difference in the mean achievement scores of male and female Biology students taught plant classification using 5E teaching method?

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance to guide the study.

1. There is no significant difference in the mean achievement scores of Biology students taught plant classification using expeditionary, 5E and didactic teaching methods
2. There is no significant difference in the mean achievement scores of male and female Biology students taught plant classification using expeditionary teaching method
3 There is no significant difference in the mean achievement scores of male and female Biology students taught plant classification using 5E teaching method

Methodology

The design adopted for this study was non-randomized pretest-posttest control group of the quasi-experimental design with three (3) groups, two (2) experimental groups and a control group. Experimental group one (1) was taught plant classification using expeditionary teaching method, experimental group two (2) was taught using 5E teaching method and group three (3) was the control group taught with didactic teaching method. The design was considered appropriate since the students were taught in their intact classroom setting. The population of the study was three thousand, seven hundred and eighty-six (3,786) and the sample was one hundred and thirty-eight (138) Senior Secondary Two (SS2) Biology students (male and female) for 2023/2024 session from three (3) secondary schools in Abak Education Zone of Akwa Ibom State. The instrument was BATIPC with a reliability coefficient of 0.86. On the basis of the high index, the instrument was considered reliable and suitable in conducting the research

The Biology teachers were used as research assistants. The research assistants were trained for three (3) days and they were given detailed instructions with well-articulated lesson packages on the concept of plant classification. The researchers randomly assigned three (3) classes, two (2) experimental groups and a control group respectively. The teaching of the concept was done by the research assistants in each school from a well-articulated lesson package developed by the researchers for two (2) weeks. The lesson packages prepared by the researchers were used in order to standardize the concept taught by the research assistants. After the teaching, post-test was administered to the three (3) groups. All activities in the three (3) groups were strictly supervised by the researchers. The data collected were analyzed using descriptive statistics (mean and standard deviation), and Analysis of Covariance (ANCOVA) based on its ability to control for the effect of pre-test. All the hypotheses were tested at .05 level of significance.

Results

Research question one: What is the difference in the mean achievement scores of Biology students taught plant classification using expeditionary, 5E and didactic teaching methods? The results of these analyses are presented in Table 1

Table 1: Mean and Standard Deviation of Pre-test and Post-test Scores of Students taught Plant Classification Grouped by Teaching Methods.

Teaching Methods		Pre-test		Post-test		Mean Difference
	N	$\overline{X}$	SD	$\overline{X}$	SD	
Expeditionary	51	13.59	3.79	33.67	4.08	20.08
5E Model	55	11.75	2.43	32.42	3.39	20.67
Didactic	53	10.87	1.65	24.43	7.07	13.56

Results in Table 1 show the mean difference scores of students taught the concept of plant classification using expeditionary, 5E model and didactic teaching methods as 20.08, 20.67 and 13.57 respectively. Comparing the mean difference scores of the three groups, it indicates that 5E model with mean difference score of 20.67 was the highest in enhancing students' achievement, followed by expeditionary with mean difference score of 20.08. The use of didactic teaching method was the least with mean difference score of 13.56 in enhancing students' achievement in plant classification.

Research question two: What is the difference in the mean achievement scores of male and female Biology students taught plant classification using expeditionary teaching method? The results of these analyses are presented in Table 2.

Table 2: Mean and Standard Deviation of Male and Female Biology Students' Pre-test and Post- test Scores Taught Plant Classification Grouped by Teaching Method.

Teaching Method	Gender	N	Pre-test		Post-test		Mean Difference
			$\overline{X}$	SD	$\overline{X}$	SD	
Expeditionary	Male	21	14.10	3.84	34.40	5.30	20.30
	Female	30	13.23	3.77	33.43	3.04	20.20

Results in Table 2 show that the mean difference in the achievement score of male students taught plant classification using expeditionary teaching method is 20.30 and their female counterparts is 20.20. It can be inferred from the results that male students achieved a little better than their female counterparts when taught plant classification using expeditionary teaching method.

Research question three: What is the difference in the mean achievement scores of male and female Biology students taught plant classification using 5E model teaching method? The results of these analyses are presented in Table 3.

Table 3: Mean and Standard Deviation of Male and Female Biology Students' Pre-test and Post- test Scores Taught Plant Classification Grouped by Teaching Method.

Teaching Method	Gender	N	Pre-test		Post-test		Mean Difference
			$\overline{X}$	SD	$\overline{X}$	SD	
5E Model	Male	19	11.05	2.32	32.37	2.89	21.32
	Female	36	12.11	2.44	32.44	3.67	20.33

Results in Table 3 show the mean difference in the achievement score of male students taught plant classification using 5E model teaching method as 21.33 and their female counterparts as 20.33. It can be inferred from the results that male students still achieved a little better than their female counterparts when taught plant classification using 5E model teaching method.

Hypothesis one: There is no significant difference in the mean achievement scores of Biology students taught plant classification using expeditionary, 5E and didactic teaching methods. The results of these analyses are presented in Table 4.

Table 4: Summary of Analysis of Covariance (ANCOVA) of Students' Post-test Scores Classified by Teaching Methods with Pre-test Scores as Covariate

Source	Type III Sum of Squares	Df	Mean Square	F-value	P-value
Corrected Model	2876.993[a]	6	479.499	19.04	.00*
Intercept	6066.778	1	6066.778	241.01	.00*
Pre-test	26.317	1	26.317	1.04	.30[NS]
Methods	2289.498	2	1144.749	45.47	.00*
Gender	45.879	1	45.879	1.82	.17[NS]
Methods * Gender	143.608	2	71.804	2.85	.06[NS]
Error	3826.076	152	25.172		
Total	151307.000	159			
Corrected Total	6703.069	158			

[NS] = Not significant at .05 level of significance; * = Significant at .05 level of significance

Results in Table 4 show that the analysis of covariate (pre-test scores) of the three groups of students taught plant classification using expeditionary, 5E model and didactic teaching methods is not significant since the calculated F-value (1.04) having a calculated p-value (.30) is greater than the significant level (.05), indicating that the mean of the three groups were statistically equivalent. The table also shows that the calculated F-value (45.47) having a calculated p-value (.00) of the main effect of teaching methods is less than the significant level (.05), therefore, the null hypothesis one is rejected. This implies that there exists a significant difference among the achievement mean scores of Biology students taught plant classification using expeditionary, 5E and didactic teaching methods. In order to determine the direction of significance, the scores were subjected to post hoc analysis as shown in Table 5.

Table 5: LSD (Least Square Difference) Post hoc Analysis of Students' Post-test Grouped by Teaching Methods with Pre-test as Covariate

(I) Methods	(J) Methods	Mean Difference (I-J)	Std. Error	Sig.[b]
Expeditionary	5E	.996	1.05	.34[NS]

	Didactic	9.041*	1.07	.00*
5E	Expeditionary	-.996	1.05	.34NS
	Didactic	8.045*	.99	.00*
Didactic	Expeditionary	-9.041*	1.07	.00*
	5E	-8.045*	.99	.00*

NS = Not significant at .05 level of significance; * = Significant at .05 level of significance

Table 5 shows the post hoc analysis scores of students taught plant classification using expeditionary, 5E model and didactic teaching methods. Students taught using expeditionary and 5E model teaching methods had a significantly higher achievement when compared with those taught using didactic teaching method. A non-significant difference existed between the achievement scores of students taught using expeditionary and 5E model teaching methods.

Hypothesis two: There is no significant difference in the mean achievement scores of male and female Biology students taught plant classification using expeditionary teaching method. The results of these analyses are presented in Table 6.

Table 6: Summary of Analysis of Covariance (ANCOVA) of Students' Post-test Scores Grouped by Teaching Method with Pre-test Scores as Covariate

Methods	Source	Type III Sum of Squares	Df	Mean Square	F- value	P-value
	Corrected Model	72.194a	2	36.097	2.27	.11NS
	Intercept	3064.961	1	3064.961	192.78	.00*
	Pre-test	68.228	1	68.228	4.29	.04*
Expeditionary	Gender	1.093	1	1.093	.06	.79NS
	Error	763.139	48	15.899		
	Total	58641.000	51			
	Corrected Total	835.333	50			

Results in Table 6 show that the analysis of covariate (pre-test scores) of male and female students taught plant classification using expeditionary teaching method is significant since the calculated F-value (4.29) having a calculated p-value (.04) is less than the significant level (.05), indicating that the mean of the three groups were not statistically equivalent. The table also shows that the calculated F-value (.06) having a calculated p-value (.79) of the main effect (gender) is greater than the significant level (.05), therefore, the null hypothesis two is not rejected. This implies that there exists no significant difference between the mean achievement scores of male and female Biology students taught plant classification using expeditionary teaching method.

Hypothesis three: There is no significant difference in the mean achievement scores of male and female Biology students taught plant classification using 5E model teaching method. The results of these analyses are presented in Table 7.

Table 7: Summary of Analysis of Covariance (ANCOVA) of Students' Post-test Scores Grouped by Teaching Method with Pre-test Scores as Covariate

Methods	Source	Type III Sum of Squares	Df	Mean Square	F-value	P-value
5E	Corrected Model	.128b	2	.064	.00	.99
	Intercept	2316.461	1	2316.461	193.27	.00

Pre-test	.056	1	.056	.00	.94
Gender	.097	1	.097	.00	.92
Error	623.254	52	11.986		
Total	58425.000	55			
Corrected Total	623.382	54			

Results in Table 7 show that the analysis of covariate (pre-test scores) of male and female students taught plant classification using 5E model teaching method is significant since the calculated F-value (.00) having a calculated p-value (.94) is more than the significant level (.05), indicating that the mean of the three groups were statistically equivalent. The table also shows that the calculated F-value (.00) having a calculated p-value (.92) of the main effect (gender) is greater than the significant level (.05), therefore, the null hypothesis two is not rejected. This implies that there exists no significant difference between the mean achievement scores of male and female Biology students taught plant classification using 5E model teaching method.

Discussion of Findings

The findings on the difference among the mean achievement scores of Biology students taught plant classification using expeditionary, 5E and didactic teaching methods indicated a significant difference. Students taught using expeditionary and 5E teaching methods had a significantly higher achievement when compared with those taught using and didactic teaching method. A non-significant difference existed among the achievement mean scores of Biology students taught using expeditionary and 5E teaching methods.

The significantly higher achievement of students taught using expeditionary and 5E teaching methods when compared with those taught using didactic teaching method could be attributed to the fact that they encourage students to take active role in planning, executing and reflecting on their learning experience which could not be possible with the use of didactic teaching method. This is why Abonyi (2024); Udoh, Anidu, and Ekon (2024) asserted that for learning of Biology to be meaningful and effective, the teacher should be able to select appropriate teaching methods that would stimulate the achievement of the learners and get them actively engaged in the process of learning since learning is facilitated by involving students in active processing. Udoh and Ekon (2018) also added that teaching methods plays an important role in the knowledge of a particular concept in science. This shows that when a learning task is set before the students, the aptness in responding to the said learning task is centrally controlled by interest. The extent to which the student will achieve in a particular course of study is indicated by active participation in the study. The finding of this study is in line with that of Ekon and Udoh (2021) who found that students taught Biology concept using innovative teaching methods had a significantly achievement than those taught the same concept with conventional teaching method. The findings also collaborate with Attah (2023) who found that there is a significant difference in the achievement of science students when taught with chemical equations. However, the findings disagree with Edet (2024) who found no significant difference on students' achievement when taught with improvised DNA model and flip chart.

A non-significant difference existed between the achievement scores of students taught using expeditionary and 5E teaching methods. This could be attributed to the fact that the use of innovative teaching methods promotes conceptual change, motivation and excitement for enriching the learning of plant classification resulting in enhancement of students' achievement. This is Richard (2024) stated that innovative teaching methods generate motivation hence,

facilitate concept attainment. The findings of the study is in line with Yusuf (2018) who showed that there was no significant difference between the achievement scores of students in senior secondary schools. However, the findings of the study disagree with the findings of. Anidu and Udoh (2021); Dinah (2022) also found that that there was significant difference between the achievement scores of students in senior secondary schools with perception of difficult topics.

The findings on the difference between the mean academic achievement scores of male and female Biology students taught plant classification using expeditionary and 5E teaching methods indicated a non-significant difference. The observation from the result confirms that both male and female students achieve equally. This shows that both male and female students explored their environment leading to higher academic achievement of both male and female students in the concept. This is why Chew (2014) asserted that teachers should be able to select appropriate teaching methods that would actively engage students in the learning process to enhance academic achievement. The findings of the study corroborate with Anidu and Udoh (2021); Abonyi (2014) who observed that there is no significant gender difference in academic achievement of Mathematics and Science students. This implies that when male and female students are exposed to the same learning environment with appropriate instructional resources irrespective of gender, they will assimilate faster and achieve equally since knowledge has to do with intellectual ability. However, the findings disagree with Attah (2023) and Edet (2024) who showed that male students achieved better than female in chemistry when using simulation technique while female achieved better significantly than male when using video compact disc tape.

Conclusion

Based on the findings from the study, it is concluded that the use expeditionary and 5E teaching methods in teaching resulted to a significant higher academic achievement on Biology students when compared with those taught using didactic teaching method. This implies the need to move from conventional teaching method to student- centered and practical oriented for teaching of Biology concepts. This is because student- centered instructional methods provide complementary learning activities that can serve as alternative to conventional teaching method like didactic teaching method.

Recommendations

1. Science teachers, especially the Biology teachers should adopt expeditionary and 5E as innovative teaching methods in teaching various concepts. This will make their teaching more effective and meaningful to the students.

2. Parents and Biology teachers should encourage both male and female students towards excellence in Biology since they can benefit equally from science instructions depending on the involvement of an individual student.

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