

## Effect of Ethnochemistry Based Approach on Secondary School Students' Attitude Toward Chemistry Concepts in Malumfashi Educational Zone, Katsina State, Nigeria

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#### Abstract

This study investigated the effect of Ethnochemistry based Approach on Secondary School Students' Attitude toward Chemistry Concepts in Malumfashi Educational Zone, Katsina State, Nigeria. Quasi-experimental design involving pretest-posttest control group was adopted for the study. 97 Students were selected through Multistage sampling procedure out of the total population of 5501 SSII Chemistry Students. Adapted Chemistry Attitude Questionnaire (CAQ) with split-half reliability index of r=0.897 was used as tool for collecting data in the study. Mean, Standard Deviations and Mann Whitney (U-test) were used to answer the two research questions and two corresponding null hypotheses at p $\leq$ 0.05 level of significance using SPSS V.20.0. The findings of the study revealed that the use of Ethnochemsitry based approach have significant positive effect in improving the attitude of students toward Chemistry concept over the use of Lecture Method and in favour of female students. Therefore, the study recommended that chemistry teachers should adopt Ethnochemistry Based Approach for teaching school chemistry. Also, textbooks writers should support their content explanations with relevant cultural and indigenous examples.

Keywords: Ethnochemistry based Approach, Attitude, Chemistry Concepts.

#### Introduction

Advancements in Science and Technology (S&T) are the principal features of the 21st century. It plays a significant role in the development of many nations across the globe. Science and technology education is the composites that gear national development these days. S&T remain the key for economic and social development (Halliru, 2021). It is also the instrument for global competitiveness and job creation (Fomunyam, 2019). Hence, science learning and its understanding become imperative (Ahmad, 2017). The developed nations are characterized by high commitment to issues that quest for scientific and technological research and development. Thus, Science and Technology entail contextual findings from various subject science subject ranging from Basic Science at Junior Secondary School to Biology, Chemistry, Physics and Mathematics at Senior Secondary School in Nigeria.

Chemistry Education is the acquisition of knowledge or ideas relevant to chemistry. Within the sphere of science education as reported several times over the years, chemistry has been identified as a crucial contributing subject in secondary schools in Nigeria as proved by the astronomical elevation of the harvests in science and technology not only in Nigeria but worldwide. It is the miracles of chemistry education that allow human to possibly manipulate and transform substances from one form into another as it is possible to convert a fuel into poison, change one colour into another, revert some inedible substances to edible, replace a pungent odour with a fragrance one (Eilks & Hofstein, 2015). It is because of its importance that it has been made a core-subject among the natural sciences and other science related courses in the Nigerian education system (Ayodele, 2018) and has been a pre-requisite subject for offering most science-oriented courses in the tertiary institution such as Medicine, Biochemistry, Pharmacy, Geology, Toxicology, Pharmacology, Laboratory Technology, Agricultural Science etc. (Nja, et al., 2019).

However, even with the beauty of chemistry and its novel role to the human life and educational carriers, recent researches advocate students' negative or nonpositive attitude toward learning chemistry concepts. Thus, attitude is a major factor in a subject choice. Abudu and Gbadamosi (2014) simply defined attitude as an indicator of likes or dislikes of a person about something which is based on the person's idea or thought at a certain situation. Moreover, there is a direct and positive relationship between attitude and its associative concepts (e.g. motivation and interest) with academic achievement in science and chemistry (Ezike, 2018; Cox, 2019; Risa & Pupung, 2019). Specifically, Oloyede and Demide (2000) attributed the cause of the prevalence of negative attitudes towards chemistry by secondary school students in Nigeria to teaching problems. This shows that there exists a relationship between chemistry students' attitude and with nature of teaching chemistry (Chepkorir, et al., 2014; Musengimana, et al., 2021).



Therefore, distinguishing attitude as a psychological antecedent to academic achievement in chemistry calls for intervention that would improve students' attitude toward the subject. Because, poor attitude to sciences culminated in poor enrolment in science subjects at the secondary and even tertiary level of education and poor performance in sciences and science-related fields (Peni, 2015).

However, several interventions were made which aimed at discovering solutions to curtail these problems identified. Many researchers trialed and endorsed the feasibility of several teaching approaches and strategies to be adopted such as Concept Mapping and Guided Inquiry (Jack, 2013), Jigsaw Model (Isa, 2018); Hands-on-activities (Ogbeba & Ajayi, 2016); Computer Animations (Ikwuka & Samuel, 2017), Computer Simulations (Okwuduba, et al., 2018), Demonstration Strategy (Giridharan & Raju, 2016), Concept Mapping (Yakubu, 2016), Experiential and Generative Learning Strategies (Adevemi & Awolere, 2016) among others. Notwithstanding, more innovative teaching strategies that are learners-favoured, activity-based or context-based are encouraged for their potentiality in objective realisation (Fathima et al., 2012). Thus, these Approach/Methods were of course found to stimulate attitude to positive when compared to Conventional Teaching Strategies. Quietly, at this juncture, it can be deduced that the attitude of students might change as a function of the nature of teaching approach used by teacher.

In this regard, teaching strategy that will positively stimulate and sustain attitude of students toward studying chemistry is needed. Meanwhile, Adodo and Gbore (2012); Alshammari, et al., (2015) also recognized that, any instructional methods which have bearings on students' daily life practices and prior cultural belief can make their academic achievement better. In other words, the use of instructional method which have no account on the day-to-day activities of the students majorly caused their achievement poor. Thus, incorporation of indigenous knowledge into school curricula for teaching and learning has the potentiality of enabling students to gain further experiences and develop corresponding attitudes towards science (chemistry) (Zidny, et al., 2020).

As a response, Igbokwe (2010); Ugwu and Diovu (2016) conducted similar studies which found that, incorporation of indigenous knowledge and local practices found in the midst of the learners' environment is also an innovative pedagogical strategy. It is a paradigm shift from conventional pedagogy to the integration of relevant cultural practices, beliefs and experiences to teach science and is proved viable to enhance academic achievement of students in chemistry. Hence, integration of indigenous knowledge and practices into chemistry teaching for effective teaching and learning of chemistry and for improved academic achievement was recommended.

Hence, this study employed Ethnochemistry based Approach to teaching chemistry as an alternative or modification to the conventional teaching approach. Basically, ethnochemistry simply means Indigenous Chemistry (IC), Native Chemistry (NC), Original Chemistry (OC) or Traditional Chemistry (TC). It could be defined as all chemically related activities, techniques, productions, processes, practices, presumptions of a certain people on natural material substances pertinent to its properties, classification, transformation and nomenclature. Accordingly, ethno as related to chemistry refers to various indigenous chemically related socio-scientific practices and contextual perceptions of chemistry of a particular identified culture. It is a sort of chemistry which is by culture of a given society. influenced Ethnochemistry based Approach is an instructional method that utilizes the initial chemistry related knowledge and experiences found within the learners' culture and environment to explain new concepts taught in chemistry classroom. It further involves designing a practical model in balancing local knowledge and western science as a process of learning (Abonyi, et al., 2014).

The aim is to connect and smooth the existing barrier between the school chemistry and local or indigenous chemistry concepts and practices for development. It is worth of note that, Ethnochemistry Based Approach is beyond the use of native language as a medium of instruction or used of improvised instructional materials developed from local available materials. It also aims to weave culturally relevant chemistry and science is to innovate teachinglearning process through the process of two-eyed sight. Two eyed seeing allow students to see from one eye with the strengths of indigenous ways of knowing and from the other eye with the strengths of Western ways of knowing (Mckeon, 2012). This means, ethnochemistry approach is like an academic vehicle that voyage learner from his home world to the school of Western worldview smoothly and unmolested. In that, the existing lacuna between students' day-to-day life activities and chemistry taught in their schools can be bridged. For instance; Sieving as a separation technique can be taught through local home activity practice by reminding the children (students) how their mothers (of Hausa Tribe) use to obtain fine flour from processed cereals (e.g. maize or corn) using 'Rariya' through the process of 'Tankade'; How their



mothers use to obtain use filtrate for making 'Koko. Similarly, to teach the concepts of Catalysis, the teacher may begin by rising a question as; normally, beans take long time and heat to be cooked, but in Hausa tradition, a little piece of potash (red or black) is dropped in the pot. This makes the beans to be cooked in a very short time. So why? and host of sundry examples. It could be noted that, the activities mentioned are associated with the responsibilities of females at home, similarly boys took part in other responsibilities that contain related chemistry practices like farm clearance by burning. The teacher who intends to teach the concepts of Combustion reaction may introduce his lesson by raising the question as; when we try to burn wasted papers or leaves, we can observe that the product of burning is a kind of black amorphous solids. It stains the surface on which it burns, but when we burn a dried firewood or coal, the product is ashes. Why? Therefore, this gender parity in the responsibilities of male and females posed the need to investigate the viability of Ethnochemistry based approach in facilitating equality or otherwise in gender (males & females) in terms of attitude. Though, Abumchukwu, et al. (2021); Idah (2018) in their separate study reported that Ethnochemistry based approach is gender friendly in terms of achievement and interest.

Thus, plethora of research results show the viability of the integration of indigenous knowledge (IK) into teaching and learning of science subjects at different levels and at different locations e.g.; Mathematics (Ozofor & Onos, 2018), Basic Science (Peni, 2015; Fasasi, 2017), Chemistry (Idah, 2018; Siwale, et al., 2020), Biology (Mukuka, 2019), Physics (Chongo & Baliga, 2019). Noticeably, this suggest that similar results are possible when ethnochemistry is applied in chemistry classroom setting. It can also help students to be aware of the role in which chemistry plays in their everyday lives. Moreover, there is an increasing recognition and supportive findings about the positive impact of integrating indigenous knowledge (IK) into global (WS) on students' achievements locally and internationally. As such, the present study aimed at denaturing the impact of Ethnochemistry based Approach on Secondary School Students' Attitude Chemistry Concepts toward in Malumfashi Educational Zone, Katsina State, Nigeria.

## **Statement of the Problem**

The depth and breadth of the contribution of chemistry to almost all facets of humanity make its educational research and development highly crucial. But, it was observed that chemistry teachers often neglect the integration of cultural practices, examples and illustrations found in everyday life of the learners (students) and their environment to facilitate their instructions which should serve as previous knowledge and experiences on which the new knowledge could be smoothly and efficiently constructed meaningfully (Adesoji, et al., 2019).

As such chemistry students encounter problem when Science (Chemistry) is taught through purely western science method to students of culture other than Western; their mentality is resort to a kind of mental disturbance known as 'Cognitive Conflict' alias 'Cognitive Dissonance' or 'Mental Perturbation' or 'Mental Disequilibria' (Jegede, 1995; Aikenhead, 2001). Consequently, this has resulted to the problems of negative attitude toward the chemistry which give birth to many other problems among which poor academic indices among chemistry students.

Recently, Musengimana et al. (2021) extensively reviewed several research reports on chemistry students attitude over the years. The findings indicate a significant number of studies reporting negative or non-positive attitude of students toward the study of chemistry concepts as a function of several factors ranging from teachers' factors, students' factor to environmental factors. this suggest for the need for students' attitude improvement toward study of the subject. However, before any decision on the appropriate effort to improve students attitude, identification of its root cause is of crucial (Kubiatko et al., 2017). Accordingly, Musengimana, et al. (2021) lamented that inappropriate teaching approaches and gender as the determinants of the students' attitude among others. Hence, the need of teaching approach the will positively cater for student attitude is apt and timely. Such teaching approaches that are students-centered, students culturally centered, a teaching approach that will inflict sense of positive feelings toward. Such approach like Ethnochemistry based Appraoch.

However, the researcher observed that there are abundant ideas, beliefs and practices derived from daily activities of indigenous Hausa culture which are relevant in teaching and learning chemistry. But unfortunately, these ideas, beliefs and practices are often abhorred and therefore not inclusive in teaching-learning of school chemistry. This is perhaps why Ogonnaya (2011) stressed the need for both local and national research to comprehensively search, identify and document those local and indigenous knowledge of all tribe and communities in Nigeria. Hence, this study tends to revive the glory of the relevant indigenous and local knowledge, skills, ideas, beliefs and practices so that their impact could be formalized. Therefore, the present study sets to address the effect (if any) of Ethnochemistry based



Approach on Secondary School Students' Attitude toward Chemistry Concepts in Malumfashi Educational Zone, Katsina State.

#### **Objectives of the Study**

The objectives of this study were to:

- 1. Ascertain the effect Ethnochemistry based Approach on SSII students' attitudes toward Chemistry Concepts.
- 2. Determine the impact of Ethnochemistry based Approach on male and female SSII Students' attitude toward Chemistry Concepts.

#### **Research Questions**

The following research questions guided the study:

- 1. What is the difference between the attitude of SSII students toward chemistry concepts before and after being exposed to Ethnochemistry based Approach and Lecture Method?
- 2. What is the difference between the attitude of male and female SSII students taught Chemistry Concepts using Ethnochemistry based Approach?

#### **Research Hypotheses**

The following null hypotheses are formulated for testing at  $p \le 0.05$  level of significance:

**Ho<sub>1</sub>:** There is no significant difference in attitude of SSII students taught Chemistry Concepts using Ethnochemistry based Approach and those taught using Lecture Method.

**Ho<sub>2</sub>:** There is no significant difference in the attitude of male and female SSII Students taught Chemistry Concepts using Ethnochemistry based Approach.

## Methods

This research adopted Quasi-experimental nonequivalent control group research design in form of pre-test, post-test. This is according to Kerlinger and Leer (2005) that the design involves two groups, one group is assigned as experimental and the other group is controlled. The population of this study targeted total of 5501 Students in Public Senior Secondary Schools Two (SS II) under Malumfashi Zonal Education Quality Assurance (MZEQA). The Government Public Schools were selected for use in this study because of their prior experiences, sociocultural background, curriculum and population. There were Twenty-Six (26) Government-owned Senior Secondary Schools under MZEQA who are offering Chemistry as a subject. Records of Students Returns of February 2021 of 2020/2021 Session show that the schools comprise of a total number of Five Thousand Five Hundred and One (5501) SSII students offering Chemistry as a subject. Out of which 3311 are males and 2190 are females with an average age of 17 years.

This study employed Multi-Stage Sampling procedure in the selection of schools for the study. The first stage involved the selection of coeducational schools based on their accessibility. convenience and to cater for gender variable involved in the study through Convenience Sampling Technique. The sample size of the study consisted of 97 SSII Chemistry Students. This composed of 75 Males and 22 Females. The second stage involved selection of Experimental School and Control School through Simple Random Sampling Technique. The two schools were randomly assigned Experimental and Control Schools. Each of the two schools selected has two arms of Science Classes (A & B). In each of these two schools, an intact class was selected randomly and used so that no student was exempted or left out and to avoid the disturbance of the school classes structure. The selected intact classes comprise of Fifty-two (52) students (42 Males & 10 Females) for Experimental Group and Forty-five (45) students (33 Males & 12 Females) for Control Group.

Chemistry Attitude Questionnaire (CAQ) was used for data collection in the study. The CAQ was adapted from (Singh & Chibuye, 2016). The CAO is a 24items questionnaire which consists of two sections (A & B). Section A is Biodata Section and consists of items on demographic information (Name of School, Class & Gender). Section B consists of positive and negative items soughing students' attitude toward Chemistry. The CAQ was based on 5-point Likert Scale namely; Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D) and Strongly Disagree (SD) with their corresponding point of 5, 4, 3, 2 & 1 respectively for positively stated items. However, negatively stated items are to be scored in reverse. The data collected using CAQ was on ordinal scale. The same questionnaire was administered to Experimental and Control Group before the treatment (pretest) and after the treatments (posttest) to determine students' attitude toward Chemistry. The instruments and instructional plans were validated by experts in the Departments of Science and Technology Education, Department of Pure and Industrial Chemistry, Bayero University Kano and Department of Science and Technology Education, Umaru Musa Yaradua University, Katsina, Nigeria. The CAQ was pilot tested on 65 students (35 Males & 30 Females) G.S.S Danrimi SSII Chemistry





Students (which is not part of the sample). Spearman Rank Order Correlation Coefficient (SROCC) statistical tool was employed for analysis through Split-half Method Technique. The reliability rho coefficient of CAQ was computed to be r = 0.897 indicating strong positive correlation, stable and acceptable to be used for data collection. All the analyses were ran using Statistical Package for Social Sciences (SPSS) version 20.0.

The experimental procedure was in three sessions namely: pre-treatment session, treatment stage and post-treatment session. The pre-treatment session entails the introduction of researcher, stating the aim of the research for participant consent, and training of the regular chemistry teachers who served as research assistants. With granted permission, the researcher pretested the students using CAQ from both Experimental and Control Groups before any treatment. This session last for one (1) week.

The treatment session entails teaching of the Chemistry Concept (Separation Techniques, Catalysis, Combustion, Acid, Base and Saponification) through Ethnochemistry based Approach: The researcher taught the Chemistry Concepts to the students in Experimental Group using Ethnochemistry Lesson Plans (ETCLP) The Ethnochemistry Lesson Plan was developed by the researcher in accordance with Ethnochemistry based Approach adapted from Fasasi (2018) (See Appendix A).

The control group were also taught same concepts through lecture method. Lecture Method involves teaching topic(s) in a regular chemistry class where teaching and learning activities are mainly teachercentred with students as passive listeners and notetakers. The CAQ was coded appropriately for convenient analysis. This session last for the duration of six (6) weeks.

For the two research questions, the data collected in ordinal scale ware converted to interval scale and analysed using Mean and Standard Deviations whereas, for the two corresponding hypotheses, the ordinal data collected were subjected to Mann Whitney (U-test) analysis at 0.05 level of significance ran with version 20.0 Statistical Package for Social Science Software.

#### Results

Presentations in this section are based on research questions and hypotheses simultaneously:

Fable 1: Summary of Mean, Standard Deviation and Gain in Mean of Attitude Scores of the Studen	ts
before and after being exposed to Ethnochemistry based Approach and Lecture Method	

		Pre-atti	tude	Post-atti	tude	
Groups	Ν	Mean(x)	SD	$Mean(\tilde{x})$	SD	Gain in Mean
Experimental	52	83.62	16.63	114.96	2.59	31.34
Control	45	83.42	16.62	109.11	4.06	25.69

Table 1 shows the attitude mean, standard deviation and gain in mean scores of students before and after being exposed to Ethnochemistry based Approach and Lecture Method. The result shows that the gain in mean score of students taught chemistry concepts using Ethnochemistry Based Approach was 31.34, while their counterpart taught using conventional

lecture method had gain in mean score as 25.69. This gives a difference in gain in mean scores of 5.65 between the two groups in favour of the students taught with Ethnochemistry based Approach. This means attitude of students in the experimental group (taught using Ethnochemistry Based Approach) improved better than those in the control group.

Table 2: Summary of Mann Whitney Analysis on Attitude of Students exposed Ethnochemistry based
Approach and Lecture Method

Groups	Ν	Mean	Sum of	Mann	<b>Z-value</b>	Р	Decision			
		Rank	Ranks	Whitney U		value				
Experimental	52	71.10	3697.00							
				21.000	-8.385	0.000	Significant			
Control	45	54.63	2840.400				-			

Table 2 shows the Mann Whitney analysis of the mean rank scores of students taught chemistry using Ethnochemistry based Approach and those taught using Lecture Method. The result shows the observed Z-value of -8.385 and the p-value of 0.000 ( $p \le 0.05$ ).

Hence, two groups (Experimental and Control) differ significantly in the attitude of the students towards chemistry concepts. Therefore, null hypothesis one is hereby rejected.

# Table 3: Summary of Mean, Standard Deviation and Gain in Mean of Attitude Scores of the Male and<br/>Female Students before and after being Exposed to Ethnochemistry based Approach



			Pre-attitude		Post-attitu	ıde		
Group	Gender Males	<b>N</b> 42	<b>Mean(x̃)</b> 83.74	<b>SD</b> 15.86	<b>Mean(x̃)</b> 114.62	<b>SD</b> 2.60	Gain in Mean 30.88	
Experimental	Females	10	83.10	20.51	116.40	2.07	33.30	
hows the attitude	mean star	dard	deviation	male s	students was	30.88	whereas that of	

Tables 3 shows the attitude mean, standard deviation and gain in mean scores of the experimental group male and female students before and after being taught Chemistry Concepts using Ethnochemistry based Approach. The result shows gain in mean of male students was 30.88 whereas that of the female counterpart was 33.30. This gives a difference in gain in mean scores of 2.42 in favour of female students. This means attitude of female students slightly improved better than their male counterpart.

 Table 4: Summary of Mann-Whitney Analysis on Attitude of Male and Female Students exposed

 Ethnochemistry based Approach

Group	Gender	Ν	Mean	Sum of	Mann	Z-	Р	Decision
			Rank	Ranks	Whitney U	value	value	
	Males	42	52.98	1002.50				
Exper.					671.500	-1.112	0.02	Significant
	Females	10	60.66	3950.50				

Table 4 shows the Mann Whitney analysis of the attitude scores of male and female students taught chemistry concepts using Ethnochemistry based Approach. The result shows the observed Z-value of -1.112 and the p-value of 0.02 ( $p \le 0.05$ ). Hence, two groups (Males and Females in the Experimental) differ significantly in improving the attitude of the students towards chemistry concepts. Therefore, the null hypothesis two is hereby rejected.

## **Summary of Major Findings**

From the data collected and analyzed the following findings were made:

- 1. The use Ethnochemsitry based Approach improves attitude of students toward chemistry concepts over the use of Lecture Method. The difference in attitude observed as a result of the treatment was statistically significant.
- 2. The attitude of female students slightly improves better than that of the males after being exposed to Ethnochemistry based Approach. However, the effect of the treatment on attitude toward chemistry concepts was statistically significant.

## **Discussion of Findings**

The findings from the Research Question and Null hypotheses number One unveiled that, the use Ethnochemsitry based Approach was found to have significant effect in improving the attitude of SSII students toward Chemistry concept over the use of Lecture Method. This finding is in concordance with the findings of Siwale, et al., 2020; Chongo & Baliga, 2019; Singh & Chibuye, 2016; Abonyi, 2002) who in their separate studies found and reported that, students taught through the use of cultural and indigenous practices were found to have higher positive attitude toward chemistry concepts than those taught same concepts through conventional method like lecture method. Accordingly, incorporating ethnochemistry practices in teaching chemistry does influenced secondary school students' attitude towards chemistry concepts.

Also, the findings from Research Question Two shows that female students' attitude in experimental group is slightly higher than that of male counterparts. In other words, the Approach succeeded in improving the female students' attitude toward the chemistry concepts slightly higher than their male counterparts. However, Null Hypothesis Number Two was rejected. That means there was a significant difference in attitude of male and female students taught chemistry concepts using Ethnochemistry based Approach. This maybe be associated to the fact that there are many feminine societal responsibilities that are somewhat related to chemistry. Such responsibilities include sieving, cooking, washing and other kitchen and domestic chores which are relevant to chemistry. This finding is in line with that of Peni (2011) who similarly found and reported that, significant difference exists between the attitude score of male and female students when taught science concepts using culturally and indigenous rich lesson in favour of female students. This finding is also supported by the finding of Ugwu (2020) who reported female students' interest improved better than their male counterparts with incorporation of ethnochemistry practices. However, this finding contradicts that of Mukuka (2019); Idah (2018) who found no difference in attitudes between males and females when taught with similar approach.

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## Conclusion

Based on the findings of this study, it can be concluded that, teaching chemistry concepts with Ethnochemistry based Approach positively improved students attitude toward chemistry better than Lecture Approach. More so, Ethnochemistry based Approach improved female students' attitude more positive compared to their male counterpart. Henceforth, this approach can be used to improve students attitude toward chemistry irrespective of gender difference.

#### Recommendations

- 1. Chemistry teachers should be encouraged to always begin their lessons with relevant ethnochemistry practice, for that will positively convey and hold their students' attitude toward learning the concepts been taught. This would further inculcate sense of belonging in the mind of the students to always feel chemistry as their own not an alien subject.
- 2. Textbooks writers and publishers should support their content explanations with relevant scientific cultural and indigenous examples, practices and illustrations with the view of improving attitude of students. This would make their textbooks friendlier.

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