Effects of Geographic Information System on the Learning of Environmental Education Concepts in Basic Computer-Mediated Classrooms in Nigeria

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Abstract

This research paper specifically examined the impact of Geographic Information System (GIS) integration in a learning method and on the performance and retention of Environmental Education (EE) concepts in basic social studies. Non-equivalent experimental research design was employed. 126 pupils in four intact, computer-mediated classrooms were sampled. Instruments included Envi-Geo Info System (EGIS) package and Environmental Information Achievement Test (EAT). The study found no significant effect of treatment on performances of participants in EGIS integrated treatment groups. No significant effect was found across the groups on pupils retention even though, treatment groups retention mean was higher than contemporaries. The study concluded that, adaptation of EGIS into sorted EE concepts will improve learning and might boost retention even in computer-mediated social studies classroom provided the use of GIS is made feasible in Nigeria and adopted into teaching-learning process. It recommended that stakeholders in Nigerian education system should foster workable strategies to improve teaching and learning and that, the use of GIS locally must be placed in the national education objectives. It is in the best interest of the people to learn the rudiments of personal safety, spatial development, incidental natural alerts, as well as preventions and solutions.

Keywords: computer-mediated classroom; geographic information system; environmental education; transversality.

Introduction

The yawn for conducive natural world - clean protected water, air, plants, and wildlife; each respectably placed within the ecosystem as against resource depletion, loss of species, and climate change which has threatened the sustainability of planet earth remain a mirage in spite of the many efforts over the decades, the world over and more specifically in Nigeria. A fundamental shift in approach toward instilling a sense of care and responsibility for the well-being of communities and the planet Earth as an abode for man and his neighbors - centripetal or centrifugal - is inexcusable. The need to immunize the Nigerian society against nature deficit disorder and eco-phobia are overt. Louv (2005) characterized modern children's isolation from nature as the foundation for disgust for science learning in elementary schools, less discovery of scientific truths, developing disaffection for nature within children and terse sense of conservation. Lorsbach and Jinks (2013) suggested teaching and learning process as turning points.

Environmental Education (EE) according to the Working Group on Environmental Education (2007) is education about the environment, for the environment, and in the environment that promotes an understanding of, rich and active experience in, and an appreciation for the dynamic interactions of the:

• The Earth's physical and biological systems;
• the dependency of our social and economic systems on these natural systems;
• scientific and human dimensions of environmental issues;
• positive and negative consequences, both intended and unintended, of the interactions between human-created and natural systems.

The social studies subject as a child of circumstance can encompass EE. Historically, social studies was born to resolve contemporary societal problems within the humanities. It has its parentage from the social sciences and concerned disciplines to address particular problems in the United States hence, a continuous bid on social studies subject at resolving fundamental societal issues is never out of place. The subject was introduced into Nigeria educational system in 1963. Therefore, the modern-day environmental challenges of global warming, resource depletion, loss of plant and animal species, climate change and such issues threatening the human race and his host planet become central concerns of the social studies subject as an amalgamative, multi-disciplinary school discipline. This is especially important in the view of non-existence of environmental education as a school subject in the basic and middle schools in Nigeria.

This study, therefore, examined the effect on the performance of pupils exposed to Geographic Information System (GIS) integrated with environmental education concepts in basic computer-mediated classrooms with social studies as the teaching subject. It also determined the effect of the intervention on pupils' retention. These are with a view to tout on the best strategy for the teaching and learning of the diffused environmental education concepts in social studies subject in Nigeria.

Literature Review

Literature provides a few studies on varieties of strategies explored in the teaching and learning of environmental education both in formal and non-formal education settings. Experiential learning advocated by Water Monitoring Youth Portal (WMYP, 2016) in

Canada to entrench the awareness, knowledge, attitude, skills and participation in affective and cognitive experiences with their biophysical or social environment. Adult environmental literacy had been experimented and found good earlier in Europe by Mancl, Carr & Morrone (1999). The public of Ohio, United States overwhelmingly supports EE in public schools (Environmental Education Council of Ohio (EECO, 2000). Environmental education takes place in all types of settings with all types of learners. It is only paramount that educators consider the developmental stages and the motivations of their intended learners and the educational setting when developing EE programs. Yet, the leading voices in EE clearly affirm that good EE does not impose prescribed views or courses of action onto learners (NAAEE, 2000). Rather, good EE helps people learn how to evaluate information and points of view for themselves in order to make informed decisions. Despite this commitment to objectivity, very few works however related these to learners' performance or underscore the very essence of retention of learnt concepts.

Senemoglu (2003) lauded the use of computer-mediated instructions as engendering motivating force, immediate feedback and reinforcement capabilities which enable learners to progress at their own pace and accordingly provides them with appropriate alternative ways of learning by individualizing the learning process. Computer-mediated classroom instruction (CMI) is an offshoot of Information and communication technology which has lifted education off from borderlines in terms of time and place. Even in the developing nations of the world including Nigeria, Adeleke (2016) and Adeleke, Jegede & Iroegbu (2017) have utilized CMI in institutions to expose learners to the whole scope and varieties of learning in numeracy, literacy and enculturation with plausible effect on performance and retention. It is especially needful in EE to enable learners to self-evaluate and reflect on the learning process. In Social Studies, the dart of access to spatial data collection, an electronic representation of earth's natural features as well as man-made environments are consistent challenges that require solution.

The Kansas State Teacher's College (1954) exhibited a concern with nature study and related science for children similar to what the researcher has today. Several projects which incorporated pupils from the primary level through the eighth grade were fostered with a view to help teachers to choose the most suitable instructional material and textbooks for their own teaching situations and as well help learners in the specific grades.

The framework for this study is rooted in the concept of transversality which according to Greenblatt (2015), referred to a description of objects intersection. It is rooted in generic and stable Thom's Transversality Theorem (1954). The adaptability of this concept in this study is premised on its emphasis on transversal teaching process presence in the social studies subject, a "guardian" of interdisciplinarity. UNESCO-UNEP (1978) recommended avoidance of environmental education becoming just another discipline added to those already existing but be introduced as a transversal theme in school curricula. This infusion of EE into Social Studies in the basic computer mediated classroom was the conceptual application of transversality theorem. Like Pujol and Bonil (2003) who saw the greening of today's curriculum as a complex and dynamic process constructed on three essential bases: a new collective ethic, a new style of thinking, and a new form of transformational action; the researcher adapted EE teaching within the social studies subject with the application of GIS as vehicle for instruction.

In spite of the paucity of research on performance and retention of environmental education concepts in the best interests of the learners' rudiments of personal safety, spatial

development, incidental natural alerts, preventions and solutions; this study would add to the existing body of knowledge, expand teachers and curriculum designers' choices of meaningful learning experiences and instructional strategies.

Methodology and Methods

The study adopted non-randomized pretest, posttest experimental research design to examine the impact of Envi-Geo Info System (EGIS) package on the learning and retention of environmental education concepts in basic social studies. The entire basic school pupils in Nigeria make up the population. Four junior secondary schools operating computer-mediated classrooms were purposively selected in south-west Nigeria. Four intact classes, one from each school were sampled into the study. A total of 126 pupils, of the four intact, computer-mediated classrooms were participants.

Instrumentation included Envi-Geo Info System (EGIS) package, having environmental education induced concepts in social studies subject, was principally used as a computer-mediated instructional package. The Environmental Information Achievement Test (EAT) was used as pretest, posttest and retention tests to assess the impact of the intervention. The posttest assessment was done on school basis (four schools) while the retention assessment was grouped into the two categories of research participants (experimental EGIS and control CM). The research instruments – Envi-Geo Info System (EGIS) package was self-developed using a taxonomy based on Blooms' principles as revised by Anderson and Krathwohl (2001) in Wilson (2013). It was trial-tested and Cronbach alpha value of 0.765; correlation values at r = 0.744 which (Berg, Wood-Dauphinee & Williams, 1995) asserted high enough to justify the reliability of instruments. The Environmental Information Achievement Test (EAT) used as pretest, posttest and retention tests were also validated by test experts prior use. The research hypotheses were analyzed for an answer using one-way ANOVA and T-test.

Results and Discussion

The first null hypothesis assumed that there is no significant effect of treatment on performances of participants in EGIS integrated treatment groups. To establish the assumption, analysis of the performance test results was undertaken. Descriptively, Table 1 showed the marginal scores in groups (25 and 60) and the actual mean score of each of the groups. It also exhibited the non-equivalent structure of the study groups.

Table 1: Analysis of Groups Performance in Environmental Information Achievement Test.

Groups	**N**	**Mean**	**Std. Dev.**	**Min**	**Max**
CM-EGIS 1	31	43.69	7.84	28.00	56.00
CM-EGIS 2	36	44.48	6.82	25.00	54.00
CM-1	25	39.00	7.23	39.00	58.00
CM-2	34	41.17	10.66	25.00	53.00
Total	**126**	**44.28**	**7.02**	**25.00**	**58.00**

Field Data (2017)

The table revealed mean scores of CM-EGIS 2 as the highest mean score (44.48), CM-EGIS 1 (43.69), CM-2 (41.17) and CM-1 score the lowest (39.00). However, the groups mean average of 44.28 did not negate score from any of the groups. Further analysis was

undertaken to predict the significance of result and a One-way analysis of variance was employed as shown in Table 2.

Table 2: Analysis of Variance - Groups Performance in Achievement Test.

ANOVA: Groups Performance in Environmental Information Achievement Test					
Variable	**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
Between Groups	126.43	3	45.51	0.92	>0.05
Within Groups	13594.07	122	49.32		
Total	13730.62	125			

According to Table 2, the result showed mean squares between groups and within groups as 45.51 and 49.32 respectively. It yielded F-ration of 0.92 which is not significant at the 0.05 level. The implication of this result is that the EGIS integration in computer-mediated basic social studies teaching of EE concept has no significance.

Findings predicted that the EGIS integration in computer-mediated basic teaching of EE concept has no significance ($F = 0.92$, $p>0.05$). This finding negated Conde and Sánchez (2010) postulation of environmental education (EE) as a lifelong process. The prominent objective of imparting EE are to inculcate environmental awareness, ecological knowledge, attitudes, values, commitments for actions, and ethical responsibilities for the rational use of resources and for sound and sustainable development. The significance of these has been emphasized through several seminars, summits, conferences and workshops locally and internationally. Achievements in advancing the course included the integration of EE into school curricula at basic, secondary, tertiary and graduate studies levels. Additionally, the result was in tandem with Bednarz (2004) opinion that, the many assumptions underpinning the initial period of enthusiasm for the GIS technology must be ascertained. Bednarz also reiterated that barriers to successful dissemination need be identified in order to help shape and inform phases of GIS implementation. It can be deduced that there is a need for developing an improved pedagogical foundation for GIS if it is to be explored as a strategy for teaching EE concepts.

Literature, educators and researchers affirmed that GIS is useful in the learning-teaching process (Aladağ, 2007; Alibrandi, 2003, Alibrandi & Sarnoff 2006; Beishuizen, 2006; Demirci, 2007; Siegmund, Viehrig & Volz, 2007). Pang (2006) however opined that GIS use in education will develop students' information and media literacy, preparing them well for the digital age. One of the main strengths of using GIS in education according to Pang (2006) is that, they engage students in 'scientific visualization' through the use maps and their databases, the process of interaction, manipulation and expression of information by the learners. These enrich and immerse understanding of the concepts related to the data being explored. It also instill the skills of organization and communicating information in our data-rich environment. More importantly, a "culture" that allows for an active research process, so that teachers can develop new ways of using GIS in their lessons (Jenner, 2006) is created by integrating GIS into school programs. When students navigate the range of visualization methods to constructively explore, discover and hypothesize on various scientific theories and concepts, they move from being passive recipients of information to active discoverers and constructors of knowledge.

The second null hypothesis stated that there is no significant effect of CM-EGIS intervention on pupils' retention. Study population was re-categorized into two namely, Computer Mediated-EGIS (CM-EGIS) and Comparison Method (CM). The retention ability test administered three weeks after the posttest; the scores of the two groups were subjected to t-test analysis with results presented in Table 3.

Table 3: Retention Ability Test on CM-EGIS Interventions.

Group	N	Mean (x)	SD	df	T	p-value	Remark
CM-EGIS	67	88.17	19.0249	60	-0.316	0.782	Not Significant
CM	59	84.38	17.8897				

The analysis indicated that there was no significant effect of CM-EGIS on pupils' retention of EE concepts in basic social studies classrooms across the study sampled population ($t = -0.316$, $p<0.05$). The hypothesis 2 not being rejected implied that no better retention ability was enhanced with the application of EGIS in teaching environmental education concepts. This contrasted with the literature supporting the use of virtual laboratory in various study subjects as potent at enhancing retention (Lux (2002), Kara (2008), Tuysuz (2010), Murniza (2010), Gambari, Falode, Fagbemi, & Idris (2012). There is scarcity of literature on the test of retention using EGIS in social studies education in Nigeria. However, the exploration of this field of research towards imparting environmental awareness, ecological knowledge, attitudes, values, commitments for actions, and ethical responsibilities for the rational use of scarce, natural resources and for sound and sustainable development is on the continuum.

Conclusion

Information and communication technology (ICT) has been found an ally in the effort to improve teaching and learning. Geographic Information System (GIS), as adopted in this study is a modern brand of ICT. The adaptation of EGIS into sorted EE concepts is a powerful strategy via which educational improvement in learners' performance and retention - even in computer-mediated classroom – might be enhanced. The study however concluded that, while EGIS seems not feasible for adoption into teaching-learning process in Nigeria momentarily, subsequent researches in various geo-political zones of the nation overtime might reiterate the needfulness for implementations.

It is hereby recommended that stakeholders in Nigerian education system – students, teachers, parents, school management, policy makers, politicians, entrepreneurs, government and non-governmental agencies should foster and awaken workable strategies that can improve teaching and learning of environmental education across disciplines, given its importance in the modern world to sustainable development. Additionally, the crux of working with GIS within the local environment must be considered for placement in the national education objectives. Nigeria needs to join the technology-driven crusade using GIS in the best interests of her populations' personal, social, educational, spatial development and incidental alerts, prevention and solutions.

Appendix

Envi-Geo Info System (EGIS) Package Codes using C-Sharp

```
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Windows.Forms;
using System.Media;
//using System.Timers;
namespace EGIS {public partial class frmTest : Form
{int TrialNo = 2;
int nxt = 0;
int prv = 0;
int last = 300;
int score = 0;
int totQ = 0;
//int first = 1;
string qList = "";
int inc = -1;
int queN = 1;
string answr = "";
bool cor = false;
bool tr = false;
int s1 = 0; int s2 = 0; int s3 = 0; int s4 = 0; int s5 = 0; int s6 = 0; int s7 = 0; int s8 = 0; int s9 = 0; int
s10 = 0;
int s11 = 0; int s12 = 0; int s13 = 0; int s14 = 0; int s15 = 0; int s16 = 0; int s17 = 0; int s18 = 0; int s19
= 0; int s20 = 0;
int s21 = 0; int s22 = 0; int s23 = 0; int s24 = 0; int s25 =
string c1 = ""; string c2 = ""; string c3 = ""; string c4 = ""; string c5 = ""; string c6 = ""; string c7 = "";
string c8 = ""; string c9 = ""; string c10 = "";
string c11 = ""; string c12 = ""; string c13 = ""; string c14 = ""; string c15 = ""; string c16 = ""; string
c17 = ""; string c18 = ""; string c19 = ""; string c20 = "";
string c21 = ""; string c22 = ""; string c23 = ""; string c24 = ""; string c25 = "";
//System.Timers.Timer myTimer = new System.Timers.Timer(5 * 60);
Timer timer = new Timer() { Interval = 1000 };
public frmTest()
{ InitializeComponent();
txtTime.Text = TimeSpan.FromMinutes(0).ToString();
lblNam.Text = ClspassVal.name;
lblStandby();
}
//SoundPlayer My_Correct = new
SoundPlayer(Resource1.correct);@"C:\Users\Adsonet\Documents\correct.wav");//Application.Startup
Path + @"\correct.wav");
SoundPlayer My_Wrong = new SoundPlayer(Resource1.Crowd_Boo);
SoundPlayer My_Applause = new SoundPlayer(Resource1.applause);
void lblStandby()
int val = 0; int val1 = 0; int val2 = 0; int val3 = 0;
```

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