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Effect of Ethnochemistry Based Instructional Package on Students' Achievement in Chemistry

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Abstract:
The study investigated the effect of ethno-chemistry based instructional package on Student's Achievement in Chemistry. The study adopted quasi experimental research design. The instrument used for data collection is Chemistry Achievement Test (CAT), with the reliability index of 0.70 using Kuder-Richardson (K-R20) approach. Four co-educational schools were drawn from all the co-educational schools in Enugu State through simple balloting. Out of the four schools drawn for the study two were assigned to the treatment group while the remaining two schools were assigned to the control group. The treatment group was taught chemistry using ethnochemistry-based approach in while control group was taught chemistry using conventional method. The same topics were taught to both the treatment and control groups. Four regular chemistry teachers from the four schools were used as research assistants.Before the onset of the experiment, subjects in both treatment and control groups were given the pre-test. After the pre-test the regular chemistry teachers started the experiment in their respective schools adhering strictly to the lesson procedure that was developed from the packages during the pre-experimental conference. The experiment was conducted during the normal school periods, following the normal timetable of the school. At the end of the experiment that lasted for 8 weeks the teachers administered the post-tests to the subjects in the two groups. Three research questions and three null hypotheses guided the study. The research questions were answered using mean and standard deviation while the hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). The study revealed that students taught chemistry using ethnochemistry based instructional package had significantly higher mean achievement scores than those taught using conventional package and that there is no significant difference in the mean achievement scores of male and female students taught chemistry using the ethnochemistry-based approach. The study further revealed that there is interaction between methods and gender on students mean achievement scores in chemistry.
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Introduction:

Chemistry is a branch of science that studies matter, its chemical composition, properties, transformation and uses. Chemistry as a branch of science operates on the principle of observation, experimentation and inference to understand the nature of the environment and thus an empirical science. Being an empirical science makes it necessary for the realization of the nation's technological advancement. The importance of chemistry in the technological development of the nation is enormous since it features prominently in petroleum and petrochemical industries where the nation's income depends. Apart from petrochemical industries, the process of chemistry can be found in other areas of development such as health services, water supply, solid minerals, textile factories, crime detection, waste management, control of environmental pollution among others (Zuru, 2019). In addition, Jegede (2010) supported that chemistry occupies a central position among the sciences due its remarkable contribution in medicine, Nursing, Engineering, Pharmacy, Agriculture, environmental waste management among others. Although the knowledge of chemistry is essential for technological development of the nation, yet achievement of students in chemistry is not encouraging.

Academic achievement of students ordinarily refers to the successful outcome of training learners in academics through their efforts and skills. Achievement in chemistry is the measure of accomplishment in that specific field of study (Idah, 2018). When the measure of the accomplishment in chemistry is high, achievement will be high and the aim of its education will be actualized and the society will benefit economically, on other hand if the accomplishment is low, learners will achieve poorly and it will affect the national development. This low achievement in chemistry is said to have hindered the realization of the national goals. Some authors had attempted to identify the factors contributing to poor achievement in chemistry. Ajayi, Achor and Agogo (2017) argued that foreign or Eurocentric nature of chemistry invariably translates to students' poor achievement in classroom. In other words introducing chemistry in a foreign culture makes it difficult for the learners to understand it and thereby lead to poor achievement. Ugwu and Diovu (2016) also suggested that chemistry is an abstract subject possibly because the way it is taught does not relate it to day to day activities of the learner. Their argument is that chemistry is introduced in our educational system in a pattern that is foreign and Euro-

centric, built on western cultural background that has no meaning to the students. Also the subject is mainly taught by traditional method whereby the knowledge imparted on students is isolated from natural practices. As such students resorted to learning by role memorization with the attendant consequences of poor achievement (Ajayi et al, 2017). Chemistry educators are concerned with effective teaching methods at Secondary school level to change students' attitude and enhance understanding and achievement (Ugwu and Diovu, 2016). However among several methods tried, none of them employed home-based and cultural approach, since majority of the activities carried out at home involve chemical process. On this context, most chemistry concepts can be observed in some indigenous practices of students' culture in their environment which the teacher can organize and apply in classroom to sensitize and create curiosity in students for better achievement (Idah and Odume, 2019). The interconnectivity between indigenous practices and chemistry concepts might go a long way bringing chemistry home to the learners thereby making them to see the relationship between indigenous knowledge and modern chemistry. This interconnectivity could be achieved using ethnochemistry based instructional package.

Ethno according to Ajayi, Achor and Agogo (2017), are members of a group within a cultural environment identified by their cultural traditions, codes, symbols myths and specific ways used to reason and to infer.

Indra and Bitwell, (2016), opined that, ethnochemistry are various chemically related cultural and community practices. This goes further to show that the practices vary from culture and community. In support of the above Ajayi et al, (2017) defined ethnochemistry as the study of chemistry practices of specific cultural groups in the course of dealing with their environmental problems and activities using their own ideologies. In other words ethnochemistry based instructional package involve the method of organizing the teaching of chemistry through the use of the learner's culture, language, activities and background to explain situations in their environment. Most chemistry concepts have their origin in many diverse indigenous knowledge and practices of the people, being carried out unknowingly in isolation from chemistry as a school subject. This approach might go a long way in resolving cognitive conflicts imposed on students by certain chemical concepts and invariably have far reaching implications on students achievement in chemistry.

In this case, the aim of ethnochemistry based instruction in this study is to use a familiar concept of acids and bases activities in the learners culture, ideologies, background and reasoning to integrate with foreign-centric acids and bases to improve their achievement. Integrating ethnochemistry into chemistry instructions may enable students to see chemistry as a familiar subject, instead of one that is strange and unfamiliar. In this case the study examined the effect of ethnochemistry based instructional package on students' achievement in chemistry (acids, bases) in Enugu Education Zone. Specifically, the study intended to:

Determine the effect of ethnochemistry based instructional package on the mean achievement scores of students in chemistry.

Ascertain the interaction effect of methods and gender on students mean achievement scores in chemistry.

Research Questions

The following research questions guided the study:

1. What are the mean achievement mean scores of students taught chemistry using ethnochemistry-based approach and those taught with conventional method?
2. What are the achievement mean scores of male and female students taught chemistry using the ethnochemistry-based approach?
3. What is the interaction effect of methods and gender on students' achievement in chemistry?

Hypotheses

HO_1: There is no significant difference in the achievement mean scores of students taught chemistry using the ethnochemistry-based approach and those taught using conventional method.

HO_2: There is no significant difference in the achievement mean scores of male and female students taught chemistry using the ethnochemistry-based approach.

HO_3: There is no significant interaction between methods and gender on students mean achievement scores in chemistry.

Research Methods

The study employed pre-test, post-test non-equivalent quasi experimental design, due to intact classes used. The area of study was Enugu Education zone of Enugu state. The sample comprised of 208 students from intact classes of four co-educational schools. Four coeducational schools were drawn from all the coeducational schools in the state through simple balloting. Out of the four schools drawn for the study two were assigned to the treatment group while the remaining two schools were assigned to the control group. The treatment group was taught chemistry using ethnochemistry-based approach in line with the lesson procedures prepared by the researcher while control group was taught chemistry using traditional Talk & Chalk method. The same topics

were taught to both the treatment and control groups. Four regular chemistry teachers from the four schools were used as research assistants. These assistants were trained by the researcher for one week before commencement of the experiment. The instrument used to collect data is Chemistry Achievement Test (CAT) which was developed and validated by the researcher. The content validity of the achievement test was ascertained using a test blueprint and goodness of fit test. The internal consistency of the instrument was determined using the K-R20 approach. Internal consistency index of 0.70 was obtained. The instrument was used both for the pretest and posttest. Before the onset of the experiment, subjects in both treatment and control groups were given the pre-test. After the pre-test the regular chemistry teachers started the experiment in their respective schools adhering strictly to the lesson procedure that was developed from the packages during the pre-experimental conference. The experiment was conducted during the normal school periods, following the normal timetable of the school. At the end of the experiment that lasted for 8 weeks the teachers administered the post-tests to the subjects in the two groups. Data that was collected from the pre-test and post-test were kept separately for the two groups and was used to answer the research questions and test the hypotheses. The research questions were answered using mean and standard deviation while the hypotheses were tested at 0.05 level of significance using analysis of Covariance.

Results

Research Question 1

What is the effect of ethnochemistry based instructional package on the mean achievement scores of students in chemistry.

Data collected from the treatment and control groups were used to answer this research question. Data were analyzed descriptively using adjusted mean and standard deviation. Summary of result is presented on Table1

Table 1: *Mean achievement scores of students taught chemistry using ethnochemistry method and those taught using conventional method.*

Methods	Cases	Mean	SD
Ethnochemistry-based	108	29.06	2.40
Conventional method	100	18.11	1.87

Table 1 indicated that the students who were taught chemistry using ethnochemistry-based had mean achievement score of 29.06 and standard deviation 2.40 while those taught using conventional method had 18.11 and 1.87. This implies that ethnochemistry-based package is superior to the conventional package.

Research Question 2

What are the mean achievement scores of male and female students in chemistry who were taught using the ethnochemistry based instruction?

Table 2: *Mean achievement scores of male and female students taught chemistry using ethnoscience based instruction*

Gender	Cases	Mean	SD
Males	41	29.49	2.55
Females	67	28.79	2.28

In table 2, the summary of result showed that male students had mean achievement score of 29.49 with standard deviation of 2.55 while female students had mean achievement score of 28.79 with standard deviation of 2.28 indicating that the male students had higher achievement scores than the female students.

Research Question 3

What is the interaction effect of methods and gender on students mean achievement scores in chemistry?

Table 3: *Interaction effect of methods and gender on student's achievement in chemistry*

Methods	Cases	Gender	
		Males	Females
Ethnochemistry	108	29.49	28.79
Conventional	100	18.36	17.97

Summary of result on Table 3 showed that at the two levels of gender, the ethnochemistry-based instructional approach yielded higher mean achievement scores than the conventional approach. This implies that there is no interaction between methods and gender on students' achievement in chemistry.

Hypotheses

HO_1: There is no significant difference between mean achievement scores of students taught chemistry using ethnochmistry based instructional strategy and those taught using the conventional method.

HO_3: There is no significant interaction between methods and gender on students mean achievement scores in chemistry

Table4: *Analysis of co-variance for students overall chemistry achievement scores by teaching strategies and interaction.*

Source of variation	Sum of Squares	DF	Mean Square	F	Sig. of F
Co-variates	457.926	1	457.926	104.531	.000
Pretest	457.926	1	457.926	104.531	.000
Main effects	5833.976	2	2916.988	665.865	.000
Methods	5816.107	1	5816.107	1327.651	.000
Gender	11.753	1	11.753	2.683	.103
2-way interactions	.917	1	.917	.209	.648
Methods gender	.917	1	.917	.209	.648
Explained	6292.818	4	1573.205	359.118	.000
Residual	889.292203	20	4.381		
Total	**7182.111207**	**207**	**34.696**		

ANCOVA result on Table4 showed that the alpha level (0.05) is greater than the significance of (0.000), P<0.05. the null hypothesis was rejected. This implies that there is significant difference between mean achievement scores of students taught chemistry using ethnochemistry based instruction and those taught using the conventional method.

HO_2: There is no significant difference in the achievement mean scores of male and female students taught chemistry using the ethnochemistry-based approach.

Table 5: *Analysis of Co-Variance of Mean Achievement Scores of male and female students taught chemistry using ethnochemistry-based approach (Treatment group only).*

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Covariates	58.324	1	58.324	11.176	.001
Pretest	58.324	1	58.324	11.176	.001
Main effects	9.363	1	9.363	1.794	.183
Gender	9.363	1	9.363	1.794	.183
Explained	67.687	2	33.844	6.485	.002
Residual	547.979	105	5.219		
Total	**615.667**	**107**	**5.754**		

Summary of result on table5 revealed that the alpha level (0.05) is less than the significance of F (.183). Since the alpha level is less than the significance of F the null hypothesis was upheld. Therefore, there is no significant difference in the mean achievement scores of male and female students taught chemistry using ethnochemistry-based instructional approach.

Discussion

The findings of the study revealed that students taught chemistry using ethnochemistry based instruction had higher mean achievement scores than those taught using conventional method. This is based on the fact that chemistry is made to be more culturally based, learners oriented, active and applicable to the local environment of the students. This finding agreed with the findings of Abonyi (2002), Ugwu and Diovu (2016). Abonyi (2002) discovered that ethnoscience based instructional package is more effective than the conventional package in enhancing the achievement of students in science. Ugwu and Diovu (2016) found that there was a positive change as with students taught with integration of indigenous knowledge than their counterpart. Idah (2018) also found that ethnochemistry approach to teaching was more effective in enhancing achievement of students in chemistry.

The finding of the study also revealed that interaction effect of the methods and gender on students' mean achievement scores in chemistry is not statistically significant. This finding is consistent with the report of Idah (2018) that there is no significant difference in the students' achievement of male and females with respect to culture based science instruction.

Conclusion

Ethnochemistry instructional approach was found to be significantly more effective in enhancing better achievement due to familiar activities and practices connected to the students cultural background. Based on the conclusion, it is recommended that chemistry teachers should be trained and encouraged to adopt the use of ethnochemistry teaching strategy through seminars conferences and workshops. Curriculum planners should incorporate ethnochemistry based instructional package in the syllabus and education programmes.

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