

FRAME QUADRAT AND BELT TRANSECT TECHNIQUES ON STUDENTS' ACADEMIC ACHIEVEMENT IN BIOLOGY IN AKWA IBOM STATE, NIGERIA

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ABSTRACT

The study investigated the use of frame quadrat and belt transect techniques on students' academic achievement in Biology in Akwa Ibom State, Nigeria. To achieve the purpose of the study, three research questions and three hypotheses were formulated to guide the study. A non-randomized pretest posttest control group experimental design with two treatment groups for two intact classes that was adopted. The population of the study consisted of all Senior Secondary Two (SS2) Biology students in the eleven public secondary school in Abak Local Government Area. The sample for the study was one hundred and fifty (150) Senior Secondary Two (SS2) Biology students drawn from the three randomly selected secondary schools in the study area. The instrument used for the study was the Biology Achievement Test (BAT) comprising of twenty-five (25) multiple-choice items designed by the researcher. The instrument was duly validated and subjected to reliability analysis using Kuder Richardson 20 (K-R20). The result showed reliability coefficient of 0.89 and was deemed appropriate for the main study. Mean and standard deviation were used in answering the research questions while analysis of covariance was used in testing the hypotheses at 0.05 alpha level. From the results of the analyses carried out, the findings showed that there was a significant difference in students' academic achievement when taught the concept of specie abundance in population ecology based on frame quadrat and belt transect as students in the experimental groups achieved better than their control group counterparts in Biology. Students in the experimental groups (frame quadrat and belt transect) performed better than student in the control group in the concept of specie abundance. But within the experimental groups, those taught with frame quadrat achieved better than those taught with belt transect; there is significant difference in achievement of students with different cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) when taught species abundance (in population ecology) in Biology using the frame quadrat and belt transect method with those taught using the conventional method. The interaction effect between cognitive styles and treatments given, affect significantly the academic achievement of the students in the concept of specie abundance in Biology. Based on the findings, it was recommended, among others, that strengthening the use of frame quadrat and belt transect learning techniques through in-service courses could help science teachers to adopt proper use of appropriate learning techniques.

Keywords: Frame quadrat, belt transect, academic achievement, cognitive styles, Biology.

1. INTRODUCTION

Science is a means of finding practical ways of using scientific discoveries or turning scientific knowledge into use. Science is also addressed as a systematic process of acquiring the fundamental knowledge about the universe (Duru, Uko, & Utibe, 2024). The aim of learning science in secondary schools is to promote the understanding of concepts taught, with a view to applying knowledge of such understanding in the real life situation. The National Policy on Education (FRN, 2014) emphasizes that sciences should be taught in schools in such a way that it will have meaning and relevance to the needs of the students and society; provide the students with the opportunity to explore; interact with and intercept certain scientific processes going on in their environment. Science and technology however are important tools for development and productivity in any nation. Science is a necessity for any nation that wants to maintain its independence, sovereignty, self-reliance, ensure growth, and have its head held high among civilized nations (Uko, Uko, & Utibe, 2024; Uko, & Uko, 2019; UNESCO, 2015). This is because science and technology provide the basic tools for industrialization and economic development in the areas of communication, transportation, energy, information, pollution and waste control. Infact, Babayemi (2014) described science and technology as the arrow head that determines the direction and dimension of national development. In Nigeria, the study of science is of great importance that a lot of emphasis had been laid on the Learning and learning of science, as contained in the Federal Ministry of Education (FME, 2014). This can be achieved by the inculcation in the learners the necessary scientific skills and attitudes. The inculcation of scientific skills and attitudes in students can only be achieved through the effective teaching and learning of various science subjects using new and emerging technologies (Akpan & Itighise, 2019). These science subjects include Biology, Chemistry, Physics, Mathematics, Health science and Agriculture.

Biology is a branch of science education that deals with the study of living organisms which is divided into many specialized fields that cover their morphology, physiology, anatomy, behavior, origin and distribution (Duru, Uko, & Utibe, 2024). It is a science subject that has its origin in the need of human beings to know more about themselves and the world around them (Michael, 2018). Biology contexts are often complex and studied at various levels from the individual molecule to global ecosystem (Chukwuneke, 2016).

In Nigeria, the Biology curriculum as a Learning syllabus has National objectives at secondary school level. These include preparing students to acquire: adequate laboratory and fields skills in Biology; meaningful and relevant knowledge in Biology; ability to apply scientific knowledge to everyday life in matters of personal and community health and agriculture; and reasonable and functional scientific attitude. To ensure full realization of these objectives, the content and context of the syllabus placed great emphases on field studies, guided-discovery, laboratory techniques and skill coupled with conceptual thinking (Federal Republic of Nigeria, 2014). Biology education is an indispensable instrument for the development of any nation; it is offered in all senior secondary schools in Nigeria which attracts the greatest patronage of both science-oriented and art-based student (Nwosu, 2016). According to Paul (2014), Biology provides a platform for teaching students to develop the ability to apply science concept and principles in solving everyday life problems and building a progressive society. There are records in the field of Ecology, Biochemistry, Physiology and Molecular Biology among others that made subject a central focus in most human activities including problem like radiation, family life, food scarcity management and conservation of natural resources as well as ethics. There are various

concepts in Biology and there are ways of learning them effectively. Some Biology concepts described things which are not easily accessible or abstract concepts that cannot be fully comprehended at the first time (Chew, 2014; Duru, Uko, & Utibe, 2023). Students struggle to form their cognitive structures in many alternative conceptions (Umoke & Nwafor, 2014).

Population ecology considers the number of individuals of particular species that are in an area, how and why number changes or remains fixed (Idodo, 2015). Population ecologists try to determine the processes common to all population (Ramalingam, 2018). They study how a population interacts with its environment that is how predation and other environmental pressures affect the population. Population size is only meaningful when the boundaries of that population are defined. Often when a population is too large to study, the population is usually examined by sampling a part of it and then expressed in terms of density (species abundance) such population include number of grasses of a single species per square metre. Species refers to a group of closely related organism that are similar to each other and capable of interbreeding and species abundance; an ecological concept referring to the relative representation of a species in a particular ecosystem usually measured as number of individuals found per sample (Michael, 2018). Teaching ecology requires a lot of quantitative method ranging from classroom lecture method to field practical methods. The practical method (field) requires approaches like capture- recapture method for mobile organism, quadrat method for species density as well as transect, manual and ridge method for learning and teaching Biology (Rosier, 2016).

According to WAEC Chief Examiner Report, (2023) it is shown that students' performance in Biology examination is not encouraging. An examination of the performance of Biology students mirrored a decline in the percentage of Biology candidates obtaining credit grades. The senior secondary school Biology candidates have a number of problems associated with both the cognitive and motor skills which have culminated in the poor achievements in the certificate examination, (Chief Examiner's report, 2023).

Thus, students' performance as generally observed by Duru, *et al.*, (2023) has been attributed to teachers' failure to use effective learning strategy such as instructional techniques during the learning process in Biology. Study conducted by Itighise (2016) on innovation in higher teacher education revealed that teachers lack expertise skill in the use of innovative teaching methods in instructional delivery of the course content in science Education. Duru, *et al.*, (2024) reported that planning of instructional materials before lesson delivery have influence on students' performance thereby helping the teacher achieving the goals of the lesson. Biology requires serious input by the teacher in terms of planning to teach to achieve instructional objectives (Nwosu, 2016). This trend of poor performance of students in Biology and the high percentage of failure if not addressed, will spell doom for the scientific and technological development of the nation. The use of quadrat and transect in teaching biological concept like species abundance makes significant contributions by providing appropriate learning opportunities to diverse learners and also motivating students to learn ecology both in the school and outside the school have potential to address the problems of effective teaching and learning in ecology (Mantar, 2011; Idodo, 2015). This is designed both to teach content and to enhance higher order problem-solving skills. Cognitive styles as related to students' achievement are another important variable in this study.

Cognitive styles means a psychological construct which is concerned with how an individual learns, thinks, solve problem, remember and relate to others (Umanah & Rebecca, 2022). Hence, the diversity of each group of students is a challenge for teachers to assume. Individual differences are almost always seen as a difficult and instead of strengthening them; teachers tend to homogenize the skills of the students with the intension of improving the outcomes. It is possible to change the approach of the individual differences taking advantage of specific characteristics of each student to favor team learning. According to that, it is important to know the different ways of learning and of approaching the knowledge that the students have, that is to say: their cognitive styles (Keen, 2015). Research findings have indicated several consistent major dimensions of individual differences. Of these dimensions, cognitive style is a major one (Uko, & Mary, 2024; Babayemi, 2014; Umanah & Rebecca, 2022).

This study was an attempt in the direction to fill the gap and to improve the poor achievement of the student in Biology when taught species abundance using quadrat and transect method. It is on this platform that the researcher wants to compare the effect of using plot base frame quadrat and belt transect techniques to teach the concept of species abundance in population ecology on students' achievement in Biology in Abak Local Government Area of Akwa Ibom State, Nigeria. The influence of how cognitive styles on students' academic achievement in Biology taught with frame quadrat and belt transect was also investigated in the study.

Statement of the Problem

Ecology is one of the important branches of Biology in Nigeria secondary school and is relatedness to major courses in higher instruction cannot be over emphasize but students' performance in this concept in external examination is usually not commendable; attributed to poor teaching strategies and resources. The agitating question of this research is; will the use of appropriate techniques to teach specie abundances in population ecology have any facilitative effect on Biology students' academic achievement in Abak L.G.A of Akwa Ibom State?

Purpose of the Study

The purpose of this study was to compare the effect of using plot base frame quadrat and belt transect to teach the concept of species abundance in population ecology and students' achievement in Biology in Abak L.G.A of Akwa Ibom State. Specific objectives of the study aimed to:

1. compare the achievement mean scores of students taught species abundance in Biology using frame quadrat and belt transect method with those taught with conventional method
2. determine the achievement mean scores of students with the cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) when taught the concept of species abundance (in population ecology) in Biology using belt transect and frame quadrat learning strategies.
3. determine the interaction effect of treatment by cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) on students' achievement on the concept of species abundance (in population ecology) in Biology.

Research Questions

Specifically. The study sought plausible answers to the following questions:

1. What is the achievement mean scores of students when taught species abundance (in population ecology) in Biology using the frame quadrat and belt transect method with those taught using the conventional method?
2. What is the achievement mean scores of students with cognitive styles(systematic style, intuitive style, integrated style, undifferentiated style and split style) when taught species abundance (in population ecology) in Biology using the frame quadrat and belt transect method with those taught using the conventional method?
3. What is the interaction effect of treatment by cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) on students' achievement on species abundance (in population ecology) in Biology?

Hypotheses

The following hypotheses were formulated to guide the study.

1. There is no significant difference between the achievement mean scores of students when taught species abundance (in population ecology) in Biology using the frame quadrat and belt transect method with those taught using the conventional method.
2. There is no significant difference in achievement mean scores of students with different cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) when taught species abundance (in population ecology) in Biology using the frame quadrat and belt transect method with those taught using the conventional method.
3. There is no significant interaction effect of treatment by cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) on students' achievement on species abundance (in population ecology) in Biology.

2. METHOD

A non-randomized pretest posttest control group experimental design with two treatment groups for two intact classes that was labeled 1 and 2. Group 1 and 2, was the experimental groups that was taught with the belt transect and frame quadrat. Group 3 was the control group that was taught with the conventional approach. Structurally the design is illustrated thus;

E1: $O_1 \times O_2$

E2: $O_1 \times O_2$

C: O_1 C O_2

Where E1 and E2 are the experimental groups (belt transect and frame quadrat).

C is the control group (conventional approach). O_1, O_2 is the pretest and posttest observation with respect to the three groups respectively.

The study was carried out in Abak Local Government Area of Akwa Ibom State, Nigeria. The population of the study consisted of all Senior Secondary Two (SS2) Biology students in the eleven (11) public, secondary school in Abak Local Government Area for 2024/2025 academic session. The sample for the study was one hundred and fifty (150) Senior Secondary Two (SS2) Biology students for the 2024/2025 academic session in three (3) intact classes from three

secondary schools were randomly selected. The sampling technique used was the simple random sampling technique to select the school and the sample. The instrument that was used for the study was Biology Achievement Test (BAT). The instrument was duly validated and subjected to reliability analysis using Kuder Richardson 20 (K-R20). The result showed reliability coefficient of 0.89 and was deemed appropriate for the main study (Eduwem & Umoinyang, 2014). Descriptive statistics of mean and standard deviation were used in answering the research questions while analysis of covariance (ANCOVA) was used in testing the hypotheses at 0.05 alpha level.

Permission was sought for from the principals of the three secondary schools and the biology teachers in each school were used as research assistant. The research assistants were trained for one week on how to use the packages on the concepts of specie abundance in population ecology. Three intact classes; to two experimental groups and one control group was used for the study. Pretest was administered and the results were used as covariate measures. The teaching of the concept of species abundance was done by the researcher and research assistants in each of the three schools. After the teaching, post-test was administered to the three groups.

The data obtained was analyzed using descriptive statistics and analysis of covariance (ANCOVA).

4. RESULTS

The summary of the results used in answering the research questions and testing the null hypotheses formulated to guide the study, are presented and interpreted in this subsection.

Research Question One

What is the difference in achievement mean scores of students taught specie abundance (in population ecology) in Biology using the frame quadrat and belt transect method with those taught using the conventional method?

Mean and standard deviation were used in answering research question one as presented in Table 1.

Table1: Mean and standard deviation of the difference in achievement mean scores of students taught specie abundance (in population ecology) in Biology using frame quadrat and belt transect method with those taught using the conventional method(N=150)

Technique	Pretest			Posttest		
	N	Mean	SD	N	Mean	SD
Frame Quadrat		49	12.16	2.04	49	39.78
Belt Transect	51	12.41	3.13	51	36.27	6.51
Conventional	50	12.16	1.98	50	13.80	2.19

Source: Field work 2023

Table 1 indicates that there is a difference in achievement mean scores of students when taught species abundance (in population ecology) in Biology using the frame quadrat and belt transect method with those taught using the conventional method. The result show that students in the experimental groups (frame quadrat and belt transect) with posttest mean scores of (39.78 and 36.27) respectively performed better than their counterparts in the control group with posttest mean

score of 13.80. But within the experimental groups, the students with frame quadrat performed slightly better than students taught with belt transect.

Research Question Two

What is the achievement mean scores of students with cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) when taught species abundance (in population ecology) in Biology using the frame quadrat and belt transect method with those taught using the conventional method?

Mean and standard deviation were used in answering research question two as presented in Table 2.

Table 2: Mean and standard deviation of the difference in achievement mean scores of students with cognitive styles (Systematic style, Intuitive style, Integrated style, Undifferentiated style and split Style) when taught species abundance (in population ecology) in Biology using the frame quadrat and belt transect method with those taught using the conventional method (N=150)

Technique	Cognitive Style		Pretest			Posttest		
			N	Mean	SD	N	Mean	SD
Frame quadrat	Systematic	9	10.67	1.73	9	41.33	3.24	
	Intuitive	8	11.63	1.77	8	42.50	3.70	
	Integrated	10	12.80	2.30	10	41.40	2.98	
	Undifferentiated	12	12.59	2.31	12	38.58		
	Split	10	12.80	1.32	10	36.00	4.94	
Belt transect	Systematic	10	11.10	1.66	10	33.20	4.92	
	Intuitive	10	15.00	5.21	10	41.40	2.99	
	Integrated	10	13.20	1.87	10	38.30	9.78	
	Undifferentiated	10	11.90	1.97	10	37.40		
	Split	11	11.00	1.95	11	31.55		
Conventional	Systematic	10	12.20	2.34	10	13.90	3.31	
	Intuitive	11	12.91	2.02	11	14.64	2.29	
	Integrated	10	11.80	2.12	10	12.90		
	Undifferentiated	10	12.40	1.58	10	13.80		
	Split	9	11.33	1.73	9	13.67	1.50	

Source: Field work 2023

Table 2 indicates the difference in achievement mean scores of students' with cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) taught species abundance (in population ecology) in Biology using the frame quadrat and belt transect method with those taught using the conventional method. The result shows that students' with cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) taught species abundance (in population ecology) in Biology in the experimental groups (frame quadrat and belt transect) with posttest mean scores of (41.33, 42.50, 41.40, 38.58, 36.00 and 33.20, 41.40, 38.30, 37.40, 31.55) respectively achieved better than their counterparts in the control group with posttest mean of (13.90, 14.63, 12.90, 13.80, 13.67) respectively. But within the experimental groups, those taught with frame quadrat in experimental group one achieved slightly better than their counterpart taught with belt transect in experimental group two based on cognitive styles.

Research Question Three

What is the interaction effect of treatment by cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) on students' achievement on species abundance (in population ecology) in Biology?

Mean and standard deviation were used in answering research question three as presented in Table 3.

Table 3: Mean and standard deviation of the interaction effect of treatment by cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) on students' achievement on species abundance (in population ecology) in Biology (N=99)

Technique	Cognitive Style	Pretest			Posttest		
		N	Mean	SD	N	Mean	SD
Frame quadrat	Systematic	9	10.67	1.73	9	41.33	3.24
	Intuitive	8	11.63	1.77	8	42.50	
	Integrated	10	12.80	2.30	10	41.40	2.98
	Undifferentiated	12	12.59	2.31	12		
	Split	10	12.80	1.32	10		
Belt transect	Systematic	10	11.10	1.66	10	33.20	4.92
	Intuitive	10	15.00	5.21	10	41.40	
	Integrated	10	13.20	1.87	10	38.30	
	Undifferentiated	10	11.90	1.97	10	37.40	
	Split	11	11.00	1.95	11		

Source: Field work, 2023

Table 3 indicates the difference in the interaction effect of treatment by cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) on students' achievement on species abundance (in population ecology) in Biology. The result shows that students with cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) taught species abundance (in population ecology) in Biology in the experimental groups (frame quadrat and belt transect) with posttest mean scores of (41.33, 42.50, 41.40, 38.58, 36.00 and 33.20, 41.40, 38.30, 37.40, 31.55) respectively. But within the experimental groups, those taught with frame quadrat in experimental group one achieved slightly better in their interactive effect than their counterpart taught with belt transect in experimental group two based on cognitive styles. The results show that the interaction effect of treatments by cognitive styles given, affect significantly the achievement of the students' in the concept species abundance (in population ecology) in Biology.

Hypothesis One

There is no significant difference in achievement mean scores of students when taught species abundance (in population ecology) in Biology using frame quadrat and belt transect method with those taught using conventional method.

Analysis of covariance were used in testing hypothesis one as presented in Table 4.

Table 4: Analysis of covariance of students' academic achievement in the concept specie abundance (in population ecology) taught using frame quadrat and belt transect with those taught using conventional method (N=150)

Source	Type III Sum of squares	df	Mean Square	F	Sig.
Corrected Model	19981.911 ^a	3	6660.637	252.829*	.000
Intercept	3415.3431	3	415.343	129.642*	.000
Pretest Technique	170.4061	1	70.406	6.468*	.012
Error	19731.230	2	9865.615	374.486*	.000
Total	3846.282	146	26.344		
Corrected Total	158169.000	150			
	23828.193	149			

*significant at $p < .05$ alpha level, $N=150$, $df=1$ and 146

R Squared = .839 (Adjusted R squared = .835)

Source: Field Data

The result in Table 4 indicates that there is a significant difference in the mean achievement scores of students taught the concept of specie abundance (in population ecology) using frame quadrat and belt transect with those taught with conventional ($F_{\text{cal}} = 374.486$, $p=0.000$) with degree of freedom of 1 and 146 at 0.05 alpha level. This implies that the p-value of 0.000 is less than the .05 alpha level. The null hypothesis is therefore rejected which means, there is significant difference between the academic achievement of students taught the concept of specie abundance

(in population ecology) using frame quadrat and belt transect than those taught with conventional method. This implies that frame quadrat and belt transect significantly influenced students' academic achievement in Biology. The table also shows a regression index squared of 0.839, indicating that 84% of the total variance in the achievement of students' is attributable to the influence of treatments in the concept of specie abundance (in population ecology) in Biology. Therefore, there is a significant difference in achievement mean scores of students when taught species abundance (in population ecology) in Biology using frame quadrat and belt transect method with those taught using conventional method.

Since there is a statistically significant difference in hypothesis one, post hoc test is presented in Table 4.1.

Table 4.1: Multiple comparisons and mean differences in academic achievement by experimental and conventional group

(I) Technique	(J) Technique	Mean Difference (I-J)	Standard Error	Sig.
Frame quadrat	Belt transect	3.610	1.028	0.001
	Conventional	25.974	1.032	0.000
Belt transect	Frame quadrat	-3.610	1.028	0.001
	Conventional	22.364	1.022	0.000
Conventional	Frame quadrat	-25.974	1.032	0.000
	Belt transect	-22.364	1.022	0.000

*Significant at $p < .05$ alpha level

Source: Field Data, 2023

The fisher's LSD Post Hoc test was conducted to determine the group with the significant mean and reveals that the group with the most significant difference is frame quadrat because it has the highest mean difference when compared with other groups. This implies that frame quadrat was better followed by belt transect on students' academic achievement in Biology.

Hypothesis Two

There is no significant difference in achievement mean scores of students with different cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) when taught species abundance (in population ecology) in Biology using the frame quadrat and belt transect method with those taught using the conventional method.

Analyses of covariance were used in testing hypothesis two as presented in Table 5.

Table 5: Analysis of covariance of students' achievement mean scores of students with different cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) when taught species abundance (in population ecology) in Biology using the frame quadrat and belt transect method with those taught using the conventional method(N=150)

Source	Type III Sum of squares	df	Mean Square	F	Sig.
Corrected Model	20792.919 ^a	15	1386.195	61.197*	.000
Intercept	3432.186	1	3432.186		
	151.523*	.000			

Pretest	41.216	1	41.216	1.820*	.180
Technique	19893.337	2	9946.668	439.121*	.000
Cognitive Style	429.068	4	107.267		4.736*
.001					
Techniques*					
Cognitive Style	372.608	8	46.576	2.056*	
.044					
Error	3035.274		134	22.651	
Total	158169.000	150			
Corrected Total	23828.193	149			

*significant at $p < .05$ alpha level, $N=150$, $df = 1$ and 134

R Squared = .873 (Adjusted R squared = .858)

Source: Field Data

The result in Table 5 indicates that there is a significant difference in the mean achievement scores of students' with different cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) when taught species abundance (in population ecology) in Biology using the frame quadrat and belt transect method with those taught using the conventional method ($F_{cal} = 2.056$, $p = 0.044$) with degree of freedom of 1 and 134 at 0.05 alpha level. This implies that the p-value of .044 is less than the .05 alpha level. The null hypothesis is therefore rejected which means, there is no significant difference in achievement of students with different cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) when taught species abundance (in population ecology) in Biology using the frame quadrat and belt transect method with those taught using the conventional method. This implies that frame quadrat and belt transect based on cognitive styles significantly influenced students' academic achievement in Biology. The table also shows a regression index squared of 0.873, indicating that 87% of the total variance in the achievement of students' is attributable to the influence of treatments in the concept of specie abundance (in population ecology) in Biology. Therefore, there is a significant difference in achievement mean scores of students with different cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) when taught species abundance (in population ecology) in Biology using the frame quadrat and belt transect method with those taught using the conventional method.

Since there is a statistically significant difference in hypothesis one, Post Hoc test is presented in Table 5.1

Table 5.1: Multiple comparisons and mean differences in academic achievement by cognitive styles

(I) Cognitive Style	(J) Cognitive Style	Mean	Standard	
Sig.	Difference(I-J)	Error		
Systematic	Intuitive	-2.924	1.299	.026
	Integrated	-1.083	1.261	.392
	Undifferentiated	-.217	1.235	.861
	Split	2.500	1.244	
.046				

Intuitive	Systematic	2.924	1.299	.026
.143	Integrated	1.840	1.249	
.031	Undifferentiated	2.706	1.238	
.000	Split	5.424	1.274	
Integrated	Systematic	1.083	1.261	
.392	Intuitive	-1.840	1.249	
.143	Undifferentiated	.866	1.213	.477
.005	Split	3.583	1.241	
Undifferentiated	Systematic	.217	1.235	.861
.031	Intuitive	-2.706	1.238	
.477	Integrated	-.866	1.213	
.027	Split	2.717	1.218	
Split	Systematic	-2.500	1.244	.046
.000	Intuitive	-5.424	1.274	
.005	Integrated	-3.583	1.241	
.027	Undifferentiated	-2.717	1.218	

*significant at $p < .05$ alpha level

Source: Field Data, 2023

The fisher's LSD Post Hoc test was conducted to determine the group with the significant mean and reveals that the group with the most significant difference based on cognitive styles is intuitive style followed by integrated style, systematic style, undifferentiated style and split style) when taught with frame quadrat and belt transect in the concept of specie abundance (in population ecology) on students' academic achievement in Biology.

Hypothesis Three

There is no significant interaction effect of treatment by cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) on students' achievement on species abundance (in population ecology) in Biology.

Analyses of covariance were used in testing hypothesis three as presented in Table 6.

Table 6: Analysis of covariance of the interaction effect of treatment by cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) on students' achievement on species abundance (in population ecology) in Biology (N=99)

Source	Type III Sum of squares	df	Mean Square	F
Sig.				
Corrected Model	1241.920 ^a	10	124.192	3.882
*	.000			
Intercept	594.375	1	4594.375	
143.621*	.000			
Pretest	11.474	1	11.474	
.359*	.551			
Technique	326.873	1	36.873	
10.218*	.002			
Cognitive Style	654.206	4	163.551	
5.113*	.001			
Technique*				
Cognitive Style	154.838	4	38.709	1.210*
.002				
Error	2847.070	89	31.990	
Total	148413.000	100		
Corrected Total	4088.990	99		

*significant at $p < .05$ alpha level, $N=99$, $df = 1$ and 89

R Squared = .304 (Adjusted R squared = .225)

Source: Field Data

The result in Table 6 indicates that there is a significant difference in the interaction effect of treatment by cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) on students' achievement on species abundance (in population ecology) in Biology ($F_{\text{cal}} = 1.210$, $p = 0.002$) with degree of freedom of 1 and 89 at 0.05 alpha level. This implies that the p-value of .002 is less than the .05 alpha level. The null hypothesis is therefore rejected which means, there is significant difference in the interaction effect of treatment by cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) of students' achievement on species abundance (in population ecology) in Biology. This implies that frame quadrat and belt transect based on cognitive styles significantly interact on students' academic achievement in Biology. The table also shows a regression index squared of 0.304, indicating that 30% of the total variance in the achievement of students' is attributable to the difference in the interaction effect of treatment by cognitive styles in the concept of species abundance (in population ecology) in Biology. Therefore, there is a significant interaction effect of treatment by cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) on students' achievement on species abundance (in population ecology) in Biology.

5. DISCUSSION OF FINDINGS

Three hypotheses were formulated to guide the investigation into the effect of using quantitative techniques to teach species abundance in population ecology and students' academic achievement in Biology. The findings based on the results of the hypothesis tested are discussed.

Finding in research question one revealed that there is a significant difference in the mean achievement scores of students taught the concept of specie abundance (in population ecology) using frame quadrat and belt transect with those taught with conventional. The result also showed that students in the experimental groups (frame quadrat and belt transect) performed better than their counterparts in the conventional group. But within the experimental groups, the students with frame quadrat performed slightly better than students taught with belt transect. This is in agreement with the work of Sampson (2012) that quadrats are usually adopted in ecological work to provide a very good introduction to the principles of making estimates based on sampling in the field.

The finding in research question two showed that there is a significant difference in the mean achievement scores of students with different cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) when taught species abundance (in population ecology) in Biology using the frame quadrat and belt transect method with those taught using the conventional method. This is in consonance with the works of Umanah and Etiubon (2022) that cognitive styles as relatively stable ways in which a learner approaches a learning task, acquire and process information, as well as including the consistent ways in which an individual memorizes and retrieves information.

The finding in research question three revealed that there is a significant difference in the interaction effect of treatment by cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) on students' achievement on species abundance (in population ecology) in Biology. The results also showed that the interaction effect of treatments by cognitive styles given, affect significantly the achievement of the students in the concept species abundance (in population ecology) in Biology. This work is in line with the work of Babayemi (2019) which opined that cognitive styles mean a psychological construct which is concerned with how an individual learns, thinks, solve problem, remember and relate to others.

6. CONCLUSION

In conclusion, evidence from the results shows that students in the experimental groups (frame quadrat and belt transect) performed better than their counterparts in the control group. Also, students' with cognitive styles (systematic style, intuitive style, integrated style, undifferentiated style and split style) taught species abundance (in population ecology) in Biology in the experimental groups (frame quadrat and belt transect) achieved better than their counterparts in the conventional group; the interaction effect of treatments by cognitive styles given, affect significantly the achievement of the students' in the concept species abundance (in population ecology) in Biology.

Educational Implication of Findings

- i. The implication of this study suggests that teachers need to be aware of the available Learning strategies such as multi-quantitative learning strategies (frame quadrat and belt transect) to aid achievement of learned concept.
- ii. Teachers need to be trained and re-trained on the use of good Learning strategies such as frame quadrat and belt transect to enhance students' academic achievement.

- iii. Findings also implied students' cognitive styles interacted well when taught and this goes a long way to improve achievement and minimize decay.

Recommendations

Based on the findings, it was recommended that;

- i. Quantitative learning techniques which are purposeful and efficient should be used in learning specie abundance in population ecology so that students could reap the full benefits of active classroom involvement.
- ii. Education stakeholders should organize conferences, seminars and workshops for Biology teachers to acquaint them with the use of frame quadrat and belt transect learning techniques to improve the process and product of learning.
- iii. Textbook authors should adopt quantitative learning in their books to support student's organizational process.

REFERENCES

- Akpan, I. F. & Itighise, A. E (2019). Students' perception of teachers' utilization of information and communication technology (ICT) tools for instructional delivery in science education programme. *Journal of Education and Development*, 3(2), 35-41
- Asano, R., Amponsah, K., Baah-Yanney, O., Quarcoo, F. & Azumah, D. A. (2021). Using quality teaching and learning resources for effective Integrated Science Education among senior high schools in Ghana. In: *Education Quarterly Reviews*, 4(3), 51-63.
- Babayemi, O .J. (2019).Cognitive style and gender as predictors of students' academic performance in basic science and technology in Mkpato Enin Local Government Area, Akwa Ibom State, Nigeria. *Kampala International University, KIU Journal of Humanities* 4(2), 151-159.
- Chew, E. G. (2014). *Designing Work; Strategies for Heterogeneous Classroom*. New York Teachers College Press.Pp7-21
- Chukwuneke, B. W. (2016). *Attainment of Millennium Development Goals (MDGS) in Nigeria*. Through the Use of Computer Assisted Instruction (CAL) in the Learning and Learning of Biology. In: Proceedings of the 54th Annual Conference of Science Teachers Associations of Nigeria Pp.192- 203
- Duru, C. M., Uko, P. J & Utibe, U. J. (2024).Application of DNA animation, improvised model and realia in teaching and students' performance based on gender in Biology in Akwa Ibom State, Nigeria. *African Journal of Educational Foundations*, 5(1), 75-92.
- Duru, C. M., Uko, P. J & Utibe, U. J. (2023).Effect of DNA animation, improvised model and realia on teaching and students' performance based on school location in Biology in Akwa Ibom State, Nigeria. *Inter-disciplinary Journal of Science Education*, 5(1), 11-25
- Eduwem, J. D., Umoinyang, I. E. (2014). Item types and upper basic education students' performance in Mathematics in the southern senatorial district of Cross River State Nigeria. *Journal of Moderns Education Review*, 4(1), 57-73.
- Federal Ministry of Education, FME (2014). Senior Secondary School Curriculum in Biology Abuja, NERDC Press. P5
- Federal Republic of Nigeria FRN (2014). *National Policy on Education (NPE)*. (5thed)
- Idodo, G. U. (2015). College Biology for senior secondary schools. Idodo-Umeh publishers

- Itighise, A. E. (2016). Innovation in higher teachers' education: An imperative for achievement of sustainable national development. *Journal of Educational Media and Technology*, 21(1), 264-273.
- Keen, P.G.W. (2015). The Implications of Cognitive style for Individual Decision-making. *Doctoral Dissertation*, Harvard University, Cambridge, MA. Pp1-15
- Mantar, L. S (2011). Effect of quadrat and lecture method in teaching population ecology in Canada, *dioco./0161j.compedu.2007.07.009*. Retrieved Oct. 2015
- Micheal, M. C. (2018). Essential Biology for Senior Secondary Schools. TONAD Publishers Ltd.
- Nwosu, A. A. (2016). *Using the instructional model to communication science*. 39th STAN Annual conference Proceedings, Pp.349-353.
- Paul, T. (2014). Biology Education for Social and Sustainable Development. 23rd Biennial Education Conference as Asian Association for Biology Education (Aabe) Nanyang Technology University. Available at <http://www.sensepublishers.P4>
- Ramalingam, S. T. (2018). Modern Biology, SS Science Series. New Edition, AFP
- Rosier, M. (2016). What is science? *Journal of Research in Science Education*,
- Uko, P. J., Uko M. P., & Utibe, U. J. (2024). Assessing the impact of dunning – kruger effects on secondary school science teachers. *International Journal of Education and Evaluation (IJEE)*, 10(3), 149-159.
- Uko, P. J., & Mary P. J. (2024). Evaluating the pedagogical competence of interdisciplinary strategies in the teaching of Physics in secondary schools in Akwa Ibom State. *International Journal of Education, Humanities and Social Science (EJEHSS)*, 7(3), 308-320.
- Uko, M. P., & Uko, P. J. (2019). Effects of structured instructional assessment activities on secondary school Student's academic achievement in STEM (Mathematics and Agricultural Science). *African Journal of Theory and Practice of Educational Assessment (AJTPEA)*, 7(1), 117-132
- Umanah, F. I. & Rebecca U. E. (2022). Effects of roundrobin and jigsaw cooperative learning Strategies on Chemistry students' academic achievement on hydrocarbons in senior secondary schools, *African Journal of Educational Assessors*, 9(1), p.49
- Umoke, J. C. & Nwafor, C. C. (2014). Student understanding of purpose, of model in life biological context. *International Journals of Biology Education*. 2(2), 187-198.
- UNESCO (2015). A place to learn, lesson from research on learning environment. Conaldge: UNESCO. *Institute for Statistics*. P4
- Utibe, U. J. & Onwiodukit, F. A (2019). guided-discovery, demonstration methods and Physics students' acquisitions of entrepreneurial skills in household electrical circuit sketch and wiring in Akwa Ibom State. *Curriculum and Media Technology Research Journal of CUDIMAC* 6 (1), 9-21
- WAEC (2023). West Africa Examination Council Chief Examiner Reports for 2016-2023 May/June Senior Secondary School Certificate Examinations. *O Level Paper*, WAEC Press.
- Wilshire, A. N. (2009). Effect of transect method on high school standards academic performance in Texas: <http://edugameredeard.com/blog/2013/10/0pdf>. Retrieved September, 2015.