Article history
Received: November 9, 2025
Revised: January 7, 2025
Accepted: February 22. 2025
Published: July ,9, 2025

Unicross journal of Science, Engineering & Technology (UJOSET), Journal of the Faculty of Physical Sciences, University of Cross River State
VOL 1 ISSUE 1, 2025

Article Type: Research

Ethno-Chemistry Practices: A Panacea for Teaching Selected Difficult Concepts and Enhancing Rural Secondary Schools Students' Interest and Understanding in Chemistry

Hope Amba Neji

Department of Science Education, University of Calabar, Nigeria
Correspondence to: hopeneji@gmail.com

Abstract

The design adopted was semi-experimental design where the experimental group was taught chemistry content using ethno-chemistry practices while the control group were also taught same content with conventional method. The study involved all rural (SS2) participants made up of (2,764) students from the 113 schools in six (6) local Government Areas. Stratified and purposive sampling technique were employed in selecting one hundred and forty-four (144) subjects after the students were taught in intact classes. The instrument used for data collection was the chemistry interest questionnaire and the chemistry understanding test (CUT). The research questions were answered using descriptive statistics. The hypotheses were tested using analysis of covariance (ANCOVA). The study revealed that rural secondary school students taught selected difficult chemistry concepts with the use of ethno-chemistry practices had a significantly higher interest in learning chemistry (p=0.000; >.05) than those taught with the conventional method. Furthermore, findings revealed that the use of ethno-materials accounted for 76.6% of the variance in understanding of chemistry concepts among students taught with ethno-chemistry materials than their counterparts taught without ethno-chemistry materials. It was recommendation that chemistry teachers should adopt ethno-chemistry practices in teaching chemistry as an innovative approach to enhancing students' interest and understanding

Keywords: Ethno-chemistry, interest, understanding

Cite this article as: Hope Amba Neji (2025). Ethno-Chemistry Practices: A Panacea for Teaching Selected Difficult Concepts and Enhancing Rural Secondary Schools Students' Interest and Understanding in Chemistry. *Unicross journal of Science, Engineering & Technology* ***1****(1) pp:49 -59*

Introduction

One of the richest countries in Africa in terms of natural and cultural resource endowments is Nigeria. There is great abundance of mineral resources, salts deposit and palms embedded in the vast land, rocks, river and the forest. Comparatively, it is disheartening to observe that the21st century chemistry teachers are yet to affect the society and chemistry teaching and learning with their innovations and creativity the way the early man harnessed the natural resources during farming, palm oil production, soap making, alcohol production, construction of canoe, mat, fishing boot etc (Mkpa,2012)The world is now a global village, where science and technology has become the driving force behind economic and national development.

Chemistry by its nature consists of numerous abstract concepts and ideas that

require formal reasoning and interactive methods for better understanding (Meremikwu & Neji, 2019). However, it was noted by Marasinghe (2013) that majority of students find chemistry very difficult due to the mode of presentation by teachers in secondary schools and at the higher level of education. There is need to sustain the academic performance, understanding and interest of students in learning chemistry, especially at the rural secondary schools where most students perceive that chemistry is tough and most of them shy away from offering the subject. Effective teaching and learning has been aptly described as a situation where above 50% of the students' are able to recall concepts without rote memorization as it in a traditional classroom setting. In a situation where the learning output of the students does not yield desired results, the basic foundation of education at that level especially suffers. The use of constant practices with familiar materials within the environment of the learner enhances good grasp and understanding which tremendously help to build up lasting learning in the students. It also encourages a balance in cognitive, affective and psychomotor domain of the learner. (Asim &Neji,2018)..

A cursory look at the performance of students in chemistry in the past four years according WACE chief examiners report shows poor performance in the overall students' performance.

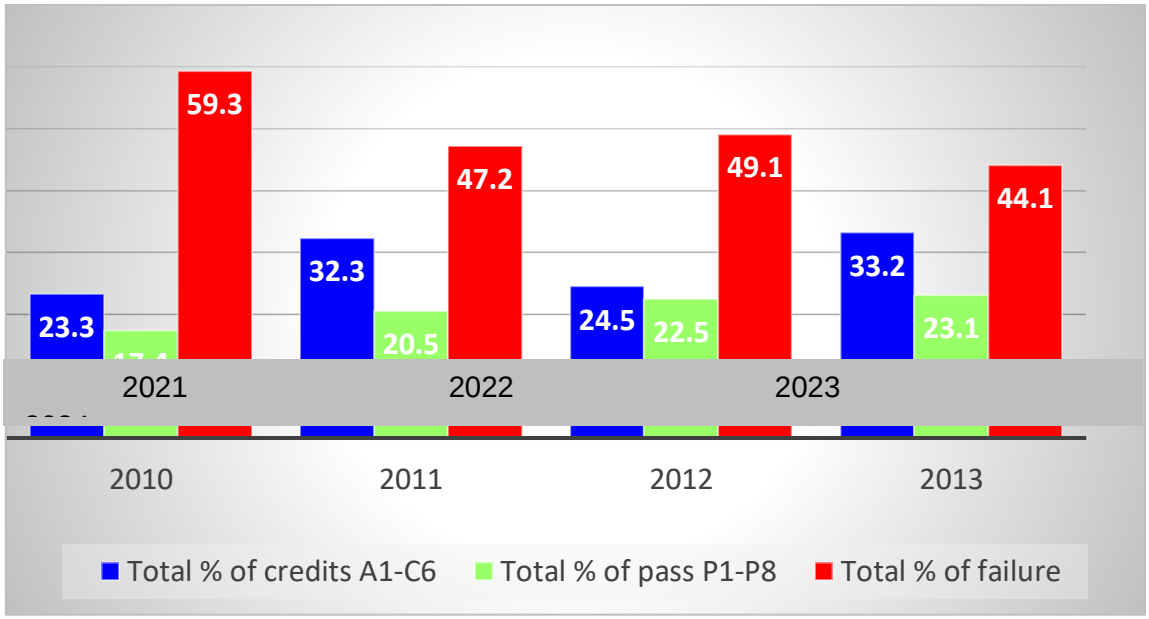

Figure 1 Students' Performance in Senior Secondary Certificate Examination O' level Chemistry in Cross River State 2021-2024.

Effective lesson presentation helps to foster quick understanding and is pivotal to quality learning of chemistry concepts. Science education current trend is emphasizing on learning models that involves learners directly in the learning process to promote positive understanding and high interest when communicating content (Mustafa, 2015).

Ethno-chemistry is a traditional method of doing chemistry by people without knowing that they are practicing chemistry. It is the study of traditional ideas found in any culture, where an appreciation of cultural heritage is preserved. Ethno- chemistry is defined as an attempt 'to use the natural materials within the environment which serves as scientific processes, practice and knowledge to explain chemistry concepts to the clarity and understanding of learners. For instance, in the African countries like Ghana, 'the bead makers' which can be used to explain the concept of periodic table, concept of electrolysis and chemical reactions. An inquiry teacher should be able to deploy cultural ideas to explain some of these abstract concepts to the understanding of slow learners. Ethno-chemistry practices is also found in Nigeria for instance, the

production of ogogoro (alcoholic beverages) through the fermentation and distillation process of palm sap such as raphia palm (raphia hookeri) oil palm (elaeis genesis) and coconut palm (cocus-nucifera). Also, the saponification of fats and oils, evaporation of salt (brine)from the reservoir, these are all-natural resources found in the environment and culture of the people without chemical explanation of what they do (Indra & Bitwell, 2016). Every culture in the world applies different methods of harnessing their local materials within the environment. For example, in the production of black soap by soap maker from animal fats of sodium and potassium salts of fatty acid by hydrolyzing fats and oils with caustic soda (alkali).

Ethno-chemistry is a traditional method of doing science without the people knowing that they are practicing science.

s According to soap maker (2011) the traditional procedures for making black soap involves;

i. Extracting the base oil from palm fruits
ii. Burning dried plantain skin or cocoa pods to get the ashes
iii. Mixing the scent or herbs into the very soft hot soap
iv. Scooping off the semi liquid hot soap and placing on a surface to dry
v. Cutting the soap into bars.

Teaching methods and approaches are among the numerous determinant factors that fertilizes active learning, interest and understanding in chemistry. Most chemistry teachers use uninspiring and less activities during instructions. The 5-E's constructivist theory of learning propounded by Vygotsky (1978) theory of learning which underpinning is based on activity-oriented learning epistemology that involve student's engagement in the learning process by constructing their own learning, ideas, experiences in order to get satisfaction of existing knowledge. Learning is meaningful and subsumed within the cognitive structure when it is real and creative to the learner. The use of ethno-chemistry practices creates channels for participatory learning, explore the environment and stimulate students' interest and understanding of concepts. According to Ugwu (2018), worked on the effect of ethno-chemistry-based curriculum delivery on students' interest in chemistry. It was reported that students' interest in chemistry was improved significantly with the incorporation of ethno-chemistry practices into curriculum delivery. Furthermore, studies by Singh and Chibuye (2016) showed that ethno-chemistry practices on secondary school students' attitude towards chemistry were still in favour of ethno-chemistry. The researcher added that the inclusion of knowledge related to ethno-chemistry practices may instill a sense of creative, innovative and entrepreneurial ability in the learner.

The application of ethno-chemistry practices as an effective tool is a crossover approach moving from the conventional approach to the environment or the use of cultural materials which could bridge the gap between what the students are already conversant with in the environment and delivery of concepts in the classroom which is no doubt a sine-qua-non to sustainable learning. Oluwatosin, Emmanuel and Peter (2017) investigated the use of ethno-chemistry teaching approach and achievement and retention of senior secondary students in standard mixture separation techniques. Finding revealed that students taught using ethno-chemistry approach had higher mean achievement and retention scores than those taught with discussion method. The researcher recommended that chemistry teachers should be encouraged to use ethno-chemistry. In the same vein, research by Indra and Bitwell (2016) examined the effect of ethno-chemistry practices on secondary school students' attitude towards chemistry. Finding showed that incorporating ethno-chemistry practices in teaching chemistry was found to have a positive effect on enhancing secondary school student' attitude towards chemistry learning. It describes the interactions found in identifiable cultural groups and may be regarded as the study of chemical ideas found in any culture.

Furthermore, Ugwu and Diovu (2016) submitted that the environment is richly endowed with abundance indigenous knowledge and practices that could reduce the complexity and abstract nature of chemistry teaching to simple and interesting to the learner. Therefore, incorporating the use of indigenous knowledge and practice (ethno-chemistry) in the teaching of chemistry concepts is pivotal to enhancing interest and students' understanding. Okwara and Upu (2017) investigated the effects

of ethno-science instructional approach on students' achievement and interest in upper basic science and technology in Benue State. Their findings revealed that both achievement and interest were increased with the use of ethno-chemistry instructional approach. Nwankwo (2021) worked on the effects of ethno-science instructional strategy on junior secondary students' achievement in basic science. Finding showed that the use of ethno-science instructional strategy significantly increased students' achievement and interest in basic science. The researcher recommended that basic science teachers should adopt the use of ethno-chemistry instructional approach in the teaching of basic science concepts as it relates to the indigenous and cultural practices.

Understanding is one of the higher order cognitive domains in blooms' taxonomy. It demonstrates comprehension of task and abilities in the learner. Understanding therefore, is the ability to assimilate, comprehend or the act of increasing knowledge about a subject, situation or concept. The issue is; how much do students understand and assimilate concepts? This the big problem facing science (chemistry) teaching and learning generally. The researcher is sourcing for alternative ways of presenting chemistry for better understanding and increasing students' enthusiasm.

Interest is defined as a powerful motivational tool that energizes learning, guides choice of career trajectories, and it is essential to academic success. Interest is both psychological where attention and affection are geared towards a particular subject or topic. Despite the relevance of chemistry in every sphere of human endeavor, most students' still express low interest studying chemistry especially in rural secondary schools. It is based on this trend the researcher wants to find out if the use of ethno-chemistry practices would help increase students' interest to learn chemistry and enhance understanding of difficult chemistry concepts.

Despite the immeasurable relevance of chemistry in all spheres of human endeavor, students still lack interest and poor understanding in the subject and consequently affect their performance in external examinations. This ugly trend is blamed on the way teachers presents the subject, methods and strategies used. Based on this premise, it is expedient to find out if the use of different appropriate methods, strategies and approaches among other factors can help improve the problem of low interest and poor understanding of chemistry concepts amongst rural secondary school students.

Research Questions

1. What is the effect of ethno-chemistry practices on rural school students' interest to learn difficult concepts in chemistry?
2. What is the effect of ethno-chemistry practices on rural school students' understanding of chemistry?

Statement of Hypotheses

1. There is no significant effect of the use of ethno-chemistry practices on rural students' interest to learn difficult concepts in chemistry.
2. There is no significant effect of the use of ethno-chemistry practices on rural students' understanding of difficult concepts in chemistry.

Method

The design used for the study was pretest posttest non-equivalent control group quasi-experimental design. This design is considered suitable as intact classes were used. The population of the students comprised of 2,764 SS11 chemistry students in 113 public secondary schools in Ikom Education Zone, Cross River State. The sample of the study comprised of 144 rural secondary school students involving 2 experimental groups and one control group. 85 experimental and 39 control respondents from the research area were used for the study. The chemistry teachers in the sampled schools were trained and used as research assistants. The sampled schools and respondents were selected using stratified and purposive sampling technique. The experimental groups where taught selected topics such as; fermentation and distillation of alcohol (local gin or ogogoro) derived from palm sap. Crystallization process of salt or brine derived from (sea water or lake) and production of soap and detergents through saponification and hydrolysis of fats and oil and

rates of chemical reactions while the control group was taught without ethno-chemistry materials. The teaching process lasting for 4 weeks in 2021/2022 academic sessions.

The instruments used for the study were twenty (20) chemistry students' understanding test (CSUT) and chemistry students' interest questionnaire (CSIQ) on modified 4 points likert scale. The instruments were constructed by the researcher and validated by 2 experts from test and measurement and science education, University of Calabar, Calabar. The reliability of CSIQ and CUT were ascertained using cronbach alpha reliability and Kudar-Richson formular (KR-20) which yielded a reliability coefficient of 0.84 and 0.87 respectively. All the students were both pre- and post-tested with CSIQ and CUT Data obtained through students' responses and CUT scores were analyzed using simple percentages, mean and standard deviation and analysis of covariance (ANCOVA).

Presentation of Results

Research question one:

What is the effect of ethno-chemistry practices on rural school students' interest in learning chemistry? To answer this research question, simple parentages and bar graph was used and the result is presented in Table 1

Table 1 Simple percentage analysis on responses to ethno-chemistry practices on students' interest in learning chemistry for the experimental

S/N	Statements	SA	A	D	SD
1	Chemistry is the subject that I like best because how it is taught	23	14	34	53
2	I can stay away from all other classes except for chemistry because of the practices that is involved in it	17	24	35	42
3	I would like to read chemistry as a course when l enters the University.	23	15	22	64
4	Chemistry is one of the most interesting subject l have studied because of the way it is taught in my school	17	23	44	13
5	I am not interested in any chemistry in my life	16	27	28	53
6	Chemistry is the only subject that I ensure that I sit down to read on daily basis because it is practically related	23	33	39	29
7	The only time I like chemistry is when the teacher uses pictures to teach	34	32	22	36
8	I don't like to participate in chemistry practical because of the risk involve.	32	23	22	47
9	I don't like chemistry because people who study are always sick	26	38	32	28
10	I do not like chemistry because it involves a laboratory work.	34	12	10	68
	Total	245 (19.75%)	241 (19.43%)	278 (22.42%)	433 (34.92%)

SA-strongly Agree, A-Agree, D-Disagree, SD-Strongly Disagree Source (Field work, 2022)

What is the effect of ethno-chemistry practices on rural school students' interest in learning chemistry? To answer this research question, simple parentages and bar graph was used and the result is presented in Table 1

The result in Table 1 and Figure 1 shows the summary of responses of students in their interest in learning chemistry. The result showed that 245 responses representing 19.75% showed that they strongly agree that they have interest in learning chemistry, 241 responses representing 19.43% agreed that they have interest in learning chemistry, 278 responses representing 22.42% disagreed that they have interest in learning chemistry while 433 responses representing strongly disagreed that they have interest in learning chemistry. On aggregate, 39.18% of the responses showed that they have interest in learning chemistry while 60.82% noted that they don't have interest in learning Chemistry. This implies that students don't have interest in learning chemistry.

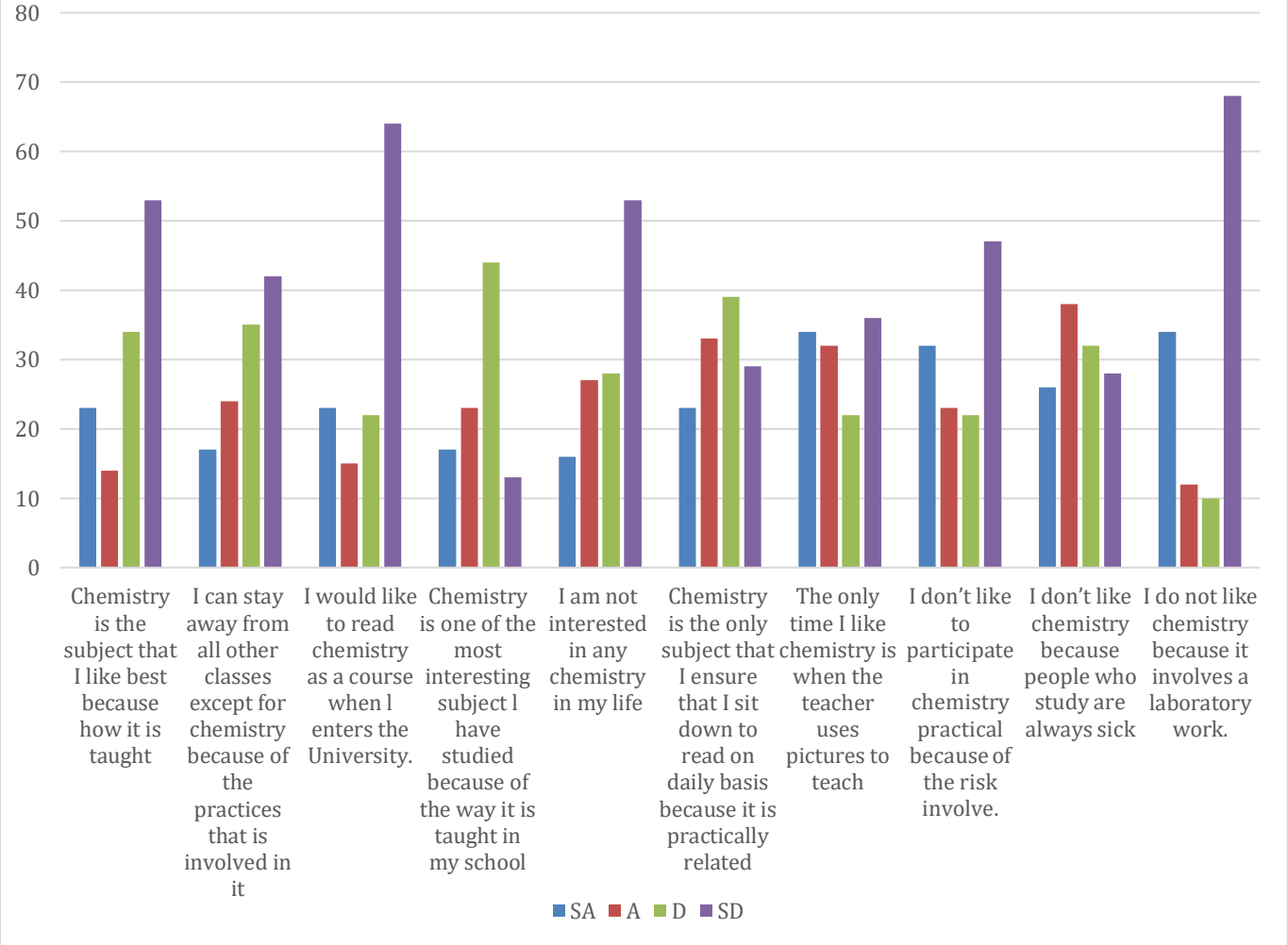

Figure 1 Bar Graph showing respondents responses on ethno-chemistry practices on interest in learning chemistry

Research question two

To what extent does ethno-chemistry practice influence students understand of difficult concepts in chemistry? To answer this research question, mean and standard deviation scores were used to ascertain the difference between students' pretest and posttest scores as regards to their understanding of chemistry see result is presented in Table 2

Table 2 Mean and standard deviation scores for pre-test and protest measure of students' understanding of chemistry concepts taught with ethno-chemistry practices

Variable		N 240	pre-test scores	post-test scores	Understanding gain
Treatment	Experimental	120	18.02	38.80	20.78
	Control	120	14.10	18.17	4.07

Mean (x) and standard deviation scores were used to answer research question 2. The result shows that the difference between the pre-test and post-test scores for the experimental group had a significance difference of (20.78) while the control group had a difference of (4.07) difference taught selected chemistry concepts without the use of ethno-chemistry practices. This result revealed that rural secondary students taught selected difficult chemistry concepts with the use of ethno-chemistry practices had higher understanding capacity than those taught without ethno-chemistry practices in chemistry.

Hypothesis I:

Table 3 Analysis of Covariance (ANCOVA) result on the effect of ethno-chemistry practices on students' interest in learning chemistry

Groups	**Mean**	**Std. Deviation**	**N**
Experimental Group	28.1064	7.34620	47
Control Group	14.0000	2.66557	39
Total	21.7765	9.10308	86

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected model	4224.478[a]	2	2112.239	63.299	.000
Intercept	2413.882	1	2413.882	72.339	.000
Pretest1	12.088	1	12.088	.362	.549
Group1	4104.026	1	4104.026	122.988	.000
Error	2736.275	82	33.369		
Total	47269.000	144			
Corrected Total	6960.753	141			

R Squared = .607 (Adjusted R Squared = .597)

There is no significant effect of ethno-chemistry practice on rural students' interest in learning chemistry. The independent variable in this hypothesis is ethno-chemistry practices while the dependent variable is interest in learning chemistry. To test this hypothesis, Analysis of Covariance (ANCOVA) was used, and the result as presented in Table 3 showed that the mean value (X=28.11) for students exposed to the treatment is greater than the mean value (X=13.94) for students taught with the traditional approach. This implies that students who are exposed to ethno-chemistry practices have better interest in chemistry compared to those who are

not. A cursory look at the analysis of covariance (ANCOVA) table showed that (F=122.988, p<.05). Since p (.000) is less than p(.05), this implies that there is a significant effect of ethno-chemistry practice on rural students' interest in learning chemistry. Hence, the null hypothesis is rejected, and the alternate hypothesis is upheld. A cursory at the table also revealed and an Adj R^2 = .597 which implies that the variations in the dependent variable could be explained using 59.7% of the contributions of the independent variable.

Hypothesis II

There is no significant effect of the use of ethno-chemistry practices on rural secondary school students' understanding of difficult concepts in chemistry

Table 4 Analysis of Covariance (ANCOVA) result on the effect of ethno-chemistry practices on rural secondary school students' understanding of difficult concepts in chemistry

Group	**Mean**	**Std. Deviation**	**N**
Experimental Group	23.3421	2.59184	38
Control group	14.0000	2.66557	39
Total	18.6104	5.37821	77

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1698.085[a]	2	849.042	125.601	.000
Intercept	1049.348	1	1049.348	155.233	.000
Pretest2	18.326	1	18.326	2.711	.104
Gropu2	1626.416	1	1626.416	240.600	.000
Error	500.227	74	6.760		
Total	28867.000	144			
Corrected Total	2198.312	141			

a. R Squared = .772 (Adjusted R Squared = .766)

There is no significant effect of ethno-chemistry practice on rural students' understanding of difficult concepts in chemistry. The independent variable in this hypothesis is ethno-chemistry practice while the dependent variable is academic understanding of difficult concepts chemistry. To test this hypothesis, Analysis of Covariance (ANCOVA) was used, and the result as presented in Table 4 showed that the mean value (X=23.34) for students exposed to the treatment is greater than the mean value (X=14.00) for students taught with the traditional approach. This implies that students who are exposed to ethno-chemistry practices have better understanding of difficult concepts in chemistry compared to those who are not. A cursory look at the analysis of covariance (ANCOVA) table showed that (F=240.600, p<.05). Since p (.000) is less than p (.05), this implies that there is a significant effect of ethno-chemistry practice on rural students' understanding of difficult concepts in chemistry. Hence, the null hypothesis is rejected, and the alternate hypothesis is upheld. A cursory at the table also revealed and an Adj R^2 = .766 which implies that the variations in the dependent variable could be explained using 76.6% of the contributions of the independent variable.

Discussion

Findings revealed that 63.07% of the students have difficulty in the understanding of some concepts in chemistry which may be attributed to the methods and other related factors in presenting the concepts in chemistry. There is a significant effect of the use of ethno-chemistry on students' interest in learning chemistry in rural secondary schools. This implies that when chemistry teachers increase hands-on practices with the use of environment and cultural materials it will increase students' interest to

learn chemistry more. Chemistry is better learnt and achieved with the use of activities that makes learning inspiring and friendly to the learner. This finding agrees with Indra and Bitwell (2016) whose work revealed that the use of ethno-chemistry strategy have a positive effect on secondary school students' attitudes to learning chemistry. Similarly, Nwankwo (2021) work on ethno-science instructional strategy on junior secondary school students' achievement in basic science showed that there is a positive effect of the use of ethno-science instructional strategy on students' achievement in basic science and technology. The researcher added that students' achievement is enhanced when taught with ethno-science strategy.

Hypothesis II: Finding based on hypothesis two revealed that, there is a significant effect of the use of ethno-chemistry practices promotes rural students' understanding and enthusiasm to learn difficulty concepts in chemistry. This implies that students taught with ethno=chemistry materials had better understand and enthusiasm to learn. This area of research is novel, so much research work has not been carried out to ascertain the effect of ethno-chemistry practices on students' understanding, so far achievement, performance, attitude where considered by other researches. For instance, Okwara & Upu (2017) worked on the effects of ethno-chemistry instructional approach on students' achievement and interest in upper basic and technology. Finding revealed that the use of ehno-chemistry approach significantly influenced students' achievement and interest in chemistry.

Conclusion

It is evident from the study that the use of ethno-chemistry practices has significant effect on students' interest and understanding of difficult concepts in rural secondary schools.

Recommendations

It is recommended that: chemistry teachers should be adequately trained to deploy the use of ethno-chemistry practices to enhance students' academic interest, performance, retention, academic understanding. Ministry of Education and other professional bodies should organize workshops and seminars for science and chemistry teachers especially on the use of ethno-chemistry practices and knowledge in teaching concepts. Curriculum experts should incorporate ethno-chemistry practices into the curriculum in the next review.

Suggestion for Further Research

The researcher hereby encourages more research in ethno-chemistry practices as few evidences has been documented especially as regards interactive variables on the cognitive and affective domains,

References

Asim, A. E. & Neji, H. A. (2017). Enhancing pupils' learning of primary science, mathematics and practical agriculture through science process skills. *Journal of Education for Today*. 13 (3) 140-145.

Indra, S. S. & Bitwell, C. (2016), Effect of ethno-chemistry practices on secondary school students' attitude towards Chemistry. *Journal of Education and practice*. 7 (17), 44-56.

Marasinghe, B. (2013) Ethno-chemistry and ethno-medicine of ancient papua New Guineans and their use in motivating secondary school children and University undergraduates in PNG. GOROKA: University of Goroka.

Meremikwu, A. & Neji, H. A. (2019), Investigating the effectiveness of using collaborative and individualized methods on under-graduate students' academic performance in science and mathematics, University of Calabar, Nigeria. Promoting Research visibility through inter-tertiary collaboration and intellectual competition. 10,283-290.

Mkpa, M, A. (2012), Nigeria overview of Educational pre-colonia to present day/ www.onlinenigeria.com/education. Accessed on the 22nd July,2022.

Mustafa, S. (2015). Standard mixture separation techniques. Retrieved on 18th August,

2022 from, http://www.separation technique by drsana.Mustafa.pdf.

Njoku, Z.C. (2009) Teaching chemistry using science, technology and society (S.T.S) approach. Science, Teachers Association of Nigeria. Chemistry panel series 4, 5-15.

Nwankwo, G.O (2021) Effects of ethno-science instructional strategy on junior secondary school students' Achievement in Basic Science. African *Journal of Science Technology & Mathematics Education* (AJSTME). 6,1,58-62.

O'dwyer, A. (2012) Identification of the Difficulties in teaching and learning of introductory organic chemistry in Ireland and the development of a second-level intervention programme to address the OilscoilLuimnigh: University of Limerick.

Okwara, K.O & Upu, F. T.(2017), Effects of ethno-chemistry instructional approach on students' achievement and interest in upper basic science and technology in Benue State. *International Journal of science Research in Education* 10 (1), 69-78.

Oluwatosin, V.A; Ayaji, E.A.& Peter,O.A (2017), Use of ethno-chemistry approach and achievement and retention of senior secondary students in standard mixtures separation techniques. *Journal of the international centre of science Humanities and Education Research* (ICSHER), 3,1,21-30.

Rosa, M. & Orey, D.C. (2011) Ethno mathematics: the cultural aspects of mathematics. Revisited Latino Americana de Ethno-mathematics, 4(2), 32-54.

Soap Maker (2011)African black soap wwwmakerfn.com/making.homemadesoap: Retrieved 2oth September, 2022.

Ugwu, A. N. (2016) Effects of ethno-chemistry-based curriculum delivery on students' interest in chemistry in Obolla-Afor Education Zone, Enugu State. *Journal of the Nigeria. Academy of Education*, 14,2, 129-132.

Ugwu, A. N. & Diova, C. I. (2016) Integration of indigenous knowledge and practices into chemistry teaching and students' academic achievement. *International Journal of Academic Research and Reflection* 4,4,22—32.

Vygotsky, L. S. (1978) Through and Language Cambridge M.A. Harvard University press.

WAEC (2018-2021) Chief examiners' report for may/June WASSCE, Lagos: WAEC.