EFFECT OF ETHNOCHEMISTRY INSTRUCTIONAL STRATEGY ON SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT AND RETENTION IN CHEMISTRY IN BAUCHI STATE NIGERIA

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ABSTRACT
The study investigated the effect of ethno-science instructional strategy (EEI) on senior secondary school students' achievement and retention in chemistry. Three research questions and three hypotheses guided the study. The hypotheses were tested at 0.05 level of significance. The design of the study was pretest, posttest, and quasi-experimental experimental design. The population of the study was 20604 senior Secondary School year two (SS 2) chemistry students in Bauchi state, Nigeria. Multi-stage sampling technique was used at six levels in selecting the sample size of this study. One hundred and ninety-three (193) SS II chemistry students from four intact classes in four senior secondary schools made up the sample for the study. Chemistry Achievement Test (CAT) with Kuder-Richardson formula reliability index of 0.94 was used for data collection after validation by experts. Data were collected by administering the instrument as pretest and posttest after treatment of the groups. The data obtained were analyzed using mean, standard deviation and Analysis of Covariance (ANCOVA). The results showed that there is a significant difference in the mean achievement and retention test scores of students in the experimental and control groups in favour of the experimental group taught using EEI strategy. However, based on school location the instructional approach was successful in helping students retain and apply knowledge over time, irrespective of their school location. The study recommended that strategy improved senior secondary school academic achievement and retention irrespective of school location, hence it should be encouraged.

Introduction

The miracle workers on the road towards national development are science, technology and mathematics education (STME) this explains why most countries of the world particularly the developed ones make huge investments in them. For any country that wants to maintain its independence, sovereignty, self-reliance, ensure growth, and have its head held high among civilized countries most have a sound STME (Ifeyinwa, 2016; Okwara & Upu, 2017, Halliru, 2021; Suwaiba & Halliru, 2022). It is an instrument for worldwide effectiveness and profession (Fomunyam, 2019). Hence, a lot of premium has been placed on its teaching and learning so as to achieve the key aim of science education, as contained in the National Policy on Education. Nevertheless, for decades, there have been repetitive calls for improvements and revolutions aimed at improving Science Education in Nigeria. These means that there are problems in Science Education in Nigeria that searches for its value-addition and improvement so as to achieve the national purposes and goals. The objective of Science Education in Nigeria as reflected in the National Policy on Education is to produce scientifically literate personalities that are concerned with high competence for balanced judgments and actions for national development. Similarly, it is part of the objectives of Science Education include the need to foster curiosity, enthusiasm, critical reflection and objectivity to develop students' attitude toward science (FRN, 2009). In addition, the National Policy on Education states that STME should be taught in an integrated manner in the schools (FGN, 2014). This mean to empower the students to be able to unravel day-to-day problems encountered in their environment by applying the science knowledge and skills gained so as to be self-assured and self-determining.

In Nigerian Senior Secondary School, science curriculum Chemistry is one of the core science subjects taught in Nigerian Secondary Schools. It is a subdivision of knowledge that is concern with the study of material substances and the physico-chemical, transformational and structural changes the material undergo in the universe. It is a popular and mandatory subject among Senior Secondary School Subjects in Nigeria due to its nature, central important position and novel role toward national development. Thus, for Nigerian post primary candidate, credit in Chemistry Examination (SSCE) result is measure of the prerequisite for the study of discipline in Sciences, and all science and Technology related courses at high educational level in Nigeria. However, in spite of the importance of chemistry and its educational value, which is relevant to the need of individual learner, economics and technological breakthrough of a nation and the efforts of researchers to improve on its teaching and learning the academic achievement of students in the subjects is not very encouraging. Literature have been reporting displeasure and no considerable improvement with regard to academic achievement and retention of students' in senior secondary school certificate examination (SSCE) in Chemistry (WAEC, Chief Examiners report, 2020; Chikendu, Obikezie, & Abumchukwu, 2021). This unfavourable remark has been associated with many factors by different researchers to different various factors, UNESCO (2006); Ugwu and Diovu (2016); Khaddour, et al. (2017); Ibe and Nwosu (2017); Shumba (2017; Siwale, Singh & Hayumbu, 2020).

Hereafter, it is part of the necessities of learning that, it should be retained. Nonetheless that should go afar from simple memory but relatively meaningful memory. Simple memory indicates rote-learning, then meaningful memory implies meaningful learning. This brings about ineradicable meaningful learning. The learning style which covers only 'remembering' is simple memory and is not encouraged because is the lowest cognition stage. Whereas, meaningful learning includes 'remembering', 'understanding' and 'application' stages of the cognition. In this case the search for retention ability of students becomes of paramount important to researchers. Researchers were also found curious in search for means either in or outside the classroom by which students' ability to regurgitate learned knowledge after a long period of time could be enhanced (Azuka, 2012). Hence, there are some things that enhance students' retention and some things that retard students' retention. Ideally, any phenomenon, materials or activities in learning situation should improve students' academic achievement and poster retention ability, but those phenomenon that leads to misperception, misunderstanding or misreading between learning activities or materials hinder the swiftness, effectiveness and quickens forgetting (Bichi, 2002 & Muhammad, 2011).

However, instructional ways of realizing improved academic achievement and retention as a shift to successful chemistry understanding and usefulness it should be taught based on sociocultural context of the students. Which

involve social and traditional applies, indigenous knowledge and applies and other daily lifespan familiarities of the students (Afrianawati, et al., 2016). Indigenous Knowledge (IK) is a wide term that designate numerous local knowledge completely held and accomplished by Native people of a given culture or community. It also holds Indigenous Science (IS) which means restrictively indigenous knowledge related to science of a certain culture (Siwale, Singh & Hayumbu, 2020). The broad Indigenous or cultural practices that have scientific relevance are referred to by experts in science education (Peni, 2015; Abonyi, Ugama, Okafor, & Abiam, 2016;). as ethno-science. This is a sub-system of IK that includes an description of the natural creation, which has real-world presentations and is used for extrapolative purposes by a specific individuals in a specific culture (Hwang, 2013). Ethno-science is the scientific information that is original in a given culture and is concerned with natural substances and proceedings so that it may have possibly the same divisions as western science which include ethno-physics, ethno-mathematics, ethno-biology, ethno-chemistry to mention but a few. Hence, this study employed ethno-chemistry instructional strategy to teaching chemistry as modification to the conventional teaching method. Essentially, ethno-chemistry instructional strategy utilizes the initial chemistry related knowledge and experiences found within the students' culture and environment to explain new concepts in chemistry classroom. (Abumchukwu, Eke, & Achugbu, 2021 accordingly, ethno-chemistry in this study refers to the initial chemistry related knowledge and experiences found within the students' culture and environment that are used to explain new concepts in chemistry classroom.

Hence, this study employed Ethno-chemistry Based Approach to teaching chemistry as an alternative or modification to the conventional teaching approach. Basically, ethno-chemistry is the study of chemical ideas found in any culture, where appreciation of cultural heritage is preserved. It describes the chemical practices of identifiable cultural groups. It comprises of various chemically related cultural and community practices of a particular people (Singh & Chibuye, 2016). For this study, accordingly, ethno as crossed with chemistry (i.e. ethno+chemistry) denotes to numerous original, old-style, socio-historico-scientific applies and background insights of chemistry of known culture of a specific individuals at a specific setting.

Similarly, available literature shows the evidence of the effects of ethno-science instructional strategies to teaching and learning for example, on academic achievement, interest and retention in mathematics (Abonyi, et al., 2016); academic performance and attitude in physics (Chongo & Baliga, 2019). This suggests that related results are likely when ethno-chemistry is functional in chemistry classroom setting. It can also assistance students to be conscious of the part in which chemistry shows in their commonplace be in this world. In the interim, Marasinghe (2016) succeeded in the synthesis and introduction of Unit in Chemistry Syllabus of students in Grade 11 and 12 titled 'Traditional Chemical Practices' of ancient Papua of New Guinea. Correspondingly, Fasasi (2018) prospers in developing an instructional framework of ethno-science for teaching science subjects in Nigeria. Consequently, the study re-exposed the usability of ethno-chemistry in the resolute effect of Ethnoc-hemistry instructional strategy on Senior Secondary School Chemistry Students' Academic Achievement and Retention in Bauchi State, Nigeria.

Statement of the Problem

Recognizing the novel part of chemistry on the road to the progress of humankind and carrier importance makes its academic achievement and retention by students vital. This can be visualized form the level of academic achievement and retention of students in chemistry at various examinations both internal and external. This stresses for the need of any probable instructional strategy that will improve chemistry students' achievement and retention in the subject. However, in Nigeria, report form summative evaluation bodies on chemistry shows encouraging results in the research setting. This claim can be supported by West African Senior Secondary Certificate Examination (WASSCE) academic achievement in chemistry in Bauchi state, between, 2018-2023 (Table 1).

Table 1: Students' Academic Achievement in WAEC (2018 - 2023) in Bauchi state

Years	Number of registered Candidate	Number of Student With Credit and Above	Percentage Pass
2018	26,202	1,733	7%
2019	34,969	6,524	18%
2020	11,989	2,901	24%
2021	17,123	9,242	27%
2022	7,118	4,500	47%
2023	7,228	4,625	61%

Source: Bauchi State Directorate for examination and Record 2023.

Table 1, illustrate the percentage pass in credit and above in WASSCE in chemistry over the years.. The lowest percentage was 7% in 2018 and the highest percentage 61% in 2023. There has been a gradual increase in the percentage pass 7% in 2018 and 18% in 2019. The trend continued to increase to 24% in 2020, 27% in 2021 and to 47% in 2022 until it riches peak that is 61% in 2023. Observations from the percentage of students with credit and above in WASSCE was below 50% pass except in 2023 which was 61%. Though, there was improvement in the percentage pass this seems to suggest that a lot need to be done to improve the percentage passes. This would give students more chance to gain admission into other science related courses in the university and other institutions of higher learning.

In this study, this problem is connected with the inattention of teachers in assimilating relevant cultural and indigenous does and practices from around the students in teaching and learning chemistry concepts. This claim is backed by the assertions made by Ugwu and Diovu (2016); studies that reported the rejection of students' culture in the way chemistry and other sciences are taught in Africa and Nigeria inclusive which in turn lead to poor academic achievement. However, an alarming bell of poor students' retention abilities of learned concepts was toll by (Ogbeba & Ajayi, 2016). Hence, students' academic achievement is a function of student' ability to retained the concepts learned in chemistry. .Similarly, students measured chemistry as difficult subject who led poor students' ability to retain concepts learned which in turn manifest in their poor academic achievement in the subject. Also, chemistry teachers adopt "examination focused teaching" in which fundamental concept that has relevant simple analogues in the student background experience and environment are not utilized. Consequently, students possess low retention, and adopt "read-and-pass learning style" and could not explain simple everyday occurrence around them with which meaningful learning can take place. This entails the role of teacher to determine the students' previous knowledge and commencement before a new knowledge or concept is taught. In this respect, Ethno-chemistry instructional strategy as the teaching strategy involving cultural and local practices which were already familiar, by the students recommend its practicability in improving academic achievement and hence retention capability of students'.

Purpose of the Study

The purpose of this study is to determine the effect of ethno-science enriched instruction (EEI) on rural and urban secondary schools' chemistry students' academic achievement, attitude and retention. Specifically, the objectives of the study are to:

1. Determine the effect of EEI strategy on academic achievement of secondary school chemistry students in Bauchi state.

2. Determine the effect of EEI strategy on retention abilities of secondary school chemistry students in Bauchi state.

3. Determine the effect of EEI on retention of secondary school students in chemistry based on school location in Bauchi state.

Research Questions

The following research questions were raised to guide the study:

1. What is the pre-test and post-test mean scores difference of secondary school chemistry students taught using ethno – science-enriched instruction (EEI) strategy and those taught using conventional teaching method (CTM) in Bauchi state?

2. What is the post-test and retention mean scores difference of secondary school chemistry students taught using EEI strategy and those taught using CTM in Bauchi state?

3. What is the post-test and retention mean scores of secondary school chemistry students in urban and rural schools taught using EEI strategy in Bauchi state?

Hypotheses

The following null hypotheses were stated and tested at 0.05 alpha level;

H_{01}: There is no significant difference in the mean pre-test and post-test scores of secondary school chemistry students in Bauchi state.

Ho_2. There is no significant difference between the retention of chemistry students taught using EEI and those taught using CTM in Bauchi state.

Ho_3. There is no significant difference between the academic achievements of secondary school chemistry students taught using EEI based on school location in Bauchi state.

Methods

The design of the study was pre-test, post-test, control group, quasi-experimental, 2x2 Factorial Matrix as recommended by (Kelinger, 1973) that recommended minimum number of subjects is 30 in each experimental and control for an experimental study. However, 2x2 factorial design allows the researchers to understand the effects of two independent variables (each with two levels) on the dependent variable. The study involves experimental group that were taught chemistry concepts using ethno-science-enriched-instructional strategy (EEI), and a control taught chemistry concepts using the conventional lecture method (CTM)). Both the experimental and control groups consist of subjects from rural and urban schools.

There are three categories of variables in the study. The independent variable (that is method of instruction) manipulated at two levels namely, Ethno science Instructional Strategy (EEI). Conventional Teaching Method (CTM). The dependent variables or outcome variables namely; Academic Achievement and Retention. The moderator variable categorized at two levels. That is Urban and Rural locations (School location) respectively. The population of this study comprised of all senior secondary school students (SSII) in the 2022/2023 academic session in Bauchi state. Accordingly, the total number of (SSII) students that offer chemistry is 20604 from 221 public senior secondary schools spread across the three education zones in Bauchi state. The Sample of the study comprised 193 SS II Chemistry students drawn from four intact classes of the four senior secondary schools selected for the study. The sample was obtained through a multi-stage sampling technique. Chemistry Achievement Test (CAT) was used as the instrument for data collection. The Chemistry Achievement Test (CAT) was reshuffled to serve as retention test after two weeks of treatment. The Chemistry Achievement Test (CAT) was face validated by experts from chemistry, physical sciences education departments of Moddibo Adama University Yola and an experienced chemistry teacher from government girls' college Sakwa (special school) in Bauchi State respectively. Reliability coefficient of CAT was determined by administering it to 40 SSII Chemistry students of Government Secondary school Madara (which is not part of the sample). Kuder-Richardson formula was used for the estimation of the reliability coeffient of the test items. Internal

consistency co-efficient of 0.94 was obtained, showing that the instrument is reliable for the study. The research questions were answered using mean and standard deviation, while the hypotheses were tested using Analysis of Covariance (ANCOVA) with the pre-test scores as serving as covariates.

Results

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

Research Question 1: What is the pre-test and post-test mean scores difference of secondary school chemistry students taught using ethno – science-enriched instruction (EEI) strategy and those taught using conventional teaching method (CTM) in Bauchi state?

Table 2: Pre-Test and Post-Test Mean Scores Difference of Secondary School Chemistry Students Taught Using Ethno – Science-Enriched Instruction (EEI) Strategy and Those Taught Using Conventional Teaching Method (CTM) in Bauchi State.

Group	N	Pretest Mean	S.D	Posttest Mean	S.D	Mean difference
Ethno – Science Enriched Instruction	96	14.30	3.86	32.56	4.80	18.26
Conventional Teaching Method	97	12.78	2.82	24.32	4.68	11.54

Table 2 presents the pre-test and post-test mean scores for the two groups. The group taught using EEI showed a notable improvement in mean scores from the pre-test (M = 14.30, SD = 3.86) to the post-test (M = 32.56, SD = 4.80), with a mean difference of 18.26. This suggests a substantial learning gain attributed to the EEI strategy. In contrast, the group taught using CTM also demonstrated improvement but to a lesser extent. Their pre-test mean score was lower (M = 12.78, SD = 2.82) compared to the EEI group, and the post-test mean score increased to 24.32 (SD = 4.68), resulting in a mean difference of 11.54. These results indicate that both instructional methods led to improvements in students' chemistry knowledge, but the EEI strategy resulted in a higher mean difference between pre-test and post-test scores compared to the CTM.

Research Question 2: What is the post-test and retention mean scores difference of secondary school chemistry students taught using EEI strategy and those taught using CTM in Bauchi state?

TABLE 3: Post-Test and Retention Mean Scores Difference of Secondary School Chemistry Students Taught Using EEI Strategy and those Taught Using CTM in Bauchi State.

Group	N	Retention test Mean	S.D	Posttest Mean	S.D	Mean difference
Ethno – Science Enriched Instruction	96	34.79	4.96	32.56	4.80	2.23
Conventional Teaching Method	97	25.49	4.26	24.32	4.68	1.17

Based on the results from Table 3, which compares the post-test and retention mean scores of secondary school chemistry students taught using Ethno-Science Enriched Instruction (EEI) strategy and Conventional Teaching Method (CTM) in Bauchi State, several key findings emerge. Firstly, regarding the post-test scores, students in the EEI group achieved a mean score of 32.56 with a standard deviation of 4.80, while students in the CTM group achieved a slightly lower mean score of 24.32 with a standard deviation of 4.68. This indicates a statistically significant mean difference of 8.24 points favoring the EEI strategy. This difference suggests that students exposed to EEI performed markedly better on the post-test compared to those taught through CTM. Secondly, looking at retention test scores, students taught with EEI maintained a higher mean score of 34.79 with a standard deviation of 4.96, whereas those taught with CTM had a lower mean score of 25.49 with a standard deviation of 4.26. This

shows a significant mean difference of 9.30 points in favour of the EEI strategy for retention scores. This suggests that not only did EEI lead to higher immediate test scores, but it also facilitated better retention of knowledge over time compared to CTM. These results strongly support the effectiveness of the Ethno-Science Enriched Instruction (EEI) strategy over the Conventional Teaching Method (CTM) in enhancing both immediate learning outcomes (post-test scores) and longer-term retention of knowledge (retention test scores) among secondary school chemistry students in Bauchi State.

Research Question 3

What is the post-test and retention mean scores of secondary school chemistry students in urban and rural schools taught using EEI strategy in Bauchi state?

Table 4: Post-Test and Retention Mean Scores of Secondary School Chemistry Students in Urban and Rural Schools Taught Using EEI Strategy in Bauchi State

Group	School Location	N	Retention test Mean	Retention test S.D	Posttest Mean	Posttest S.D	Mean difference
EEI	Urban	49	34.41	4.93	32.18	5.24	2.23
	Rural	47	35.19	5.02	32.96	4.31	2.23

Based on the results presented in Table 4, which compare the post-test and retention mean scores of secondary school chemistry students in urban and rural schools taught using the EEI (Explore, Explain, Illustrate) strategy in Bauchi State, several insights can be derived.

In urban schools, the mean retention test score was 34.41 (SD = 4.93), while the mean post-test score was 32.18 (SD = 5.24), resulting in a mean difference of 2.23 points. This suggests that students in urban schools maintained a slightly higher level of understanding after the teaching intervention compared to their initial post-test achievement.

Conversely, in rural schools, the mean retention test score was slightly higher at 35.19 (SD = 5.02), with a mean post-test score of 32.96 (SD = 4.31), also resulting in a mean difference of 2.23 points. This indicates a similar pattern of retention and performance improvement following the EEI strategy, though with slightly higher scores in rural schools compared to urban schools.

These results suggest that the EEI strategy was effective in both urban and rural settings in Bauchi State, as evidenced by the consistent mean difference of 2.23 points between post-test and retention scores in both groups. This consistency implies that the instructional approach was successful in helping students retain and apply their knowledge over time, irrespective of their school location.

Testing Hypotheses

The following null hypotheses were formulated and tested at a 0.05 level of significance in this study.

H_{01}: There is no significant difference in the mean pre-test and post-test scores of secondary school chemistry students in Bauchi state.

Table 5: Summary of ANCOVA of Effect of Ethno - Science - Enriched Instruction (EEI) on the Academic Achievement of Secondary School Chemistry Students.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	4171.864[a]	2	2085.932	97.082	.000	.505
Intercept	10414.405	1	10414.405	484.700	.000	.718

Pretest	1.685	1	1.685	.078	.780	.000
Teaching methods	4003.525	1	4003.525	186.329	.000	.495
Error	4082.395	190	21.486			
Total	183337.000	193				
Corrected Total	8254.259	192				

a. R Squared = .505 (Adjusted R Squared = .500)

The results of the analysis in Table 5 show the summary of ANCOVA conducted to test whether there is significant effect of ethno-science-enriched instruction (EEI) on the academic achievement of secondary school chemistry students. The results reveal that there is significant effect of ethno-science-enriched instruction (EEI) on the academic achievement of secondary school chemistry students, F (1, 192) = 186.329, p< 0.05 with a moderate effect size as indicated by the Partial Eta Squared value of 0.495. Hence, the null hypothesis was rejected.

Ho_2. There is no significant difference between the retention of chemistry students taught using EEI and those taught using CTM in Bauchi state.

Table 6: Summary of ANCOVA of Effect of EEI on the Retention Scores of Secondary School Chemistry Students.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3373.146[a]	2	1686.573	76.409	.000	.446
Intercept	7335.240	1	7335.240	332.318	.000	.636
Pretest	94.859	1	94.859	4.298	.040	.022
Teaching methods	2883.579	1	2883.579	130.639	.000	.407
Error	4193.859	190	22.073			
Total	163449.000	193				
Corrected Total	7567.005	192				

a. R Squared = .446 (Adjusted R Squared = .440)

The results of analysis in Table 6 reveal that there is significant effect of EEI on the retention of subjects in chemistry, F(1, 192) =130.639, p< 0.05 with a moderate effect size as indicated by the Partial Eta Squared value of 0.407. Thus, the null hypothesis was rejected.

Ho4. There is no significant difference between the academic achievements of secondary school chemistry students taught using EEI based on school location in Bauchi state.

Table 7: Summary of ANCOVA of Effect of EEI on the Academic Achievement of Secondary School Chemistry Students Based On School Location.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	14.883[a]	2	7.441	.298	.743	.006
Intercept	7301.006	1	7301.006	292.046	.000	.758
Pre test	.163	1	.163	.007	.936	.000
School location	13.180	1	13.180	.527	.470	.006
Error	2324.950	93	24.999			
Total	118544.000	96				
Corrected Total	2339.833	95				

a. R Squared = .006 (Adjusted R Squared = -.015)

As shown in Table 7, the effects of EEI on the academic achievement of subjects in chemistry are insignificant based on school location, F(1, 95) = 0.527, p>0.05 with a very low Partial Eta Squared effect size of 0.006. Thus, the null hypothesis was upheld.

Discussion of Findings

This suggests that not only did EEI lead to higher immediate test scores, but it also facilitated better retention of knowledge over time compared to CTM. These results strongly support the effectiveness of the Ethno-Science Enriched Instruction (EEI) strategy over the Conventional Teaching Method (CTM) in enhancing both immediate learning outcomes (post-test scores) and longer-term retention of knowledge (retention test scores) among secondary school chemistry students in Bauchi State. This finding is in consistent with the findings of (Abumchukwu, et al., 2021; Idah, 2018; Ajayi, et al., 2017; Ugwu & Diovu, 2016; Singh & Chibuye, 2016;) who reported that, students taught chemistry concepts through the Ethno-chemistry-based approach have higher academic achievement than the students taught same chemistry concepts through conventional method. Conversely, when the retention abilities of the two groups were compared, it indicates a similar pattern of retention and academic achievement following the EEI strategy, though with slightly higher scores in rural schools compared to urban schools. These results suggest that the EEI strategy was effective in both urban and rural settings in Bauchi State, as evidenced by the consistent mean difference of 2.23 points between post-test and retention scores in both groups. This consistency implies that the instructional approach was successful in helping students retain and apply knowledge over time, irrespective of their school location. Similarly, the results reveal that there is significant effect of ethno-science-enriched instruction (EEI) on both the academic achievement retention of secondary school chemistry students in Bauchi state. However, the EEI was found to have no significant effect based on school location in Bauchi state.

Conclusion

This study was carried out as part of the determinations of researcher's efforts in finding suitable, applicable and appropriate instruction in teaching chemistry in senior secondary schools which will assistance in speaking on problems associated to student's academic achievement and retention in Chemistry. Based on the findings of the study, it can be established that ethno chemistry instructional strategy is effective in augmenting students' academic achievement and retention irrespective of school location. Henceforth, this teaching strategy could be used to address the present trend of senior secondary students' poor

academic achievement and retention in Chemistry.

Recommendations

1. Chemistry teachers should be encouraged to use such teaching strategy as ethno-chemistry instructional strategy in teaching senior secondary school students chemistry irrespective of school location.

2. Chemistry teachers should be encouraged to teach the subject within the students' cultural background understanding and should similarly relate to their day-to-day undertakings and involvements.

3. Government should make effort in reinforcing and integrating relevant indigenous cultural practices that are relevant in teaching and learning chemistry (ethno-chemistry) into senior secondary school curriculum for effective teaching and learning of chemistry.

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