BINARY SALTS: THEIR EFFECTS ON ACADEMIC ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS IN QUALITATIVE INORGANIC ANALYSIS IN OYO METROPOLIS

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Abstract

The study examined the effect of binary salts on academic achievement of secondary school students in qualitative inorganic analysis. The study employed quasi experimental design with pretest, posttest, non – randomized control group and non – equivalent intact groups. The study was carried out in Oyo Educational Zone of Oyo State. 450 senior secondary II Chemistry students were used for the study. The instrument for data collection was Test of Concept of Qualitative Inorganic Analysis developed by the researcher. Kuder Richardson was used to establish the reliability of the instrument and the coefficient of internal consistency gave an index of 0.87. The data gathered from the instrument was analysed using Analysis of Covariance {ANCOVA} statistic. Findings revealed that students taught qualitative inorganic analysis using improvised materials as salts have higher academic achievement than those taught the same concept using standard salts. It was recommended that Chemistry teachers should be using dried plantain peels powder and limestone ore in the teaching of qualitative inorganic analysis

Keywords: Binary salts, academic achievement, qualitative inorganic analysis

Introduction

The overall of what a student is capable of learning in a particular subject contents in a given period of time can be referred to as academic achievement. It can also be regarded as the totality of information and skills acquired by individual through education or experience (Gyuse, 2010). The display of knowledge attained or skill developed in school subjects designed by test and examination scores or marks as ascribed by the subject teacher is the academic achievement acquired by the students, which is the knowledge attaining ability of degree of competence in school subjects usually measured by test and examination scores, expressed in a grade according to learners' performance (Obaka, Bichi &Yusuf, 2010). However, the outcome of a standardized test or examination used to measure the level of developed skill or knowledge in students can also be referred to as academic achievement of the students in such test or examination. This helps in determining the level of instruction for which a student is prepared. If the score of the achievement test is high, it connotes mastery of the grade level, hence such student is ripe for higher instructions. Also, if the achievement test score is low, this calls for repetition or

remediation (Tanwar, 2020).Chemistry can be defined as the properties of matter and their related energies. The life process of all living things revolve around chemical changes and many of these activities centre on the study of Chemistry. It is therefore a branch of science that is concerned with the properties, composition, and structure of substances and the changes they undergo (Attah, 2014). Chemistry is the science that deals with the properties, composition and structure of properties known as elements and compounds, the transformation they undergo, and the energy that is released or absorbed during these processes. Chemistry is the study of matter- what it consists of, what its properties are and how it changes. Chemistry is the study of the properties, structure, behavior and reactivity of matter. Practical activities in Nigeria secondary school chemistry are in two phases, qualitative analysis and quantitative analysis.

Qualitative analysis is an aspect of practical chemistry that deals with the identification of a substance, which includes determining what chemical elements that are present in the sample tested, what ions, functional groups or molecules are in its composition. Qualitative analysis helps students to identify substances like anions, cations, gases and functional groups[7]. Qualitative analysis can be divided into two-qualitative inorganic analysis and qualitative organic analysis. Qualitative inorganic analysis is the process of detecting anions and cations present in simple salts while qualitative organic analysis involves the detection of elements, identification of functional groups and tests for unsaturation in organic compounds (Ojokuku, 2023). The two major types of instructional materials in chemistry teaching are conventional (standard) instructional materials and improvised instructional materials. The conventional or standard materials are imported or factory made laboratory equipment and reagents for teaching chemistry. They are referred to as standard because they adapt to all conditions and serve the same purpose wherever they are used. Examples are laboratory chemicals, laboratory glassware, Bunsen burners, etc.Standard laboratory salts are chemical materials (imported or factory made) use in qualitative inorganic analysis. Examples are KNO_3, $CuSO_4$, K_2SO_4, $(NH_4)_2SO_4$, KCl, $CaCL_2$, etcetera. Earlier study confirmed unripe plantain peels ashes contain K_2CO_3, KNO_3, KCl, $CaCO_3$, $Ca(NO_3)_2$, CaO among other compounds which are some of the metallic ions or radicals determined by qualitative inorganic analysis. Cocoyam leaves contain minerals such as Na, K, Ca, Mg, Fe and Mn (Nnoli, 2021). Available study earlier conducted show limestone ore contain metallic ion concentration. The metallic oxides and elements present in limestone ore in various percentages. Another strategy that can be adopted in teaching science is improvisation of materials sourced from one immediate environment or designed by the teacher; this may also include collaboration with the students or with the help of local personnel to enhance instruction (Usoro, 2008). Improvisation refers to sourcing and using relevant materials for teaching and learning processes. Effective improvisation in Chemistry, demands a good knowledge of subject matter and excellent understanding of the laws of nature. One of such improvised materials is an organic material synthesized from living things or produced without the use of artificial material (Nnoli, 2021). One of such organic material that is used in a chemical reaction is known as a reagent. It usually implies a substance that is added to bring about a chemical change. Hence, organic reagents are improvised chemical reagents used in the Chemistry laboratory too bring about a chemical change when added to a system or added to see if a reaction will occur. For instance, a crushed grape fruit that is allowed to ferment for two days is an organic reagent for production of ethanol. Organic reagents, highly germane in modern methods of analysis, are from living things- plants and animals. Examples include olive oil, palm oil, dyes, flowers, fruits, palm wine, animal fats and skin.

The teaching of science is now shifting emphasis to exploratory, practical and experimental works, where teachers and students are to explore their immediate environment for the teaching and learning of science which Chemistry is a part (Ojo, 2022). Sourcing materials for instruction from students' immediate environment promote first hand science experience, thus creativity and innovation have not only become permanent features of the educational system, but also a dynamic handy tool in science classrooms. The use of locally sourced materials for science instructions means better use of scientist's environment, which is the practice in improvisation. Improvisation enhance academic achievement of students in Chemistry, this is because using locally sourced materials within their environment could improve their performance and then achievement in the subject. Standard equipment, chemicals and concrete resources are required for meaningful teaching and learning of Chemistry. However, inadequacies of all these aforementioned together with poor funding and population exposition of students makes it difficult to get required resources for effective Chemistry teaching. The concept of improvisation rests on the use of locally available materials for science instructions.

Improvisation as a concept is an act of designing totally new tools, materials, instruments or modifying the existing ones for instructions in science classroom. Improvisation demands from Chemistry teacher resourcefulness and creativity in both thinking and manipulative skills. The use of learners' immediate environment and locally available resources are germane while developing teaching and learning materials for teaching of Chemistry. Locally sourced materials allow learner to explore their biological and physical environment thus promoting creativity and ingenuity which has now become a permanent feature of science teaching and means of better use of scientists' environment. The use of locally sourced materials is advocated for in the teaching of Chemistry. If students learn from the materials that are natural to them, it brings excellent learning performance, enhance self-confidence and self-esteem. Dire need of science equipment and materials as well as being a propelling force for both teachers and learners to make use of their cognitive, affective and psychomotor domains in science teaching make improvisation to be highly significant. Improvisation is a means of widening creativity, curiosity, inquiry and productive application of intellect. It reduces the bad attitude of some teachers avoiding some topics due to the absence or shortage of science equipment and materials (Ojo, 2022).

Statement of the Problem

Chemistry is a science subject which is activity-based and the method advocated for its teaching is guided discovery that is highly resource based. Students' achievement in practical Chemistry is low. Some of the identified students' weaknesses are inability to correctly record observation and logical inference, assigning wrong charges to ions. The West Africa Examinations Council (WAEC) Chief Examiners report recommended that the candidates should be exposed to practical skills early in their formative years and they should also improve in their qualitative inorganic analysis skill. The needed facilities and chemicals for qualitative inorganic analysis are teaching are either in short supply or not inexistence. Relevant studies have however shown that sourcing for instructional materials from the student's immediate environment can easily fill the gaps created due to shortage of standard materials and reagents. The all-embracing problem of this study lies on how student's achievement in qualitative inorganic analysis can be enhanced, if improvised materials used as salts will promote academic achievement in qualitative inorganic analysis.

Objectives of the Study

The study was designed to achieve these objectives:

1. To investigate the academic achievement of students taught using improvised materials as salts with those using standard salts as resources in the teaching of qualitative inorganic analysis in Oyo Metropolis
2. To identify the effects of cognitive ability levels (high, medium and low) on students achievement in qualitative inorganic analysis when taught using improvised materials as salts and standard salts in Oyo Metropolis.

Hypotheses

To guide the study, the following null hypotheses were formulated:

H_{01}: There is no significant difference in the mean achievement scores of Chemistry students taught qualitative inorganic analysis using improvised materials as salts and those taught using standard salts in Oyo Metropolis.

H_{O2}: There is no significant difference in the mean achievement scores of Chemistry students with high, medium and low cognitive ability levels taught using improvised materials as salts and those taught using standard salts in Oyo Metropolis.

Methodology

The research adopted quasi experimental design with pretest, posttest, non – randomized control group and non-equivalent intact groups. The study was carried out in Oyo Metropolis. The population of the study consist of seven thousand, six hundred and thirty nine (7639), senior secondary l l students in Oyo Educational Zone of Oyo State using multistage sampling procedure. Four hundred and fifty students (450) students constituted the sample for the study. Purposive sampling technique was used to select six (6) schools from the target population. The instrument for data collection was a twenty five (25) multiple choice – questions consisted of three (3) distractors and one correct option. Each correct answer scored one mark. The instrument was administered to one hundred and one (101) senior secondary l l Chemistry students of Oranyan Grammar School, Oyo for pilot testing. The data collected was computed for a reliability coefficient of the internal consistency of the instrument using Kuder Richardson (KR-20) which gave a reliability coefficient of 0.87. A pretest was administered to the two groups (experimental and control) for thirty (30) minutes. After the administration of pretest, the cognitive ability test was administered to all the groups and the results obtained was used to classify students into high, medium and low ability levels using interquartile range. The improvised materials used as salts are dried unripe plantain peels powder and limestone ore. The treatment was carried out by research assistants for four (4) weeks in each school. The experimental group was taught qualitative inorganic analysis using improvised materials as salts while the control group was taught the concept using standard salts. The posttest was immediately administered after treatment to the two (2) groups. The data collected were analysed using Analysis of Covariance

(ANCOVA) using pretest as co-variates. The two (2) hypotheses were tested at 0.05 level of significance.

Results

H_{O1}: There is no significant difference in the mean achievement scores of Chemistry students taught qualitative inorganic analysis using improvised materials as salts and those taught using standard salts.

Table 1: Analysis of Covariance {ANCOVA} of Students Pretest Academic Achievement of Binary Salts

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	11575.755a	12	964.646	17.035	0.00	0.294
Intercept	139963.2	1	139963.2	2471.665	0.00	0.834
Posttest	33.107	1	33.107	0.585	0.445	0.001
Treatment	6383.985	1	6383.985	112.737	0.00	0.187
Error	27803.91	491	56.627			
Total	2542553	504				
Corrected Total	39379.67	503				

a R Squared = .294 (Adjusted R Squared = .277)

Table 2: Estimated Marginal Means of Students' Achievement in Qualitative Inorganic Analysis by Treatment.

Treatment	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Experimental	74.343a	0.503	73.354	75.332
Control	66.798a	0.501	65.813	67.782

a Covariates appearing in the model are evaluated at the following values: pre_achievement2 = 24.20.

Table 3: Estimated Marginal Mean of Students' Achievement in Qualitative Inorganic Analysis by ability levels

Levels	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Low Ability	71.946a	0.983	70.014	73.878
Medium Ability	71.651a	0.793	70.092	73.21
High Ability	71.736a	0.994	69.783	73.69

Discussion

The results of hypothesis one revealed that students taught concept of qualitative inorganic analysis using improvised materials as salts have higher academic achievement than those taught the same concept using standard salts. The above finding is in agreement with Ugbe (2018) which states that resource materials from student's immediate environment were effective in enhancing academic achievement in analytical Chemistry. The results of hypothesis two showed that students with low cognitive ability level have higher academic achievement than those of high and medium cognitive ability levels. This is inconsistent with Alonge (2003), Orimogunje (2003) and Ugbe (2018) that revealed that student's ability level is a significant factor in their achievement in Chemistry.

Conclusion

The findings of this study have shown that teaching of qualitative inorganic analysis using improvised materials as salts has significantly enhanced academic achievement of students than standard salts It was also discovered that low cognitive ability level students have higher academic achievement than those of high and medium cognitive ability level students.

Recommendations

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

1. Chemistry teachers should be using dried plantain peels powder and limestone ore in the teaching of qualitative inorganic analysis.
2. Chemistry teachers are implored to be using materials sourced from the student's immediate environment to teach various concepts in Chemistry.

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