

# Effect of Ethnochemistry Instructional Approach on Secondary School Students' Interest in Chemistry in Bayelsa State

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**Abstract:** The study determined the effects of ethnochemistry instructional approach (EIA) on interest of students in chemistry. Two research questions and three hypotheses guided the study. The quasi-experimental design was adopted, specifically the pretest-posttest non-randomized control group was used. The population of the study was 4, 955 senior secondary year two (SS2) students offering chemistry in Yenagoa Education Zone out of which 153 students were selected for the study using purposive and random sampling techniques. The instrument for data collection was Chemistry Interest Scale (CIS) validated experts in Departments of Science Education and Educational Foundation, from NnamdiAzikiwe University, Awka and one experienced secondary school chemistry teacher. The reliability of CIS was established using Cronbach Alpha to be 0.78. Analysis of data for the study was done using mean and standard deviation and analysis of covariance. The result of the study showed that students taught using EIA has higher gains in mean interest scores than those in the conventional instructional approach. The findings of the study revealed that there was a significant difference between mean interest scores of students taught chemistry using EIA and conventional instructional approach in favour of EIA. It was concluded that EIA is an effective instructional approach for improving students' interest. It was recommended that chemistry teachers should adopt EIA in teaching chemistry concepts so as to enable students marry their learning with the common realities in their immediate environment, thereby making them interested in learning chemistry.

**Keywords:** ethnochemistry, conventional, chemistry, interest, acid

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## I. Introduction

Interest is one of the factors that drive learning. Interest according to Abakpa (2011) is an energized power of learning, without which meaningful learning cannot take place. It can be defined as persistent tendency to pay attention and enjoy some activities or contents (Nworgu, 2015). The growth of interest can be described in terms of academic advancement processes in which students evaluate their perceived strength and weakness (Kpolovie, Joe & Okoto, 2014). Interest in the present study was conceived to mean persistent attention students give to the subject of chemistry. Students' interest when understood in preference for school subjects like chemistry affects educational achievement. Effort by the chemistry teacher, to improve students' interest in chemistry therefore, could inform their choice of instructional approaches or the decision to stick to the conventional approach to learning.

Conventional instructional approaches are traditional or common means of instruction used by or known to the teacher, for instance lecture method. It is often a teacher directed method of teaching where students receive instruction from the teacher with little or no participation (Marsh, 2010). Conventional instructional approaches usually are suitable for large number of students and for covering large content areas (Seifert, 2012). Despite the benefits of adopting conventional methods of instruction, studies have shown that the quality of students' interest could be enhanced through adoption of innovative instructional approach (Amosa et al., 2014; Tatli & Ayas, 2013).

Most innovative instructional approaches are however, difficult to adapt into the Bayelsian secondary school classroom owing to the state of secondary school environments and levels of secondary school chemistry teachers' awareness, skills and knowledge of such methods. Since these methods, tenably, may not be easily applicable in the classroom, chemistry teachers who must improve students' interest in chemistry should make recourse with what is attainable in the Bayelsian secondary school environment. It is in the light of this discourse that the present study proposed the use of ethnochemistry instructional approach.

The concept of ethnochemistry according to Indra and Bitwell (2016) are the various chemically related cultural and community practices. It describes the chemical practices of identifiable cultural groups and may be regarded as the study of chemical ideas found in any culture (Oluwatosin, Emmanuel & Peter, 2017). Ethnochemistry is therefore, the study of chemistry practices of specific cultural groups in the course of dealing with their environmental problems and activities using their own ideologies. The application of ethnochemistry in the classroom leads to the ethnochemistry teaching approach.

Ethnochemistry teaching approach can be defined as a means of organizing chemistry instruction based on diverse cultural context. It is an approach to chemistry instruction that draws on traditional culture while focusing attention on the chemistry needed by the learners in an integrated society. In other words, ethnochemistry teaching approach is an approach adopted by the teacher in the process of teaching chemistry through the use of learners' cultural background, in teaching the students to understand, explaining and managing classroom situations and using materials and activities arising in their own immediate environment. Ethnochemistry is conceived therefore to mean, those cultural practices and local materials in the environment of a given people that have direct bearing to the science of chemistry or can be scientifically defined.

Ethnochemical development can be viewed as a 2-step process: one is the use of indigenous knowledge as a starting point for chemicals as leads; the second is advancing the chemical leads, by further testing and patenting of them (Anna & Alexander, 2013). In the same vein, ethnochemistry can be applied in the classroom as a teaching approach by first overviewing the indigenous knowledge that is related to the concept to be taught and secondly developing the understanding into that concept during instruction using generalized modern and scientific knowledge as well as local materials from that environment. Empirical studies such as those of Kurume (2004) shows that ethno-science instructional approaches was more effective in facilitating students' interest in geometry and mensuration and basic science respectively. The advantages of using ethnochemistry instructional approach notwithstanding, the availability of local materials for ethnochemistry instruction varies from location to location such as urban and rural locations.

The Centre for Rural Education and Community (2014) observed that, most methods of classifying territory along an urban-rural continuum make reference to population size and density, level of urbanization, and/or the relationship to urbanized areas in terms of economic activity and commuting patterns. Urban environment may be referred to as those environments which have high population density while rural environments are characterized by low population density with low variety and isolated place views (Owoeye&Yara, 2011). According to Michigan (2013), students' performance is greatly affected by the area in which the students live mainly because of the variation in resources, availability of technology and quality of teachers. Okoro (2013), Nworgu, Ugwuanyi and Nworgu (2013) and Akagobu and Ajiwoju (2015) showed student significantly differed based on location. showed that location was not a significant factor in students achievement and interest while Babatunde (2015) Schools situated in urban and rural areas vary in their ease of assessment to local materials which could be used for ethnochemistry instruction. More so, students in the urban areas may have little knowledge of these materials compared to those in the rural areas (Bosede, 2010). Arguments as to whether students in the rural locations possess more indigenous knowledge of cultural practices with scientific relevance than those in the urban location is not well articulated in literature. There is need therefore, to investigate the influence of location when such instructional approach as ethnochemistry instructional approach is adopted.

#### PURPOSE OF THE STUDY

The purpose of the study was to find out the effects of ethnochemistry instructional approach on secondary school students' interest in chemistry. Specifically, the study determined the:

1. difference between the mean interest scores of students taught chemistry using ethnochemistry instructional approach (EIA) and those taught using conventional instructional approach (CIA).
2. difference between the mean interest scores of urban and rural secondary school students taught chemistry using EIA.
3. interaction effect of instructional approaches and school location on students' interest in chemistry.

#### RESEARCH QUESTIONS

The following research questions guided the study.

1. What is the difference between the pretest and posttest mean interest scores of students taught chemistry using ethnochemistry instructional approach (EIA) and those taught using conventional instructional approach (CIA)?
2. What is the difference between the pretest and posttest mean interest scores of students from urban and rural secondary school taught chemistry using EIA?

## **HYPOTHESES**

The following hypotheses were tested at 0.05 level of significance:

1. There is no significant difference between the mean interest scores of students taught chemistry using ethnochemistry instructional approach (EIA) and those taught using conventional instructional approach (CIA).
2. There is no significant difference between the mean interest scores of students from urban and rural secondary schools taught chemistry using EIA.
3. There is no interaction effect of instructional approaches and school location on secondary school students' interest in chemistry.

## **II. Method**

### **Research Design**

The study adopted the quasi-experimental design. Specifically, the pretest-posttest non-randomized control group of 2x2 factorial design was used. Quasi-experimental design is one in which intact classes are used since there is no random assignment of the research participants into control and experimental groups rather independent variables was manipulated so as to observe the effect on the dependent variable (Nworgu, 2015). The design was adopted for the study because the administrative setup at the secondary school level of education in Bayelsa state may not allow for random assignment of participants/students into groups, given that it may disrupt school activities relative to school timetable.

### **Area of the Study**

The study was carried out in Yenagoa Education Zone of Bayelsa State, Nigeria. The zone comprises of three sub-zone namely: Yenagoa-Epie-Atisa, Biseni-Okodia-Zarama and Gbarain-Ekpetiama. There are 28 government owned secondary schools in the Zone. Yenagoa is also a Local Government Area in Bayelsa State, Nigeria, its headquarters are in the town of Yenagoa (the State capital) in the south of the area. The Ijaw form the majority of the state but Epie-Atissa language is one of the local language spoken in Yenagoa while others such as Ekpetiama, Gbarian, Buseni and Zarama are Ijaw dialect in Yenagoa LGA.

### **Population of the Study**

The population of the study was 4, 955 senior secondary year one (SS1) chemistry students in Yenagoa Education Zone (Source: Post Primary School Services Commission, Yenagoa, 2020).

### **Sample and Sampling Technique**

The sample size for the study was 153 SS1 chemistry students. The sampling was done using a multistage procedure. First, secondary schools in Yenagoa Education Zone were stratified under the three sub-education zones. Secondly, purposive sampling was used to select two sub-education zone namely: Yenagoa-Epie-Atisa and Gbarain-Ekpetiama. The reason behind the selection of the two sub-education zones was to take care of the location variable, since Yenagoa-Epie-Atisa and Gbarain-Ekpetiama have schools located in urban and rural areas. In the third step, two schools each were selected from the two sub-education zones using purposive sampling again. This was to ensure that the schools selected were situated miles apart to reduce subject contamination/class interaction. In each sub-education zones, the two selected schools were randomly assigned into experimental and control groups. In each school, one intact class of SS1 chemistry students were selected using random sampling (balloting without replacement). Experimental group one (ethnochemistry instructional approach group) has 79 students (37 urban, 42 rural) while the control group (conventional instructional approach) has 74 students (36 urban, 38 rural).

### **Instrument for Data Collection**

The instrument for data collection was Chemistry Interest Scale (CIS). CIS was adapted from Chikendu (2018). The adaptations involved the removal of the biographic information such as name of students and school, change of chemistry concepts indicated in the interest scale to the concepts that were taught in the present study, and the change of 'lecture' to lesson or class depending on the context. The instrument was made up 17 item designed with a four response options ranging from strongly agree (SA) to strongly disagree (SD). The instrument was designed to contain 10 positively worded items and seven negatively worded items on which students are to rate their interest in chemistry. CIS was also used to measure interest retention of SS1 students in chemistry.

### **Validation of the Instrument**

The instruments (CIS and CAT) and lesson plans, the objectives of the study, research questions and hypotheses were given to two lecturers in the Departments of Science Education and of Educational Foundations, NnamdiAzikiwe University, Awka, and one experienced secondary school chemistry teacher for

validation. The validators were required to vet the items in terms of clarity, plausibility of distractors and suitability for the level of students under study. They were also requested to write 'R', 'M' or 'D' against any item(s) they wish the researcher to retain, modify or delete respectively. One of the validators which is a science education expert suggested dropping one experimental treatment (improvised instructional approach). She also requested the re-writing of the entire lesson plans for the experimental groups to reflect the suggestions. Their corrections, suggestions and recommendations were effected before the production of the final draft of the instruments.

### **Reliability of the Instrument**

The reliability of CIS was established using Cronbach Alpha method. Cronbach Alpha was chosen because it is suitable for establishing the reliability of polytomously scored items. CIS was administered once to 40 SS1 chemistry students in Ogbia Education Zone of Bayelsa state which is not part of the study. The generated scores from the exercise were collated and reliability computations was carried out using the stated formulae. The index obtained for CIS is 0.78.

### **Experimental Procedure**

The experiment was conducted in two phases. Phase one was training of research assistants for the study. The research assistants were the regular SS1 chemistry teachers in the selected schools. The training was carried out in one week, three contacts and in 1hour 30 minutes per contact. The second phase involved the treatment using the different lesson plans prepared for the experimental and control groups. The treatment was preceded by a pretest using CIS and CAT. The treatment activities in each group are presented as follows.

### **Experimental Group one on ethnochemistry instructional Approach (EIA):**

The general step by step procedures that was taken in teaching the chemistry concepts to the students in the ethnochemistry experimental group is as follows: The teacher in the first step briefly introduced the concept to be taught, with students attention drawn to the contents under the concepts to be learnt and briefly explain them to enable them have a grasp of what they were learning and to know also, what cultural knowledge and practices to present when asked, that is related to the contents.

The brief introduction was followed by the teacher presenting some of the ingenious knowledge and cultural practices through a demonstration with local materials obtained from the students' immediate environment. The teacher asked the students to present other cultural practices or knowledge of such practices that are related to the concepts. A demonstration of some of the cultural practices was done by the students. The teacher explained the practices presented by the students in relation to the concept taught and classify them into three categories namely: compactible with science, compactible with science with modifications and misconception. Under the compactible with science category, the teacher presented only those ethnochemical practices that are compatible with science. In the category for compactible with science with modification, the teacher presents those ethno-related practices that can be modified and made compactible with science whereas in the misconception category, only those cultural ideas and practices that are not compatible with science were presented. Students during this comparism were allowed to state their opinion to make the class more interactive and to further clear misconceptions that may further be made known. Students were also allowed to ask questions on confusing subjects that may form the quorum for discussion at any instance. The teachers' interaction with the students, was with the view to further explore other the cultural practices and indigenous knowledge known to them and emphasized the scientific connotations in each of the cultural practices mentioned by the students.

The teacher summarized the important points of the lesson, emphasizing the misconceptions discovered and evaluated the students' learning by asking questions based on what was learnt. Every class ended with an assignment given to students to enable them explore cultural practices and ingenious knowledge that are related to the next concept to be taught. The conventional group was taught using the conventional instructional approach. It involved presentation of lesson content to the students with in-depth explanation for their understanding. Students were allowed to ask questions about what they understand and get further clarification.

### **Control of Extraneous Variables**

The researcher adopted the following procedures to ensure that extraneous variables which may confound the outcome of the study are controlled.

**1. Class interaction:** Classinteraction occurs where the experimental and control group participants exchange or share information and materials peculiar to their groups. The researcher purposively selected schools situated miles apart for the experiment in order to eliminate the possibility of research subject interacting over the study.

**2. Teacher variable:** The researcher in order to control the error that may arise due to teacher difference organised training for the teachers of the experimental and control groups. The training helped to establish a

common instructional standard for all the research assistants. In the training, the researcher sought the informed consent of the teachers to adhere strictly to the lesson plan that was given to them. The training also provided opportunity to assess the teachers' weakness in their use of the lesson plan and corrections were given where necessarily. The researcher also monitored the instructional process regularly to ensure that teachers stick to the lesson plans.

**3. Initial group difference:** The subjects were assigned into the groups randomly instead intact class were used, implying non-equivalence of the groups. To eliminate the error that may arise due to this initial group difference, the researcher employed the use of analysis of covariance (ANCOVA) for the analysis of data generated in the study. Ancova as a robust statistics eliminated initial group difference.

**4. Hawthorne Effect:** Hawthorne effect is said to occur when the subjects become aware that they are being observed or used in a study making them to put up untrue behaviour. To reduce error that may arise due to hawthorne effect, the research used the trained research assistants as teachers in each of the schools.

**5. Test Knowledge:** The experiment lasted long enough (five weeks from pretest and three weeks after posttest) to reduce test knowledge. The retention test was printed on different coloured papers so as to reduce the effect of pretest scores on posttest scores and retention scores.

### Method of Data Collection

The instrument was administered in the first week and immediately was followed with the treatment. The scores of students were collated and no feedback on their performance was given. There was no corrections or revisions for the students also. After the treatment, the same instruments was administered as posttest and scores were collated by recording them against the pretest score of each student. The test was administered by the research assistants who are the regular chemistry teachers in the schools that were used for the study.

### Method of Data Analysis

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). ANCOVA was used to eliminate the initial group differences among the students. The decision rule is: reject null hypothesis if Probability value (p-value) was less than or equals significance value of 0.05 ( $P \leq 0.05$ ) and do not reject null hypothesis if P-value was greater than 0.05 ( $P > 0.05$ ).

## III. Results

**Research Question 1:** What is the difference between the pretest and posttest mean interest scores of students taught chemistry using ethnochemistry instructional approach (EIA) and those taught using conventional instructional approach (CIA)?

**Table 1: Pretest and Posttest Mean Interest Scores of Students taught Chemistry using Ethnochemistry Instructional Approach (EIA) and those taught using Conventional Instructional Approach (CIA)**

Group	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Gained Mean
EIA	79	25.00	5.79	53.87	4.97	28.87
CIA	74	27.39	6.69	46.39	11.27	19.00
Mean Difference		2.39		7.48		9.87

Table 1 reveals that the students taught chemistry using EIA has pretest mean interest score of 25.00 and posttest mean interest score of 53.87 with gained mean achievement score of 28.87, while those in the control group taught with conventional instructional approach has pretest mean interest score of 27.39 and posttest mean score of 46.39 with gained mean 19.00. Students taught chemistry using EIA had a more homogeneous scores in their posttest (4.99) that those taught using CIA (11.27). The difference between the between the mean gained interest scores of the students is 9.87 in favour of EIA.

**Research Question 4:** What is the difference between the pretest and posttest mean interest scores of students from urban and rural secondary school taught chemistry using EIA?

**Table 2: Pretest and posttest Mean Interest Scores of Urban and Rural Students taught Chemistry using EIA**

Gender	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Gained Mean
Urban	37	23.00	2.66	54.19	5.21	31.19
Rural	42	26.76	7.12	53.60	4.83	26.84
Mean Difference		3.76		0.59		4.35

Table 2 reveals that the urban students taught chemistry using EIA has pretest mean interest score of 23.00 and posttest mean interest score of 54.19 with a gain in mean scores of 31.19 while the rural students have pretest mean interest score of 26.76 and posttest mean interest score of 53.60 with a gain in mean scores of 26.84. The difference in mean interest score of the urban and rural students is 4.35 in favour of urban students.

**Hypothesis 1:** There is no significant difference between the mean interest scores of students taught chemistry using ethnochemistry instructional approach (EIA) and those taught using conventional instructional approach (CIA).

**Table 3: ANCOVA Test of Significance of Difference between the Mean Interest Scores of Students taught Chemistry using EIA and CIA**

Source of variation	SS	Df	MS	F	P-value	Decision
Corrected Model	2147.029 <sup>a</sup>	2	1073.515	14.383	.000	
Intercept	21187.921	1	21187.921	283.867	.000	
Pretest	8.340	1	8.340	.112	.739	
Method	2012.601	1	2012.601	26.964	.000	Sig
Error	11196.029	150	74.640			
Total	399753.000	153				
Corrected Total	13343.059	152				

Table 3 shows that there is a significant main effect of the treatment on students' interest in chemistry  $F(2, 150) = 26.964, P = 0.000 < 0.05$ . Therefore, the null hypothesis is rejected meaning that there is a significant difference between the mean interest scores of students taught chemistry using ethnochemistry instructional approach (EIA) and those taught using conventional instructional approach (CIA) in favour of EIA.

**Hypothesis 4:** There is no significant difference between the mean interest scores of students from urban and rural secondary schools taught chemistry using EIA

**Table 4: ANCOVA Test of Significance of Difference between the Mean Interest Scores of Urban and Rural Students taught Chemistry using EIA**

Source of variation	SS	Df	MS	F	P-value	Decision
Corrected Model	28.642 <sup>a</sup>	2	14.321	.570	.568	
Intercept	11398.843	1	11398.843	453.545	.000	
Pretest	21.703	1	21.703	.864	.356	
Location	.939	1	.939	.037	.847	Not Sig
Error	1910.092	76	25.133			
Total	231224.000	79				
Corrected Total	1938.734	78				

Table 4 shows that there is no significant main influence of location on students' interest in chemistry  $F(2, 76) = 0.037, P = 0.847 > 0.05$ . Therefore, the null hypothesis is accepted meaning that there is no significant difference between the mean interest scores of students from urban and rural secondary schools taught chemistry using EIA

**Hypothesis 7:** There is no interaction effect of instructional approaches and school location on secondary school students' interest in chemistry.

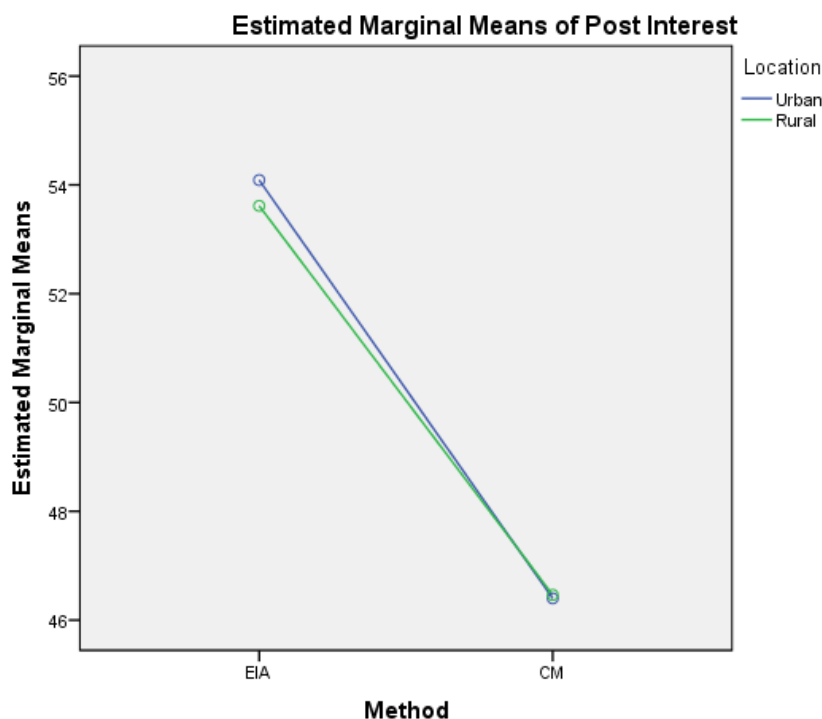
**Table 5: ANCOVA for Testing the Interaction Effect of instructional approaches and school location on secondary school students' interest in chemistry**

Source	SS	df	Mean Square	F	Sig.	Decision
Corrected Model	2151.330 <sup>a</sup>	4	537.832	7.112	.000	
Intercept	20011.963	1	20011.963	264.639	.000	
Pretest	5.700	1	5.700	.075	.784	
Method	2013.422	1	2013.422	26.626	.000	
Location	1.506	1	1.506	.020	.888	
Method * Gender	2.744	1	2.744	.036	.849	Not Sig.
Error	11191.729	148	75.620			
Total	399753.000	153				
Corrected Total	13343.059	152				

Table 5 shows that there is no significant interaction of instructional approaches and school location on secondary school students' interest in chemistry  $F(4, 148) = 0.036, P = 0.849 > 0.05$ . Therefore, the null hypothesis is accepted meaning that there is no interaction effect of instructional approaches and school location on secondary school students' interest in chemistry. The plot of interaction effect is shown in figure 3.

The plot of interaction effect of instructional approaches and school location on secondary school students' interest in chemistry is not significant and disordinal. This shows that the instructional approaches

have different effects on interest of students on different conditions, for example, the effect of the sequential usage of teaching on students' interest changed when location was consideration.



Covariates appearing in the model are evaluated at the following values: Pretest Interest = 26.16

**Figure 3: Plot of interaction effect of instructional approaches and school location on secondary school students' interest in chemistry.**

#### IV. Discussion

The findings of the study showed that students taught chemistry using ethnochemistry instructional approach had significant higher interest in chemistry than those taught using conventional instructional approach. Generally, students get interest in learning when the learning process or the concept being taught is meaningful to them. The use of EIA communicated that idea that the concept being taught has some connotations with the common cultural practices in the immediate community of the students and that alone aroused the students' interest. Students had the feeling that the concept taught were already practiced in their communities and made effort to marry it with reality. Thus, the learning being meaningful to them led to continually sustained interest in learning.

The effort to understand which of the cultural practices, knowledge or ideologies are compatible with science and the cognitive engagement due to that must have intrigued the students enough to have them show more interest in the learning than in the conventional classroom. Students eagerly argued their points as to what they felt as right scientifically. The eagerness with which they participated in the instructional process is indicated of heightened interest to learn since the learning has been brought close to realities found in their immediate cultural environments.

The finding of the study is in line with the findings of Kurume (2004) that ethnomathematics approach was more effective in facilitating students' interest in geometry and mensuration. The findings of Okwara and Upu (2017) supports the findings of the present study when they reported that significant difference in the mean achievement and interest scores of students taught using ethno-science instructional approach ESIA and their counterparts taught using demonstration teaching method (DTM). The finding of the study also lends credence to the finding of Indra (2016) that there was statistically significant difference in the post-test attitude scores for control and experimental groups in favour of the experimental group. The study concluded that incorporating ethnochemistry practices in teaching chemistry was found to have a positive effect on enhancing secondary school students' attitude towards Chemistry.

The finding of the study revealed that there was no significant difference between the mean interest scores of urban and rural students taught chemistry using EIA. Again there was no significant interaction effects of instructional approaches and location on students' interest. The findings on location could be attributed to the

fact the use of EIA is all involving. Thus, both urban and the rural students alike have one or two indigenous knowledge or cultural practices known to them that they brought to class. When the instruction in chemistry probed into these knowledge and ideologies, students' interest irrespective of their location was triggered and they became more actively engaged in the learning process. The findings of the study is in line with the findings of Okoro (2013) that location was a significant factor in students' interest in home economics.

## V. Conclusion

The findings of this study showed that students taught chemistry using EIA had significantly higher interest scores than those taught using CIA. It is concluded that EIA is an effective instructional approach for improving students' interest in chemistry.

## VI. Recommendations

In line with the findings of this study, the following recommendations are made:

1. Chemistry teachers should adopt EIA in teaching chemistry concepts so as to enable students marry their learning with the common realities in their immediate environment.
2. Seminars and workshop should be organised by Science Teachers Association of Nigeria on how to plan chemistry lessons using EIA and how to use the approach in teaching chemistry.

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