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Local Instructional Resources as Strategy Towards Sustainable Science Classroom Engagements in Imo State, Nigeria

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Abstract

The sustainable development goals (SDGs) also called Global Goals, are a call to use current resources of the world in a manner that future generations will still depend on them for their livelihood. SDGs therefore, create equal opportunities for all citizens of the world, even in the future because they are organized principles that aim at meeting human prosperity through enabling natural ecosystems to provide necessary resources and services that humans need without impeding on their capacity to keep functioning. The focus of this study is on Goal number four (4) which emphasizes quality education, including science teaching and learning. It is against this background that this paper investigated the effect of local instructional resources on the academic achievement of secondary school chemistry students in Imo State, Nigeria.

Keywords: Science Teaching, Local teaching Resources, chemistry students and Sustainable Development.
JEL Classification Code: A1

1. Introduction

In many countries, science subjects are taught from the earliest grades because science and technology are an integral part of our lives already and will continue to play important roles in the future. An understanding of, and participation in, science and technology is very important in today's global world. However, for the sake of sustainability and adaptability, both of educational goals, classroom practices and the environment, a link should be clearly discernable in minds of science students as they make sense of the epistemological activities in their classrooms. It is only in doing this that the aims of MDGs generally and the principle of sustainability as enshrined in MDG 4, can be achieved: Ensure inclusive and equitable quality education and promote life long learning opportunities for all (UN, 2017) Poor comprehension, participation and performance of chemistry students may be traceable to classroom activities devoid of inclusion of resources available in the immediate environments of the students. The study therefore, covered topics on acids, bases and acid-base reactions. The present researchers therefore, tried to provide much of the perishable materials used in teaching and learning the chemistry topic from locally available resources.

The purpose of the study is to find out, if the use of local instructional resources will have an effect on:

i. Students' achievement in chemistry generally
ii. Male and female achievement in chemistry
iii. Male and female interaction with instructional materials.

The following hypothesis guided the study:

i. There is no significant difference in the mean post-test score of students taught with substituted local materials and students taught with standard materials in Chemistry Achievement Test (CAT).
ii. There is no significant difference in the post-test CAT scores of male and female students in the control and experimental groups.
iii. There will be no significant interaction between students' sex and instructional material on CAT.

2. Literature Review

Sustainable developments in line with earlier definitions provided, refers to the many processes and pathways to achieve careful use of present resources without being exploitative and without subjugating the chances of future generations to depend on same for their survival, (UNESCO, 2020). Sustainable development, therefore, ensures that necessary natural resources and ecosystem services are provided to human beings at all times. The international community has pointed to education as the most viable means of promoting sustainability (Onwu, 2013). According to Onwu and Kyle (2011) in Onwu (2013) Science education has much to offer in helping to facilitate knowledge and skills required for development in the global economy. According to Jerick, Aquino, Romiro, et al (2022), Chemistry, as a science subject, provides abstract concepts that need a contemporary concept formation to build foundations on. This is to enable concepts learnt from theory to influence quality of teaching and learning the subject impactfully. There are, therefore, wake up calls on science teachers, including chemistry teachers, to think of alternative classroom experiences that will still maintain high quality teaching and learning and at the same time provide opportunities for students towards alternative routes to scientific realities imbedded in their environments. This will surely have impact on sustainable developments at both the community, national and global levels.

An important goal of science education is for learners to be able to create a link between science education and the real world. Further, science education ought to expand both teachers and learners' engagement to identify possibilities and use their imagination in problem-solving and decision-making within their immediate environment. In a similar view, Omebe and Akani (2015) opined that mastery of science content and the achievement of the objectives of the science curriculum cannot be fully achieved without adequate and proper articulation of human and material resources. It will be woeful if science teaching fails to excite and be attractive to many learners irrespective of gender and immediate environment, as they may perceive science to be abstract and impracticable (Akpan, 2015). This is already the experience of many students in many science classroom practices. According to Nbina, Viko and Birabil, (2010), experimenting provides a forum for hands-on activities drawn from theoretical knowledge. Experiments lead to new knowledge, modification or outright rejection of existing body of knowledge. Scientific knowledge comes in the form of concepts, laws, theories and models. Scientific knowledge acquired through practical activities in a real-world situation reduces the abstractness of scientific concepts, (Jerick, Aquino, Romiro, et al (2022) Classroom science experimentations however, dependent on the availability of instructional materials.

The theoretical basis of this study is rooted in the local instructional theory. A local instruction theory (LIT) informs teachers about how innovative educational approaches work so that they can adapt them to their classrooms (Gravemeijer & van Eerde, 2009). Local instruction theory, which consists of a number of theories about the learning process on certain topics and means to support the learning, is believed to lean heavily on Benjamin Blooms 1956 work at the university Chicago, USA. The theory supports teachers in the

development of innovative-oriented instructional sequences (Andrea, Cloudio and Diego (2019).

This study employed local resources in teaching a specific chemistry topic after careful study of the learners' environment and mapping the local resources therein that can improve on classroom experiences of students and possibly enhance their achievements. The design therefore, concerned both the process of learning and the means put in place to enhance learning (Bulstang, Darlmawijoyo Mallen, et al, 2013) Local instructional resources refer to a diversity of educational resources that can easily be obtained from an environment with a high local content and have high relevance to the curriculum (Engida, 2012). Local instructional resources facilitate teaching and learning of science concepts as well as improve the intellectual and practical skills of the learners. It has also been identified as the panacea for the effective delivery of the Nigerian science curriculum in order that her educational goals might be achieved. To solve the problem of abstraction in science, local instructional resources will also help the students to acquire scientific knowledge which applies directly to their daily lives and induce them to observe their own local environment as a way of live (Davidson, 2010). Many empirical reviews reveal that gender was not a factor on academic achievements of chemistry students. There was also indication of interaction effect of gender and treatment on students' retention in chemistry (Adenkunle, Nwabuno, Okebukola, et al, 2021, Samphina Academy, 2017)

3. Methodology

This study is domiciled in the science subject of chemistry because it is a central branch of science which deals with the composition and properties of matter. Chemistry is a good knowledge tool to carry out classroom related studies. The role of chemistry education to nation building cannot be overemphasised. Chemistry teaching and learning requires instructional materials that can easily be sourced from local environments. The research design was quasi-experimental design. A stratified random sampling technique was used to place schools in strata of males and females while a simple random sampling technique was used to select schools from each stratum into experimental and control groups. The sample size was made up of one hundred and sixty-nine (169) chemistry students, drawn from two male and two female secondary schools respectively. The research design, being quasi-experimental, intact classes of senior secondary school class one (SS1) chemistry students were randomly assigned into experimental and control groups. Students in the experimental group worked with local instructional materials while those in the control groups were taught with and worked with standard materials as shown in table 1.

Table 1
Experimental Design of the Study

Group	Pre-test	Treatment	Post-test
Experimental	O_1	X_1	O_2
Control	O_1	X_2	O_2

Key:
O_1 = Pretest for experimental and control group
O_2 = Post-test for experimental and control group
X_1 = Treatment for experimental group
X_2 = Treatment for control group.

The lesson unit contents for the study were Acids, Bases and Acid-Base reactions. Before treatment commenced, chemistry teachers from the sampled schools were trained on

how to follow the lesson plans in the class sessions of both groups. They were also provided with instructional materials and lesson plans to be used for the study. The classroom activities and procedures were exactly the same except that those in the experimental group were supplied with local materials and preparations therefrom (specifically, solutions of unripe orange juice, vinegar and sour palm wine in place of a standard acid solution, unripe plantain as a basic solution, Hibiscus Sabdariffa Calyx, locally called zobo, was used as indicator among other local materials suitable for the lesson) while those in the control group were given standard solutions of acids and bases (specifically, solutions of hydrogen chloride acid, sodium hydroxide and phenolphthalein indicator solutions were used.). The acids and base which were obtained from local resources provided clear solutions when filtered with filter paper. The indicator was prepared by extracting the dye with 50% ethanol and 50% water. However, the concentrations of these solutions from the local resources were not measured accurately but the workability was determined by trial and error.

The students in each group were aware of the materials they used and helped in preparing them. Six instructional periods were given to the students to ensure they gain mastery of the topics. A pretest was administered before treatment started. Students from both groups were given same assignments after each lesson A period of one week was given to the students to allow for mastery of the lessons after the treatment and before administering the post-test.

4. Data Analysis and Discussion of Findings

Data was analyzed using mean and ANCOVA at 0.05 significant level.

Table 2:
Mean achievement of scores of students in experimental and control groups

Group	N	X
Experimental	103	52.01
Control	66	39.54
Total	169	47.14

Key
N = Number of students in experimental and control groups
X = Mean of post-test score
Source: Authors' Computation (2023).

The table 2 above shows that students in the experimental group had higher mean achievement score when compared to those in the control group.

Table 3:
Mean achievement of male and female students in both groups

Sex	N	X
Male	93	45.03
Female	76	49.72
Total	169	47.14

Source: Authors' Computation (2023).

The table 3 above shows that female students had a higher mean achievement score when compared with male students in CAT

Table 4:
Mean achievement score of male and female students in both groups

Sex	XE	XC	XT
Male	53.44	35.25	45.03
Female	50.66	47.57	49.72
Total	52.01	39.55	47.14

Source: Authors' Computation (2023).

Table 4 above shows that both male and female students in the experimental groups had a higher mean score.
Hypotheses Testing

Table of ANCOVA in Table 5 was used to test hypotheses 1, 2 and 3.
Table 5:
Summary of ANCOVA results for CAT

Source	Df	F	Sig(p)
Pretest (covariate)	1	13.74	.00
Group	1	17.39	.00
Sex	1	4.11	.04
Group* Sex	1	18 53	.00

Source: Authors' Computation (2023).

Hypothesis 1
There is no significant difference in the mean post-test score of students who were taught with local instructional resources and students taught with standard materials in CAT.
Decision rule: reject the null hypothesis if $p<0.05$
From Table 5, (source = GROUP, F = 17.393, $p<0.05$) we reject the null hypothesis and uphold an alternative hypothesis of a significant difference in the mean achievement of students in the experimental group. The difference in mean scores is in favor of those taught with resources from their local environment.

Hypothesis 2
There is no significant difference in the post-test CAT scores of male and female students in the control and experimental group.
From Table 5, (source = SEX, F = 4.11, $p< 0.05$), we reject the null hypothesis and uphold an alternative hypothesis of a significant difference in the mean achievement of students based on sex (male = 45.03, female = 49.72), in favor of female students.

Hypothesis 3
There will be no significant interaction between student's sex and instructional material on CAT.
Table 5 (source = GROUP* SEX, F = 18.53, $p< 0.05$), we reject the null hypothesis and uphold an alternative hypothesis of a significant interaction between students' sex and instructional material in CAT.

4.2 Discussion of Findings

The findings of the study revealed that students taught chemistry with local instructional resources significantly achieved more than those taught with standard instructional materials. There was an interaction between sex and instructional material in

achievement. This is in line with the studies of Onasanya and Omosewo (2011) who in a similar study revealed that students taught with local materials in physics achieved more than those taught with standard materials. This finding is also supported by the assertion in Onwukwe, Okereke, et al. (2014) that instructional procedures that incorporate fun and engender relaxed mood tend to change the perception of chemistry as a difficult subject, over-crowded with difficult concepts.

5. Conclusion and Recommendations

Based on these findings, it was concluded that the use of instructional materials from local resources can create meaningful practical experiences for chemistry lessons. Recommendations made include that:

i. Chemistry teachers should endeavor to incorporate materials sourced from their immediate local environments as much as possible.
ii. Chemistry teachers should encourage equal participation of Male and female students in chemistry activities in their classrooms without adherence to stereotypes among male and female dichotomies. This will help chemistry and indeed all science classroom engagements more sustainable and move towards equity in all science achievements.

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