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EFFECT OF CULTURO-TECHNO-CONTEXTUAL APPROACH ON SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN BIOLOGY IN IN NSUKKA EDUCATION ZONE

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ABSTRACT

The study determined the effect of Culturo-Techno-Contextual Approach (CTCA) on secondary school students' academic achievement in Biology in Nsukka Education Zone of Enugu State, Nigeria. The study was guided by two research questions and three hypotheses using quasi-experimental research design. Population of study consisted of 2,870 senior secondary school year two (SS2) students offering biology in the government-owned co-educational secondary schools in the zone. Eighty-one (81) SS2 students were sampled from two out of 41 co-educational schools in the zone using multistage sampling procedure. The instrument for data collection was Biology Achievement Test (BAT). The instrument was validated by three experts from Faculty of Education in Nnamdi Azikiwe University, Awka. Kudder-Richardson Formula 20 was used to establish a reliability coefficient of 0.87 for BAT. The experimental group was taught using CTCA while the control group was taught using conventional lecture method. Mean and standard deviation were used to answer the research questions, while Analysis of covariance was used to test the null hypotheses at 0.05 alpha level. The findings revealed among others that CTCA significantly enhanced the achievement of students in biology more than conventional lecture method. Also, CTCA is a gender friendly teaching approach that could be used to enhance the achievements of secondary school male and female students in Biology equally. It was concluded that CTCA is an effective teaching approach that could be adopted as an alternative instructional approach for teaching of Biology in Nsukka Education Zone. Based on the findings of the study, it was recommended that teachers should be trained on how to use CTCA to improve students' achievement through seminars, workshops and conferences. Also, secondary school Biology teachers should be encouraged by school administrators to adopt the use of CTCA for Biology instructions.

Keywords: Culturo-Techno-Contextual Approach, Secondary school, Biology achievement, Enugu State.

Introduction

Education remains the most valuable and important tool for sound national growth and development. The extent to which recipients gain the knowledge and skills necessary to contribute effectively to national development is determined by the quality of education provided to the citizens. This could be one of the reasons the Federal Government of Nigeria (Federal Republic of Nigeria, FRN, 2014) in the National Policy on Education (NPE) emphasized the teaching of science and technology subjects at all levels of Education. The NPE stated among other things that education is accountable for equipping its beneficiaries with the necessary skills, knowledge, understanding and competencies for long-term development (FRN, 2014). This implies that education is critical for national progress and the long-term development of any nation. Hence, if Nigeria is to reach the requisite level of science and technology development in this highly technological world, a strong foundation in science education is a worthy platform essential to prepare students for challenges ahead. The knowledge of science according to Badmus and Omosewo (2018) is relevant and applicable in all areas of life endeavors, without which life on the planets could be primitive, hence, relevance of science is seen in its branches. For instance, the production of essential human needs such as soap of all kinds, creams, drinks, petroleum and its bi-products, clothing, drugs, household utensils and chemicals for preservations of food items as well as textiles are all a product of principles of chemistry. The knowledge of biology, according to Onowugbeda (2020) is applicable in medicine, physiology and anatomy to preserve and save lives. The knowledge of agriculture gives way for the production of food and animals which serve as meat and sources of protein as well as raw materials for industries. As an evidence of the importance of science, it follows that science education should be of paramount importance.

Science education is that particular field of study that exposes learners to the contents as well as the methodology (processes) of acquiring scientific knowledge for practical application. In line with this, Okeke (2017) defined science education as an integrated field of study that considers both the subject matter of science discipline (Biology, Physics, Chemistry and Agriculture) as well as the processes involved in the teaching and learning of science. This type of education takes place in a formal school setting under the auspices of the science educator who is professionally qualified to moderate the scientific activities in the classroom with the use of appropriate pedagogies. Science education requires a composite teaching method that incorporates several potent elements in its structural framework as the traditional methods of teaching haven't particularly been convincing in promoting meaningful learning of science on the part of the students (Ademola, Okebukola, Oladejo, Onowugbeda, Gbeleyi and Agbanimu, 2021). Science education is classified into so many branches of which Biology is one of them. Biology is one of the most important

prerequisites for students in secondary schools who want to continue their education in tertiary institutions to pursue science-related topics (Ahmed, Lawal and Ahmed, 2017). It is also an important subject which enables students to understand their own body and have better understanding of how different species evolve, function and interact. Biology is one of the three most important science subjects taught in senior secondary schools across Nigeria. Biology according to Akintola (2019) encompasses every aspects of life due to the fact that it focuses on the study of life and living organisms, their features, structures, functions, taxonomy and evolution. Therefore, Biology education is of vital importance for any nation like Nigeria that needs growing economy for survival.

Despite the importance of Biology in any society/nation, there are some challenges hindering the understanding of Biology among senior secondary school students such as lack of appropriate teaching methods or approaches which has been singled out in literature as a major contributing factor to students' unsatisfactory performance in the subject (Onowugbeda, Okebukola, Agbanimu, Ajayi, Oladejo, Awaah and Ige, 2022). Available data from the West Africa Examination Council Chief Examiners' Report (2021) show that students' academic achievement in biology in Nigeria continues to diminish as time goes on. Unfortunately, the WAEC (2018, 2019, 2020, 2021, 2022 and 2023) Chief examiners' reports stated that a lot of candidates did not attempt questions raised on genetics and those that attempted it performed poorly in them. Adebanjo (2019) reported that students have difficulties, misconceptions, confusions and incoherent knowledge of genetics concepts because they include abstract concepts difficult to learn, understand and comprehend. A lot of factors have also been revealed by so many researchers to be responsible for students' poor performance in Biology. These factors as earlier identified by Etobro and Fabinu (2017) include; poor teaching methods, poor classroom /school environment, lack of teaching aids etc. Other constraints to teaching of Biology concepts in secondary schools according to Harrison (2021) include; complexity, abstractness, misconception of some of the Biology topics and most importantly the use of inappropriate instructional strategies. These inappropriate instructional strategies used by secondary school Biology teachers tend to raise doubts about the possibility of realizing the objectives of Biology education in Nigerian secondary schools as stated in the NPE by FRN (2014).

Nowadays, Biology students face a lot of challenges learning the subject. One of these challenges identified by Adebanjo (2019) include the inability of students to relate what is been taught in the Biology classroom to their daily life activities. These challenges that students encounter have contributed to their poor performance in internal and external examinations. To assist students to overcome these challenges, Akintola (2019) emphasized that numerous teaching strategies and pedagogies have

been used in the Biology classroom either for instruction or for research purposes. Nevertheless, students' comprehension of difficult concepts in Biology such as genetics, ecology, variation and evolution as well as their application to daily life activities and performance in both internal and external assessments, remained discouraging (Onowugbeda, 2020 and WAEC, 2017, 2018, 2019, 2020, 2021, 2022 and 2023). Studies revealed that this difficulty in the comprehension of some concepts in Biology and other science subjects is attributed to complexity, misunderstanding and misinterpretation of concepts which are used in the topic which in most cases tend to affect students' academic achievement in science subjects (Okebukola, 2020; Oladejo, 2018).

Academic achievement is referred to as the outcome of education and it is one of the performance measures of any educational system (Nabizadeh, Hajian, Sheikhan and Rafiei, 2019). It is the result obtained by students or grades awarded by teachers to students after undergoing a learning process (Christian- Ike and Okoli, 2022) and it is a crucial factor in determining how well students are doing. Academic achievement can be viewed as the knowledge attained and skill developed in school subjects, the level of what is determined by test scores. As an indicator of intellectual education, academic achievement according to Akintola (2019) is the most prerequisite for individual and societal prosperity. This makes academic achievement a vital issue in all spheres of life. Academic success includes the capacity to retain information over an extended length of time in addition to the ability to study and transmit knowledge. Hence, there is need to find out if an innovative teaching method such as culture-techno-contextual approach implemented in the teaching of Biology could improve the academic achievement of students in secondary schools.

Due to the continuous variation of social context within a classroom environment, learners are 'frequently involved in unfamiliar learning situations of which in some learners this creates a sense of challenge; for others it causes uncertainty and some level of distress, thus, the introduction of Culturo- Techno-Contextual Approach (CTCA) as a teaching tool to the academic system. According to Okebukola (2015; 2020), if science concepts are tackled via linkage with indigenous knowledge and cultural practices, the chances are bright that the 'genie of poor performance in Science Technology Engineering and Mathematics (STEM) will be thrown progressively back into the bottle. Culturo-Techno-Contextual Approach (CTCA) is a method invented to teach science, developed in 2015 by Peter Okebukola after over 40 years of exploration with different methods in African settings to find a solution to the issues that inhibit the meaningful learning of science (Okebukola, 2020). According to Okebukola (2020), the approach is a conglomerate that derives its potential from three frameworks- (a) cultural context with which learners are preoccupied; (b) technology-mediation to which teachers and learners are progressively dependent; and (c) locational context, a unique identity

of every education institution and which plays a strong role in the instance and local case studies for science lessons. Remarkable within the framework of the cultural context in CTCA is indigenous knowledge. Indigenous knowledge is the resultant of the course of action of the world's perception through the lens of communities in understanding how the world operates and how such understanding can be harnessed for their well-being and improved quality of life (Onowugbeda, 2020). In adopting CTCA in science classrooms, all lessons are linked with students' indigenous knowledge systems and cultural practices, which are proposed to make the subject matter of the concept learned closely connected, relevant, plausible and meaningful. The synthesis of indigenous knowledge and cultural practices within the confines of school curricula in various disciplines and not only in sciences could perhaps spawn a favourable effect on students' interest in science, thereby sustaining and preserving the indigenous knowledge of their culture.

The conceptualisation of factoring indigenous knowledge and cultural practices associated with a concept being learned is to diminish the 'foreignness' that non-Western students may feel in science classrooms. On account of the technology element in CTCA, a survey of the findings from several works of the literature for instance in Okebukola (2015), suggests that learners have access to YouTube, Wikipedia resources, WhatsApp, Facebook and other technology-related resources for their online activities regularly, suggesting to the CTCA research team to utilize these technologies. Since students already possess some yearning for contemporary technologies, the ideology in CTCA is to ride on the back of such interest in technology. Culturo-Techno-Contextual Approach (CTCA) is a learner-centered approach as opposed to the conventional lecture method where learners are passive and are dependent on the teacher for all or most of their information. It has its foundation rooted in the idea that meaningful learning takes place when there is a link between the existing knowledge and the new knowledge. Okebukola (2020) opined that CTCA provides a functional and supportive learning environment where the learner receives encouragement, commendation, as well as positive feedback after each assignment. It is an approach where learning is metamorphosed from the conventional unidirectional flow of knowledge into a multi-directional knowledge flow that incorporates the application of ICT tools to reinforce the learning process as well as the student to student, student to teacher, and teacher to student exchange of knowledge and information (Adebanjo, 2019).

Furthermore, the reports on the effects of instructional methods on achievement of males and females in Biology have not been concluded. For instance, Asuzu and Okoli (2019) in their research on the effects of multimedia integrated instruction and demonstration method on students achievement in ecological concepts, found significant differences in Biology achievement in favour of females. However, Nwuba and

Osuafor (2021) in their study on the effect of experiential learning approach on students' academic achievement in biology found out that male students achieved higher than their female counterparts. Yet, Pat-Anyaeji and Okeke (2019) in their study on the effect of scaffolding instructional strategy on students' achievement in Biology found that there is no significant difference in the mean achievement scores of male and female students in Biology. These contradictory findings show that gender stereotyping is still very much in Nigerian education setting and in science education and biology learning in particular. From the foregoing, it can be deduced that the issue of gender differences in secondary school students' academic achievement and retention in Biology is still far from being conclusive. This is the premise on which this research is conceived. Given the claims of the effectiveness of the CTCA in improving Academic Achievement of secondary school students in Genetics in Ojo, Lagos State, according to Oladejo (2021), it is the goal of this study to examine the effect of CTCA on secondary school students' academic achievement in Biology in Nsukka Education Zone of Enugu State, Nigeria. Specifically, the study sought to achieve the following objectives

1. Mean achievement scores of students taught Biology using Culturo-Techno-Contextual Approach (CTCA) and that of those taught using Conventional Lecture Method (CLM).
2. Mean achievement scores of all male and female students taught Biology using Culturo-Techno-Contextual Approach and Conventional Lecture Method.
3. Interaction effect of gender and teaching methods (CTCA and CLM) on secondary school students' achievement in Biology.

Research Questions

1. What are the mean achievement scores of students taught Biology using Culturo-Techno-Contextual Approach (CTCA) and those taught using Conventional Lecture Method (CLM)?
2. What are the mean achievement scores of male and female secondary school students taught Biology using CTCA and those taught using CLM?

Research Hypotheses

Three hypotheses were tested at 0.05 alpha levels in this study, thus;

1. There is no significant difference between the mean achievement scores of secondary school students taught Biology using the Culturo-Techno-Contextual Approach (CTCA) and those taught using the conventional lecture method (CLM).
2. There is no significant difference between the mean achievement scores of male and female secondary school students taught Biology using CTCA and those taught using CLM.
3. There is no significant interaction effect of gender and teaching methods (CTCA and CLM) on the mean achievement scores of students in Biology.

Research Method

The study adopted quasi-experimental specifically, the pretest, posttest non randomised control group design was used. The study was carried out in Nsukka Education Zone of Enugu State. The population of the study comprised of 1,944 SS 2 students from the 41 co-educational secondary schools in the zone during the 2023-2024 academic year. The sample of the study comprised of 81 (35 males and 46 females) SS 2 Biology students drawn from two out of 41 co-educational secondary schools in Nsukka Education Zone of Enugu State. The sampling was drawn using two-stage sampling techniques involving purposive and simple random sampling techniques. The instrument that was used for data collection was Biology Achievement Test (BAT). The BAT was adopted from WASSCE past questions. The BAT is designed into two sections, A and B. Section A seeks personal information on the students while Section B contains 50 multiple - choice questions on the basic aspects of Genetics. Each question has four options a, b, c and d and students are required to pick one.

The instrument was validated by three experts: two from the Department of Science Education and one from Department of Educational Foundations, all from Faculty of Education Nnamdi Azikiwe University, Awka. To determine the reliability coefficient of the BAT, the instrument was administered to an intact class of 36 SS2 students in one of the schools in Igbo-Eze North Education Zone (outside the zone under study). Kuder- Richardson formula 20 (KR-20) was used to analyze the data collected. The choice of KR-20 was because the question items are not equal and, the instrument contains multiple-choice objective questions that are dichotomously scored. The reliability coefficient for BAT was found to be 0.87.

The treatment was done in two phases, in the first phase, the teacher in the experimental group was briefed by the researcher before the treatment process on how to effectively use Culturo-Techno-Contextual Approach, while the teacher in control group was given topics with the lesson plans and then asked to teach the students as usual. Thereafter, both the experimental and control groups took a pretest as part of the pre-testing and familiarization phase. Thirty minutes was allowed for the pretest. The teachers invigilate their students in both the experimental and control groups. At the end of the test the question papers and answers was collected from the students by their teachers. The pretest achievement paper was marked; scores was collected and handed over to the researcher. In the second phase teaching commenced on the next biology class by their regular teachers for 4 weeks of teaching on genetics. After the teaching, posttest was administered to the subjects by the biology teachers. Thirty minutes was allowed for the test. The test was marked by the teachers. Scores was collated, collected by the teachers and handed over to the researcher. The aim of the posttest was to find out if there was any gain in knowledge that might have arisen from the treatment.

The data obtained from each group using the Biology Achievement Test (BAT) was analyzed using mean, standard deviation and Analysis of Covariance (ANCOVA) statistics. Mean and standard deviation was used to answer the research questions and ANCOVA was used to test the hypotheses. The choice of ANCOVA for testing the research hypotheses was based on its ability to control the effect of pretest. All the hypotheses were tested at 0.05 level of significance. The decision rule for the hypotheses was that whenever the probability value (p-value) is less than or equal to the significant value of 0.05, the null hypothesis is rejected, otherwise the null hypothesis is not rejected.

Presentation of Results

***Table 1*:** Mean and standard deviation on achievement scores of students taught Biology using CTCA and those taught using CLM

		Pre-test		Post-test		Mean Gain
Teaching method	**n**	**Mean**	**SD**	**Mean**	**SD**	
CTCA	37	23.51	3.413	68.46	4.782	44.95
CLM	44	27.45	4.608	56.36	5.867	28.91
Mean Diff.		-3.94		12.1		16.04

Table 1 shows that students taught Biology using CTCA had a pre-test mean score of 23.51 and a post-test mean score of 68.46 with gained mean achievement score of 44.95. On the other hand, the students taught with the CLM had a pre-test mean score of 27.45 and a post-test mean score of 56.36 with gained mean achievement score of 28.91. Therefore, this suggests that both methods are effective in enhancing the students' scores. However, compared to the CLM, CTCA method is more effective than the traditional method of teaching with a mean gain difference of 16.04. This implies that CTCA was effective in improving students' achievement in Biology than CLM.

***Table 2*:** Mean and standard deviation on achievement scores of male and female students taught Biology using CTCA and those taught using CLM

			Pre-test		Post-test		Mean Gain
Teaching method	**Gender**	**n**	**Mean**	**SD**	**Mean**	**SD**	
CTCA	Male	17	23.82	3.712	69.29	5.289	45.47
	Female	20	23.25	3.210	67.75	4.315	44.5
Mean Diff.			0.57		1.54		0.97
CLM	Male	18	23.33	5.139	56.89	7.095	33.56
	Female	26	24.31	4.285	56.00	4.964	31.69
Mean Diff.			-0.98		0.89		1.87

From table 2, it was observed that both male and female students taught with the Culturo-Techno-Contextual Approach (CTCA) and the Conventional Lecture Method showed

significant improvements from pre-test to post-test. Male students taught with the CTCA method had the highest mean post-test score (69.29) and mean gain of 45.47, while the female students had post-test score of 67.75 with mean gain of 44.5. However, the CLM showed slightly lower mean gain for both male (33.56) and female (31.69) students, indicating that CTCA is effective in enhancing male students' performance in Biology compared to CLM.

Table 3: Summary of ANCOVA test of significance of difference in the mean achievement scores of students taught Biology using CTCA and CLM

Source of Variation	SS	Df	Mean Square	F	Sig.	Decision
Corrected Model	3003.324[a]	2	1501.662	52.274	.000	
Intercept	6472.043	1	6472.043	225.298	.000	
Pretest	62.695	1	62.695	2.182	.144	
Teaching Methods	2731.048	1	2731.048	95.070	.000	Sig.
Error	2240.676	79	28.727			
Total	315493.000	82				
Corrected Total	5244.000	81				

Table 3 shows that at 0.05 level of significance, 1df numerator and 81df denominator, the calculated f is 95.070 with p-value of .000 which is less than 0.05. Therefore, the null hypothesis was rejected. Thus, there is a significant difference between the mean achievement scores of students taught Biology using CTCA and those taught using CLM. This is in favour of CTCA group.

Table 4: Summary of Analysis of Covariance of mean achievement scores of male and female secondary school students taught Biology using Teaching Approaches

Source of Variation	SS	Df	Mean Square	F	Sig.	Decision
Corrected Model	328.756[a]	2	164.378	2.609	.080	
Intercept	12663.889	1	12663.889	200.963	.000	
Pretest	263.955	1	263.955	4.189	.044	
Gender	56.479	1	56.479	.896	.347	Not Sig.
Error	4915.244	79	63.016			
Total	315493.000	82				
Corrected Total	5244.000	81				

Table 4 shows that at 0.05 level of significance, 1df numerator and 81df denominator, the calculated f is .9.447 with p-value of .003 which is less than 0.05. Therefore, the null hypothesis is rejected. Thus, there is a significant difference between the mean achievement scores of male and female students taught computer studies using CTCA in favour of females.

Table 5: Summary of Analysis of Covariance of interaction effect of gender and teaching methods (CTCA and CLM) on the mean achievement scores of students in Biology.

Source of Variation	SS	df	Mean Square	F	Sig.	Decision
Corrected Model	3033.247[a]	4	758.312	26.069	.000	
Intercept	6458.468	1	6458.468	222.026	.000	
Pretest	62.305	1	62.305	2.142	.147	
Teaching Methods	2692.492	1	2692.492	92.561	.000	
Gender	29.713	1	29.713	1.021	.315	
Teaching Methods * Gender	.724	1	.724	.025	.875	Not Sig.
Error	2210.753	77	29.089			
Total	315493.000	82				
Corrected Total	5244.000	81				

Table 5 further shows that at 0.05 level of significance, 1df numerator and 81df denominator, the calculated f is 29.089 with p-value of .875 which is greater than 0.05. Therefore, the null hypothesis is not rejected. Thus, there is no interaction effect of teaching methods (CTCA and CLM) and gender on students' achievement in Biology.

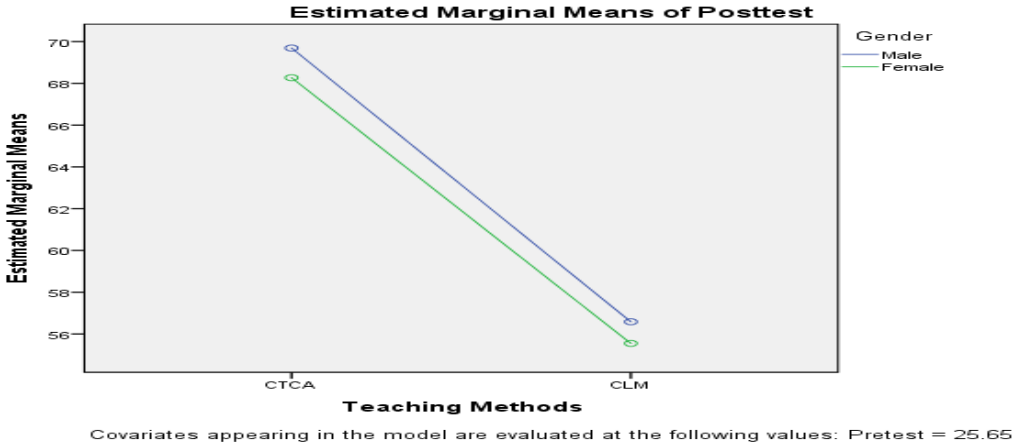


Fig. 1: Profile plots of interaction effect of gender and teaching method (CTCA and CLM) on academic achievement of students in Biology.

Discussion of Findings

The findings from this study show that the Culturo-Techno-Contextual Approach (CTCA) method showed significant higher mean post-test scores, and a high mean gain indicating its effectiveness in enhancing students' performance in biology compared to the CLM. When testing the hypothesis, the result statically showed that there is a significant difference in the mean achievement scores between students taught using the Culturo-Techno-Contextual Approach and those taught using the conventional lecture method. This result is consistent with the findings of Okebukola (2020) who examined the efficacy of Culturo-Techno-Contextual Approach (CTCA) on secondary school students' academic achievement in biology. They found that students taught using a culturally relevant and technologically supported approach showed improved engagement and performance. Similarly, Ogunbanwo (2019) explored the effectiveness of CTCA on students' performance in genetics and evolution concepts in Biology, which aligns with the principles of the CTCA method. The effectiveness of the CTCA method can be attributed to its holistic integration of cultural, technological, and contextual elements, making learning more relevant and engaging for students. This approach not only fosters a deeper understanding of the subject matter but also enhances students' ability to relate the content to their real-life experiences.

The findings from this study show that the CTCA method had a slightly higher mean difference for both male and female students and a higher mean gain compared to the CLM. CTCA method maintained higher mean post-test scores, indicating its effectiveness in enhancing students' performance in biology. When testing the hypothesis, the result statically showed no significant difference in the mean achievement scores of male and female secondary school students taught Biology using the Culturo-Techno-Contextual Approach and those taught using the conventional lecture method. This finding agrees with the results of Oguguo (2019) who investigated the effect of metacognitive learning style on the academic achievement and retention of concept of Ecology by Biology student. They discovered that while traditional lecture methods resulted in slightly higher mean gains, students taught using innovative approaches showed higher post-test scores, indicating a deeper understanding of the material. It also falls in line with the findings of Nsikke, Okon and Dominic (2023) on the effect of selected teaching method on academic achievement of Biology students. Their study revealed that both male and female students benefited from instructional methods that incorporated cultural and technological elements, aligning with the principles of the Culturo-Techno-Contextual Approach.

The outcome of the analysis revealed that there was no significant effect of gender

and teaching method on students' academic achievement in biology. This means that the combined effect of gender and the teaching techniques (Culturo-Techno-Contextual Approach and lecture method of teaching) did not affect students' post-test mean scores in the biology achievement test (BAT). This result corroborates the study by Oguguo (2019) who investigated the effect of metacognitive learning style on the academic achievement and retention of concept of Ecology by Biology student. His findings indicated no significant interaction effect between gender and teaching methods, implying that both male and female students had similar academic achievements regardless of the instructional approach used.

Conclusion

Based on the findings of this study, the study concluded that Culturo-Techno-Contextual Approach is significantly more effective than Conventional Lecture Method in enhancing the achievement of students in Biology in Nsukka Education Zone. Also, the lack of significant gender-based differences and interaction effects suggests that the CTCA is an inclusive, gender friendly and versatile instructional strategy that can benefit a diverse student population.

Recommendations

The following recommendations were made based on the findings of the study

1. Professional development programs should be designed to train teachers through seminars, workshops and conferences in implementing the CTCA method effectively to improve students' achievement.
2. Educational authorities should revise the curriculum to incorporate the CTCA but, ensuring that CTCA is integrated into the teacher education syllabus by the curriculum developers during the pre-service training of Biology teachers.
3. Students should be given equal opportunity just as seen in the CTCA classroom regardless of their gender in order to develop and sustain their achievement in Biology.

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