Development and appraisal of new biodiversity loss and conservation game (BLACOG) in assessing students' knowledge, attitude and perception of biodiversity conservation

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Abstract

Educational programmes have for long been used in biodiversity conservation; however introduction of board games in these efforts is a new concept, which is believed, will result in greater achievements. This study developed and used a new educational board game, biodiversity loss and conservation game (BLACOG) and a test-questionnaire to appraise the knowledge, attitude and perception of biodiversity (KAPOB) among secondary school students in Abeokuta, Nigeria. Students (n=283) were selected randomly from three schools, two of the schools serving as Experimental Groups while the third served as the control-group. The test-questionnaire, rated on a Likert scale, was administered to both the control and experimental groups prior to and after five exposures to the game, though the control-group did not have any exposure to the game. Data obtained were tested for significant differences in the mean scores of the respondents in the tests prior to and after the game. T-test comparison of the mean scores of the pre- and post-tests of the Control Group was not significantly different (p=0.207). The mean scores in the post-test were significantly higher than the pre-test scores in both of the experimental schools. The results also showed that, though the mean scores of the pre-tests of the control and experimental groups were not significantly different, the mean score in the post-test of the Experimental Group was significantly higher than in the control group. This study showed that the use of BLACOG had significantly positive effects on the KAPOB of the experimental group and that the game could become a veritable educational tool for teaching biodiversity conservation in schools.

Keywords: Conservation education; biodiversity conservation; biodiversity loss; biodiversity education game.
Accepted: 15 May, 2018.

Introduction

Biodiversity; the number, variety and variability of living organisms, usually defined in terms of genes, species and ecosystems corresponding to fundamental and hierarchically related levels of biological organization are crucial to the maintenance of many ecosystem services (Adeyinka, 2012; Ladan, 2015). Biodiversity is important to the regulation of chemical composition of the atmosphere, food production, supply of raw materials, water provision, nutrients' recycling, biological control of populations of flora and fauna, use of genetic resources, leisure activities and others (Allister *et al* 2009). However, since the onset of the industrial revolution, biodiversity has continued to decrease at unprecedented rates as human development and expansion result in the fragmentation and loss of habitat for flora and fauna.

The loss of biodiversity is expected in most scenario studies to continue at an increasing pace in the coming decades – with projections estimating a decrease from about 70% in 2000 to about 63% by 2050 (Allister *et al* 2009). Global environmental degradation occurs as the human enterprise now threatens most of the world's biodiversity and the ecosystems of which they are part (Ehrlich and Pringle, 2008). Experts believe that the rapid loss and decline of species is not attributable only to natural processes, rather from the destructive effects of human activities. People hunt and collect wildlife, destroy natural habitats by clearing trees and filling swamps for development. Aquatic habitats are altered or destroyed by the building of dams. Humans also contaminate habitats with pollutants: chemicals and industrial waste. Indeed, human activity may be causing changes in climate patterns (*Library Index*, 2014).

According to Oyelowo *et al* (2009), there is an urgent need to improve public awareness and understanding of environmental issues with a view to promoting the conservation and wise use of natural resources at the community level. Onumadu and Mbakwe (2010) were of the view that community participation was the most

http://dx.doi.org/10.4314/tzool.v16i1.2
© *The Zoologist, 16:* 6-11 December 2018, ISSN 1596 972X.
Zoological Society of Nigeria
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viable option for conserving forest biodiversity in Nigeria. According to Caroline (2010), conservation is a process that links the environment, both human and natural, and inputs and outputs to produce desired outcomes. Environmental or conservation education aims to provide learners with the opportunity to gain an awareness or sensitivity to the environment, knowledge and experience of the problems surrounding the environment; to acquire a set of values and positive attitudes, to obtain the skills required to identify and solve environmental problems and, the motivation and ability to participate in the management and sustainment of biodiversity (Jacobson *et al* 2006).

Studies attempting to quantify the effect of formal education on conservation are limited. On the whole the few studies available agree that using formal education in increasing awareness on conservation of biodiversity has beneficial effects (Alix-Garcia, 2007). For example, one study estimated that between 4 and 21.5 per cent less annual area of old growth forest was cut per household for each additional year of education that the household head received (Godoy and Contreas, 2001, Godoy *et al* 1998). In a study on the effects of conservation education on students' knowledge and attitude to biodiversity, Ramadoss and Poyyamoli (2011) observed a significantly better performance in post-test than the pre-test. The study emphasized that active biodiversity education programmes increase the student's knowledge, interest and skills in order to protect and conserve local natural resources and biodiversity. In effect, environmental education has become education for behavioural, personal and social change (Mappin and and Johnson, 2005). Education speciûcally has also been shown to influence attitudes. Aipanjiguly *et al* (2003) in a study on manatee conservation reported that greater knowledge about manatees was positively correlated with support for manatee protection. Caro *et al* (1994) however noted that undergraduate students' knowledge of conservation biology may affect the environmental opinions that they hold. The need to make Nigerian citizens aware of environmental issues through education was echoed by Ogunleye (2004). This author argued that developing nations failed to see the need to aggressively promote environmental education and awareness. With this attitude, many citizens, especially those with little or no education do not see the value of environmental stewardship. An example of this was a statistics that showed that a large number of residents of some major cities in Nigeria failed to dump their household wastes in officially designated dumpster (Ogunleye, 2004).

The Hines model, based on the premise that people will act on environmental issues only if they are cognizant of the existence of such issue, could be interpreted as meaning that knowledge of an issue is a criterion to action. Another important component of the model is individual skill to apply the acquired knowledge to solve environmental issue (Hines *et al* 1987). The postulation of this model strengthens the need for more interactive approaches to conservation education. Shofoluwe and Sam (2012) also added that education was important to change how people behave towards the environment. To change peoples' behaviour, environmental education should not be limited to conventional campaign and traditional education methods. Evidence suggests that other alternative approaches or methods have been used successfully in improving community response and attitude to biodiversity conservation. The present study developed a biodiversity loss and conservation board game (BLACOG) Plate 1, and used an educational assessment tool to appraise the knowledge, attitude and perception of secondary school students towards biodiversity conservation.

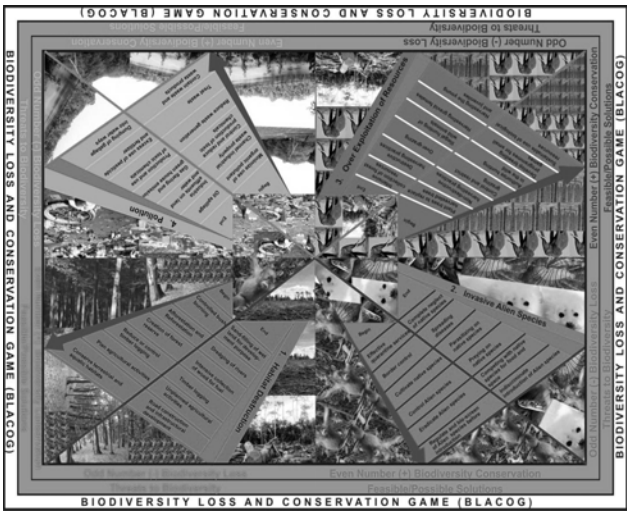

Plate 1. Biodiversity loss and conservation game (BLACOG).

Materials and methods

Study area and population

This work was carried out in three secondary schools, Asero High School, Asero, Abeokuta (Control Group), Salawu Abiola Comprehensive High School, Osiele (Experimental Group 1) and Muslim High School, Isolu (Experimental Group 2) all in Odeda Local Government Area of Ogun State, Nigeria. The study-population included students at both junior and senior levels within the selected-schools. The study was conducted during the early months of the third term resumption, between April and June 2015.

From the study-population, a sample-size of two hundred and eighty three (283) students was selected using a modified version of Ene-Obong *et al* (2001). A simple random sampling technique was used in selecting participants based on the population sizes of students from each of the selected schools. The students comprised 88 students from Salawu Abiola Comprehensive High School, 44 each from both the Junior and Senior Schools respectively. One hundred and eleven (111) students were selected from Asero High

School of which 66 were selected from the Junior School while 45 students were selected from the Senior School. Muslim High School had 84 participants, comprising 49 students from the Junior School and 35 from the Senior School. The number of students selected from each school was based on the proportion of students present in the classes used for the study.

Instrument and instrumentation

Two instruments were used in carrying out this study, an educational board game and a structured questionnaire. The game (Plate 1), titled "Biodiversity Loss and Conservation Game" (BLACOG) highlights threats that, according to literature are major causes of biodiversity loss and activities, which support conservation. The threats included habitat destruction, invasive alien species, over-exploitation of resources and pollution (Convention on Biological Diversity, 2009).

A structured questionnaire was also designed and tested for reliability and validity with the guidance of staff of the Department of General Studies, Federal University of Agriculture, Abeokuta, Nigeria.

Experimental procedure

The general procedure of questionnaire-test administration and exposure to the Biodiversity Loss and Conservation Game (BLACOG) included:

- a general pre-test: administered to both the Control and Experimental Groups;
- BLACOG administration: The two (2) Experimental Groups were exposed to the biodiversity game while the Control Group had no such experience; and
- a post-test, which was again administered to both groups.

The questionnaires were administered with the help of field assistants and collected on the same day, which ensured 100% return of the questionnaires from the respondents. Students in the two Experimental Groups were given the biodiversity game to play several times during their break and free lesson periods in order to ensure active participation of the selected students. The game was taken back each day by the field assistant and brought back the next time slated for the game. Game-playing days were Mondays and Wednesdays for 6 consecutive weeks. The post-test questionnaire was administered to both the Control and Experimental Groups a week after the last exposure day of the Experimental Group to the game.

The mean test scores of the participants in the pre- and post-tests were subjected to *t*-test comparison to see if there was significant improvement of test scores. All analysis was done using the SPSS package Version 20.

Results

The results of the demographic characters showed that females formed the highest number of participants from all the schools (160; 56.5%). The Control Group (Asero High School), Plate 2, and one of the Experimental Groups (Salawu Abiola School, Osiele), Plate 3, also had more females (64.0% and 56.8% respectively), while the other Experimental Group, Muslim High School, Isolu, Plate 4, had more males (54.3%) than females (Table 1).

Plate 2. Some students of the Control Group (Asero High School, Asero) during questionnaire administration.

Plate 3. Students of Salawu Abiola Comprehensive High School, Osiele (an Experimental Group) playing BLACOG.

Plate 4. Some female students of Muslim High School, Isolu (Experimental Group) playing BLACOG.

The distribution of age among the students showed that most of the participants were aged 14-16 years (53.7%) while those aged 8-10 years (2.1%) were the least in number (Table 1). The most prevalent religious practice was Christianity with 173 (61.1%) adherents, Islam had 106 (37.5%) adherents while only 4 (1.4%) practiced traditional African religion (Table 1).

The performance of the participants in the pre-test showed that the mean score for participants were relatively the same with no significant difference (p=0.506) in the mean scores of the Control (12.67) and Experimental Groups (12.85; Table 2). However, the means of post-test scores showed a significant (p<0.05) improvement in the performance of the experimental groups (13.91) above the Control Group (12.92; Table 2).

The pre-test scores of the junior school students in the Control Group, which was slightly higher than that of the senior school students (12.46), was not statistically significant (p>0.05; Table 3). There was, however a significantly higher difference in the post-test score of the junior school (13.44) and the senior school (12.14; Table 3).

Table 1. Demographic characteristics of the respondents.

Demographic features	Variables	AHS		SACHS		MHS		Total
		Junior	Senior	Junior	Senior	Junior	Senior	n=283 (%)
		n=66 (%)	n=45 (%)	n=44 (%)	n=44 (%)	n=49 (%)	n=35 (%)	
Sex	Male	24(36.4)	16(35.6)	15 (34.1)	23(52.3)	23(46.9)	22(62.9)	123(43.5)
	Female	42(63.6)	29(64.4)	29 (65.9)	21(47.7)	26(53.1)	13(37.1)	160(56.5)
Age-group	8-10 years	2(3.0)	0(0.0)	1(2.3)	0(0.0)	3(6.1)	0(0.0)	6(2.1)
	11-13 years	32(48.5)	6(13.3)	18(40.9)	0(0.0)	23(46.9)	1(2.9)	80(28.3)
	14-16 years	29(43.9)	32(71.1)	25(56.8)	25(56.8)	23(46.9)	18(51.4)	152(53.7)
	17 years & above	3(4.5)	7(15.6)	0(0.0)	19(43.2)	0(0.0)	16(45.7)	45(15.9)
Religion	Christianity	44(66.7)	29(64.4)	21(47.7)	27(61.4)	32(65.3)	20(57.1)	173(61.1)
	Islam	22(33.3)	16(35.6)	23(52.3)	16(36.4)	15(30.6)	14(40.0)	106(37.5)
	Traditional African	0(0.0)	0(0.0)	0(0.0)	1(2.3)	2(4.1)	1(2.9)	4(1.4)

Keys: AHS: Asero High School; SACHS: Salawu Abiola Comprehensive High School, Osiele; MHS: Muslim High School, Isolu.

Table 2. Comparison of the control and experimental of students pre- and post-test score.

	Group	N	Mean±SE	t	df	Sig. (2-tailed)
Pre-test	Control	111	12.67±0.166	-0.666	281	0.506
	Experimental	172	12.85±0.178			
Post-test	Control	111	12.92±0.200	-5.578	281	0.000
	Experimental	172	13.92±0.063			

Table 3. Comparison of pPre- and post-test scores of junior and senior classes of the Control Group.

Test	Class	N	Mean ± SE	t	df	Sig. (2-tailed)
Pre-test	Junior school	66	12.82±0.192	1.085	109	0.280
	Senior school	45	12.46±0.296			
Post-test	Junior school	66	13.44±0.235	3.334	109	0.001
	Senior school	45	12.14±0.323			

Table 4. Comparison of pre- and post-test scores of junior and senior classes of the Experimental Groups.

Test	Class	N	Mean ± SE	*t*	*df*	Sig. (2-tailed)
Pre-test	Junior school	93	13.16±0.209	1.933	170	0.055
	Senior school	79	12.48±0.967			
Post-test	Junior school	93	13.84±0.106	-1.278	170	0.203
	Senior school	79	14.00±0.057			

In the experimental schools, the pre-test mean scores of the students of both the junior and senior schools had no significant difference. However, though the post-test mean score of the senior school looked much higher than the junior school, the difference was not statistically significant (p=0.203; Table 4).

Discussion

A comparison of the pre-test and post-test results for the two schools that served as the Experimental Groups showed that students in the post-test group that were exposed to the biodiversity loss and conservation game had a significant increase in their level of knowledge, attitude and perception to biodiversity conservation than the pre-test group. This was indicated in the improved, positive response to the set of questions in the questionnaire. This implied that the game approach had a positive impact in influencing students' knowledge and attitude towards biodiversity conservation. The result of this finding agrees with the findings of Ramadoss and Poyyamoli (2011) who developed a biodiversity module that entailed active biodiversity education, teaching methods, active classroom sessions, hands-on-trainings and field exposures in teaching biodiversity conservation they also reported in their findings that students in the post test phase significantly increased their confidence in biodiversity knowledge after being exposed to biodiversity education through the developed biodiversity module. This is in tandem with the results of this study.

The lack of statistical difference in the performance of the experimental Junior School and Senior School students in both the pre-test and post-test may have been due to the simplicity of the game and its' suitability for the different age-groups. The non-significance in the mean scores of the pre-test for both junior and senior students of the Control Group and its significance in the post-test, with the senior school students having a slightly higher mean score, may allude to the fact that the senior students had keen interest in biodiversity concepts and might have read related topics. The performance of the experimental school students in the post-test is indicative of the positive effects the game approach had on the participants. It is worthy to note that a high point in the present study is the positive interest in biodiversity conservation elicited in the students by the game approach than the conventional method of teaching and classroom work. Wendye (2009) had earlier observed a 50% improvement in students' performance in biodiversity tests after exposure to modules that improved on regular classroom methods. The results of the comparison between the junior and senior school students also informed that the game approach was a better tool for communicating scientific concepts at the different levels of study. This suggests a further study on the impacts this game will have on uneducated locals and indigenous people living around wildlife. The view of Leather and Quicke (2009) on loss and reduction in number of biodiversity as influenced by man-made pressure and activities, are partly driven by lack of knowledge about biodiversity. Hence, educating people serve as one of the control measure to bring an end to loss of biodiversity. Leather and Quicke, (2009) stated that biodiversity education program enable students to become knowledgeable about uses related to biodiversity, to develop the commitment and skills to maintain biodiversity at local, regional and global levels. The education system plays a decisive role in educating about the threat against biodiversity and effective measures to avoid it.

The Millennium Ecosystem Assessment (MEA, 2005) included public awareness, communication and education as one of the actions to be taken to ensure biodiversity conservation. The introduction of gaming technique in this study has shown that this trio of awareness, communication and education could be effectively carried out through the use of BLACOG and other possible games that would convey the message of conservation in the simplest way. The Independent Commission for Environmental Education (ICEE) also noted that environmental topics that were generally infused into other subject areas often do not provide a framework for progressive building of knowledge (Disinger, 1997). Such situations, it is believed, could be remedied by bringing up modules, which incorporate games such as BLACOG in the school curriculum to reinforce what has been taught through the conventional teaching approach.

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Citation: Aladesida, A. A., Dedeke, G. A., Onifade, E. O., Bamidele, J. A. and Ekpo, U. F. Development and appraisal of new biodiversity loss and conservation game (BLACOG) in assessing students' knowledge, attitude and perception of biodiversity conservation. http://dx.doi.org/10.4314/tzool.v16i1.2

The Zoologist, 16: 6-11 December 2018, ISSN 1596 972X.
Zoological Society of Nigeria.