HOME MATERIALS AND ACADEMIC ACHIEVEMENTS OF CHEMISTRY STUDENTS

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Abstract

This research work examined the use of home materials in the teaching of Thermochemistry to SS1 Chemistry students in public and private schools. Home materials used include the following; fermentation fruit juices, heating capacities of wood, induced thermal decomposition of shellfish shell powder, and dissolution of glucose were used for the experiment. A total of 100 senior secondary one chemistry students were involved in the study. The sample was made up of 60 males and 40 females from two secondary schools in Ikom Local Government Areas in Cross River State, Nigeria. The design for the study was a pre-test post-test control design. Chemistry Achievement Test (Cat) was used to collect data for the study Kinder Richardson Formula 21 was used to establish the reliability of Cat. The reliability of Cat was 0.84. Analysis of covariance and descriptive statistics was used for data analysis. Findings showed a non-significant difference in the type of school environment and sex. It was recommended that teachers be innovative and resourceful using materials found at home to teach Chemistry concepts. This is so because the type of school environment does not affect learning but rather the materials used in teaching.

Keywords: kitchen, resources, academic achievements, and chemistry students

Background to study

In every given society, education is very important. This education can be formal or informal and is very necessary for the transfer of societal norms and values. Studies have found that type of school environment be it a rural or urban school, materials used in teaching, functioning laboratories among others are all school locational variables that can have a significant effect on the academic performance of students (Adewuyi, 2002; Ahmed, 2003; and Ijeoma, 2007). Academic performance in this research refers to the ability of chemistry students to pass all exams both internal and external with at least a credit pass. In the last few years, the academic performance of students in the Ikom Education Zone and Nigeria has witnessed a sudden surge in academic failure. The academic performance of students in Cross River state is at an alarming rate. There is a problem of a dearth of science resources and this contributes to students' poor academic performance in chemistry at the secondary level (Ifeakor, 2006). Ifeakor,(2006) opined that learning is not meant to be a passive activity that targets only the mental information students receive but that students learning is at its optimum

when students can combine physical activity with mental activity. A cursory look at the classroom situation shows how teachers subject their students to long periods of sitting which is not only boring but works against effective learning. Chemistry is a school science subject that could be best taught using activity (Ifeakor, 2006) these teachers do not comply accordingly. The most commonly cited reason is the lack of science equipment in schools. Despite all the put in by the government by providing science equipment in schools it has not matched the demands of schools in any satisfactory manner due to the recent population explosion in intakes into our secondary schools. Since the problem of equipping schools with materials and apparatuses is enormous and the absence of these facilities appears to dangerously affect the teaching and learning of Chemistry, some measures need to be taken to address this problem. The home is stocked with quality materials and is most likely to be the best chemical laboratory in the world (Hayward, 1992). Many materials and activities abound in the home. In the absence of standard acid, base, and indicator for a titration experiment, materials in the home can be used as resources to teach titration. Juice from unripe fruits will serve as acid, ashes of roasted cocoa pod shell dissolved in water and filtered can be used as a base, red cabbage can be used as an indicator. Activities taking place in refrigerators can be used to teach change of state. Boiling of water can be used to teach change of state. The disappearance of camphor balls can be used to teach sublimation. Elders in the villages and towns do often practice Chemistry in their various homes but there is no formal use of materials in the home in a chemistry laboratory. It is based. on this that the researcher attempted to find out how students can learn when taught using home materials as teaching resources for Chemistry concepts.

Theoretical Frameworks

Ausubel's theory of meaning learning and advanced organize.

Ausubel (1968) said that if he had to reduce all educational psychology in just one principle, he would say that, the most important single factor influencing learning is what the learner already knows, ascertain this and teach them. Essentially, the theory has two components. First, there is the elaboration of what he called "advance organizer" that serves the purpose of increasing the clarity and stability of learning materials.

The second is a formulation of a procedure for the attainment of meaningful learning. Advance organizers as defined by Ausubel, consist of those introductory materials that are presented in advance of actual learning at a higher level of abstraction and generality. The second component of Ausubel's postulation is the theory of meaningful verbal learning. The central key that explains the theory of meaningful verbal learning is subsumption, a process that describes the relevant knowledge already extant in the learner's cognitive structure and the new elements of information or concepts to be learned.

The implications of Ausubel's theory to the study are as follows: Concepts are meaningful only when the learner can visualize them and subsume them within a cognitive structure. This means that the learners already understand more generic concepts that incorporate or include the concept one is trying to teach. This can be achieved when a Chemistry teacher uses resources from the environment (e.g home) as learners can visualize the materials they already know as an advance organizer in the teaching and learning process.

When teaching, instructional resources should proceed from the most generic (those in

students' homes) concepts to the most specific ones. Before trying to define activation energy for instance, first teach with materials that deal with more generic concepts, for example, enthalpy of reaction which subsumes activation energy.

Learners can learn a concept only when they are "ready" for it. (Learner readiness). It is from this theory that the principle of previous knowledge, which forms the background for learning became very important. The implication here is that when materials from homes that are familiar to the learner are used in the teaching-learning process, students' readiness can be enhanced.

Literature review

The home as a resource in teaching Chemistry

The environment (e.g. home) is the largest laboratory and learning system ever imagined (Eshiet, 1996). According to Eshiet (1996), the laboratory is a workhouse for scientific practices such as teaching, learning, learning practical skills, the search for new ideas, and the designing/testing of prototypes in engineering technology (Nanjwan. & Owojaiye, (2019) Nanjwan. & Ashi 2019).

A home is a unit of the environment. The special consideration of the home as a resource in teaching science and technology can be seen in the light of the following: The early years of the learners are mostly spent at home where various experiences are gained through the sensory-motor, pre-operational to concrete operation, and formal operational stages. The modern home can be regarded as a workshop of various practices which expose the learner to or involve the learner in experiences in the various aspects of the subject such as Chemistry, Physics, Engineering, Technology, Biology, Agricultural Science, Arts, Music, Information Technology and Mathematics (Eshiet, 1996).

Talking about the home as a laboratory, Hayward (1992) sees the kitchen as a place stocked with quality approved materials and probably the safest chemical laboratory in the world. Snodgrass (2001) believes using the home is a familiar reference point. The inquiring science teacher will find much information that is relevant and vulnerable in motivating students. When students participate in the presented activities, demonstration, and discussion of home science, they perform better in science. Demonstration in the home serves as a motivational function and is termed appetizers or desserts, and more involved activities or laboratory exercises are listed under main courses.

Snodgrass (2001) observes that pupils who go to school to study Chemistry at a post-secondary institution and had contact with the outcome of Chemistry in the environment, are stimulated and motivated to learn Chemistry, first as a subject and secondly as a means of finding answers to many questions in the environment. We experience "science" every day and everywhere. The home is the best place to learn and think about science. In our homes, we are familiar with the cookware and the cooking methods, the food flavor, texture and its storage, etc; however, the sciences behind those things are not clear in mind. We are, sometimes, puzzled about some experiences at home. A look at some of the experiments will give a better understanding of those mind-blowing questions (Home experiments, 2011)

Boiled and Raw eggs: boiled and raw eggs cannot be distinguished at a glance, since both eggs have the same look. However, a conclusion can be made when the trick is known. When a boiled egg and a raw egg are placed on the table and spun one by one gently with the fingers and are touched lightly with the fingers to break the spinning, and then the finger is removed, the egg that spins again is

the raw egg. This experiment obeys the first law of motion (law of inertia) by Sir Issac Newton that objects are inert to change their motion. Boiled and un-boiled eggs can be home resources in teaching Newton's first law of motion (Brain, 2011).

The hot pizza: the hot pizza just out of the oven burns the tongue more severely when one bites the fruit filling. The drier crust in the pizza burns ones' tongue less severely. This can be used to introduce the concept of "heat" and temperature. All ingredients in a hot pizza contain heat, but the amount of heat stored in each ingredient is not the same though they are at the same temperature (Brain, 2011).

The thermostat: An electric hot pot boils and maintains water inside at a specific temperature. The working principle is not difficult but an application of basic science thermal expansion in substances. The rice cookers apply the same device to warm the rice after cooking. Thus a rice cooker and an electric hot pot are kitchen resources for the teaching of thermal expansion. The thermal expansion of water in the kitchen is a common scene in the kitchen when one pours a small number of water droplets into the oil at red-hot temperature this can be used to explain the thermal expansion of water.

The smell of fish: fish caught immediately do not have an odour at all. The fishy smell develops as chemical reactions take place in the flesh of the fish sometime after they have been caught. This fishy smell cannot be eliminated even though the fish is preserved under low temperatures. This can be used to teach enzymes in Biology (Chris, 2012).

Everyday science (science at home) shows that while cooking vegetables if salt is added at the beginning it takes lesser time to cook one may ask why this is so. Impurities dissolved in water elevate its boiling point. Hence when salt is added to vegetables at the beginning, the salted water boils at a higher temperature. This can form the resource for the teaching of purity (Chris, 2012).

Chemistry of fire (works) a common chemical reaction is combustion or burning. As something burns, heat and light are given off. Fire can be devastating but it can also be spellbound. These resources help students to understand the combustion reaction and provide insight into how fireworks work.

Exploring the science of molecular gastronomy through lectures and demonstration reveals the Chemistry and Biochemistry of food ingredients and their preparation with the kitchen as a laboratory and molecular cooking was delved into. This was the bait in the course catalog that lured 28 students at Carnegie Mellon University to sign up for the kitchen Chemistry sessions, a five-week mini-course during the fall semester. In the laboratory (aka kitchen) in Mellon Institute, the students donned aprons and safety glasses, normal laboratory procedures, using food as the working medium, Das covered a sampling of the science topics with the students' Lipids (fats and oils), emulsion, foams, and "air" carbohydrates and proteins polymers and liquid food spheres, protein structure, denaturing and enzyme action. The students had to identify key chemical features and characteristics of basic food ingredients and explain how these properties affect and determine their handling, use, and taste (Das, 2009).

Chemistry teachers must think on their feet. While Chemistry is an exact science, the teaching of Chemistry often requires creativity and improvisation. To make Chemistry concepts comprehensible to students the teachers must employ creative teaching methods and be prepared to respond to queries or explain concepts in a typical manner. Teachers who are adept at improvisation will likely be more successful in imparting Chemistry information to the Chemistry students in the classroom (Schreiner 2012).

Helmenstine, (2008) suggested that to explore science where one cannot find or afford chemicals, the following kitchen resources can be used for experiments and projects. Rainbow Density column; materials are sugar water, food colouring, glass can be used to teach separation by chromatography. Baking soda & Vinegar volcano: this can be used as a classic science fair demonstration in which one stimulates a volcanic eruption using chemicals found at home. This experiment requires materials like; baking soda, vinegar, water, detergent, food colouring, and either a bottle, else one can build a dough volcano.

Home Chemistry can be stimulating for many students. The material also allows teachers to reinforce the idea that everything is made of chemicals and that there is no difference between manmade and natural chemicals. Students can also be guided to learn that Chemistry is around them. A surrounding environment of Chemistry and the sharing of real-world objects that connect to science can play a large role in helping students (or anyone) relate to Chemistry and its concepts. It happens in any home and therefore can happen in the classroom. The beauty of National Chemistry Week (NCW) is that it provides an incredibly easy way to surround students with Chemistry that is related to familiar, everyday items and ideas (Jacobsen, 2007)

Chemistry is all around us and affects every moment of our lives. Children love to experiment and are fascinated by chemical bang or changing colour. Harnessing this desire to experiment, in a safe and controlled way, has often meant that science lessons cannot be dull and also that they are teacher-led affairs. The kitchen Chemistry aims to change all that by bringing into the classroom all the resources and information that are needed to run experiments (Helmestine, 2010).

In many ways, the home can be considered the Chemistry laboratory of the home. Within its confines, many complex chemical reactions occur daily such as the denaturing of proteins, the conversion of starch to sugar, and the incorporation of that sugar into favorite recipes.

If the teacher is convinced that hands-on science activities have educational value, the kitchen also might be the place to look at because of the plethora of products and possibilities contained within its confines. Educational experiences of all ages, including middle school students can be developed using kitchen science (Freier & Anderson, 1996). It could perhaps be concluded that the home particularly the (kitchen) can hardly be equaled by any unit of the human environment in the provision of experiences for the learning of science and technology. Eshiet (1996) points out that the list of activities in the home is long and all that a teacher needs to do is careful analysis, identification, and deployment of these experiences and practices as backup knowledge in the teaching and learning of sciences in the classroom (Eshiet, 1996).

Instructional Materials and Academic Performance of Science Students

Dahar and Faize (2011) conducted a study on the effect of Availability and the use of instructional material on the academic performance of students in Punjab (Pakistan). 20 students and 10 teachers from each school were randomly selected as samples for the study. The study used the value-added approach. A questionnaire for teachers and a result sheet were the instruments of the study. Pearson Product Moment Correlation was used to find out the relationship (association) and stepwise regression analysis with the linear function was used to find out the differential impact (causal relationship). The study found that there is a great efficiency in the availability

and use of instructional materials as t = 4.909 and significant at .000.

Ekpo (1990) observes that there were two problems associated with the teaching and learning of science which may account for the poor performance of science at the lower levels of education. This also accounts for the number of science students in our higher institutions. The first problem, he states, is that pre-science is introduced into our culture as an alien form of knowledge. Scientific activities, he notes are not alien to us, but the fundamental principle in these activities are lacking. The second problem according to him, is the manner of presentation of pure sciences.

Onasanya and Omosewo (2011) researched the effect of improvisation and standard materials on students' achievement. The research employed a quasi-experimental design of the pretest-posttest non-randomized control design. There was a significant difference between the students taught with standard instructional materials and those taught with improvised instructional material in their mean scores (t=4.09, df =14, p=0.005). Students acquire more information through many instructional materials to bring a deeper understanding of the topic under consideration. In order not to be stagnant as life is dynamic one would find out that improvised materials have at most the same effects as standards materials (Shafquat, Muhammad, Imran & Nawmullah,(2010).

Adebola and Ademola, (2011) researched school quality factors and secondary school students' achievement in Mathematics in South Western and North Central Nigeria. A descriptive survey research design of the ex-post facto type involving a sample of 1,014 Mathematics teachers and principals selected through a multi-stage sampling procedure. The analysis of data gave a t=2.370; p<0.05. Achievement in mathematics was significantly related to instructional materials /resources.

Sahin (2010) studied on cooperative technique Jigsaw II using a pretest/posttest with a controlled experimental design to investigate sex and academic achievement among senior secondary school students. The research discovered a non-significant difference between sex and academic achievement. Ikedolapo and Adetunji (2009) studied the comparative effect of the guided discovery (D) and concept mapping teaching strategies on senior Secondary School Students' (SSS) chemistry achievement in Nigeria. A total of 360 SSS chemistry students from Bauchi state was used for the study. Student taught with the guided discovery method had a lower mean (X =19.55) than those taught with concept mapping (21.22). There was a significant difference at a 5% level of confidence in the level of retention of both groups of students. This difference is in favour of the concept mapping strategy (t-cal. = 2.82 t – critical = 1.96). Adebola and Sakiru (2012) explored the problem-solving model as a strategy for improving secondary school students' achievement and retention in Further Mathematics in Ijebuode Ogun State. The study adopted the pre-test post-test control group design. Data collected were analysed using ANCOVA. Students taught with problem-solving models had higher retention mean of 22.45 compared with the conventional method mean of 2.78. The (F1,75) F = 196.345 *p<.05. The result was significant. The guided inquiry produced higher retention scores.

Wagh (2008) studied effectiveness for learning styles in theory and practice of "PC hardware maintenance" had a significant retention performance. The experiment had a higher mean (61) than the control (45). Statistical analysis of t at 5% level of significance was 2.718 for 10 degrees of freedom. The t critical

was 1.796. The result indicated that the I CAL package does help the students to acquire and understand knowledge, acquire skills, and retain what they have learned.

A sample of fourth-grader elementary pupils of a provincial town in North-West Germany was used for the study. The pre-test post-test design, means, standard deviation, Bonferroni, and the one–way analysis of variance (ANOVA) was used for the study. The test revealed a mean difference between the experimental group (ground inquiring (1.81) and the control group (unguided inquiring (0.57). A Bonferroni corrected comparison of the means indicated that students in the experimental group outperformed their peers in retaining more concepts than the control group (F 92, 64 =5.475 p = .006).

The zip code in which a child grows up directly or indirectly affects much more than their mailing address (Berliner, 2005), where a child lives indirectly influences the type and quality of education that he or she receives.

From the literature reviewed so far, evidence abounds to show that there is a disparity in academic performance of students as investigate the difference in chemistry performance between public and private schools resources using home resources which are found around the home

Statement of Problem

Emphasizing the importance of home material as a resource in teaching Chemistry and its effect high academic performance of students in both public and private schools is worth investigating as intelligence is not based on where you live but what you interact with. Research on the use of home materials as a teaching resource was mainly assertions and no empirical setting especially in Nigeria in general and Ikom Education Zone specifically.

Objectives of the Study

To examine the relationship of type of school environment and academic performance of students when taught using home materials.

ii. To examine how gender affects the performance of students when taught using home materials in an urban and rural school.

Research Questions

Is there any relationship between the type of school environment and the academic performance of students when taught using home resources?

ii. What effect does sex have on public and private schools when taught using home resources?

Research Hypothesis

There is no significant difference between the type of school environment and the academic performance of students when taught using home resources.

ii. Sex does not significantly affect the academic performance of Chemistry students when taught using home materials and academic achievement of students about the type of school environment.

Significant of Study

It is hoped that this study will provide information to educators, teachers, and administrators to reflect upon home materials as teaching resources in the absence of standard materials.

Materials and Methods

A pre-test-post-test control group design was used for the study. One instrument was used for the study called Chemistry Achievement Test (Cat). It was a 25-item four-option objective test. This served as a pretest and a post-test. Cat had a reliability of 0.84. Students in both public and private schools were taught using identified researchers home materials

Experiments Carried Out by Public and Private School

Enthalpy change Type of reaction Experiments Heat of formation Exothermic Fermentation of fruits Heat of combustion Exothermic Burning of firewood Heat of solution Endothermic Dissolution of glucose Heat of formation Endothermic Decomposition of shellfish shell powder Before teaching, Cat was administered and at the end of four weeks of teaching Cat was re-administered. The data collected were analyzed using descriptive statistics and analysis of covariance using pretest scores as covariates.

Table 1: Descriptive statistics and 2 x 2 analysis of covariance of SS1 Chemistry students classified by location and gender

Variable	Group	Sample size	Mean	Pre-test standard deviation	Post test mean	standard deviation
Type of school environment	Rural	48	3.96	1.29	11.15	4.48
	Urban	52	3.52	1.93	11.58	5.21
Sex	Male	60	3.45	1.41	11.48	4.65
	Female	40	4.15	1.92	11.18	5.19
	All	100	3.73	1.69	11.36	4.92
Sources of variation	Sum of squares	Df	Mean square	F	Significant of F	Decision at 0.05
Covariates (pre-test)	1650.749	1	1650.749	338.895	.000	.005
Main effects	241.525	2	80.508	3.663	.015	NS
Location	15,717	1	15,717	.715	.400	NS
2-way interactions	33.533	2	11.178	.509	.677	NS
Location Vs Treat	9.120	1	9.120	.415	.521	NS
Gen Vs location	21.854	1	21.854	.994	.321	NS
Explained	308.815	6	44.116	2.007	1062	NS
Residual	2022.225	92	21.989			
Total	2331.040	99	23.546			

Hypothesis 1: There is no significant difference between the academic performance of SS21chemistry students in public and private schools when taught using home resources. As shown in Table I, the 2-way interaction between teaching with home materials and type of school environment (rural or urban) was not significant 0.521 <0.05 probability levels used. This implies that school location did not affect students' performance in Thermochemistry when taught using kitchen resources. The null hypothesis was retained.

Hypothesis 2: There is no significant difference between the performance of male and female SS21 Chemistry students in public and private schools taught Thermochemistry using home materials as teaching resources. As shown in Table 1, the 2-way interaction between teaching with kitchen resources and gender in both public and private schools was not significant (0.947 < 0.05). This implies that

teaching with home materials as teaching resource resources does not significantly affect the academic performance of students in respect to gender (male & female).

Discussion of Results

Effect of type of school environment (rural or urban) on the academic performance of students when taught Thermochemistry using home materials. This implies that both public and private schools gained equally from using home materials to teach Thermochemistry. Studies have shown that public and private residents relate differently to educational achievement (Rodney & Hamilton, 2000 & Williams, 2005). Particularly, these studies indicated that urban residents were almost always better educated than rural residents, regardless of age, sex, maturity, or percentage. Such study affirms that there exists an interplay of the learning process and learning environment, which is directly related to where the school is situated. The environmental resources can therefore make or mar an individual's performance in learning. Abdullahi, 1992 noted that science environments that include resources used in teaching are an indispensable factor for the understanding of concepts, principles, and application of knowledge. This implies that it is not just the location that affects students' academic performance but the absence of basic resources for teaching and learning. Reeves, (2005) studied the effect of school location on science and mathematics achievement trends. The findings revealed that rural locations do not significantly influence the achievement trends of 5th grade, mathematics, and 12th-grade Chemistry. Where ever a student resides, when the necessary materials example kitchen resources that are found in the child's location are used to teach, the students will understand the concept very well since intelligence is not based on where one stays. Effect of gender on student's academic performance taught using kitchen resources. Table 1 showed a non-significant difference in the academic performance of SS2 male and female students when taught using home resources (0.94>0.05). In a similar study by Nsofor (2001) and Nwosu (2001), it was discovered that both male and female students perform well in science when given equal opportunity to learn. Learning does not have anything to do with sex organs.

Summary

The study sought to find out how students in public and private schools learn when exposed to the same learning situation of home materials as teaching resources. Home materials were materials identified in the home by the researcher that were used to conduct experiments and teach Thermochemistry. Chemistry students in public and private schools were taught using home resources. The results of CAT were collected and analyzed. Analyses showed that both public and private schools gained from the use of home materials used as teaching resources and the analysis showed a non-significant difference. The study also sought to find out how male and female students learn when taught using home materials. The result was also not significant as intelligence was not dependent on sex but on how and what materials are presented to learners.

Recommendation

Teachers are advised to try as much as possible to ascertain what the learner already knows and teach accordingly by home materials in teaching Chemistry concepts that learners are already used to. Teachers are expected to be resourceful.

References

Abdullahi, A. (1992). An investigation into the status of primary science in Nigeria. *Journal of Science Teachers Association of Nigeria. 20*(2), 193-195.

Adebola, O. J. & Ademola, I. A. (2011). School quality factors and secondary school students' achievement in mathematics in southwestern and north-central Nigeria. *The African Symposium: An Online Journal of The African Educational Research Work 2* (1), 91.

Adebola, S. I & Sakiru I. A (2012). A problem-solving model as a strategy for improving secondary school student's achievement and retention in further mathematics. *ARPN Journal of Science and Technology. 2* (2), 122 – 130.

Berliner, D. C. (2005). *Our impoverished view of educational reform:* Presidential invited speech to the American Educational Research Association Meeting in Montreal Canada.

Brain M. (2001) *Marshall Brain's How Stuff Works*, New York: John Wiley & Sons, Inc

Chris, F. C. (2012) *Science in the kitchen*: London: Franklin Watts Ltd.

Dahar, M. A. & Faize, F. A. (2011). Effect of the availability and the use of instructional material on academic performance of students in Punjab (Pakistan). *International Journal of Finance and Economics. 11,* 1450-2889.

Das S. R. (2009). *The kitchen chemistry sessions*. Retrieved from http://www.chem.cmu.edu/groups/das/. onmarch20,2011

Eshiet, I. T. (1993). *Science curriculum development in colonial Africa*. In Eshiet, I. T. Edition. Methodology of Science Teaching Historical and Conceptual Approach. Abak: Belpot (Nig) Ltd.

Eshiet, I. T. (1996). *Improvisation in science teaching philosophy and practice*. Abak: Belpot (Nig.) Co.

Freier, G. D. & Anderson, F. J. (1996). *A demonstration handbook for Physics.* American association of physics teachers. New York: Holt Reinhart & Winston

Hayward, D. (1992). Do it your self chemistry for elementary schools. *International Newsletter on Chemical Education. IUPAC (UK), 37* (99), 1 – 3.

Helmenstine, M. A. (2008) Kitchen science experiments. New York: Times company.

Xxxxx A. C.(2006). The status of resources for effective teaching of Chemistry in Nigeria Secondary Schools. *STAN*,205-207

Ijeoma,M.E . (2007). Students'perception of their classroom environment. *Journal of Educational Administration and Planning.3* (1):145-152.

Ikedolapo, O. O. & Adetunji, A. F. (2009). Comparative effect of the guided discovery and concept mapping teaching strategies on senior secondary school students (SSSS) chemistry achievement in Nigeria. *EJPCE Eurasian Journal of Physics and Chemistry Education 1* (2), 86-92.

Jacobsen, E. K. (2007) *Chemistry in my kitchen.* Tamilnadu textbook corporation: Chairperson & Author.

Kapitzki, E. (2011). *Guided inquiring learning.* How much support is most effective for children's learning? (Master thesis).

Nsofor, C. C. (2001). Cultural impediments on women in STM education. *STAN* 63-68.

Nwosu, J. A. (2001). Students' task involvement and achievement in

process-oriented science activities. *Science Education. 70,* 1-72.

Onasanya S. A. & Omosewo, E. O. (2011). Effect of improvisation and standard instructional materials on secondary school student's academic performance in physics in Illorin, Nigeria. Singa pore *Journal of Scientific Research. 1,* 68-76.

Reeves, J. P. (2005). *Learning science in the changing world*: Cross-National Studies of Science Achievement Australia: IEA Headquarters.

Rodney, J. & Hamilton, S. (2000). The study of science by high school students and environmental variables. *Journal of Educational Research 72*(3), 213-220.

Rural Education (2013). *The University of Michigan* Downloaded from Internet 07-05-13.

Schreiner, E. (2012) *Roles of improvisation in chemistry teaching.* Retrieved from www.ehow.com>ehow>education).

Shafquat, H., Muhammad, S. Imran, V., & Nawmullah, I. (2010). An experimental study of the effectiveness of super-learning technique at Elementary level in Pakistan. *Educational Research and Reviews 5 (1),* 86 – 89.

Sahin, A. (2010). Effects of jigsaw II, technique on academic achievement and attitudes to written expression course. *Educational Research and Reviews 5* (12), 777 – 787.

Snodgrass, J. B. (2001). *From the kitchen to the classroom ideas and lessons for the science teachers*. New York: Harper & Row.

Wagh, V. G. (2008). *Effectiveness for learning styles in theory and practice of "pochard ware maintenance"*. Retrieved from http://www.\ed\.org

Williams, R. T. (2005). The teaching-learning environment in students centered physics classroom. *Journal of Research in Science Teaching. (4)*186