Towards Scaling up Students' Performance and Retention in Basic Science Using Ethno science Enriched Instruction

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Abstract

This study investigated the impact of Ethno science Enriched Instruction on Basic Education Students' Performance and Retention in Basic science in Wukari education zone, Taraba State, Nigeria. Quasi-experimental design, involving non-equivalent control group design was used for the study. Four research questions guided the study while four null hypotheses were tested at .05 level of significance. The sample size for the study was 127 upper basic II basic science students; consisting of 78 males and 49 females drawn from two public secondary schools using multistage sampling techniques. The instrument used for the study was Basic Science Performance Test (BSPT) with reliability index of 0.78. The research questions were answered using mean and standard deviation, while the null hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). The findings revealed that there was statistical significant difference between the mean performance and mean retention scores of students taught Basic science using ethno science enriched instruction strategy and those students taught using conventional learning strategy. However, the findings on gender revealed that there is no statistical significant difference in the performance and retention scores of male and female students taught Basic science using ethno science enriched instruction strategy. It is therefore recommended that Science teachers should be exposed to Ethno science-enriched instructional strategy through seminars or trainings to improve their inputs during teaching/learning, and Basic science teachers should be encouraged to use Ethno science-enriched instructional strategy to improve and bridge the gap between male and female Basic science students' academic performance and retention.

Key Words: Ethno science-Enriched Instruction, Performance, Retention; Conventional strategy, and Gender.

Introduction

Basic science is the first form of science taught at the elementary level (primary and junior secondary level) in Nigeria to prepare students at the Upper Basic Education level for the study of core science subjects which lays the foundation for the study of these core science subjects such as Biology, Chemistry and Physics at the senior secondary school level of education (Adeniran, et al 2018). The implication is that, students grounded in Basic Science at the Upper Basic level of Education would be able to study single science subjects such as

Biology, Chemistry and Physics at the senior secondary school level successfully. Progress in the teaching and learning of basic science and technology still remained very slow, in spite of the introduction of the 9-year Basic Education Curriculum, developed by the Nigeria Educational Research and Development Council (NERDC) from the primary and junior secondary curricula, enumerates the objectives of the new Basic Education Curriculum in science and technology to develop interest in science and technology; apply their basic knowledge and skills in science and technology to meet societal needs; take advantage of the numerous career opportunities offered by the study of science and technology; and become prepared for further studies in science and technology. (FRN, 2014). Despite this laudable purpose of basic education, Liga and Emaikwu (2016) submitted that academic performance of students still remains poor in science subjects particularly in basic science which is the foundation to science education.

Academic performance according to Okwara and Upu (2017), is the exhibition of knowledge attained or skills developed by students in a subject as determined by test scores of students assigned by teachers. Performance also means the extent to which a student has reached its educational goal, commonly measured by examinations. In another assertion, Tukura, et al (2020) described performance as a composite students' behavior underlying several abilities which include previous knowledge, interest and retention among others. Retention is the level at which an individual is capable of recalling an acquired knowledge at any given time (Kyado, et al 2020). The ability of learners to remember what they were taught after some time is an important component of learning. According to Aina and Keith (2015), an average student only retains what is learnt and forgets after a short while if he was not involve in the teaching/learning process. Poor retention and failure in retention results in poor performance in examinations

The poor performance in Basic Science at Basic Education Certificate Examination in Taraba State becomes evident considering the percentage credit passes which has been less than 50% between 2018 to 2022 (Taraba State Examination Board). There are many factors responsible for this poor performance. These factors as stated by Ode, et al (2020) include use of inappropriate teaching methods, lack of instructional materials and inadequate number of qualified teachers. Students' poor performance and lack of retention of science concept is attribute of poor foundation and instructional method/strategies adopted by science teachers (Atadoga & Lakpini, 2013; Dike & Rowland, 2020). Basic science syllabus has been designed with activities, methods and instructional strategies permits the learner to learn

through the activity-based method of teaching among which Ethnoscience instructional strategy.

Ethno-science according to Okwara & Upu, 2017 refers to the materials, ideas, beliefs and technology in a given society or environment, driven from the past and present cultural practices and traditions. It is knowledge that is indigenous to a particular people. Ethno-science instructional strategy involves the organization of instruction based on diverse cultural context. The strategy requires the teacher to draw analogy and explanations from traditional culture while focusing on the basic science needed by students in the society. In the ethno-science classroom, the teacher introduces the lesson by presenting students with cultural practices and knowledge related to the concept with the leaner's environment (Nwankwo, 2021). The teacher explains the concept to the students and engage the students by tasking them to present more cultural knowledge related to the concept. The benefit of the instructional strategy is such that the gap in knowledge of the students and their culture and the new field of knowledge is bridged (Abonyi, et al 2014; Nwankwo, 2021). Similarly, Ethno-science-Based instruction bridges the gap of abstraction in teaching and learning. This makes learning concrete, since what is to be learnt is linked to the cultural or indigenous practices of the leaner irrespective of the learners gender.

According to Filgona (2017) gender is the range of physical, biological, mental and behavioural characteristics differentiating between the female and male. The disproportion in the performance of males and females in the sciences has been studied over the years. There are varying opinions on whether males or females achieve better than the other. In some studies, (Odagboyi, 2015; Achor & Abuh, 2020) showed that the male students achieved better than the female students in science, while Achor and Gbadamosi (2020); Bileya and Danjuma (2021) revealed that there is no significant difference in science achievement between males and females students. These shows that the issue of gender with regards to students' performance has not been resolved. These findings gave room for inclusion of gender as a moderating variable for this study.

Problem of the study

Many research studies have been carried out on retention leading to poor performance in Basic Science in Basic Education Certificate Examination (BECE). Many of those studies found out that lack of qualified basic science teachers, teaching strategy employed by science teachers among others influences students' mayhem in the subject. However, basic science

teachers have applied various strategies like concept mapping strategy, jigsaw, collaborative learning strategy, cooperative learning strategy, problem-solving strategy among others for teaching Basic Science, yet there has been poor retention, leading to poor performance in Basic Science in Basic Education Certificate Examination (BECE). There is an outcry from parents, teachers, curriculum planner and other stakeholders in the educational industry about the poor retention, which leads to decline in performance of students in both internal and external examination in the basic science. It is on this background that the researcher seeks to determine the impact of ethno science enriched instruction on students' retention and performance in Basic Science.

Purpose of the Study

The purpose of this study was to determine the impact of use of culturally relevant practices (ethno science-enriched-instruction) in the teaching of Basic Science concepts. Specifically, the study examined:

1. the difference in the performance of students taught Basic science using ethno science enriched instructional strategy and those taught using conventional instructional strategy?
2. the difference in the retention ability of students taught Basic science using ethno science-enriched-instructional strategy and those taught using conventional strategy?
3. the difference in the performance of male and female students taught Basic science using ethno science enriched instructional strategy and those taught using conventional strategy?
4. the difference in mean retention scores of male and female students taught Basic science using ethno science enriched instructional strategy and those taught using conventional instructional strategy?

Research Questions

1. What is the difference in the mean performance scores of students taught Basic science using ethno science-enriched-instructional strategy and those taught using conventional instructional strategy?
2. What is the difference in the mean retention scores of students taught Basic science using ethno science–enriched-instructional strategy and those taught using conventional instructional strategy?

3. What is the difference in the mean performance scores of male and female students taught Basic science using ethno science-enriched-instructional strategy and those taught using conventional instructional strategy?
4. What is the difference in mean retention scores of male and female students taught Basic science using ethno science–enriched-instructional strategy and those taught using conventional instructional strategy?

Hypotheses

1. There is no significant difference between the mean performance scores of students taught Basic science using ethno science-enriched-instructional strategy and those taught using conventional instructional strategy.
2. There is no significant difference between the mean retention scores of students taught Basic science using ethno science-enriched-instructional strategy and those taught using conventional instructional strategy.
3. There is no significant difference between the mean performance scores of male and female students taught Basic science using ethno science-enriched-instructional strategy.
4. There is no significant difference between the mean retention scores of male and female students taught Basic science using ethno science-enriched-instructional strategy.

Methodology

Quasi-experimental design specifically the pre-test post-test non-equivalent control group design was adopted for the study. The study was carried out in Wukari education zone, Taraba State, Nigeria. The population of the study was 8673 upper basic II students in the study area. The sample size for the study was 127 upper basic II basic science students; consisting of 78 males and 49 females drawn from two intact classes using multistage sampling techniques. Out of the 2 local government areas in the education zone under study area, Wukari local government area was selected using simple ransom sampling. 2 co-educational schools were purposively selected. This was followed by the sampling of 1 intact classroom from each of the sampled schools using random sampling making a total of 2 intact classes. One of the 2 intact classes was designated experimental group while the other class was designated control group. The experimental group was taught Basic Science concepts using ethno science enriched instructional strategy and the control group taught

Basic Science concepts with the conventional instructional strategy. The instrument used for data collection developed by the researchers was a 25-item multiple choice test tagged Basic Science Performance Test (BSPT). Using Kuder Richardson coefficient of internal consistency for the instrument was found to be 0.78. To control for possible pre-existing differences in overall ability between the experimental and control groups a pretest was administered to both groups before the commencement of the experiment in the respective classes. At the end of the treatment, a posttest using the same instrument used for the pretest was administered to assess the students' academic performance due to the treatment. Two weeks later, a post-posttest was administered to assess the extent of retention of the concepts learned. Data collected were analyzed using mean and standard deviation to answer the research questions, while the null hypotheses were tested at 0.05level of significance using Analysis of Covariance (ANCOVA).

Results

Research Question One: What is the difference in the mean performance scores of students taught Basic science using ethno science-enriched-instructional strategy and those taught using conventional instructional strategy?

Table1: Mean Performance and Standard Deviations of Pre-test and Post-test of Control and Experimental Groups

Group	N	Pre-test		Post-test		
		Mean	Std. Dev	Mean	Std. Dev	Mean gain
Control	61	17.41	1.82	28.95	4.14	11.54
Experimental	66	17.03	1.75	36.75	3.92	19.72
Mean differences		0.38		7.80		8.18

Results on Table 1 show that the mean performance scores of students taught basic science using Conventional instructional Strategy is 28.95 with standard deviation of 4.14, while that of those taught using Ethno science-enriched-instructional Strategy at post-test is 36.75 with standard deviation of 3.92. The difference between the pre-test and post-test performance mean scores of the control group is 11.54 and that of the Ethno science-enriched-instructional Strategy group is 19.72. These differences show an increase in performance by the two groups. There is also a difference of 7.80 between the post-test mean scores of the two groups

in favour of the Ethno science-enriched-instructional Strategy group with mean gain of 8.18. The implication is that the students taught Basic Science using Ethno science-enriched-instructional Strategy gained in performance more than their Conventional instructional Strategy counterparts.

Research Question Two: What is the difference in the mean retention scores of students taught Basic science using ethno science-enriched-instructional strategy and those taught using conventional instructional strategy?

Table2: Mean Retention and Standard Deviations of Pre-test and Post-Post-test of Control and Experimental Groups

Group	N	Pre-test		Retention test		
		Mean	Std. Dev	Mean	Std. Dev	Mean gain
Control	61	17.41	1.82	24.89	4.67	7.48
Experimental	66	17.03	1.75	35.70	3.92	18.67
Mean differences		0.28		10.81		11.19

Results of Table 2 show that the retention scores of students taught Basic science using Conventional instructional Strategy is 24.89 with standard deviation of 4.67, while that of those taught using Ethno science-enriched-instruction Strategy is 35.70 with standard deviation of 3.92. The difference between the pre-test and retention mean scores of Conventional instructional Strategy group is 7.48 and that of the Ethno science-enriched-instruction strategy group is 18.67. These differences show what was retained by the two groups. There is also a difference of 10.81 between the retest mean scores of the two groups and the mean gained by the experimental group is 11.19. The implication is that the students taught Basic science using Ethno science-enriched-instructional Strategy retain the acquired knowledge more than those under Conventional instructional Strategy.

Research Question Three: What is the difference in the mean performance scores of male and female students taught Basic science using ethno science-enriched-instructional strategy?

Table3: Mean Performance and Standard Deviations of Pre-test and Post-test based on Gender of Experimental Group

Group	N	Pre-test		Post-test		
		Mean	Std. Dev	Mean	Std. Dev	Mean gain

Male	29	17.57	1.48	36.43	4.49	18.86
Female	37	16.34	1.75	37.17	3.00	20.83
Mean differences		1.23		0.74		2.03

Results of Table 2 show that the post-test mean performance scores of male students taught Basic science using Ethno science-enriched-instructional Strategy is 36.43 with standard deviation of 4.49, while that of the female students is 37.17 with standard deviation of 3.00. The difference between the pre-test and post-test mean scores of the male students is 18.86 and that of the female students is 20.83. The difference between the post-test mean scores of the two sexes is 0.74 and the mean gained in favour of the female students is 2.03. The implication is that the female students taught Basic science using Ethno science-enriched-instructional Strategy gained in performance is more than their male counterparts.

Research Question Four: What is the difference in mean retention scores of male and female students taught Basic science using ethno science enriched instructional strategy?

Table4: Mean Retention and Standard Deviations of Pre-test and Post-Post-test based on Gender of Experimental Group

Group	**N**	**Pre-test**		**Retention test**		
		Mean	**Std. Dev**	**Mean**	**Std. Dev**	**Mean gain**
Male	29	17.57	1.48	35.67	4.94	18.10
Female	37	16.34	1.75	35.72	3.39	19.38
Mean differences		1.23		0.05		1.28

Results of Table 4 show that the mean retention scores of male students taught Basic science using Ethno science-enriched-instructional Strategy is 35.67 with standard deviation of 4.94, while that of the female students is 35.72 with standard deviation of 3.39. The difference between the pre-test and retest mean scores of the male students is 18.10 and that of the female students is 19.38. These differences show what was retained by the female and male students. The difference between the retest mean scores of the two sexes is 0.05 and the mean gained in favour of the female students is 1.28. The implication is that the female students taught Basic science using Ethno science-enriched-instructional strategy retained the acquired

knowledge more than their male counterparts. This could be due to the fact that in the study area females are used to doing household chores than males.

Hypothesis One: There is no significant difference between the mean performance scores of students taught Basic science using ethno science-enriched-instructional strategy and those taught using conventional instructional strategy.

Table 5: Analysis of Covariance of the Mean Performance scores of students taught Basic science using Ethno science-enriched-Instructional strategy and those taught using conventional instructional strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1097.040[a]	2	548.520	33.492	.000
Intercept	1160.218	1	1160.218	70.841	.000
Pretest	28.140	1	28.140	1.718	.192
Group	**1093.722**	**1**	**1093.722**	**66.781**	**.000**
Error	2030.834	124	16.378		
Total	149668.000	127			
Corrected Total	3127.874	126			

Table 5 is a between groups analysis of covariance to compare the effect of Ethno science-enriched-instructional strategy and conventional instructional strategy on students' performance in Basic science. The result F (1, 126) = 66.781, P = .000 < 0.05 shows that the two groups differ significantly. Thus, the null hypothesis is rejected. Therefore, there is a significant difference between the mean performance scores of students taught Basic science using ethno science enriched-instructional strategy and those taught using conventional instructional strategy. The Adjusted R Squared (0.340) indicates that 34% of the difference in the mean score is based on the strategy used.

Hypothesis Two: There is no significant difference between the mean retention scores of students taught Basic science using ethno science-enriched-instructional strategy and those taught using conventional instructional strategy.

Table 6: Analysis of Covariance of the Mean Retention scores of students taught Basic science using ethno science-enriched-instructional strategy and those taught using conventional instructional strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3705.789[a]	2	1852.895	89.263	.000
Intercept	1209.581	1	1209.581	58.271	.000

Pretest	.177	1	.177	.009	.926
Group	**3669.656**	**1**	**3669.656**	**176.785**	**.000**
Error	2573.959	124	20.758		
Total	124452.000	127			
Corrected Total	6279.748	126			

Table 6 is a between groups analysis of covariance to compare the effect of ethno science enriched instructional strategy and conventional instructional strategy on students' retention in Basic science. The result F (1, 126) = 176.785, P = .000 < 0.05 shows that the two groups differ significantly. Thus, the null hypothesis is rejected. Therefore, there is a significant difference between the mean retention scores of students taught Basic science using ethno science enriched instructional strategy and students taught using conventional instructional strategy.

Hypothesis Three: There is no significant difference between the mean performance scores of male and female students taught Basic science using ethno science enriched-instructional-strategy

Table 7: Analysis of Covariance of the Mean Performance scores based on Gender of the Ethno science-enriched instructional strategy group

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	8.906[a]	2	4.453	.279	.757
Intercept	832.386	1	832.386	52.168	.000
Pre-test	.004	1	.004	.000	.988
Gender	**7.714**	**1**	**7.714**	**.483**	**.489**
Error	1005.215	63	15.956		
Total	90188.000	66			
Corrected Total	1014.121	65			

Table 6 is a between gender analysis of covariance to compare the effect of ethno science enriched instructional strategy on male and female students' performance in Basic science. The result F (1, 65) = .483, P = .489 > 0.05 shows that the variation of scores for male and female students of ethno science-enriched-instructional strategy group is about the same. Thus, the null hypothesis is not rejected. Therefore, there is no statistically significant difference between the mean performance scores of male and female students taught Basic science using ethno science-enriched-instructional strategy.

Hypothesis Four: There is no significant difference between the mean retention scores of male and female students taught Basic science using ethno science-enriched-instructional strategy

Table 8: Analysis of Covariance of the Mean Retention scores based on Gender of Experimental Group

Dependent Variable: Experimental Group Post-post test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.651[a]	2	.325	.017	.984
Intercept	824.113	1	824.113	41.827	.000
Pretest	.612	1	.612	.031	.861
Gender	**.008**	**1**	**.008**	**.000**	**.984**
Error	1241.289	63	19.703		
Total	85344.000	66			
Corrected Total	1241.939	65			

Table 8 is one-way ANCOVA between gender analysis of covariance to compare the impact of Ethno science-enriched-instructional strategy on male and female students' retention in Basic science. The result F (1, 65) = .000, P = .984 > 0.05 shows that the variation of scores for male and female students of Ethno science-enriched-instructional strategy group is the same. Thus, the null hypothesis is not rejected. Therefore, there is no statistically significant difference between the mean retention scores of male and female students taught Basic science using ethno science enriched instructional strategy.

Discussion of Findings

The results obtained revealed that students taught using Ethno science-enriched instructional strategy portrayed a higher level of performance than their counterparts taught using Conventional instructional Strategy. This is supported by the fact that there is a significant difference between the mean performance scores of the students taught Basic science using Ethno science-enriched-instructional strategy and that of the students taught Basic science using Conventional instructional Strategy. This finding agrees with that of Nwankwo (2021); Okwara and Upu (2017); Fasisi (2017), who revealed that students exposed to the Ethno science-enriched-instructional-strategy obtained significantly higher mean scores in Performance Test compared to those exposed to Conventional instructional Strategy. This indicates that Ethno science-enriched-instructional-strategy improves Basic science students' performance.

As observed in the result of the study, students taught Basic science using Ethno-science-enriched-instructional-strategy retain the acquired knowledge more than these under Conventional instructional Strategy. This finding is in line with that of Tukura, et al (2020) and Peni (2017), the authours revealed that students exposed to Ethno science-enriched-instructional strategy obtained significantly higher mean scores in retention compared to those exposed to Conventional instructional strategy. This indicates that using Ethno science-enriched-instructional-strategy is improves Basic science students' retention ability.

The result of the study showed that, female students taught Basic science using Ethno science-enriched instructional strategy gained more in performance than their male counterparts. However, the difference in the mean performance scores of male and female students was not statistically significant. The result contradicts the finding of Nwankwo (2021); Okwara and Upu (2017) which states that there was significant difference between the mean performance scores of male and female students taught Basic science using Ethno science-enriched- instructional strategy. These findings indicate that Ethno science-enriched-instructional strategy reduces gender gap in Basic science performance.

Conclusion and Recommendations

From the foregoing, it is evident that Ethno science-enriched-instructional-strategy enhances students' performance and retention more than the conventional instructional strategy. However, male and female students exposed to Ethno science-enriched instructional strategy have no significant difference in performance and retention in Basic science learning.

Based on the results of the data analysis, the following recommendations are made.

1. Basic Science teachers should be exposed to Ethno science-enriched-instructional strategy through seminars or trainings to improve their inputs during teaching/learning.
2. Basic science teachers should endeavor to give female and male students equal opportunities in the classroom.

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