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Chemistry Of Limestone Ores And Its Application In The Teaching Of Analytical Chemistry

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***Abstract:** The purpose of the study was on the chemistry of limestone ores and its application in the teaching of the concept of qualitative analysis. A total of 120 NCE 1 chemistry students were involved in the study. This number was made up of 73 males and 47 females drawn from the two colleges of Education in Cross River State of Nigeria, 3 research hypotheses and four research questions were formulated to guide the study. The instruments used in gathering data for the study were Achievement Test in Chemistry (ATC), Cognitive Ability Test (CAT) and Chemistry Retention Test (CRT). A non-randomized pretest-posttest control group design was adopted for the study. Kuder-Richardson formula 21 was used to establish the reliability of Achievement Test in Chemistry (ATC). The reliability coefficient of ATC and CAT were 0.83 and 0.78 respectively. Data collected were analyzed using Analysis of Covariance (ANCOVA) and Scheffe posthoc analysis was used to obtain the direction of significance. From the findings, it was observed that the chemical components of limestone ores was effective in teaching the concept of qualitative analysis in analytical chemistry. It was also observed that limestone ores had significant main effect on student's performance and retention in the concept of qualitative analysis in analytical chemistry. There was also a significant different in the performance of male and female students when taught the concept of qualitative analysis using limestone ores. Cognitive ability levels had significant effect on student's performance and retention in the concept of qualitative analysis in analytical chemistry. Also there was significant joint effect of treatment, gender and cognitive ability level. Conclusion from the findings led to the recommendation that chemistry lecturers should explore the use of local resource materials within their immediate environment to teach various concepts in sciences and indeed chemistry.*

***Keywords:** Limestone Ores, Analytical Chemistry, Qualitative Analysis, Cognitive Ability Levels.*

I. INTRODUCTION

The relevance of science and technology to national aspirations and development cannot be overemphasized. According to Acquaye (2001) apart from raising man's standard of living, science has today enabled developing nations to achieve their desires in areas like health, agriculture, shelter, communication and Environment. Modern development is no longer possible outside the framework of science and technology hence the need to teach science especially chemistry, effectively in school, and tertiary institutions.

Extensive use has been made of the rich deposit of limestone ores of Ewekoro in Ogun State, Nkalagu in Enugu State and Mfamosing in Cross River State in the areas of agriculture and cement production. It could also serve as a potential resource in the teaching of certain concepts in chemistry curriculum of the colleges of Education as well as other tertiary institutions.

Dareng (2010) opined that science teaching now shifts more emphasis to practical, exploratory and experimental work, there is therefore every reason for teachers and learners to explore the immediate environment especially in teaching science subjects such as chemistry.

Balogun (2005) advised that in developing learning and teaching materials, the use of learners environment and locally available resources should be used in providing first hand science experience, thus creativity and innovation has not only become a permanent feature of the educational system, but also a handy tool in science which is dynamic.

The use of local materials in science teaching implies the utilization of the scientists environment, which is a practice in improvisation (Inyang, 2011). He advocated the use of local materials in chemistry education. He admitted that we are yet to devise school-based experiments to illustrate, justify or explain the usage of such materials. He further stressed the values for such experiments not only for teaching chemistry in colleges of education but also application in cement industries.

Analytical chemistry deals with methods for the identification of one or more of the components in a sample of matter and the determination of the relative amounts of each. The identification process is termed qualitative analysis while the determination of amount is termed quantitative analysis. Simple qualitative tests are usually more rapid than quantitative procedures.

Results from research studies carried out on resource materials used for teaching suggests that, it yields greater interest and more positive attitudes (Awolola, 2000). Emphasis on practical activities in science classroom stems from the fact that science (Chemistry) is a practical subject in nature and its progress therefore depends on practical activities and experimentation. It is also true that when learners learn in ways that are natural to them, it brings better academic performance, improves self-esteem and self confidence. Thus the application of limestone ores in teaching the concept of qualitative analysis in analytical chemistry is an innovation and creativity in science teaching.

On this ground, the need to use limestone ore deposit as a resource in teaching the concept of qualitative analysis in analytical chemistry is in support of (Eshiet, 2006) that the environment provides a situation that helps learners to acquire experiences that enhance learning in affective, psychomotor and cognitive domains.

II. STATEMENT OF THE PROBLEM

Chemistry as a science course is activity-oriented and the suggested method for teaching it, which is guided discovery method is resource based (FRN, 2013).

Effective and meaningful teaching and learning of abstract concepts like cations and anions in qualitative analysis requires active students involvement in the teaching-learning process through meaningful and relevant hands-on-activities. The harsh economic realities experienced in Nigeria today, coupled with the high cost of standard commercial equipments and chemicals needed for experiments and the increase in enrolment in our schools have made it virtually difficult for the teaching sector to provide enough essential science facilities in our schools both secondary and tertiary, thereby leaving our laboratories as mere demonstration and practical examination centres.

Enoahwu and Umeoduagu (2012) observed that 74% of the needed facilities and chemicals for science teaching were either in short supply or non-existent due to high cost or non-availability of such materials in the market. It is therefore not uncommon to see schools with large students population not utilizing any aid in teaching or during practical classes. This results in poor interest of students in science and consequently high failure rate.

Studies however have shown that improvisation-sourcing, selection and deployment of relevant instructional elements of the teaching/learning process in the absence of shortage of standard or accredited teaching learning elements can always help in filling the gap, especially when the materials are drawn from the learner's local environment (Eshiet, 2012).

It may imply that conventional materials and reagents used in the teaching of qualitative analysis in analytical chemistry may not have helped in enhancing student's academic performance and retention. Therefore it becomes inevitable to try out other learning resources that could enhance effective teaching and learning of analytical chemistry. The problem of the study is how can student's performance and retention in analytical chemistry be enhanced? Will limestone ores also be effective in facilitating student's performance and retention in the concept of qualitative analysis in analytical chemistry? This work seeks to provide an example of the utilization of local materials in the teaching of cations and anions in qualitative analysis in analytical chemistry.

III. PURPOSE OF THE STUDY

The purpose of this study was to investigate whether teaching the concept of qualitative analysis in analytical chemistry to NCE chemistry students in tertiary institutions using limestone ores as a teaching resource had advantage on their performance compared to standard reagents and materials.

The study was designed to achieve the following specific objectives.

- ✓ To determine the chemical components of limestone ores as a teaching resource.
- ✓ To compare the performance of students taught using limestone ores with those using standard materials and reagents as resources in teaching the concept of qualitative analysis in analytical chemistry.
- ✓ To compare the effects of using limestone ores and standard materials and reagents as resources in teaching the concept of qualitative analysis on students retention in analytical chemistry.
- ✓ To assess the effects of cognitive ability levels (high, average and low) on student's performance in the concept of qualitative analysis in chemistry when taught with limestone ores and standard materials and reagents.

IV. RESEARCH QUESTIONS

In order to guide the study, the following research questions were raised in the study:

- ✓ What are the chemical components of limestone ore deposits? And how is it suitable as a teaching resource?
- ✓ What difference exists among the mean performance scores of chemistry students taught the concept of qualitative analysis using limestone ores and those taught using standard materials and reagents as resources?
- ✓ What differences exists among the mean retention scores of chemistry students taught the concept of qualitative

analysis using limestone ores and those taught using standard materials and reagents as resources?

- ✓ What is the difference in the mean performance scores of chemistry students with high, average and low ability levels taught the concept of qualitative analysis using limestone ores and those using standard materials and reagents as resources?

V. HYPOTHESES

The following hypotheses were formulated.

Ho_1: There is no significant difference in the mean performance scores of chemistry students taught the concept of qualitative analysis using limestone ores and those taught using standard materials and reagents as resources.

Ho_2: There is no significant difference in the mean retention scores of chemistry students taught the concept of qualitative analysis using limestone ore deposits and those taught using standard materials and reagents as resources.

Ho_3: There is no significant difference in the mean performance scores of chemistry students with high, average and low cognitive ability levels taught using limestone ores and those taught using standard materials and reagents as resources.

VI. RESEARCH METHODS

RESEARCH DESIGN

The research design adopted for the study was a prettest-posttest control group design.

SAMPLING AND SAMPLING TECHNIQUES

A total of 120 students took part in the study using intact classes. Out of a population of 230 students comprising male and female students in the 2014/2015 session in colleges of Education in Cross River State. This was made up to 73 males and 47 females. Purposive sampling technique was used to select the colleges from among other colleges. The criteria was:

- ✓ College must be co-educational
- ✓ College must possess well equipped chemistry laboratory
- ✓ College must have accredited NCE programmes by the National Commission for College of Education
- ✓ College must have well staffed and experienced chemistry teachers.

Four (4) colleges met the above criteria two (2) colleges among those that met the above criteria were selected by balloting. The two colleges were randomly assigned to experimental and control groups. These were Federal College Education Obudu and College of Education, Akamkpa. They were 72 students in the experimental group and 48 students in the control group.

INSTRUMENTS AND VALIDATION

Two researchers made Achievement Test in Chemistry (ATC) and Chemistry Retention Test (CRT) were the instruments used for the study. A total of fifty (50) multiple choice items were constructed on the concepts of cations and anions for both instruments used. The instruments were faced and content validated by two chemistry experts. Reliability of the instruments were determined using Kuder-Richardson's formula 21. A reliability index of 0.83 was obtained. The tests were used to determine the performance and retention of students in the concepts using limestone ore deposits and standard materials and reagents as teaching resources.

RESEARCH PROCEDURE

Chemistry lecturers in each College served as research assistance to teach each group and were trained for one week on the use of the teacher's instructional guide for conduct of experiments that were used for teaching the concepts of cations and anions. This was however done in three phrases. Firstly, lecturers were briefed on the modalities of the guide and resource materials to be used for the lesson. Secondly, the researcher demonstrated the experiments using the resource materials and finally the research assistants were asked to teach some students that will not take part in the main lesson using the resource materials.

A pretest was administered to the two groups (experimental and control) for one hour and results used as covariates. After the administration of pretest, the cognitive ability test was administered to all the groups and results used to classify the students into three ability levels using inter-quartile range. The teaching of the concepts cations and anions was done by the research assistants within a period of four (4) weeks in each college using the teacher's instructional guide on experimental detection of cations and anions developed by the researcher. The experimental group was taught the concept using limestone ore as resource materials, while the control group was taught the concept using standard reagents and materials. The posttest was administered immediately after treatment to all the groups. Two weeks after the posttest had been given the retention test was administered.

The fifty multiple choice-questions consisted of three distracters and one correct option; and lettered A-D. The instruments were scored by the researcher immediately after its administration. Each correct answer scored one mark. The entire exercise was activity base and focused on the identification of metallic radicals or cations. Cations to be identified were calcium ion (Ca^{2+}), Copper II ion (Cu^{2+}), Magnesium ion (Mg^{2+}), Zinc ion (Zn^{2+}), Aluminum ion (Al^{3+}) and Lead ion (Pb^{2+}). Experimental activities were conducted using suitable reagents like sodium hydroxide ($NaOH$), Ammonium hydroxide (NH_4OH), Potassium iodide (KI), Trioxonitrate(V) acid (HNO_3), Hydrochloric acid (Hcl).

METHOD OF DATA ANALYSIS

The data collected were analyzed using Analysis of Covariance (ANCOVA) using pretest as covariates. All hypotheses were tested at 0.05 level of significance.

VII. RESULTS AND DISCUSSION

RESEARCH QUESTION 1

What are the chemical components of limestone ore deposits? And how is it suitable as a teaching resource?

This was tested using Atomic Absorption Spectrometry (AAS). The results obtained indicated that limestone ore contains metallic oxides and elements in various percentages as indicated below.

OXIDES/ELEMENTS	%COMPOSITION
Na_2O	1.75
K_2O	0.45
CuO	0.1
ZnO	1.015
MnO	2.35
MgO	19.5
PbO	1.001
$Fe2O_3$	49.3
$CaCO_3$	90.65
S	1.5
P_2O_5	2.65
SiO_2	25.6
Al_2O_3	0.152

Table 1: Percentage Composition Of The Constituent Mixture Present In Limestone Ore Sample M (Mfamosing)

All elements and oxides were determined using atomic absorption spectrometry (AAS).

Make - UNICAM
Type - 939/959
Lab - ALSCON Laboratory
Location - Ikot Abasi

A bar chart summary of the results on table 1 shows that calcium trioxocarbonate (IV) has the highest percentage composition of 90.65%.

This means that limestone ore is predominantly composed of $CaCO_3$. The observed trend is in agreement with Murray (1980).

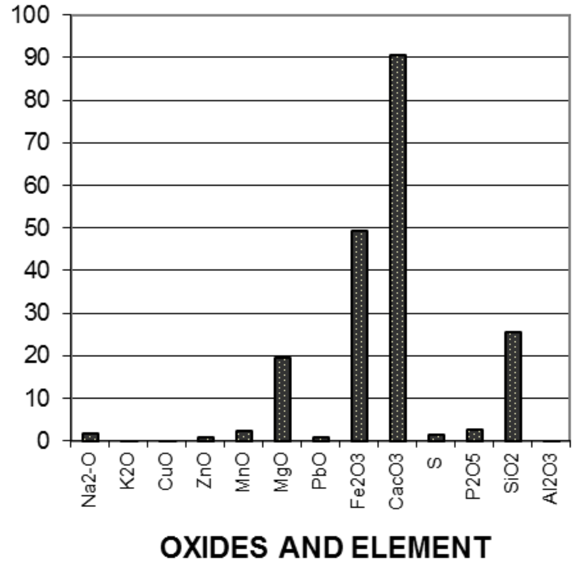

Figure 1: Bar Chart Showing The Relative % Distribution Of The Oxides And Elements In Sample M (Mfamosing)

RESEARCH QUESTION TWO

What is the mean performance scores of chemistry students taught the concept of qualitative analysis using limestone Ores and those taught using standard materials and reagents as resources?

This research question was answered using mean and standard deviation as presented in table 2.

Group	N	Pretest $\bar{X}$	Pretest SD	Posttest $\bar{X}$	Posttest SD	Mean Gain
Experimental	62	24.66	7.98	69.81	5.67	45.15
Control	58	22.95	7.25	54.97	6.32	32.02
Total	120	23.83	7.65	62.63	9.54	38.80

Table 2: Mean and Standard Deviation Scores of Students Taught Using Limestone Ores and those taught Using Conventional Materials and Reagents

As shown in table 2, the mean gain (45.15) of the experimental group (students, taught using limestone Ores) is greater than the mean gain (32.02) of the control group (students taught using standard materials and reagents). This indicates that students taught using limestone Ores as a resource performed better than their counterparts taught using standard materials and reagents.

RESEARCH QUESTION THREE

What differences exists among the mean retention scores of chemistry students taught the concept of qualitative analysis using limestone Ores and those taught using standard materials and reagents as a resource?

Mean and standard deviation was used in answering this research question as presented in table 3.

Group	N	Pretest $\bar{X}$	Pretest SD	Posttest $\bar{X}$	Posttest SD	Mean Gain
Experimental	62	24.66	7.98	59.24	4.94	34.58
Control	58	22.95	7.25	48.14	5.85	25.19
Total	120	23.83	7.65	53.87	7.74	30.04

Table 3: Mean and Standard Deviation Scores of Experimental and Control Group

Table 3 showed that the mean gain (34.58) of the experimental group is greater than the mean gain (25.19) of the control group. This indicate that students taught using limestone Ores as a resource retained better than their counterparts taught using standard materials and reagents.

RESEARCH QUESTION FOUR

What is the mean performance scores of chemistry students with high, average and low ability levels taught the concept of qualitative analysis using limestone Ores and those using standard materials and reagents as resources?

This research question was answered using mean and standard deviation as presented in table 4.

Group	Ability Level	N	Pretest $\bar{X}$	Pretest SD	Posttest $\bar{X}$	Posttest SD	Mean Gain
Experimental	High	25	25.04	7.60	74.00	5.47	48.96
	Average	26	24.73	9.08	67.38	3.19	42.65
	Low	11	23.64	6.50	66.00	4.90	42.36
Control	High	5	21.40	7.13	51.60	2.97	30.20
	Average	32	23.66	7.53	58.25	6.42	34.59
	Low	21	22.24	7.04	50.76	3.06	28.52
Overall	High	30	24.43	7.53	70.27	9.90	45.84
	Average	58	24.14	8.21	62.34	6.92	38.20

Low	32	22.83	6.79	36.00	8.24	33.17

Table 4: Mean of Standard Deviation of Experimental and Control Group Based on Ability Levels

As shown in table 4, the mean gain (48.96) of students with high ability level in the experimental group was greater than those (42.65 and 42.36) of average and low ability levels. Also the mean gain (42.65) of average ability level students was greater than that (42.36) of low ability level. In the control group, the mean gain (34.59) of average ability was greater than those (30.20 and 28.52) of high and low ability level. Overall, the mean gain (45.84) of those with high ability was greater than the mean gains (38.20 and 33.17) of those with average and low ability level.

HYPOTHESES

Ho_1: There is no significant difference in the mean performance scores of chemistry students taught the concept of qualitative analysis using limestone ore deposits and those taught using standard materials and reagents as resources.

Source	Sum of Squares	Df	Mean Square	F	Sign. of F	Decision
Corrected Model	6625.04[a]	2	3312.52	92.00	.000	*
Intercept	40957.91	1	40957.91	1137.50	.000	*
Pre-test	24.78	1	24.78	0.69	.409	NS
Resource Materials	6426.97	1	6426.97	178.49	.000	*
Error	4212.83	117	36.01			
Total	481590.00	120				
Corrected Total	10837.87	119				

**=significant at .05 level of significance*
NS = Not significant at .05 level of significance

Table 5: Covariance Analysis (ANCOVA) of Students' Pretest Performance Classified by Resource Materials with Pretest as Covariate

As shown in table 5, the calculated probability value (F-value) .000 of the main effect of resource materials is less than the declared Probability value (alpha level) .05. Therefore, the null hypothesis is rejected. This implies that there exist a significant difference in the mean performance scores of chemistry students taught the concept of cations and anions using limestone Ores and those taught using standard materials and reagents as resources.

Grand Mean = 32.55	**N**	**Unadjusted**		**Adjusted for independent Variable Covariates**	
Variable + Category		**Dev'n**	**Beta**	**Dev'n**	**Beta**
Resource Material			0.68		0.63
Limestone ore	64	3.23		3.01	
Standard materials	56	-3.69		-3.45	
Multiple R, Squared = 0.56					

Table 6: Multiple Classification Analysis (MCA) of the possttest scores of students taught with limestone ore and those taught with standard materials

Table 6 shows that students taught with limestone ore performed significantly better than those taught with standard materials. Table 6 also indicates a multiple regression index of R = 0.75 with a multiple regression squared of $R^2 = 0.56$. This implies that 56% of the total variance in the performance of students in Chemistry is attributable to the influence of the resource material used for teaching the concept of cations and anions.

HYPOTHESIS TWO

Ho_2: There is no significant difference in the mean retention scores of chemistry students taught the concept of qualitative analysis using limestone ores and those taught using standard materials and reagents as resources.

This hypothesis was tested using the results in table 7.

Source	Sum of Squares	Df	Mean Square	F	Sign. of F	Decision
Corrected Model	3706.71[a]	2	1853.35	63.29	.000	*
Intercept	30615.35	1	30615.35	1045.41	.000	*
Pre-test	11.85	1	11.85	0.41	.526	NS
Resource Materials	3601.65	1	3601.65	122.98	.000	*
Error	3426.42	117	29.29			
Total	355435.00	120				
Corrected Total	7133.13	119				

*=significant at .05 level of significance
NS = Not significant at .05 level of significance

Table 7: Covariance Analysis (ANCOVA) of Students' Retention Scores Classified by Resource Materials with Pretest as Covariates

As shown in table 7, the calculated F-value .000 of the main effect of resource materials was less than alpha level .05. Therefore, the null hypothesis is rejected. This implies that there exist a significant difference in the mean retention scores of chemistry students taught the concept of qualitative analysis using limestone Ores and those taught using standard materials and reagents as resources.

HYPOTHESIS THREE

Ho_3: There is no significant difference in the mean performance scores of chemistry students with high, average and low cognitive ability levels taught the concept of qualitative analysis using limestone Ores and those taught using standard materials and reagents as resources.

This hypothesis was tested using the results in table 8.

Source	Sum of Squares	df	Mean Square	F	Sign. of F	Decision
Corrected Model	8129.01[a]	6	1354.84	56.52	.000	*
Intercept	39664.00	1	39664.00	1654.58	.000	*
Pre-test	4.31	1	4.31	180.00	.672	NS
Resource Materials	4790.12	1	4790.12	199.82	.000	*
Cognitive Ability	402.05	2	201.02	8.39	.000	*
Resource * Cognitive Ability	611.74	2	305.87	12.76	.000	*
Error	2708.86	113	23.97			
Total	481590.00	120				
Corrected Total	10837.87	119				

**=significant at .05 level of significance*
NS = Not significant at .05 level of significance

Table 8: Covariance Analysis (ANCOVA) of Students' Posttest Performance Classified by Cognitive Ability Level with Pretest as Covariate

As shown in table 8, the calculated F-value (.000) of the main effect of cognitive ability level was less than the declared alpha level (.05). Therefore, the null hypothesis was rejected. This implies that there exist a significant difference in the mean performance scores of chemistry students with high, average and low cognitive ability levels taught the concept of qualitative analysis using limestone Ores and those taught using standard materials and reagents as resources.

In order to determine the direction of significance, a Scheffe' Pairwise Comparison test was done and the results are summarized in table 9.

(I) Students' Reasoning Ability	(J) Students' Reasoning Ability	Mean Difference (I-J)	Std. Error	Sign at P<.05
High	Average	.01	1.36	.996
	Low	4.41*	1.51	.004
Average	High	-.01	1.36	.996
	Low	4.41*	1.12	.000
Low	High	-4.41*	1.51	.004
	Average	-4.41*	1.12	.000

**Significant at P < 0.05 alpha.*

Table 9: Summary of Scheffe' Posthoc Comparison of Students' Posttest Scores Classified by Reasoning Ability with Pretest as Covariate

The mean differences shown in table 9 are 0.01 for high and average reasoning ability; 4.41 for high and low ability, and 4.41 for average and low ability. The levels of significance displayed in table 9 indicated that students in high reasoning ability level performed significantly better than their counterparts in low reasoning ability level. Students in average reasoning ability level also performed significantly better than those in low ability level. However, the mean difference between high and average was not significant.

VIII. DISCUSSION

Chemical analysis of the components of the limestone ore showed that it was a mixture of elements and oxides in various concentrations or percentages. The constituents mixtures composed of Na_2O $CaCo_3$, Zno, Fe_2O_3, Pbo, S, P_2O_5, Cuo, Mno, Mgo, SiO_2 and Al_2O_3, with this result, metallic elements present are calcium (Ca), Zinc (Zn), Magnesium (Mg), Lead (Pb), Copper (Cu), Iron (Fe), Aluminum (Al) and Silver (Ag). It was therefore a suitable resource material in teaching the concept of cations.

In activity 1, which was the identification of calcium ion (Ca^{2+}) and Magnesium ion (Mg^{2+}) in the sample. A dirty white precipitate was obtained which was insoluble in excess sodium hydroxide solution confirming Ca^{2+} and Mg^{2+} ions. This was in agreement with the works of Ojukuku (2001), emphasizing that all basic metallic radicals (cations) are identified by the formation of precipitates on the addition of a suitable reagent to the solution of the substance.

In activity 2 which was identification of Aluminum ion (Al^{3+}) and Zinc ion (Zn^{2+}) in the sample. A white precipitate was obtained soluble in excess ammonia solution, confirming the presence of Zinc ion (Zn^{2+}).

In activity 3, Copper II ion (Cu^{2+}) was also confirmed with the formation of a deep blue colouration and so also Iron II (Fe^{2+}) forming a dark green precipitate, insoluble in excess sodium hydroxide solution.

The results of hypothesis one showed that a significant difference was found to exist between the performance of students taught the concept of qualitative analysis using limestone ore as a resource material and those taught using standard materials. Findings resulting from the testing of this hypothesis as presented in table 1 showed that the limestone ore had a significant main effect P < .05. This is because the calculated probability value (P-value) .000 of the main effect was less than the declared probability value (178.49).

The results also showed that 56% of the total variance in the performance of students in chemistry was attributed to the influence of the resource material used in teaching the concept of cations and anions. This might be due to the fact that using local materials from the environment as resource in teaching, provide concrete basis for conceptual thinking and thus facilitates better and proper understanding of chemistry concepts. Also, using local materials from the environment as a resource for teaching enhances students' interest and attitude towards the subjects due to the nature of activities in the class. The above findings appeared consistent with those of Nworgu (2003) and Alonge (2003) that resource materials from the environment were effective in enhancing achievement.

The results of hypothesis two showed that a significant difference was found to exist in the mean retention scores of chemistry students taught the concept of qualitative analysis using limestone ore and those taught using standard materials and reagents as resources. As shown in the table, the calculated P-value .000 of the main effect was less than the declared probability value (122.98). The above findings appeared consistent with those of Nworgu (2003), Obi (2000) and Ezeliora (2001). These studies pointed out that resource material from the environment were effective in enhancing performance and retention in science. Concrete objects provide concrete basis for conceptual thinking and thus facilitate better and proper understanding of chemistry concepts.

The results of hypothesis three in table 3 indicated that, a significant difference was found to exist in the mean performance scores of chemistry students with high, average and low cognitive ability levels taught using standard material, and reagents. The result is in agreement with the findings of Orimogunje (2003) that, students ability level is a significant factor in their performance in chemistry. Resource materials used (limestone ore enable the students to acquire various scientific skills through hands-on-activities and enhances the intellectual and aesthetic understanding of the nature of scientific concepts.

IX. CONCLUSION

Based on the results of the study, it can be concluded that limestone ore deposit also facilitates student's performance and retention in the concept of cations and anions in qualitative analysis.

X. RECOMMENDATIONS

Based on the results of the study, the following recommendations were made.

- ✓ Chemistry lecturers/teachers should explore the use of limestone ore in teaching various concepts in chemistry.
- ✓ Lecturers/science teachers should endeavour to use resources from the environment alongside standard materials and chemicals in teaching various concepts in chemistry.

REFERENCES

[1] Acquaye, J. E. Integrated Science Programme: Constraints and Prospects in Nigeria Schools. The Nigeria Teacher Education Today, 1 (2):96-100, 2001.

[2] Alonge, E. I. Improvisation in Integrated Science. Proceedings of the 24th Annual Conference of Science Teacher Association of Nigeria: 171-177, 2003.

[3] Awolola, J. B, Community Resource Utilization of the Teaching of Integrated Science. A paper presented at the National Workshop on Integrated Science May 15-20th, 2000.

[4] Balogun, T. A. Improvisation of School Science Teaching Equipment. Journal of Science Teachers Association of Nigeria. 2(2):36, 2005.

[5] Dareng, M. K. Improvisation in Mathematics. A paper presented at Science Teacher Association of Nigeria National Conference in Kano, 2000.

[6] Enaohwa, J. O. & Umeoduagu, J. N. Science, Technology and Mathematics Education in Contemporary Nigeria. Onitsha, Kmerisua Education Publishers, 2012.

[7] Eshiet I. T. Safety in the Science Laboratory in Methodology of Science Teaching (Historical Approach) Abak. Belpot, 1993.

[8] Ezeliora, B. Women Human Rights and Education. A review of the Igbo Women Situation. Torch. Enugu 113 pp38 – 42, 2001.

[9] Federal Republic of Nigeria, National Policy on Education, FMB Press, 2013.

[10] Ige, I. A. Boosting Resources Utilization in Biology Classrooms. A paper presented at the 41st Annual Conference of Science Teachers Association of Nigeria, 2000.

[11] Inyang, N. E. U. & Ekpenyong, H, E. Influence of Ability and Gender Grouping on Senior Secondary School Chemistry Students' Achievement on the Concept of Redox Reactions. Journal of Science Teachers Association of Nigeria. 25(1&2):36-42, 2000.

[12] Ireogbu, T. O. & Ige, T. A. Innovations in Science Teaching for the new millennium in Bamisaiye, D. A. Nwazuoke, I. A. & Okediran, A. (eds) Education in this millennium: Innovations in theory and Practice. Ibadan: Macmillan Publishers, 2003.

[13] Nworgu, B. G. Effect of Gender and School Location on Students' Achievement in Physics. 40th Annual Conference Proceedings of Science Teachers' Association of Nigeria 23(2): 79 – 85, 2003.

[14] Ojokuku, G. O. Practical Chemistry for Senior Secondary Schools. Gbabeks Publishers (Ltd). Ibadan. Nigeria, 2001.

[15] Orimogunje, T. The Relative Effectiveness of Two Instructional Mehtods on Students' Achievement in Chemistry. Unpublished M.Ed Thesis, Adekunle Ajasin University Akungba-Akoko, Ondo State, 2003.