APPLICATION OF DEVELOPMENT MODEL AND CONCEPT MAPPING ON STUDENTS ACHIEVEMENT AND INTEREST IN CLIMATE CHANGE CONCEPTS OF ENVIRONMENTAL EDUCATION IN ZARIA

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ABSTRACT

The study investigates the application of development model and concept mapping strategies to students' achievement and interest in climate change concepts of environmental education in Zaria. The objective of the study therefore is to determine the effectiveness of the application two of two instructional techniques (development model and concept mapping) on students achievement and interest in climate change concepts of environmental education in Zaria. Climate change in Nigeria, according to some researchers, has adversely affected the economy, hence the need for this study. The design is a quasi-experimental non-equivalent control group here 246 students used for the study were purposely selected from four senior secondary schools in Zaria Educational Zone. Two instruments namely Environmental Climate Change Instrument (ECCI) and Environmental Climate Change Interest Inventory (ECII) were developed and validated. The results of the study were analyzed using mean, standard deviation and analysis of covariance (ANCOVA). The findings of the study revealed that Development Model and Concept mapping have significant effects on students' achievement and interest in climate change concepts of Environmental education. Based on the findings of the study, it was recommended amongst others that seminars, conferences and workshops should be organized by professional bodies like STAN on the use of appropriate instructional techniques like development model and concept mapping. Hence, it was concluded that the study is effective in engendering academic achievement and students' interest in climate change concepts of environmental education.

Key words: Development model, Concept mapping, Climate change, Environmental climate change instrument, Environmental climate change interest inventory,

INTRODUCTION

Human and animal species share common environment in areas of land, air, water on the earth's surface (biosphere). It is an obvious fact that these populations have in recent years continued to be threatened by climate change due to global warming which have adversely affected agricultural production (World Bank Report, 2010). This underlines a need for environmental education to understand the causes of environmental changes and to be abreast with effects of the changes and ways to minimize them. Hence, Ezeudu (2003) opined that environmental education refers to education aimed at developing the world population that is aware of and concerned about the environment and its associated problems. Many contextual definitions also abound in literatures. The International Union for the Conservation of Nature and Natural Resources as cited in Obeka (2010) viewed environmental education as the process of reorganizing values and clarifying concepts in order to develop skills and attitudes necessary to

understand and appreciate the interrelatedness among mankind, his biophysical surroundings and culture.

The environment however is not devoid of problems due to incessant climatic changes as a result of global warming, green house effect, Ozone layer depletion, drought, deforestation, erosion, pollution and generally due to both physical and man-made environmental problems. These environmental problems have effects on agricultural land use and subsequently, human health, population growth, settlement pattern, urban and rural migration and economy of the nation (UNESCO – UNEP, 1987).

Students' knowledge and interest on environmental education at secondary school level is currently very low due to absence of curriculum for it (Ezeudu, 2003). Education about the environment therefore should commence at the secondary school level for it to attain the desired objective. According to Fien (1993), environmental education enables the citizenry to be aware of the utility values of the environment, care for the environment, and protect it from wanton destruction.

Environmental education was initially perceived as a study of environment or nature assimilated with ecology, but because of increased awareness, it has been broadened in scope and content to include several issues on the environment and its interrelationship with humanity (UNESCO-CONECT, 1995). To facilitate this increase in awareness, interest is a factor toward positive achievement. This was also emphasized that for any meaningful teaching and learning to take place generally on human discourse and particularly on environmental issues, Ezeike (1996) maintained that interest is a motivational factor. Hence, this study investigates the effect of development model and concept mapping on students' achievement and interest in some climatic change concepts of environmental education in Zaria.

Development model was presented by a group of research team named meadows et al (1992) who addressed the limits to economic growth. It was therefore used to present development concepts in clear rather than abstract manner for easy assimilation. Meadows et al, further found that the use of development model was found to be effective in clarifying relevant concepts to facilitate teaching and learning in schools.

Development model relied heavily on experimental growth and feedback effects. Exponential growth occurs when population, economic production, resource use, or pollution increases by a certain percentage each year. For instance, the study by meadows and Donella (1992) employed a development model which attempted to capture interrelationships between population, agricultural output, economic growth, resource use, pollution and effects of climate change on the environment. The authors concluded in their work that humans will reach environmental limits to global growth within a century, and that without drastic changes, there was a strong likelihood of an "overshoot/collapse" outcome: a sudden and uncontrollable decline in both population and industrial capacity.

Feedback effects on the other hand occur when two variables interact, for example when capital accumulation increases economic output, which in turn leads to a more rapid accumulation of capital. Positive feedback effects strengthen growth trends whereas negative feedback effects moderate them. Negative feedback effects however may be undesirable. For example, climatic change may cause population decline through malnutrition, disease, drought, climate change, ozone layer depletion and pollution. Development model used in this study is a twelve step model showing development concepts to the students, step by step, and at intervals specified to get their feedback.

Environmental education is the study of the biophysical environment, its associated problems, and interrelationship between man and his physical environment. Therefore study of the effect of agricultural climatic change concepts in developing nation like Nigeria is of paramount importance toward sustainable development.Concept mapping technique was developed and introduced by Novak (1990) as an instructional technique. The development of concept mapping was based on Ausubel's assimilation theory which is anchored on the principle that the single most important factor influencing learning is what the learner already knows (Novak, 1990). Hence concept maps are made of concepts and linking of conceptual words. They are diagrams indicating interrelationship among concepts as representation of meaning.

According to Okebukola (1992), concept maps can be applied to any subject matter and to any level within the subject. Concepts are arranged hierarchically with the general concepts at the top and the lower ones at the bottom showing its resultant effects. Concepts are arranged in hierarchical order from complex to simple in map form. This is demonstrated in ten step order of arrangement. Concept maps therefore, help students to build on what they have already known and used as a teaching techniques and text books, maps and charts are used as a study tool or as a way of teaching and evaluating what a student has learned.

Okebukola (1992), Okpala (1987), and Obeka (2005) in their separate studies maintained that models and concept maps are practical instructional oriented strategies toward improvement in teaching and learning of geographical concepts. In the present study, the concepts are arranged in a hierarchical model (Network of concept maps). The concept map strategy made use of charts, diagrams and maps and students are made to participate actively by identifying the concepts. The study lasted for four weeks.

Two research questions that guided the purpose of this empirical paper are: (1)Do development model, concept mapping and lecture any effect on students' academic achievement, when exposed to agricultural, climate change concepts of environmental education (E.E)? and, (2)Has teaching method any effect on students' interest when exposed to climate change concepts?.The sole objective of this study therefore is to determine the relative effectiveness of two instructional techniques namely; development model and concept mapping on students cognitive achievement and interest in some climate change concepts of environmental education in Zaria.

The two null hypotheses tested at 0.05 levels of significance are:

$H_01 = $ Instructional methods have no significant effect on the mean achievement scores of students exposed to environmental climate change inventory interest (C.C.I.I)

$H_02 = $ Teaching Methods have no significant effect on overall interest scores of students when exposed to E.C.I.I.

MATERIALS AND METHODS

All the senior secondary schools in Zaria educational zone of Kaduna state constituted the target population. A sample of four senior secondary schools was purposively drawn from the entire population namely: Demonstration secondary school A.B.U, Federal Government Girls College Zaria, Barewa College Zaria and Buk's International College Zaria with a sample population of 246 students were used. In each of the sampled schools, SS2 classes with up to 3 arms for two experimental and one lecture (control) class were used for the study which lasted for four weeks. Maps, charts and pictorial diagrams were also used

Two instruments were used for the study namely environmental climate change instrument (ECCI) and environmental climate change interest inventory (ECII). They were validated by three experts in science and mathematics education department, A.B.U Zaria. The ECCI was a 50 item multiple choice objective test based on the climate change concepts as found in the two models, while the ECII was a 50 items structured questionnaire on the same concepts. A 5-point Likert rating scale was used: strongly agree (5), Agreed (4), Undecided (3), Disagree (2) and strongly disagree (1). The cut-off point of acceptance is based on the real limit of number principle mean score of 3.50 and above or below is used to determine acceptance or rejection.

The research design was a quasi experimental study of non-equivalent control group involving three groups; two (development model and concept map groups) and one control group. The questionnaires were used to elicit information on the students' interest on the subject taught. For decision to be made on data collected, mean scores and standard deviations were used to answer the research questions while ANCOVA was used in testing the hypothesis at 0.05 levels of significance.

RESULTS AND DISCUSSION OF FINDINGS

Tables 1-4 present the findings and the discussion provided subsequently.

Table 1: Means and Standard Deviation of Students' Post Achievement Scores

Group	N	X	SD
Development Model (Exp 1)	83	62.60	9.40
Concept mapping (Exp 2)	82	50.55	8.01
Lecture (Control)	81	49.44	7.73
Total	**246**	**54.25**	**8.42**

Table 1 showed that the mean achievement score of the experiment group 1, experiment group 2 and control groups were 62.60, 50.55 and 49.44 respectively with their respective standard deviations as 9.40, 8.01 and 7.73. This implied that students taught with the development model had the highest mean achievement score followed by students taught with concept mapping and lastly those with lecture method with the least mean score.

Table 2: Analysis of Covariance of Overall Students Achievement Score

Score of variation	Sum of squares	Degree of freedom	Mean squares	F-Value	Sign. of F	Interpretation
Covariates	45203.95	1	45203.95	7994.24	.00	
Pre-test	45203.95	1	45203.95	7994.24	.00	
Main effects	4217.37	2	2108.63	372.92	.00	
Methods	4217.37	2	2108.68	372.92	.00	Significant
Explained	49421.32	3	16473.77	2913.36	.00	
Residual	2759.43	488	5.65			
Total	**52180.75**	**491**	**106.27**			

Significance at $P \leq 0.05$

The data showed that calculated F – value for the effect of treatment on students' achievement of 372.92 was significant at the probability level of 0.00 which is less than 0.05. Therefore the F-value is significant at the probability level of 0.05. This implies that there are significant differences in the mean achievement scores of students taught using development model, concept mapping and lecture methods.

Table 3: Mean and Standard Deviation of Students Interest (Post-achievement scores)

Group	N	X	SD
Development Model (Exp 1)	83	61.81	7.48
Concept mapping (Exp 2)	82	52.68	7.23
Lecture Method (Control)	81	42.50	8.28
Total	**246**	**52.40**	**7.67**

Result in Table 3 showed that mean interest scores of students taught with development model, concept mapping and lecture methods were 61.81, 52.68 and 42.40 respectively with standard deviation of 7.48, 7.23 and 8.28 respectively. This implies that development model strategy had the greatest influence on students' interest in the climate change concepts, than the other teaching methods. Lecture method had the least influence on the students' interest.

Table 4: Analysis of Covariance of Overall Students Achievement and Students Interest.

Score of variation	Sum of squares	Degree of freedom	Mean squares	F-Value	Sign. of F	Interpretation
Covariates	40898.03	1	40898.03	3166.00	.00	
Pre-test	40898.03	1	40898.03	3166.00	.00	
Main-effects	12277.96	2	6138.98	475.23	.00	
Methods	12277.96	2	6138.98	475.23	.00	Significant
Explained	53175.99	3	17725.33	1372.15	.00	
Residual	6303.93	488	12.92			
Total	**59479.92**	**491**	**121.14**			

Significance at $P \leq 0.05$

The following findings were made on the research questions and hypotheses of the study: It was found that development model strategy yielded better achievement gains than concept model and lecture methods. Furthermore, development model had greater influence on students' interest in climate change concepts of environmental education. Therefore, there exist significant differences in students' cognitive achievement and interest, when students were exposed to development model, concept mapping and lecture methods of instruction as evidence in the result of this study.

The study has some educational implications. Accessibility of instructional techniques calls for a closer and more objective appraisal of its effect on instructional techniques, selection and utilization in teaching/learning of climate change concepts of environmental education. Environmental education concepts are relevant in the current curriculum of instruction in secondary schools. Teaching of its concepts and methodology on climate change expose learners to current trends in environmental education and facilitate improvement of the learning motor

skills. But inaccessibility of instructional techniques may constitute a serious setback in the realization of the teaching/learning objectives.

The result of this study has proved that the use of development model and concept map has proved to be effective in teaching and learning of environmental education concepts and stimulating students' interest for the lesson and learning processes. This affirms positions of authors like Okpala (1987), Okebukola and Akpan (1997) and Obeka (2009), that the use of appropriate instructional techniques, models/concept maps facilitates teaching and learning in schools.

RECOMMENDATIONS AND CONCLUSION

As a result of this research findings and educational implications of this study, the following recommendations were made;
1. That development model and concept mapping techniques were effective in engendering cognitive achievement and interest in climate change concepts of environmental education, hence, should be developed as part of instructional techniques in secondary school curriculum.
2. That serving teachers in secondary schools should be given adequate orientation on the use of development model and concept mapping to teach concepts in their various subject areas through seminars, workshops and conferences.
3. Environmental educators and government ministries/ parastatals should organize training workshops on development of new instructional techniques in environmental education.

This study which assesses the application of development model and concept mapping techniques in teaching climate change concepts of environmental education has achieved its stated objectives. Development model and concept mapping technique used in this study have been proved to be efficacious in engendering teaching and learning in schools over the traditional lecture method. These new techniques also enhanced students' interest in learning climate change concepts of environmental education, hence, could be applied to concept studies in other disciplines. This study can therefore help the user in further research, teaching and learning, hence is recommended for use as instructional technique in schools.

REFERENCES

Ezeike, E.O. (1996). *The Students Under-Achievement in Science. Who is to Blame?* In Bello O.O. (ed) 27th STAN Annual Conference Proceedings pp105 – 166.

Ezeudu A.S. (2003). *Environmental education for sustainable development*: *A Nigerian Perspective.* Onitsha: BEL's Books Publication.

Fien, J. (1993). *Education for the environment*. *A critical Curriculum theorizing and environmental education*. Australia: Deskin University Press.

Intergovernmental Panel on Climate Change (2001). *Mitigation*. Cambridge University Press .

Meadows, S. and Donella, H. (1992*). Limits to growth model*. New York Universe Books

Novak J.D. (1990). Concept mapping and the cartography of cognition: *Journal of research in science teaching.* 27 (10) 937-949.

Obeka S.S. (2005). Development of "EPODEWALAD" model of Instruction. *Journal of CUDIMAC.* Faculty of Education. University of Nigeria, Nsukka. 1 (1) 369-382.

Obeka S.S. (2009): *EPODEWALAD and power simulation games of geographical and environmental education:* Research perspective. Zaria. Ahmadu Bello University Press.

Obeka *S*.S. (2010). Current trends in Geographical and Environmental Education. Zaria: Ahmadu Bello University Press

Okebukola P.A. (1992). Can good concept mappers be good problem solvers in science? *Journal of educational psychology* 12(2) 113 – 129.

Okpala J.I.N. (1987). The feasibility of reality oriented problem solving questions in W.A.E.C examination as a means of improving the teaching of Map work in Nigerian secondary schools. Unpublished Ph. D Thesis. London University, London

UNESCO-CONNECT (1995). Environmental education research. *A journal of environmental education.* 1(1)10-25.

UNESCO-UNEP (1987) *Educational Technology and Micro-teaching for teachers effectiveness.* Onitsha: Emba Press.

World Bank Development Report (2010). *Development and climate change.* Washington D.C The World Bank Publication.