Journal of Educational Research on Children, Parents & Teachers, Volume 4, Number 2, 2023, 102-111
ISSN: 2664-3812, https://ercptjournal.org/

EFFECTS OF ETHNO-CHEMISTRY INSTRUCTIONAL APPROACH ON SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT AND RETENTION IN CHEMISTRY IN IDEMMILI -NORTH LOCAL GOVT. AREA, ANAMBRA STATE.

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Abstract

The study investigated the effects of Ethno-Chemistry Instructional Approach (ECIA) on Secondary School Students' Academic Achievement and retention in Chemistry. The quasi-experimental research design was adopted; the pretest-posttest non-equivalent control group was used. The population of the study was 1,997 senior secondary school year two (SS2) chemistry students in Idemmili-North Local Government Area (LGA) of Anambra State. A sample of 113 SS 2 students was involved in the study. The instrument for data collection was chemistry Achievement Test (CAT) validated by two experts in science Education and one expert in measurement and evaluation. The reliability of the instrument was established using Kuder-Richardson Formula 20 which yielded an internal consistency reliability index of 0.81. The data obtained were analyzed using mean, standard deviation and analysis of covariance. The findings of the study revealed among others that there was a significant difference between the mean academic scores of the students taught chemistry using Ethno-Chemistry instructional Approach and those taught using conventional method in favour of Ethno-Chemistry Instructional Approach. The finding also revealed that the students taught Chemistry using Ethno-Chemistry Instructional Approach had significantly higher mean retention scores than those taught using conventional method. It was recommended that workshops should be organized for chemistry teachers by the state ministry of education on how to use Ethno-chemistry Instructional Approach in teaching.

Keywords: Ethno-Chemistry, Achievement, Retention,

Introduction

Background to the Study

Science, Mathematics and technology provide the basic framework and direction in most aspects of development of every nation. Ajewole (2003) observed that the current developments in science and technology have so greatly affected the lives of human beings that to be ignorant of these developments is to live an empty, meaningless and probably unrealistic life. However, technological development may not be achieved

without a solid foundation in the basic sciences; Physics, Chemistry and Biology, in our secondary schools. Oloruntegbe and Oduntuyi(2003) opined that 'out of the three major sciences, Chemistry plays major role in the choice of career of many Nigerian youth.' According to them, 'a student who is deficient in chemistry, although may have good grades in other science subjects may hardly be able to offer any course in the faculties of science, medicine and engineering in the Universities.'\

Chemistry is the study of matter and energy and the interaction between them. It is the scientific study of the composition, structure, properties and reactions of matter. Hassan (2019) opined that Chemistry is important even one's body is made of chemicals. Chemical reactions occur when one breathes, eat or just sit there reading. All matters are made of chemical and so chemistry is the study of everything The role of chemistry and other sciences (physics, biology and mathematics) in technology development is acknowledged worldwide. Its importance in the development of any nation cannot be underrated, especially in Nigeria where the national income rest on petroleum and petrochemical industries. However, several researches have shown that Chemistry is generally a difficult subject to students at all level (O'dwyr, 2012). This is reflected in low achievement and retention of students in chemistry in both internal and external examinations. Science educators, parents, government and other stakeholders are equally amazed and disturbed at the poor achievement of students in chemistry (Olorundare, 2014).

Academic achievement is the academic results that indicate the extent to which a student has achieved their learning objectives and goals which is often measured through students' grade point and average. Narad and Abdullah (2016) opined that academic achievement of students determines the success or failure of any academic institution. Equally academic achievements of students have a direct implication on the socio-economic development of a country (Signh, Malik & Signh, 2016). Retention in this context is the ability of transferring new information from short-term memory to the long-term memory by the students in such a way that it can be readily retrieved in response to standard prompt. Retention is measured in collaboration with achievement (Ogbeba & Ajayi, 2016).

Among the several factors that can lead to low achievement and retention in chemistry, the use of non-innovative and non activity-based strategies such as the use of conventional teaching method such as lecture and discussion methods which do not consider the students' culture, background and experiences can contribute to the low achievement in chemistry. The reason being that chemistry introduced in our system is foreign and euro-centre in origin, and built on western cultural background and seems unreal to the students with a lot of meaningless jargon (Ajayi & Achor, 2017). According to Indra and Bitwell (2016), many chemistry learners need to transform instructional language or material that teachers use in the classroom into meaningful representations. Learning of chemistry may be more meaningful if students are allowed to make use of materials in their immediate environment to learn. The use of familiar materials in the learners' environment during teaching and learning may contribute positively in the students' achievement and retention of the subject matter. The principle aim of this study

is investigate on the effects of ethno-chemistry instructional approach on secondary school students' achievement and retention in chemistry in Idemmili-North LGA of Anambra State.

Ethno encompasses members of a group within a cultural environment identified by their cultural traditions, codes, symbols, myths, and specific ways used to reason and infer. Ethno-chemistry is the study of chemical ideas found in any culture, where an appreciation of cultural heritage is preserved (Norlayn, 2017). Indra and Bitwell (2016) opined that ethno-chemistry is the various chemically related cultural and community practices. It is a chemical practice known in a particular cultural setting. In other words, it is the study of chemical ideas found in any culture. Ethno-chemistry makes use of chemistry practices in a particular society in the view to proffer solution to their environmental problem. Ethno-chemistry instructional approach (ECIA) involves a teaching approach in which a chemistry teacher uses the learners' cultural practices/background in conveying chemistry content during the process of teaching and learning. The teacher in the course of teaching chemistry makes use of the learners' culture, traditions and background in explaining and managing situations and the activities emanating in their own environment.

The following are some chemically related practices that may be used to make the unfamiliar chemistry content familiar to students for a greater achievement and retention. In teaching of production of ethanol by fermentation in organic chemistry, fermentation of cassava, maize or corn and palm wine in the traditional production of alcoholic drink (Kai Kai or Ogogoro) may be used. The distillation process of obtaining the ethanol from the above substances equally displays the ethno-chemistry in using the materials in the students' environment in constructing the local distillation apparatus. Also this distillation stage in the same ethno-chemical practice may further be used when teaching students' distillation techniques of separation two miscible liquids. In addition charcoal burning commonly when cooking or roasting of corn in the coal pot can be used when teaching complete and partial combustion of carbon.

In the study made by Ajayi, Achor and Agogo (2017) on the Use of Ethno-chemistry Teaching Approach and Achievement and Retention of Senior Secondary students in Standard mixture Separation Technique, a sample of 198 students were used. The study adopted nonequivalent quasi experimental research design. The study revealed that students taught mixture separation techniques using ethno-chemistry approach had significantly higher mean achievement and retention scores than those taught using discussion method. Achor, Imoko and Uloko (2009), in their findings on the effect of ethno mathematics teaching approach on senior secondary student's achievement and retention in locus, the sample size of senior secondary 2 used was 253. Mean and standard deviation was used to answer the research questions while ANCOVA was used to test the hypotheses. Results from the analysis revealed that students exposed to ethno mathematics teaching approach were superior in achievement and retention than those taught with conventional lecture method. There was equally a statistically significant difference in the posttest attitude scores of for control and experimental group on the Effect of Ethno-chemistry Practice on secondary school students' Attitude towards

Chemistry (Singh & Bitwell , 2016). Equally, in research work carried out by Abumchukwu et al (2021) on Effect of Ethnochemistry Instructional Strategy on Secondary School Students' Achievement in Chemistry in Onitsha Education Zone, the population of the study comprises of 2,345 senior secondary school year two chemistry students. 94 chemistry students were used for the study. The findings of the study depict that there was significant difference in the mean achievement scores of the students in favour of ethno-chemistry instructional strategy and gender had no significant influence of students' achievement. The researchers recommended that chemistry teachers should critically analyze cultural practices of the school community and relate them to chemistry .The above study on the use of Ethno-chemistry instructional Approach has not been carried out in Idemmlil-North LGA of Anambra State and therefore, there is the need for the study in the area to see if teaching and learning of chemistry will lead to greater achievement and enhancement of retention. The study will equally help in making the abstract nature of chemistry to be more concrete.

The abstract nature of chemistry as subject and its terminologies makes it to be among the most difficult science subjects to teach and to learn by the students which regularly results to low achievement and retention of the subject. The persistent low achievement and retention of chemistry concepts has been a concern to many. Chemistry teachers are making effort to adjust the method of lesson delivery to improve the situation. They have tried and still trying to make their teaching familiar to students making use of the available material in their environment and teaching from known to unknown from concrete to abstract. The present study therefore investigated on the effects of ethno-chemistry instructional approach on secondary school students' achievement and retention in chemistry in Idemmili-North LGA of Anambra State.

Purpose of study

The main purpose of the study was to ascertain the effects of ethno-chemistry instructional approach on secondary school students' achievement and retention in chemistry in Idemmili-North LGA. Specifically, the study seeks to

1. Determine the effect of ethno-chemistry instructional approach on students' achievement in chemistry.
2. Ascertain the effect of ethno-chemistry instructional approach on students' retention in chemistry.

Research Questions

The following research questions were answered in this study:

1. What is the difference in the mean achievement scores between students taught chemistry concept using ethno-chemistry instructional approach and those taught using conventional method?

2. What is the difference in the mean retention scores between students taught chemistry concept using ethno-chemistry approach and those taught using conventional method?

Hypotheses

The following null hypotheses were tested:

1. There is no significant difference in the mean achievement scores between students taught chemistry concepts using ethno-chemistry instructional strategy and those taught using conventional method.
2. There is no significant difference in the mean retention scores between students taught chemistry concepts using ethno-chemistry instructional approach and those taught using conventional method.

Method

The design adopted for the study is quasi-experimental, specifically the pre-test, post-test, non-equivalent control group design. The area chosen for the study is Idemmili-North Local Government Area (LGA) of Anambra State. The population of the study consisted of 1,997 senior secondary school year two (SS 2) chemistry students comprising of 892 male and 1105 female chemistry students in sixteen public schools in the LGA.

Total sample size for the study was 113 SS2 chemistry students obtained through a multi-stage procedure. The two schools in the LGA were selected through purposive sampling technique. There was no consideration for co-education school since gender variable was not needed in the study. The two schools chosen through, toss of coin were categorized into experimental and control groups. The experimental school had 58 students while the control group had 55 students.

The instrument for data collection was Chemistry Achievement Test (CAT). CAT consisted of 50-item multiple choice objective questions obtained from WASSCE past questions. A table of specifications was used to draw up a pool of 50 items which was used as CAT. This is to ensure that enough sample questions were drawn from each of the contents to be taught. An instructional plan using Ethno-Chemistry instructional approach was also developed on the concepts to be taught. Chemistry Achievement Test (CAT), the objective of the study and research questions and hypotheses along with the lesson plans were given to lecturers in the Departments of Science Education, and Educational Foundations, Nnamdi Azikiwe University, Awka. The validators were requested to vet the instrument on the clarity of language, appropriateness for the students' involved and plausibility of the distractors. They were required to write retain (R), modify (M) or delete (D) against any question they wished the researcher to retain, modify and delete respectively. They were also requested to examine the lesson plan and its activities for level of language, suitability for the level of the students. Their corrections and recommendations were effected in the final copy of the instrument.

The reliability of the CAT was established using Kuder-Richardson formula 20 (KR-20). KR-20 was chosen because it is a suitable reliability estimate for multiple-choice objective test items that are dichotomously scored and with heterogeneous difficulty level. The instrument was administered once to 40 students in Idemili- South Local Government Area and the generated scores were computed for reliability using KR-20. The coefficient of internal consistency obtained for CAT was 0.81.

The experiment was conducted in two phases. The first phase dealt with the training of the research assistants and the second phase for the teaching of the students. The teaching of the students in the experimental and control groups was done by the trained regular chemistry teachers. The experimental group was taught using Ethno-Chemistry Instructional Approach. For experimentation, the students were given pretest in the first week. No feedback was provided on the pretest and no corrections or revisions were made on the pretest. After the pretest, the actual treatment started.

The experimental group studied fermentation of sugar to produce ethanol, distillation of ethanol using locally made distillation apparatus to produce ogogoro/ kaikai. The distillation apparatus consisted of bamboo stick filled with water which served as a Liebig condenser, plastic tubing which served as a delivery tube, firewood which was the source of heat, a clay pot which served as a round bottom flask, three big stones that served as tripod stand, a container for collecting the distillate. Also the experimental group was taught incomplete and complete oxidation of carbon using coal pot which is familiar equipment for cooking and roasting of corn, yam, plantain etc.. The teaching and learning took four (4) weeks. The control group studied the same content using conventional method. Ethno-chemistry teaching strategy was not incorporated during their teaching and learning process.

In the control group, the students were exposed to the same content using conventional method. A revision exercise was conducted for the students in the both groups before the posttest. In order to found out if the gained knowledge was retained, the posttest was reshuffled and administered to both the experimental and control group as retention test.

Data relating to the research questions were analyzed using mean and standard deviation. Analysis of covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance. The choice of ANCOVA is to take care of the initial group differences and to eliminate any imbalances the students may have before the experiment. 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.

Results

Research Question 1 : What is the difference in the mean achievement scores between students taught chemistry concept using ethno-chemistry instructional approach and those taught using lecture method?

Table 1: Mean Achievement Scores of Students taught chemistry using ECIA and those taught using Conventional Method (CM)

Group	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Gained Mean
ECIA	58	19.29	5.33	64.78	7.00	45.49
CM	55	29.45	4.00	46.89	5.60	17.51

Table 1 reveals that the students taught chemistry using ECIA has pretest mean achievement score of 19.29 and posttest mean achievement score of 64.78 with gained mean achievement score of 45.49, while those in the control group taught with conventional method has pretest mean score of 29.45 and posttest mean score of 46.89 with gained mean of 17.51. The use of ECIA increased the variation of score from 5.33 in the pretest to 7.00 in the posttest. There was a low score variation in the posttest of CM group (4.00) compared to those taught using ECIA (5.60)

Research Question 2: What is the difference in the mean retention scores between students taught chemistry concept using ECIA and those taught using CM?

Table 2: Mean Achievement scores of students taught chemistry concept using ECIA and those taught using CM

Group	N	Retention Mean	Retention SD
ECIA	58	61.98	7.00
CM	55	37.89	4.43

Table two shows that students taught chemistry concept using ECIA has the mean retention score of 61.98 while the students taught chemistry concept using CM has the mean retention score of 37.89. There was a high retention score variation of the students taught using ECIA (7.00) compared to those taught using CM (4.43)

Ho_1: There is no significant difference in the mean achievement scores between students taught chemistry concepts using ethno-chemistry instructional method and those taught using conventional method.

Table 3: ANCOVA Test of significant difference between mean achievement scores of students taught chemistry using ethno-chemistry instructional method and those taught using conventional method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	9872.859[a]	2	4936.429	143.387	.000
Intercept	7205.084	1	7205.084	209.284	.000
Pretest	769.268	1	769.268	22.345	.000
Method	7244.934	1	7244.934	210.442	.000
Error	3787.000	110	34.427		
Total	368476.000	113			
Corrected Total	13659.858	112			

Table 3 further shows that at 0.05 level of significance, 1df numerator and 112df denominator, the calculated F is 210.442 with p-value of .000 which is less than 0.05. Therefore, the null hypothesis was rejected. Thus, there is a significant difference in the mean achievement scores between students taught chemistry concepts using ethno-chemistry instructional method and those taught using discussion method.

Ho_2: There is no significant difference in the mean retention scores between students taught chemistry concepts using ethno-chemistry instructional approach and those taught using conventional method.

Table 4: ANCOVA Test of significant difference between mean retention scores of students taught chemistry using ethno-chemistry instructional method and those taught using conventional method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	17259.535[a]	2	8629.767	3617.248	.000
Intercept	26.251	1	26.251	11.004	.001
Posttest	4420.894	1	4420.894	1853.059	.000
Method	124.542	1	124.542	52.203	.000
Error	262.430	110	2.386		
Total	311231.000	113			
Corrected Total	17521.965	112			

a. R Squared = .985 (Adjusted R Squared = .985)

Table 4 shows that at 0.05 level of significance, 1df numerator and 112df denominator, the calculated F is 52.203 with P-value of .000 which is less than 0.05. Therefore, the null hypothesis was rejected. Thus, there is a significant difference in the mean retention scores between students taught chemistry concepts using ethno-chemistry instructional method and those taught using discussion method.

Discussion

The finding of the study showed that there is a significant difference in the mean achievement scores of students taught chemistry concept using Ethno-Chemistry Instructional Strategy and those taught using conventional method in favour of Ethno-Chemistry Instructional Approach. Also the findings reveals that there is a significant difference in the mean retention score of students taught chemistry using ethno-chemistry instructional approach and those taught using conventional method. The students in Ethno-Chemistry instructional approach group performed better than those in the conventional group because the use of Ethno-Chemistry instructional approach gave the students opportunity to manipulate local materials in their environment. The learning materials were very familiar and at the students immediate environment and culture.

The Ethno-Chemistry instructional approach group was able to achieve better because the materials in the students' environment were used during the process of teaching and learning. For example the abstract equation of fermentation of sugar during the production of alcohol /$C_6H_{12}O_6$ + zymase → C_2H_5OH + CO_2, were made concrete using fermentation of sugar cane and palm wine. The students brought these materials from their natural environment. The bubble which is the CO_2that was given off during the fermentation process was seen by the students. Also local distillation apparatus constructed by the students were used to distill the alcohol produced leading to the production of illicit gin. Here the concept of separation of miscible liquids were x rayed. Equally, the two forms of combustion of carbon- complete and incomplete combustion; $2C + O_2 \rightarrow 2CO$ (incomplete combustion); $C + O_2 \rightarrow CO_2$(complete combustion) were taught using combustion process in coal pot.

The findings of the study are in line with Ajani, Anchor and Agogo (2017) and Abumchukwu et al. (2021) that the mean score of the experimental group taught chemistry concept using Ethno-Chemistry Instructional Approach is higher than the mean score of the control group. The findings of the study also support that of Singh and Bitwell (2016) that experimental group taught chemistry using ethno-chemistry instructional approach has a higher interest rate than their counterpart in the control group.

Conclusion

The findings of the study showed that Ethno-Chemistry Instructional Approach significantly improved the achievement and retention of chemistry students. Conclusively, Ethno-Chemistry is effective for improving students' achievement and retention in chemistry in Idemmili-North LGA of Anambra state.

Recommendations

The following recommendations are made in the light of the findings of the study:

1. Workshops and seminars should be organized by the state ministry of education for secondary school teachers on how to use ethno-chemistry instructional strategy in teaching chemistry concepts.
2. Students should be allowed to contribute their own knowledge based on their cultural endowment in the science class. Teachers should be discouraged from dominating the science class.

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