

Promoting Chemistry Teaching/Learning Through the Use of Local Materials and Students' Academic Achievement/Retention In Cross River State. Nigeria.

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ABSTRACT

The study investigated students' learning outcome in terms of academic achievement and retention when taught rates of diffusion of gases using with learning resources in Cross River, Nigeria. The resources include, perfume, lemon, plantain peels, rose flower, yam, cup, cassava, firewood, camphor balls, ginger extra, red cabbage, sugar cane, milk, sand, organic indicators, balloons, gas jar, ammonia gas, hydrochloric acid, two connecting rods, rotten eggs. Fume cupboard, and oxygen gas. Two research hypotheses were formulated to guide the investigation. The researcher adopted pretest-posttest, Quasi-Experimental Research design. A total of 240 SS1 Chemistry Students' participated in the study. Two research instruments were used to ascertain students' learning outcome, Chemistry Achievement Test (CAT) and Chemistry Retention Test (CRT). The reliability of the instrument was established which yielded a reliability coefficient of 0.89 using Richard Kudarson formula- 21. The experimental classes were taught rates of diffusion of gases with learning resources (from the environment) while the control class was taught with the traditional method. Before the treatment a pretest was administered to experimental and control participants and after the treatment, A posttest was also given to the students after two weeks. To ascertain the level of retention of concepts a retention test was administered three weeks after treatment. Data obtained were analyzed using analysis of co variance (ANCOVA). Results of finding revealed that the experimental group taught rates of diffusion of gases with learning resources performed and retained significantly better than the control group. . Recommendation and Conclusion were drawn as teaching rates of diffusion with the use of learning resources is a physio-therapy for students' performance and retention especially in our society where science education is at a deplorable state.

Keywords: Learning Resources, Chemistry, Achievement, Retention, Diffusion, Gases.

Aims Research Journal Reference Format:

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1. INTRODUCTION

Learning outcome in science subjects in Cross River State in recent years has remained considerably low over the years. The past five years chemistry is one of the most poorly performed subjects at the Senior Secondary Certificate Examination. Table 1 for example, provide evidence of poor performance of student at the senior secondary certificate examination in Cross River State between 2005-2013. Available literature (Nnake & Anakwe, 2006) indicates that the poor achievement in science subjects has been partly attributed to teacher dominated teaching method, inadequate opportunities for learners to be fully involved in the learning process, mode of presentation of science concepts.

Shukle (2012) had argued that learning should emphasize experiment based learning that described a teaching process where teaching and learning process are integrated that will trigger critical thinking. Literature on teaching method emphasized the need to have classroom that are less teacher scripted and commanded if learners are to be properly engaged in the process. In view of this ugly trend observed in secondary schools, alternative method of delivery chemistry concepts are being sought and promoted by researchers worldwide to enhance the efficacy of service (chemistry) teaching and learning and achievement. Teaching rates of diffusion of gases is an activity – based approaches and use of locally sourced environmental resources are some of such approach that are being promoted in learning chemistry today in secondary schools recently for promoting the quality of chemistry teaching and learning. Similarly, Gbamanja (1991) observed that, learning is more efficient and effective if the laboratories and resources are maximized. A bare and uninteresting classroom environment offers little or no stimulation for learning to take environmental resources are biotic physical and chemical resources or minerals that are component parts of the learners’ environment outside the standard resources that can be used in teaching rates of diffusion of gases to extract from leaves, flowers, water (H₂O), salt solution, yam, potassium manganate, potatoes, thermometer, extract from grape, hydrochloric acid, ammonium beakers, basin, parchin paper filter/paper sugar, funnel and a membrane.

TABLE 1: Students’ Performance in Senior Secondary Certificate Examination O’ level Chemistry in Cross River State 2005-2013

| Year | Entry | Total credits A ₁ -C ₆ | Total % of credits A ₁ -C ₆ | Total pass P ₇ -P ₈ | Total % of pass P ₁ -P ₈ | Total failure | Total % of failure |
|------|-------|--|---|---|--|---------------|--------------------|
| 2005 | 5080 | 1218 | 20.0 | 1009 | 24.00 | 2862 | 56.00 |
| 2006 | 4976 | 1054 | 18.0 | 866 | 21.00 | 3056 | 61.00 |
| 2007 | 5460 | 1082 | 24.4 | 1333 | 19.80 | 3045 | 55.79 |
| 2008 | 5630 | 1023 | 21.7 | 1221 | 18.20 | 3386 | 60.10 |
| 2009 | 5138 | 1321 | 15.76 | 809 | 25.70 | 3008 | 58.54 |
| 2010 | 6105 | 1062 | 23.3 | 5043 | 17.40 | 3618 | 59.30 |
| 2011 | 6345 | 2052 | 32.3 | 1302 | 20.5 | 2991 | 47.2 |
| 2012 | 6872 | 1958 | 24.5 | 1543 | 22.5 | 3372 | 49.1 |
| 2013 | 7325 | 2431 | 33.2 | 1668 | 23.1 | 3226 | 44.1 |

Source: WAEC, 2005 - 2013

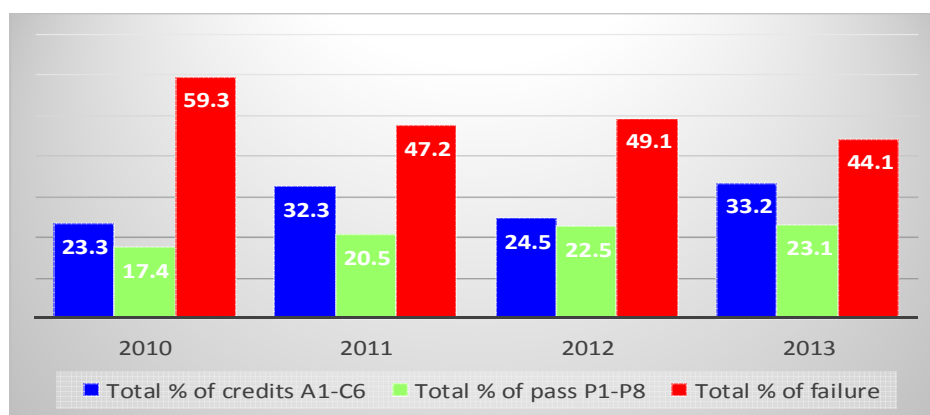


FIG. 1: Students’ Performance in Senior Secondary Certificate Examination O’ level Chemistry in Cross River State 2010-2013

Thomas Graham (1869) in his experiment on rate of diffusion of gases observed that a gas occupies any volume accessible to it. The process in which a substance spontaneously permeates or spreads through another medium through the process of diffusion, every substance has a rate of diffusion which depends on the cohesiveness of the bond holding particles in position. For instance, rotten egg odour penetrates the environment or room which suggests that the gas has become distributed throughout the entire volume of room by diffusion supporting the rate of diffusion of different gases under the same condition of the particles of the gases hydrochloric acid and ammonia travels from a higher region forming white dense fume of ammonia gas. An inquiry teacher should be able to explore alternative teaching strategies that will involve the learners in the process. Ugwu (2011) stated that the essence of learning is imparting knowledge to the learners. Concepts in chemistry could better be explained with available science resources locally sourced within the environment. Supporting this assertion, Dunguryil, Denji & Hibia (2013) posits that students are expected to be involved in chemistry lessons but on the contrary they are most often reduced to mere listeners. Dunguryil, Denji & learning is more interesting when it is participating method.

Environmental r

resources may possibly stimulate and arouse the ability of students in science especially (chemistry) and probably influence students' learning outcome in science. The purpose of the research was to investigate the learning outcome of students' taught rates of diffusion of gases with environmental resources. Specially, the research question does teaching with and without environmental resources affect students' learning outcome.

1.1 Significance

The largest chemistry laboratory is a learning environment which stimulates learning of science. The environment offers individuals various resources for teaching science (chemistry) more than anyone could ever imagine on earth. It is a place where they gain their first life experiences as they go through the various developmental stages as highlighted in Piaget's theory of intellectual development. The environment is stocked with quality physical, biotic, abiotic resources that can explain the concept of rate of diffusion of gases for proper understanding of the concept science teachers should explore resources within the confines of the environment. The significance of this study depends on the findings that will provide the relevance of teaching chemistry with environmental resources and the impact on students' achievement and retention in chemistry.

2. THEORETICAL BACKGROUND/LITERATURE

Five construction model of teaching science modified by the researcher, constructivist theory of learning is a theory that believes that knowledge is constructed in the individual on the basis of past experiences. It is based on scientific studies and observations about how different people learn. Active participation during learning offers the learners a paradigm to learn actively and differently which differs from the traditional method of teaching, where the teacher does not give room to students' involvement.

Constructivism Model of teaching five steps conceptual change constructivism model.

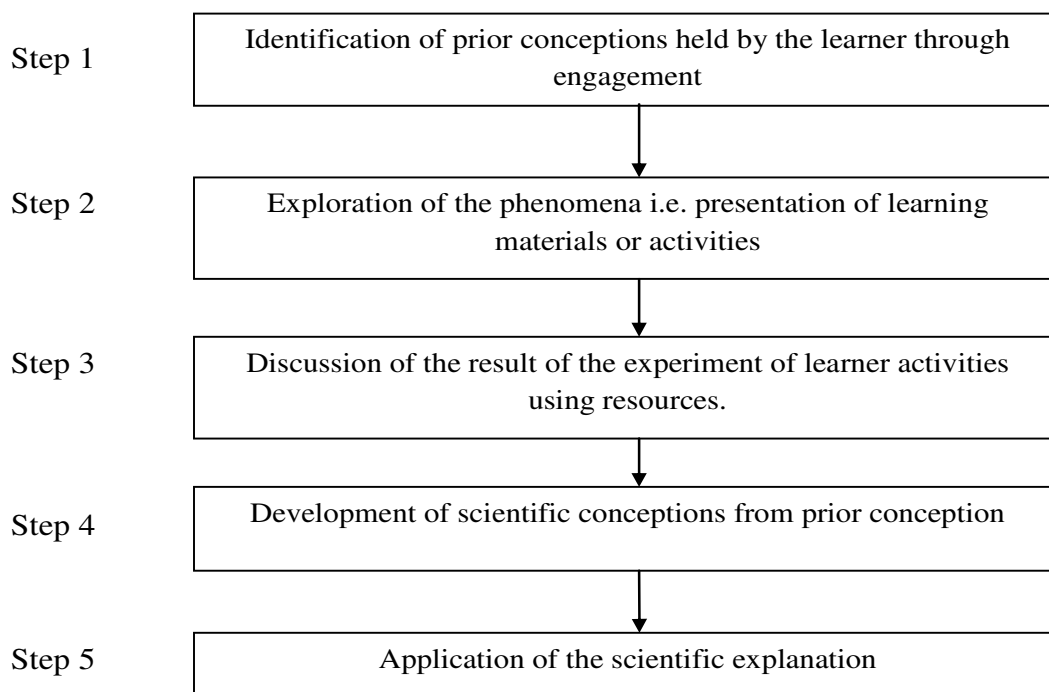


Fig. 2: five steps conceptual change constructivism model.

Science teachers who are concern with students academic needs have been found to encourage more students participation to create opportunities for students' doing things by themselves producing meaningful learning outcome Obiekwe and Njelita (2013) illustrated teaching rates of diffusion of gases, Boyle's law and Charles law using activity – oriented learning approach with resources like bicycle pumps balloon, tripod stand, 2 transparent bottles, matches, meter rule and water. Finding revealed that gaseous particles escape from that balloon, bottles, springe and piston at different time rate from a high concentration to a lower region of concentration. Johnson (2007) discovered that the environment create innovative teaching that makes science teaching and learning easier and fun for the learners. Environmental resources promote collaborative learning, cooperative learning and entrepreneurial skills environmental resources contains lots of innotive experiments and activities, which positive learning efficacy in the learner.

Snodgrass (2001) asserted that learners who go to school to study science at the secondary institution and had contact with the learning resources in the environment are stimulated and motivated to learn science as a means of finding answers to many questions in the environment. Science is experienced and practice every day and anywhere. Environmental resources can be stimulating for many learners. The resources allow teachers to simplify the abstract nature of science with real objects. Learning experiences with real objects connect the learner to the world of science which plays a vital role in understanding chemistry better than the conventional mode of presentation. The term diffusion of gases involves the movement of particles through a medium from a region of high concentration to a region of low concentration. It occurs in all states of matter but that of gases is the fastest.

Gases diffusion according to Abbing and Gammon (2005) is a process whereby a gas spread out through another gas to occupy the space uniformly. Thomas Graham (1869) in his various experiments noted that the more massive a gas is, the less is its rate of diffusion. Supposing the rates of diffusion of two gases under the same conditions are R_1 and R_2 then;

$$R_1 = \frac{1}{\sqrt{d_1}} \text{ and } R_2 = \frac{1}{\sqrt{d_2}}$$

$$\frac{R_1}{R_2} = \sqrt{\frac{d_2}{d_1}}$$

$$\frac{R_1}{R_2} = \sqrt{\frac{m_2}{m_1}}$$

The rate of diffusion of equal volumes of the two gases in time t_1 and t_2 and $R_1 =$

$$\frac{V}{t_1}$$

$$\frac{R_1}{R_2} = \frac{t_1}{t_2}$$

$$\frac{t_1}{t_2} = \sqrt{\frac{M_1}{M_2}}$$

$$\frac{t_1}{t_2} = \sqrt{\frac{M_1}{M_2}}$$

If two gases are made to diffuse from the cylinders at the same time, the energy of the two gases must be equal.

$$\frac{1}{2} M_A U_B^2 = \frac{1}{2} M_B U_B^2$$

$$\frac{R_A}{R_B} = \frac{M_B}{M_A}$$

Also Jerome Bruner's theory of discovery learning (1966) emphasizes the importance of the discovery learning approach in science instruction. The theory states that learning is best promoted when a learner is able to figure things out for himself. The theory emphasized on the principle of motivation structure, sequence and reinforcement. The principle of motivation is based on curiosity drive which leads learners to turn from one activity to the other in quick succession and so the learner must be channeled and discipline. Learners become interested in whatever they are good at doing to enhance their proficiency. Thus, learning resources in teaching rates of diffusion of gases will help increase the curiosity and interest of the learners to learn science especially (chemistry).

Instruction specify the ways in which a body of knowledge is presented to the learners so that it can easily be understood. This structure considers the methods, time scope, content and actions learning should be sequentially arranged from enactive through iconic to symbolic representation. Bruner believes that to achieve mastery of any task feedback must be received. He consequently stressed the importance of reinforcement and its timing. Therefore, the purpose of this work is to investigate the learning outcome of students in terms of achievement and retention of concepts when taught rates of diffusion of gases using learning resources locally sourced from the environment.

3. METHOD AND MATERIALS

The researcher adopted a quasi-experimental design for this study. the population consist of the entire senior secondary are in Calabar Education Zone, Cross River State.



Fig. 3: A Typical Class Setting

A total of two hundred and forty (240) students were sampled from four secondary schools using purposive sampling technique. The researcher intentionally and credibly selected the respondents to avoid bias and give room for effective engagement and interaction with the learning resources. The researcher prepared two different teaching plan which were used to teach the experimental and control groups. The experimental groups were taught rates of diffusion of gases using learning resources locally sourced within the environment but the control groups were taught without learning resources.

At the end of the lesson and experimental procedures a chemistry achievement Test (CAT) was administered to the students after two weeks of treatment. The Chemistry Test comprised of 50 – items multiple choice question with four options. There was a sharp difference between the pretest and posttest scores of the two independent groups. Two weeks after the administration of the Achievement Test, a Chemistry Retention Test (CRT) was administered to the same group of students.

The scores of students both in achievement and retention test were subject to analyses using analysis of covariate (ANCOVA) because the pretest scores were used as the bases of comparison. The two null hypotheses were tested at 0.05 level of significance. The mean and standard deviation scores were computed.

4. RESULTS OF FINDINGS

Hypothesis 1

Influence of learning resources on senior secondary one (SSI) students' academic achievement in chemistry.

TABLE 2: Summary of analysis of covariance on post-test scores according to treatment on achievement in chemistry.

| Source of variance | Sum of squares | df | Mean square | F-ratio | p-level |
|--------------------|----------------|----|-------------|---------|---------|
| Intercept | 996.822 | 1 | 996.822 | 30.028 | .000 |
| Pre-test | 141.692 | 1 | 141.692 | 4.268 | .040 |
| <u>Main effect</u> | | | | | |
| Treatment | 234.676 | 1 | 234.676 | 7.069 | .008 |

R Squared = .647 (Adjusted R Squared = .634)

The analysis in table 2 revealed that the experimental group had a higher mean score which is greater than the F-value (7.069) at 0.05 level of significance. This means that there is a positive influence of learning resources on students' academic achievement in chemistry.

Hypothesis 2

Influence of learning resources on students' retention in chemistry

TABLE 3: Summary of analysis of covariance on retention-test scores according to treatment in chemistry.

| Source of variance | Sum of squares | df | Mean square | F-ratio | p-level |
|--------------------|----------------|----|-------------|---------|---------|
| Intercept | 4223.010 | 1 | 4223.010 | 97.592 | .000 |
| Pre-test | .191 | 1 | .191 | .004 | .947 |
| <u>Main effect</u> | | | | | |
| Treatment | 1032.276 | 1 | 1032.276 | 23.856 | .000 |

R Squared = .496 (Adjusted R Squared = .477); Model Goodness of fit R=.617; R Squared = .381

Table 3 revealed that the retention scores of the experimental group is higher than that of the control group which the calculated value (.617) at 0.05 level of significance

5. DISCUSSION OF FINDINGS

The findings in the research hypotheses showed that there is a positive influence of learning resources on students' academic achievement in secondary school. It means teaching science (chemistry) with engagement using resources locally sourced within the students environment help to enhance the effectiveness of learning and learning outcome in chemistry.

The finding agrees with Inyang (1997) that teaching is more effective and maximized when science teachers adopt the use of instructional materials. Stephen, Isaac & Iorkpilgh (2013) confirmed that there is a significant correlation between instructional materials on academic performance of senior secondary students in chemistry in Yakurr Local Government Area of Cross River State. Neji, Nja and Ukwetang (2014) noted a positive influence on the adequacy of laboratory facilities and students' academic performance in chemistry in Calabar Municipality, Cross River State.

Finding on retention also shows that the experimental group retained significantly higher than the control group in chemistry. This finding is in consonance with Udofia and Nsikanabasi (2014), studied the effect of laboratory environment on Senior Secondary two (SS2) Chemistry students' performance in qualitative analysis. The study consisted of six hundred and fifty (650) Senior Secondary School students in public Schools in Ikot Ekpene Local Government Area. Stratified random sampling technique was used to select thirty (30) students in the study area. A validated Chemistry Achievement Test (CAT) was the research instrument. The CAT had a reliability coefficient of 0.99. The results obtained gave a significant difference between laboratory apparatus and non-laboratory apparatus; and teacher's attitudes with academic performance in qualitative analysis. Consolidating the above findings, Nsikap-Abasi, Ibiritam and Onweh (2014) conducted a study on the effect of instructional methods on students' academic achievement in Technical Colleges in Akwa Ibom State.

The researchers compared the effect of demonstration and conventional methods in the construction of load bearing walls, and block-laying. It was a quasi-experimental, study using a sample of 90 subjects drawn through purposive random sampling technique from a population of two hundred and forty six senior technical two students. The experimental and control groups were taught block-laying and concreting topics from NABTEB syllabus and tested by research attendants. Block-laying and Concreting Achievement Test (BCAT) was developed by the researchers. The reliability coefficient was established using Cronbach alpha reliability estimate. Analysis of Covariance (ANCOVA) was used to test the hypotheses. Results indicated that scaffolding instructional method can be used in teaching workshop based subjects such as Block-laying and concreting. Scaffolding and demonstration instructional methods were found to be better teaching methods than conventional instruction method in teaching block-laying and concreting. In ascertaining the level of achievement and retention of students in Science.

Similarly, Busari (2001) studied the effect of four instructional approaches on students' academic achievement and retention in Science using selected secondary schools in Lagos state. The subjects were grouped into four instructional groups; concept mapping and problem-solving; guided group discussion mode; Inquiry and discovery mode and lecture mode (LM). Students were taught using the different instructional approaches for ten (10) weeks and pos-tested. A retention test was duly administered two weeks later. Findings of the study showed a significant difference among students in the instructional groups on students' cognitive achievement. ($F=2, 218=49,97, P.0.05$). The CGP produced a positive effect on students' academic achievement followed by the CPL and the least of all was the LM. In the CGP group, students retained knowledge best after two weeks. The study further showed that Lecture method as well as discovery method did not produce effective learning among all the students with heterogeneous characteristics in the classroom. Rather, concept mapping and problem-solving provided better opportunity for the teacher to diagnose students' weak ability in comprehension and application of Science concepts. Experimental class taught rate of diffusion of gases using learning resources

6. CONCLUSION

In this study the aim was to investigate the influence of learning resources on students' academic achievement and retention of senior secondary schools in chemistry in cross river state, Nigeria. It is therefore, concluded that;

Students taught rates of diffusion of gases with learning resources performed significantly better than those taught without learning resources. There is also a positive influence of learning resources on students' retention in chemistry.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations were made

1. Science (Chemistry) teachers should employ the use of resources within the environment and should engage the students actively in the learning process.
2. Workshops, mentorship for science teachers generally should be encouraged especially at the secondary schools on how to utilize learning resources

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