INTEGRATION OF INDIGENOUS KNOWLEDGE AND PRACTICES INTO CHEMISTRY TEACHING AND STUDENTS' ACADEMIC ACHIEVEMENT

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ABSTRACT

This study was designed to determine the influence of integration of indigenous knowledge and practices into chemistry teaching on students' academic achievement. Three research questions and three null hypotheses guided the study. A quasi-experimental research design was adopted for the study. Simple random sampling technique was used to select 115 senior secondary one (ss1) students from 4 intact classes as the sample size. A 25-item chemistry achievement test developed from the contents taught was used to collect data for the study. The instrument had a face and content validation by three specialists. Kudder-Richardson (K-R20) was used to determine the internal consistency of the test items and a coefficient of 0.89 was obtained. Mean and standard deviation was used to answer the research questions while ANCOVA was used to test the hypotheses at 0.05 level of significance. The findings show that there is a change as students taught with integration of indigenous knowledge and practices had higher mean achievement score than their counterpart and that gender had no significant influence on the achievement. Also there was no interaction between gender and method. It was recommended that indigenous knowledge and practices be integrated into chemistry teaching for effective teaching and learning of chemistry and for improved academic achievement.

Keywords: Integration, indigenous knowledge and practices, chemistry teaching and academic achievement.

INTRODUCTION

Teaching sciences generally needs to be rooted in indigenous knowledge and practices. Indigenous in the words of Utibe (2010) means being grown or produced in a locality. Indigenous knowledge which can also mean native science refers to different ways of tribal process of perceiving, thinking, acting and understanding as a result of human experience with the natural world. Indigenous or local knowledge can also refer to a complete body of knowledge, know –how and practices maintained and developed by people in rural areas, who have extended histories of interaction with the natural environment (Boven & Morhashi, 2002).

Indigenous peoples' traditional education processes were carefully constructed around observing natural processes, adapting modes of survival, obtaining sustenance from the plant and animal world and using natural materials to make their tools and implements (Barhardt & Kawagley, 1999). However, the authors observed that indigenous views of the world and approaches to education have been brought into jeopardy with the spread of western societal

structures and institutionalized forms of cultural transmission. This is affirmed in the following context thus:

> *Indigenous knowledge has a broad knowledge of how to live sustainably. However, formal education systems have disrupted the practical everyday life aspects of indigenous knowledge and replacing them with abstract knowledge and academic ways of learning. Today, there is a grave risk that much indigenous knowledge is being lost along with its valuable knowledge about ways of living*
>
> *sustainably(http://www.unesco.org/education/tisf/mods/th).*

Sustainable living on the other hand has to do with the ability to meet the needs of the present without destroying or damaging the environment, economic or social resources needed by future generations. Through indigenous knowledge and practices, the needs of the society are provided without destroying the environment for future needs and this is sustainable living. Indigenous knowledge is used to sustain the community and its culture and to maintain the genetic resources necessary for the continued survival of the community (Lambert, 2003). Indigenes of different localities/communities through indigenous knowledge and practices live sustainably as they manage their natural resources in efficient and sustainable ways – ways adapted to their needs and manageable within the scope of their limited facilities. It becomes imperative to integrate it into formal education process to find out if it can create any change in students' understanding towards the subject for better achievement.

To create means to make a new something probably as a result. In this study, creating change refers to bringing or making a new situation for better. Consequently, this study intends to create change into chemistry teaching through integration of indigenous knowledge and practices into chemistry teaching not only to enhance students' understanding and achievement in the subject but to help in restoring and transferring the native peoples' traditional ways of knowing the world to the new generation thereby living sustainably.

Chemistry is an important and everyday science that requires varieties of teaching strategies that can enhance understanding and application for sustainable living. Consequently, stakeholders of chemistry have been concerned with identifying effective methods of teaching the subject at secondary school level that can change students' attitude towards the subject in order to enhance understanding and achievement.

Chemistry is an experimental science that demands a high standard of experimental work for its knowledge and application (Bernett & O`Neale as cited in Ugwu, 2009). It is practical oriented and as such must be taught and learnt through hands- on and minds – on activities that relate to activities outside school for relevance and sustainable living. This will help to sustain the unique world views of people of different cultures in different traditional spheres of life and not only in chemistry.

Chemistry is an abstract subject for both teachers and students possibly because of the ways it is taught and learnt - not relating it to day to day activities of the learner. This has resulted in students' poor performance in the subject. The teaching is isolated from indigenous knowledge and practices. This is quite unhelpful to the teaching of chemistry for according to Thornton (2008), chemistry controls the environment. The science of chemistry that is noted as abstract is being practiced with the environmental resources within the context of indigenous knowledge at different levels of human societies across the globe unknowingly. In

Nigeria for instance, the concept of saponification is fully practiced in the production of local soap. In the same vein, separation techniques like, sieving, decantation, evaporation, distillation, chromatography among others are also indigenously practiced. These concepts have their origin in many and diverse indigenous knowledge and practices of the people. These and many other chemistry concepts are unknowingly practiced indigenously but in isolation from chemistry as a school science subject. It therefore, becomes imperative to integrate indigenous knowledge and practices of the people in the society into chemistry teaching in order to dispel the notion that the subject is abstract and has no relevance to common daily activities; hence the study.

The Problem

It has been observed that Students' academic achievement in chemistry in senior secondary school certificate examination from 2005 - 2010 been persistently poor (West African Examination Council, 2010). This poor result is not unconnected with the notion that chemistry is known as an abstract subject that has no relevance to common daily living (Umoh, 2009). The science of chemistry though practiced unknowingly in everyday life of the people is isolated from school chemistry. The students' life experiences are neither integrated into the classroom nor linked with chemistry concepts.. The local knowledge/experiences are abandoned for modern science. Consequently, chemistry becomes difficult to understand and so seen as abstract.

The abandonment of indigenous knowledge and practices of the society in science for academic ways of teaching and learning makes the science of chemistry abstract to science students today. Efforts are made towards indigenization of science through improvised local materials (Achimugu, as cited in Abonyi, 2002) and use of mother tongue in science instruction (Fafunwa, as cited in Abonyi, 2002) in Nigeria. These notwithstanding, many science students still maintain that chemistry is abstract and perform very poorly in school certificate examinations.

Apart from the general notion that chemistry is abstract, studies (Bolarin & Williams as cited in Ifeakor, 2001 and Alamina, 2001) have shown that poor enrolment and poor performances in chemistry are well pronounced in female students. In other words, male students do better than female students in chemistry. The problem of this study, therefore, is to determine whether integration of indigenous knowledge and practices into chemistry teaching can create any change among chemistry students towards better achievement in the subject and equally find out the effect of gender on students' achievement with integration of indigenous knowledge and practices.

Purpose of the Study

The purpose of this study, therefore, was to integration of indigenous knowledge and practices into chemistry teaching for sustainable living. Specifically, the study intended to find out the-

1. Mean achievement scores of students taught chemistry with integration of indigenous knowledge and practices and those taught without.
2. Effect of gender on the academic achievement of chemistry students taught with integration of indigenous knowledge and practices; and
3. Interaction effect of method and gender on the academic achievement of students in chemistry.

Research Questions

The following research questions were raised to guide the study.
1) What is the mean achievement scores of students taught chemistry with integration of indigenous knowledge and practices and those taught without?
2. What is the mean achievement scores of male and female students taught chemistry with integration of indigenous knowledge and practices?
3. What is the interaction effect of method and gender on the mean achievement scores of students in chemistry?

Hypotheses

The following null hypotheses were generated and tested at 0.05 level of significance.
HO_1: There is no significant difference between the mean achievement scores of students taught chemistry with integration of indigenous knowledge and practices and those taught without.
HO_2: There is no significant difference in the mean achievement scores of male and female students taught chemistry with integration of indigenous knowledge and practices.
HO_3: There is no significant interaction effect of method and gender on the mean achievement scores of chemistry students.

Significance

It is hoped that integration of indigenous knowledge and practices into chemistry teaching will be significant in the following ways:-

1. It will reduce the abstract nature of chemistry concepts and enhance students' understanding and achievement in chemistry. The concepts will be simplified when indigenous knowledge and practices are integrated and applied.
2. It will reduce a lot of stress on the teachers both on activities to be carried out and on the collection of instructional materials as some of the students might even explain certain concepts and phenomena better using indigenous knowledge and practices and can equally help in gathering teaching resources from the locality.
3. It will help both teachers and students to gain respect for local activities and culture, its' wisdom and ethics and appreciate indigenous science and technology and appreciate the use of local resources more thereby enhancing sustainability.
4. It will enable curriculum planners to know instructional materials and activities that should be included in the chemistry curriculum content.

Theoretical Framework

Ausubel's subsumption theory of meaningful learning has very significant contribution towards science and science education. Ausubel believes that learning of new knowledge depends on what is already known. Gbamanja (1990) submitted that Ausubel emphasised the role of the existing cognitive structure or advanced organisers in subsuming newly introduced concepts to be learnt. According to the propounder of subsumption theory of meaningful learning, learning occurs when there is interaction between the learner's appropriate element in the knowledge that already exist and the new material to be learnt. In the same vein, indigenous knowledge and practices of the learner that have chemistry undertone need to be infused into chemistry teaching to serve as advanced organisers for new related chemistry concepts thereby enhancing understanding, hence, the theoretical framework of this study.

Design and Procedure

The study adopted the quasi experimental research design that specifically used pre-test, post-testnon-equivalent control group design. This design allows maximum control of extraneous variable (Nworgu, 2006). The use of the design was anchored on the fact that intact classes that are not equivalent were used. The sample size consists of 115 ss1 chemistry students randomly selected from 16 public senior secondary schools in Uyo metropolis of Akwa Ibom state, Nigeria. Using a flip of coin, two schools were assigned each to experimental and control groups respectively.

The two groups were given pre-test before the commencement of the treatment. The two groups were then taught separation techniques, change of state, acids, bases, salts, neutralization reactions and saponification all from senior secondary school chemistry curriculum content by their regular chemistry teachers. Both the experimental and control groups were taught the same concepts with the same contents and instructional objectives but with different approaches in the instructional activities. The treatment teachers that has been trained by the researcher taught with lesson notes that integrated indigenous knowledge and practices in the activities while the control group teachers taught with the conventional lesson notes that did not integrate indigenous knowledge and practices in its activities. This lasted for twelve (12) weeks after which the test items were rearranged and post-test given to them and data collected.

Chemistry Achievement Test (CAT) developed by the researcher based on the concepts taught was used for data collection. The instrument had a face and content validation by three specialists with a test blue print. Using Kudder- Richardson formula- 20 (K-R20), the internal consistency reliability coefficient of CAT was found to be 0.89 while the coefficient of stability using test-retest method is 0.81.

Both groups of students were given pre-test and post-test before and after the treatment respectively. Analysis of covariance (ANCOVA) was used to test the hypotheses formulated at 0.05 level of significance.

RESULTS

Table 1: Mean and Standard Deviation of students' scores in both experimental and control groups

Group		No. of Students	Mean	Standard Dev.	Mean Achievement Gain
Experimental	Pre-test	52	37.90	8.037	20.31
	Post-test	52	58.21	8.759	
Control	Pre-test	63	33.87	7.038	16.86
	post-test	63	50.73	6.225	

Table 1 shows that the mean achievement gain for the experimental group is 20.31 while that of the control group is 16.58 indicating the superiority of the experimental group over the control group in chemistry achievement test.

Table 2: Mean and Standard Deviation for the experimental and control groups across the gender

Group	Gender		No. of students	Mean ($\bar{x}$)	Standard Dev.	Mean Achievement Gain
Experimental	Male	Pre-test	30	38.03	8.656	20.90
		Post-test	30	58.93	9.255	
	Female	Pre-test	22	31.73	7.304	17.86
		Post-test	22	55.59	8.233	
Control	Male	Pre-test	33	33.64	7.713	17.39
		Post-test	33	52.03	8.512	
	Female	Pre-test	30	34.13	6.329	15.17
		Post-test	30	49.30	5.658	

Table 2 shows the mean achievement scores of male and female students in both the experimental and control groups. The mean achievement gain for the male and female students in the experimental group are 20.90 and 17.86 respectively, while that of the control group are 17.39 and 15.17 for males and females respectively.

Table 3: Test of interaction between method and gender on students' achievement in chemistry

Gender groups	Mean achievement gain for experimental	Mean achievement gain for control
Males	20.90	17.39
Females	17.86	15.17

From Table 3 above, it is seen that the mean achievement gains are higher in the experimental group for both male and female students than in their control group counterpart. This implies that there is no interaction between gender and methods on students' achievement in chemistry.

Table 4: summary of (ANCOVA) by approach and gender

Sources	Sum of squares	df	Mean square	f	Sign f
Corrected model	698.764	4	174.691	3.105	0.018
Intercept	13730.448	1	13730.448	244.061	0.000
Pre-test	4.036	1	4.036	0.72	0.739
Group	578.961	1	578.961	149.001	0.000
Gender	30.024	1	30.024	0.608	0.432
Group*Gender	79.527	1	79.527	0.17	0.895
Error	6188.418	110	56.258		
Total	326961.000	115			
Corrected Total	6887.183	114			

Table 4 shows that f value of 149.001 is significant at 0.000 for methods at 1 and 114 degree of freedom (df), since 0.000 is less than 0.05 significant level set for the hypothesis. The hypothesis, therefore is not accepted. There is significant difference in mean achievement scores of students taught chemistry with integration of indigenous knowledge and practices and those taught without.

The findings also revealed a no significant difference for gender at 1 and 114 degree of freedom (df), since$f$ value of 0.608 is not significant at 0.432 for gender at 1 and 114 degree of freedom (df). This is because 0.432 is more than 0.05 significant level earlier set for the hypothesis, therefore the hypothesis is accepted. That is, there is no significant difference in the mean achievement scores of male and female chemistry students taught with integration of indigenous knowledge and practices.

It also revealed that f value of (.017) is not significant at .895 for the interaction between groups and gender at 1 and 114 degree of freedom (Df) since .895 is more than .05 significant level set for the hypothesis. Hence, the hypothesis is not rejected and so there is no significant effect between teaching methods and students' gender in the mean achievement scores of chemistry students.

DISCUSSION

The findings of the study revealed that the experimental group performed significantly better than their control group counterpart in chemistry achievement test. This is an indication that integration of indigenous knowledge and practices into chemistry teaching enhances students' understanding and achievement in chemistry. The significant performance could be attributed to the relationship between what they have been practicing in their day to day activities and the new topics. Again the students' outstanding performance could be due to the joy that their indigenous practices are relevant in modern science.

This finding is in consonance with the findings of Cadwallader (2004) who opined that when indigenous knowledge was systemically and holistically included into schools, students' achievement improved. It is equally in agreement with the submission of Fafunwa, as cited in (Abonyi, 2002) who found that infusing some elements of the child's culture into science curriculum will improve interest and achievement in modern science. . It is also in line with Abonyi (2002,) who revealed that ethnoscience-based instructional package facilitates interest in science. The improved interest in ethnoscience which is also indigenous science could be due to the wealth of knowledge and experiences of both male and female students from cultural practices.

Integration of indigenous knowledge and practices into chemistry teaching has no significant effect on male and female students' achievement in chemistry as revealed by the findings. This could possibly be due to the fact that both males and females participate in local practices in the society and so are both conversant with the knowledge and practices. This could according to Fafunwa be that the gap between the learner's culture and the new field of knowledge has been bridged by the integration of indigenous knowledge. This is at variance with some findings which believes that females will benefit more from instruction that includes culture and the environment although researchers like (Davison as cited in Abonyi, 2002) noted that some culture forbid females from participating in some practices that can make them understand the environment and its function.

On the significance of interaction, summary of result presented in the table 4, shows that, there is no interaction between gender and teaching approach on students' achievement in chemistry. This is an indication that integration of indigenous knowledge and practices into chemistry teaching is superior to conventional approach in enhancing achievement in chemistry in both male and female students, since gender did not combine with teaching approach to affect the students' achievement in chemistry. This is in agreement with (Usman,

2007, Nwagbo, 2011 and Ogbu 2011) who found no significant interaction between instructional methods and gender on performance.

CONCLUSION

From the findings of the study, the researcher drew the following conclusion:

1. Integration of indigenous knowledge and practices into chemistry teaching enhances the understanding of chemistry concepts and hence enhances students' achievement in the subject.
2. There is no statistically significant difference between the academic achievement of male and female chemistry students that are taught with integration of indigenous knowledge and practices although the male students tend to perform better than the female students that are taught chemistry with the integration of indigenous knowledge and practices.
3. There is no significant interaction effect between the teaching approaches and gender of the students on achievement in chemistry considering the fact that both male and female students showed improved performance with integration of indigenous knowledge and practices than with conventional method.

RECOMMENDATIONS

Based on the findings of this study, the researcher recommends that:

1. Indigenous knowledge and practices should be integrated into chemistry teaching approaches especially under activities. This will help them to easily grasp the new concepts and enhance understanding and achievement.
2. Practical examination in chemistry which is basedon modern science/academic ways of learning should include indigenous knowledge and practices in the society that has chemistry orientation in them.

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