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THE IMPACT OF TWO CURRICULUM PACKAGES IN ENVIRONMENTAL EDUCATION IN BIOLOGY ON LEARNERS' PERFORMANCE, PROBLEM-SOLVING ABILITIES AND ENVIRONMENTAL ATTITUDES

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ABSTRACT

This study investigated the impact of two curriculum packages in environmental education (Environmental Education and Conventional Modules) in Biology , gender and subject specialization on students' performance, problem-solving abilities and environmental attitudes.

The subjects involved in the study consisted of 347 senior secondary two science and non-science students (177 Experimental and 170 Control) in twelve intact classes randomly selected from six senior secondary schools in Ibadan Municipality of Oyo State.

A pre-test, post-test control group quasi-experimental design was adopted for the study. The four instruments used to collect data were: students' Attitude to Environmental Conservation Questionnaire (S.A.E.Q.) with Cronbach alpha measure of 0.90; Test on Environmental Conservation Knowledge in Biology (T.E.C.K) with KR(21)-Kuder Richardson reliability index of 0.92; Test of Problem-solving Achievement in Environmental Conservation (T.P.S.S.) with KR(21) Kuder Richardson reliability index of 0.85; Environmental Education Module (E.E.M.) and the Teacher's Instructional Guide on E.E.M(T.I.G.E.) which were pilot tested and validated, with Pearson r = 0.97.

The experimental subjects were exposed to the Environmental Education Module (Package) by trained teachers while the control groups were taught the conventional (existing) biology curriculum by their regular teachers for six weeks at an average of three periods per week.

The data collected were analyzed using descriptive statistics (mean, standard deviation) and inferential statistics (Analysis of Covariance and t-test). Seven hypotheses were tested at 0.05 level of significance.

The major findings include:

1. Students taught using the E.E.M. performed significantly better in their cognitive achievement [$F(1,345) = 3680.317$, $P < .05$]; problem-solving achievement [$F(1,345) = 3189.326$, $P < .05$]; and environmental attitudes [$F(1,345) = 3134.800$; $P < .05$] than students who were not exposed to EEM materials.
2. There was no significant main effect of gender on students' cognitive achievement [$F(1,345) = 0.65$, $P > .05$]; problem-solving achievement [$F(1,345) = .127$, $P > .05$]; and environmental attitudes [$F(1,345) = .886$, $P > .05$] toward resolving conservation issues and problems.
3. The students' subject specialization had a significant

main effect on students' cognitive achievement [$F(1,345) = 22.205$, $P < .05$]; and environmental attitude scores [$F(1,345) = 14.944$, $P < .05$], but with no significant effect on students' problem-solving achievement [$F(1,345) = 2.414$, $P > .05$].

4. There was no significant interactive effect of treatment and gender on students' cognitive achievement [$F(1,345) = 3.027$, $P > .05$]; problem-solving achievement [$F(1,345) = .504$, $P > .05$] and environmental attitudes [$F(1,345) = .177$, $P > .05$].

5a Significant interactive effects of treatment and subject specialization on students' cognitive achievement [$F(1,345) = 18.300$, $P < .05$] and environmental attitude scores [$F(1,345) = 4.507$, $P < .05$] were obtained.

b The subjects' problem-solving achievement was not significantly influenced by subject specialization and treatment [$F(1,345) = 2.143$, $P > .05$],

6 The subjects' gender and subject specialization did not exert any significant interactive effect on students' cognitive achievement [$F(1,345) = 1.046$, $P > .05$]; problem-solving achievement [$F(1,345) = 2.147$, $P > .05$]

and environmental attitude scores [$F(1,345) = .299$, $P > .05$].

7. There was no significant interactive effect of treatment, gender and subject specialization on students' cognitive achievement [$F(1,345) = 1.675$, $P > .05$]; problem-solving achievement [$F(1,345) = 0.002$, $P > .05$]; and environmental attitudes [$F(1,345)$ .008, $P > .05$].

In the light of these findings, it could be inferred that the Environmental Education Module was effective in enhancing subjects' attainments.

These findings showed the need to incorporate this newly developed curriculum (EEM) as a viable instructional material in its environmental components in Biology. This will help to promote the level of students' cognitive achievement, problem-solving abilities and the right attitude to conserve our natural environment, in the country's stride for sustainable development.

DEDICATION

First, this work is dedicated to the glory of the Living GOD, the Alpha and the Omega.

Second, to the loving memory of my Late Father, Dr. Samuel Omotoso BABATUNDE, who consistently inspired his children's struggle for greater heights.

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Unto the Lord, my GOD, the Master Planner, be the GLORY great things he has done, for planning and executing this programme to his utmost glory. For it could be said, that,

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CERTIFICATION

I certify that this work was carried out by ***MRS Alice Morenike Olagunju*** in the Department of Teacher Education, Faculty of Education, University of Ibadan, Ibadan, Nigeria.

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LIST OF ABBREVIATIONS

E.E	=	Environmental Education
E.E.M	=	Environmental Education Module
F.E.P.A.	=	Federal Environmental Education Agency.
I.E.E.P.	=	International Environmental Education Programme.
I.U.C.N	=	International Union for Conservation of Nature and Natural Resource.
N.A.E.M.T.	=	Nigerian Association for Educational Media and Technology.
N.A.F.E.E.	=	Nigerian Association for Environmental Education
N.C.C.E.E.	=	National Coordinating Committee on Environmental Education
N.C.E.S.	=	National Conservation Education Strategy.
N.C.F.	=	Nigerian Conservation Foundation
N.E.R.D.C.	=	Nigerian Educational Research and Development Council.
N.E.S.T.	=	Nigerian Environmental Study/Action Team
N.G.O.	=	Non-Governmental Organization.
N.R.C.C.	=	Natural Resources Conservation Council
S.A.E.Q.	=	Students' Attitude to Environmental Conservation Questionnaire
S.S.C.E.	=	Senior School Certificate Examination
S.T.A.N.	=	Science Teachers' Association of Nigeria.
T.E.C.K.	=	Test on Environmental Conservation Knowledge in Biology
T.I.G.E.	=	Teacher's instructional Guide for E.E.M.
T.P.S.S.	=	Test of Problem-solving Achievement in Environmental Conservation.
U.N.E.P.	=	United Nations Environment Programme
U.N.E.S.C.O.	=	United Nations Educational Scientific and Cultural Organization
W.C.S.	=	World Conservation Strategy
W.W.F.	=	World Wildlife Fund.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The 1990's have been declared the decade for Environmental Education and Training by the United Nations Educational, Scientific and Cultural Organization (UNESCO) and United Nations Environment Programme (U.N.E.P.) (Aina, 1990). This declaration emanated from the United Nations Environment Programme's (U.N.E.P) reports on the state of the World Environment between 1972 and 1992 that revealed the general degradation of our environment which calls for urgent attention. For instance, plants and wildlife which are very essential for human survival and development are constantly being destroyed or depleted by human carelessness. Also, the encroachment of the desert, indiscriminate felling of forest trees and over-grazing of land are all accompanied with other adverse implications for the cattle rearers. Erosion, too reduces the area of farmland, and over-utilization of such farmland eventually destroys its fertility and decreases the overall production, quality and variety of food supply to the human populace. Since we all rely on nature for food, water, energy, clothing, shelter, minerals, drugs and so on, then the need arises to keep the system that provides these needs in running order and to check the destructive trends. Thus, the concept of Environmental Education (EE) emerged from the study of the environment and its significant role in human life. These challenges to improve human environment steadily grew and culminated into several international events which are summarised in Table 1a below.

Table 1a. LANDMARKS IN THE HISTORY OF ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

EVENT	VENUE	MAIN SIGNIFICANCE
1. The United Nations Conference on Human Environment.	Stockholm Sweden 1972.	i Stockholm declaration. ii Creation of U.N.E.P. iii Recognition of EE as independent study.
2. Internaional EE Workshop, Belgrade Charter.	Belgrade Yugoslavia 1975.	Defined the concept the goals and objectives, target, groups, the methods, guiding principles and basic contents of EE.
3. The inter-governmental conference on EE.	Tbilisi, Georgia in former U.S.S.R. 1977.	Recommendations on a plan of action at national and inter national levels on the specified goals philosophy and principles of EE.
4. International Congress on EE and Training.	Moscow, Russia 1987.	An International Strategy for EE and Training for the 1990 and beyond was developed.

Table 1a. LANDMARKS IN THE HISTORY OF ENVIRONMENT AND SUSTAINABLE DEVELOPMENT (Contd.)

EVENT	VENUE	MAIN SIGNIFICANCE
5. The United Nations Conference on Environment and Development (U.N.C.E.D) or Earth Summit.	Riode Janeiro, Brazil June,1992	i. Recognised the integral and interdependent nature of the earth. ii. Set out principles to guide future development (e.g. Agenda 21) iii. Matters relating to the conservation and Exploitation of the environment were sequenced out.
6. International Conference on population and Development (I.C.P.D.)	Cairo, Egypt 1994	Concept of Inter-disciplinarity was incorporated into EE, scope
7. World Summit on Social Development.	Copenhagen Denmark, 1995 March	Global themes as Environment, Population or Social/ Economic Development were also incorporated into EE Scope.
8. Inter-regional Workshop on re-orienting EE for sustainable Development.	Athens Greece, June,1995.	i.Development of strategies for an integrated perception of issues on Environment, population and

The above landmarks later inspired major programmes and activities on EE in various countries. Several nations met to consider and develop strategies to solve environmental problems and integrate EE into schools' curricula for sustainable development.

A national profile of Nigeria's environmental problems documented in "Nigerias Threatened Environment" by Nigerian Environmental Study/Action Team (N.E.S.T, 1991) reported that land, water, atmosphere, vegetation and wildlife, population and cultural degradations result from ignorance, poverty, growth and spatial distribution of population, the mode of economic organisation and distribution, style of living and technology adopted (Ivowi, 1995). Hence, the need to study the environment in order to know how to manage the human use of plants, water, wildlife and other resources to allow for their renewal and balance in nature.

Through this, the resources can yield the greatest sustainable benefits to present generations and possibly still meet the needs and aspirations of future generations.

The situation in Nigeria is further described by Ajao (1993) who stressed that Nigerian environment is ill and beset with several problems.

The above statement is corroborated by earlier findings of Noibi and Lawal (1992) who also enumerated other environmental problems in Nigeria as including

> flooding, soil erosion, gully erosion coastal and marine-erosion, desertification deforestation, surface and ground water pollution, oil spills, gas flaring, industrial pollution, loss of bio-diversity, water hyacinth invasion, etc.

In addition, a recent World Bank findings (study in Nigeria) and estimates of risks and enormous costs of eight items, are summarised in Table 1b.

Table 1b: Nigeria's environmental Balance Sheet. The costs of Unsustainable Development in Nigeria.

ENVIRONMENTAL PROBLEMS	ESTIMATED ANNUAL LOSS	NAIRA EQUIVALENT AT N82 = $1
Soil Degradation	$3000 Million Per Year	N264000m
Water Contamination	$1240 Million Per Year	N 82000m
Deforestation	$ 750 Million Per Year	N 61500m
Coastal erosion	$ 150 Million Per Year	N 12300m
Gully erosion	$ 100 Million Per Year	N 8200m
Fisher losses	$ 50 Million Per Year	N 4100m
Water hyacinth	$ 50 Million Per Year	N 4100m
Wildlife losses	$ 10 Million Per Year	N 820 m
	$5,110 Million Per Year	N419020m

Source: World Bank Reports, 1990.

The cost estimated above is really exorbitant for a nation to be economically sustainable. Therefore there is a need for an urgent and drastic measure to arrest this situation and prevent a catastrophe.

Also, coupled with the economic wastage is the issue of pollution. In both urban and rural areas, its is a common sight to observe heaps of refuse and garbage on streets, beside streams in different corners of the towns. This problem of solid waste collection and disposal eventually culminated to various forms of pollution - of water, air and land (Oluwande, 1977).

The questions are: What do we do? How do we rectify this appalling situation? When the legislation or decrees failed, what next? The most probable solution, as highlighted by Gifford et al, 1982/83) is that

> A well educated populace is the best insurance for the preservation of our environment.

From the above assertion, conservation education becomes the tool that can be adopted for behaviour modification. Moreover, the 1991 National Curriculum Review Conference which appraised the Curriculum of the nation's educational system in Kaduna noted the deficiencies of EE elements in the content of the various syllabuses, and those that have EE elements do not reflect the linkage between development actions and the environment. The conference therefore recommended that the various syllabuses be updated or renovated to reflect EE elements appropriately and comprehensively.

Also, Ajao (1993) added that,

> We must go beyond awareness of Nigeria's environmental problems to the institution of instruments and education programmes that would ensure that environmental degradation, unsustainable use of natural resources can be arrested and the stability of the Nigerian ecosystem assured.

However, a quick recapitulation of the nature of our educational programmes will reveal its gross deficiencies. According to Noibi and Lawal (1993), students are trained or educated to acquire certain knowledge and skills but with less concern for the effects of their activities on the ecological balance of nature. This non-chalant attitude is also reflected in their lack of Willingness in environmental sanitation, until they sight law enforcement agents.

Therefore, there is need for a more functional education with desirable practices capable of leading learners towards living more sustainable lifestyles. This calls for acquisition of environmental conservation knowledge, skills and attitude. It is in a bid to achieve the above intentions that the present study was undertaken.

1.1.1 ENVIRONMENTAL EDUCATION IN THE NIGERIAN EDUCATIONAL SYSTEM.

The evolution of education about the environment in Nigeria can be traced back to the colonial periods when EE elements were incorporated into our formal education system initially through subjects like nature-study and hygiene, and later through primary science, biology, chemistry, integrated-science agricultural science, geography and social studies.

In the 1981 National Policy on Education (N.P.E. 1981), the Nigerian commitment to the protection of the environment was reflected in the educational objectives, specifically, the need

- to provide people who can apply scientific knowledge to the improvement and solution of environmental problems for the benefit and convenience of man.

Similar need was also articulated at all levels of our educational system. For instance, at the secondary (education) level.

- preparation for useful living within the society, equip students to live effectively in our modern age of science and technology.

  In a parallel fashion, higher education is expected to provide learning experience for
- the development of the intellectual capacities of individuals to understand and appreciate their environments. (Balogun, 1987; 1992).

From the above, it is evident that the integration of EE into our educational system for sustainable development, received a strong backing and support from the Nigerian Government.

Other efforts extended to protect the Nigerian environment include the promulgation of legislations/decrees such as the

i) environmental Sanitation Decree, 1984,

ii) endangered Species Decree No 11, 1985.

iii) federal Environmental Protection Agency (F.E.P.A.) Decree 58, (1988), and

iv) natural Resources Conservation Council Decree (1989).

In spite of these efforts (both national and international) extended, the environment appears to continue to degrade the more (Ogunseitan, 1992; Sunray, 11th March, 1993; Noibi and Lawal, 1993). Therefore, the magnitude of these seemingly unstoppable problems warrants more conscious awareness and training programmes if the goal of sustainable development ethics must sink into individuals. As declared at the Earth Summit by Isabel Abrams (1992),

> education is essential to change the destructive relationship between human beings and the rest of nature.

Therefore, it is apparent that the causal factors of inadequate environmental ethics, ignorance or inadequate environmental awareness, knowledge, skills and actions can be removed through <u>education.</u>

It is in pursuit of the above goals that the Nigerian Conservation Foundation (N.C.F), a non-governmental organization, in collaboration with the Federal Ministry of Education, organised the 1988 Yankari Conference which developed the National Conservation Education Strategy (N.C.E.S.). Their recommendations include the need to:

(a) establish EE units in Ministries of Education,

(b) set up conservation clubs in schools,

(c) establish conservation resource centres,

(d) furnish school subjects in environmental education.

The above recommendations were approved by the National Council on Education in 1990. Several other attempts have been made at national , state and local levels to accomplish the stated tasks.

This present study was designed in order to foster and accomplish the need to enrich school subjects in environmental education.

The specific conservation issues and problems to be considered include;

i) water pollution - e.g dumping of wastes in flowing water/streams/rivers;

ii) land pollution - littering the environment with garbages and need for recycling of unused papers, defaecation of environment, overgrazing, etc;

iii) air pollution - Overburning, noisy environment, exhaust from vehicles etc

iv) forest conservation - e.g the effects of devegetation, desertification, erosion and the need to conserve forests, etc.

v) wildlife conservation - e.g. the effects of game - poaching, illegal grazing, overhunting and the need to conserve our wildlife, etc.

vi) impact of some mining activities and recycling of metal (or mineral conservation)

vii) pests/insect invasion & diseases as related to conservation of different types of animals (poultry, rabbitry, snailery, fishponds etc.,)

viii wastage of energy and emphasis on 'Saving Energy' at home, school, in automobiles and in the community.

The overall goal of the study is to document the activities and results of the programme as an example of the degree to which salient conservation related messages could be communicated effectively to the generality of student populace, utilising basic environmental conservation measures prepared into a module in Biology for Senior Secondary School level.

1.2 CONCEPTUAL FRAMEWORK

Curriculum development, as stressed by various curriculum theorists involves the planning of learning opportunities intended to bring about certain desired changes in learners coupled with the assessments of the extents to which these changes have taken place (Tyler, 1950; Kerr, 1968; Nicholls and Nicholls, 1975; and Wheeler, 1983). In planning these opportunities the curriculum process involves a continuous cycle of activities in which all elements of the curriculum are considered interrelated and arranged into various models.

This study is therefore posited on both Wheeler's and Nicholl's & Nicholl's, curriculum models as diagrammatically presented below:

Figure 1: WHEELER'S MODEL ON CURRICULUM PROCESS

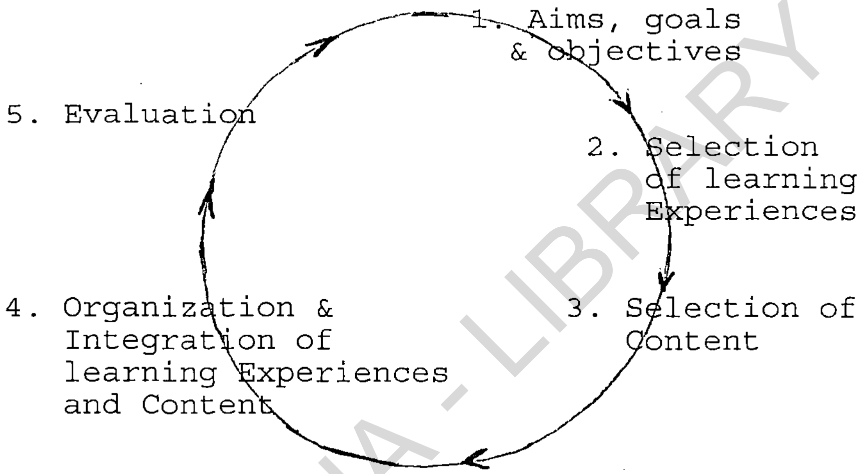
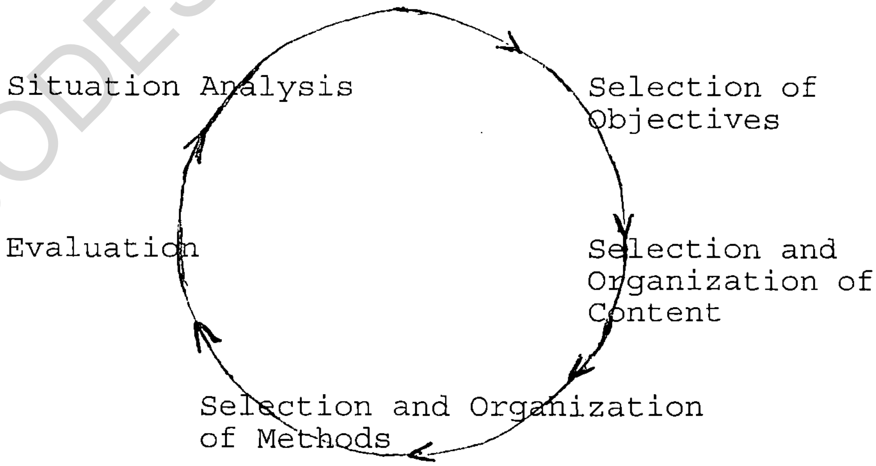


Figure 2: NICHOLL'S & NICHOLLS' MODEL ON REVISED CURRICULUM PROCESS



The situation Analysis calls for adequate consideration of all the various factors in the overall environment such as the needs of the learner (pupil); teachers; subject matter; school (building and climate) and the society in relation to Environmental Education as discussed later on in this chapter. The instructional objectives relate to Bloom's (1956) Classification of Educational Objectives in order to justify the basic assumption of the models that the end of education is to change behaviour. The study further adopts the views of Bruner and Ausubel in the structure of the disciplines and the implications for its teaching and learning.

Bruner (1962) described the structure of any discipline as the principles, organization and methods of discovery of the subject-matter. Bruner argued further, that once a learner is allowed or guided to see the relationships of things in a subject, he can put new things into their proper relationships. Hence he recommends learning by doing, acting, or behaving in his principle of structural adaptation, coupled with spiral curriculum and Discovery learning.

Ausubel and Robbinson (1969) advocated the use of meaningful verbal learning as involving the learner's ability to relate new materials to existing cognitive structure. Thus, the need arises to equip learners with organised facts or knowledge which he can assimilate, relate, organise, and store through practice.

In addition to the above learning theories, several other learning principles and criteria were considered in selecting and organising the learning opportunities as outlined by Wheeler (1983) and Nicholls & Nicholls (1975) to ensure content validity, comprehensiveness, variety, suitability, pattern, relevance to life and pupils' participation in line with the process of science. Also, the organization and integration of experiences of content fostered unity (continuity), correlation (integration) and sequences; from general to specifics (Ausubel and Robbinson, 1969, Wheeler, 1983).

However, there is a considerable evidence to justify the need to include evaluation in the current national biology Curriculum (Odunusi, 1993). In particular, since evaluation would reveal how far the learning objectives have been attained or not, its absence leaves so much gaps than to be desired. Also, several educators have described the process 'evaluation' as an integral part of a module/ curriculum package or teaching in order to assert its coverage, assimilation and application or transfer (Ezewu and Okoye, 1981).

A further attempt was made to analyse the current situation of the subject matter, the societal values and aspirations and learners' attributes in relation to the meaning, goals, objectives and principles of environmental education; environmental conservation, and the directives of the World Conservation Education Strategy.

1.2.1 NEED FOR AN ENVIRONMENTAL EDUCATION CURRICULUM OR PACKAGE

1.2.1.1 WHAT IS ENVIRONMENTAL EDUCATION?

The Longman Dictionary of contemporary English defines environment as

> all the surrounding conditions which influence growth and development.

Such surrounding conditions include air, water and land in which man lives.

On the other hand, the Collins Reference Dictionary of Environmental Science also defined 'environment' as

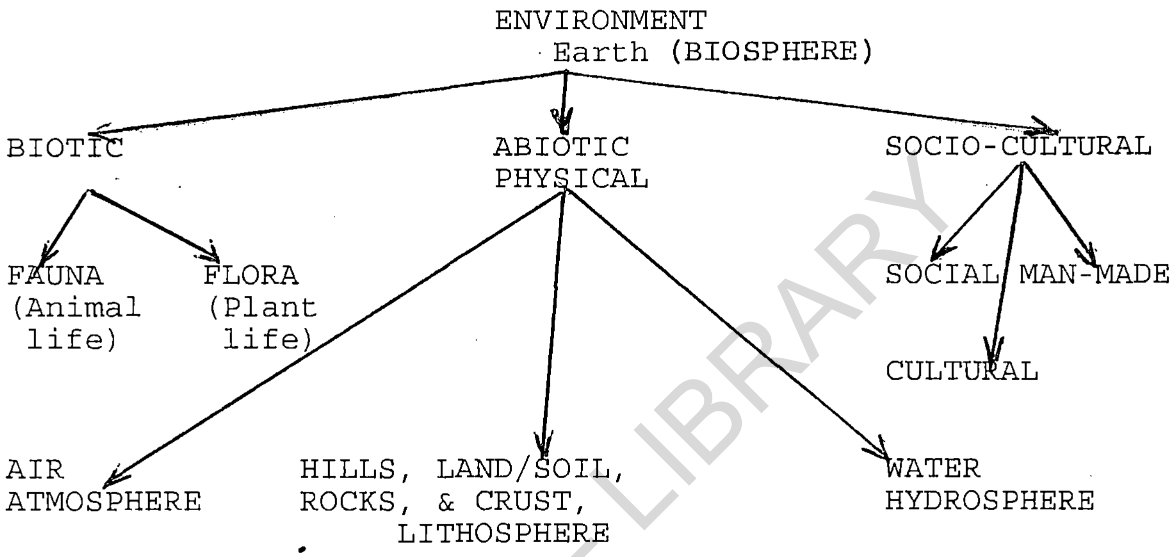
> the combination of external conditions that influence the life of individual organisms. The external environment comprises the non-living, ABIOTIC components, (physical and chemical) and the inter-relationships ;with other living, BIOTIC components.

Moreover, the Macmillan Dictionary of the Environment simply defined environment as

> the physical, chemical and biotic conditions, surrounding a living organism.

From these various definitions, it is quite clear that environment refers to the surrounding conditions which influence the process of behaviour, growth and development of living things. Such surroundings (as shown in fig. 4) include air, water, land or soil, climate, hills, materials, cultural practices, buildings etc.

Therefore, the term 'environment' consists of various components and can be further divided into some parts - Biotic, Abiotic, Natural, Social-cultural and Man-made (as represented in the Nature of environment model) fig. 3 NATURE OF ENVIRONMENT MODEL



The socio-cultural environment can further be divided into the customs, beliefs, social institutions, political institutions/systems and man-made environment. The man-made environment depicts the physical structures constructed by man, for example, factories, fixed Industrial plant, movable machinery, buildings etc.

Therefore, environment refers to all these surroundings that are capable of affecting the behaviour, growth and development of the interacting living things within the system.

Education, on the other hand has been described as

i the systematic training and instruction especially of the young in school (Oxford Advanced Learners Dictionary of Current English).

ii the training of mind and character

iii a field of knowledge dealing with how to teach effectively (Longman Dictionary of Contemporary English).

Thus, Education refers to the act or process of imparting or acquiring knowledge, skills and attitude to prepare a person intellectually for a profession or a stated goal.

Environmental Education which simply means the education about the environment, has been defined in several but similar ways by educationist and environmentalists.

Okebukola (1993) defined EE as

- the process of acquiring or transmitting knowledge, attitude and skills for the sustainable use of natural and man - made resource.

Obi (1993) quoted Wheeler (1975) who adopted **the** use of U.S. Senate Reports on the 1970 EE Act which defines Environmental Education as

an integrated process which deals with

> man's inter-relationship with his natural and man-made surroundings. It is seen as a study of the factors influencing ecosystems, mental and physical growth, living conditions, the decay of cities and population problems. It is intended to promote among citizens the awareness and understanding of environment, our relationship to it and the responsible actions necessary to assure our survival while improving the quality of life. (p. 28-29).

Furthermore, Noibi and Lawal (1991) quoted Schmieder (1977) and summarised the various definitions of EE as

- Education from the Environment (experience learnt from the environment)
- Education about the Environment (teaching about the environments)
- Education for the Environment (commitment to

environmental protection and conservation for sustainable development).

Other notable definitions of EE include the followings:

- a process that affords individuals an understanding of the implications of the changes inthe environmental factors, the source and components of the change, the creative and constructive utilization of the environment for the present and future well-being of the individual, the family and the society at large. (Adegbola, 1992).
- the process of individual and collective internalisation of knowledge, attitudes, skills about, from and for the environment towards ensuring ecological stability and improving the quality of life for man.

  (Noibi, 1993).

A working definition emerging from all these definitions, is to take EE as a process of acquiring or imparting knowledge, skills and attitude about, from and for the environment, for the sustainable use of natural and man-made resources.

1.2.1.2 GOALS, OBJECTIVES AND PRINCIPLES OF ENVIRONMENTAL EDUCATION

The World Intergovernmental Conference on EE held at Tbilisi, U.S.S.R (1977) specified the goals, objectives and principles of EE as follows:

Goals of EE

(i) To foster clear awareness of and concern about economic, social, political and ecological interdependence in urban and rural areas.

(ii) To equip individuals with opportunities to acquire the knowledge, values, attitudes, commitments and skills needed to protect and improve the environment.

iii) creating or developing new patterns of behaviour in individuals, groups and society as a whole towards the environment.

In essence, EE aims at developing individual that

(i) is aware of and concerned about the total environment and its associated problems.

ii) has knowledge, attitude, motivation, commitment and skills to work individually and collectively toward solutions of current problems and the prevention of new ones. (UNESCO, 1977a).

These EE goals were cited in UNESCO-UNEP International EE Programme (1989). The Conference identified three ways of assisting students to achieve EE goals -

(1) to understand that people are an inseparable parts of an environmental system and that their interactions or activities can alter their surroundings in both harmful and beneficial ways.

(2) to acquire a basic knowledge of how environmental problems can be solved and recognise the role of individuals and each segment of society in solving the problems.

(3) in developing analytical thinking and action skills necessary for prevention and correction of environmental abuses. (Obi, 1993).

Objectives of EE

As cited in UNESCO-UNEP International EE programme (1989), the categories of EE objectives are:

(1) **AWARENESS**: To assist social groups and individuals in acquiring an awareness of and be sensitive to the total environment with its associated problems.

(2) **KNOWLEDGE**: To assist social groups and individuals gain

a variety of experiences in, and acquire a basic understanding of the environment and its associated problems.

(3) **ATTITUDE**: To help social groups and individuals attain a set of values and feelings of concern for their environment, and motivation for active participation in environmental improvement and protection.

(4) **SKILLS**: To help social groups and individuals acquire the necessary skills for identifying and working towards the solution of environmental problems.

(5) **EVALUATION ABILITY**: To assist individuals and social groups evaluate environmental measure and education programmes in terms of ecological, political, economic, social, aesthetic and educational factors.

(6) **PARTICIPATION**: To develop in individuals and social groups, a sense of responsibility and urgency in working towards resolution of environmental problems.

From the above stated objectives, it is quite evident that EE provides learners with knowledge, attitude and skills about environmental problems and how to solve them.

Thus, EE is geared towards sustainable use of the natural resources for both the present and future generations.

Principles of EE

At the Tbilisi Conference, the following guiding principles for EE were stated. That EE should

(1) look at the environment in its totality - natural and built, technological, cultural, historical, moral and aesthetic aspects of the environment;

(2) be a continuous life long process commencing from the Pre-school age and proceeding through all formal and non-formal stages;

(3) adopt an inter-disciplinary approach, drawing on the specific content of each discipline in making possible a holistic and balanced perspective;

(4) foster active participation (of all) in preventing environmental problems and working towards their solution;

(5) address major environmental issues from local, national, regional and inter-national point of view, in order to ensure that students attain insight into environmental conditions in other geographical areas;

(6) concentrate on current and potential environmental situations while considering the historical perspective;

(7) promote the value and necessity of local, national and

international cooperation or support in the prevention and solution of environmental problems.

(8) foster adequately the environmental aspects in plans for development and growth.

(9) address the complexity of environmental problems and the need for critical thinking and problem-solving skills.

(10) allow learners to play a role in planning their learning experiences, and provide them with opportunities for making decisions and accepting their consequences.

(11) use diverse learning environments and a wide spectrum of educational approaches to teaching and learning about, and from the environment with more emphasis on practical activities and first hand or real experiences.

(12) relate or apply environmental sensitivity, knowledge, problem solving skills and values clarification to every age but with special emphasis on environmental sensitivity to the learner's own commitment in early years.

Therefore, EE is learner oriented, whereby the teacher is expected to create a conducive learning environment for his learners, adopt the inquiry method, ensure that learners participate actively in the learning process, and the teacher should participate in EE projects as team member and guide to the group rather than a dispenser of knowledge.

1.2.1.3 **ENVIRONMENTAL CONSERVATION**

Having defined the terms - Environment, Education and Environmental Education, as stated earlier on, the need arises here to explain what 'Conservation' is.

The word 'Conservation' has been defined in several ways, as;

- The management, protection and preservation of the earth's natural resources and environment. (Collins Reference Dictionary of Environmental Science by Gareth Jones et al, 1990).
- The management of human use of plants, water and wildlife so that it may yield the greatest sustainable benefit to present generations while maintaining their potential to meet the needs and aspirations of future generations.
- An orderly exploitation of such resources to allow for their renewal and balance in nature.

From all these definitions stated above, conservation refers to the wise use of the country's resources of land, water and wildlife, for the long term benefit of mankind.

Conservation further includes the protection of all our indigenous species and prevention of any of them from becoming extinct. It deals with a balanced harvest of a population or community, eliminating both over-exploitation and under-exploitation. It also seeks better ways of living in and with nature to serve our needs but not destroying it.

Environmental conservation means preservation of the environment-biotic and abiotic, socio-cultural, political, technological, etc). It deals with the interaction between man and his environment, and refers to the resource's management and utilization, for the benefit of present and future generations.

In a bid to achieve the above goals at international level, the World Conservation Strategy was developed.

1.2.1.4 THE WORLD CONSERVATION STRATEGY

This strategy, a 72 - page document, directs the world's attention to the increasingly dangerous stresses being placed on the earth's biological systems and recommends measures for relieving the situation. The strategy was developed by more than 450 government agencies and conservation organisations, and more than 700 scientists and other specialists from round the world working in collaboration with international Union for the conservation of Nature, (I.U.C.N.) ,the World Wildlife Fund (W.W.F.) and with adequate support of the United Nations Environment Programme (U.N.E.P.)

Goals of the Strategy

The integration of conservation and development to ensure that modifications done to the planet do

i) secure or protect the survival and well being of all people.

ii) improve the human environment world-wide

iii) protect the biosphere that sustains all life on earth.

Main Purpose of the Strategy

The main purpose of the strategy is to persuade all nations of the world to adopt conservation policies and practices, and ecological sound development practices. These policies can be adopted at home, in the community and in schools.

Moreover, the strategy supplies remedies, applicable worldwide, for on going destruction of nature, and points the way for development and conservation for survival and a life of dignity for all people.

Problem to be Solved - A Deteriorating Planet.

The biosphere - the air, water, soil and living things that sustains human existence, is deteriorating fast, largely because of the burdens put on it by our increasing numbers and needs or demands.

Baez (1987) further described the problems as follows:

> The combined destructive impacts of a poor majority struggling to stay alive and an affluent minority consuming most of the world's resources are undermining the very means by which all people can survive and flourish.

He further alerted, that;

> By the end of the century, there will be about 6000 million people on the earth and four fifths of them will be in the Third World. More than 2000 million people today are landless peasants in the developing countries. Caught in a daily struggle for enough food and fuel to stay alive, they strip the land bare of trees and bushes for firewood. They overgraze grassy, dry lands and over-fish and over-hunt local wildlife. Many migrate to crowded cities, where they find shelter in slums and shanty towns, often falling victim to hunger and disease.

In order to arrest this disastrous trend, it is the responsibility of this generation to act fast and reverse the situations that are rendering the planet less fit to live on.

The World Conservation Strategy therefore arose, and points the way to what must be done to rectify this appalling situation.

OBJECTIVES OF THE STRATEGY (W.C.S.)

1. To maintain ecological processes and life support systems to ensure its functionality.

2. To preserve genetic diversity in order to ensure that the earth's numerous species of plants and animals are protected from extinction.

   Thus, the strategy calls on all governments to participate in international programmes and treaties designed to preserve the world's genetic resources. The strategy further recommends financial aid to less developed nations to assist them preserve the species-rich ecosystem within their borders.

3. Ensuring the sustainable utilization of species and ecosystems. This calls for urgent need to curb overfishing, over-grazing, unsuitable farming practices, deforestation of watershed forest. ('denuding the land in search of firewood.), accidental killing of none-target animals. etc.

The Strategy (W.C.S.) and the Role of Education

The World Conservation Strategy highlights how education should be used for building support for conservation. It maintained that;

> Ultimately the behaviour of entire societies towards the biosphere must be transformed if the achievement of conservation objectives is to be assured. A new ethic, embracing plants and animals as well as people, is required for human societies to live in harmony with the natural world on which they depend for survival and well-being. The long term task of environmental education is to foster or reinforce attitudes and behaviour compatible with this new ethic.

In other words, the infusion of an environmental ethic into various disciplines in Education has emerged the overall aim of Environmental Education.

Furthermore, the declaration made by the participants of a recent conference on EE held in Bariff, Alberta, states that,

> The new basic education must endow learners with environmental competencies that will enable them to contribute to the resolution of local and global problems and to the development of an ecologically sustainable society...
>
> This movement must achieve no less than an infusion of the new environmental ethic into every aspect of the educational process. (Baez, 1987).

Thus Baez further stressed the need for educators throughout the world,

> To restructure their entire educational programs to meet effectively the urgent needs of humanity and of the plant.

Hence, the need arises to restructure programmes in science and technology education to meet the above needs. Moreover, textbooks and other materials still need to be restructured to meet the specified needs. This act can make learning more meaningful and applicable to solving human environmental problems. Teaching science and technology in such social responsible ways will lead to the improvement of quality of life on earth.

1.2.1.5 DEVELOPMENT OF CONSERVATION EDUCATION STRATEGY IN NIGERIA

The Nigerian Conservation Foundation (N.C.F.), in its continuing and unflinching effort to promote and inculcate conservation ethics in Nigerians, sensitized the Federal Government towards the introduction of conservation education in 1987. Therein, the need for a coordinated conservation education at all levels of our educational system, was stressed.

This move, resulted in the 1988 Yankari Conference, which developed the National Conservation Education Strategy (N.C.E.S.).

This strategy was based on the Philosophy by UNESCO for such education. It also drew largely from ideas, models and programmes already developed all over the world.

The strategy also maintained that the cross curricular approach be used wherein the environmental dimensions of already existing courses are to be emphasized by the existing teachers.

In conclusion, the main elements in the strategy for introducing EE to the formal education programme in Nigeria are:

i) Developing uniform curricula for every level of education in Nigeria,

ii) Writing suitable textbooks and teachers' guides on EE for primary and secondary levels,

iii) Running a series of orientation workshops for teachers on the use of the textbooks,

iv) Trial testing of the syllabuses, text-books and teacher guides.

v) Commencement of the EE programme by January, 1992,

vi) Establishment of EE Unit in the Federal Ministry of Education.

vii) Appointment of EE Coordinators and Committees at the Federal, State, and Local levels,

viii Organizing in -service and pre-service training programmes for teachers (on EE) on a regular basis,

ix) Establishment of EE Clubs in all schools, colleges and universities, and

x) Provision of adequate funds to support the programme.

This strategy was adopted in 1990 by the National Council on Education as part of the National Policy on Education. In addition, the Federal Government directed all states to establish EE Units in their Ministries of Education and conservation clubs in their schools. Also, NERDC was charged with the responsibility of infusing EE elements within the new Citizenship Education Curriculum, a core requirement at both primary and secondary school levels.

In 1989, the National Policy on the Environment was launched. Also, the National Resources Conservation Council was set up by Decree No 50, to formulate policy and coordinate activities of conservation agencies in Nigeria.

At the N.C.F/W.W.F. National Seminar on EE for State Conservation Education Coordinators, held at Gateway Hotel, Ota, in June, 1995, Ivowi (the N.E.R.D.C. representative), in his address, further stressed that each school adopts a policy of

(a) establishing conservation clubs,

(b) environmental auditing to identify environmental problem areas and adopt local solutions, and

(c) instant group action to ameliorate environmental degradation within the schools.

From the on going events discussed above, it appears that Environmental Conservation Education is warmly and heartily embraced by the Nigerian Government, and has come to stay on our soil.

1.2.1.6 **CONSERVATION EDUCATION IN THE BIOLOGY CURRICULUM**

Lots of researches have been conducted in developed countries on conservation education programmes which emanated as offshoots of Biology Curriculum in order to develop the Curriculum to bring out pupils commitment to environmental issues, and the right attitude to maintain the quality of the environment. (Birch & Schwaab 1983; Pomerantz, 1991; Westerman & Johnson, 1991; Rock castle, 1991; Jimenez - Alexandre, et al , 1995).

However, in Nigeria, a review of literature revealed that research studies on conservation education programmes are very sparse. (IgbinoKpogie and Igbarakpak, 1990). Very few attempts have been made to review the existing curriculum vis-a-vis its adequacy for achieving the EE goals and objectives. Therefore, Noibi and Lawal (1993) alerted that

> The structure and the content of training and education which most of us are used to in the Nigerian society do not provide awareness that are capable of stimulating conservation ethics and sustainable life styles.

In addition, literature review has revealed that though the National Biology Curriculum is enriched with several environmental education topics including conservation of matter and energy (Okebukola, 1990; Balogun, 1992) yet it appears that teachers are not knowledgeable on how best to impart the knowledge skills and values of conservation into their learners (Ajewole, 1991; Noibi & Lawal, 1993). According to Noibi & Lawal, the conservation topics are taught largely with examination in mind. Students therefore resorted to learning the facts (in fragments) and losing the values inherent in the subject matter. Therefore, some drastic measures must be employed, the curriculum contents, methods, learning experiences, its organization and evaluation still need to be revised and restructured (Noibi & Lawal, 1993) in order to reflect proper environmental ethics for learners to acquire. Moreover, the performance objectives covering conservation knowledge, values, attitudes and problem-solving actions are required for subsequent applications in both present and future environmental crisis (Majasan, 1995).

In a bid to achieve the above needs, an attempt was made, at the elementary level, whereby Umozurike revealed the gross deficiencies of the National Primary Science Core Curriculum - in objectives, content and activities, in meeting up with EE goals and objectives.

However, at the secondary school level, little efforts have been expended. Therefore, an attempt was made in this study to examine the adequacy of the National Senior Secondary School Biology Curriculum in the same manner.

In addition, this study designed, implemented and evaLuated the impact of a pre-packaged EE module in Biology for school children in some selected secondary schools, to increase their knowledge about environmental conservation issues (based on conservation of natural resources), develop their problem-solving abilities and inculcate in them a more positive attitude to environmental conservation activities or projects.

1.2.2 ACHIEVEMENT IN BIOLOGY CURRICULUM

Despite the massive thrust in science and technology curriculum development, students' improved performance has not really met educators' expectations (as shown in Table 2) (Balogun, 1992; George, 1993; Ball, 1994).

Table 3: STATISTICS OF RESULTS IN THE S.S.C. EXAMINATION 1990-1996 (SCIENCES).

YEAR	SUBJECTS/ GRADE	PHYSICS	CHEMISTRY	BIOLOGY
1990	Credit (1-6)	12741 (20.2)	3307 (4.1)	29972 (15.7)
	Pass (7-8)	20323 (32.2)	16657 (20.8)	58674 (30.8)
	Fail 9	30097 (47.6)	60035 (75.1)	101734 (53.5)
1991	Credit (1-6)	17037 (17.6)	12117 (10.4)	72988 (25.5)
	Pass (7-8)	28601 (29.6)	23585 (20.2)	82270 (28.8)
	Fail 9	51104 (52.8)	80824 (69.4)	130432 (45.7)
1992	Credit (1-6)	20168 (16.4)	26760 (19.0)	100050 (28.1)
	Pass (7-8)	35932 (30.1)	40913 (29.0)	110271 (31.0)
	Fail 9	65709 (53.5)	73183 (52.0)	45261 (40.9)
1993	Credit (1-6)	37309 (24.5)	39206 (23.0)	90035 (18.7)
	Pass (7-8)	40235 (26.4)	51435 (30.2)	159686 (33.2)
	Fail 9	74731 (49.1)	79896 (46.8)	231313 (48.1)
1994	Credit (1-6)	21490 (14.7)	38172 (23.7)	158180 (11.4)
	Pass (7-8)	40472 (27.7)	46487 (28.8)	138527 (27.3)
	Fail 9	64038 (57.6)	76573 (47.5)	311677 (61.3)
1995	Credit (1-6)	22825 (18.9)	48747 (36.6)	85809 (19.0)
	Pass (7-8)	41544 (34.4)	38491 (28.9)	137082 (30.2)
	Fail 9	56399 (46.7)	45950 (34.5)	230462 (50.8)
1996	Credit (1-6)	16929 (12.8)	48514 (33.5)	80734 (16.0)
	Pass (7-8)	40392 (30.4)	39162 (27.0)	127497 (25.2)
	Fail 9	75426 (56.8)	57314 (39.5)	297797 (58.8)

Source : WAEC Research and Statistics Unit
( ) Percentage

Hence, within the past two decades, several factors suggested for the seeming decline in the performance of students in the sciences, especially in Biology, include -

(i) shortage of teaching learning facilities, over-loaded time-table, and low teacher/student ratio (Bajah 1983;

Olafimihan, 1992).

(ii) the influence of ability and classroom interaction variables (Okebukola and Ogunniyi, 1984; Kirjirikah 1989).

iii) the level of utilization of resource (Oyedokun, 1990)

(iv) the nature of instructional design (Seweje, 1987).

(v) the type of teaching strategies adopted (Oyekan, 1993)

(vi) concept variables (Popoola, 1990) and

vii) learning context/problem-solving variable (Agina-Obu, 1993).

Nevertheless, despite all these various efforts, the situation is degenerating to an appalling state. Therefore, the need arises for a way out. Various criticisms have been expressed on our schooling system at all levels but the solution appears not far fetched.

As stressed by Umoren (1991), the major criticism of schooling at all levels is that students do not learn to reason and think critically. According to her, a problem-oriented societal context for science courses provides the framework essential for the development of such intellectual skills as problem-solving, decision making and the synthesis of knowledge.

Learning becomes more meaningful, practically acquired and of permanent retention. Through this process, the performance level might be improved, and the problem-solving skill might be fully developed.

In this study, an attempt was made to expose some secondary school students to a prepared curricular package in order to improve their cognitive performance and problem-solving abilities that they could transfer to solve present and future socio-scientific issues. Herein lies an attempt that could probably rectify the poor performance of students in Biology.

1.2.3 **PROBLEM-SOLVING IN BIOLOGY**

Problem-solving, according to several educators means

(i) adopting information and reasoning to overcome obstacles and barriers (Frazer, 1986).

(ii) a deliberate attempt to apply the content and process required to fill the gap between the given and the goal (Ashmore et al, 1979).

iii) a process by which the learner discovers a combination of previously learned rules that can be used to achieve a solution for a novel problem situation (Garrett and

Satterly, 1990).

From the above definitions, the problem-solving environment involves having a resultant problem to be solved. Thus, the concept has been widely studied in various disciplines especially inthe sciences (Onwu and Moneme, 1986; Adeagbo, 1985 Ahiakwo, 1987; Grayford, 1989; Ikitde, 1993; Agina-Obu, 1993). The various theorists in problem-solving have identified some basic stages or steps involved in the problem-solving process (Ashmore et al, 1979; Grayford, 1989) and several models have been suggested.

According to them, a problem-solver must

(i) be aware of the problem to be solved

(ii) define the problem

(iii gather evidence to solve the problem

(iv) form hypothesis about the solutions to the problem,

(v) test the hypotheses

(vi) find solutions to the problem, and

(vii apply the solution to solve other related problems.

Several studies in biology have indicated superior achievement levels for students taught using the above problem-solving steps/stages. (Olarewaju and Balogun, 1985; Grayford, 1989; Okebukola, 1992; Ikitde, 1993: Agina-Obu, 1993).

However, teachers are continuously criticised for their lack of problem-solving proficiency. This shortcoming usually prevents the students from understanding the meaning and nature of science (Ogunniyi, 1988) and from acquiring the problem-solving skills necessary for resolving their immediate environmental problems (Ajewole, 1990).

Little wonder then that the UNESCO-UNEP International EE Programmes specified the problem-solving approach as one of the strategies for promoting education for conservation and sustainable development. In their recommendations, it was emphasized that

- Students who engage in problem solving generally learn to become responsible, capable and creative individuals. One sure way of making them learn is by making them respond actively, collect data, answer questions and organize information.

In this study therefore, an attempt was made to document the activities and results of the pre-packaged EE module as an example of the degree to which salient conservation-related skills could be imparted effectively to the generality of student populace utilizing basic environmental conservation issues and problems prepared into the module or curriculum.

1.2.4 **ENVIRONMENTAL ATTITUDE**

> One of the aims of Environmental Education is, developing a world population that is aware of, and concerned about the environment and its associated problems and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively toward solution of current problems and the prevention of new ones. (UNESCO, 1977a).

From the above, it is apparent that environmental attitude is essential. Therefore, at the international level, various modules that are environmentally-based have been developed to change learners' attitude. Moreover, since teachers and learners are the key consumers and implementers of any programme developed, educators have constantly expressed the importance of identifying the users' attitudes or feelings to the programmes developed (McCaw, 1979/80; Bedwell, 1982).

Moreover, other educators still highlighted that environmental crisis of present times is a reflection of a disoriented value system (Dyasi, 1981; Noibi, 1990). According to them, environmental knowledge is a pre-condition for changing attitude, and that both knowledge and attitude are important to change human action towards the environment.

The Challenge now confronting different nations (Nigeria inclusive) becomes even greater when it is realised that environmental legislation or decree alone cannot resolve the social problems and issues, such as, deforestation, desertification, soil erosion, industrial pollution, water pollution, bush-burning, poaching and poor urban sanitation. (Igbinokpogie, 1990). Therefore, changes in human behaviour, attitudes and values must complement the efforts of environmental technologists and legislation or decrees (Noibi, 1981; Gwena, 1992).

Lots of researches have been conducted in developed countries on environmental attitudes of students, teachers and administrators, and a decreasing emphasis on EE at the junior and senior high levels were reported (Bowman 1974; MCCaw 1979/80; Bedwell, 1982). In Nigeria, relatively few studies have been carried out on environmental attitude (Gwena 1992; Umozurike, 1992) in the sciences.

Umozurike (1992) in her study also reveaLed the inadequacies of the current National Primary Science Core Curriculum in fostering proper environmental values/ attitudes in learners. In her analysis, only sixteen intended learning outcomes (ILO'S) were those aimed at attitude acquisition, about 13.6% of the total ILOS specified in the National Primary Science Curriculum. Since the ILOS are not well spread or balanced, they are regarded as inadequate to cause-effect attitudinal change in pupils to make them embark on personal and community environmental problem-solving projects. (Noibi, 1992; Adara, 1992; UNESCO/NERDC, 1992).

In the circumstances, it seems useful to analyse the distribution of ILOS specified for National Biology Curriculum (topics) in order to determine if the total number of ILOS aimed at attitude acquisition is balanced to cause-effect a change in learners to pursue environmental problem-solving projects. This was one of the objectives of this study.

Also, previous studies have reported a very strong positive relationship between environmental knowledge and environmental attitude (Jacobson & Padua, 1992; de-White & Jacobson, 1994; Mansaray & Ajiboye, 1997). Therefore, an attempt was made in this study to assess the impact of the pre-packaged EE module on students' environmental attitude in order to determine its adequacy and effectiveness in assisting students to embark on environmental problem-solving projects.

1.2.6 GENDER

A recent synthesis of studies on the impact of gender on students' learning outcomes revealed diverse and inconsistent influences. For instance, while some researchers reported that Females possess more verbal commitment to the environment than males (Borden and francis, 1979; Gifford et al, 1982/83), other researchers reported no significant difference between the sexes. (Strickland, et al, 1983/84).

Moreover, while the results obtained in some studies revealed that males possess more environmental knowledge than the females (Gifford, et al, 1982/83), other investigations pointed out that females possess more positive attitudes and behaviours toward conservation than males (Kushler, 1980; Lucko et al 1982).

This attitude difference has also been attributed to differential socialization of women or sex-role stereotyping. Therefore, there is need to acquire greater understanding of such factor (gender) in relation to environmental knowledge, problem-solving achievement and attitudes for designing and implementing effective conservation education programmes in our schools.

1.2.7 SUBJECT SPECIALIZATION.

Various researches have also revealed the influence of subject specialization on students' environmental outcomes (Gifford et al, 1982/83). In these studies, the environmental education students were found to possess more environmental knowledge, verbal and actual committment than other students. Moreover, although the natural science majors were also reported to know more and to be more emotionally affected by the environment than the non-science students, yet they were found to be neither verbally nor actually committed to environmental conservation.

Therefore, the need arises to clarify the consistency of these findings in related researches. Such investigation will foster greater understanding of the existing relationship for developing and implementing good conservaton education programmes.

An attempt was made in this study to investigate the impact of the pre-packaged EE module on students' environmental knowledge, problem-solving acheivement and attitudes, and to determine the relationship of both gender and subject specialization to these environmental outcomes.

1.3 STATEMENT OF THE PROBLEM

This study investigated the main and interactive effects of treatment (EE module and the conventional Biology curriculum), gender and subject specialization on

(a) cognitive achievement

(b) problem-solving achievement, and

(c) environmental attitudes of Biology students in some selected secondary schools in Ibadan Municipality of Oyo State of Nigeria.

1.4 RESEARCH QUESTIONS

The following research questions were addressed in the study:

1. Will there be any main effect of treatment on students'

(a) cognitive achievement?

(b) problem-solving achievement?, and

(c) environmental attitudes?

2. Will there be any main effect of gender on students'

(a) cognitive achievement?

(b) problem-solving achievement?, and

(c) environmental attitudes?

3. Will there be any main effect of subject specialization on students'

(a) cognitive achievement?

(b) problem-solving achievement?, and

(c) environmental attitudes?

4. Will there be any interaction effect of treatment and gender on students'

(a) cognitive achievement?

(b) problem-solving achievement?, and

(c) environmental attitudes?

5. Will there be any interaction effect of treatment and subject specialization on students'

(a) cognitive achievement?

(b) problem-solving achievement?, and

(c) environmental attitudes?

6. Will there be any interaction effect of gender and subject specialization on students'

(a) cognitive achievement?

(b) problem-solving achievement?, and

(c) environmental attitudes?

7. Will there be any interaction effect of treatment, gender and subject specialization on students'

(a) cognitive achievement?

(b) problem-solving achievement?, and

(c) environmental attitudes?

1.5 HYPOTHESES

In seeking answers to the above questions, the following null hypotheses were tested;

(1) There will be no significant main effect of treatment on students'

(a) cognitive achievement

(b) problem-solving achievement, and

(c) environment attitudes.

2. There will be no significant main effect of gender on students'

(a) cognitive achievement

(b) problem-solving achievement, and

(c) environment attitudes.

3. There will be no significant main effect of subject specialization on students'

(a) cognitive achievement

(b) problem-solving achievement, and

(c) environment attitudes.

4. There will be no significant interaction effect of treatment and gender on students'

(a) cognitive achievement

(b) problem-solving achievement, and

(c) environment attitudes.

5. There will be no significant interaction effect of treatment and subject specialization on students'

(a) cognitive achievement

(b) problem-solving achievement, and

(c) environment attitudes.

6. There will be no significant interaction effect of gender and subject specialization on students'

(a) cognitive achievement

(b) problem-solving achievement, and

(c) environment attitudes.

7. There will be no significant interaction effect of treatment, gender and subject specialization on students'

(a) cognitive achievement

(b) problem-solving achievement, and

(c) environment attitudes.

1.6 SIGNIFICANCE OF THE STUDY

This study is significant in the following ways:

(1) It attempts to reveal the efficacy of the instruction of

EnvironmentalEducation Module (E.E.M.) in helping students

(a) learn more meaningfully, thereby improving their performance in Biology;

(b) acquire necessary problem-solving abilities required to embark on personal and community environmental projects;

(c) apply the inculcated attitudinal change in solving related personal and community environmental problems.

(2) It provides information relevant to curriculum designers and science educators on different ways of improving the teaching and learning of conservation of natural resources in Biology Curriculum.

(3) It attempts to determine the adequacy of the National Biology Curriculum in its distribution of

(a) EE themes or topics, and

(b) Performance Objectives or Intended Learning Outcomes (ILOS) for imparting knowledge, attitude and skills.

(4) It assesses the adequacy of the prescribed activities for teaching and learning of the EE elements inthe curriculum

in order to determine teachers' usability of the environment to teach.

1.7 LIMITATIONS OF THE STUDY

This study was restricted to secondary school II Biology students in Ibadan Municipality of Oyo State because of financial constraints, materials and time-resources.

Eight co-educational schools were involved - two for pilot study (Experimental and Control), and six for main study.

The study involved the senior secondary school II students because it is anticipated that at that level, they would have acquired the requisite scientific information on conservation of natural resources and the necessary background to respond effectively to the instruments.

Moreover, the study involved both science and non-science majors. This is in accordance with the national objectives that stipulate the need to prepare students who can apply scientific knowledge to the improvement and solution of environmental problems for the benefit of man.

The study also involved two levels of treatment - the Environmental Education and conventional Modules. It did not examine the effects of other moderating varibles other than gender and subject specialization. Cognitive and problem solving achievements and environmental attitudes are the only outcome measures examined in the study.

1.8 DEFINITION OF TERMS

1. **CURRICULUM PACKAGES**: Instructional materials designed for learners, capable of being taught and learned within a specified length of time, and consist of stated objectives, content, method and performance test.
2. **ENVIRONMENTAL ATTITUDES**: An expression of individual intended actions on an environmental issue and feeling towards the environment.
3. **ENVIRONMENTAL ETHICS**: Expression of awareness of environmental knowledge, issues and activities in individual learner.
4. **ENVIRONMENTAL ISSUES**: The daily activities or events occurring in the environment or surroundings and that can be either detrimental or beneficial to individual(s).
5. **ENVIRONMENTAL KNOWLEDGE**: Ideas and facts that individuals have about the environment, the influence or impact of human action on the environment;
6. **INDOOR ENVIRONMENTAL EDUCATION**: A process of learning

through activities and projects that take place indoors for educational benefits or purposes.

7. **INTERACTION EFFECT**: This is the difference that result from a specific combination of levels of factors whereby the result is predicted on the basis of the knowledge of all factors involved.
8. **MAIN EFFECT**: This is a difference in mean scores for a given factor disregarding the other factor involved.
9. **OUTDOOR ENVIRONMENTAL EDUCATION**: A process of learning through activities, projects and field trips that take place outdoors, involving first-hand learning experiences and direct inquiries or observations for participants and mainly for educational benefits or purposes.
10. **PERFORMANCE**: This refers to learners' achievement as measured by scores obtained in three research instruments developed and validated by the researcher:
    (a) Test on Environmental Conservation knowledge in Biology (T.E.C.K)
    (B) Test of problem-solving achievement (T.P.S.S.)
    (c) Students Attitude to Environmental Conservation Questionnaire (S.A.E.Q).
11. **PROBLEM-SOLVING ABILITIES**: Are basic attainments

developed mainly through practice and reasoning which enable the participants become responsible, capable and creative in resolving both current and future problems or issues.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This study is concerned with the effect of environmental education module in Biology curriculum on students' performance, problem-solving and environmental attitude in some selected secondary schools in Ibadan metropolis of Oyo State of Nigeria. This chapter therefore presents description of EE and previous works related to the study, and the review is organised along the following sub-headings:

2.1 History and Philosophy of Environmental Education(EE)

2.2 Need for Environmental Education in Nigeria.

2.3 Environmental Education in Nigeria Educational System.

2.4 Proposed strategies for effective teaching of EE in Senior Secondary Schools.

2.5 Focus on National Biology Curriculum for Senior Secondary School - Historical Background.

2.6 Research studies on Environmental Conservation Education Programmes.

2.6.1 Research studies on Conservation Education Programmes in Developed Countries.

2.6.1.1 Conservation Education Programmes and Cognitive Achievement

2.6.1.2 Conservation Education Programmes and Problem-Solving Achievement.

2.6.1.3 Conservation Education Programmes and Environmental Attitudes.

2.6.1.4 Conservation Education Programmes and Gender/

2.6.1.5 Conservation Education Programmes and Subject Specialization.

2.6.1.6 Enriching Traditional curriculum with Environmental perspectives.

2.6.1.7 Using the Environment to Teach - The Need for training teachers on Environmental Education.

2.6.2 Research Studies on Curriculum Development in Environmental Education in Nigeria.

2.6.2.1 The S.T.S based Instruction

2.6.2.2 Researches on Environmental Knowledge and Attitudes.

2.7 The Present Study.

2.1 HISTORY AND PHILOSOPHY OF ENVIRONMENTAL EDUCATION

The initial global concern about the quality of our environment (the Earth) can be traced to the 1972 Stockholm Conference at Sweden (Table 1a) followed by series of other international Workshops and Conferences on EE at Belgrade

(1975), Tbilisi (1977); Moscow (1987); Cairo (1994); Denmark (1995) and Athens, Greece (1995); as stated earlier on in chapter one (Table 1a). The main contributions and activities of one of these conferences are hereby discussed

INTER-GOVERNMENTAL CONGRESS ON EE AND TRAINING AT MOSCOW, 1987

This congress, held in Moscow, U.S.S.R., 17-21 August 1987, was attended by over 300 specialists from 100 countries, observers from IUCN, and other international organizations.

Achievements:

(1) Reporting the international studies and surveys, pilot projects and research carried out on EE e.g. the IEEP has conducted a series of research activities, resulting in the production of several teaching materials, methodological guides, thematic modules and textbooks for use in general education and in pre-and in-service teacher training.

(2) Development of an international strategy for action in the field of EE and training for the 1990's.

The content of the strategy can be divided into 3 parts -

(1) Environmental problems and the aims of an International Strategy for action in EE and training.

(2) Principles and essential characteristics of EE and training.

(3) Guidelines, objectives and actions for an international strategy for the 1990's.

This part has several sections:

(a) Access to Information-Strengthening of international system for information and exchange of experience of IEEP e.g. use of a computerized service, strengthening regional networks of institutions, publication of newsletter 'Connect'.

(b) Research and Experimentation - strengthening of research and experimentation on Educational content and methods and strategies for the organization and transmission of messages on EE and training.

(c) Education Programmes and Teaching Materials - promotion of EE through the development of curricular and teaching materials for general education.

(d) Training of Personnel - promotion of pre -and in-service training for qualified formal and non-formal EE personnel.

(e) Technical and vocational Education - incorporating EE dimension into technical and vocational education.

(f) Educating and informing the Public using the media and the new communication and information technologies.

(g) General University Education - Incorporating EE into general University Education through the development of study programmes, teaching materials and training, and suitable institutional - machinery.

(h) Specialist Training: To promote specialized scientific and technical environmental training.

(i) International and Regional Co-operation Developing EE through coordinated international and regional co-operation.

Finally, 1990-2000 was designated as a "World Decade for Environmental Education", for worldwide development of EE.

Apart from several other conferences and workshops organized at international level, the UNESCO-UNEP/IEEP has launched an initiative to re-orient EE in different regions of the world. For example, the organization of an inter-regional workshop in Athens, Greece in 1995.

2.2 **NEED FOR EE IN NIGERIA**

Nigerians' awareness of the environment is not a recent phenomenon. The traditional knowledge of the environment and the necessary skills required to cope with the environment are normally routed through informal systems of indigenous education, passed from generation to generation. However, such knowledge and skills are culturally and socially oriented and partly based on Land Use and human settlement practice. In essence, people depend directly on the environment for their supply of water, energy, medicine, food supplements, materials for home-building, arts and crafts and cultural artefacts. Therefore, in order to ensure adequate protection, land was usually allocated for farming, hunting, and for religious purposes including rituals and disposals of people dying under mysterious circumstances.

Other measures used to protect certain plant and animal species include folkloric taboos and rituals, restriction of hunting and fishing practices linked with festivals and seasons.

And as revealed in a recent study conducted by Aina and Salau (1992), Nigeria has about 4614 plant species ranking it eleventh in Africa in diversity, 274 species of birds, 56 species of forest snakes, 59 Savanna snake species, 19 Amphibian species and very rich invertebrate fauna. However, the situation has degenerated as observed by Oyeshola (1995) who pointed out that

> .. with modernization and its monetized economy and increased population exploitation, relation between Nigerians and their environment has appeared disfigured and this has weakened the effectiveness of communal approaches to using environmental resources primarily as sources of sustenance and well-being.

The above observation is also supported by the World Bank (1990) report that environmental degradation directly affected the lives of about 50 million people in Nigeria. Hence, the situation has degenerated at an alarming rate and needs to be checked.

There are two types of degradation observed, mainly Renewable degradation and Land Resource degradation. In Nigeria, examples of renewable degradation observed are deforestation, fishery losses, wildlife and biodiversity losses usually caused by indiscriminate logging, improper resource management, drought, firewood gathering, industrial pollution, net fishing techniques, bush fires and oil spillage.

Also, symptoms of land resource degradation in the country include gully erosion, coastal erosion and desertification, usually caused by improper construction techniques, poor farming techniques, overgrazing, mining activities, natural phenomenon, wave action etc. (World Bank Report, 1990:26).

Other notable environmental degradation symptoms are - ground and surface water contamination, air-pollution, water hyacinth mainly caused by industrial pollution, oil spillage and raw sewage discharges.

In addition, the skyrocketing increase in environmental degradation results from people using the environment for their own immediate needs without caring very much for the inherent consequences especially for succeeding generations. (Mabogunje, 1985).

In a related manner, the National Policy on Population for Development (1988) noted that

> .. the present high rate of our population growth is already contributing substantially to the degradation of the ecology of the country.

This devastating condition calls for immediate arrest in order to make the environment more conducive for human habitation/sustenance and for national development. Moreover, oil spillage comes from petroleum industry, which plays a dominant role in the nation's economy, Desertification and erosion, reduced food production, with erosion resulting in gross depletion of soil, and plant nutrients. Notable examples of related incidents are discussed as follows:

2.2.1 INDUSTRIAL POLLUTION

The manufacturing industries serve as a major source of environmental pollution in Nigeria. (Oyeshola, 1995:). For example

(i) Some industries discharge their effluent inthe inland rivers and streams, like River Kaduna which stores all water born wastes of industries on its bank.

(ii) The limestone dust of Benue Cement Company (B.C.C) of Gboko, that destroyed the peoples' crops rendering their lands in fertile. (Guardian July 21, 1991:B1).

iii) More than 20 tonnes and as high as 62 tonnes of dust made up of oxides of calcium, magnesium, sulphur and iron are discharged into the atmosphere annually from the Aladja Steel Plant

(iv) The Ajaokuta Steel Plant emits 5,600 tonnes of SO_2 annually

(v) Emission of gaseous pollutants such as No, SO_2, CO_2, and particulates into the atmosphere, during fertilizer production from the super-phosphate fertilizer plant in Kaduna.

(vi) Emission of SO_2 pollutants from newsprint manufacturing plants of the Pulp and Paper industries of Cross River, Ogun and Kwara States.

vii) A lunar landscape of steep-sided mounds and multicolored points orlakes resulting from the tin and columbite mining operation in Jos Plateau.

viii Pollutants released from he limestone mines at Ewekoro, Nkalagu, Okpella, Sokoto, the coal mines at Enugu, and oil- wells scattered along Southern Coast. (Alexander, 1985).

2.2.2 **OIL-SPILLAGE.**

Oil spillage usually results from the leaking of crude petroleum from pipe and storage facilities, and this is partially caused by various factors such as low level of technological know-how, the weaknesses of our laws coupled with their feeble enforcement; the callousness of multinational enterprises involved inthe oil business; the carelessness of several personnel within and outside the industry and sabotage by aggrieved individuals and communities. (NEST, 1991).

About 3,000 oil-spill incidents were recorded with over 2.4 million barrels discharged into our coastal and offshore marine environment within the last 20 years. (Guardian, Lagos, March 9, 1992).

This widespread pollution of rivers, creeks, pond and wells, inevitably/eventually results in scarcity of good drinking water, and this in turn results in many people becoming afflicted with diarrhoea and dysentery.

Other effects of oil-spillage include -

(i) destruction of fishes, crustaceans and other aquatic animals (Guardian, Lagos 25 February, 1992: 7) which are sources of animal protein.

(ii) destruction of microorganisms thereby rendering the soil infertile,

iii) loss of recreational and aesthetic value of water bodies

(iv) loss of money entailed in pollution, clean-up and rehabilitation of oil spillage victims.

(v) rural underdevelopment

(vi) destruction of lives and property. (NEST, 1991).

An example of the devastated effect of oil spillage is illustrated in the precarious situation of Ogoni people of River State of Nigeria, as the spokesperson for the Ogonis (Ken Saro Wiwa) rightly puts it;

Oil exploration has turned Ogoni into a

> wasteland; lands, streams and creeks are totally and continually polluted, the atmosphere has been poisoned, ... with hydrocarbon vapours, methane, carbon monoxide, carbon dioxide, and soot emitted by gas ... in very close proximity to human habitation. Acid rain, oil spillage and oil blow-outs have devastated Ogoni territory... (Weekly Sunray, 18 Oct., 1992).

Such unchecked environmental pollution and degradation led to the complete destruction of the ecosystem, rainforest, wildlife, marine life and farmlands.

2.2.3 DESERTIFICATION

This is the loss of productivity of land, which may eventually result into the creation of desert where before there has been green vegetation. This situation is usually caused by poor land management and environmental pressures by man e.g. Overcultivation, over-grazing and unskilled irrigation. The effects of desertification include

(i) exposure of the land which causes devastating sand storms. For instance, the May 30, 1988 Sandstorm of Maiduguri in Northern Nigeria.

(ii) destruction of livestock, life and property. (NEST, 1991:111)

2.2.4 SOIL EROSION

Is the removal of soil by water or wind and usually caused by exposure of the surface soil to running water or wind. It can also result from overgrazing of range-lands or nomadic grazing, bush-burning, and cutting down of trees. For instance, gully erosion can occur in exposed land such as 18,390 hectares of Ajaokuta forests used for the Steel Development Company; Ilorin airport occupies about 1,140 hectares and Abuja Federal Capital Territory took about 27,330 hectares of forest reserves in Niger State (NEST Profile, 1991).

If these land portions exposed experience violent heavy down-pours, gully erosion results.

The effects of soil erosion are multifarious

A Gross depletion of

(i) soil

(ii) plant nutrients

iii) moisture retention capability

(iv) the organic content

B Adverse impact on agriculture - being a limiting factor to crop and livestock production.

C Total destruction of

(i) residential buildings

(ii) schools

iii) water pipe-lines

(iv) electricity installations

(v) industrial grounds

(vi) patches of forest and wildlife habitats

vii) recreational spots and visual amenities

viii livestock and human lives through accidental falls into erosion channels.

In Nigeria, soil erosion can come in form of

(a) Coastal erosion - as in Lagos, Akwa-Ibom, Ogun, Ondo, Delta and Rivers States.

(b) Gully erosion - Very common in Anambra, Imo and Ondo States, and some other towns like Gombe, Ankpa and Efon Alaye.

(c) Wind erosion: Visible in Kano, Sokoto, Borno and Yobe where there is low amount of rainfall.

(d) Sheet erosion: Slow removal of top-soil by surface run off down the slope, common in Jos, Plateau, Anambra, Imo, Sokoto, and part of Kwara States.

(e) Rill erosion: Occurs after heavy rainfall which forms shallow ponds all around the field (Lawal, 1993).

2.2.5 GAS FLARING

Atmospheric pollution by combustion or burning of vegetation. This air pollution can disturb associated wildlife. Also, acid rain formed by the atmospheric pollution damages buildings. Even destruction of soil and crops by heat occurs. The effects of gas flaring include -

(i) movement of properties and house-hold with psychological consequences of fear, insecurity and anxiety on the residents.

(ii) forced population migration.

iii) impairment of human health.

However, with all these detailed descriptions of effects of environmental degradation, what is Nigeria's response to Ecological and environmental issues? An attempt shall be made here to highlight Government actions.

2.3 EE IN NIGERIAN EDUCATIONAL SYSTEM

2.3.1 EVOLUTION OF EE IN SCHOOL CURRICULUM

In response to the World Conservation Strategy directives on all governments to strive hard to preserve the genetic resources within their borders, several efforts were extended to protect Nigerian environment by the government.

In the 1970's, the committee of nations considered Education for Awareness and actions on the environment as the sole responsibility of various socio-economic sectors, while the Federal and State Ministries of Works and Housing Solitarily dealt with environmental matters (Adara, 1993). During this period, the Ministries of Agriculture and Natural Resources and Education played very little role since they received no national mandate on environment.

However, with the successive degradations of the environment - droughts of the early 1970's, oil spillage, dumping of toxic wastes on the Nigerian shores of the 1980's, the federal government deemed it necessary to perpetuate environmental awareness and protection through our formal education system.

By 1981, the need to produce useful citizens who can protect the environment was specified in the Technical Education section of the National Policy on Education (As stated earlier on).

By 1982, the Nigerian Conservation Foundation (N.C.F.) was formally inaugurated to promote better and more widespread understanding of the concerns and relevance of conservation. Later, the promulgation of legislations and decrees by the

Government followed as mentioned earlier on.

The Federal Government's commitment to improved environmental actions in formal and non-formal education sectors is further indicated in the

(i) involvement of the Presidency in tree-planting campaigns,

(ii) monthly environmental sanitation exercises,

iii) Annual organisation of workshops and seminars to mark the World Environmental Day,(5th June)

(iv) establishment of the one percent ecological fund for combating natural disasters,

(v) establishment of National Coordination Committee on EE (N.C.C.E.E) with secretariat at NERDC (a parastatal of the FME and YD) to facilitate joint efforts and relationships among EE associations, citizen groups, educational institutions, government and non-government including voluntary organisations, (NCCEE, July, 1992).

(v) internationally sponsored training programmes on EE for Nigeria;

vii) Sponsorship of Nigerians to the Earth summit.

viii establishment of National Parks, forests reserves and Wetland Sanctuaries,

(ix) development of EE Resource materials as mass literacy tools,

(x) pursuance of plans in collaboration with NERDC to revise the national schools curriculum and incorporate elements at all education levels,

(xi) formation of school conservation clubs,

xii) establishment of ordinary and postgraduate programmes in University of Calabar;

xiii establishment of the Federal Environmental Protection Agency (F.E.P.A) in 1988;

xiv development and ratification by government of the National Conservation Education strategy.

(xv) launching of the National Policy on Environment in 1989, which aims at

(a) raising public awareness,

(b) promoting understanding of the relationship or link between environment and development, and

(c) encouraging individuals and community participation in environment improvement efforts.

By 1990, the Federal directives prompted states to select EE co-ordinators and establish EE Units (at the NCE - National Council on Education meetings). The N.C.C.E.E. also served for exchange/communications, between the federal government and the schools, public and private sectors on EE.

Examples of EE materials produced, in collaboration with NCF, as mass literacy tools, include

(a) Tortoise (N.C.F., Lagos) for primary and secondary pupils,

(b) NCF Newsline (N.C.F., Lagos) or general readership,

(c) EEU news (College of Education, Ekiadolor) for general readership;

(d) Teacher's guide to conservation clubs (N.C.F, Lagos)

(e) Reading in EE for Tertiary Institutions (Noibi and Lawal, 1991).

(f) Environmental Education Basis. (SIRF, Calabar)

(g) EE Modules - Calabar Nigerian Voice- Calabar

(h) EE for teachers - Inyang - Abia Institute of Education, University of Calabar, and

(i) NERDC Voice (In Press, Adara, 1993).

Moreover, the federal Ministry of Education, through the NERDC, in cooperation with EE professionals, N.C.F education Department and EE Units have introduced EE Module into the citizenship education core curriculum guidelines. (Nwabueze, 1993).

2.3.2 COLLABORATIVE EFFORTS OF N.C.F. EDUCATIONAL DEPARTMENT AND EE UNITS

The Nigerian Conservation Foundation (N.C.F.), is a non-governmental organisation in Nigeria, working nationwide for the following purposes - in

(i) saving the country's flora and fauna from extinction.

(ii) protecting the environment from pollution and degradation, and

iii) improving the quality of life of the custodians of our wildlife heritage.

N.C.F. was inaugurated by the President of Nigeria, Alhaji Shehu Shagari, on february 12, 1982, and became formally affiliated to the World Wide Fund for Nature (W.W.F.) in 1989. N.C.F. has several departments amongst which is the Education Department.

The education department arose out of interest of NCF Public Awareness Committee under the distinguished chairmanship of Chief A.A. Ajao, and charged with the responsibility of promoting conservation through schools.

In the interest of "catching them young", the public awareness committee (instigated the establishment of school conservation clubs and conservation activities. These various activities have been sponsored through the joint funding of integrated Environmental Awareness and Education Programme for Nigeria (Project Number NG0005) by the World Wide Fund for Nature (WWF, U.K.) and the Overseas Development Administration (O.D.A.). The Foundation's sustained interest in conservation work of government agencies, research institutes and universities has been acknowledged by various sectors of the federal ministries and parastatals.

2.3.2.1 ORGANISATION STRUCTURE OF N.C.F. EDUCATION DEPARTMENT

The education department has a Coordinating/Conservation Education Unit at Lekki, that coordinates three other member units, which include

(i) The Environmental Education Units (EEU) in Benin-city

(ii) EEU, in Calabar, and

iii) Okomu Community Education Unit at the Okomu Forest Reserve.

2.3.2.2 NCF FUNCTIONAL PROGRAMMES/ACHIEVEMENTS

The education department coordinates or supervises four functional programmes, notably

(i) school's programme

(ii) community education

iii) curriculum and training, and

(iv) special projects.

As recorded in the WWF (UK) sponsored mid-term evaluation of the programme, the achievements shall be categorised into the four sections.

2.3.2.3 **SCHOOL'S PROGRAMMES**

The NCF's achievement in schools' programmes include the followings:

(i) Facilitating the establishment of 302 active conservation clubs in Nigeria;

(ii) organising annual conservation week beginning from 1989;

iii) organising annual Art and Essay competitions;

(iv) organising a debating competition in 1989;

(v) staging musical concert "Yanomamo' on the environment in 1989 and 1990;

(vi) hosting school visits to the Lekki conservation centre;

vii) administering the WWF/Longman Reading for the Environment competition in 1991;

viii conducting along with academic associates, a short story competition which resulted in several children going to the Youth for Environment and service camp in Virginia, U.S.A.

(ix) organising a poetry competition in 1992;

(x) devoting a stand in the exhibition hall at the Lekki Conservation Centre to show various works carried out by children.

2.3.2.4 **COMMUNITY EDUCATION ACHIEVEMENTS**

(i) Conducting adult literacy classes which have led to the acquisition of knowledge on conservation, sustainable development and the development of basic literacy and numeracy skills;

(ii) Developing urban environment education programme;

(ii) Making appropriate provisions for infrastructural facilities to foster conservation education in protected areas in Lekki and Okomu;

(iv) Coordinating and supervising community education efforts of the field units;

(v) Conducting fieldwork in community-based environmental education project towards evolving a viable strategy for community education.

2.3.3.5 **ACHIEVEMENT IN CURRICULUM DEVELOPMENT AND TRAINING**

(i) Developing the National Conservation Education Strategy (approved by government in 1990/91);

(ii) Developing EE curriculum for secondary schools, already accepted by government for inclusion into the citizenship education programme (1991);

iii) Developing Teacher's conservation guide for EE;

(iv) Developing textual materials for the postgraduate and Ordinary Diploma in EE (on-going);

(v) Establishing seminars, conferences and training workshops;

vii) Publishing resource materials;

viii Developing a Bachelor of Science degree in EE at the University of Calabar;

(ix) Adding five Nigerian Educationist to the 19 trained in EE at the JordanHill College, Glasgow;

(x) Visiting lectureship of the Head of Education at the JordanHill College for nine months (1991).

(xi) Developing curricula for the Ordinary Diploma and Postgraduate Diploma in EE at the University of Calabar;

(xii Contributing "Nigerian Environment and Development" to the WWF book series on 'What We Consume';

xiii Organising the first National Conference on EE in March 17th-19th, 1993;

xiv Facilitating the formation of the Nigerian Association for Environmental Education (N.A.F.E.E.) in 1993.

(xv) Establishing a Research and Publication Committee to facilitate research and publication in EE; and

xvi) Publishing the Journal of Environmental Education. (In Progress).

2.3.2.6 **SPECIAL PROJECTS**

Amongst the special projects embarked upon are

(i) Research on relationship between environment and development in Nigeria, towards the publication of a text on environment and development for use by schools in the U.K. and Nigeria;

(ii) Co-ordination of research and text-development on Benin History and Environment project, which examine the relationship of Benin culture with the natural environment;

(iii Exhibition of EE materials at the Shell Petroleum Company's Health and safety Week activities in Lagos and Warri;

(iv) Ecology and Religion Project.

However, the education department still anticipates to achieve the following:

(i) Strategic planning for the sustainability of on-going projects;

ii) developing EE programme of Gashaka-Gumpti National Park;

iii) promoting international exchange programme inthe implementation of EE projects in Nigeria;

(iv) establishing conservation clubs in ALL schools in Nigeria;

(v) promoting sustainable life-style through awareness, training and education;

(vi) professionalising EE through N.A.F.E.E.

vii) collaborating further with State, Federal, National and Inter-national agencies.

In order to enhance the attainment of the proposed projects, the four functional units are adequately staffed, with member comprising of professionals from Universities, Federal Ministry of Education, Colleges of Education, and other resource centres.

2.3.3 **FORMAL TRAINING OF ENVIRONMENT WORKERS**

There are three categories of workers that work professionally on environmental problems, that need to be trained. They are

(i) the teacher s

(ii) technical staff, and

(iii change agents or extension personnel or community development workers.

An attempt shall be made here to discuss the training of teachers on EE.

2.3.3.1 **THE TEACHERS**

These are the teaching personnel used to impart appropriate EE knowledge and skills to pupils or students and the public. As mentioned earlier on, those institutions training teachers on EE include

(1) University of Calabar, Calabar for B.Ed., PGDE programmes.

(2) College of Education, Ekiadolor, Benin for NCE Programme.

(3) Lagos State University, Lagos - B.Ed. (In progress).

Other means employed to induct teachers on EE include the organization of workshops and conferences to train secondary school teachers (both in-service and pre-service). For example, workshops and seminars on EE for

(i) Secondary school teachers held at the University of Lagos Conference Centre, 13th-15th June, 1990 (Organized by NCF)

ii) School Principals and Administrators, 1991.

iii) Secondary School teachers/club leaders, 3rd-4th July, 1991(At Lekki Conservation Centre)

(iv) Marking the World Environmental Day, 3rd-5th june, 1992 (at Lekki).

(v) Utilising Drama in communicating about the environment at Lekki. 16th Feb., 1993.

(vi) First National Conference on EE, at Lagos, 17th-19th March, 1993. (NCF/WWF-U.K.).

vii) The development of EE Resource materials, on 24th May, 1993 (at Lekki).

viii Secondary school teachers, 1995 (Lekki).

(ix) Private Primary school teacher and Headmistresses/ proprietors, May, 1995 (at Lekki)

(x) Secondary school teachers (STAN Workshop on EE) at Corona school, Lagos, May, 1995; at PortHarcourt, May, 1998.

2.4 PROPOSED STRATEGIES FOR EFFECTIVE TEACHING OF EE IN SENIOR SECONDARY SCHOOLS.

According to Layton et al (1993), a socially responsible science education has a vital role to play in the development of a more meaningful science Education during schooling.

Inorder to achieve this, teachers need to adopt teaching-learning skills and strategies on how to learn from, about, and for the environment. Therefore, Cross and Price (1992, 1994) recommended that the necessary skills teachers are expected to adopt in handling a social issue in science include -

(1) Defining the projects - breaking social issues or topics into separate projects that can be assigned to student individually or in groups.

(2) Sorting the questions on different projects.

(3) Handling the arguments - considering evidence involved, problems of terminology, conceptualisation or logic, prior knowledge or skills required of learners and inherent values.

(4) considering the concepts - defining the concept or term, identifying difficult concepts and possible solutions.

(5) Adopting appropriate teaching methods e.g. brainstorming and cooperative learning strategies (Hassard, 1990), Debates, value tree analysis where various views or solutions are proposed

(6) Using relevant Resource - up to date or current materials can be used by learners for adequate clarification and permanent learning.

These recommended skills or strategies are synonymous to Ajewole's (1990) proposed strategies for teaching EE in

Nigerian schools. According to him, instructional strategies which are

(1) affective-based enhance environmental behaviour,

(2) psycho-motor-based enable learners to participate and be more active in solving environmental problems,

(3) cognitive based enable learners to acquire EE knowledge and enhances their commitment to EE.

These views were supported by Lawal and Noibi (1990). Moreover, Ajewole added that the teacher should consider

(1) the nature of environmental issue to be taught,

(ii) the objectives of teaching the environmental issue,

(iii the choice of methods (indoor or outdoor)

(iv) content of the integrated lesson,

(v) learners' readiness for learning the contents

(vi) models for evaluating the objectives of the lesson.

These methods should be constantly used in teaching EE in order to change the learners' behaviour and get them into action willingly. Examples of specific methods for teaching EE in senior secondary schools, as cited by Ajewole (op cit) include the following:

(1) Inquiry method

(2) Role playing

(3) Dramatisation

(4) Case studies

(5) Field trip

(6) Problem-solving

(7) Use of Resource persons

(8) Pictorial presentation or photo analysis,

(9) Enter-educate approach, and

(10) Future's wheel.

However, a combination of two or more methods can be adopted to achieve the stated EE objectives. A brief description of selected few of the above methods is provided as follows:

(1) Inquiry method - whereby the teacher offers minimum guidance to the learner who is expected to discover or create an answer to solve a defined problem through the scientific method.

(2) Fieldtrips - since EE has more to do with the outdoor, fieldtrip provides opportunity for learners to have personal or direct contact with the environment so that they can see things, perceive and obtain first hand information about a particular issue or problem.

(3) Problem-solving - That is, resolving a problem through

investigation, such as

- describing and clarifying the problem
- developing hypotheses or assumptions
- analyzing the causes of the problem
- operationalizing the questions
- testing the hypotheses
- drawing conclusions and applications

(NERDC, 1988; Ajewole,. 1990).

(4) Use of Resource Persons: whereby an expert is invited from outside to enlighten, educate and share his experience, facts or ideas with the learners on a topic, issue or problem.

(5) Pictorial Presentation/Photo-analysis - using pictures from magazines, newspapers and photographs in order to create awareness about environmental problems through personal interactions with the materials.

(6) 'Enter-Educate' Approach: Educating learners through entertainment using the mass media - (e.g. television, films), New coverage, music video, documentaries, televised Mini-Drama & Variety shows, Advertising Sports and Jingles etc.

(7) Future's Wheel: allowing students to examine or assess

the results of present day actions in relations to the future, and to recognise different levels of consequences (using diagrams/discussions) or each environmental problem or issue.

2.5 FOCUS ON NATIONAL BIOLOGY CURRICULUM FOR SENIOR SECONDARY SCHOOL

HISTORICAL BACKGROUND

The teaching of Biology dates back to 1860 in Nigeria (Okebukola, 1990). Then, the students of C.M.S. Grammar School, Lagos received the course content in the form of Anatomy, botany and physiology. In 1902, the Biology programme used in British schools were replicated for Nigerian Schools, wherein students were expected to study British plant and animal species, with no bearing to their immediate environment.

Later, the West African Examinations Council, in the early 50's, developed Biology syllabus with integration of 'Soil Conservation - Causes of soil infertility methods of renewing soil fertility and control of erosion.

By the 70's, there had been inclusion of more EE topics in Biology syllabus, such as Pollution - causes, types and control; soil and water conservation.

In 1985, the Federal Ministry of Education prepared a Core Curriculum in Biology for Senior Secondary Schools, in response to the objectives of the 6-3-3-4 system of education for secondary level.

2.5.1 **OBJECTIVES OF EXISTING BIOLOGY CURRICULUM**

The objectives of the syllabus are to enable pupils attain:

(1) adequate laboratory and field skills in biology;

(2) meaningful and relevant knowledge in biology;

(3) ability to apply scientific knowledge to everyday life in matters of personal and community health and agriculture; and

(4) reasonable and functional scientific attitudes. (FME, 1985).

Therefore, the structure of the syllabus was organised into five sections - Topic; ;performance objectives; content; activity and explanatory notes.

However, for subsequent applications in both present and future environmental crisis, the performance objectives are expected to cover knowledge, problem-solving actions and attitudes. (UNESCO-UNEP, 1987; Umozurike, 1992; Majasan, 1995). Despite the extended effort, the realisation of our environmental goals and objectives is yet to be attained. Then the question arises; Are the performance objectives covering EE knowledge, values/attitudes and problem-solving actions stated in a balanced mode as recommended by the UNESCO-UNEP report?

An attempt shall be made in this study to determine the adequacy or inadequacy of the performance objectives of the existing curriculum vis-a-vis the main objectives of EE.

2.5.2 SELECTION AND ORGANIZATION OF CONTENT AND LEARNING EXPERIENCES

The contents and contexts of the syllabus centre on field studies, guided discovery, laboratory techniques and skills and conceptual thinking. The concepts in the syllabus include concept of living, basic ecological concepts, plants and animal nutrition, conservation of matter and Energy, Variations and Variability; Evolution and Genetics. Other EE topics in the syllabus are: man and microbes, and public health and personal hygiene.

Despite the intensive efforts extended to enrich the Biology syllabus in EE topic (Okebukola,1990), students are persuaded and most of the time forced, to carry out certain environmental tasks to solve serious environmental problems.

Moreover, land degradation or deterioration still persists. Noibi and Lawal (1993) also observed, that most teachers are not knowledgeable on how best to impart the values of EE in their learners. Therefore, the EE topics are taught with examination orientation. Also, inthe teaching-learning process of EE, the teachers' use of their local environment is highly recommended. but literature review has revealed that not many teachers adopt this (Noibi, 1989).

From his findings, it is evident that several students are not provided with enough practical experiences to explore their environment, utilize resources discovered, and apply to related environmental issues and problems. Hence, the revelations reflected a contrary disposition to the recommended approaches - projects, developmental and problem-solving, for fostering EE values or attitudes in learners. Then, some drastic measures must be employed to rectify the anomalies inherent in our educational system. According to Baez (1987), Noibi (1992), Adara (1992) and UNESCO/NERDC (1992), Petters (1995) the curriculum content, methods, learning experiences, its organization and evaluation still need to be revised.

Beside, several other questions arose:

- Did the existing biology curriculum give teachers enough opportunities to use outdoor activities?
- What are the various factors inhibiting the teachers' use of fieldtrips or outdoor activities?
- Is there any need for adequate pre-service or in-service EE training for teachers on the use of the specified approaches?
- These and several other questions (raised earlier on) form the basis of educational challenge of this present study.

2.6 RESEARCH STUDIES ON ENVIRONMENTAL CONSERVATION EDUCATION PROGRAMMES

2.6.1 RESEARCH STUDIES ON CONSERVATION EDUCATION PROGRAMMES IN DEVELOPED COUNTRIES

In response to the ultimate goal of Environmental Education to endow learners with environmental competencies that will enable them to contribute to the resolution of environmental problems, several conservation/education programmes evolved. These Education programmes have often been recommended as a way to encourage resource conservation (Ramsey, et al; 1981; Sandra and Schwaab, 1983; Strickland et al, 1983/84; Westphal, et al, 1985/86) based on the belief that what children learn in school can assist them in the future to deal with and perhaps prevent environmental hazards.

This recommendation is also supported in UNESCO-UNEP Report (1989) that a well planned education programme is needed to create an environmentally conscious individual (or environmental ethic) which will overcome the commonly held view that natural resource is abundant and that its wastage/destruction/ overexploitation is of little consequence. Therefore, the inclusion of resource conservation in the school curriculum has been recommended to encourage the careful use of natural resources. (Westerman and Griner, 1991).

Notable among such curricular conservation programmes, in developed countries, are:

i Water Conservation Instruction (Birch and Sch waab, 1983; George, 1989; Crites, 1991)

ii Water and energy Conservation Instruction (Westerman, and Griner, 1991; Rockcastle, 1991).

iii Garbage Crisis Module (Heffernan, 1991)

iv Energy Conservation Instruction (Stevens et al, 1979; Kushler, 1980; Crater and Mears, 1981; Strickland et al, 1983/84; National Energy Foundation(NEF) 1986; Jimenez-Alexandre et al, 1995).

v Natural Resources Education Materials (Pomerantz, 1991; Duffy, 1991).

vi Conservation Education Programmes (de-White and Jacobson, 1994), Leeming, et al (1997)

vii Wildlife Module (Sigman, 1991).

viii Land Conservation Programme (Rhein, 1981)

ix Forest Conservation Programme (Miller, 1991; Jacobson and Padua, 1992).

x Air Conservation (Woodford and Lass, 1993);

xi Outdoor Conservation Education Programme (Lucko, et al, 1982; Shephard and Speelman, 1985/86; Hungerford and Tomera, 1985/86; Herman, 1991; Alexander, 1991; Moore, 1992; Schatz, 1993; Blythe, 1994).

Most of the above studies were concerned with effects of presenting an environmental curriculum unit and often compared children who had received the curriculum with controls who had not. Several studies have reported positive effects only for experimental children who received the particular environmental curriculum and not for control group children

(Wendling et al, 1989; Westerman & Griner, 1991; Jimenez-Alexandre, et al, 1995).

However, other researchers examined the impacts of the various programme on students' learning outcomes. For instance, Leeming, et al (1993) in their critical review of outcome research in Environmental Education reported 34 studies evaluating the effects of some form of Environmental Education programmes on changes in students' knowledge, attitudes, or behaviours. Twenty of these studies were carried out on elementary school children in Grades K-8 while the remaining 14 were on older children or adults. An attempt shall be made in this chapter to discuss the various findings obtained from few of the sited studies.

(A) **STUDIES ON WATER CONSERVATION INSTRUCTION**

Birch and Schwaab (1983) designed a study to evaluate the effectiveness of a water conservation instructional unit in increasing students' knowledge of water conservation practices and influencing their attitudes about efficient water use. The study was based on the beliefs that what children learn in school can assist them to deal with, and prevent water shortages in future. Although several studies support the need for water conservation education in public schools

(Birch, 1981), this study was carried out to provide empirical basis for the assertion. Using a Solomon 4 Group design to analyze data collected on a sample population of 843 seventh grade Life Science Students, the results showed

(a) a significant difference in

 i water conservation knowledge of experimental and control subjects

 ii attitudes toward water use of the experimental and control subjects.

(b) a significant correlation ($r=.46$, $p < .0001$) between attitude and knowledge post-test scores for the groups used.

Therefore, the water conservation curriculum package (or kit) tested in this study was found effective in increasing knowledge and positive attitudes of students about water conservation. Similar results were also obtained in other subsequent investigations on water conservation education program developed for students (George, 1989; Crites 1991).

(B) **EFFORTS ON WATER AND ENERGY CONSERVATION INSTRUCTION**

Rockcastle (1991), in his paper on 'Researching Energy and Water Use at Home, provided background material to facilitate tabulation of water and energy use at home, as part of Nature study curriculum. In addition, Westerman and Griner (1991) described the efforts of two camps administered by the Branders Bardin Institute (California) in implementing water and energy conservation programs embracing recycling, composting and landfill savings. The findings showed the effectiveness of the programs in eliminating excess water waste and teaching campers to care more about their environments both at home and at work.

(C) **GARBAGE CRISIS MODULE**

Heffernan (1991) developed a module on the garbage crisis for intermediate and advanced learners. It informs learners about the environment and provides them with opportunity to direct their concerns about the environment into positive action. The module consists of five units:

i What is Typical Household Garbage?

ii Where Does this Garbage Go?

iii where Does it Come from?

iv And what Are We Doing to reduce, reuse, and recycle our household Garbage?

Questions for discussion are also included for each unit with a quiz called 'Great Recycling Quiz'.

(D) **ENERGY CONSERVATION INSTRUCTION**

Initially, Stevens et al, 1979 discovered that in-class energy instruction and task oriented activities whereby students are directly involved in attempting to manage energy wisely have a positive impact on student energy conservation attitudes and actions. However, some other strategies like the assembly format, student energy teams and school campaIgns were not effective.

In order to confirm this, Strickland et al (1983/84) investigated the Pre-test and Post-test comparisons of Pre-school Children's knowledge about Energy, after conducting a three-week energy education programme (or curriculum) on what energy is, sources of energy, uses of energy and wise energy use. The results obtained revealed similar significant differences in the amount of information the total group of pre-school children have relating to energy before and after the presentation of an energy education programme (even at .01 level).

At secondary school level, Kushler (1980) reported in his study that energy conservation efforts targeted at high-school-age youth could produce immediate energy savings as a result of their actions and influence on their immediate families. He further suggested that prior to their assumption of full adult roles, students could develop an "energy ethic" with a lasting impact on society. Data obtained from the multi-phase research effort, especially on instructional intervention and attitude survey also confirmed a significant effect of the energy conservation instruction on the attitudes and behaviours of high school students.

(E) **NATURAL RESOURCE EDUCATION MATERIALS**

Pomerantz (1991), in his analysis of elementary school natural resource lessons (n = 700) that focused on ecological principles, resource management issues and analytical skill development affecting students' environmental behaviour, discovered that very few of the lesson materials help to develop critical thinking skills and behaviours necessary for prompt environmental action. Hence, the need for a revised module. Duffy (1991) therefore compiled 65 resource materials for elementary and secondary school teachers for classroom use or as students' activities on a broad range of environmental issue.

(F) **SPECIAL CONSERVATION EDUCATION PROGRAMMES**

Driver and Johnson (1983/84) earlier on, conducted a pilot study of the perceived long term benefits (of the

Youth Conservation Corps (Y.C.C.). Y.C.C. is an EE programme for Youths of ages 15 to 18, sponsored by the United States Dept. of the Interior, U.S.D.A. Forest service and by individual States with Federal cost-sharing. The enrollees were kept in residential camps; or at non-residential camps (as they choose) for 4 to 8 weeks in the summer. They were paid for 30 hours of conservation work per week on public lands and spent extra 10 hours each week on EE without pay.

Using 600 enrollees and 600 parents of enrollees exposed to Questionnaires, the result revealed that both the enrollees and their parents perceived that the enrollees have gained some long-term benefits from their Y.C.C. experience.

Similarly, de-White and Jacobson (1994) reported a study to determine the effectiveness of conservation education strategies in use at zoological parts by comparing programme formats. The 4th grade students (n = 1,015) were assigned to experimental groups and they completed the preparatory Questionnaires. The results revealed that knowledge and attitude scores of students whose teachers participated in the educational programme improved significantly.

In addition, Leeming, et al (1997) investigated the effects of participation in Class Activities on children's

Environmental attitudes and knowledge. The study was designed to assess, firstly, whether the environmental attitudes and knowledge of participants changed relative to non-participants, and secondly whether caretaker children influenced their parents environmental attitudes and knowledge. The experimental classes were exposed to the caretaker classroom programme developed. 16 participating experimental classes and 19 non-participating control classes were selected. The pre-test and post-test environmental attitudes and knowledge assessed showed that the program had a significant positive effect on attitude toward the environment but with no influence on knowledge of environmental issues. Moreover, children rated by their teachers as most interested in the activities showed greater increase in pro-environmental attitudes than those rated least interested. Also, parents of the experimental group showed significantly more pro-environmental behaviours after their children's activities than did parents of the control classes. The establishment of the parents' habits and attitudes is in line with the cognitive theorists' assertion that conscience and values develop early in the socialization process. Therefore, if children can have an impact on their parents attitudes and values, thereby facilitating changes in their behaviour, then similar influence can be exerted on their peer groups and members of the community.

(G) WILDLIFE CONSERVATION MODULE

On wildlife conservation, Sigman, (1991) prepared a curriculum guide for students at the secondary level as an awareness of Alaska's Wetlands and the fish and wildlife that live there. The curriculum is divided into several sections with related learning activities. Each of the learning activities consists of the following units

i Objectives

ii Methods

iii Background Information

iv Needed material

v Procedures

vi Information about combining with related academic subjects,

vii use of relevant student skill,

viii Suggestions for student evaluation

ix Extended learning activities, and

x A glossary and additional resources, illustrations and maps.

(H) LAND CONSERVATION PROGRAMME

Rhein (1981) examined the topic of land use, synthesized as land-use education, and suggested a model land-use education curriculum for grades 7-12. In addition, Lucko, et al (1982) evaluated the effectiveness of a set of Land Use Decision-making kits designed by Haakonsen et al, (1977) to translate technical reports into instructional material, and the curriculum was found to be effective and flexible.

(I) **FOREST CONSERVATION PROGRAMME**

The need for forest conservation led Miller (1991) to present a staggering statistics and dramatic headlines about the destruction of rain forests, the world's richest ecosystems(deforestation). He examined the costs and consequences in human, economic and ecological terms, of the scientific catastrophe in the making, and described the relevance of arboreal genetic diversity. In order to rectify these deffiencies, Jacobson and Padua (1992) examined two conservation education programmes that involved local primary schools and national parks in Malaysian Borneo (Kinabalu Park) and Central Brazil (Morro do Diabo Park) using a comprehensive systems evaluation model as design. it was discovered that both programmes resulted in cognitive and affective gains for students involved.

(J) **EFFORTS ON AIR CONSERVATION INSTRUCTION**

Woodford and Lass (1993) examined Noise Exposure and Hearing Loss in Rural Children and discovered that a higher level of work-related and recreational noise led to a high prevalence of noise-induced hearing loss in rural students. From their study, they asserted that teachers should endeavour to prevent this problem by integrating hearing conservation education with existing curricula. In addition, educators should be trained about hearing conservation by professional audiologists.

(K) **OUTDOOR CONSERVATION EDUCATION PROGRAMME/INSTRUCTION**

A review of literature revealed several efforts extended on outdoor conservation education programme or instruction (Lucko, et al (1982), Shephard & Speelman, 1985/86; Hungerford & Tomera, 1985/86; Herman, (1991), Moore, (1992); Alexander, (1991), Schatz, (1993), and Blythe (1994).

Lucko, et al (1982) reported three studies of attitudes toward and effects of field trips of Falk and Balling (1979). Inthe first study, 425 fifth and sixth graders participated in outdoor science activities and results showed that more learning took place when the concepts to be learned and setting novelty were maximized. In the secondary study, the four groups involved had positive attitudes toward fieldtrips. In summary, the three studies revealed that field-trips possess clear cognitive and affective benefits and can influence students' attitudes, behaviour and learning.

Similar inferences were also drawn by other researchers such as Shephard and Speelman (1985/86) and Hungerford and Tomera (1985/86). Moreover, while Herman (1991) discussed 186 learning activities that encourage children to experience and appreciate the earth, Alexander (1991) inferred that Outdoor education enables students to learn about environmental concerns through direct experience within natural settings. He (Alexander) therefore recommended that all subject areas in the school curriculum be enriched through outdoor education experiences. He provided 10 model lessons with each consisting of a list of objectives, an inventory of related curriculum area, required teacher background skills, catalog of activities with questions to guide etc.

In a parallel fashion, Moore, (1992) presented a step-by step approach to organizing or strengthening volunteer groups to conserve and manage natural resources. Schatz, (1993) added how camp programmes can incorporate the objectives of Environmental Education using a holistic approach. Hence, Blythe (1994) recommended the use of a site inventory for Outdoor Education facilities and recreational camps.

2.6.1.1 CONSERVATION EDUCATION PROGRAMMES AND COGNITIVE ACHIEVEMENT IN EE

Research findings on the impact of different conservation programmes on cognitive achievement of student have been diverse and inconsistent. For instance, while some researchers reported a positive impact (Iozzi, 1980; Lucko, et al 1982; Kushler, 1980; Crater and Mears, 1981; Strickland, et al (1983/84); Wendling and Wuensch (1985), Wendling, et al (1989); Mansaray and Ajiboye (1997), other researchers pointed out a negative correlation (Jurin, 1995; Leeming et al, 1997).

Iozzi (1980) evaluated a futures-focused EE program titled 'Preparing for Tomorrow's World, consisting of 14 modules supplementing existing curricula for grades 7-12. The programme was found to be highly effective in increasing cognitive achievement and moral/ethical reasoning about issues at the interfaces of science, technology and society. Lucko, et al (1982), reporting Brown (1979)'s study on the relationship between students' cognitive knowledge of Environmental/energy terms and student environmental energy 'behaviour as perceived by their parents, discovered that increased cognitive knowledge of such terms resulted in a change in behaviour of participants.

However, Jurin (1995) discovered in his study that higher levels of Environmental awareness in a general population do not lead to higher levels of environmental behaviour in students. According to the researcher, environmental awareness and environmental attitudes do not predispose students to act with responsible environmental behaviour. He therefore recommended that an awareness of the type of belief structure should assist educators and communicators to focus messages that can be processed through cognitive pathways, which can form a more lasting change that matches the attitudinal components. This finding is related to Leeming et al (1997)'s discovery of an environmental programme exerting significant positive effect on students' attitudes but with no influence on their knowledge of environmental issues.

The above inconsistencies have a lot of implications. Is there any relationship between EE programme and cognitive achievement of students in EE?. If so, in what direction? An attempt shall be made in this study to justify the above assertions/recommendations inorder to bring out the positivity or negativity in impact-relationship of the prepared EE package in this study.

2.6.1.2 CONSERVATION EDUCATION PROGRAMMES AND PROBLEM-SOLVING ACHIEVEMENT IN EE

The acquisition of responsible environmental problem-solving behaviour or achievement has long been recognised as a major goal of Environmental Education (UNESCO-UNEP, 1989). Yet an examination of EE research and curricular materials showed that this goal is not granted the desired emphasis. According to Hungerford and Wilson (1982); Fryman, et al (1982) and Volk (1983), emphasis are directed towards the awareness and analysis of environmental problems to the detriment of environmental problem-solving skills and citizen participation. These latter two are critical for taking any positive environmental action (Klingler, 1980).

Hungerford (1983) further stressed that skills training for citizen participation in environmental problem-solving is either ignored by practitioners or perceived as something that can be achieved by awareness education. Similarly, Linke

(1981) also observed that there is lack of knowledge of those factors which influence the development of environmentally responsible individuals. And since responsible environmental problem-solving behaviour is a learned response or action, Hungerford and Tomera (1982) identified eight causal variables, which are: knowledge of issues, beliefs concerning issues, individual values, individual attitudes, locus of control, environmental sensitivity, knowledge of and skill in the use of environmental action strategies and ecological concepts. In a bid to ascertain the validity of these causal factors, Hungerford and Tomera (1985/86) conducted another investigation and seven out of these eight variables were found to be statistically significant. However, the most parsimonious set of variables found to predict environmental behaviour are:

- Perceived knowledge of environmental action strategies,
- perceived skill in using environmental action strategies, and
- attitudes toward environmental problem.

A critical review of literature revealed positive impact of conservation instruction involving task oriented activities in developing students' problem-solving skills or achievement.

Few examples are the positive impact of

(1) Energy conservation instruction of

(a) Hepburn (1978), Brown (1979) and Kushler (1980) as reported by Lucko, et al (1982); and

(b) Stevens et al, 1979 as reported by strickland, et al (1983/84).

(2) Environmental Action Instruction of Ramsey et al (1981);

(3) Water and Energy Conservation Instruction of Westerman and Griner (1991)

However, another research conducted by Jurin (1995) produced a negative report, that higher levels of environmental awareness in a population do not lead to higher levels of environmental behaviour in students. Therefore, there is still a significant shortage of research on variances attributed to the predictors of environmental problem-solving behaviour.

The above shortcomings led Leeming, et al (1997) to review several related researches evaluating the effects of some form of environmental education on changes in students' knowledge, attitudes and behaviour. In his observation, relatively few of the studies examined the effects of participating in relevant environmental activities either in class or outside the class. And since previous researches suggest that encouraging participation in environmental activities is a promising technique for improving children's environmental attitudes, knowledge and behaviours (Ramsey, et al (1981), Leeming, et al (1993), he therefore investigated the effects of participation in class activities on children's learning outcomes. In his findings, participation of students in class activities had a positive effect on their learning outcomes.

Similar results were also obtained by other researchers like Crater and Mears (1981), Wendling and Wuensch (1985), and Wendling et al (1989). In their studies, positive impact of student participation in various types of environmentally relevant activities either in class (indoor) or outside the class (outdoor) on students' learning outcomes were observed. And since other factors that promote environmental sensitivity include outdoor experiences as stated in earlier assertions that field trips and other outclass activities influence students' attitudes, behaviour and learning, (Alexander (1991); Moore, (1992), Blythe (1994), therefore, this study is an extended work using the two strategies. Thus an attempt was made in this study to combine both in-class and out-class activities designed into a module in a balanced fashion, to examine its impact on the selected secondary school students with a view to determining its effect on their problem-solving actions or behaviours.

2.6.1.3 CONSERVATION EDUCATION PROGRAMMES AND ENVIRONMENTAL ATTITUDES

The development of ecologically sound attitudes toward the environment has emerged in recent literature as a viable and worthwhile goal of environmental education. (Bedwell 1984) . As a result, several studies have been carried out to assess the attainment of positive environmental attitudes by students of both conservation education programs and the total environment (Miller (1980); Alaimo and Doran (1980); Kushler (1980); Westerman and Griner (1991); Jacobson and Padua (1992); de-White and Jacobson (1994); Jimenez Aleixandre et al (1995); and Leeming et al (1997). Of these, many researchers have taken the approach of examining students' attitudes toward selected environmental issues. As stressed by Bedwell (1984), social/environmental issues must become the central focus or themes of instruction in Biology, in order to develop the right environmental attitudes in students. However, in a short study conducted by him on environmental

Education attitudes of Biology students, teachers and administrators, the subjects involved seemed to prefer the social/environmental goals in fourth place ahead of career orientation to the teaching and learning of biology. Hence he recommended that more emphasis should be placed on the social /environmental aspects of biology.

A recent, synthesis of studies on the impact of several conservation education programmes that emanated on students attitudes revealed both positive and negative influences. Alaimo and Doran (1980) conducted an investigation of factors influencing the values of junior high school students. They used an environmental inventory instrument developed to measure students self-perceptions of concern about environmental problems, chances of solving them, likelihood of personal participation in problems, chances of solving them, likelihood of personal participation in problem solutions, knowledge of environmental problems and sources of environmental information. The results revealed that instruction in these areas had little influence on modifying values. Similarly, Miller (1980) used a multi-item indices of concern about pollution, overpopulation and energy conservation on 17,000 students in approximately 130 high schools each year between 1976-1979. In his report, the environmental attitudes of the U.S. high school senior classes showed little change over the four year period, with lower support for pollution control and population planning. These findings are also related to Shephard and Speelman (1985/86)'s study whereby treatment has little effect on environmental attitudes of the 405 campers exposed to a summer course on a resident outdoor education programme.

However several other attempts extended to change attitudes of students to the environment through different conservation programmes/instruction have reported positive impacts. (Collins, 1979; Stevens et al, 1979; Kushler, 1980; Westerman and Griner, 1991; Jacobson and Padua, 1992; de - White and Jacobson, 1994; Jimenez-Aleixandre et al, 1995 and Leeming et al, 1997).

Leeming et al (1997) investigated the effects of participation in class activities on children's environmental attitudes and knowledge. The study was designed to assess the impact of the caretaker instruction on participants and the influence on their parents. using 16 participating experimental classes from 11 schools, the pre-test and post test scores showed a significant positive effect on attitudes toward the environment. Also, children rated by their teachers as most interested in the activities showed greater increase in pro-environmental attitudes than those rated least interested. In addition, parents of the experimental group showed significantly more pro-environmental behaviours after their children's activities than did parents of the control classes.

All the above studies with positive attitudinal disposition are strong indications of positive relationship between environmental knowledge and attitude. And since behaviour modification results after attitudinal and valuational changes in a person, an assumption from the theory of operant conditioning (Skinner, 1976), therefore change in attitude must first occur in an individual before it results into change of behaviour. However, because of the mixed findings of various researches; additional research is needed to further clarify the relationships among the variables.

One of the purposes of the present study therefore, was to examine the students' attitude to both the conservation education instruction developed and the environment in order to determine the effectiveness of the designed instruction in inculcating attitudinal change for the resolution of social environmental problems or issues.

2.6.1.4 **CONSERVATION EDUCATION PROGRAMME AND GENDER**

Over the years, with the advent of various researches, environmental educators have observed that certain factors such as personality and gender, over which the educator has little control seem to predispose individual's environmental outcomes in one way or the other independently of the educational experience. (Gifford et al, 1982/83). For instance, the work of Borden and Francis (1979) titled "Who cares about Ecology? Personality and sex difference in Environmental concern", revealed that females possess more verbal commitment to the environment than males. This finding is further supported by Gifford et al (1982/83) who conducted a study on individual differences in Environmental attitudes. On using 136 students of British columbia University, administered with 45 item-inventory/ questionnaire (an adapted version of Maloney et al, 1973), he tried to estimate the contribution of each individual difference variable to the prediction of attitude while controlling for the effects of other individual difference variables. The results obtained revealed that

(1) the males possess more environmental knowledge than the

females (r=.31, P=.001)

(ii) females display greater affect or concern about the environment than males (r=.20, p=.02)

iii) females possess more verbal commitment than males (r=.17,p=.05).

Moreover, Lucko et al (1982) reported Kushler (1980)'s investigations on Energy savings programme (as discussed earlier on). The result showed a significant effect of energy conservation instruction on the attitudes and behaviours of high school students with females possessing more positive attitudes and behaviours toward conservation than males.

However, a slightly different report was made by Strickland et al (1983/84). In their study, no significant difference was observed between males and females in the amount of acquired information relating to energy before and after treatment. Although the females still had a higher mean difference score of 6.0500 to the males" mean difference score of 5.2286, yet this difference was not statistically significant. Also, no significant interactions was observed between age , sex and change in scores from pre-to post -test. Hence, it is inferred that all age groups and both sexes profited from the energy instruction.

The present study investigated the influences of gender factor (that is less amenable to control) on students' environmental knowledge, skills or achievement, and attitudes. The purpose is to gain an insight into the need for incorporating changes in environmental education programmes in response to the differences.

A review of literature further showed that females appear to know less, while professing to be more emotionally upset and more verbally committed. Hence, the attitude differences are merely attributed to differential socialization of women or sex-role stereotyping. (Gifford, et al (1982/83). In conclusion, since environmental outcomes are importantly related to individual difference measures, greater understanding of such individual difference in relation to specific environmental knowledge, skills/achievement and attitude will create greater potential for designing and implementing effective programmes on conservation education.

2.6.1.5 CONSERVATION EDUCATION PROGRAMMES AND SUBJECT SPECIALIZATION

An overview of various researches on the effect of certain conservation educational programmes on students' knowledge, problem-solving achievement and environmental attitude revealed the influence of several personality traits or factors within the educational system, (Gifford, et al, 1982/83). Such factors include offering environmental education or not; subject specialization, year in school, age, etc.

In a bid to confirm the speculated relationship, Gifford and others further conducted an investigation on the effect of individual differences on Environmental attitudes of 136 students of British Columbia university. The subjects were categorized into three distinct academic orientations:

(i) Natural science: Biology, microbiology, chemistry, biochemistry, physics

ii) Social sciences: Political science, psychology, social science, economics, geography, human development, anthropology.

iii) Non-science: History, Classics, physical education, recreation, french, philosophy, music, visual arts, English, social work, outdoor education, public administration, art, history.

After administration of the prepared questionnaire, the findings revealed that

(i) environmental education students have more actual commitment than other students (r=-.30, p=.001)

ii) natural science majors possess more environmental knowledge than those in social sciences or non-science (r=-.27, p=.003).

iii) environmental education students report more verbal commitment than non-environmental education students. (r=-.24, p=.003)

iv) natural science students express more emotion about the environment than social sciences and non-science students (r=.22, p=.01), and

v) environmental education students possess more knowledge than others (r=-.20, p=.02).

This study therefore provides an analysis of the relationship between the individual subject combinations and the learning outcomes. From the result, the natural science majors know more about and report being more emotionally affected by the environment than the others, yet they are neither verbally nor actually committed. That is, they do not report being engaged in more pro-environment actions unlike the environmental education students. Hence, Gifford and others stressed the need to provide further clarifi-cations for these findings through related researches.

In responses to this call, the present study arose to examine the influence of a pre-packaged EE programme and the accompanying learning outcomes on students subject specialization (specifically science and non-science students). Through this, greater understanding of the relationship is fostered, and this will create greater potential for developing and implementing programmes that work well.

2.6.1.6 ENRICHING TRADITIONAL CURRICULUM WITH ENVIRONMENTAL PERSPECTIVE.

The need to enrich traditional curriculum with environmental components ensued from the recommendations of the international conservation strategy.

Since then, various attempts have been made to develop new conservation programmes from the traditional curriculum or syllabus and test these new programmes in the classroom settings. (Stevens, et al, 1979; Kushler, 1980; Wilson and Tomera, 1980; Strickland et al, 1983/84; Duffy, 1991; Heffernan, 1991; and Sigman, 1991). For instance, inspite of all these newly developed programmes infused into school curricula, the realization of EE goals and objectives are still far to be accomplished . That is students only acquired the knowledge but failed to clarify their own value positions regarding conservation based environmental problems and were less willing to take actions to remediate these problems.

Therefore, concerted efforts were made by educators to examine the adequacy of the existing curriculum.

Pomerantz (1991) in his analysis of some school natural resource lessons (n=700) focused on ecological principles, or resource management issues and on analytical skill development affecting students environmental behaviour and discovered that very few of the lesson materials actually help to develop critical thinking skills and behaviours necessary for prompt environmental action.

Thus, these findings underscore the need for subsequent curriculum review, to prepare materials that can foster environmental affects, skills and behaviours.

Wilson and Tomera (1980), in their attempts to enrich traditional Biology with an Environmental perspective, used case studies in a simulation format to influence students' environmental attitudes. They exposed two intact classes of 44 students to two differential treatments in order to investigate the effectiveness of specific method of integrating the affective components of an existing taxonomic biology programme. On completion of two prepared affective instruments with each consisting of an 18-item Likert Scale format based attitude inventory (Pearson, r=o.70 and r=0.53), the analysis of the data revealed inconsistent results in that no significant difference was obtained between pre-test to post-test measures for either group. However, the post test comparison of the mean values for the two treatments showed a definite statistical difference in the effect of the respective treatments. In summary, both case studies and simulations did influence students' environmental concern as regards the issues involved in each . Hence, Wilson and Tomera recommended the use of case study approach with a simulation Experience as a viable strategy for increasing 10th grade students' attitude towards specific environmental issues in Biology.

Similarly, Jimenez-Alexandre, et al (1995) provided ways of integrating environmental education into a traditional science topic (energy) with several activities for developing an awareness about the need and ways to save energy. Using the 15 - 16 year old pupils, exposed to the materials developed, the programme proved effective.

Therefore, recently, the emphasis has shifted to the effects of participating in various types of environmentally relevant activities either within or outside the class, and positive results were reported on both the students' attitude and knowledge. (Leeming, et al, 1997) These recent researches have also suggested that encouraging participation in environmental activities is a worth while technique for improving children's environmental attitudes, knowledge or both.

This present study extended its scope to determine the adequacy of the conventional Biology curriculum on conservation, to design a new package in Biology and determine its impact on students' cognitive achievement, problem-solving abilities and environmental attitudes to resolving environmental social problems.

2.6.1.7 **USING THE ENVIRONMENT TO TEACH: THE NEED FOR TRAINING TEACHERS ON EE**

If indeed environmental education is embodied in schools curricula as the study of the environment, then teachers are expected to use their local environment in its teaching - learning process. But do they really use the environment to teach EE components effectively ? Results of a study on the feasibility of establishing an EE programme in the Columbus Ohio, Public schools revealed a 'No' answer. McCaw (1979/80) in his study, decided to find out:

i) the extent to which teachers are currently using the environment to teach - both by study trips and school - site study.

ii) what is generally taught outside,

iii) where study trips are taken,

iv) teachers priorities regarding EE and other non-basic parts of the curriculum

v) those factors inhibiting them from conducting EE activities, and

vi) the willingness of teachers to obtain in service training on the use of the environment to teach.

On administering a set of questionnaire on 102 participants drawn from a stratified population of 4513 Columbus teachers of all grade levels and subject areas, the results obtained showed

i) a decreasing emphasis on EE at the junior and senior high levels,

ii) no significant differences between answers of teachers at the more affluent, suburban and the other schools,

iii) that principals held the same attitudes toward their teachers' use of the environment to teach,

iv) that elementary teachers reported teaching outside the school building much more often than the secondary school teachers.

Some of the factors listed by teachers as influencing their use of study trips include,

i) transportation problem

ii) district financial troubles,

iii) time conflicts, and

iv) lack of pertinence to the subject taught.

In all, 25% of all the secondary teachers indicated that they had difficulties arranging trips for their students. From these findings, McCaw recommended that

1. teachers in-service training should be taken as the basis of an effective EE programme,

ii) such training should be offered on school time.

These recommendations were further supported by Winslow (1981) who conducted a state wide survey in Indiana, emphasizing teacher - training and certification efforts and the need to increase the extent of implementation of EE in the classrooms. In addition, Volks (1983) explained that if teachers are to use EE curricula effectively, they would need to be trained on how to use them.

A review of literature also confirmed the positive impact of such training on teachers' productivity. For instance, de-White and Jacobson (1994) reported that knowledge and attitude scores of students whose teachers participated in an educational programme improved significantly.

2.6.2 RESEARCH STUDIES ON CURRICULUM DEVELOPMENT IN ENVIRONMENTAL EDUCATION IN NIGERIA.

Several efforts expended to enrich school curricula in Environmental Education (EE) in Nigeria include;

a In the integration of science-technology- society (STS) based instructions (Oladele, 1991; Umoren, 1991)

b On environmental knowledge and attitude (Noibi, 1990, 1992; Gwena, 1992; Umozurike, 1992, Igbinokpogie and Ighrakpak, 1992)

2.6.2.1 THE S.T.S. BASED INSTRUCTION

The need for STS based instruction cannot be over-emphasised with few investigations reporting low level of awareness of environmental issues of many Nigerian communities. For instance,, in a study conducted on the needs of Abeokuta residents, in order of priority, as perceived by the residents, Olokesusi (1985) discovered that environmental sanitation and protection were ranked ninth out of ten factors. This low level of awareness can be attributed to the high level of illiteracy and lack of sensitivity to environmental issues and problems.

However, without public awareness at all levels of society, no national strategy for the environment can be successfully implemented (NEST, 1992). Therefore, one cannot overemphasize the need for government actions to expose citizens to appropriate orientations on current environmental issues in order to acquire the necessary skills, motivation and commitment to take decisions individually or collectively toward resolution of existing environmental problems and prevention of future problems.

At the school level, several efforts have been expended on curricular changes in the integration of science and technology education with societal issues and values. Umoren (1991) studied the effect of a science, Technology and society (STS) Curriculum on secondary school students' scientific literacy, problem-solving and decision -making abilities.

About 480 SSII science and Non-science students of six secondary schools in Calabar Municipality of Cross River State were used for the study as Experimental and Control groups. The experimental group was exposed to a designed and validated curriculum on STS (termed COSTS) for 24 weeks at 2 hours per week, while the control group adopted the conventional science curriculum. Using a quasi experimental design (a pre-test - Post test - retention test control group design, the results revealed that;

i) Students exposed to COSTS performed significantly, better than students not exposed to it.

ii) Students in the experimental group out- performed their counterparts in the control group in their retention of scientific literacy, problem-solving ability and decision making ability.

iii) Students' scientific literacy was independent of their sex, subject specialization, age, religion and socio-economic status.

iv) Students problem-solving ability was also dependent on their sex, but independent of subject specialization, religion and socio-economic status.

v) The subjects' decision-making ability was not significantly influenced by age, subject specialization and religion.

From these findings, Umoren recommended that Curriculum developers should strive hard to work out strategies to design STS curriculum materials for students during their training.

Similarly, Oladele (1991) investigated the World-view held by the senior secondary one (SSI) students in Oyo state and the effect of a STS curriculum model on their world view, scientific-technological literacy, cognitive achievement in and attitude to Biology. Using 490 SSI Students in 14 Secondary Schools in Oyo state of Nigeria, the experimental groups of 200 students were exposed to the S.T.S. curriculum model for 13 weeks at two hours of activities, while the control groups were not. The results showed that the

i) subjects hold both scientific and traditional world view formed from individuals interactions with his natural environment from birth to adulthood.

ii) experimental group performed significantly than the control group, being more scientifically and technologically literate and in terms of attitude towards Biology.

iii) Subjects shifted from traditional to scientific world-view after exposure to treatment.

The above findings have implications for science teachers and teacher educators (or curriculum developers) to resolve conflicts in World-views in individual students minds by exposing them to an S.T.S. curriculum model.

2.6.2.2 **RESEARCHES ON ENVIRONMENTAL KNOWLEDGE AND ATTITUDES**

Concerted efforts have been directed towards investigating and integrating environmental knowledge, problem-solving actions and attitudes in schools curricula in Nigeria. For instance, Gwena (1992) appraised some Lagos state secondary schools' students' and teachers' knowledge and attitude on environmental issues. In her study, the relationships between socio-demographic variables and environmental knowledge and attitude of respondents were established. The results obtained revealed

i) that students had a very poor knowledge of their local and global environment.

ii) a significant correlation between actual environmental actions and attitudes, and also between their intended and actual environmental actions,

iii) that teachers had an average knowledge and attitude towards their environment,

iv) a significant correlation between teachers environmental knowledge and intended environmental actions, knowledge and affect,

v) no significant relationship between environmental knowledge and actual environmental action of teachers examined for the study.

Therefore, this study substantiated the need to integrate EE in schools curricula in order to impart appropriate environmental knowledge, actions and attitudes in students.

Umozurike (1992) also embarked on how to improve the teaching and learning of environmental education topics in the national primary science core curriculum. In her analysis, it was observed that the curricular package is rather inadequate for Environmental Education in terms of content, performance objectives and prescribed activities. The following observation were made.

i) 24 topics (45.28%) are EE topics while 29 (54.72%) are non-EE topics

ii) Based on Adara's (1992) Environmental themes for infusion, the majority of the EE topics, about 16 topics (66.7%) of the 24 EE topics fall within the category of ecological foundations instead of spreading across the four themes. The other EE topics are mainly on Health and Safety.

Thus, it appears that what primary school pupils are exposed to is a combination of nature study and hygiene.

iii) Classification of the performance objectives or intended learning objectives (ILOS) of the EE topics on the basis of knowledge, attitude and skill acquisition revealed that

a. 75 ILO'S (63.6%) were aimed at knowledge acquisition,

b 16 ILO'S (13.6%) on attitude acquisition and

c. 26 ILO'S (22.8%) on skill acquisition.

Since the ILO'S are not well spread or balanced, they are inadequate to inculcate attitudinal change in pupils that can make them committed to personal and community environmental problem-solving. The ILO'S are not also appropriate to develop relevant skills in pupils to make them participate in problem-solving. (UNESCO, 1985; Noibi, 1992; Adara 1992; UNESCO/NERDC, 1992)

iv) Categorisation of prescribed activities for teaching EE topics revealed that 119 (77.3%) activities are indoors while 35 (22.7%) are outdoors.

In order to provide the pupils with a holistic experience of EE, a balance of the activities should be maintained in teaching EE topics That is, the teacher should take pupils out of their classrooms to learn about, from and for the environment.

Based on these revelations, more topics were proposed for infusion or incorporation into the core curriculum to ensure a balance between the four environmental themes proposed. The researcher further called for a review of the core curriculum to reflect the following changes.

a. updating the performance objective of EE topics to ensure a balance of knowledge, attitudes and skills acquisition for problem-solving and actions.

b. maintaining a balance between indoor and outdoor activities in order to enable pupils acquire first hand learning experiences and direct observation in outdoor activities which can enrich them with relevant skills for problem-solving and action.

However, a review of literature revealed that research studies on conservation education programmes or efforts extended on integration of EE in school curricula at secondary school level in Nigeria are very sparse. (Igbinokpogie, et al., 1992), except for the STS approach proposed earlier on (Oladele, 1991; Umoren, 1991). Herein lies the need to examine the adequacy of the National Biology Curriculum in line with the EE goals and Objectives, for which this study, is prompted.

Moreover, Noibi (1990) also investigated teachers' use of the environment to teach schools subjects and their level of recognition of EE as an important component of school subjects. Apart from the fact that teachers consider population education to be more relevant to them than environmental education, less than 25% of secondary school teachers were found to actually use the environment to teach as reflected in the table below

TABLE: 3 FREQUENCY OF TEACHING OUTSIDE THE SCHOOL BUILDING

RESPONSE	PRIMARY FREQ.	(N=328) %	SECONDARY (N=300)	
			FREQUENCY	%
NEVER	0.0	0.0	120	40.00
ONCE A YEAR	12.0	3.0	80	26.6
TWICE A YEAR	74.0	22.5	60	20.6
MORE THAN 3 TIMES A YEAR	242	74.00	40	13.3

Source: Noibi, A.S (1989): current Research on Environmental Education.

From the above table, the primary school teachers taught outside the school building much more often than the secondary school teachers.

However, the teachers listed two factors influencing their use of the environment/study trips, basically. lack of

i information about the immediate environment or where to go,

ii support from the school authorities or adminístration

Therefore, the need to train teachers on EE cannot be overemphasised (as stressed earlier on by McCaw, 1979/80; Volk, 1983).

In this study therefore, an attempt was made to train the experimental group teachers on how to teach the EE conservation topics effectively in order to accomplish the stated objectives, and to take care of the above short-comings.

2.7 THE PRESENT STUDY

From all the aforementioned points on needs raised to integrate environmental education into school curricula, coupled with the urgent need to determine the adequacy of the existing school curricula, this present study arose.

Specifically, an attempt was made in this study to i examine the adequacy of the National Secondary Schools Biology Curriculum in its objectives, content and activities in line with EE goals and objectives.

ii design, implement and investigate the impact of a pre-packaged EE module in Biology on students' performance, problem-solving abilities and environmental attitude.

iii examine the influence of other factors like students' gender and subject specialization on the specified EE outcomes.

Therefore, this project is essentially an exploratory one aimed at designing the impact of a participatory, children-based programme, using the biology curriculum for school children in some selected secondary schools in Ibadan metropolis, to increase knowledge about environmental conservation issues and create a more positive attitude to environmental conservation activities or projects among the school children within the school compound and in their communities.

First base data on environmental knowledge, attitudes and problem-solving achievement related to conservation issues were obtained from SSII Biology students through the use of questionnaires.

Next, the students received instruction (the pre-packaged EE Module in Biology) from trained teachers for some weeks, during which they are expected to undergo a series of activities (indoors and outdoors) or projects to resolve some specific conservation issues.

Finally, the newly acquired experiences were also measured through questionnaires in order to ascertain the impact of the pre-packaged EE Module or instruction.

CHAPTER THREE

METHODOLOGY

3.1.1 RESEARCH DESIGN

A 2x2x2 pre-test, post -test control group, quasi-experimental design was adopted for this study. The design is diagrammatically illustrated below:

Fig. 5a: diagrammatic representation of the Research Design.

01 X1 02 (E)
03 X2 04 (C)

where X1 = treatment (Environmental Education Module).

X2 = Conventional package on conservation)

E = Experimental group

C = Control group

01 03= Pre-test Measurement

02 04= Post-test Measurement

Fig. 5b: 2 x 2 x 2 factorial representation of the design.

	SCIENCE		NON - SCIENCE	
	(M) MALE	(F) FEMALE	(M) MALE	(F) FEMALE
EXPERIMENTAL (E)	X	X	X	X
CONTROL (C)	X	X	X	X

This factorial representation was chosen mainly because more than one variable can be manipulated and studied within it. Moreover, it brings out the effect of each independent variable separately along with their corporate effect. Also, it allows the investigator to identify the simultaneous and separate effects of one or more moderator variables (s) within the stipulated design (Tuckman, 1972; p 136)

The design was therefore employed to examine any possible effect of the Environmental Education Module (treatment) on student's

(a) performance in environmental conservation education test,

(b) problem-solving achievement in environmental conservation and

(c) attitude to environmental conservation

3.1.2 VARIABLES OF THE STUDY

The following variables were included in the study.

1. **Independent Variable**

The curriculum Module:

a. The EE infused Module - This was the instructional package used as treatment for the experimental group (Environmental Education Module)

b. The conventional Biology curriculum.

2. **Dependent Variables**

These are the students'

a. performance in environmental conservation test

b. problem-solving achievement and

c. attitude to environmental conservation.

3. **Moderating Variables**

These include students'

a. gender (male or female)

b. subject specialization (science and non-science)

3.1.3 SELECTION OF SUBJECTS

The target population for this study was the senior secondary two (SS II) Biology students in Ibadan, Oyo State.

The stratified random sampling technique was used to select six co-educational schools for the main study. The criteria used for stratification are schools having:

a. fifteen years of establishment,

b. adequate personnel, laboratory facilities and large population of students.

In the six schools used, only two arms (streams) of the various classes (streams) of SS II Biology students were randomly selected for the study.

However, since the streaming procedure in schools is based on two major categories-science and non-science students, the selection procedure used here also took these categories into consideration. Furthermore, the six schools chosen for the study were randomly assigned as Experimental and control groups in each stratum (three schools for Experimental and three schools for Control groups). Separate schools were assigned to the experimental and control groups to avoid interaction among the subjects.

A sample consisting of all senior secondary two (SSII) Biology students of both science and non-science majors in two intact classes of each of the six schools selected were used for the study.

3.1.4 RATIONALE FOR CHOICE OF SUBJECTS

The SS II students are considered appropriate for this study for some notable reasons.

(1) They have chosen their subjects and are already classified as either science or non-science majors.

(2) The SS II students are expected to have learnt some aspects of conservation, an environmental education in their SS I , and are yet to cover details on the topic based on spiral and thematic approach used in organising

the basic concepts in their SS II curriculum.

3. They had been exposed to three years of integrated science course and their participation in the JSS examinations in integrated science culminated into their preceeding common background or similar experience.

4. They are considered mature enough to respond to the problem-solving tasks and exhibit the expected environmental attitude in resolving environmental issues and problems.

3.1.5 SAMPLE

A sample consisting of 347 senior secondary two biology students was used for the study. There were 177 subjects in the experimental group and 170 in the control group.

A further breakdown of 177 SS II Subjects in the experimental group showed that 87 were science majors and 90 non-science majors. Likewise, 76 science majors and 94 non-science majors constituted the 170 SS II subjects in the control group.

From the total sample of 347 subjects, 194 (55.91%) subjects were males, while 153 (44.09%) were females. From these figures, 79 (22.77%) males and 98 (28.24%) females were exposed to treatment while 115 (33.14%) males and 55 (15.85%)

females were not exposed to treatment. The breakdown of the sample is shown in Table 4a.

Table 4a

DISTRIBUTION OF SAMPLE SUBJECTS

	SCIENCE		NON-SCIENCE		
	(M) MALE	(F) FEMALE	(M) MALE	(F) FEMALE	TOTAL
EXPERIMENTAL	44	43	35	55	177
CONTROI	55	21	60	34	170
TOTAL	99	64	95	89	347
TOTAL	163		184		347

3.2 **INSTRUMENTATION**

Four instruments were developed by the researcher and used in this study [one stimulus (package) and three evaluative instruments]. They are:

1. Environmental Education Module in Biology (EEM), and Teachers' Instructional Guide for EEM (TIGE) - (A component of EEM)
2. Test on Environmental Conservation knowledge in Biology (TECK)
3. Test of Problem-solving achievement on environmental conservation (TPSS), and
4. Students attitude to environmental conservation questionnaire (SAEQ)

All the instruments were constructed and validated by the researcher.

3.2.1 ENVIRONMENTAL EDUCATION MODULE IN BIOLOGY (E.E.M)

3.2.1.1 CRITICAL ANALYSIS OF ENVIRONMENTAL EDUCATION TOPICS IN BIOLOGY CURRICULUM

The national secondary school biology curriculum was first analysed to identify the elements of environmental education contained therein and to determine the adequacy or inadequacy of these environmental education elements/topics vis-a-vis the main objectives of environmental education. The environmental education topics were then identified and categorised, based on Adara's (1992) Environmental themes for infusion.

The four broad themes are:

1. Ecological foundations (EF)
2. Human Environment / Development (HE/D)
3. Environmental Change/Impacts (EC/I)
4. Sustainable Development (SD)

These themes cover all the Environmental education topics/elements (as sub-themes) for all levels of education. A brief description of the themes is as follows:

a. Ecological foundations - embrace all resources of the natural environment.

b. Human Environment/Development: deals with human activities that can alter the quality of the environment.

c. Environmental change/Impact: embraces issues and problems arising from human interaction with the natural environment.

d. Sustainable Development: highlights all management activities/efforts extended towards sustainable development of the environment from generation to generation (Adara, 1992)

The analysis of the biology curriculum for identification of the environmental education elements/topics was based on the various sub-themes by the researcher using the scheme of work for SSI - SSIII Biology. Table 4b shows a summary of the distribution of environmental education topics under each theme.

TABLE 4b: DISTRIBUTION OF ENVIRONMENTAL EDUCATION THEME/TOPICS IN BIOLOGY CURRICULUM

NO	THEME/TOPIC	UNITS			TOTAL	%
		SS1	SS 2	SS3		
1	ECOLOGICAL FOUNDATION	5	10	1	16	34.04
2	HUMAN ENVIRONMENT/DEVELOPMENT	3	5	8	16	34.04
3	ENVIRONMENTAL CHANGE/IMPACT	5	3	1	9	19.15
4	SUSTAINABLE DEVELOPMENT	5	1	-	6	12.77

(Details in Appendix I)

In order to attain the EE set goals, (as indicated in chapter 1) , the performance objectives of the environmental education topics (referred to as intended learning outcomes-ILOS) in the biology curriculum were categorized into:

i) ILOS for attaining knowledge (K)

ii) ILOS for acquiring attitude (A)

iii) ILOS for acquiring skills (S)

Each of these categories was weighted through calculation of the percentages, as shown in Table 5

TABLE 5: DISTRIBUTION OF ILO'S AND PERCENTAGES

NO	THEME/TOPIC	RELATED ILO'S					
		FREQUENCY			PERCENTAGES %		
		K	A	S	K	A	S
1	ECOLOGICAL FOUNDATION.	94	10	31	69.53	7.41	22.96
2	HUMAN ENVIRONMENT.	99	1	33	74.44	0.75	24.81
3	DEVELOPMENT ENVIRONMENTAL CHANGE/ IMPACT.	39	11	10	6500	18.33	16.67
4	SUSTAINABLE DEVELOPMENT.	17	6	2	68.00	24.00	8.00
	TOTAL NO OF ILO'S	249	28	76	70.54	24.00	8.00

K* = Knowledge, A* = Attitude,
S* = Skills, (Details in Appendix II)

Furthermore, the prescribed activities for teaching and learning of Environmental education topics were categorized into two levels - indoor and outdoor activities. These categories were weighted by calculation of the percentages, as reflected in Table 6.

TABLE 6: ANALYSIS OF ACTIVITIES IN BIOLOGY CURRICULUM

NO	THEME/TOPIC	FREQUENCY		PERCENTAGE %	
		(1) IN.D	(0) OUT.D	I	0
1	ECOLOGICAL FOUNDATION	62	54	53.45	46.55
2	HUMAN ENVIRONMENT/DEVELOPMENT	105	15	87.50	12.50
3	ENVIRONMENTAL CHANGE/IMPACT	28	20	58.33	41.67
4	SUSTAINABLE DEVELOPMENT	16	16	72.73	27.67
	TOTAL NO OF ACTIVITIES	211	95	68.95	31.05

(Details in Appendix III)

All the analyses carried out in Tables 4b,5 and 6 was given to judges made up of three secondary school Biology teachers and three lecturers in college of Education who had some experience in curriculum construction. They ascertained the adequacy of the analysis using biology curriculum for SSI - SSIII.

However, an analysis of the Biology curriculum (in tables 4b, 5 & 6) revealed that:

1. the environmental education topics/elements are fairly represented in the curriculum (Okebukola, 1990). Using Adara's (1992) Environmental themes for infusion, the bulk of the environmental education topics fall within the

a. ecological foundation with 16 topics (34.04%) of the 47 environmental education topics, and

b. human environment/development with 16 topics (34.04%) of all the topics.

However, only nine topics (19.15%) fall within environmental impact/change, and 6 topics (12.77%) within sustainable development. For any curriculum to be considered as relevant and adequate for Environmental education at any level of formal education, there should be topics representing each of the four themes; without any of them over shadowing the other. Therefore, there is need to work on the curriculum in order to have an adequate spread of the topics.

2.(a) 249 ILO'S (70.54%) were those aimed at knowledge acquisition;

(b) 28 ILO'S (7.93%) were those aimed at attitude acquisition;

(c) 76 ILO'S (21.53%) were those aimed at skill acquisition (as shown earlier on in table 3.3)

Since the ILO'S are not well spread or balanced, the curriculum appear not to be adequate in imparting relevant skills for pupils to engage in problem-solving and for inculcating into learners attitudinal change to pursue or embark on personal and community environmental problem-solving projects (KirK, 1980; UNESCO, 1985; Noibi, 1992; Adara, 1992; UNESCO/NERDC, 1992)

Therefore, there was need to develop or construct more ILO'S for acquisition of skills and attitudes in learners in all the various themes specified. However, an attempt was made in this study to develop an appropriate EE Module (based on conservation topics in biology curriculum) that is balanced.

3. 211 (68.95%) are indoor activities and 95 (31.05%) are outdoor activities, out of the total 306 activities. In other words, students are retained in the classroom most of the time during the teaching and learning of Environmental education topics in biology. However, an appraisal of the curriculum revealed a good proportion of indoor/outdoor activities in

a. Human Environment/Development (87.50%)

b. Sustainable Development (72.73%); and average proportion for

c. Ecological/foundation (53.45%) and

d. Environmental change/Impact (58.33%)

Nevertheless, there should be a balance of the activities to equip students with a holistic experience of environmental education, which the new module on conservation adopted in this study.

3.2.1.2 DEVELOPMENT AND VALIDATION OF ENVIRONMENTAL EDUCATION MODULE IN BIOLOGY (E.E.M)

The development of EEM followed the generally agreed procedure for curriculum development which include

i Aims/goals and objectives/philosophy

ii Selection of content and learning experience

iii Organisation and integration of content and learning experiences, and

iv Evaluation (as shown in fig. 2).

EEM ultimate goal was to significantly improve students' awareness of their environment, to improve their acquisition of knowledge, attitude, skills and experiences in order to act individually and in group (Collectively) to solve present and future conservation issues and problems. This goal is in accordance with the recommendations of the Tbilisi conference (1977) on environmental education

(UNESCO-UNEP congress report, 1987, p6).

The main goal of EEM can further be exemplified in five ways of assisting students to achieve environmental education, mainly:

1. to understand how individual's interactions or activities can alter their surroundings in both harmful and beneficial ways (UNESCO-UNEP, 1989)
2. to attain basic knowledge of how environmental problems evolve, and how it can be solved, and to recognise individuals and societal's roles in solving the problems.
3. in developing analytical thinking and action skills necessary for prevention and correction of environmental abuses (Obi, 1993)
4. to assist students to acquire the necessary skills for identifying and working towards the solution of environmental problems individually and in groups, and
5. in developing in individuals and social groups, a sense of responsibility and urgency in working towards resolution of conservation issues and problems in their immediate environment.

In order to attain the above five goals of EEM, the package was defined in terms of eight units of environmental conservation or conservation of natural resources, which are:

1. conservation of water
2. conservation of land
3. conservation of forests
4. conservation of wildlife
5. conservation of air
6. conservation of minerals/rocks
7. conservation of animals (fish, animal husbandry)
8. conservation of energy

Closely aligned with the goal of attaining adequate knowledge of conservation issue, problems and solutions were the goals of developing critical thinking or positive environmental attitude to conservation of natural resources vis-a-vis the acquisition of appropriate problem-solving skills (Blum, 1981; UNESCO-UNEP, 1987).

EEM encouraged critical thinking and positive environmental attitude by training students to construct their own practical conservation measures in different events of environmental problems identified on their own.

Furthermore, EEM, also assisted students to identify the various causes, effects and possible solutions to numerous problems associated with the environment. The curricular package exposed students to more practical dimensions, enabling them to construct means of solving environmental problems within their vicinity.

The contents of EEM was also built around the four broad themes for infusion (Adara, 1992; Umozurike,1993) as identified earlier on.

A Heuristic outline of each section of the EEM is presented in Appendix IV, with a detailed description of each topic (subtopics). Even though EEM may not embrace all the topics in Biology curriculum, however, its content covered the essential structure/facts on conservation, learned in depth and with critical thought. Students were actively involved and were expected to construct their knowledge, rather than memorize isolated bits of information for test and examination grades.

The package also included other related social problems/needs, for example, conservation of energy, fuel, oil/minerals, water soil/land, animals, wild life, forest, atmosphere/air and other attendant ecological effects, like pollution, diseases or ill-health, release of hazardous sub stances (wastes, toxic chemicals), erosion, desertification, over-grazing, over-cropping etc. These areas were included because students must learn the environmental changes usually subsumed in Agricultural and industrial revolutions. Thus, in earnest, concerted efforts must be extended to

1. save whatever they can of their flora and fauna (plants and animal conservation) through their own management measures for sustainable, benefits to present and future generations.
2. ensure orderly exploitation of natural resources in order to allow for their renewal and balance in nature (Rocks/oil, soil, forest, wildlife and water conservation)
3. make students enjoy the bounties and beauties of nature that can be transferred from present to future generations (conservation ethics), and
4. engage students in constructive and problem-solving activities that can secure or protect human survival and improve human environment/development. (Conservation of water, energy, plants and animals).

In realising the above stated intensions, Ajewole (1991) quoting Nwanza (1982) earlier on analysed some critical issues that needed to be resolved in developing environmental education. These include, that curriculum content should integrate.

i the environmental facts and information derived from scientific experiments and experiences necessary to produce the desired knowledge and awareness.

ii methodological innovation and procedures/derived from research on pedagogy, which if applied to teaching and learning situations are likely to foster better perception and attitudes.

iii instructional materials like audio-visual aids and devices which can be used as tools for improving understanding and skill development.

iv education and training programmes for students and teachers at the senior secondary level, in order to enable them to implement the aims and objectives of environmental education and training.

Therefore, the structure of E.E.M. followed both the design adopted and the above patterns in the National Curriculum except for little modifications. The E.E.M.

teaching syllabus was organized into the following sections: unit; topic; performance objectives; content; explanatory notes; activities; evaluation; estimated number of periods per week; resource materials; and assignment. Brief description of each of the ten sections is given below:

1. UNIT: Designation/serial number
2. TOPIC: Entails all forms of conservation of natural and human resources.
3. PERFORMANCE OBJECTIVES: These are the intended learning outcomes in the higher cognitive, affective and psychomotor domains; that can guide teachers in self-evaluation of their own teaching and the achievement of their students.
4. CONTENT: Details on conservation concept - causes, effects and solutions of environmental problems that students are expected to learn.
5. EXPLANATORY NOTES: These serve as teacher's guide on how to manage the lesson, students, resources (teaching aids), experiments or activities.
6. RESOURCE MATERIALS: These include both human and material resources for effective coordination of all the activities planned for each topic. For example,

the use of resource persons centres; field escorts; printed materials (newspapers, pamphlets, textbooks, journals, conservation magazines, media (audio-visual) and the environment.

7. ACTIVITIES: The prescribed activities for the lesson presented in sequence involving a balanced combination of outdoor and indoor exercises that can enhance adequate grasp of the knowledge, attitude and skills.

8. ESTIMATED NUMBER OF PERIODS/WEEK: E.E.M. required the prescribed three periods per week for Biology lessons on conservation topics and the instruction lasted for six weeks for the SSII classes involved in the six schools selected.

9. EVALUATION: Use of specified questions which can be used to ascertain students comprehension/or areas of difficulties for more expansion or review of content, in accordance with the stated objectives. However, teachers can also add new ones as deemed necessary from time to time.

10. ASSIGNMENT: These are specific/or constructive projects or surveys for students to partake ;in, either individually or collectively, in order to foster other

analytical thoughts and problem-solving actions through direct experience. (See Appendix Va).

The first draft of this package was sent to four well experienced secondary school biology teachers to determine the suitability of the instruction for classroom use. They found it adequate, with little modifications.

The face and content validity of the curriculum (E.E.M)was further ascertained by a group of experts and lecturers in science education, resource persons in conservation centres, who were conversant with recent trends in conservation Education/Environmental Education and natural resource management, for constructive criticism and appraisal. The face and content validity for items on the E.E.M. were established by the panel of experts.

Some other items were modified or deleted from the package based on divergent opinions of the experts.

The final E.E.M. package was obtained after undergoing critical appraisal, advise, revisions and modifications. This final draft was tried out by the researcher on a group of students representative of the sample ;to appraise the ease of its use and to identify areas for modification. Through this experience (direct contact with classroom setting), other teaching materials, strategies and activities were identified and adopted into the Teachers' Guide. Therefore, the E.E.M. package was further validated using the mean difference between the experimental and control groups of the pilot study.

A sketch of the difference between the conventional and E.E.M. packages is presented in Appendix Vb while the specific differences in arrangement of topics covered in the conventional and E.E.M packages are presented in Appendix Vc.

3.2.2 DEVELOPMENT AND VALIDATION OF TEACHERS' INSTRUCTIONAL GUIDE FOR E.E.M. (T.I.G.E.)

This guide consists of four major procedural steps each of which involves some activities embracing the steps in a typical lesson plan These are:

Step 1: Introduction

2: Presentation of theoretical base/content.

3: Explanatory Notes/Students Activities/Strategy Implementation.

4: evaluation and Consolidating knowledge/attitude/skills gained.

1. INTRODUCTION

The introduction involves several activities such as:

i Stating the topic, identifying sub-topics or sub-concepts .

ii Stating the instructional objectives to be attained.

iii Linking new topic or concept with past knowledge and experience

iv Asking relevant questions to introduce the new topic.

2. PRESENTATION OF THEORETICAL BASE/CONTENT

To present theoretical base or content to students, the following methods can be adopted:

i Teacher can explain the facts or ideas(or lecture).

ii Class or group discussions

iii Practical(s) such as teacher demonstration or experimentation.

3. EXPLANATORY NOTES/STUDENTS' ACTIVITIES/ STRATEGY IMPLEMENTATION

Students can be engaged in different activities in order to develop their initiatives, attitudes and skills acquisition. Examples of such activities specified in E.E.M. are:

i taking students for a walk around the school, ii guiding students to define a concept,

iii assigning students to bring labelled samples for clarification/observation,

iv engaging students in experimentation, filtration, boiling (reciprocative activities).

v visitation to place outside the school e.g. field-trips and excursions.

vi summary of content.

4(a) **EVALUATION**

The attainment of instructional objectives can be measured by the teacher by using at least two of the following:

(i) Oral questions probing into

1. the attainment of new knowledge, ideas, or facts.
2. application of knowledge in resolving environmental issues and problems.

(ii) using certain steps involving problems.

iii) Class discussions for clarification or description of issues/solutions e.g. debate, narration.

(iv) Written test or class assignments.

(b) **KNOWLEDGE/ATTITUDE/SKILLS GAINED.**

This step involves students responding to specific questions on the:

i) level of knowledge acquisition vis-a-vis improvement in performance.

ii) inculcation of attitudinal change to certain environmental issues and problems.

iii) attainment of new problem-solving skills applicable in resolving both current and future conservation issues and problems.

Examples of such questions include:

i) How do you ensure adequate availability or supply of water in a community ?

ii) What are the possible solutions to the problems of

(a) Water contamination ? and

(b) Water diseases ?

(iii Enumerate your contributions in water conservation activities in your community.

In order to ensure the effective use of T.I.G.E., an operational phase was prepared, specifying teacher and student activities typical of each step enumerated above . (see Appendix Vi a). TIGE is a components of EEM

To establish the face validity of T.I.G.E., The first draft of this guide was examined by judges made up of three secondary school biology teachers and three lecturers in college of education who had experiences in curriculum construction.

They ascertained that the items were suitable in terms of clarity, breadth and language. This final draft was tried out by the researcher using a group of 4 teachers and 156 students representative of the sample to appraise the ease of its use and to identify areas for modification.

After two weeks of training during which the teachers were provided with explanation and step by step study of the guide, the teachers were asked to teach or provide several demonstration lessons. The researcher used the prepared assessment guides (see Appendix VIb) to score the teachers in all the items listed in the teacher guide (TIGE) and their total scores or performance indicating their capacity levels. Another assessment was carried out two weeks after the first assessment. A reliability coefficient index of 0.97 was obtained using Pearson's product moment correlation formula.

Moreover, the teachers involved commented on the nature of the EEM and T.I.G.E materials, as being very clear, simple to understand and easy to use. They also maintained that the materials are suitable to student's level, relevant and appropriate to the purpose of its use.

3.2.3 DEVELOPMENT AND VALIDATION OF THE TEST ON ENVIRONMENTAL CONSERVATION KNOWLEDGE IN BIOLOGY (T.E.C.K)

This instrument was developed in order to measure the acquisition of environmental conservation knowledge in students (both science and non-science)

T.E.C.K. is designed to measure the following:

1. Acquisition of knowledge and experiences in environmental conservation in Biology, in order to assist them individually and collectively to solve conservation issues and problems within their environment now and the future.
2. Involvement of students in application of knowledge attained in environmental conservation in Biology in solving sub-sequent problems that arise from time to time to protect human survival and improve human environment.
3. To determine how well students can express their understanding of certain conservation topics in relation to their personal and societal needs.

The instrument is divided into two sections:

SECTION A: This consisted of the personal or demographic data of the subjects involved(SSII Students) their gender, name, science subjects studied, etc.

SECTION B: Designated as the environmental conservation knowledge test. It was adopted to ascertain students' view on the acquisition of knowledge on the environment, its problems and issues, and on conservation (or how to resolve the social issues and problems).

It consisted of 50 items on the topics to be taught during the treatment period. Seventeen items were arranged at two levels - Yes or No. Students were required to pick the option in line with their views on each item. In addition, T.E.C.K consisted of objective/multiple choice test, completion of expression format and all the items in T.E.C.K. were drawn in line with Bloom's taxonomy of cognitive domains/educational objectives. More test-items were picked for application in line with the Tbilisi conference recommendations (UNESCO-UNEP Report, 1987).

Table 7 shows a table of specification indicating the number and categories of test items prepared for the concept to be taught.

TABLE 7: TABLE OF SPECIFICATION FOR ITEMS IN T.E.C.K.

CONCEPTS/SUB-CONCEPTS	KNOWLEDGE	COMPRE	APPL	ANALYSIS	SYNTHESIS	EVAL	TOTAT
NATURAL RESOURCES	1	2	3	18	36	20	6
CONSERVATION OF WATER	38	6	37	5	21	4	6
CONSERVATION OF LAND	-	8	39	19	-	7	4
CONSERVATION OF FOREST	43	9	42	40	-	4	5
CONSERVATION OF WILDLIFE	10	22	23,44	46	45	24	7
CONSERVATION OF AIR	-	11	13,25	12	47	26	6
CONSERV. OF MINERAL/ROCK	48	14	15	27	-	28	5
CONSERVATION OF ANIMALS	-	16	32	29	49	30	5
CONSERVATION OF ENERGY	-	17	50	35	33,34	31	6
TOTAL	5	9	11	9	7	9	50
%	10	18	22	18	14	18	100

Almost equal number of items survived scrutiny to evaluate comprehension, analysis, synthesis and evaluation, but there were less questions on knowledge, and more questions on application. Details of T.E.C.K. is shown in Appendix Vii a & b.

In order to establish the face validity of this instrument, the initial 100 test-items were given to a panel of experienced secondary school biology teachers and experts in test construction for evaluation of the suitability for target population in terms of clarity, breadth, and language. From their assessment, only seventy-five items survived the scrutiny and were judged to be content and face valid.

The discriminating power and difficulty indices of the items were computed after administering the test on SSII biology students of a school.

Fifty items were found to possess between 40-60 difficulty indices and were therefore selected. Others items were dropped because they were either too easy possessing P-Value of 70% and above, or too difficult possessing P-values of 15% and 30%.

The final form of the test had items distributed as shown in Table 7.

In order to determine the reliability coefficient of the test, the fifty-item test was further administered to some SSII biology students of another school, and the measure of internal consistency KR (21) calculated is 0.92. T.E.C.K. was scored on a total of hundred marks.

To determine those who success fully answered the application problems, the model of Richards (1986) and used by Okebukola (1992) was adopted. Correct solution means that the student scored at least 75% of the total scores allocated for the problem correctly. Therefore, a student is expected to score 3 out of 4 marks for each short answer question to be considered as having successfully solved the problem.

3.2.4 DEVELOPMENT AND VALIDATION OF TEST OF PROBLEM-SOLVING ACHIEVEMENT IN ENVIRONMENTAL CONSERVATION (T.P.S.S)

Problem-solving involves individuals reasoning abilities in attaining correct response mode of students and can always be studied with an instrument that provides both the correct response option and matching reason. Through this method, a researcher can easily identify students who merely quessed answer since they will fail to select the correct reasoning modes. (Tobin, 1981; Umoren, 1991; Agina-Obu, 1993).

T.P.S.S. is an instrument designed to monitor students' reasoning mode, and it consisted of both the correct response option and matching reason. This procedure will assist the researcher to identify those students who guessed the answers through their wrong choice of reasons.

Umoren (1991) quoting Lawson (1978) pointed out five reasoning modes; mainly

(a) Identifying and controlling variables

(b) Combinational reasoning

(c) Probabilistic reasoning

(d) Correlational reasoning , and

(e) Proportional reasoning.

Therefore, a test of problem-solving ability (T.O.P.S.A) which was based on Tobin (1981)'s T.O.L.T. (Test of Logical Thinking) which in turn was based on Lawson's five reasoning modes, was developed.

T.P.S.S, (Test of problem-solving achievement) is a modified version of T.O.P.S.A.

Four main methods /procedure were adopted in developing T.P.S.S.

1. Test Planning

(a) Test Content areas: the five reasoning modes adopted by T.O.P.S.A. were also used here (as outlined earlier on).

(b) Hierarchy of Behaviourial Objectives: The behaviourial objectives of the test were classified on the basis of the Educational Testing Services (E.T.S) at different levels of Remembering, Understanding and Thinking (R.U.T.) Okpala, 1985).

(c) Specification of Content areas: The content areas and the accompanying behavioural objectives were specified in terms of reasoning modes, in a two - dimensional table (see Table 8).

TABLE 8: TABLE OF SPECIFICATION FOR T.P.S.S.

LEVEL OF OBJECTIVE/OR CONTENT AREA	REMEMBERING	UN-STD.	THINKING	TOTAL
1. IDENTIFYING CONTROLLING VARIABLES	11,14	*	15,9	4(26.67%) 4(26.69%)
2. COMBINATIONAL REASONING	-	*	1,6,8,10	3(20.00%)
3. PROBABILISTIC REASONING	-	*	7,12,13	2(13.33%)
4. CORRELATIONAL REASONING	-	*	3,5	2(13.33%)
5. PROPORTIONAL REASONING	-	*	2,4	
TOTAL PERCENTAGE OF ITEMS	2		13	15(100%)

* Tested students logical reasoning through their selection of correct matching reason to correctly solve problem.

2. Item Writing:

The T.P.S.S. Items written out followed the above table of specification. The final T.P.S.S. version consisted of 15 relevant questions or items. Each item was in a question form with five possible distracters used to assess students' matching reasoning. It would also identify students' who merely guessed answers from those with correct reasoning, modes for resolving societal, problems.

However, most of the questions were on thinking and understanding level because problem-solving requires higher order mental processes. Thus it entails students' understanding of the concept before thinking out the solution using the correct reasoning mode.

To ascertain the face and content validation of T.P.S.S., twelve experts in science education were involved in assessing the initial twenty test items developed (ie . non-empirical method of validation). These experts confirmed that the test items were appropriate, well-sequenced and covering the content on the table of specification, with effective distracters.

Thorough analysis of the thinking process involved in each of the T.P.S.S. items also determined the most adequate behaviour al objectives.

The discriminating power of the test and the difficulty indices of the items were computed after administering the test on SSII Biology students of a School.

Each item of the T.P.S.S. was subjected to an analysis in order to ascertain if the test items.

(i) discriminate between those who know and those who guess wrongly or do not know;

(ii) have appropriate difficulty level,

iii) possess effective distracters or not.

Responses of the students in the upper and lower one third using the total test were compared. Scores of students in the middle category were not used in the analysis.

In selecting an item, it should have a positive discriminating power of at least 40, and effective distracters with no apparent detector and should measure a significant learning outcome.

Fifteen out of the initial twenty test items survived scrutiny and are found to possess between 40-60 difficulty indices and were therefore selected (see Appendix VIII a&b).

In order to find the reliability coefficient of the test, the fifteen item test was further administered to some SSII Biology students of another school, and the measure of internal consistency KR(21) calculated is 0.85. T.P.S.S. was scored on a total of sixty marks. Based on Richard's (1986) model adopted by Okebukola (1992), a student is expected to score 45 out of 60 marks to be considered as having successfully solved the problem.

3.2.5 DEVELOPMENT AND VALIDATION OF STUDENTS' ATTITUDE TO ENVIRONMENTAL CONSERVATION QUESTIONNAIRE (S.A.E.Q)

This instrument was prepared to measure the following:

1. Attainment of necessary environmental conservation attitudes for identifying and working towards the solution of environmental problems individually or collectively.
2. Development of a sense of responsibility and urgency in solving conservation issues and problems in the immediate environment of individuals or social groups. (Cross & price, 1994)
3. Improvement of students' awareness and attitude towards conservation of natural resources such as water,land, forests, air, wildlife, minerals/rocks, animals and energy.

4. Inculcation of the right conservation ethics in order to make students enjoy the beauties of nature that can be transferred from present to future generations.
5. Involvement in constructive thinking and activities for sustainable development.

The instrument has two sections:

SECTION A: This consisted of the personal data of the respondents (SSII students), gender, science subject studied, etc).

SECTION B: This section assessed students' views or attitudes towards environment. It consisted of 48 items, of eight different parts (I - VIII) covering the topics to be taught during the treatment period. Each part contained equal number of positive and negative items reflecting certain attitudinal dispositions to environmental problems/or conservation (as shown in Appendix IXa).

These items were also arranged in a four option likert type scale ranging from Strongly Agree, Agree, Disagree and Strongly Disagree.

The table of specification for S.A.E.Q is included in Appendix IXc. The face validity of S.A.E.Q was ascertained by five science educators who were asked to identify items suitable in terms of language of presentation, clarity of ideas and class level, length and relevance or applicablity to the investigation.

The format for the non empirical validation used by judges is included in Appendix IXd. The initial draft contained twenty items for each of the eight parts, which were modified to six items for each of the eight parts in the final draft. Therefore forty-eight out of the one hundred and sixty items survived scrutiny.

The instrument was further administered to SS II Biology students of a school in order to establish its' construct validity and internal consistency.

The Cronbach alpha measure of the test is 0.90. The positive statements in the questionnaire with scale strongly Agree (SA); Agree (A); Disagree (D); and strongly Disagree (SD) were scored 4,3, 2 andlrespectively while the reverse is the case for the negative statements. Thus, the total score on the questionnaire was correlated with students' attitude to environmental conservation.

3.3 **PROCEDURE FOR THE STUDY**

The processes involved in the procedure for the study (for data collection) adopted the following time schedule/distribution for both pilot study and the main study.

Time Schedule

1. The first two weeks - Training of participating teachers.
2. The next one week - Pre test, that is administration of S.A.E.Q; TECK & T.P.S.S.
3. The next six weeks - The main treatment, that is, teaching the students the EE infused module (E.E.M) and the conventional Biology curriculum simultaneously.
4. The next one week - Post test, that is administration of all the instruments (S.A.E.Q), TECK & T.P.S.S) immediately after the main treatment.

The procedure for data collection were discussed in two parts, the pilot study and the main study.

3.3.1 THE PILOT STUDY

The first phase of this investigation was a pilot study designed to achieve the following objectives:

i To test the work ability or otherwise of the research design adopted in the field.

ii To identify inherent weakness in the evaluative instruments.

iii To apply necessary corrective measures before the main study is embarked upon.

iv To validate and assure the reliability of the evaluative instruments in order to improve their quality, sensitivity and foster components balance and

(v) To test the set hypotheses based on data collected from a micro subset of a sample that is equivalent to the sample selected for the main investigation.

The secondary schools used for the pilot study were those that met the set criteria of selection for the main study. Two secondary schools were randomly selected out of all the sixteen secondary schools considered to have met the stated criteria and within proximity to the researcher.

The two schools were also randomly assigned to experimental and control groups using balloting technique (with pieces of folded papers). Moreover, two streams or classes were randomly picked (science and non-science) from all the stratified streams or classes of the SS II students in the two schools selected. Intact classes were used because these foster the natural classroom environment.

The stratified random sampling technique was adopted to ensure that schools have equal and independent chance of being selected for the pilot study.

The pilot study was carried out during the 2nd term of 1996/97 session. The biology teachers of the two schools that met the following criteria were used for the study.

(a) Qualification - the teacher must be at least a B.Ed (Science) Certificate holder.

(b) Experience - He must have attained a minimum of five years post qualification experience.

(c) Such teacher must have been handling the class (in Biology teaching) for at least two years.

The biology teachers of the experimental school that met the above criteria were further exposed to a two - week training exercise on the use of the prepared E.E.M. package.

3.3.1.1 TRAINING OF PARTICIPATING TEACHERS FOR THE PILOT STUDY

A formal permission to carry out the study in the selected secondary schools was obtained from the appropriate authorities. The training provided explanation on the purpose of the study, the step by step study of the teaching guide (T.I.G.E) and the materials to be used (E.E.M. and teaching aids).

After two weeks involvement the teachers were asked to teach or provide at least two demonstration lessons. The researcher however used prepared assessment guides to select the teacher found capable. Only one of the teachers found capable was randomly picked to teach the selected science and non-science classes of the experimental school (for pilot study).

3.3.1.2 ADMINISTRATION OF RESEARCH INSTRUMENTS

All the subjects for the pilot study were given a pre-test on all the evaluative instruments in the following order:

(a) Students' Attitude to Environmental Conservation Questionnaire (S.A.E.Q)

(b) Test on Environmental Conservation knowledge in Biology (T.E.C.K)

(c) Test of problem solving Achievement (T.P.S.S.)

S.A.E.O was first administered because of the possibility that if T.E.C.K and T.P.S.S were administered first, they may influence students' attitude to environmental conservation. The pre-test lasted for one week (using the 3 periods for biology).

The instruction or treatment was carried out in two stages i.e. pre-treatment and treatment stages by the trained biology teachers for the experimental group.

(A) **Pre - treatment stage**

During this stage, students were exposed to the various techniques adopted in conservation. They were taught examples, types and categories of Natural Resources; problems of not conserving resources; values of conservation. They were taught examples, types and categories of Natural Resources; problems of not conserving resources; values of conservation; agencies for conservation and conservation laws. Moreover, students were adequately guided from outdoor to indoor activities and were allowed to profer measures for resolving environmental problem (a problem solving approach). This stage lasted for another one week (using the 3 periods per week (see Appendix X)

(B) **Treatment stage**

During this period/stage, students were taught the various aspects/types of conservation-water; land; forest wildlife; air; minerals/ rocks; animals and energy, using Exposition/discovery, field trips/excursions debates and essay work. This stage lasted for five weeks and total of 15 lessons (See Appendix X)

The pre-treatment and treatments stages lasted for 18 periods lessons.

The content of the E.E.M package was taught by the trained biology teacher to the subjects in the experimental group of the pilot study during the afternoon session. This was to minimize interference with regular school time table (i.e. during the prep and free periods). This was done for 6 weeks at 3 periods per week, after which the instruments were administered. Additional one week was used for the administration of the evaluative instruments/or post-test.

The control group subjects of the pilot study were not exposed to the E.E.M material but received their normal biology curriculum (the conventional package) and its manner of presentation by the teacher.

The data collected from students' responses were later scored and analyzed using descriptive and inferential statistics.

3.3.1.3 SUMMARY OF FINDINGS FROM THE PILOT STUDY AND IMPLICATIONS FOR MAIN STUDY

The responses of the pilot study sample to all the evaluative instruments when administered as pre-tests were analysed to provide further information on their reliabilities and item characteristics.

Based on this analysis, one item on the TECK and two on the SAEQ were reworded. This was a consequence of the ambiguity of the items as expressed by many of the respondents during administration.

The Kuder Richardson (21) reliability estimates of TECK = 0.92; TPSS = 0.85; and the reliability index (Pearson, r) of T.I.G.E = 0.97; the Cronbach alpha index of SAEQ = 0.90.

Further analysis of the pre and post-test scores using ANCOVA showed significant

1. main effect of treatment on students;

a) cognitive achievement, $[F(1,141) = 1569.224,$ $P<.05]$.

b) problem-solving achievement $[F(1,141) = 2650.949, P<.05]$.

c) environmental attitudes $[F(1,141) = 1705.412, P<.05]$.

2. main effect of subject specialization on students'

a) cognitive achievement, $[F(1,141) = 6.289,$ $P<.05]$, and

b) environmental attitudes $[F(1,141) = 50.008, P<.05]$.

3. interaction effect of treatment and subject specialization on students'

a) problem-solving achievement $[F(1,141) = 22.640, P<.05]$.

b) environmental attitudes $[F(1,141) = 13.301, P<.05]$.

Based on these findings, the pilot study has provided the following useful information before embarking on the main study.

i. A reasonable degree of confidence in the design used,

ii. An improvement in the quality and validation of evaluative instruments,

iii. A trial test of the set hypotheses

iv. A frame of reference in training

v. Availability of instructional materials/ resources for the main study, and

vi. Insight to the rigour and experience involved in the study.

It is anticipated that the main study would be an improvement on the pilot study experience.

3.3.2 MAIN STUDY

The secondary schools used for the main study were those that met the set criteria of choice indicated earlier on.

The biology teachers that also met the stated criteria (discussed earlier on) were used for both experimental and control groups.

However, the biology teachers of the experimental schools that met the set criteria were further exposed to two-week training exercise on the use of the E.E.M package and T.I.G.E. Same procedure used for the pilot study teachers was adopted to train the experimental (main-study) teachers. Other ways of improving the quality of instruction that ensued from the pilot study were integrated into the training. After the training, three biology teachers were randomly selected out of all the teachers assessed to be capable, and were involved in the experimental schools for the main study.

3.3.2.1 ADMINISTRATION OF RESEARCH INSTRUMENTS: PRE TEST/TREATMENT/POST -TEST FOR MAIN STUDY

The main study was carried out during the third term of the 1996/97 session, and it covered a period of 8 weeks for the experimental and control groups (See Appendix X).

All the subjects for the main study were given a pre-test on all the evaluative instruments in the same order as done for pilot group (that is, S.A.E.Q, T.E.C.K & T.P.S.S). The pre-test was conducted for one week (using the 3 periods for Biology).

The pre-test was given to obtain a base for measuring gain during instruction. The test score on the pre-test provided the cognitive entry knowledge, attitude and problem solving achievement possessed by the students (in relation to the selected dependent variables at the beginning of the unit of instruction.

The experimental groups were treated with the E.E.M package using the teachers' instructional guide (T.I.G.E) by teachers who were trained on the E.E.M. and T.I.G.E. while the control groups were not given this treatment but experienced their normal biology curriculum taught by their teachers. The content of the E.E.M package and the conventional biology curriculum was taught for a period of 6 weeks at 3 periods per week (same as pilot study).

The post test were later administered for additional one week. Although same instruments served both as the pre test and the post test but certain minor changes were effected on the test instruments to give a vague impression that the tests were essentially different from the ones taken previously. This helped to guide against testing effect.

The science teachers used for the control classes were assigned with regards to the study. The teachers were instructed to administer the pre-test promptly, for students to provide immediate answers to the test instruments. The post tests were administered at the end of the course to both the experimental and control classes.

However, through frequent visits by the researcher to the schools, the progress or other wise of the control group was ascertained.

Moreover, the class attendance kept by the teachers and the researcher were used to ensure that only students who received at least 80% of the instruction had their scripts scored and later analyzed.

3.4 PROCEDURE FOR ANALYSIS OF DATA

The data obtained for testing the hypotheses were computer analyzed using the appropriate SPSS sub-programmes.

A 2x2x2 analysis of covariance, the Multiple Classification Analysis and graphs were used to examine the possible effect of treatment groups, gender and science/non-science specialization on the dependent variables.

Where significant difference is observed, post-hoc analysis, such as t test was used to determine the source of the significance and to estimate the amount of variation due to each independent variable(or treatment).

CHAPTER FOUR

RESULTS

4.1 INTRODUCTION

The descriptive statistics of the students' achievement scores with respect to cognitive achievement, problem-solving and environmental attitude are as shown in Table 9. The pretest and post-test mean scores as well as the learning gains are reported for each group of subjects-experimental, control, science, non-science, male and female.

An inspection of Table 9 shows that the pre-test scores were low for all the groups, and this can be assumed to be largely due to the unfamiliar content of the test domain to the subjects. After the treatment, the achievement levels improved in most of the cells, and the experimental group outperformed the control group. This superior performance of the experimental group is also assumed to be largely due to the effect of treatment. The marginal increase of post-test mean scores for the control groups over their pre-test scores may be due to additional information obtained from the existing biology curriculum.

However, it is quite evident that the effect of such exposure cannot be compared with the exposure to the Environmental Education Module experienced by the experimental group.

Table 9: SUMMARY OF DESCRIPTIVE STATISTICS ASSOCIATED WITH THE TREATMENT, GENDER, AND SPECIALIZATION OF SUBJECTS COGNITIVE ACHIEVEMENT, PROBLEM SOLVING AND ENVIRONMENTAL ATTITUDE

	TREATMENT						GENDER						SUBJECT COMBINATION					
	COGNITIVE ACHIEVEMENT		PROBLEM SOLVING		ATTITUDE		COGNITIVE ACHIEVEMENT		PROBLEM SOLVING		ATTITUDE		COGNITIVEE ACHIEVEMENT		PROBLEM SOLVING		ATTITUDE	
	TECK		TPSS		SAEQ		TECK		TPSS		SAEQ		TECK		TPSS		SAEQ	
	C	E	C	E	C	E	M	F	M	F	M	F	S	N	S	N	S	N
No. of Cases	170	177	170	177	170	177	194	153	194	153	194	153	163	184	163	184	163	184
Pre-test Mean	34.65	33.62	17.22	16.62	121.12	121.27	34.28	33.92	17.15	16.61	121.08	121.34	36.92	31.64	20.61	13.64	122.64	19.91
Pre-test SD	8.88	9.32	8.47	8.88	11.92	11.37	9.05	9.21	8.75	8.60	13.36	8.99	8.29	9.10	9.06	6.84	11.51	11.61
Post-test Mean	33.46	72.56	17.58	45.81	118.45	171.94	49.50	58.35	29.32	35.35	140.71	152.11	50.55	48.84	35.96	28.46	149.93	142.02
Post-test SD	10.60	10.83	9.62	6.68	13.71	9.75	21.69	22.16	16.38	15.76	30.13	26.94	22.38	21.29	16.13	15.79	30.73	27.48
Mean Gain	-1.19	38.94	0.35	29.19	-2.66	50.68	15.22	24.43	12.17	18.73	19.63	30.77	21.63	17.20	15.34	14.82	27.29	22.11

C = Control
E = Experimental

M = Male
F = Female

S = Science
N = Non-science

Moreover, the superior performance of the female subjects over their male counterparts was also revealed coupled with the marginal increase of science group over the non-science group. This increase was found to cut across cognitive achievement, problem-solving and attitude (as shown in the mean gain scores of the subjects in Table 9).

However, further statistical clarification is needed to confirm if these differences are significant or not as indicated in the seven hypotheses tested.

4.2 HYPOTHESIS ONE (Ho1)

There will be no significant main effect of treatment on students'

(a) cognitive achievement

(b) problem-solving achievement, and

(c) environmental attitudes.

This hypothesis was tested by a 2x2x2 analysis of covariance of the post-test with the pre-test as covariates. The results are shown in Tables 10,11,12,13,14 & 15.

(a) Cognitive Achievement

Ho_1(a) There will be no significant main effect of treatment on students' cognitive achievement.

TABLE 10: SUMMARY OF ANALYSIS OF COVARIANCE OF COGNITIVE ACHIEVEMENT SCORES BY TREATMENT, GENDER AND SUBJECT SPECIALIZATION

SOURCE OF VARIATION	SS	DF	MS	F	P
Covariates	19910.298	1	19910.298	568.081	.000**
PRE-TECK	19910.298	1	19910.298	568.081	.000**
Main Effects	139687.732	3	46562.577	1328.524	.000**
Treatment	128989.048	1	128989.048	3680.317	.000**
Subject Combination	778.239	1	778.239	22.205	.000**
Gender	2.271	1	2.271	.065	.799
2-Way Interactions	694.441	3	231.480	6.605	.000**
Gender x Subj.Comb	36.669	1	36.669	1.046	.307
Gender x Treatment	1065.101	1	106.101	3.027	.083
Subj.Com x Treatment	641.380	1	641.80	18.300	.000**
3-Way Interactions					
Gender x Subj. Com. x Treatment	58.701	1	58.701	1.675	.196
Explained	160351.172	8	20043.896	571.893	.000**
Residual	11846.344	338	35.048		
TOTAL	172197.516	345	497.681		

** significant $P < .05$

The summary of ANCOVA as contained in Table 10 shows that the F-ratio $[F(1,345) = 3680.317; P < .05]$ is significant. This is because the F-value of 3680.317 is far greater than the critical F-value of 3.84 needed to reject $Ho_1(a)$ at $P = 0.05$ level. This significant difference between the groups is probably due to the effect of treatment. Hence, the null hypothesis suggesting that there will be no significant main effect of treatment on students' cognitive achievement was thus rejected.

TTABLE 11: MULTIPLE CLASSIFICATION ANALYSIS (MCA) OF POST-TEST COGNITIVE ACHIEVEMENT SCORES BY TREATMENT, GENDER AND SUBJECT SPECIALIZATION

Grand Mean = 53.403

Variable + Category	N	Unadjusted Deviation	ETA	Adjusted for Independents + Covariates	BETA
TREATMENT					
1. Experimental	177	19.16		19.53	
2. Control	170	-19.94	.88	-20.33	.89
SUBJECT COMB.					
1. Science	163	5.15		1.68	
2. Non-science	184	-4.56	.22	-1.48	.07
GENDER					
1. Male	194	-3.90		- .07	
2. Female	153	4.95	.20	.09	.00
Multiple R^2					.927
Multiple R					.963

The Multiple Classification Analysis (M.C.A.) in Table 11 shows the adjusted mean attainment scores of the subjects according to treatment, subject combination and gender. At the treatment level, the experimental group has a higher adjusted post-test mean (72.93) than the control group (33.07), the grand mean being 53.40.

Moreover, the relative contribution of all the variables to cognitive achievement is found to be 92.7% $(0.963)^2$ of the total variance. That is, only 92.7% of the variance in the criterion measure of post-test scores in cognitive achievement was associated with the treatment. The computed Beta scores show that the treatment contributed the greatest proportion to the variation in the scores. The EEM treatment contributed 79.21%, followed by subject specialization (0.49%) and gender (0%).

The above results further showed that the students exposed to the EEM package performed significantly better than their counterparts exposed to the existing curriculum in their cognitive achievement scores.

(b) Problem-solving Achievement

Ho1(b): There will be no significant main effect of treatment on students' problem-solving achievement.

TABLE 12: SUMMARY OF ANALYSIS OF COVARIANCE OF PROBLEM-SOLVING ACHIEVEMENT SCORES BY TREATMENT, GENDER AND SUBJECT SPECIALIZATION

SOURCE OF VARIATION	SS	DF	MS	F	P
Covariates	13923.592	1	13923.592	662.277	.000**
PRE-TPSS	13923.592	1	13923.592	662.277	.000**
Main Effects	171455.500	3	23818.500	1132.92	.000**
Treatment	67051.864	1	67051.864	3189.326	.000**
Subject Combination	50.754	1	50.7549	2.414	.121
Gender	2.661	1	2.661	.127	.722
2-Way Interactions	131.677	3	43.8920	2.088	.102
Gender x Subj. Comb	45.137	1	45.137	2.147	.144
Gender x Treatment	10.606	1	10.606	.504	.478
Subj.Com x Treatment	45.046	1	45.046	2.143	.144
3-Way Interactions					
Gender x Subj. Com. x Treatment	.033	1	.033	.002	.968
Explained	85510.803	8	10688.850	508.416	.000**
Residual	7106.056	338	21.024		
TOTAL	92616.859	345	267.679		

** Significant P < .05

Table 12 presents the result of the 2x2x2 analysis of covariance of the problem-solving achievement scores of both experimental and control groups with the pre-test scores serving as covariates.

The table further reveals an F-ratio [$F(1,345) = 3189.326$, $P < .05$] as being highly significant. This value at .05 alpha level was seen to be greater than the critical F-ratio of 3.84 at 1 and 345 degrees of freedom. Therefore, the null hypothesis Ho1(b) that there would be no significant main effect of treatment on students' problem-solving achievement was rejected. In other words, there is a significant main effect of treatment on students' problem-solving achievement. That is, a significant difference was obtained between the subjects in the experimental group and those in the control group with regards to problem-solving.

The result of the Multiple Classification Analysis presented in Table 13 reveals the order of increasing effect of treatment mean scores. It gives the performance of each group. The experimental group has a higher adjusted post-test mean (46.04) than the control group (17.34). The grand mean is 31.98. Moreover, the relative contribution of all the variables to problem-solving achievement is found to be 92.00% $(0.96)^2$ of the total variance. The computed Beta scores show that the treatment contributed the greatest proportion to the variation in the scores. The EEM treatment contributed 77.44%, followed by subject specialization (0.09% and gender (.01%).

TABLE 13: MULTIPLE CLASSIFICATION ANALYSIS (MCA) OF POST-TEST PROBLEM-SOLVING ACHIEVEMENT SCORES BY TREATMENT, GENDER AND SUBJECT SPECIALIZATION

Grand Mean = 31.98

Variable + Category	N	Unadjusted Deviation	ETA	Adjusted for Independents + Covariates	BETA
TREATMENT					
1. Experimental	177	13.83		14.06	
2. Control	170	-14.40	.86	-14.64	.88
SUBJECT COMB.					
1. Science	163	3.98		.45	
2. Non-science	184	-3.52	.23	-.40	.03
GENDER					
1. Male	194	-2.66		- .08	
2. Female	153	3.37	.18	.10	.01
Multiple R^2					.92
Multiple R					.96

The above results provide further support to the fact that the subjects exposed to the EEM package were better problem-solvers than their counterparts (Control groups) that were not exposed. Therefore, the treatment was found to be effective in improving the subjects problem-solving achievement scores.

(c) Environmental Attitudes

Ho1(c): There will be no significant main effect of treatment on students' environmental attitudes.

Analysis of covariance was also conducted on the subjects' post-test environmental attitude scores using their pre-test scores as covariates, as presented in Table 14.

TABLE 14: SUMMARY OF ANALYSIS OF COVARIANCE OF ATTITUDE SCORES BY TREATMENT, GENDER AND SUBJECT SPECIALIZATION

SOURCE OF VARIATION	SS	DF	MS	F	P
Covariates	22653.080	1	22653.080	304.438	.000**
PRE-SAEQ	22653.080	1	22653.080	304.438	.000**
Main Effects	248417.549	3	82805.850	1112.839	.000**
Treatment(GRP)	233259.104	1	233259.104	3134.800	.000**
Subject Combination	1112.0104	1	1112.010	14.944	.000**
Gender	65.927	1	65.927	.886	.347
2-Way Interactions	369.491	3	123.1640	1.655	.176
Gender x Subj.Comb	22.252	1	22.252	.299	.585
Gender x Treatment	13.164	1	13.164	.177	.674
Subj.Com x Treatment	335.328	1	335.328	4.507	.034*
3-Way Interactions					
Gender x Subj. Com. x Treatment	.588	1	.585	.008	.929
Explained	271440.706	8	33930.088	455.991	.000**
Residual	25150.429		338	74.410	
TOTAL	296591.135	345	857.200		

** Significant; P < .05

The table also reveals that the F-ratio obtained is highly significant [$F(1,345) = 3134.800; P < .05$]. The F-ratio was observed to be greater than the critical F-value of 3.84. The null hypothesis which suggested that there will be no significant main effect of treatment on subjects' environmental attitude was thus rejected. This finding reinforces that there is a significant difference between the experimental and control groups with respect to acquisition of the right attitudes to resolve conservation problems and issues in their environment.

The result of the Multiple Classification Analysis presented in Table 15 reveals the performance of each group. The experimental group has a higher adjusted post-test mean (171.92) than control group (118.48). The grand mean is 145.74. Moreover, the relative contribution of all the variables to problem-solving achievement scores is found to be 91.00% $(0.95)^2$ of the total variance. The computed Beta scores show that the treatment contributed the largest proportion to the variation inthe scores. The EEM treatment contributed 82.81%, followed by subject specialization (73.96%) and gender (0.04%).

TABLE 15: MULTIPLE CLASSIFICATION ANALYSIS (MCA) OF POST-TEST ATTITUDE SCORES BY TREATMENT, GENDER AND SUBJECT SPECIALIZATION

Grand Mean = 145.74

Variable + Category	N	Unadjusted Deviation	ETA	Adjusted for Independents +Covariates	BETA
TREATMENT					
1. Experimental	177	26.21		26.18	
2. Control	170	-27.28	.91	-27.26	.91
SUBJECT COMB.					
1. Science	163	4.19		1.93	
2. Non-science	184	-3.72	.14	-1.71	.86
GENDER					
1. Male	194	-5.03		-.40	
2. Female	153	6.37	.19	.51	.02
Multiple R^2					.91
Multiple R					.95

In summary, the experimental subjects were found to possess a superior environmental attitude scores in resolving social conservation issues and problems than their control counterparts.

4.3 HYPOTHESIS TWO (Ho2)

Ho2: There will be no significant main effect of gender on students'

(a) cognitive achievement,

(b) problem-solving achievement, and

(c) environmental attitudes.

In order to verify this hypothesis, a 2x2x2 analysis of covariance was used for the post-test scores with their pre-test scores as covariates as indicated in Tables

10,11,12,13,14 & 15. The analysis of covariance was used in the data analysis to partial out any initial differences that existed between the groups (male and female) prior to treatment, so that any difference obtained in their performance could be attributed to the effectiveness of the treatment in environmental conservation.

(a) Cognitive Achievement

Ho2(a): There will be no significant main effect of gender on students' cognitive achievement.

An examination of Table 10 shows that the F-ratio, [$F(1,345) = 0.065$; $P > .05$], is not significant. The value of the critical F-ratio is 3.84. The null hypothesis suggesting that there is no significant main effect of gender on students' cognitive achievement was therefore not rejected.

The multiple classification analysis of the cognitive post-test' achievement scores in Table 11 reveals the performance of each group. The female subjects have a higher adjusted post-test mean score of 53.49 while their male counterparts have 53.33. The grand mean is 53.40. Although the female students performed averagely better than the male students, but the difference in mean scores was found to be insignificant.

(b) Problem-solving Achievement

Ho2(b): There will be no significant main effect of gender on students' problem-solving achievement.

Table 12 displays the result of the ANCOVA on post-test scores or performance in the test of problem-solving achievement (T.P.S.S.). The F-value, $F(1,345) = .127$, $P > .05$, was not significant. Therefore, the null hypothesis that speculated a non-significant main effect of gender on students' problem-solving achievement was not rejected.

Further examination of the M.C.A result of the problem-solving post-tests achievement in Table 13 also reveals the performance of each group. The female students have a higher adjusted post-test mean score of 32.08 while the male student have 31.90. The grand mean is 31.98.

This result confirmed that the female students performed better than their male counterparts in problem solving achievement. However, this difference was not significant.

(c) Environmental Attitude

Ho2(c): There will be no significant main effect of gender on students' environmental attitude.

As can be seen in Table 14, the F-ratio, $F(1,345) = .886$; $P > .05$, was also found to be insignificant. Therefore, the null hypothesis that stated a non-significant main effect of gender on students' environmental attitude was not rejected.

Further explanation of the M.C.A. result of the attitude post-test scores in Table 15 shows the performance of each group. The female subjects have a higher adjusted post-test mean (146.25) than their male counterparts (145.34). However, such difference in mean scores was also found to be non-significant.

4.4 HYPOTHESIS THREE (Ho3)

Ho3: There will be no significant main effect of subject specialization on students'

(a) cognitive achievement,

(b) problem-solving achievement, and

(c) environmental attitudes.

Analysis of Covariance was conducted on the post test scores of student in T.E.C.K., T.P.S.S. and S.A.E.Q using their pretest scores as covariates.

(a) Cognitive Achievement

Ho3(a): There will be no significant main effect of subject specialization on students' cognitive achievement.

As presented in Table 10 the F-ratio, $F(1,345) = 22.205$; $P < .05$, was found to be highly significant, with the critical F-value of 3.84. This high significant difference between the cognitive achievement scores of the groups is probably due to the effect of subject specialization. Hence, the null hypothesis suggesting that there will be no significant main effect of subject specialization on students cognitive achievement was thus rejected. In other words, a significant main effect of subject specialization on students' cognitive achievement was found. That is, a significant difference was obtained between the science subjects and their non-science counterparts with regards to their cognitive achievement.

The result of the Multiple Classification Analysis displayed in Table 11 on the cognitive post test' achievement also gives the relative performance of each group. The adjusted post-test mean score for science group (55.08) is higher than that of the non-science group (51.92). The grand mean being 53.40.

Furthermore, the table provided the amount of variance accounted for by subject specialization effect (0.49%) and all the variables contributed 92.7% (0.963) of the total variance. This result clarifies the fact that the science subjects were found to be superior to their non-science counterparts in their academic performance.

This result is an indication that marked differences exist between the two groups. That is, the science subjects out-performed their non-science counterparts in their cognitive achievement scores.

Therefore, subject specialization was found to exert a significant effect on subjects cognitive achievement.

(b) Problem-Solving Achievement

Ho3(b): There will be no significant main effect of subject specialization on students problem-solving achievement.

Considering the effect of subject specialization on students' problem-solving achievement, the result presented in Table 12 shows that there is no significant influence of subject specialization on students' problem-solving achievement [$F(1,345) = 2.414$; $P>.05$]. Therefore, the null hypothesis stipulating a non-significant main effect was retained.

The Multiple classification Analysis reveals the performance of each of the groups. The adjusted post test mean score for science class (32.43) is higher than their non-science counterparts (31.58) as revealed on the problem-solving post-tests' achievement. (Table 13) Moreover the relative contribution of all the variables to problem-solving achievement score is found to be 92% $(0.96)^2$ of the total variance., and the main effect of subject specialization accounted for difference of 0.09%. Thus, no significant main effect of subject specialization was recorded. That is, although the science class performed better than their non-science counterparts in problem-solving tasks, yet, the effect was found to be non-significant.

(c) Environmental Attitudes.

HO_3 (c): There will be no significant main effect of subject specialization on students' environmental attitudes.

From the result presented in Table 14, the F ratio [$F(1,345) = 14.944$; $P<.05$],[1] was found to be highly significant, with the critical value of F being 3.84. The null hypothesis speculating a non-significant main effect of the subjects majors on environmental attitudes was therefore rejected. This high significant difference obtained between the groups is probably due to the effect of subject specialization. The result of the multiple classification Analysis of the attitude post test scores in Table 15 further reveals the adjusted post test mean score for science group (147.67) to be higher than that of the non-science group (144.03). The grand mean being (145.74).

Furthermore, the table provides the amount of variance accounted for by subject specialization effect as 73.96% while all the variables contributed 91% $(0.95)^2$ of the total variance.

This result confirmed the marked differences existing between the two groups. That is, the science class subjects were found to exhibit more favourable attitudes toward environmental conservation than their non-science counterparts.

4.5 HYPOTHESIS FOUR (HO_4)

(HO_4): There will be no significant interaction effect of, treatment and gender on students'

(a) Cognitive achievement,

(b) Problem-solving achievement, and

(c) environmental attitudes.

This hypothesis was tested by a 2x2x2 analysis of covariance of the post test scores, using the pre-test scores as covariates. The results obtained are presented in Table 10,11,12,13,14 & 15.

(a) Cognitive Achievement.

HO_4 (a): There will be no significant interaction effect of treatment and gender on students' cognitive achievement.

The summary of ANCOVA as presented in Table 10 was revisited and the result of the two-way interaction shows that the F ratio, [$F(1,345)=3.027$, $P>.05$] is not significant. The critical F value is 3.84. Therefore, the null hypothesis suggesting no significant interaction effect of treatment and gender on students' cognitive achievement was not rejected.

(b) Problem-Solving Achievement.

HO_4 (b): There will be no significant interaction effect of treatment and gender on students' problem-solving achievement.

The data collected with their corresponding analysed result as presented in Table 12 were revisited.

The result as contained under the two way interactions show that there is no significant interaction between treatment and gender on students' problem-solving achievement scores. [$F(1,345)=.504$; $P>.05$]. The null hypothesis was therefore not rejected.

(c) Environmental Attitude.

HO4(c): There will be no significant interaction effect of treatment and gender on students' environmental attitudes.

The data collected with their corresponding analysed result as presented in Table 13 were also revisited. The result reveals that there is no significant interaction between the treatment (instruction) and gender on students' environmental attitude scores. [$F(1,345)=.177$, $P > .05$]. Therefore, the null hypothesis was not rejected.

4.6 HYPOTHESIS FIVE (HO5):

HO5: There will be no significant interaction effect of treatment and subject specialization on students'.

(a) cognitive achievement,

(b) problem-solving achievement, and

(c) environmental attitudes.

The data collected with their corresponding analysed result (A.N.C.O.V.A.) as presented in Tables 10,11,12,13,14 & 15 were revisited, using the pre-test scores as covariates.

(a) cognitive Achievement

HO5 (a): There will be no significant interaction effect of treatment and subject specialization on students' cognitive achievement.

As presented in Table 10, [F(1,345)=18.300; P<.05], the F ratio was found to be highly significant with the critical F value of 3.84. Therefore, the null hypothesis stipulating a non-significant interaction effect of treatment and subject specialization on students' cognitive achievement was rejected. In other words, a significant interaction effect was found.

To probe for the significance of the interaction between the variables, the t-test was computed on the post -test scores of the groups at the cognitive achievement level. The result is presented in Table 16.

The table shows that the science and non-science subjects of both experimental and control groups performed significantly different in cognitive achievement scores (Experimental Science $\bar{X}$=77.54; Experimental Non-science $\bar{X}$=67.74; control science $\bar{X}$=36.82; control non-science $\bar{X}$=30.74).

TABLE 16: MEANS, STANDARD DEVIATIONS, AND T-TEST COMPARISONS OF SCIENCE AND NON-SCIENCE SUBJECTS IN THE EXPERIMENTAL AND CONTROL GROUPS ON COGNITIVE ACHIEVEMENT SCORES.

GROUP	N	$\bar{X}$	SD	t	P
(i) Experimental					
Science	87	77.54	8.40		
Non-Science	90	67.74	10.76	6.73	.000**
ii. Control					
Science	76	36.82	10.18		
Non -Science	94	30.74	10.20	3.86	.000**

** Significant, P<.05)

That is, the science subjects of both groups performed significantly better than their non-science counterparts.

The nature of this interaction was however determined by plotting an interaction graph of treatment by subject specialization on cognitive achievement scores as recommended by Glass and Stanley (1970). This is also shown in fig. 6.

This graphical representation reflects an ordinal interaction between treatment and subject specialization . This indicates that in both situations, the science subjects are superior to their non-science counterparts across all levels of treatment.

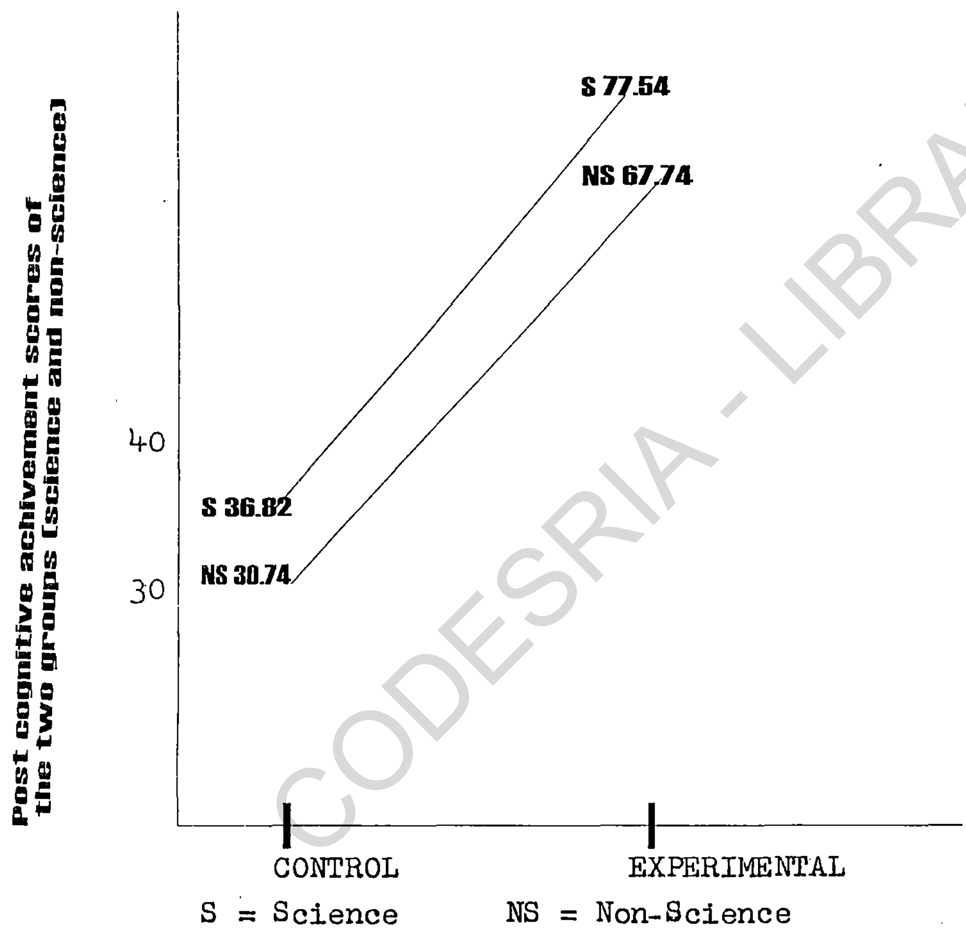


FIG 6: Graphical Representation of post cognitive achievement mean scores of science and non-science subjects in the experimental and control groups

That is, the significant interactions as well as the variations between the scores of science and non-science subjects seem to indicate that though subject specialization on its own might not have caused the scores to vary significantly, it probably combined with the treatment to significantly influence the scores.

Therefore, although the effect of the EEM treatment overshoots the existing biology curriculum, nevertheless, the use of the EEM package itself is a function of whether it will be used for science or non-science subjects. (McCall, 1975).

(b) Problem-solving Achievement.

HO5 (b): There will be no significant interaction effect of treatment and subject specialization on students' problem-solving achievement.

The data collected with their corresponding analysed result as presented in Table 12 were revisited. The result as shown in the two way interactions revealed an F ratio value $[F(1,345)=2.143; P > .05]$, which is not significant. The critical F value being 3.84. Therefore, the null hypothesis suggesting no significant interaction effect of treatment and subject specialization on students' problem-solving achievement was not rejected.

(c) Environmental Attitudes.

HO5 (c): There will be no significant interaction effect of treatment and subject specialization on students' environmental achievement.

Table 14 was revisited with the corresponding analysed result. The two - way interactions revealed an F-ratio value [$F(1,345)=4.507$; $P<.05$], which was found to be significant. (The critical F-value being 3.84) The null hypothesis stipulating a non-significant interaction between treatment and subject specializations on students' attitude scores was therefore rejected.

To further search for the source of the significance, or how significant the difference are, the t-test comparison analysis was carried out. The result of the t-test comparisons is presented in Table 17:

TABLE 17: MEANS, STANDARD DEVIATIONS AND T-TEST COMPARISONS OF SCIENCE AND NON-SCIENCE SUBJECTS IN THE EXPERIMENTAL AND CONTROL GROUPS ON COGNITIVE ATTITUDE SCORES.

GROUP	N	X	SD	t	P
i. Experimental					
Science	87	176.59	8.35		
Non-Science	90	167.46	8.90	7.03	.000**
ii. Control					
Science	76	119.42	13.87		
Non -Science	94	117.67	13.60	.83	.41NS

** Significant, P<.05; NS = Not significant

The table shows that the science and non-science subjects of experimental group performed significantly different in attitude scores unlike those in the control group. (Experimental science $\overline{X}$=176.59; Experimental Non-science $\overline{X}$= 167.46; control science $\overline{x}$=119.42; control non-science $\overline{X}$=117.67).

The nature of this interaction was also determined by plotting a graph of treatment by
subject specialization on attitude scores, as shown in fig 7.

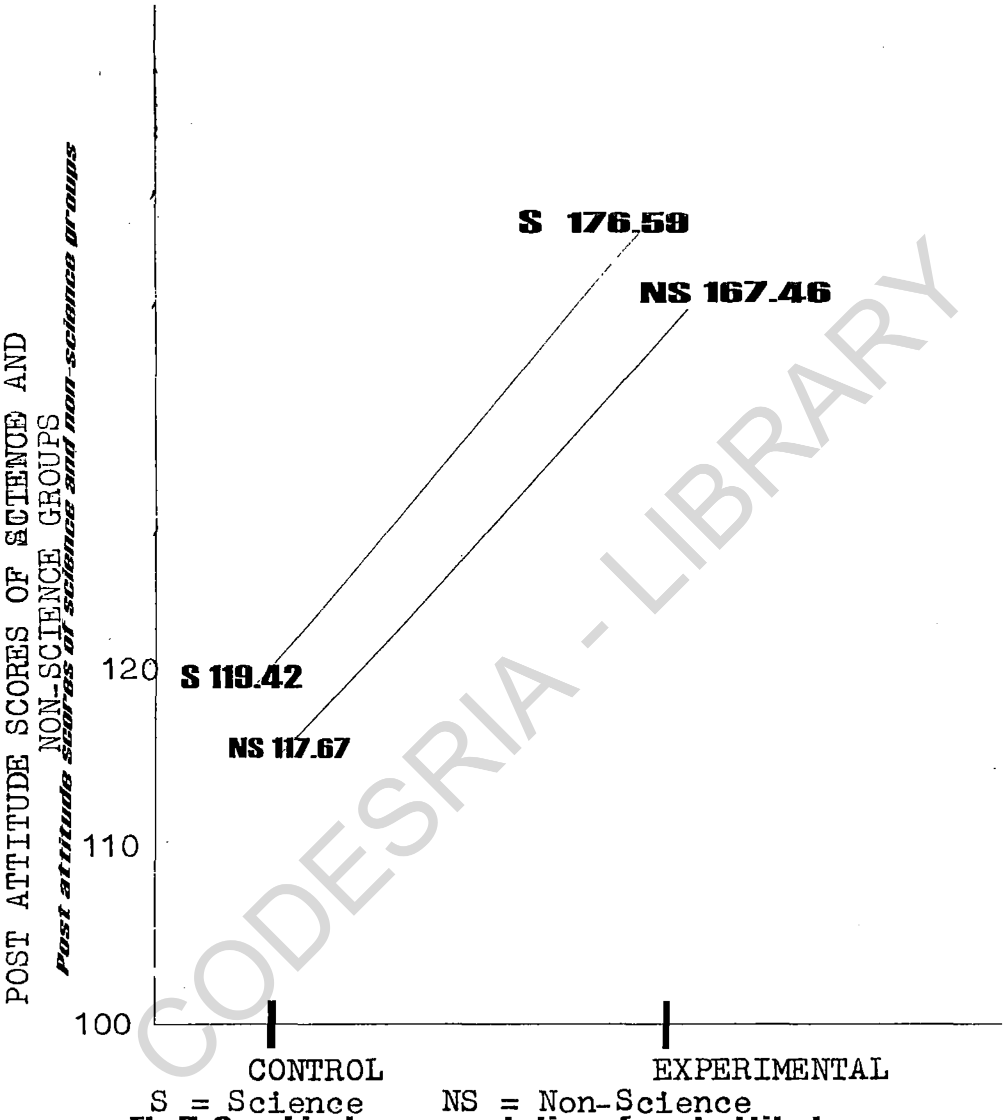


Fig 7: Graphical representation of post attitude mean score of science and non-science subjects in the experimental & control groups.

This graphical representation displays an ordinal interaction between treatment and subject specialization . That is, in both situations, the science subjects were found to be superior to their non-science counterparts in their attitude scores.

However, it is interesting to note that the control science subjects were not significantly different from the non-science subjects in their attitude scores.

On the strength of these the significant interaction is an indication that treatment on its own might not have caused the scores to vary significantly, but rather it probably combined with the other factor, subject specialization, to significantly influence the attitude scores. That is even though the effect of the EEM treatment is significantly better than that of the existing biology package, nevertheless, the use of the EEM package to influence the students' attitude scores depends on whether it will be used for science or non-science students. (McCall, 1975).

4.7 **HYPOTHESIS SIX HO6:**

HO6: There will be no significant interaction effect of gender and subject specialization on students'.

(a) cognitive achievement,

(b) problem-solving achievement, and

(c) environmental attitudes.

This hypothesis was tested by a 2x2x2 Analysis of Covariance of the post test scores, using their pretest scores as covariates, as presented in Table 10,11,12,13,14 & 15.

(a) cognitive Achievement

H6 (a): There will be no significant interaction effect of gender and subject specialization on students' cognitive achievement.

The result presented in Table 10 (from the analysis of data collected) was revisited and the F-ratio value [F1,345)=1.046, P>.05] obtained is not significant in their two -way interactions. The critical F-value being 3.84. That is there is no significant interactive effect of gender and subject specialization on students cognitive achievement scores. Based on these findings, the null hypothesis was not rejected.

(b) Problem-solving Achievement.

HO6 (b): There will be no significant interaction effect of gender and subject specialization on students' problem-solving achievement.

The data collected and the analysed result presented in Table 12 were revisited. The F-ratio value obtained [F1,345)=2.147, P>.05] was found to be non-significant.

That is, the result as contained under the two-way interactions shows that there is no significant interaction effect of gender and subject specialization on students' problem-solving achievement scores. Therefore, the null hypothesis was not rejected.

(c) Environmental Attitudes.

HO6 (c): There will be no significant interaction effect of gender and subject specialization on students' environmental attitudes.

The result presented in Table 14 revealed an F-ratio value of $F(1,345)=.299$, $P>.05$, which is not significant. In other words, no significant interaction effect of gender and subject specialization on students' environmental attitudes was found. The critical F-value being 3.84. Therefore, the null hypothesis was not rejected.

4.8 **HYPOTHESIS SEVEN (HO_7)**

HO_7 There will be no significant interaction effect of treatment, gender and subject specialization on students'

(a) cognitive achievement,

(b) problem-solving achievement, and

(c) environmental attitudes.

The data collected were analysed as presented in Tables 10,12, & 14, using the pretest scores as covariates.

(a) Cognitive Achievement

HO_7 (a): There will be no significant interaction effect of treatment, gender and subject specialization on students' cognitive achievement.

As shown in Table 10, the result of the 3 - way interaction shows that no significant interaction exist among the treatment, gender and subject specialization on students' cognitive achievement scores [$F(1,345) = 1.675$, $P>.05$]. Therefore, the null hypothesis was not rejected.

(b) Problem-Solving Achievement

HO_7 (b): There will be no significant interaction effect of treatment, gender and subject specialization on students' problem-solving achievement.

The summary of A.N.C.O.V.A. as presented in Table 12 was revisited and the three - way interactions' result shows that no significant interaction exist among the treatment, gender and subject specialization on students' problem-solving achievement scores. [$F(1,345) = .002$, $P>.05$]. The null hypothesis was therefore not rejected.

(c) Environmental Attitude

HO_7 (c): There will be no significant interaction effect of treatment, gender and subject specialization on students' environmental attitudes.

attitudes.

The summary of ANCOVA as shown in Table 14 was revisited and the three - way interactions' with an F-ratio value [$F(1,345) = .008$, $P>.05$]. shows that no significant interaction exists among the treatment, gender and subject specialization on students' environmental attitude scores. Since the F-value .008 is less than the critical F-value 3.84, the null hypothesis was therefore not rejected.

CHAPTER FIVE

DISCUSSION OF RESULTS, SUMMARY, IMPLICATIONS, RECOMMENDATION AND CONCLUSION

In this section, the impacts of the two curricular packages (Environmental Education Module, EEM, and the Conventional Biology Curriculum), gender and subject specialization, on students' cognitive achievement, problem-solving achievement and environmental attitude were discussed.

Moreover, attempts were made to discuss the impacts in line with the hypotheses tested.

5.1.1. INFLUENCE OF TREATMENT ON STUDENTS' COGNITIVE ACHIEVEMENT.

Hypothesis 1(a) sought to find out if there would be any significant main effect of treatment on students' cognitive achievement. The result of the study reveals significant difference among Experimental and control groups in cognitive achievement scores [$F(1,345) = 3680.317$; $P < .05$] as shown in table 10. This result does not provide support for hypothesis 1(a) suggesting a non-significant main effect and hence was rejected.

Moreover, the data collected appear to provide evidence in favour of the experimental groups as being superior over their control counterparts in their cognitive achievement scores. (Tables 10 & 11).

And since the experimental groups were exposed to the new E.E.M package, then the package was found to have contributed significantly to the gains in cognitive achievement scores of the students exposed to it (Table 11).

The results of this study support earlier findings in this area (Iozzi, 1980; Kushler, 1980; Crater and Mears, 1981; Lucko, et at, 1982; Wendling, et at 1989; Umoren 1991).

The superior performance of the Experimental subjects probably derives from their exposure to the new EEM package coupled with their active participation in the various projects attached to the package. Since EEM deals with detailed, comprehensive and coherent knowledge or facts on social conservation issues and problems within the subjects' immediate environment, the subjects were able to acquire more information on the causes, effects, and control of pollution, - water, land and air; Wastage of Energy at home, school and community etc. From the result obtained, the experimental groups' superior performance illustrates the power of the E.E.M. package over the conventional or the existing curriculum to which the control group was exposed.

Moreover, the inability of the control group to perform as much as the experimental group might be attributed to the disordinal organization of the various social problems and issues in the various topics treated before conservation of natural resources. Such incoherent facts on social issues and problems can affect effective linkage of the facts as expected.

Furthermore, this result could be explained in terms of the fact that the EEM package takes into cognizance the balanced mode of knowledge acquisition as recommended by Adara (1992) using balanced indoor and outdoor activities or projects and relevant instructional materials to foster practice and application of acquired information by the experimental groups.

Therefore, the existing biology curriculum does not accurately present conservation of Natural Resources to foster appropriate and relevant practice and may not adequately communicate a true and realistic picture of science related social responsibility.

The findings of this study also support the fact that a more realistic approach to conservation be developed by bringing together all the elements of social issues and problems together with a view to strengthening the links -

causes, effects and solutions (control) in line with the UNESCO (1977b) specified EE goals and objectives, coupled with action - related facts or knowledge.

5.1.2 INFLUENCE OF TREATMENT ON STUDENTS' PROBLEM-SOLVING ACHIEVEMENT

Hypothesis 1(b) sought to confirm if there would be any significant main effect of treatment on students' problem solving achievement. Table 12 reveals that there is a significant difference between Experimental and Control groups in their problem-solving achievement scores. [$F(1,345) = 3189.326$; $P<.05$]. This results reveal a significant main effect of treatment on students' problem-solving achievement.

Based on these findings, the null hypothesis 1(b) was therefore rejected.

However, the data collected and analysed provide evidence in support of the Experimental groups as being superior in problem-solving over their control counterparts.

Tables, 12 & 13). This superiority probably derives from their exposure to the EEM which enabled them to apply the acquired information to relevant and appropriate problem-solving tasks related to conservation issues and problems. The EEM groups were actively involved in tackling real life conservation related problems such as provision of bins for dumping solid wastes, recycling of papers/ rubber/metals, and other activities like planting of trees around the school compound as a measure of conservation to ensure constant supply of firewoods, or energy, individualised projects in keeping poultry, rabbitry, snailery, aquarium, and beautification of the school compound with flowers to improve on their aesthetic awareness.

These dynamic measures and other activities enforced, probably led the EEM subjects to acquire and apply relevant information in resolving social conservation issues and problems. This action is supported by various experts (UNESCO-UNEP, 1987; Chisman et al, 1991) that 'Doing' is the real test of knowing and leads to first hand experience.

The poor performance of the control group in their problem-solving achievement scores may not be unrelated to the educational inadequacies of the existing biology curriculum on conservation topics. That is, the conventional curriculum do not seem to furnish students with adequate experiences that are capable of making them problem-solvers as included in EEM package. Most of the facts on conservation components in the existing biology curriculum focused mainly on isolated facts, exposed to students largely in their classrooms (indoor activities) with relatively very few outdoor experiences or applications. And as stressed earlier on in chapter one (UNESCO-UNEP, 1989), 'students who engage in problem-solving generally learn to become responsible, capable and creative individuals.

Therefore, the findings of this study also confirm that the new EEM package has contributed significantly to improve students' problem-solving achievement. (Tables 12 & 13). These findings give further empirical support to the previous findings (Hepburn, 1978; Ramsey, et al 1981; Westerman and Griner, 1991; Agina-Obu, 1994).

The need arises therefore to restructure the existing curriculum to reflect specific problem-solving tasks related to conservation and problems for students to engage in during the teaching-learning situation. Such measure will go a long way to equip individual with diverse opportunities to acquire necessary skills needed to protect and improve the environment. Moreover, as stressed at the World Inter-governmental Conference on EE (1977), such exposure may also create or develop new patterns of behaviour in the students towards the environment. In sum, such experiences can assist in developing a sense of responsibility and urgency in working towards resolution of environmental problems.

5.1.3 INFLUENCE OF TREATMENT ON STUDENTS' ENVIRONMENTAL ATTITUDES.

Hypothesis 1(c) sought to test if there would be any significant main effect of treatment on students' environmental attitudes. Table 14 reveals that there is significant main effect of treatment [$F(1,345) = 3134.800$; $P < .05$] on subjects' attitudes. This result reinforces the fact that there is a significant difference between the experimental and control groups as regards their acquisition of environmental attitudes. On the basis of these results, the null hypothesis had to be rejected.

The superiority of the EEM groups over the non-EEM groups in acquisition of environmental attitudes may not be unrelated with the nature of the task that the students are exposed to during treatment. The EEM groups were actively involved in resolving conservation problems and issues both within and outside their classrooms, and through various specified environmental activities were able to participate in environmental improvement and protection. Such involvement probably led to their acquisition of a set of values and feelings of concern for their environment. And as stressed by several educators, Leeming, et al (1997)

"...encouraging participation in

> environmental activities is a promising technique for improving children's environmental attitudes, knowledge, or both."

The poor performance of the control group in the attitude scores may not be unrelated to their lack of adequate practice or involvement in environmental activities. That is, the existing biology curriculum do not seem to sequence out sufficient experiences capable of developing students' feelings or concerns for their environment. The content of the conventional curriculum appears to be rigid on dissemination of information which are also presented in fragments across the syllabus. The nature of this conventional curriculum calls for urgent restructuring of the environmental education topics and content in line with the UNEP recommendations in order to attain the specified E.E. goals and objectives (Baez, 1987; UNESCO-UNEP, 1989; Cross and Price, 1993; Chisman, et al, 1991).

Furthermore, the EEM groups were exposed to well organised, detailed and relevant knowledge on conservation issues and problems with their corresponding control measures which are scattered inthe conventional curriculum. And since environmental knowledge is a precondition for changing attitudes (Noibi, 1990; Jacobson and Padua, 1992) then the learners' environmental knowledge is important to influence his/her attainment of the right conservation attitude.

The findings of this study lend credence to previous works in this area (de-White and Jacobson, 1994; Jimenez-Aleixandre, et al, 1995; Leeming, et al, 1997). In other words, the enhancing influence of the EEM package on subjects' environmental attitudes was observed to be significant. Therefore, the package (EEM) has contributed significantly to improve students' attitude to environmental conservation.

And as mentioned earlier on, since one of the aims of environmental education is developing attitudes, motivations, and commitment in working towards solution of environmental problems, (UNESCO, 1993; Noibi 1990), therefore any curriculum planner should incorporate this dimension in planning a viable curriculum (Bloom, et al, 1973).

5.2 INFLUENCE OF GENDER ON STUDENTS' COGNITIVE ACHIEVEMENT, PROBLEM-SOLVING AND ENVIRONMENTAL ATTITUDE

The results obtained to test hypothesis two was found to be non-significant for cognitive achievement [$F(1,345) = 0.065$, $P > .05$]; problem-solving achievement [$F(1,345) =$

.127, P > .05] and environmental attitude scores [F(1,345) = .886; P > .05]. In other words, the data collected appear to provide evidence that no significant main effects of gender on students' cognitive achievement exists. That is gender does not seem to influence the variations in cognitive achievement of the subjects in the two groups (Experimental and Control). However, even though the female subjects performed better than their male counterparts in their post-test mean scores in Table 11, (Female $\bar{X}$ = 53.49 > Male $\bar{X}$ = 53.33); yet., the difference was found to be insignificant. These findings reveal that the treatment (the two packages) had about equal, effect on male and female subjects. And since EEM package is already identified for improving students' cognitive achievement, then, irrespective of either male or female status, the package can be used inthe classroom situation. Therefore both sexes profited from the package.

Similarly, the results of this study also show that gender do not seem to influence the variations in problem-solving achievement and environmental attitudes of the two groups (Experimental and control). As shown in Table 13 (Female $\bar{X}$ = 32.08; Male $\bar{X}$ = 145.34), although the female subjects have higher adjusted post-test mean scores, nevertheless, since the differences are found to be insignificant, then both male and female subjects gained from the package. These findings are also similar to those of Strickland et al (1983/84).

5.3.1 INFLUENCE OF SUBJECT SPECIALIZATION ON STUDENTS' COGNITIVE ACHIEVEMENT

Hypothesis 3(a) sought to test if there would be any significant main effect of subject specialization on students' cognitive achievement. The result obtained, analysed and presented in Table 10 revealed an F-ratio of $F(1,345) = 22.205, p < .05)$, which failed to support the stated hypothesis because the result was found to be significant. That is, a significant difference was found between the science subjects and their non-science counterparts in relation to their cognitive achievement. Therefore, subject specialization contributed significantly to the variations in students' cognitive achievement.

The significant difference obtained between the science and non-science subjects in their cognitive achievement of interest.orthe science subjects superiority may be explained, as follows.

It may be suggested that since students are constantly involved in science process skills, gathering information through various channels - observation, manipulations, and in setting out hypothesis on certain phenomena before confirmation or verification, such experiences might have assisted their cognition and emotional readiness. Therefore, related stimuli are processed through the same channel and it serves as motivator to achieve the set goal in resolving specific conservation issues and problems within their immediate environment. Moreover, some of the topics in the package cut across several science subjects like Agricultural Science, Home-Economics, Chemistry, Physics, thereby serving as aids or keys for correlation of facts and adequate integration of the subsumed facts or knowledge. For example, Land and Water Pollution, Erosion, Conservation of Animals - Poultry, Rabbitry, Snailery, Aquarium, vegetation/devegetation, forest reservaton etc are some of the topics treated in Agricultural Science. Therefore, knowledge transfered from such discipline by any science student can also assist in enhancing comprehension, assimilation and application of such knowledge to solve related conservation issues and problems. In essence, one could deduce that science students probably transfered the skills gained in earlier experiences and in the packages to resolve environmental problems.

Furthermore, since the M.C.A. table 11 on the cognitive post-tests' achievement provides the relative adjusted mean scores of science group to be 55.08, and non-science group (51.92), certainly, more clarification is needed to confirm or disprove the effect of the treatment on the experimental and control groups, as would be discussed later in relation to subject specialization.

An alternative explanation to the superiority of the science students over the non-science students in their cognitive achievement is the pre-supposed pre-requisite factors - skills, motivation, and attitudes required in order to offer science. Such factors serve as accumulation of reinforcement for associative learning. The variation in scores between the science and non-science subjects can thus be attributed to the open-mindedness, objectivity and consistent practice of the former.

In addition, the nature of science as an open-ended venture has always been attributed as the causal factor for students' curiosity. Therefore, curiosity or inquisitiveness are accepted virtues or characteristics of a scientist. Such attitudinal dispositions are capable of enhancing students' attainments in the treatment (package). Coupled with this scientific virtue is the evidence obtained from literature which pointed out the non-science students' aversion to or lack of interest in science, thereby resulting in emotional instability and recognitive flexibility (Gifford, et al, 1982/83). Thus, Gifford and others in their study of individual differences in Environmental attitudes and knowledge asserted that:

> Natural Science majors know more about and reports being more emotionally affected by the environment than the others".

Moreover, they stressed that greater understanding of such individual differences will create greater potential for designing and implementing efficient programmes.

In essence, the call for alternative curricula for non-science students cannot be averted in order to design a good programme to meet the needs of the group (Roy and Walter, 1991; Oladele, 1991; Umoren, 1991). Such curriculum programme should incorporate various diverse experiences or activities from the environment that can sensitize the cognitive accommodation and assimilation at formal operational level (Piaget, 1950). These learning experiences are recommended by Bruner (1966) who suggested learning by Doing, Acting, or Behaving as ingredients for reiteration of knowledge. According to him, such acts strengthen discovery and transfer of learning to maintain correlation and continuity of the content.

The findings of this study support previous works

(Gifford, et al, 1982/83; Umoren, 1991;

5.3.2 INFLUENCE OF SUBJECT SPECIALIZATION ON PROBLEM-SOLVING AND ENVIRONMENTAL ATTITUDES

The result obtained for hypothesis 3(b) that stipulated a non-significant main effect of subject specialization on students' problem-solving achievement reveals an F-value of $F(1,345) = 2.414$, $P > .05$ which was not significant. Therefore, the data collected provided evidence in favour of the stated hypothesis. That is, subject specialization does not seem to influence the variations in problem-solving achievement of the subjects in both experimental and control groups.

Although the science subject out-performed their non-science counterparts in their post-test mean scores in Table 13 (Science $\bar{X} = 32.43$; Non-Science $\bar{X} = 31.58$), yet this difference was found to be non-significant. These findings strengthen the fact that the treatment had about equal effects on both science and non-science subjects. On the basis of these results therefore, the treatment applied can be used for both science and non-science groups. These findings are also similar to those of Gifford et al, 1982/83; Umoren, 1991).

As regards the influence of subject specialization on students' environmental attitudes, hypothesis 3(c), was tested using the results obtained and presented in Table 14. The F-value obtained, $F(1,345) = 14.944$, $P < .05$,was found to be highly significant. Thus, the null hypothesis suggesting a non-significant main effect of subject specialization on students' environmental attitudes was rejected. Therefore, the data collected provide enough evidence to support the fact that the differences, between the science and non-science post-test mean scores may probably be due to the effect of subject specialization on the attitude scores (Science $\bar{X}$ = 147.67; Non Science $\bar{X}$ = 144.03; in Table 17).

This superiority of the Science group over their non-science counterparts may not be divulged from the nature of the two groups in their attitudinal dispositions as depleted in various literature.

The involvement of the science groups in science process skills which entail consistent practices or activities in order to test a stated hypothesis might have culminated into stored experiences on which subsequent tasks are related. And as stressed by Gagne (1977), subordinate skills in memory lead to learning of subsequent skills, acquired through ordered set of capabilities, processed through differentiation, recall, and transfer of learning.

Moreover, the poor performance of the non-science groups can be attributed to insufficient experiences in practical, which ought to serve as bedrock for meaningful verbal learning (Ausubel, and Robbinson, 1969). As emphasized by Ausubel, the ability of a learner to relate new materials or experiences to existing cognitive structure would go a long way to develop him/her to assimilate, relate, organise and store information, thereby fostering stability or clarity of new ideas. However, for the science group, some of the topics treated on conservation cut across various science subjects which can be reiterated and used for resolving environmental problems.

Apart from all these probable explanations, the need still arises for further investigations into the nature of classroom interaction existing in both science and non-science groups. For instance, knowledge transference may occur within the science subset or group which might be absent in their non-science group or subset. Moreover, it is also possible that such interactions can call for mixture of the two groups to minimize such effects.

In summary, since the EEM package has been found to enhance students attitudinal scores (Table 12, then the need arises to check the various components of the package with a view to design more appropriate package to meet the needs of non-science learners. Through this means, individuals can develop feeling of concern for protecting and improving their environment.

The use of diverse learning environments coupled with a wide spectrum of educational approaches to teaching and learning about, and from the environment in addition to practical activities and firsthand or real experiences are relevant measures recommended for environmental sensitivity and commitments (UNESCO, 1977).

5.4 INTERACTIONS

5.4.1 INTERACTIVE EFFECT OF TREATMENT AND GENDER ON STUDENTS' ATTAINMENTS

The result obtained in Table 11 to test hypothesis 4(a) was found to be non-significant with the F-value obtained, [$F(1,345) = 3.027$, $P > .05$]. That is, the data collected appear to support the stated null hypothesis that there would be no significant interactive effects of treatment and gender on students' cognitive achievement. These findings support that the influence of the treatment did not differ upon the level of the other factor, gender. In order words, the treatment makes a difference for both male and female subjects. And since EEM package is already identified for improving students' cognitive achievement over the conventional package, then, irrespective of either male or female status, the package is found to be appropriate. Therefore, both sexes profited from the package.

Similarly, the result obtained in Table 12 to test hypothesis 4(b) was also found to be non-significant. the F-value obtained is $F(1,345 = .504, P > .05$. This means that the data collected seem to justify the stated null hypothesis that there would be no significant interactive effect of treatment and gender on students' problem-solving achievement. In essence, the findings reveal that the influences of the treatment applied have no bearing with the other factor, gender, except that it makes a difference for both sexes. Therefore, based on the above revelations, the package appears to be appropriate for improving students' problem-solving achievement, irrespective of either male or female status.

Furthermore, in order to test hypothesis 4(c), the F-value obtained from the data, $F(1,345) = .177, P > .05$ in Table 13 was found to be non-significant. In other words, no significant interactive effect of treatment and gender on students' environmental attitudes exists. That is, the treatment makes a difference for both male and female subjects in their environmental attitudes. And since the

EEM package is already identified for enhancing students' environmental attitudes over the conventional curriculum, then the package can be used for both males and females.

5.4.2 INTERACTIVE EFFECT OF TREATMENT AND SUBJECT SPECIALIZATION ON STUDENTS' COGNITIVE ACHIEVEMENT

The result obtained in Table 10 sought to test hypothesis 5a, and revealed an F-value of $F(1,345) = 18.300$, $P < .05$ which was found to be highly significant. Therefore, the results failed to support the stated null hypothesis that no significant interactive effect of treatment and subject specialization on students' cognitive achievement exists. In other words, the influence of the treatment differs upon the level of the other factor-subject specialization. The treatment seems to make a difference in cognitive achievement of both science and non-science subjects. This means that even though the EEM package is found effective for improving students' cognitive achievement, nevertheless, its use in the classroom situation is a function of whether you are facing science or non-science.

However, since subject specialization was found to have exerted a significant main effect on students' cognitive achievement, then the influence of the package is contingent on which group (Science or non-science) that will use it. And from the data collected, the package is more favourable to the science subjects than their non-science counterparts. Then, the questions arise, what factors could account for the superiority of the science groups over their non-science mates?, Why is the treatment based on whether science or non-science?, Why is the treatment favourable to science group than their non-science counterparts? etc.

The superiority of the science subjects over their non-science counterparts as earlier on stressed cannot be divulged from the science students' familiarity with the scientific processes involved in the contents of EEM package. Also, transfer of acquired related knowledge from similar disciplines like Physics (for Energy conservation), Chemistry (Mineral conservation/ recycling of resources), Agricultural Science (Conservation of land, forest, wildlife and animals), and Home Economics (water conservation, saving energy, gardening, animal husbandry) can also enhance their cognitive achievement scores. This transference of knowledge and skills have implications for preparation of any curricular package for the non-science groups. That is, attempts should be intensified by various curriculum developers to infuse similar experiences in several art-based disciplines. For instance, social sciences/study can be furnished with several EE concepts and topics that can be attained through related learning experiences or skills (Lawal, (1993), Noibi & Lawal (1993), Mansaray and Ajiboye, 1997).

Moreover, the need to improve on the EEM package to cater for the deficiencies of the non-science group cannot be over-emphasized. Apart from provision of child centred, hands-on, open-inquiry approach which can be used for improving instruction (Balogun, 1992; Oloruntegbe, 1997) other salient factors like classroom climate and interactions can exert influences on students' confidence and attainments in EEM package. The notion of Guided Peer-to-Peer teaching approach has been found to be effective in diseminating information and to influence behavioural changes from one adolescent to other fellow adolescents (Onyegegbu, 1997). Therefore, by mixing science and non-science students may also lead to peer teaching with positive interaction. The findings of this study are related to previous studies of Gifford, et al, 1982/83; Umoren, 1991);

5.4.3 INTERACTIVE EFFECT OF TREATMENT AND SUBJECT SPECIALIZATION ON STUDENTS' PROBLEM SOLVING AND ATTITUDES

Hypothesis 5(b) sought to test if there would be any significant interactive effect of treatment and subject specialization on students' problem solving achievement . Table 12, reveals that there is no significant interaction effect of treatment and subject specialization on students' problem-solving achievement with the obtained F-value of $F(1,345) = 2.143$, $P > .05$. That is, the data collected do not provide enough evidence to justify a significant interaction. These findings provide evidences to support that the influence of the treatment did not differ or depend on the level of subject specialization. In other words the treatment makes no difference for both science and non-science subjects. And since the EEM package has been identified to have more pronounced impact on students' problem-solving achievement than the conventional package, then it holds that such package is found applicable and appropriate for both science and non-science students.

On the other hand, the result obtained in Table 14 to test hypothesis 5(c) was found to be significant with the F-value reflected, $F(1,345) = 4.507$, $P < .05$. Therefore, the data collected failed to support the stated null hypothesis that there would be no significant interactive effect of treatment and subject specialization on students' environmental attitudes. This assertion means that the use of the treatment depends on which subject major it is meant for. Since both treatment and subject socialization combined to effect the change, then, the package (treatment) alone cannot impart the change except it is accompanied with the right subject major (McCall, 1975).

This means that the mode of acquiring environmental attitudes in students can be subject-combination sensitive. Then, what accounts for this marked difference?, Why did science students consistently acquire more favourable attitudes in resolving conservation issues and problems? The answer to the above questions are not far-fetched. Since inculcation of scientific attitudes like curiosity, open-mindedness, objectivity, accuracy are embedded in scientific goals and objectives and usually acquired through the prescribed process approach involving activities like projects, practicals, field trips, then, it is possible that adequate transfer of knowledge, skills and attitudes ensued. Therefore, there is need to incorporate similar attitudinal dimensions in arts-based disciplines for the non-science subjects. And as emphasized by experts, Piaget, 1950; Ausubel and Robbinson, 1969; Carin & Sund, 1975), the acts of doing reinforces understanding and acquisition of first hand and real experiences which can be used for resolving problems.

Moreover, since various studies have revealed similar positive relationship between environmental knowledge and attitude (Wilson and Tomera, 1980; Jacobson & Padua, 1992; Mansaray & Ajiboye, 1997; then, increased change in environmental knowledge of students (as shown in Table 10) can also result into increase in their environmental attitudes (Table 16). The results of this study therefore support that EEM is a viable instruction which could be used to promote the level of students' cognitive achievement (knowledge) and environmental attitudes which can lead to behaviour modification. And as indicated earlier on, since behaviour modification results after attitudinal and valuational change in a person (Skinner, 1976), then change in attitude must first occur in an individual before it results in change in behaviour. This assertion is also supported by previous researchers. (Sia et al, 1985/86; Westerman and Griner, 1991).

5.4.4 INTERACTIVE EFFECT OF GENDER AND SUBJECT SPECIALIZATION ON STUDENTS' ATTAINMENTS

The result obtained to test hypothesis six was found to be non-significant for cognitive achievement [$F(1,345) = 1.046$, $P > .05$] in Table 10, problem-solving achievement [$F(1,345) = 2.147$, $P > .05$] in Table 12 and environmental attitude scores [$F(1,345) = .299$; $P > .05$] in Table 14. In other words, the data provide evidence to support the stated null hypothesis that no significant interactive effects of gender and subject specialization on students' cognitive achievement, problem-solving and environmental attitude exists.

The above findings reveal that the impact of the two factors - gender and subject specialization are not dependent on one another. This assertion holds for all the different levels of students' attainments. Therefore the effects of gender is separate, and that of subject specialization is also separate and one factor cannot hold the other factor to ransom.

The results also suggest that whether male or female, science or non-science, the impact of any treatment holds equally or both groups will benefit from the treatment (or packages). with the advantaged position of EEM over the existing curriculum, the use of the new package is found appropriate and viable for the groups.

5.4.5 INTERACTIVE EFFECT OF TREATMENT, GENDER AND SUBJECT SPECIALIZATION ON STUDENTS' ATTAINMENTS

The findings of this study support hypothesis seven that there is no significant interactive effects of treatment, gender, and subject specialization on students' cognitive achievement [$F(1,345) = 1.675$; $P > .05$] in Table 10; problem-solving achievement [$F(1,345) = .002$, $P > .05$]

in Table 12; and environmental attitude scores [F(1,345) = .008; P> .05] in Table 14. These results suggest that the impact of treatment did not depend on the other two factors-subject majors and gender. This is because the treatment was found to make a difference for both male and female, science and non-science students.

This study contributes to the profitable line of research in education that investigates interactions between classroom instructions and students' attainments. Such 3-way interaction level is supposed to establish the dependency of the various factors on one another. It is also interesting to observe that these findings hold for both EEM package and the conventional curriculum.

However, since EEM package was noted (earlier on) to have had a relatively high significant effect on the subjects' cognitive achievement, problem-solving and environmental attitude scores, then one can assert that such EEM package should be recommended as an instructional package that is capable of recognising the variations in learners for effective teaching and learning.

5.5 SUMMARY, IMPLICATIONS, RECOMMENDATION AND CONCLUSION

5.5.1 SUMMARY

This study investigated the impacts of two curriculum packages on environmental education in Biology

(Environmental Education and Conventional Modules), gender and subject specialization on students' performance, problem-solving abilities and environmental attitudes.

The subjects were made up of 347 senior secondary two science and non-science majors (177 Experimental and 170 Control) of twelve intact classes randomly selected from six senior secondary schools in Ibadan Municipality of Oyo State. The experimental group consisted of 87 Science and 90 non-science majors while the control group comprised of 76 science and 94 non-science subjects.

A pre-test, post-test control group quasi-experimental design was adopted for the study. Four instruments were prepared, validated and used to collect data for the study.

The experimental groups were exposed to an Environmental Education Module (package) while the control group followed the conventional (existing) biology curriculum. The teacher for experimental groups were trained for two weeks on the use of the teachers' instructional guide and the EEM package, while the control groups were taught by their regular teachers. All the subjects were given a pre-test on all the evaluative instruments for one week, after which the two groups (experimental and control) were exposed to treatment for six weeks at an average of three periods per week after which the post-tests were administered for additional one week.

The data collected were analyzed using both descriptive and inferential statistics (Analysis of Covariance) and seven hypotheses were tested at 0.05 level of significance. The results revealed that:

(1) Students taught with the EEM package performed significantly better than students who were exposed to the conventional package, in terms of cognitive achievement, problem-solving and environmental attitudes.

(2) There was no significant main effect of gender on students' cognitive achievement, problem-solving and attitudes toward resolving conservation issues and problems. However, the female subjects out-performed their male counterparts in all the levels of attainments but such difference was not significant.

(3) The students' subject -combination had a significant main effect on students' cognitive achievement and environmental attitude scores, with science students performing significantly better than their non-science counterparts. Nevertheless, no significant effect of subject major on students' problem-solving achievement was observed. That is, the subjects' problem-solving

ability was not significantly affected by subject specialization.

(4) There was no significant interactive effect of treatment and gender on students' cognitive achievement, problem-solving and environmental attitudes. Therefore, the subjects' gender and treatment did not exert any significant influence on their attainments at all levels. In essence the treatment (EEM inclusive) was found to be appropriate for both sexes (male & female)

5(a) Significant interactive effects of treatment and subject specialization on students' cognitive achievement and environmental attitudes were obtained. That is, the use of the EEM package is a function of which subject major will use it because it was found to enhance the science group performance consistently. However, since the experimental non-science subjects outperformed both the control science and non-science groups, then the use of the package (EEM) as an achievement enhancing module cannot be over-emphasized.

(b) The subjects' attainment of problem-solving abilities was not significantly influenced by subject specialization and treatment. That is, the EEM package has about equal effects on science and non-science subjects in their problem-solving achievement. Therefore, the use of the package in influencing students' problem-solving abilities is not dependent on subject majors.

(6) The subjects' gender and subject specialization did not exert any significant interactive effect on students' cognitive achievement, problem-solving and environmental attitudes. In essence, the use of the EEM package was found suitable for both sexes (male, female) and subject majors (science and non-science).

(7) The subjects' attainments at all levels were not significantly influenced by the combination of gender, treatment and subject specialization. Therefore, the pronounced main effects of treatment is of paramount importance. With the higher effect of EEM over the conventional, then, the package (EEM) is not hindered at the 3-way interaction level.

5.5.2 <u>IMPLICATIONS OF THE STUDY</u>

The relative effectiveness of the EEM package to promote students' cognitive achievements, problem-solving abilities, and environmental attitudes have been clearly demonstrated by this study in the performance of the experimental group. And the poor performance of the control group has further demonstrated the weaknesses of the existing biology curriculum as a means of promoting cognitive achievement, problem-solving abilities and attitudes toward resolving conservation issues and problems. Therefore, the need to revisit, revise and restructure the existing biology curriculum on Conservation of Natural Resources cannot be overemphasized.

The results of the study have profound implications for biology curriculum development. A quick reflection on the difference between the conventional (old) and the EEM (new) packages and the different topics/sub-topics covered as shown in Appendices Vb & Vc may throw more light on the implications. For instance, appendix Vb displayed the various components of a curriculum vis-a-vis the existing and EEM packages in five dimensions.

First, the existing curriculum appears to have outdated objectives, with few objectives on attitude and skills development than can enable the learner to embark on resolution of conservation problems (Table 5). Therefore, the existing curriculum appears not to be appropriate in imparting relevant skills for pupils to engage in problem-solving and for inculcating into learners attitudinal change to pursue or embark on personal and community environmental problem-solving projects (Noibi, 1992; Adara, 1992; UNESCO/NERDC, 1992; Posch, 1996). That is, the need arises to construct more intended learning outcomes/objectives for acquisition of skills and attitudes in learners as imbibed in EEM package adopted in this study (Umozurike, 1992; Majasan, 1995).

Secondly, the pre-requisite topics/subtopics on conservation are scattered in the existing curriculum. Although all these topics were covered as conservation of Natural Resources, and content reflects causes and effects but with no control measures. Bruner (1962) advocates discovery learning, providing problem-situations which could stimulate pupils to discover solutions or control measures. This can be achieved through critical and analytical thinking (Adeyemi, 1995) and adequate provision of control measures in course-content. Such control-related content will help students to acquire more knowledge and improve their problem-solving capabilities to solve the long-term problems of

(i) Water pollution (e.g. dumping of wastes in flowing water/streams/rivers).

(ii Land pollution (e.g. littering the environment with garbages recycling of papers, rubbers etc) (iii a.ir pollution (over-burning, noisy environment)

(iv wastage of Energy (at home, schools & community), and

(v) conservation of forest/Wildlife/mineral over-exploitation and animals etc.

Therefore, provision of relevant and appropriate learning experiences and content would enable students to develop coping strategies for resolving environmental problems that arise from time to time.

As regards adequate selection of methods, several writers/experts have stressed the need to teach environmental concepts with balanced indoor and outdoor activities. UNESCO-UNEP, (1989) Noibi, (1990,1993). Several teaching methods are also applicable, for example Discussion; fieldtrips, laboratory, Demonstration, etc (Inquiry approach) but these methods should be meaningfully adopted in the context of the work, within the immediate environment. And since Table 6 has revealed more proportion of indoor activities in the existing curriculum, then, it shows that students are retained inthe classroom most of the time and are still expected to solve and possibly apply the knowledge taught in solving problems only within the classroom. Little wonder then that the UNESCO-UNEP (1987) congress rightly recommended the use of the environment, visits to forest reserves, farms, mining areas for exposing students to environmental problems and issues with a view to ginger them up to suggest possible solutions. Therefore, there should be a balance of the activities to equip students with a holistic experience of environmental education as EEM package adopted. Other experts that acknowledged the use of practice to acquire first hand and real experiences from the environment also stressed that such exposure leads to meaningful verbal learning through assimilation, storage, rehearsal, and transfer of knowledge and skills. (Ausubel, and Robbinson 1969; Leeming et al, 1997).

The need for adequate organization and integration of learning experiences and content has been emphasized by various curriculum experts, (Tyler, 1950; Nicholls & Nicholls, 1975; Wheeler, 1983). As rightly indicated, organization of content fosters unity or correlation, links and continuity between the various related topics and makes the ideas coherent with appropriate sequence, and such content/ideas/facts should be linked with specific environmental actions. (Noibi & Lawal, 1991; Leeming et al, 1997).

Examples of topics to be reordered in the existing curriculum include

(i) conservation of water:- water pollution - cause, effect and control measures

(ii conservation of forest - forests characteristics/ Distribution/Conservation.

(iii conservation of air:- Pollution of the atmosphere, air pollutants - sources, effects and control measures.

(iv conservation of minerals/rocks - Control measures.

(v conservation of animals - Cause, effect and control measures.

(vi conservation of energy - Cause, effect and control measures.

(vii conservation of land - cause, effect, control

viii conservation of wildlife - cause, effect and control (as shown in Appendix Vb & Vc).

Appendix Vc fully illustrated those topics that are scattered and several topics are discussed without the control measures for resolving the conservation problems and issues. And as stressed earlier on by Baez (1987), educators are called upon to restructure the content of their educational programmes to resolve conservation problems in their environment. Noibi & Lawal (1993) also added the need to structure the content of training and conservation education to provide awareness and reinforce control measures for sustainable life styles.

The importance of the fifth dimension, evaluation, is reflected in the purpose. Evaluation is a process of finding out how far the set objectives have been attained (Wheeler, 1983). However, a lesson without evaluation is deficient on means of identifying the weaknesses and strengths of the topic discussed, and cannot propose measures for rectification of unidentified flaws. As pointed out earlier on, Odunusi (1993), raised the need to incorporate an evaluative dimension inthe current biology curriculum. He emphasised that:

> "The Biology curriculum has no column for evaluation and reference list. No curriculum should be considered complete unless it lists an abundance of reference materials"

Therefore, the need to have rich reference lists of source materials for pupils and teachers in connection with each unit or phase (topic) cannot be overemphasized. These reference materials would assist teachers to provide variety in their teaching to meet the needs of the individual differences in pupils as adopted in EEM package. Coupled with the references, is the allocation of specific time to each topic that is absent in the conventional package but present in EEM in order to allow for adequate coverage of field experiences. In essence, there is need to allocate specific time to each topic in the conventional package (Odunusi, 1993).

Moreover, apart from revising the existing biology curriculum to provide a wider picture of a balanced curriculum package, there is also the need to reorder the content within a cultural context to preserve and improve our natural environment (UNESCO-UNEP, 1987). For instance, teaching Conservation in contemporary times requires adequate reference to the practical utility of the knowledge in the society and the need to develop a new pattern of behaviour in students to resolve both current and future environmental problems and issues.

A potent and meaningful way of accomplishing the above task is to include EEM package in the present biology curriculum with its appropriate instructional procedures. Such incorporation would go a long way to equip students with relevant knowledge and attitudes that can develop their problem-solving abilities, confidence, attributes, sense of commitment and responsibility needed for resolving conservation problems. Through consistent practice of the structured activities and projects, the students can acquire the necessary skills.

However, the insignificant influence of gender on the subjects' cognitive achievement, problem-solving and environmental attitudes is worthy of mention. This implies that science educators and teachers should not entertain any doubt concerning the potency of the EEM package in prompting the students' attainments at different levels since the package was found suitable for both sexes.

Nevertheless, the significant influence of treatment, subject specialization and the combination of the two factors suggests the need to intensify more efforts in bridging the gap between the science and non-science groups either by mixing the two groups in a class or by furnishing the non-science or arts subjects with related process skills and EE topics that can serve as 'storage bank' for references.

These findings also have implications for science education and teacher training since teachers are the key implementer of the curricular package, they need to be trained first before they can instill the expected traits in their students. And such training programme can also borrow leaflets from the EEM training provided for biology teachers using the validated Teachers' Instructional Guide (T.I.G.E). Other related educational programmes like organization of workshops and seminars which centre on EEM training on conservation will be of utmost benefit. Volk (1983) also stressed that if teachers are to use EE curricula effectively, they would need to be trained on how to use them. In addition, teachers also need training on how to adopt outdoor science activities as diverse and meaningful experiences to aid practice and application of knowledge to solve conservation issues and problems outside the classroom. The use of outdoor activities have been recommended by various educators or experts as enriching first-hand and real experiences of a child; (Lucko, et al, 1982; Sia, et al, 1985/86; Alexander, 1991) and can promote environmental sensitivity.

What are the implication of these findings for state and Federal Ministries of Education? Perhaps, the message of teaching effectiveness cannot be divulged from the accompanying facilities and instructional materials or aids. Much more is needed from the EE Units of the various Ministries in order to succeed in the various EE projects and fieldtrips or excursions to different places. For instance, while other avenues for raising funds can be sought (P.T.A.) for excursions, other necessary materials that need to be supplied or distributed to schools include various bins which can be tagged-'Paper Bins; Rubber Bins; Metal Bins; Bottle Bins; and various cardboards for adverts/notice board information, relevant pictures and posters that convey conservation-related messages. In addition, there is urgent need to revitalize the conservation clubs that are yet to take forms in several secondary schools. The various ascribed roles and projects can also acclamatize both science and non-science students to the process skills for resolving personal, school and community projects.

As regards the nature of continuous assessment desired for the existing curriculum, there is need to replace the Examination-oriented curriculum with the one that provides opportunity for creativity, problem-solving and specific solutions to specified conservation problems as included in EEM package. For example, the tree-planting exercise, flower-raising activities, burning of incinerators, etc are practical measures for protecting the environment.

Finally, the findings of this study which revealed the superiority of the EEM over the existing biology curriculum have implications for curriculum developers of our teacher education programmes, teacher-trainers and practising teachers. Therefore, there is need to revisit and redefine the content and methodology of the present teacher-education curricular packages. This act will encourage the delivery of foundational and instructional packages that are suitable for effective teaching and learning. And as stressed by Balogun, (1992), if such laudable programmes are properly implemented,

> ... they increase the possibilities of producing

more and more citizens who can think scientifically/ technologically adapt to changing environment, function effectively in society, participate and contribute positively to life in society.

5.5.3 RECOMMENDATIONS

Based on the findings of this study, the following recommendations are hereby advanced:

(A) To Curriculum Developers and Biology Teachers:

1. Environmental Education Module (EEM) is a viable instructional package which could be used by curriculum developers and secondary school biology teachers to promote students' cognitive achievement, develop their problem-solving capabilities and inculcate in them the right attitude to conserve our natural environment.
2. Since both male and female subjects benefitted from the EEM package, the package is also recommended for both sexes.
3. Biology teachers should strive hard to provide relevant fieldwork experiences related to specific conservation projects or activities for students by assigning students to various tasks in small groups and such routines can be rotated on weekly basis. Related tasks that can be assigned to them include

(i) Planting trees

(ii) Raising flowers

(iii) Gathering materials for recycling.

(iv) Emptying Bins

(v) Burning incinerators.

(vi) Poultry keeping/Rabbitry/Snailery, etc

(vii) Gardening or keeping school farms

viii Sewage Disposal

(ix) Energy Saving Team

(x) Water Purification

(xi) Noise-checkers

(xii) Conservation Club/Team

(4) Since the EEM package is subject major sensitive, teachers should extend more efforts in gearing up the motivational level, and involving the non-science biology students in more activities. Moreover, efforts should be made by teachers to integrate the process skills approach or Guided Discovery in imparting other EE concepts in arts-based disciplines like social studies, Religious Studies, Geography etc. The knowledge or experiences attained will serve as 'storage banks' for subsequent reference.

5. Teachers should endeavour to take students out on fieldtrips and excursions to industries, forest reserves, museums or zoos and other relevant places as

deemed fit inorder to attain first-hand experiences that can facilitate their critical and analytic thinking which can be applied to find solutions to conservation problems and issues.

6. Curriculum Developers should organise forum for incorporating the EEM package in biology curriculum and more efforts should be extended to restructure the existing curriculum to include specific evaluation questions, time allocation to fieldwork or laboratory activities and references for both students and teachers.
7. Curriculum experts should plan ahead to produce textual materials, teachers' guide (using T.I.G.E. as model) and workbooks or project-monitoring workbooks on EE concepts in Biology

(B) School Administrators.

All schools' principals/vice principals/heads of departments of various subjects should provide teachers with an imprest to cover the cost of transport for fieldtrips and other specific conservation projects, including the purchase of relevant materials like Dustbins or empty Cartons for collecting materials - papers, rubbers, metals etc. for recycling; cardboards which can be designed as informative posters to caution students' behaviours using checking instructions like 'stop Urinating Everywhere; Don't litter the environment with papers, bottles, nylons; etc.

In addition, other necessary materials for laboratory experiments and fieldwork should be supplied.

(C) The Tertiary Institutions

It is also recommended that all universities and colleges of education that train biology teachers should develop EEM related materials to which their prospective and practising biology teachers should be exposed.

Moreover, efforts should be extended by appropriate bodies to design EE related Curriculum or Courses for all teachers. Other related EE Courses for Bachelors Degree, Postgraduate Diploma, M.Ed etc can also be developed and integrated at tertiary levels. Such acts would go a long way to train teachers on how to promote the acquisition of EE knowledge, skills and attitudes in students.

(D) The Government.

The Federal and State ministries of education should organize workshops and Seminars on Environmental education - Awareness, Training, Evaluation, and ensure that every biology teacher attends at least one EE workshop or seminar every year. In addition, in-service training should be approved for the unqualified teachers in our secondary schools.

Furthermore, the Environmental Education Units of the Ministries should be sensitized and sponsored to monitor and coordinate the activities of conservation clubs in our secondary schools, with adequate record keeping, end of year activity or competition, or Essay Writing, or best conservation Project of the year; with adequate reinforcement for participants and prices/gifts for active biology teachers. Also, the EE units should be assisted in producing and diseminating relevant brochures, magazines, leaflets or manuscripts on EE in collaboration with National Conservation Foundation (NCF).

Moreover, the Federal and State governments should improve the working conditions of science teachers and upgrade the status of the teaching profession through appropriate incentives or introduction of EE allowance in order to boost the ego of the teachers in participating effectively in structured activities on conservation.

(E) Professional Associations/Bodies:

Professional bodies such as the Science Teachers Association of Nigeria (S.T.A.N); Nigerian Association for Educational Media and Technology (N.A.E.M.T); National

Educational Research and Development Council (N.E.R.D.C); Curriculum Organisation of Nigeria (C.O.N.) and Nigerian Association for Environmental Education (N.A.F.E.E.) should work out strategies to design Environmental Education Modules (E.E.M.) or curriculum materials in all the sciences for students at all levels of our educational system, from Primary, Junior Secondary, Senior Secondary and Tertiary institutions.

5.5.4 SUGGESTION FOR FURTHER RESEARCH.

From the findings of this investigation, the following areas are recommended for further investigation:

1. The study should be replicated in order to confirm or disconfirm the merits or otherwise of EEM curriculum and to determine the general applicability of the findings and implications to a wider population of secondary school students and teachers.
2. The influence of other factors apart from those considered in this study should be examined e.g. age, socio-economic background, location of schools (rural/urban) etc.
3. Longitudinal studies of the effect of EEM instruction on students' attainments to determine how much information was retained over a period of time.
4. In the light of the importance of transfer of learning

in education (Bruner, 1966), future investigation should determine how much of the knowledge is carried over into behaviour at home, and the level of impact such transference has on the respective parents both at home and inthe community.

5. Future research can also identify appropriate content, context, structure and practice for teaching other EE concepts in various disciplines (using the EEM as a model) and the targeted control measures for solving global problems at different ages/stages/levels, as they arise from time to time.
6. Other EE concepts apart from conservation can also be examined in relation to its adequacy in objectives, content, methods, organization and evaluation vis-a-vis its' impact on students' attainments e.g. Pollution; Population; Waste Management; etc.
7. Current research foci which can also be investigated in various disciplines, though multi-faceted, include
   - (i Gender and Youth roles in Natural Resource Management
   - (ii Coping Mechanism Against Environmental Degradation;
   - iii Environmental Impact Assessment -

Potential Instructional Models for possible integration in both science and social studies should be developed.

5.5.5 CONCLUSION

The study examined the impact of two curriculum packages in environmental education in Biology (Environmental Education and Conventional Modules), gender and subject specialization on students' cognitive achievement, problem-solving abilities and environmental attitudes.

The findings of the study include:

1. The EEM package to a large extent, succeeded in improving the students attainments at the three levels (as stated above).
2. The EEM package was found to be suitable and applicable to both male and female subjects.
3. The package (E.E.M.) was found to be subject major sensitive and can work consistently in improving the attainments of science students over their non-science counterparts.
4. No significant interactive effects of treatment and gender on students' attainments was obtained.

5(a) There were significant interactive effect of treatment and subject specialization on students' cognitive achievement and attitudes.

5(b) The students' achievement in problem-solving tasks was not significantly influenced by subject major.

6. No significant interacting effect of gender and subject specialization on students' attainments was obtained.

7. There was no significant interactive effect of treatment, gender and subject specialization on students' attainments.

From the above results, it is quite evident that EEM package is a realistic and deliberate attempt to change students from being mere recipients of knowledge or passive learners to being active participants in manual experiences/activities that can foster their love of nature and sense of responsibility towards it. Several conservation problems and issues of everyday life that beset individuals and our community require adequate knowledge of the causes, effects and control vis-a-vis the prompt practices or solutions applied from students' perspective. The teacher therefore becomes a facilitator of knowledge or skills acquisition through guided Discovery approach.

In essence, this study has proved that students' exposure to EEM package has improved their performance level more than the existing curriculum. This discovery may explain the nature of understanding or comprehension of the EEM package, and exposure to first hand experiences. Therefore, the need arises for teachers to ensure that learners are exposed to the real environment to interact and bring out their initiatives or creativity in solving pertinent conservation issues and problems. For instance, collection and purification of stream water; which involves gathering of data or information and processing it correctly to solve problems. This practice also calls for teachers commitments and training.

A well trained teacher on EE curriculum would have acquired the necessary experiences for developing the problem-solving capabilities in his learners. His full understanding of the basic human activities that tamper with the environment may be utilized in checking students' activities and inculcating in them the right attitudes toward environmental conservation. This act is also supported in UNESCO-UNEP (1987)'s recommendation no 59, which stressed that:

> Curriculum-development and teacher-training activities related to problem-solving, decision-making and environ mental attitudes should be given a priority

To this end, the EEM package has found refuge.

And since the 3-way interactive effect of gender, treatment and subject major on students' attainments was not significant, then it suggests the suitability of the EEM package for both sexes (male, female) and subject majors (science and non-science). The 2-way interactive effect found significant on the effect of science and non-science, only pointed out the need to enrich the package to sensitize more the non-science subjects in order to enhance their performance level. However, since the non-science students' exposed to the EEM package performed better than those students (science and non-science) not exposed, then the validity of EEM package as an achievement enhancing module is strongly confirmed. If such package can improve the performance of non-science subjects over the performance of control science and non-science, then, on this basis, the Environmental Education module is hereby recommended for teaching Conservation of Natural Resources in Biology, to facilitate better performance, development of problem-solving capabilities and the right attitude to conserve our natural environment, in the country's stride for sustainable development.

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APPENDIX I: DETAILS OF DISTRIBUTION OF ENVIRONMENTAL EDUCATION THEME/TOPICS IN BIOLOGY CURRICULUM.

ECOLOGICAL FOUNDATION	HUMAN ENVIRONMENT/ DEVELOPMENT	ENVIRONMENTAL CHANGE/IMPACT	SUSTAINABLE DEVELOPMENT
YEAR I (SSI) Biology and Living things Basic Ecological concepts Functional ecosystem a. Autotrophs and Heterotrophs b. Food webs and trophic level Micro organisms around us	YEAR I Nutrition (a) plant nutrition (b) animal nutrition (c) modes of nutrition	YEAR I Relevance of biology for Agriculture Energy transformations in nature Nutrient cycling in nature Pollution Micro-organisms in Action	YEAR I Ecological Management (a) Association (b) Tolerance (c) Adaptation Conservation of natural resources towards better life
YEAR 2 (SSII) The cell The cell and its Environment Some properties and functions of the cell Acquatic Habitat (a) Marine Habitat (b) Estuarine Habitat (c) Freshwateer Habitat Terrestrial Habitat (a) Marsh (b) Forest (c) Grassland (d) Arid lands	YEAR 2 Tissues & supporting system Digestive system Transport system respiratory system excretory systems (mechanism	YEAR 2 Ecology of populations (a) ecological succession (b) over-crowding (c) food-shortage	YEAR 2 Balance in nature
YEAR 3 (SSIII) Fruits	YEAR 3 Regulation of internal environment Nervous co-ordination sense organs Reproductive systems Reproductive behaviours Development of new organism Variation in populations	YEAR 3 Adaptation for survival	YEAR 3

APPENDIX II: DETAILS OF DISTRIBUTION OF INTENDED LEARNING OUTCOMES (ILO'S) AND PERCENTAGES.

RELATED ILOS				PERCENTAGE		
ECOLOGICAL FOUNDATION	K	A	S	K%	A%	S%
YEAR I (SSI)						
Bilogical and Living things	15	1	2	83.33	5.56	11.11
Basic Ecological Concepts	10	1	4	66.67	6.67	26.67
Functional Ecosystem						
(a) Autotrophs and Heterotrophs	3	-	-	100.%	0	0
(b) Food webs trophic level	7	-	1	87.5	0	12.50
Micro-organisms around us	4	1	-	80.00	20.00	0
YEAR 2 (SSII)						
The cell	6	-	3	66.67	0	33.33
The cell and its environment	-	4	2	-	66.67	33.33
Some properties and functions of the cell	17	3	5	68.0	12.0	20.0
Acquatic Habitat						
(a) Marine Habitat	4	-	1	80.00	-	20.0
(b) Estuarine Habitat	4	-	1	80.00	-	20.0
(c) Fresh water Habitat	3	-	3	50.0	-	50.0
Terrestrial Habitat						
(a) Marsh	3	-	2	60.00	-	40.00
(b) Forest	7	-	-	100	-	-
(c) Grassland	3	-	3	50.0	-	50.0
(d) Arid lands	4	-	-	100.00	-	-
YEAR 3 (SSIII)						
Fruits	4	-	4	50.0	-	50.0
TOTAL	94	10	31	135		
PERCENTAGE	69.63	7.41	22.96			

RELATED ILOS				PERCENTAGE OF ILOS		
HUMAN ENVIRONMENT/DEVELOPMENT	K	A	S	K%	A%	S%
YEAR I Nutrition						
(a) Plant Nutrition	7	-	-	100	-	-
(b) Animal Nutrition	6	-	1	85.71	-	14.29
(c) Modes of Nutrition	1	-	-	100	-	-
YEAR 2 (SSII)						
Tissues and supporting systems	5	-	3	62.5	-	37.5
Digestive System	4	-	-	100	-	-
Transport System	7	1	2	70.0	10.0	20.0
Respiratory System	5	-	1	83.33	-	16.67
Excretory system and Mechanism	2	-	-	100	-	-
YEAR 3 (SSIII)						
Regulation of Internal environment	13	-	6	68.42	-	31.58
Nervous Coordination	12	-	3	80.00	-	20.00
Sense organs	8	-	3	72.72	27.27	
Reproductive systems	8	-	2	80.00	20.0	
Reproductive behaviours	5	-	-	100	-	-
Development of new organism	9	-	8	52,94	-	47,06
Variations in population	2	2	50.0	-	-	50.00
Biology of Heredity (Genetics)	5	-	2	71.43	-	28.57
TOTAL	99	1	33	133		
PERCENTAGE	74.44	0.75	24.81			

TOPIC (IN BIOLOGY)	RELATED ILOS				PERCENTAGE OF ILOS		
ENVIRONMENTAL CHANGE/IMPACT		K	A	S	K%	A%	S%
YEAR I (SSI)							
Relevance of Biology to Agriculture	5	1	1	71.43	14.29	14.29	
Energy transformations in nature	3	-	-	100	-	-	
Nutrients cycling in nature	6	-	2	75	-	25	
Pollution	3	5	-	37.5	62.5	-	
Micro-organisms in Action	-	3	2	-	60.0	40.0	
YEAR 2 (SSII)							
Ecology of Populations							
(a) Ecological succession	6	-	1	85.71	-	14.29	
(b) over-crowding	4	-	-	100	-	-	
(c) Food-shortage	2	1	-	66.67	33.33	-	
YEAR 3 (SSIII)							
Adaptation for survival	10	1	4	66.67	6.67	26.67	
TOTAL	39	11	10	=	60		
PERCENTAGE	65.00	18.33	16.67				

	RELATED ILOS				PERCENTAGE OF ILOS		
SUSTAINABLE DEVELOPMENT		K	A	S	K%	A%	S%
YEAR I (SSI)							
Ecological Management							
(a) Association	1	1	1	33.33	33.33	33.33	
(b) Tolerance	-	1	-	-	100	-	
(c) Adaptation	2	1	-	66.67	33.33	-	
Conservation of natural resources	5	1	-	83.33	16.67	-	
Towards Better Life	5	1	-	83.33	16.67	-	
Balance in nature	4	1	1	66.67	16.67	-	
TOTAL	17	6	2	-	2	5	
PERCENTAGE	68.0	24.0	8.0				

APPENDIX III **DETAILS OF ANALYSIS OF ACTIVITIES IN BIOLOGY CURRICULUM.**

TOPIC IN BIOLOGY

ECOLOGICAL FOUNDATION	ACTIVITIES INDOORS	OUTDOOR
YEAR 1 (SSI)		
Biological and Living things	12	5
Basic Ecological Concepts	4	9
Functional Ecosystem		
(a) Autotrophs and heterotrophs	-	1
(b) Food webs and trophic level	3	1
Micro organisms around us	3	1
YEAR 2 (SSII)		
The cell		
The cell and its environment	3	-
Some properties and functions of the cell	24	0
Acquatic Habitat		
(a) marine Habitat	-	5
(b) Estuarinee Habitat	-	5
(c) fresh water habitat	-	8
Terrestrial Habitat		
(a) marsh	-	5
(b) Forest	-	5
(c) Grassland	-	5
(d) Arid lands	-	4
YEAR 3 (SSIII)		
Fruits	10	1
TOTAL	62	54
Percentage	53.45	46.55

HUMAN ENVIRONMENT/DEVELOPMENT	ACTIVITIES INDOOR	OUTDOOR
YEAR 1 (SSI)		
Nutrition		
(a) plant nutrition	14	-
(b) animal nutrition	4	-
(c) modes of nutrition	3	1
YEAR 2 (SSII)		
Tissues and supporting systems	11	-
Digestive System	5	-
Transport system	9	-
Respiratory system	4	-
Excretory systems and mechanism	3	-
YEAR 3 (SSIII)		
Regulation of internal environment	11	1
Nervous coordination	6	-
Sense organs	5	-
Reproductive systems	8	3
Reproductive behaviours	4	5
Development of new organism	6	3
Variations in populations	6	2
Biology of heredity (Genetics)	6	-
TOTAL	105	15
Percentage	87.5	12.5

TOPIC IN BIOLOGY

ENVIRONMENTAL CHANGE/IMPACT	ACTIVITIES INDOOR	OUTDOOR
YEAR I (SSI)		
Relevance of Biology to Agriculture	4	3
Energy transformations in nature	2	-
Nutrient cycling in nature	7	-
Pollution	4	1
Micro-organisms in action	4	1
YEAR 2 (SSII)		
Ecology of populations		
(a) Ecological succession	-	2
(b) Over crowding	3	-
(c) Food shortage	3	-
YEAR 3 (SSIII)		
Adaptation for survival	2	13
TOTAL	28	20
Percentage	58.33	41.67

SUSTAINABLE DEVELOPMENT	ACTIVITIES INDOOR	OUTDOOR
YEAR I (SSI)		
Ecological Management		
(a) Association	2	2
(b) Tolerance	1	1
(c) Adaptation	2	1
Conservation of natural resources	5	1
Towards Better Life	4	1
YEAR 2 (SSII)		
Balance in nature	2	1
TOTAL	16	6
Percentage	72.73	27.27

APPENDIX IV
A HEURISTIC OUTLINE OD E.E.M. CONTENT/TOPICS

	INTENDED LEARNING OUTCOMES (ILOS)						ACTIVITIES			
CONTENT/TOPIC	K	A	S	K%	A%	S%	In door 1	0	Outdoor 1%	0%
Conservation of Natural Resources	4	3	4	36.36	27.27	36.36	2	1	66.67	33.33
Conservation of Water	2	2	2	33.33	33.33	33.33	3	3	50.00	50.00
Conservation of Land	2	1	2	40.00	20.00	40.00	2	4	33.33	66.67
Conservation of Wildlife	2	1	2	40.00	20.00	40.00	1	3	25.00	75.00
Conservation of Forest	2	2	2	33.33	33.33	33.33	2	3	40.00	60.00
Conservation of Minerals/Rocks	1	2	2	20.00	40.00	40.00	2	1	66.67	33.33
Conservation of Animals	1	2	2	20.00	40.00	40.00	2	2	50.00	50.00
Conservation of Energy	3	1	2	50.00	16.67	33.33	2	2	50.00	50.00
TOTAL	19	15	20	35,19	27.04	37.04	18	22	45.00	55.00

APPENDIX Va. ENVIRONMENTAL EDUCATION MODULE IN BIOLOGY CURRICULUM (E. E.M)

UNIT	TOPIC	PERFORMANCE OBJECTIVES	CONTENT	METHODS/EXPLANATORY NOTES	TEACHING AIDS/MATERIALS	ACTIVITIES	PERIODS /WEEK	EVALUATION	ASSIGNMENT	REFERENCES
(A)	Conservation of Natural Resources (LESSON 1) LESSON 2 LESSON 3	Students should be able to 1. define conservation. 2. mention different techniques of conservation. 3. briefly describe natural resources. 4. identify and state examples of different resources in our environment. 5. classify the various resources named. 6. state the problems people create through careless use of the natural resources. 7. observe, record, gather, interprete and analyse data on environmental issues. 8. plan and apply action-oriented conservation activities. 9. enumerate agencies for conservation. 10. explain why various conservation laws should be obeyed. 11. state the need to conserve natural resources.	1. definition of conservation, preservation and exploitation. 2. techniques adopted in conservation:standardization, harnessing, expansion, restoration, recycling etc. 3. what is a Natural resource? 4. examples and types of natural resources renewable; recyclable etc. 5. Categories; plants; inorganic 6. problems of not conserving resources pollution; erosion; extinction/endangered species; depletion of resources etc. 7. benefits or values of conservation 8. agencies for conservation 9. conservation laws.	Guided discussion/ discovery A. take students for a walk around the school compound or environment. B. Guide students to define a resource as something that can be used.	Charts and pictures showing 1. various natural resources 2. method of conservation 3. the effect or consequences of lack of conservation	Students should be guided to 1. observe, identify and list the materials around the school compound/ environment (as they walk across). 2. define those things that are not made by people as natural resources e.g. matter or energy, soil, air, water, rocks, and surface etc. 3. classify resources into categories.	3	1. define conservation 2. what is a resource? 3. define the word technique 4. what are the techniques you can adopt in conservation? 5. list the different types of natural resources with examples. 6. name the different categories of resources. 7. what are the values or benefits derived from conservation?	The teacher should ask the students to 1. bring water from different sources in their local environment e.g. well, river, streams, ponds, rainwater, tap etc. 2. draw the diagram of water cycle to illustrate different states of water.	1. Fatubarin, A (1982): EE and the African Child STAN Journal, 2 (2) 2. Ndu, F.O.C et al (1989): Senior Secondary Biology pp 108-109 3. Soyibo, Kola et al (1989): Biology for Senior Sec. Schools p82-84.

UNIT	TOPIC	PERFORMANCE OBJECTIVES	CONTENT	METHODS/EXPLANATORY NOTES	TEACHING AIDS/MATERIALS	ACTIVITIES	PERIOD/ WEEK	EVALUATION	ASSIGNMENT	REFERENCES
(B)	Conservation of Water (LESSON 4) LESSON 5 LESSON 6	Students should be able to 1. define water conservation. 2. describe occurrence of water, the water cycle, impurities in water, uses of water, sources of water, water pollution etc. 3. state problems associated with water resources-availability/drought, contamination, diseases. 4. enumerate reasons or benefits of water conservation. 5. state methods of protecting water from pollutants.	1. Conservation of water 2(a) Occurrence of water (b) Water cycle (c) Impurities in water (d) Uses of water (e) Sources of water (f) Water Pollution 3. Problems associated with water pollution-causes and effects. 4. Benefits of Wateer Conservation . 5. Methods of oriteecting water from pollutants.	(A) Field trips and excursions (B) Guided discussion. 1. Ask students to bring out the samples of water collected from various sources, (label samples for clarification). 2. Guide students to use various methods e.g. filteration, boiling to remove impurities or sediments.	1. World maps to show the proportion of oceans/seas, lakes, rivers etc. 2. Pictures/photographs relevant on oil spillage into water and the effect. 3. Excursion or field-trips to a nearby pond or lake, or stream (where possible). 4. Filter paper for filteration of water. 5. Bunsen burner to boil filtered water. 6. Pictures of contaminated pond, well or river.	Using the water collected from various sources, students should a. compare and describe what they observed in it, b. use filteration method to separate the impurities. c. boil the filtered sample of water, after evaporation, check impurities left. 2. Using the world map students should draw a pie-chart on the proportions of water and where they exist. 3. Working in groups, students should carry out a survey on sources of water in their communities, and write a report on water contamination. 4. Students can be assigned group or individual projects, to (i) clear up the areas around a well or a spring, (ii) make posters to warn people from drinking contaminated water, (iii) make posters on how to make water safe for drinking (iv) display their posters all around in the community and on bulletin boards	3	1. describe conservation of water 2. what are the various uses of water for human beings? 3. How do you ensure adequate availability of supply of water in a community? 4. what policy guidelines can be used to harness the existing and potential water resources in a community? 5. What are the existing control uses that can guarantee availability of water for sustainable development? 6. What are the possible solution to the problem of (a) Water availability? (b) Water contamination? (c) Water diseases? 7. Enumerate your contributions in water conservation activities in your community.	Students should (a) complete their assigned projects. (b) submit a report on water conservation in their communities. (c) survey land-use activities in their communities, observe and record the various uses of the land.	(1) Ndu, F.O.C. et al (1989) Senior Secondary Biology, pp 106. (2) Soper, R. Tyrell Smith, S. (1986) Modern Human and Social Biology, pp.310-316. (3) Soyibo, Kola et al (1989), Biology for Senior Secondary Schools, pp80-81, 85. (4) Journal Articles e.g. Birch, S.K. Schwaab, K.E. (1983). The Effects of Water Conservation Instruction on Seventh-Grade Students. Journal of EE, 14 (4), 16-31.

UNIT	TOPIC	PERFORMANCE OBJECTIVES	CONTENT	METHODS/EXPLANATORY NOTES	TEACHING AIDS/MATERIALS	ACTIVITIES	PERIODS/ WEEKLY	EVALUATION	ASSIGNMENT	REFERENCES
(C)	Conservation of Land LESSON 7 LESSON 8	Students should be able to 1. describe conservation of land 2. state the various uses of the land 3. describe the effects of bush clearing, over burning, tillage, fertilizers/herbicides and pasticides, over-grazing, over-cropping, devegetation, desertification and erosion on the ecological system. 4. suggest possible solutions to the problems identified. 5. discuss the findings of the survey conducted.	1. Brief description of conservation of land. 2. Various uses of the land, for (a) cultivation of crops (b) Rearing of animals (c) Building shelter/industries/infrastructures. 3. Problems associated with land use - Erosion, desertification, land pollution, over-grazing, over-burning, over-cropping, devegetation etc. 4. Suggested solutions. 5. Soil conservation measures.	(A) Guided Discovery-Teachers and students can undertake a fieldtrip to 1. Agricultural land 2. Range land 3. Settlements 4. Quarrying and mining land (B) Guided Discussion - In groups, students should be guided to discuss solutions to identified problems on land use	Charts and pictures showing 1. the effects of erosion on the land 2. various agricultural practices on the land.	Students should visit places where land is being used, should observe and record (i) the various uses of the land (ii) problems associated with land use, and (iii) possible solutions. 2. Students should be involved in planting trees and flowers around the compound. 3. Students should prepare a micropilot garden in group of 4,5 or 6.	2	1. Briefly describe conservation of land. 2. State the various uses of the land. 3. Outline the problems associated with land use in your community 4. Mention possible solutions to the identified problems. 5. Discuss the various soil conservation measures that can be adopted in your community.	Students should 1. tabulate the various problems associated to land - their causes, effects and possible solutions. 2, work in groups to list the uses of trees wood in their surroundings classroom school, home and community. 3. compile the list of the various forest and game reserves in the country.	(1) Ndu, F.O.C. et al (1989). Senior Sec. Biology, Ibadan: Longman Nigeria Ltd. pp. 107-108, H.O. (2) Soyibo, Kola et al (1989): Biology for Senior Sec. Schools. Ikeja. Lagos: Nelson Publishers, Ltd. pp. 81. (3) Carin, A.A. and Sund, R.B. (1975): Teaching Science through Discovery. Merril Publishing Co.

UNIT	TOPIC	PERFORMANCE OBJECTIVES	CONTENT	METHODS/EXPLANATORY NOTES	TEACHING AIDS/MATERIALS	ACTIVITIES	PERIOD/ WEEK	EVALUATION	ASSIGNMENT	REFERENCES
(D)	Conservation of forest (LESSON 9)	Students should be able to 1. describe conservation of forest 2. list the various uses of trees (wood) and in (i) the classroom (ii) the school and (iii) the surrounding community. 3. state the values/benefits of forests. 4. identify any problem related to exploitation of forests. 5. describe various ways of conserving forests. 6. enumerate different examples of forest reserves in the country.	1. Conservation of forest 2(a) various uses of trees (wood) 3. The values/benefits of forests 4. Problems related to exploitation of forests 5. Ways of conserving forests 6. Examples of forest reserves in Nigeria.	(A) undertake a planned visitation (with students) to 1. nearby forest in the community that is safe. 2. forest reserve nearest to the school. (B) The teacher can set up a debate or essay work on the values of forest to the community (for students).	(A) pictures of forest reserves with various animals and plants, etc. can be used. (B) School items made of wood can also be used.	During visitation to the forest reserves or nearby forest, students should observe and record. 1. the various things obtainable in the forests. 2. the values of forests 3. related problems and solutions.	1	1. describe conservation of forest 2. state the local uses of trees in the (i) classroom (ii) school, and (iii) surrounding community 3. Outline the values benefits of forests. 4. Enumerate possible problems associated with exploitation of forests. 5. What are the possible solutions to the identified problems? 6. Mention different ways of conserving a forest. 7. Name different examples of forest reserves in Nigeria.	Students should 1. list examples of game reserves in Nigeria. 2. Outline the values of wildlife conservation to a community.	(1) Soyibo, Kola et al (1989): Biology for Senior Sec. Schools. Lagos: Nelson Publishers Ltd. pp. 83-84. (2) Ndu, F.O.C. et al (1989): Senior Sec. Biology Ibadan: Longman Nigeria Ltd. pp. 108-109, III. (3) Journal Articles e.g. (4) Ajewole, G.A. (1990): Effects of Guided Discovery and Expository Instructional methods on students' transfer of learning. STAN Journal 26 (2), 59-66.

ENVIRONMENTAL EDUCATION MODULEE IN BIOLOGY (E. E.M.)

UNIT	TOPIC	PERFORMANCE OBJECTIVES	CONTENT	METHODS/EXPLANATORY NOTES	TEACHING AIDS/MATERIALS	ACTIVITIES	PERIOD/ WEEK	EVALUATION	ASSIGNMENT	REFERENCES
(E)	Conservation of Land LESSON 10 LESSON 11	Students should be able to 1. define wildlife conservation 2. identify various uses of animals in both homes and the community 3. state the three major objectives of the world conservation strategy initiated in 1980. 4. describe the various efforts extended by Nigerian Government to conserve wildlife. Use of decrees or legislations). 5. identify wildlife problems and solutions. 6. state the values or benefits of wildlife conservation.	1. What is wildlife conservation? 2. The uses of animals 3. Objectives of world conservation strategy. 4. Government efforts on wildlife conservation in Nigeria. 5. Wildlife problems and possible solutions e.g. game poaching, bush fire, illegal grazing etc. 6. Benefits of wildlife conservation.	(A) Guided Discovery (B) Guided discussion. The teacher can plan a visit (with students to a (i) game reserve (ii) zoological garden.	Charts and pictures of different wildlife in their natural habitat	During visitation, students should observe and record 1. examples of wildlife obtainable or seen 2. values of the wildlife 3. Wildlife problems and possible solutions. 4. Ways of conserving wildlife.	2	1. what is wildlife conservation? 2. What are the various uses of animals in the community? 3. Mention the three major objectives of world conservation strategy. 4. Discuss the various efforts extended by the Nigerian government to conserve wildlife. 5. What are the values or benefits of wildlife? 6. State the associated problems with wildlife. 7. Identify ways of breeding endangered species in protected areas.	Students should write an essay on air pollution, associated problems and solutions.	Soper, R and Tyrell Smith, S. (1986) Modern Human and Social Biology. Hong-kong: Macmillan Education Ltd., pp.317-318. (2) Ndu, F.O.C. et al (1989) Senior Sec. Biology. Ibadan: Longman Nig. Ltd. pp. 108 (3) Ajewole, G.A. (1991): Strategies for effective teaching of EE in Schools. EE Workshop and Seminar Proceedings, N.C.F/WWF, Vol. 1, 107-116. (4) Journal Articles.

UNIT	TOPIC	PERFORMANCE OBJECTIVES	CONTENT	METHODS/EXPLANATORY NOTES	TEACHING AIDS/MATERIALS	ACTIVITIES	PERIOD/ WEEK	EVALUATION	ASSIGNMENT	REFERENCES
(F)	Conservation of Air LESSON 12 LESSON 11	Students should be able to 1. define conservation of air 2. state the benefits of air 3. identify the various components of the air and other polluting substances found in the air. 4. describe associated problems with air pollution. 5. enumerate possible solutions and Nigerian government's measures on air conservation.	1. Conservation of Air 2. Benefits or values of Air 3. Components of the Air 4. Polluting substances in the Air. 5. Associated problems with air pollution. 6. Possible solutions 7. Government's Measures	(A) Guided Discusion. (B) Guided discovery (C) The teacher can organise a field trips with students to any of the following places: 1. Industries 2. Factories 3. Breweries 4. Refineries 5. mechanic workshops 6. Petroleum industries 7. Cafetaria/kitchen using firewood.	Charts and pictures of industries, Breweries, refineries, mechanic workshops etc.	Students should visit a nearby industry, mechanic workshop, factory and should observe and record. 1. the colour of the smoke released into the air. 2. the odour of the gas/smoke 3. associated problems as indicated amongst those living around the place, working in the industry workshop. 4. Perform experiments to verify the various components of the air and their uses.	1	1. Describe conservation of air 2. State the benefits/values of air. 3. Enumerate the different components of the air 4. List the various pollutants in the air 5. What are the associated problems with air pollution 6. Identify various ways of conserving air 7. What are the various measures government adopts to conserve air?	Students should visit a nearby mining area where activities occur, and should observe and record - 1. examples of minerals/rocks extracted 2. associated effects 3. possible solutions to control the effects and impacts.	(1) Ndu, F.O.C. et al (1989): Senior Sec. Biology Ibadan: Longman Nig. Ltd. pp.105, 109, (2) Soper, R and Tyrell Smith, S. (1986). Modern Human and Social Biology Hong-kong: Macmillan Education Ltd., pp309 -310. (3) Soyibo, Kola, et al (1989): Biology for Senior Sec. Schl. Lagos; Nelson Publishers Ltd, pp78-80, (4) Journal Articles.

UNIT	TOPIC	PERFORMANCE OBJECTIVES	CONTENT	METHODS/EXPLANATORY NOTES	TEACHING AIDS/MATERIALS	ACTIVITIES	PERIOD /WEEK	EVALUATION	ASSIGNMENT	REFERENCES
(G)	Conservation of minerals/rocks (LESSON 13)	Students should identify areas of different minerals on the map of Nigeria, or visit a mining area, and should be able to 1. describe reasons for conserving minerals/rocks. 2. name examples of minerals/ rocks that can be conserved. 3. identify the associated effects and specific impacts of some mining activities. 4. profer solutions to reduce or control the effects/problems. 5. state why minerals are non-renewable resources.	1. conservation of minerals/rocks. 2. reasons for conserving minerals. 3. associated effects and specific impacts of some mining activities. - Exploration - Mineral extraction - processing transportation, storage and consumption. 4. solutions to reduce/control the effects/impacts.	(A) Guided discovery/discussion (B) Fieldtrip/excursions. Planned visitation to 1. Mining industries where students can see examples of mineral e.g. coal, gold, petroleum, tin-ore, limestone etc. 2. Rocky sitee where extraction activities take place.	Charts, maps showing the geographical locations of minerals/rocks. Field trips/excursions to extraction sites. Real specimens of minerals/rocks extracted e.g. Alums/limestone, marble, etc.	During visitations, students should observe and record 1. examples of minerals/ rocks found at the site. 2. the associated problems of some mining activities. 3. probable solutions to control the effects/problems.	1	1. what are the reasons for conserving minerals/rocks? 2. Give examples of minerals/rocks that can be conserved. 3. State the benefits of these minerals. 4. Tabulate the associated effects and specific impacts of some mining activities. 5. What solutions would you proffer to control the effects?	Students should visit (in groups or individual) any of the following places: 1. poultry 2. rabbitry 3. snailery 4. Fish pond etc. and should observe and record; (a) associated values (b) related problems (c) control measures.'	(1) Soper, R. & Tyrell Smith, S. (1986). Modern Human and Social Biology pp318. (2) Ndu, F.O.C et al (1989). Senior Sec. Biology Longman Nig. Ltd. pp. 110. (3) Soyibo, Kola et al (1989). Biology for senior Sec. School Nelson Publishers Ltd. p.81. (4) Journal Articles

UNIT	TOPIC	PERFORMANCE OBJECTIVES	CONTENTS	METHODS/EXPLANATORY NOTES	TEACHING AIDS/MATERIALS	ACTIVITIES	PERIOD /WEEK	EVALUATION	ASSIGNMENT	REFERENCES
(H)	Conservation of Animals (fish, animals husbandry, control of (insects etc. (LESSON 14) (LESSON 15)	Students should be able to 1. describe conservation of domestic animals, fish, etc. 2. state the benefits or values of such animals to man and the society. 3. identify ways of conserving different types of animals e.g. poultry, rabbitry etc. 4. describe associated problems with such conservation measures. 5. name probable solutions to control and solve the specified problems	1. conservation of Animals. 2. benefits or values of animals. (domestic, fish etc). 3. ways of conserving different types of animals- poultry, rabbitry, snailery, fish ponds, etc. 4. associated problems with animal conservation. 5. solutions to control and solve the problems. - control of pests, insects, diseases etc. - vaccination.	(A) Guided discovery. (B) Field trips. A visit can be arranged by the teacher for students, to different sites where animals are reared/bred e.g. poultry, rabbitry, fishpond, snailery (in zoological gardens).	1. Field trips to real sites of poultry, rabbitry, zoological gardens. 2. pictures of a poultry, rabbitry or animals caged/kept. 3. real specimen/materials e.g. eggs.	During visitation, students should observe and record 1. ways of conserving different types of animals. 2. associated problems with such conservation. 3. control measures adopted at different sites.	2	**1. describe conservation of animals.** **2. enumerate the benefits and economic values of such animals.** **3. briefly outline the various types of conservation method** **4. discuss how the associated problems can be solved or controlled.**	students should observe from their immediate environment the different types of energy and should record: 1. ways of conserving the energy. 2. alternative energy sources.	(1) Ndu, F.O.C. et al (1989). Senior Sec. Biology Ibadan; Longman Nig. Ltd. pp. 111. (2) Okebukola, P.A.O. (1990). Elements of EE in Senior Sec. Schl Biology, EE Workshop & Seminar Proceedings, 1, 35-37. (3) Cross, R.T. & Price, R.F. (1992). Teaching Science for Social Responsibility. St. Louis Press.

UNIT	TOPIC	PERFORMANCE OBJECTIVES	CONTENTS	METHODS/EXPLANATORY NOTES	TEACHING AIDS/MATERIALS	ACTIVITIES	PERIOD S/WEEK	EVALUATION	ASSIGNMENT	REFERENCES
(I)	Conservation of energy. (LESSON 16) (LESSON 17) (LESSON 18)	Students should be able to 1. define conservation of energy. 2. state the various types of energy available for man's use in his environment. 3. state the negative environmental impacts of different energy systems. 4. identify causes and impacts of energy crisis. 5. discuss the various approach to energy conservation. 6. enumerate the benefits of conserving energy. 7. outline various ways of saving energy at home, in automobiles and in the community.	1. what is conservation of energy? 2. Forms/types of energy geothermal; solar; hydroelectric; nuclear; wood; coal; natural; petroleum; etc. 3. negative environmental impacts of energy system. 4. causes and impacts of energy crisis. 5. energy conservation measures. - benefits/values of conserving energy. - saving energy.	(A) Guided discovery. (B) Fieldtrip/excursion planned visitation with students to either of the following places - 1. Dams 2. Petroleum station 3. NEPA station.	(A) Relevant pictures, charts of (a) Dams, gas-cooker/ cyclinder. (b) Horse pulling a load or camel loaded with goods. (B) Use of solar computing calculator/use of the sun to dry food items, like melons, pepper, etc. (C) Collection of firewood for burning (heat energy). (D) Real specimens-automobiles, grinder etc.	Students should observe from their homes and community, and record 1. the various forms of energy available. 2. degree of sustainability of the various forms of energy. 3. ways (practices) of conserving energy.	3	1. what is conservation of energy? 2. state the various forms of energy available to man. 3. what is the degree of sustainability of the forms of energy? 4. what are the approches to energy conservation? 5. state the importance of sourcing for alternative energy to promote sustainability.	students should write an essay on how to save energy at 1. home 2. school, and 3. the community	(1) Lawal, M.B. et al (1995). Education for sustainable Development. Module 4, NCF. (2) Rockcastle, V. (1991). Researching Energy and Water Use at Home. Nature Study 44(4). 16. (3) Journal Articles (a) Jimenez-Aleixandre, M.P. et al (1995) Let's save Energy. Incorporating an EE dimension in the teaching of Energy. EE Research 1 (1) 75-83. (b) Strickland, M.P. et al (1983184). Pre-test and post test Comparisons of Preschool Children's knowledge About Energy. Journal of EE, 15 (2), 32-35.

APPENDIX Vb DIFFERENCE BETWEEN THE CONVENTIONAL AND EEM PACKAGE

COMPONENTS OF A CURRICULUM	(CONVENTIONAL CURRICULUM	(EEM PACKAGE)
(1) Aims, goals and objectives	Outdated, few objectives on attitude and skills, that can enable the learner to embark on resolution of Environmental problems.	Current, in line with EE goals and objectives. and balanced or spread for knowledge, attitude and skills.
(2) Selection of learning experiences and content	Topics are scattered but covered as conservation of Natural resources. Content reflects causes and effects but no control measures.	Topics taught before are brought forward, organised, and causes, effects and control measures included for each environmental issues and problems.
(3) Selection of Methods	Very few outdoor activities are specified, but more indoor activities, teaching, conservation without first hand experiences from the environment	Balanced Indoor and Outdoor activities which can enable learners, thro' practice, to acquire the real experiences from the environment.
(4) Organization and Integration of learning experiences and content	Did not foster unity or correlation, or links between the various topics, and no sequence (not coherent), but topics presented as isolated facts and ideas	fostered unity/, correlation links (between the various topics, and sequence, (step by step), from known to unknown, previous knowledge to new one, and facts and ideas are linked with specific envtal. actions.
(5) Evaluation	No Evaluation questions	Specific evaluation questions that are consistent comprehensive relevant, objective, valid and realiable, in line with the stated performance objectives and content taught.
OTHER DIFFERENCES (6) Time-Schedule	No specific time allocated to each topic	specific time is allocated to each topic.
(7) References	None attached	Sources of information enclosed include journals, text books, magazines etc.

APPENDIX Vc SPECIFIC DIFFERENCES IN TOPICS COVERED BETWEEN THE CONVENTIONAL AND EEM CURRICULA

TOPICS	(CONVENTIONAL CURRICULA)	(EEM)
(1) Conservation of Natural Resources (introduction or overview)	Brief summary - definitions	Introduction/summary-definitions, techniques, examples, categories, benefits/values, problems, agencies, laws.
(2) Conservation of land	Reasons for protecting land from destruction and extinction	Brief description various uses of land, problems associated with land use, control- suggested solutions, soil conservation measures.
(3) Conservation of Wildlife	Reasons for protecting wildlife from destruction and extinction	Description, uses of animals, objectives of world conservational strategy, govt. efforts, problems, possible solutions/control, benefits.
(4) Conservation of Water	None (treated before under "water pollution" and nothing on its conservation. - Types and composition of pollutants/oil spillage - side effects	Description; occurrence of water, water cycle, impurities in water, uses, sources and its pollution, problems of water pollution - causes and effects; benefits; control measures.
(5) conservation of forest	None (treated before under forest, - characteristics of a forest, strata, Distribution of plants and animals in a forest, adaptative features of plants and animals. Nothing on its conservation.	Description; Uses of trees; values or benefits of forest; problems related to Exploitation of forest; Ways of conserving forests; Examples of forest Reserves.
(6) Conservation of Air	None (treated before as "pollution, of the atmosphere" - Nature, names and sources of air pollutants - Effects of noise	Description, Benefits/values of air, its' components; polluting substances in the air, problems of air pollution, possible solutions and control, government's measures.
(7) Conservation of Minerals/Rocks	The need to conserve petroleum and natural gas - why various conservation laws should be obeyed - problems and difficulties associated with oil spillage, exploitation of minerals.	Description, Reasons for conserving minerals, associated effects and specific impacts of some mining activities, solutions to reduce/control the effects of impacts.
(8) Conservation of Animals fish, animal husbandry, control of pests/insects etc.	none (but treated before under ecological studies - distribution of animals in their respective habitats on land	Description, benefits or values of animals (domestic, fish etc)., ways of conserving different types of poultry, rabbitry, snailery, fish bond; associateed problems, solutions to control and solve the problems; control of pests, insects, diseases etc; vaccination.
(9) Conservation of Energy	None (on conservation) but treated as - Benefits of conservation - Agencies responsible for conservation.	Description/meaning; forms or types of energy; negative environmental impacts of energy system; causes and impacts of energy crisis; energy conservation measures/control; benefits/values of conserving energy; saving energy.

APPENDIX VIa

TEACHER'S INSTRUCTIONAL GUIDE FOR E. E. M. (T. I. G. E)
TOPIC: Conservation of Natural Resources
OBJECTIVES: At the end of the lesson, students should be able to:
1. define the concept
2. enumerate associated problems and inherent values/benefits
3. observe, record, gather, interpret and analyse data on environmental issues.
4. plan and apply action-oriented conservation activities.
5. state the need to conserve natural resources.

PREVIOUS KNOWLEDGE: The students have acquired general knowledge/meaning of each of the resources.
DURATION: 40mins.
TEACHING AIDS: Charts and pictures showing:
- i the various natural resources
- ii associated problems-Erosion, contaminated ponds etc, and
- iii methods of conservation.

PRESENTATION:
STEP I: INTRODUCTION: The teacher should
1. State the topic
2. identify sub-topics/concepts/sub-concepts
3. list instructional objectives
4. Link new topic with previous knowledge or experience using related questions
5. Ask relevant questions to introduce the new topic.

STEP II: PRESENTATION OF THEORETICAL BASE/CONTENT
State information on topic in form of discussions specifying definitions, description of concepts, benefits or values inherent and associated problems.
STEP III: STRATEGY IMPLEMENTATION
1. Carry out practical, and pose a problem to be investigated by individual students or in groups
2. Let there by a discussion of problems or issues posed
3. Use relevant questions to direct students in the process, step by step.
4. Allow students to suggest/prefer solutions or

conservation measures

5. Discuss the inherent values/benefits of the concept using their immediate environment.

STEP IV: RECIPROCATIVE ACTIVITIES/STUDENTS' ACTIVITIES

1. Ask relevant questions on the concept
2. Allow students' discussion to evaluate their level of comprehension and assimilation.

STEP V: SUMMARY OF CONTENT

Bring all the points together in order to provide an overview

EVALUATION: The teacher asks the students specific questions that relate to

1. definition of concepts,
2. enumeration of associated problems and inherent values/benefits
3. Identification of new knowledge gained.

ASSIGNMENT: Give class assignment, score performance, allow students to initiate alternative procedure for solving problems.

APPENDIX VIb

GUIDELINES FOR EVALUATING PERFORMANCE IN THE USE OF THE E.E.M. AND T.L.G.E

STRATEGIES INVOLVED	V.G 5	G 4	AV 3	P 2	V.P 1
I. INTRODUCTION 1. Use of Questioning techniques 2. Ability to link new topic with previous knowledge 3. definition of concept/sub-concept II. PRESENTATION OF THEORETICAL BASE/CONTENT 1. Description of concept/sub-concept 2. Presentation of inherent benefits/values 3. Examination of associated problems i. Defining the problem/Issue. ii. Stating associated factors contributing to the issue. 4. Use of the teaching Aids. i. Suitability (how appropriate it is to the concept discussed) ii. Utility (effective utilization of the aids). III. STRATEGY IMPLEMENTATION 1. Directing students to carry out individual investigation/or in groups 2. Initiating ideas in students, in discussing the posed problems or issues. 3. Motivating students to suggest or prefer solutions or conservation measures. 4. Organising the inherent values or benefits of the concept. RECIPROCATIVE ACTIVITIES 1. Ability to assist students in: a. organising the data collected b. classifying the data c. drawing inferences & conclusions					

STRATEGIES INVOLVED	V.G 5	G 4	Av 3	P 2	V. P 1
SUMMARY OF CONTENT 1. Summarising the content of the concept 2. Condensing student. findings 3. Stating Decisions/suggested solutions IV EVALUATION 1. Use of relevant questions on the concept 2. Allowing students' discussion clarification 3. Enumeration of associated problems vis-a-vis the suggested solutions 4. Identification of new knowledge gained/ values/benefits ASSIGNMENT 1. Use of relevant assignment involving students' investigation/ exploration 2. Making values judgement/scoring of students' performance. KEY: VG= Very good, G= good, AV = Average P = Poor, VP = Very Poor					

APPENDIX VIIa

TEST ON ENVIRONMENTAL CONSERVATION KNOWLEDGE IN BIOLOGY (T.E.C.K)

SECTION A: PERSONAL/DEMOGRAPHIC DATA

(i) Name of Student: ....

(ii) Sex: Male [ ] ; Female [ ]

(iii) Type of School:
single Sex: Boys only [ ] ; Girls only [ ]
Coeducational/Mixed: [ ]

(iv) Religion: Christian [ ] ; Moslem [ ]
Others (specify)------------------------------

(v) Age: Below 15 years [ ] ; 15-18 years [ ]
above 18 years [ ]

(vi) Science subjects studied: Tick as appropriate
Biology [ ]; Chemistry [ ]; Physics [ ]
Agricultural science [ ]

(vii) (a) Father's occupation:--------------------
(b) Mother's occupation:--------------------

(viii) (a) Father's monthly income:------------------
(b) Mother's monthly income:------------------

Tick as applicable
Science major[ ] ; Non-science major [ ]

SECTION B: TEST ON ENVIRONMENTAL CONSERVATION KNOWLEDGE IN BIOLOGY (T.E.C.K.)

The statements below are about environmental conservation concept in Biology. Please read each statement carefully and respond in the spaces provided under AGREE, DISAGREE, OR NO OPINION Column, by circulating the appropriate column. Please choose only one option out of the three options for each statement. This test also include completion of expression and multiple choice/objective test items.

INSTRUCTIONS:

(a) Answer <u>all</u> questions
(b) Please <u>do not</u> write anything on these question sheets.
(c) Do all the answering on the ANSWER SHEETS provided
(d) At the end, return the question sheets with the answer sheets.

S/N	STATEMENT	Yes	No
1.	The best definition of ' Conservation is "the wise use of a resource"		
2.	The ultimate goal of preservation is protecting a resources by abstaining from using it.		
3.	A medicinal/health values of conservation include provision of a wide range of chemicals, medicine and vaccines from some plant species for curing ailments and improving the quality of human's life.		
4.	Conservation of water is a way of using water carelessly		
5.	Surface water cannot be polluted through deposition of human urine, faeces, rubbish and excessive chemicals.		
6.	Ground water cannot be polluted by fetching water with unsafe containers or when trapped domestic animals fall inside it.		
7.	Poor land management due to various human activities cannot cause soil erosion.		
8.	Overstocking of land with grazing animals like goats, sheep and cattle cannot make the soil bare or pruned to erosion.		
9.	Setting forest on fire or bush burning cannot render the soil infertile.		
10.	Wildlife conservation is the protection or preservation of wildlife from destruction.		
11.	Conservation of air is the protection and preservation of air in a way that it can sustain life and improve health and vitality.		
12.	Noise from radio, T.V. set/sound system, vehicle horns, broken silencer of vehicles, griding mills and electrical generator can never pollute		

13.	The smoke from vehicles, machines grinder and burning tyre or firewood/sawdust has no adverse effects on human body.	Yes	No
14.	Minerals are examples of non-renewable resources.		
15.	If minerals are over-expoloilted they can never be easily exhausted.		
16.	Conservation of animals is the protection and prevention of animals from danger, illness and untimely death in order to sustain their development for human benefits.		
17.	Constant use of wood as a major local source of energy has adverse effects such as desertifivatiom soil erosion and land degradation.		

18. ..... .is a method adopted in conservation, where a resource is processed to make it re-usable.
    (A) recycling (B) Restoration (C) Harnessing
    (D) Standardization
19. Soil nutrients that can be restored through application of fertilisers and proper management, is an example of
    (A) renewable resource (B) Non-renewable resource
    (c) Inexhaustible item (D) Recyclable item.
20. Minerals like coal, gas, petroleum, gold and diamond exist in limited amounts that are often used more than they are formed are examples of resources.
    (A) Renewable (B) restoration (c) Recyclable (D) Non-renewable.
21. Water pollution resoulting form impurities or contamination can cause diseases such as
    (A) Typhoid (B) Malaria fever (C) Sneezing
    (D) Coughing

Choose between (A) to (B) to answer questions 28 - 30.
    (A) Extinct (B) Endangered species
    (C) Threatened (D) Hunted.
22. When an animal stops living on the earth and can only be seen in pictures or heard in stories, then it is

23. Those animals that are fast disappearing are referred to as
24. Those wild animals hunted so seriously that their numbers are declining fast (even though not extinct) are called
25. The presence of toxic substances in the atmosphere inreferred to as (A) Land pollution (B) Water pollution (C) Air pollution (D) Lithosphere.
26. Possible effect (s) of air pollution on human body include
    (A) Headaches (B) Nausea and vomiting
    (C) Lung cancer (D) All of the Above (A, B, C,)
27. The benefits or values of minerals extracted include all of the following except
    (A) For body adornment
    (B) Fabrication of weapons
    (C) Generation of power and energy
    (D) Production of human protein
28. The mining of certain minerals has also resulted in various forms of land degradation examples of which are indicated below, except
    A. disruption of drainage systems
    B. deforestation
    c. land exhaustion
    D. contamination of water-table.
29. The benefits or values of animal conservation include all of the following except
    a. for food, as source of protein
    b. economic values
    c. susceptibility to diseases
    d. for scientific studies.
30. The associated problems with animals conservation include all of the following except
    a. pests and diseases
    b. Deforestation
    c. overgrazing/soil erosion
    d. Availability for dissection in Histological studies.
31. Other sources of energy with various negative environmental impacts include
    a. Hydroelectricity
    b. Thermal electricity
    c. Nuclear electricity
    d. Fossil fuels combustion

e. All of the above (A,B.C. E)

32. Read the following associated problems with animal conservation them match the lettered categories of possible solutions/control measures as appropriate with each of the stated problems.

.....1. To kill rats	(A)	Insecticides
.....2. To control diseases	(B)	Pesticides
.....3. To subsidize food for dogs or cats	(C)	Vaccination
.....4. For eliminating mosquitoes	(D)	Human wastes
	(E)	Injections

33. Energy obtained form the radiations of the sun either in heat or light form is referred to as -----
34. The energy of lowing and falling water is referred to as----
35. The heat energy produced when rocks lying below the earth's surface are heated to a high temperature is referred to as-----
36. Enumerate
    a. two achievements of Nigeria conservation foundation in propagating environmental education in schools.
    b. two environment problems in nigeria that calls for immediate attention.
    c. two activities of the government in sustaining our environment.
    d. two conservation laws or Decrees.
37. List two water conservation measures you can adopt.
38. Name one governmental or non-governmental organisation improving water supply in Nigeria.
39. List two soil conservation measures you can adopt.
40. List two values of forests.
41. Enumerate two problems associated with exploitation of forest
42. Name two ways of conserving forests
43. Give an example of forest reserve in Nigeria
44. List two values of wildlife conservation
45. Mention two wildlife problems
46. enumerate two wildlife conservation measures
47. Mention two measures adopted by government on air conservation.
48. Mention two ways of eliminating the general effects and specific impacts of quarrying and mining activities

49. Name five conservation measures for animals.
50. Mention two ways of saving energy directly
    a. at home
    b. in automobiles
    c. in the commodity.

APPENDIX VIIb

ANSWER SHEET FOR TEST ON ENVIRONMENTAL CONSERVATION KNOWLEDGE IN BIOLOGY (T.E.C.K.)

SECTION A: PERSONAL/DEMOGRAPHIC DATA

(i) Name of Student:-----------------------------------
(ii) Sex: Male [ ] Female [ ]
(iii) Type of school:
Single Sex: Boys only [ ] Girls only [ ]
coeducational/Mixed [ ]
(iv) Religion: Christian [ ] Moslem [ ]
Others (specify)-------------------------
(v) Age: Below 15 years [ ] above 18 [ ]
(vi) Science subjects studied: Tick as appropriate
Biology [ ] Chemistry [ ] Physics [ ]
(vii) (a) Father's occupation:-----------------------
(b) Mother,s occupation:-----------------------
(vii) (a) Father's monthly income:------------------
(b) Mother's monthly income:------------------

Tick as applicable
science major [ ] Non-Science major [ ]

S/N	STATEMENT	YES	NO	S/N	STATEMENT	YES	NO
	1	1	0		10	1	0
	2	1	0		11	1	0
	3	1	0		12	1	0
	4	1	0		13	1	0
	5	1	0		14	1	0
	6	1	0		15	1	0
	7	1	0		16	1	0
	8	1	0		17	1	0
	9	1	0				

18.	A	B	C	D
19.	A	B	C	D
20.	A	B	C	D
21.	A	B	C	D
22.	A	B	C	D
23.	A	B	C	D
24.	A	B	C	D
25.	A	B	C	D
26.	A	B	C	D
27.	A	B	C	D
28.	A	B	C	D
29.	A	B	C	D
30.	A	B	C	D

31. A B C D
32. A B C D
33. --
34. --
35. --
36. (a) (i) --
(ii) --
(b) (i) --
(ii) --
(c) (i) --
(ii) --
(d) (i) --
(ii) --
37. (i) --
(ii) --
38. --
39. (i) --
(ii) --
40. (i) --
(ii) --
41. (i) --
(ii) --
42. (i) --
(ii) --
43. (i) --
44. (i) --
(ii) --
45. (i) --
46. (i) ....
(ii) ....
47. (i) ....
(ii) ....
48. (i) ....
(ii) ....
49. (i) ....
(ii) ....
50 (a) (i) ....
(ii) ....
(b) (i) ....
(ii) ....
(c) (i) ....
(ii) ....

APPENDIX VIIIa

TEST OF PROBLEM-SOLVING ACHIEVEMENT IN CONSERVATION EDUCATION (T.P.S.S.)

DIRECTIONS:

The purpose of the questions on these sheets is to find out how logically and accurately you think. Your reason for choosing an answer is also very important as the answer selected.

Please record your answer to each of the questions on the separate answer sheets provided. Do not write anything on these questions sheets.

In answering each question, use the following steps.

1. Read the question thoroughly and carefully.
2. Think carefully before selecting your answer sheet provided.
3. Record your answer in the correct column on the answer sheet provided. e.g

Answer	Reason
A	

4. Read the set of possible reasons provided for your answers.
5. Carefully choose the reason which best matches your thinking after working out the answer.
6. Record your reason in the right column on the answer sheet e.g.

Answer	Reason
	2

7. If you change your mind about an answer, cross out the old answer and record the new choice e.g

Answer	Reason
	~~2~~ 3

8. Record your name and personal details on your answer sheet.

SECTION A:

For safe drinking purposes, water must be of good quality, clear, tasteless, odourless, colourless and devoid of poisonous/staining substances, in order to reduce the incidence of water borne diseases. Therefore, an expert recommended the following minimum requirements as imperative in any local setting as regards public water supply.

1. A minimum amount of 40.1 litres per person in an eight-hour period should be ensured.
2. The maximum distribution of pipes from dwellings/residents should not exceed 100 metres.
3. The maximum distance to community dug wells should not exceed 60 metres.
4. The number of households/families per communal borehole should not exceed 8.
5. Dug wells should not be closer/nearer than 12.2 metres from soak away pits or septic tanks.

Based on the above recommendations/requirements on public water supply, answer question 1 to 5.

Question 1

How many litres of public water supply will be needed by local set up, Moniya with a population of 2,200 men, 3,350 women and 8,450 children in half a day (or 12-hour period)?

A. 112,140 Litres of public water supply.
B. 14,000 Litres of public water supply.
C. 70,140 Litres of public water supply.
D. 11,022 Litres of public water supply.
E. 27,805 Litres of public water supply.

Reason

1. The number of litres of public water supply needed will always be worked at the rate of 5.01 litres per hour per person.
2. The number of litres of public water supply needed will be worked as 40.1 litres per hour per person.
3. There is no way of predicting the number of litres needed.
4. The difference in number of litres will always be 4.01 litres per hour per individual child.
5. The number of litres needed will reduce to half and be less than 40.1 litres per hour per person.

Question 2

What will be the maximum number of pipes needed in Lagelu local set up, with dwellings/houses scattered all over a range of 18.24 kilometers of land?/

A. 18.24 pipes
B. 1824 pipes
C. 182400 pipes
D. 182.4 pipes
E. None of the above

Reason!
1. The number of pipes will be a multiplication of the number of kilometre covered.
2. The number of pipes needed will be calculated as a! ratio of 10 pipes per kilometre of the local set up.
3. The number of pipes will reduce by one tenth of one! kilometre for the local set up.
4. It is very difficult to predict the number of pipes needed.!
5. The number of pipes needed can be compared with the number of kilometers at minimum distribution level.!

Question 3
How many dug wells should be situated in a local set up of Oke-Imesi with a range of 34.62 kilometers?!
A. 577 dug wells
B. 57.7 dug wells!
C. 5770 dug wells
D. 5.77 dug wells
E. 57700 dug wells !

Reason
1. The number of dug wells will increase by a ratio of! 166 per kilometers.
2. Reducing the number of dug wells to 120 per kilometre will enable more even distribution.!
3. The number of dug wells needed will be worked at the rate of 16.67 dug wells per kilometre.!
4. Doubling the size of the required 60m will reduce the number of dug wells to a reasonable level for all the kilometre.!
5. The number of dugwells will be a division of 100 dugwells by 18.24!

Question 4
Calculate the number of borehole needed in community with 4,800 household.!
A. 6000 boreholes
B. 600 boreholes!
C. 60 boreholes
D. 6 boreholes
E. 480 boreholes!

Reason
1. The number of boreholes needed will be a! multiplication of the total households by 8.
2. The number of boreholes required will be a division of the total house hold by 8.!
3. The number of boreholes cannot be predicted for such

a large community.!

4. Doubling the number of boreholes for the community per household.
5. Calculating the number of boreholes at the rate of 8! boreholes per household.

Question 5!

How many dug wells can Akinyele Local Government board supply their immediate vicinity with a range of 48.8 kilometers.!

A. 40 dug wells
B. 400 dug wells!
C. 4,000 dug wells
D. 48 dug wells
E. 488 dug wells!

Reason

1. The number of dug wells needed will be calculated at! the rate of 81.97 dug wells per kilometre.
2. Multiplication of the total number of kilometers by 12.2 meters.!
3. Division of the total number of kilometers by 12.2 km.!
4. The number of dug wells needed will increase by one eighth (1/8th) per kilometer.
5. Reducing the number of dugwells by one eight (1/8th)! per kilometer.

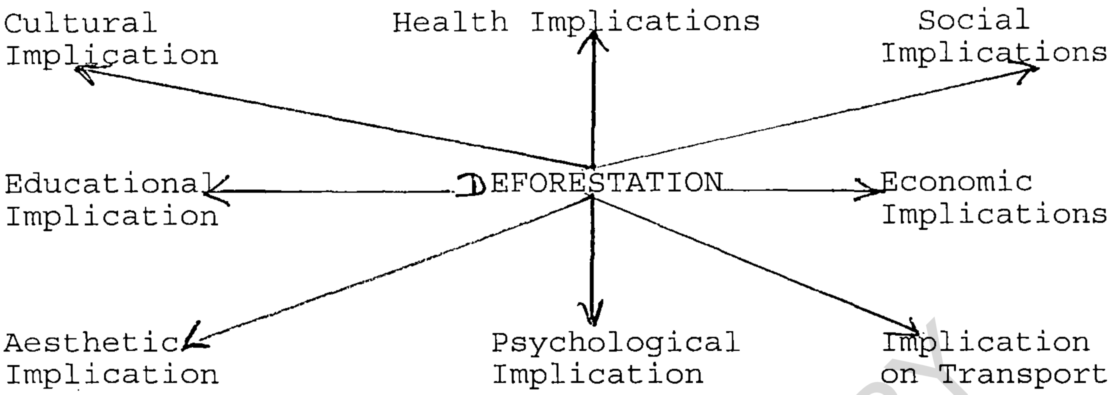
SECTION B!

Question 6-10

The following is an outline of values/ or benefits of Okomu forest reserve at Arakhuan Edo-State.!

1. To improve climatic conditions.
2. It protects the soil from erosion, excessive! evaporation and leaching.
3. For commercial value in being a source of timber.
4. for constant, supply of wood fuel and charcoal.!
5. Used by wood-allied industries to produce wood pulp, paper, newsprint, cardboard etc.!
6. Serves as centre for obtaining medicinal herbs.
7. Centres for public enlightenment and recreational activities.!
8. for making furniture for classrooms schools and community as a whole.!
9. It protects the water table, and
10. To improve the quality of air for human survival.

Therefore, the different consequences of! deforestation are diagrammatically represented as follows:



Use the above passage to answer questions 6-10.

Question 6

What will be the major psychological effects o deforestation of Okomu forest reserve on the entire community of Edo-State?

A. There will be no fire wood to cook food.
B Emotional Insecurity for lack of shelter.
C. Inferiority complex due to foreign dependence.
D. All of the above.
E. Only B and C.

Reason

1. Reduction in the quantity or supply of firewood.
2. Depression resulting from lack of shelter.
3. Low self-concept due to low foreign exchange earnings.
4. No fresh air for the people to breathe.
5. Both 2 and 3.

Question 7

What educational implications will such deforestation have on the community?

A. Poor soil as a result of erosion
B. Inadequate herbs for making drugs.
C. No wood for making furniture for classrooms and schools.
D. Shortage of materials for paper industry. (i.e. reduced paper production)
E. Both C and D.

Reason

1. Destruction of medical herbs that are used as drugs for ailments.

2. Reduction in school furniture such as chairs, tables, cupboard etc.
3. Shortage of papers in schools.
4. Soil erosion which can destroy schools farms.
5. Only 2 and 3.

Question 8

What possible economic implications can such deforestation cause to people around that community ?

A. Poor soil with low agricultural yield.
B. Hunger
C. Diseases
D. Reduces export crop production (like timber)
E. All of the above.

Reason

1. Deforestation can reduce food production in the community.
2. Lack of food can lead to malnutrition and diseases for individuals in the community.
3. Reduction in the community's foreign exchange earnings.
4. Reduction in production of commercial drugs.
5. All of the above.

Question 9

Name one major impact of deforestation on health of patients in hospitals situated in surrounding communities?

A. Shortage of drugs in hospitals.
B. Incapability of malnourished doctors, nurses and hospital attendants.
C. No wood for making hospital furniture
D. No paper to use for patients records and cards.
E. No wood to erect more hospitals.

Reason

1. Inadequate herbs for making drugs for certain ailments.
2. Depressed doctors, nurses and hospital attendants.
3. Shortage of hospital furniture like bed, cupboard, tables, chairs, benches etc.
4. Inadequate record keeping
5. Available hospitals become ever crowded with patients.

Question 10

How can such deforestation be prevented in Okomu forest reserve at Arakhuan ? By

A. Joining efforts with others to fence the forest areas.
B. Setting up afforestation and agro-forestry programmes.

C. Preventing road construction, farming building construction and other activities at the reserved area set out for forest reserve.
D. Educating citizens on the values of forest conservation and ways of conserving forest.
E. All of the above.

Reason
1. Fencing the forest will prevent everhunting, overgrazing and uncontrolled felling of trees.
2. Planting of more trees/plants will prevent extinction of certain plant species.
3. Road and building construction, farming and other destructive human activities can cause devegitation.
4. Enlightening individuals on the benefits of forest reserve and ways of maintaining it will reduce several hazards e.g. bush burning around that reserved area.
5. All of the above.

SECTION C - QUESTION 11-15

The following is a sketch of significant impacts and effects of oil spill and gas leakage due to the explosion of oil well at Ughoton village, on 12th-24th November 1991.

(a) Land Use
1. Farmlands were abandoned due to barrenness of soil, with scanty yellowish grass and slunted plants left behind.
2. Trees were partially or completely defoliated (e.g rubber trees).
3. Soil soaked with hydrocarbons.

(b) Water Use
1. The surface water (or streams) have high hydrocarbon traces in them. (No water wells in the whole area).
2. Existence of contaminated run off water and soil rich in hydrocarbon which seeps into ground water.

(c) Air Quality

Toxic air pollutants derived from spill gas leakages and its decomposition result in offensive odours, and brought about public health and safety hazards.

(d) Loss of wildlife
(e) Loss of marine life in fishponds or farms.

The total quantity of oil spilled is about 6,485.0 barrels from 148 spills in 1990.

Use the above passage to answer questions 11-15.

Question 11

What will be the major effect(s) of cooking with firewood in such a community?

A. Firewood is very economical and cooks very fast.
B. Loss of vegetation and defoliated trees will result in scarcity of wood resource.
C. Offensive odour results because of hydrocarbon present in the air.
D. Tickling time-bomb, devastating explosion and ghastly fire incidents.,
E. None of the above.

Reason

1. The people can collect firewood from other new places and use it to cook in that community.
2. The irritating odour can block human nasal passage.
3. The defoliated trees will eventually become deadened due to lack of water and fresh air.
4. No cooking with firewood should take place because any form of ignition can cause fire explosion due to oil spill and presence of hydrocarbon in the air.
5. None of the above.

Question 12

What possible diseases can such emission of hydrocarbons cause to public health, welfare and safety?

A. dizziness, headache and eye irritation.
B. nasal discharge, nausea and vomiting
C. sore throat, constricted airway, chest pains.
D. poisoning of stomach and blood stream
E. All of the above.

Reason

1. Passage of air pollutants into air sac/lungs/bronchioles which can tamper with the respiratory organ.
2. Deadly to blood stream and stomach which can cause shortness of breath.
3. Excessive coughing that can terminate in sore throat and chest pains.
4. Release of offensive and irritating odour which can cause vomiting/nausea in man.
5. All of the above.

Question 13

How can the residents of such community obtain pure water (unpolluted drinking water) for survival in such an area?

A. By boiling the Water
B. Addition of Alums or chemicals to it.
C. Filtering the water
D. By looking for a new area/place to dig another well (outside that community).
E. None of the above.

Reason
1. Evaporation of the water, leaves sediments or impurities behind and purifies the water.
2. The sediments will settle down immediately and clean water is on the surface.
3. Particles or impurities are removed by the filter used.
4. All of the above (1-3).
5. No feasible method can purify such water, except the residents move out and dig another well in another community free from such pollutants.

Question 14

State the main reason(s) behind the residents moving out of that area or vicinity (if they decide to).

A. In search of rich farm-lands to cultivate.
B. Looking for other sources of livelihood.
C. For recreation
D. For other hunting grounds.
E. All of the above.

Reason
1. Production of food through cultivation of new farmland.
2. Occupational threat resulting in search for new occupations/jobs.
3. Relaxation after the day's work.
4. To locate another fish farms for fishing activities.
5. All of the above.

Question 15

What best conservation measure can be adopted by the government to check subsequent land/soil degradation in the country?

A. Promulgation of laws, regulations or decrees.
B. Creating public awareness through media resources.
C. Heavy fines on offenders of laws/decrees.
D. Payment of fines to affected victims.
E. Educating the general masses, right from early age, on environmental conservation Education in schools.

Reason

1. Educating the general masses will remove ignorance and negative environmental attitude in them.
2. Enrichment of victims' financial status would pave way to securing new farmlands for livelihood.
3. Infringement on government's laws/decrees should be levied with heavy fines to check prohibitor.
4. Mounting up other conservation projects in every community.
5. None of the above.

APPENDIX VIIIb

ANSWER SHEET FOR TEST OF PROBLEM-SOLVING SKILLS IN CONSERVATION EDUCATION (T.P.S.S.)

SECTION A: PERSONAL/DEMOGRAPHIC DATA

(i) Name of Student....................................
(ii) Sex : Male [] Female []
(iii) Type of School
Single sex: Boys only [] Girls only []
Coeducational/Mixed; []
(iv) Religion: Christian [] Moslem []
(v) Age: Below 15 years [] 15-18 years []
above 18 years []
(vi) Science subjects studied. Tick as appropriate.
Biology [] chemistry [] Physics []
Agricultural Science []
(vii) (a) Father's Occupation:.......................
(b) Mother's Occupation:.......................
(viii) (a) Father's Monthly income:.................
(b) Mother's Monthly income: ....

Tick as applicable
Science major [] Non-Science major []

SECTION B

S/N QUEST.	ANS.	REASON	S/N QUEST.	ANS.	REASON
e.g.	A	3			
1			9		
2			10		
3			11		
4			12		
5			13		
6			14		
7			15		
8					

APPENDIX IXa

STUDENTS: ATTITUDE TO ENVIRONMENTAL CONSERVATION QUESTIONNAIRE (S.A.E.Q)

SECTION A: PERSONAL DATA Tick [] as appropriate

(i) Type of school: Single sex boys only []
girls only []
coeducational []

(ii) Sex : Male [] Female []
Other specify).........................

(iii) Religion: Christian [] Moslem []
Other specify).........................

(iv) Age: Below 15 years [] 15-18 years []
above 18 years []

(v) Science subjects studied. Tick as appropriate.
Biology [] chemistry [] Physics []
Agricultural Science []

(vi) (a) Father's Occupation:......................
(b) Mother's Occupation:......................

(vii) (a) Father's Monthly income:................
(b) Mother's Monthly income: ....

(viii) I am a (i) Science Major []
(ii) Non-Science Major []

(ix) Is there a Conservation Club in your school?
Yes [] No []

(x) If YES (to No. ix), Does the club encourage both staff and students to take part in its activities ?
Yes [] No []

SECTION B:

INSTRUCTION: Read the following statement carefully. Do all the answering on the separate ANSWER SHEETS provided. Please do not write anything on these sheets. Indicate whether you agree (A) or disagree (D) or you have no opinion. this is not a est and there are not right or wrong answers. Circulate the appropriate column as applicable to your own view in the ANSWER SHEETS.

At the end, return these sheets with the answer

S/N	STATEMENTS:	SA	A	D	SD
	PART 1				
1	I don't always feel like collecting rain water for use around my home since the tap water is always available.				
2	I like keeping a bucket of water for use in my toilet.				
3	I don't feel like turning off the pipe even when there is no water running at the moment.				
4	I always feel like covering water stored in any container in my home.				
5	I always feel like cleaning water containers before use.				
6	I don't believe that germs can be destroyed by boiling water.				
	PART II				
1	I have no interest in cultivating a garden in my home.				
2	I believe in burning a farm because it is a good technique.				
3	I believe that overgrazing can affect the fertility of a land.				
4	I have interest in planting shady trees around classrooms and homes to provide natural cooling.				
5	I believe that adequate land-husbandry can promote effective soil and water conservation.				
6	I have no interest in cleaning the environment anytime it is dirty or littered.				
	PART III				
1	I feel that forests should be cleared to give way to settlements and farms.				
2	Forests should be maintained because they also provide a high potential for wood-allied industries and for the				

S/N	STATEMENTS:	SA	A	D	SD
3	If forest are cleared, I believe more charcol and firewood would would be available to the people.				
4	Most plant nutrients used for food and medicines are stored in forest and therefore forests should be conserved.				
5	I have no interest in paying visits to a nearby forest reserve centre because it is very stressful, frightful and boring.				
6	A forest reserve centre is a place where l can stay away from the hustle and bustle of city life for a while and admire the beauty of nature.				
	PART IV				
1	Zoological gardens should be phased out (or removed) because of the wild animals kept inside them.				
2	Wildlife conservation is safe with the adoption of fencing to keep wildlife off cultivated areas farms, grazing areas and other pastoral areas.				
3	Wildlife reservation should be totally scrapped off because baboons and elephants can destroy crops for farmers.				
4	It is a wicked act to kill or wound wildlife.				
5	I can never be interested in visiting a wildlife game reserve because of my safety.				
6	Keeping wildlife conservation centre or National Parks Reserves can also fetch some economic benefits to local people through the visitors and tourists pay.				

S/N	STATEMENTS:	SA	A	D	SD
	PART V				
1.	I like the smell of cigarette smoke				
2.	I hate the sight and smell of burning tyre around my house because the smoke released can cause lung cancer.				
3.	The odour from a bad (or soiled) toilet doesn't affect me an inch.				
4.	I don't like palm oil being used to fry fish because the smoke thereof irritates my eyes and turns my eyes misty.				
5.	Industrial wastes released into the atmosphere can always diffuse into the air, therefore, we do not need to bother about them.				
6.	Incinerators should be situated far to the house because of incessant burning that can release smoke into the air				
	PART VI				
1.	People living around a mining area should be enlightened to report immediately any contaminated water/river for treatment.				
2.	I hate mining and quarrying because the pits and mines tailings formed along major highways can lead to accidents on the highways.				
3.	Metal materials should be submitted for recycling (after use) instead of dumping them away all the time.				
4.	Mining of minerals should not be allowed because of the increasing toxicity hazard to plants and animals				
5.	I don,t believe that minerals can be exhausted in the ground/rocks, they are always available and				

S/N	STATEMENTS:	SA	A	D	SD
6.	should all be extracted for our own benefits People should be educated to use other sources of energy like firewood to reduce the amount of coal consumption.				
	PART VII				
1.	I have interest in keeping a poultry.				
2.	I hate keeping and nourishing animals e.g. goats, around the house because of their indiscriminate discharge of stools or faeces.				
3.	I like keeping rabbitry (to breed rabbits)				
4.	Fish ponds are not safe because of various insects that are around the belt.				
5.	It's a lot of fun keeping or rearing animals because human wastes can be used to subsidize their food e.g. yam - peals, etc.				
6.	I hate keeping domestic animals because they can destroy farms, gardens and food in the home.				
	PART VIII				
1.	I believe that drying vegetable seeds e.g melon or pepper, under the sun is cheaper than using coal or natural gas				
2.	I cannot sleep in a dark room, so I switch on the light throughout the night				
3.	I do most of my work during daylight, in order to save energy				
4.	I don,t believe in planting trees, since nature can replace its items naturally				
5.	Motorists should switch off motor vehicles engines when stationary				
6.	I always like to put on the lantern lamps in all rooms (whether used or not).				

APPENDIX IXb

ANSWER SHEET FOR STUDENTS ATTITUDE TO ENVIRONMENTAL CONSERVATION QUESTIONAIRE (S.A.E.Q)

SECTION A: PERSONAL DATA:
Tick (/) as appropriate, fill in the answer as applicable.

i. Type of School:
Single Sex: Boys only [], Girls only []
Coeducation/mixed: []

ii. Sex: Male[] Female []

iii. Religion: Christian [], Moslem []

iv. Age: Below 15 years [] 15-18 years []
Above 18 years [] 15-18 years []

v. Science subjects studied: Tick as appropriate
Biology []; Chemistry []; Physics []

vi. a. Father's occupation:..............................
b. Mother's occupation:..............................

vii. a. Father's monthly income:........................
b. Mother's monthly income:........................

viii. I am a (i) Science major []
(ii) non science major []

ix. Is there a conservation club inyour school? Yes [] No []

x. If Yes (to no ix), Does the club encourage both staff and students to take part in its activities Yes [] No []

SECTION B:

PART I	2	2	3	4	**PART V**	1	2	3	4	
1	2	2	3	4	1	1	2	3	4	
2	1	2	3	4	2	1	2	3	4	
3	1	2	3	4	3	1	2	3	4	
4	1	2	3	4	4	1	2	3	4	
5	1	2	3	4	5	1	2	3	4	
6					6					
PART II	1	2	3	4	**PART VI**	1	2	3	4	
1	1	2	3	4	1	1	2	3	4	
2	1	2	3	4	2	1	2	3	4	
3	1	2	3	4	3	1	2	3	4	
4	1	2	3	4	4	1	2	3	4	
5	1	2	3	4	5	1	2	3	4	
6					6					
PART III	1	2	3	4	**PART VII**	1	2	3	4	
1	1	2	3	4	1	1	2	3	4	
2	1	2	3	4	2	1	2	3	4	
3	1	2	3	4	3	1	2	3	4	
4	1	2	3	4	4	1	2	3	4	
5	1	2	3	4	5	1	2	3	4	
6					6					
PART IV	1	2	3	4	**PART VIII**	1	2	3	4	
1	1	2	3	4	1	1	2	3	4	
2	1	2	3	4	2	1	2	3	4	
3	1	2	3	4	3	1	2	3	4	
4	1	2	3	4	4	1	2	3	4	
5	1	2	3	4	5	1	2	3	4	
6					6					

APPENDIX IXc
TABLE OF SPECIFICATION FOR STUDENTS' ATTITUDE TO ENVIRONMENTAL CONSERVATION QUESTIONNAIRE (S.A.E.Q)

PARTS	CONTENT/TOPIC	POSTIV ITEMS	TOTAL NO	NEGA ITEMS	TOTAL NO.
I	Conservation of water	2,4,5	3	1,3,6	3
II	Conservation of Land	3,4,5	3	1,2,6	3
III	Conservation of Forest	2,4,6	3	1,3,5	3
IV	Conservation of Wildlife	2,4,6	3	1,3,5	3
V	Conservation of Air	2,4,6	3	1,3,5	3
VI	Conservation of Minerals/Rocks	1,3,5	3	2,4,6	3
VII	Conservation of Animals	1,3,5	3	2,4,6	3
VIII	Conservation of Energy	1,3,5	3	2,4,5	3
	TOTAL		24		24

APPENDIX IXd
FORMAT FOR NON-EMPIRICAL VALIDATION OF SAEQ

Purpose: Validation of a questionnaire designed to find out the attitude of some SSII biology students towards environmental conservation in some secondary schools in Ibadan municipality.

Instruction: Please find attached a copy of the questionnaire in respect of the above. Indicate your response to the section, items and the entire questionnaire by placing a tick (-/) in the appropriate box in the format below.

	LANGUAGE		LENGTH		CLARITY		RELEVANCE		SUGGESTION		
	SUITABLE	UNSUITABLE	NORMAL	TOO LONG	CLEAR	NOT CLEAR	RELEVANT	NOT RELEVANT	RETAIN	MODIFY	DELETE
1. The instructions 2. Section A 3. Section B ITEMS 1 2 3 4 . .											
4. The entire questionnaire											

5. General Remarks/Comments..........................
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APPENDIX X
OUTLINE PLAN OF WORK FOR THE STUDY

WEEK	ACTIVITY
1	**PRETEST (SAEQ, TECK, TPSS)**
2	**PRETREATMENT ACTIVITIES** - Introduction to the concept of conservation of natural resources - water, land, forest, wildlife, air, minerals/rocks; animals and energy.
3	**TREATMENT BEGINS** -Conservation of water -Occurrence; Impurities, Uses, sources of Water. -Water Pollution (Causes and effects) -Benefits and Methods of Water conservation.
4	(a) **CONSERVATION OF LAND** -Uses; problems; land pollution; soil conservation measures. (b) **CONSERVATION OF WILDLIFE** - Benefits; problems; Possible Solutions.
5	(a) **CONSERVATION OF AIR** -Values; Polluting substances/Problem; solutions.
6	(a) **CONSERVATION OF MINERALS/ROCKS** -Benefits; Impacts/problems; solutions (b) **CONSERVATION OF ANIMALS** -Values; Measures; Problems; Control of Pests
7	**CONSERVATION OF ENERGY** -Forms/Types; Causes and Impacts of energy crisis -Benefits; Measures; Saving energy.
8	POST-TEST (SAEQ, TECK, TPSS)