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EFFECT OF ETHNO-SCIENCE TEACHING ON PERFORMANCE AMONG UPPER BASIC SCIENCE STUDENTS WITH DIVERSE LEARNING STYLES IN MAKURDI METROPOLIS

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Abstract

The study examined the effect of ethno-science teaching on performance among upper basic science students with different learning styles in Makurdi, pre-test post-test quasi-experimental research design was used. Two research questions and two null hypotheses guided the study. Out of the 1613 upper basic II students in 25 government approved public secondary schools (under Benue State Universal Basic Education Board), Makurdi. A multi-stage sample of 60 students in two intact classes from two schools was used for the study. Basic Science Performance Test (BSPT), with reliability coefficient of 0.94 determined by a test-retest method with Pearson Product Moment Correlation statistic was used for data collection. Data were analysed using mean standard deviation mean gain scores and mean gain difference to answer research questions while the null hypotheses were tested using two way analysis of Covariance (ANCOVA). Findings reveal that there is no significant difference in performance among learning styles ($F(2, 53) = 0.133$, $p = 0.876 > 0.05$). However, students taught with ethno-science performed significantly better than those taught by lecture method ($F(1, 53) = 64.537$, $p = 0.000 < 0.05$). Also, no gender difference was found ($F(1, 23) = 0.128$, $p = 0.880 > 0.05$). Therefore, it was recommended that Ethno-science Teaching should be used at basic education level.

Keywords: Ethno-Science, Basic Science and Learning Style and Performance

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Introduction

Education in its general sense is a form of learning in which knowledge, skills, and habits are transferred from one generation to another through teaching, training, or research, often under the guidance of others but sometimes through self-directed learning. Any experience that has a formative effect on the way one thinks, feels, or acts may be considered educational (Biesta, 2017). This process helps students develop critical thinking, creativity, and evidence-based reasoning all of which are important goals of contemporary educational systems (National Research Council, 2019).

Science and technology play a vital role in national development, making science education essential for societal progress. Science provides solutions to human problems through systematic methods and technological applications, contributing significantly to sectors such as medicine, agriculture, communication, transportation, and security (Chikendu, 2018). Science is the foundation of every scientific and technological breakthrough in any nation of the world. It is a way of seeking information (process) and an accumulated body of knowledge resulting from research (Itikpo, et al, 2021).

Basic Science is a foundational subject in basic education that introduces learners to the fundamental concepts, principles, and processes of science through an integrated approach combining biology, chemistry, physics, and environmental studies to help students understand nature as a unified whole (Winarno, et al, 2020; Kabang, 2021) . The subject aims to develop scientific literacy, inquiry skills, and problem-solving abilities that enable learners to apply scientific knowledge to real-life situations and everyday experiences, thereby making science meaningful and functional in society (Oginni, et al, 2024). Basic Science also promotes the acquisition of science process skills such as observation, experimentation, and critical thinking, which are essential for innovation, technological advancement, and sustainable national development (Abuh & Audu, 2024). Furthermore, it serves as the foundation for advanced science learning by preparing students intellectually and attitudinally for further studies in science and technology-related fields while fostering positive attitudes toward scientific inquiry and lifelong learning (Nwosu, et al 2022).

Academic Performance of students is a key feature in education (Anthony, 2018). It is considered to be the centre around which the whole educational system revolves because it determines the success or failure of any academic institution. Academic performance is influenced by several factors including teaching methods, learning environment, students' motivation, socio-economic background, availability of instructional materials, and teacher competence, all of which interact to shape learning achievement and educational success (Adeyemi and Adeyemi, 2021; Owan, et al, 2022).

The traditional lecture method is a teacher-centered instructional approach in which the teacher serves as the primary source of knowledge, delivering information verbally while students listen, take notes, and receive explanations with limited active participation during the learning process. This method emphasizes content transmission, structured presentation of subject matter, and classroom control, making it suitable for covering large amounts of information within a limited time and managing large class sizes (Ogunkola, 2018; Abimbola and Abidoye, 2019). Nevertheless, the traditional lecture method remains widely used in many educational systems, particularly in science classrooms, due to curriculum demands, examination orientation, limited instructional resources, and teachers' familiarity with conventional teaching practices (Aina and Olanipekun, 2024).

Learning style refers to the preferred way individuals perceive, process, and retain information during learning activities, influencing how effectively they understand and apply knowledge. The visual, auditory, and kinesthetic (VAK) learning styles model categorizes learners based on dominant sensory modalities used in learning. Visual learners understand information best through diagrams, charts, pictures, and

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written instructions; auditory learners learn more effectively through listening, discussions, and verbal explanations; while kinesthetic learners prefer hands-on activities, movement, and practical experiences that involve physical interaction with learning materials (Fleming and Baume, 2018; Gilakjani, 2019). Recognizing these learning styles helps teachers adopt diversified instructional strategies that accommodate learners' differences, improve engagement, and enhance academic achievement by aligning teaching methods with students' learning preferences (Hussain, 2021). Consequently, incorporating multisensory teaching approaches that integrate visual, auditory, and kinesthetic elements has been recommended to promote inclusive and effective classroom instruction, particularly in science education where conceptual understanding benefits from varied learning experiences (Ojeaga, et al 2024).

Gender is defined by Ugwu and Nwagbo (2019) as the socially or culturally constructed characteristics and roles which are ascribed to males and females in any society. Review of literature has shown inconsistency in the results of male and female students' academic performance in Basic Science and science at large (Tofi, et al, 2021).

Ethno-Science teaching is an approach to science instruction that teaches science through the lens of culture. Ethno-Science means the expression of scientific facts in indigenous language or native language and qualitative practices, such as counting, weighing, measuring, analyzing, sorting, classifying based on culture. According to Okwara and Upu, (2017) Ethno-Science refers to the materials, ideas, beliefs and technology in a given society or environment, that derive from the past and present cultural practices and traditions. It is knowledge that is indigenous to a particular people.

Ethno-science teaching promotes active participation, cultural identity, and deeper conceptual understanding by relating science content to familiar environmental practices such as local agriculture, medicine, food preservation, and technology used within communities (Okebukola, 2021; Adegbite and Oloruntegbe, 2022). Therefore, this study investigates whether integrating cultural practices and indigenous knowledge through ethno-science teaching can enhance learning processes and improve students' performance in Basic Science at the upper basic level.

Statement of the problem

Analysis of Basic Science results at the Basic Certificate Education Examination (BECE) from 2018 to 2020 shows a rising failure rate: 3.52% in 2018, 9.67% in 2019, and 11.15% in 2020 (Benue State Examination Board, 2022). Despite learner-centered strategies, poor performance persists where students' cultural backgrounds and everyday experiences are neglected, undermining engagement and learning outcomes (Popoola, et al, 2025). Scholars have recommended ethno-science teaching, which connects science concepts to learners' daily lives and cultural practices, as a practical approach to improving understanding and performance. This study, therefore, seeks to investigate the effect of ethno-science teaching on students' performance in Basic Science at upper basic schools in Makurdi Local Government Area of Benue State.

Purpose of the Study

The purpose of the study will be to ascertain the Effect of ethno-science teaching on performance among upper basic science students with different learning styles in Makurdi Metropolis with the following specific objectives.

1. To determine the academic performance among visual, auditory, and kinesthetic learners taught Basic Science using ethno-science and those taught using lecture methods.
2. To find out the academic performance among visual, auditory, and kinesthetic learners taught Basic Science using ethno-science based on gender.

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Research Questions

The following research questions will guide the study

1. What is the mean difference in the academic performance among visual, auditory, and kinesthetic learners taught Basic Science using ethno-science and those taught using lecture method?
2. What is the mean difference in the academic performance among visual, auditory, and kinesthetic learners taught Basic Science using ethno-science based on gender?

Research Hypotheses

1. There is no significant mean difference in the academic performance among visual, auditory and kinesthetic learners taught Basic Science using ethno-science and those taught using lecture methods.
2. There is no significant mean difference in the academic performance among visual, auditory, and kinesthetic learners taught Basic Science using ethno-science based on gender?

Review of Related Literature

The theoretical anchorage of this study is on Piaget's (1957) Theory of Cognitive Development and Ausubel's (1968) Theory of Meaningful Learning provide complementary frameworks for understanding how students acquire and apply knowledge. Piaget emphasized that learners progress through cognitive stages, with the concrete and formal operational stages being most relevant to Basic Science students, highlighting the importance of building on prior experiences, interacting actively with the environment, and linking new knowledge to existing understanding. Similarly, Ausubel stressed that meaningful learning occurs when new information is anchored to learners' pre-existing knowledge, which is shaped by cultural and everyday experiences, and can be facilitated through advanced organizers. Together, these theories are relevant to this research as it underscores the significance of integrating learners' cultural backgrounds and prior knowledge into science instruction to enhance comprehension, engagement, and academic performance, forming the theoretical basis for ethno-science teaching.

Eko, et al, (2020) examined the effect of an Ethno-Science-based Direct Instruction (DI) model on high school students' critical thinking skills in physics at High School 3, Bengkulu City. Using a quasi-experimental design, XI Natural Science 2 served as the experimental class, while XI Natural Science 4 was the control class. Post-test results showed that students taught with the Ethno-Science-based DI model achieved significantly higher critical thinking scores compared to the conventional teaching model. The study concluded that this model effectively enhances students' critical thinking in physics and recommended avoiding conventional methods. The study did not explore the influence of gender on performance, which remains an area for future research.

Dike & Roland (2020) investigated the impact of Ethno-Science-based instruction on students' understanding of sound energy in Basic Science in Abua/Odual LGA, Rivers State. Using a sample of 91 JSS II students from two schools selected via simple random sampling, the study employed a Basic Science Performance Test (BSPT) to assess learning outcomes. Results indicated that students exposed to Ethno-Science-based instruction demonstrated improved performance compared to conventional teaching. The study recommended integrating Ethno-Science strategies into science instruction. Its limitation was a focus solely on the topic of sound energy, rather than the entire Basic Science curriculum.

Nwankwo (2021) assessed the effect of Ethno-Science instructional strategy on JSS students' achievement in Basic Science in Aguata Education Zone, Anambra State. Using a multi-stage sampling technique, 74 students were assigned to experimental and control groups. The Basic Science Achievement Test (BSAT) revealed a significant increase in achievement for students taught with the Ethno-Science strategy

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compared to conventional methods. The study recommended that Basic Science teachers incorporate students' cultural practices into instruction. The study did not consider variations in student learning styles, which this current study aims to investigate.

Abumchukwu, Eke and Achugbu (2021) explored the effect of Ethno-Chemistry instructional strategy on SS2 students' achievement in chemistry. A quasi-experimental design was adopted with a sample of 94 students. Data collected via a Chemistry Achievement Test (CAT) showed that students taught using the Ethno-Chemistry strategy significantly outperformed those in conventional classrooms. Gender was found to have no significant influence on achievement. The study recommended that chemistry teachers integrate cultural practices into teaching, but it did not examine the interaction of learning styles and gender, which is the focus of the present study.

Abonyi (2013) investigated the effect of an Ethno-Science-based instructional package on students' conception of scientific phenomena using a non-equivalent control group quasi-experimental design. A sample of 243 JSS III students from six secondary schools was selected. Analysis revealed that the Ethno-Science-based package was superior to conventional instruction in fostering modern science concept formation. The study also found no significant difference between male and female students in concept formation.

Methodology

The study used a pre-test post-test quasi experimental design. The experimental group was taught Basic Science concepts using Ethno-Science Teaching and the control group was taught the same concepts with lecture methods. A sample of 60 Upper Basic II students in two schools drawn from the population of 1613 in 25 government approved secondary schools under state universal basic Education Board Makurdi (SUBEB), Using a multistage sampling technique (including stratified, purposive and random). Eight government-approved UBE secondary schools were purposely selected from 25 schools in the study area based on permission to conduct the experiment. The schools were stratified into two main groups North Bank and South Bank with four schools in each stratum. To ensure unbiased selection, one school from each stratum was randomly chosen, and in each selected school, one intact class was assigned as the experimental group and another as the control group. The sample, which is not less than 30 subjects, was considered adequate for the experimental study as recommended by Tuckman's (1975) central limit theorem and Sambo (2008). A Basic Science Performance Test (BSPT) was administered to assess student performance, with stratified random sampling ensuring representative selection across the study area. A validated and pilot-tested Basic Science Performance Test (BSPT) conducted on 20 students who are part of the population but are not part of the sample of the study with a reliability coefficient of 0.94 using test-retest and Pearson Product Moment Correlation, statistic was used for data collection. Both the experimental and the control groups were pre-tested before the four-week treatment was administered. The experimental group was treated with Ethno-Science Teaching and the control group was taught using lecture methods before administration of post-test. The research questions were answered using mean and the null hypotheses were tested at $p \leq 0.05$ using Two-way (ANCOVA).

Results

The result of this study is presented in table 1- 4 in the order of the research questions and the null hypotheses as follows:

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Research Question One: What is the mean difference in the academic performance among visual, auditory, and kinesthetic learners taught Basic Science using ethno-science and those taught using lecture method?

Table 1: Performance Mean and Standard Deviation of Student Based on Learning Style (LS) and Lecture Method (LM).

Learning Style	Teaching Method	Sample (n)	Pre-BSPT		Post-BSPT		$\bar{x}$ Gain	$\bar{x}$ Gain Difference
			$\bar{x}$	SD	$\bar{x}$	SD		
Visual	ES	10	9.20	1.619	19.30	0.823	10.1	5.61
	LM	8	8.63	1.302	13.12	3.944	4.49	
Auditory	ES	17	9.59	3.411	18.88	0.857	9.29	8.89
	LM	20	8.30	2.003	12.30	2.940	0.4	
Kinesthetic	ES	3	10.67	1.155	19.67	0.577	9.0	6.0
	LM	2	9.50	0.707	12.50	2.121	3.0	
Cluster	ES		9.82		19.28		9.46	6.83
	LM		8.81		12.64		2.63	

Group: ES (Experimental Group taught using Ethno-science), LM (Control Group taught using Lecture Method), $\bar{x}$ (Mean), SD (Standard Deviation), $\bar{x}$G (Mean Gain) and $\bar{x}$GD (Mean Gain Difference)

The result in Table 1 shows homogeneity in the pre-test Performance mean scores among learning style students, between ES and LM with cluster means of 9.82 and 81. The Table also shows that all the performance mean scores among learning style students in the ES were higher than those in the LM with cluster mean gain difference of 6.83.

Research Question Two: What is the mean difference in the academic performance among visual, auditory, and kinaesthetic learners taught Basic Science using ethno-science based on gender?

Table 2: Performance Mean and Standard Deviation of Student Based on Learning Style (LS) and Gender (G).

Learning Style	Gender	Sample (n)	Pre-BSPT	Post-BSPT	$\bar{x}$ Gain	$\bar{x}$ Gain Difference

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			$\bar{x}$	SD	$\bar{x}$	SD		
Visual	Male	4	9.25	0.957	19.25	0.500	10.0	0.16
	Female	6	9.17	2.041	19.33	1.033	10.16	
Auditory	Male	3	13.67	3.215	18.67	1.155	5.0	5.22
	Female	14	8.71	2.840	18.93	0.829	10.22	
Kinesthetic	Male	1	10.00	0.000	20.00	0.000	10.0	1.91
	Female	2	11.00	1.414	19.09	0.707	8.09	
Cluster	Male		10.97		19.31		8.33	1.16
	Female		9.63		19.12		9.49	

ES (Experimental Group taught using Ethno-science), $\bar{x}$ (Mean), SD (Standard Deviation), $\bar{x}$G (Mean Gain) and $\bar{x}$GD (Mean Gain Difference).

The result in Table 2 shows homogeneity in the pre-test performance mean scores among learning style male and female students taught Basic Science using ES with cluster means of 10.97 and 19.63. The table also shows that the performance mean scores in the post test was homogeneous between male and female reasoning ability students taught Basic Science using ES with cluster mean gains of 19.31 and 19.12 respectively.

Research Hypotheses One: There is no significant mean difference in the academic performance among visual, auditory and kinaesthetic learners taught Basic Science using Ethno-Science and those taught using lecture method.

Table 3: Summary of Two-Way ANCOVA on Performance Scores among Learning Style Students based on Teaching Method.

Source	Type III Sum of Squares	Df	Mean Square	F	P	Partial Eta Squared
Corrected Model	662.099[a]	6	110.350	20.386	.000	.698
Intercept	965.299	1	965.299	178.332	.000	.771
Pretest Performance	9.222	1	9.222	1.704	.197	.031
Teaching Method	349.333	1	349.333	64.537	.000	.549
Learning Style	5.590	2	2.795	.516	.600	.019
Teaching Method	1.442	2	.721	.133	.876	.005

* Learning Style

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Error	286.885	53	5.413
Total	15959.000	60	
Corrected Total	948.983	59	

a. R Squared = .698 (Adjusted R Squared = .663)

The ANCOVA result in Table 3 showed no significant difference in the performance mean scores among learning style students within those taught Basic Science using ES and those taught using LM, F (2, 53) = 0.133, ρ (0.876) > 0.05. The null hypothesis was therefore, not rejected. However, the table showed that the student's performance mean scores in the ES were better than those in the LM, F (1, 53) = 64.537, p (0.000) < 0.05. This implies that although Ethno-science teaching enhances performance, it is not dependent on students' learning style.

Research Hypotheses Two: There is no significant mean difference in the academic performance among visual, auditory, and kinaesthetic learners taught Basic Science using Ethno-Science based on gender.

Table 4: Summary of Two-Way ANCOVA on Performance Scores among Learning Style Students based on Gender.

Source	Type III Sum of Squares	Df	Mean Square	F	P	Partial Eta Squared
Corrected Model	2.589[a]	6	.432	.548	.766	.125
Intercept	495.977	1	495.977	629.874	.000	.965
Pretest Performance	.068	1	.068	.086	.772	.004
Gender	.024	1	.024	.030	.864	.001
Learning Style	2.106	2	1.053	1.337	.282	.104
Gender * Learning Style	.202	2	.101	.128	.880	.011
Error	18.111	23	.787			
Total	10965.000	30				
Corrected Total	20.700	29				

a. R Squared = .125 (Adjusted R Squared = -.103)

The ANCOVA result in Table 8 reveals that no significant difference existed in the performance mean scores among learning style male and female students taught Basic Science using ES, F(1, 23) = 0.128, ρ (0.880) > 0.05. The null hypothesis was therefore, not rejected. This implies that Ethno-Science is gender unbiased, hence it enhances performance in both male and female Basic Science Students.

Discussion of Findings

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This study focused on the "Effect of Ethno-Science teaching on performance among upper basic science students with different learning style and reasoning ability in Makurdi. And made four findings as discussed below:

Concerning student's learning style visual, auditory and kinaesthetics learners based on their exposure to Ethno-Science teaching and lecture method it was found that those taught using Ethno-Science instructional strategies achieved higher scores than those taught using the Lecture Method, although the difference was not statistically significant. The enhanced performance was attributed to students' active engagement with available cultural and local resources, which provided practical and contextual learning experiences. Ethno-Science teaching proved effective across different learning styles visual, auditory, and kinesthetic by allowing students to interact meaningfully with the content. This finding aligns with previous studies by Eko, Junia, Dinissjah, Nirwana, and Kristiawan (2020), Dike and Roland (2020), and Nwankwo (2021), who reported that students exposed to Ethno-Science strategies performed better than their peers taught through conventional methods.

Analysis based on gender indicated no significant difference in performance between male and female students taught using Ethno-Science teaching, showing that both genders benefit equally from engagement with cultural resources. This supports the view that the approach improves academic performance without gender bias, consistent with findings by Abumchukwu, Eke, and Achugbu (2021), Nweke (2021), and Abonyi (2013). Overall, the results demonstrate that Ethno-Science teaching effectively enhances students' understanding and achievement in Basic Science by fostering active participation and leveraging culturally relevant learning resources.

Conclusion

Based on the findings, it was concluded that: Ethno-Science Teaching has significantly enhanced the academic performance of students with different learning styles and is gender friendly as it enhances male and female student's academic performance in basic science.

Recommendations

The study advanced the following recommendations:

Teachers should use good innovative methods that will stimulate students interest in an attempt to make learning of science more meaningful to the learners and thereby generating improved learning outcomes that will lead to a change in academic performance towards science;

Science curriculum should be reviewed in terms of basic instructional approaches to incorporate some basic ethno-scientific or culturally relevant materials and practices in a systematic and well-articulated approach to facilitate learners to gain confidence and appreciate the emerging modern scientific concepts.

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