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Environmental Education: A Process for Pre-service Teacher Training Curriculum Development

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PREFACE

Teacher educators and teachers are important key personnel for the translation of a curriculum into effective teaching/learning activities in a classroom. In order to make the incorporation of environmental education (EE) into the full spectrum of curriculum and teaching/learning processes a realistic and practical educational renewal it is essential to educate the concerned teacher educators and teachers through preservice and inservice training programmes and have them also involved in the conception, formulation and implementation of strategies of such a renewal before giving them the responsibility of its execution.

In this context Unesco has developed a series of documents on teacher training in the Environmental Education Series. Environmental Education: A Process for Preservice Teacher Training Curriculum Development, as one of these documents, has been developed with the objective to address itself to a process that may be considered for use by teacher educators in different educational systems for environmentalization of their respective curriculum which may involve the incorporation of EE into the teacher education objectives, contents, methods and evaluation horizentally at one level and vertically at different levels. This document focuses through ten chapters on the development of EE; goals, objectives and guiding principles of EE; the need for EE in teacher training; essential elements of EE in teacher training; the process of curriculum development in EE for preservice teacher training; teaching methodologies and strategies, foundation education and its environmentalization; evaluation in the context of EE leraning; and mechanism of development. The document includes four appendixes covering (i) an outline for preservice teacher training courses in EE at elementary and secondary stages; (ii) suggested activities; (iii) a checklist of priority requirements, national actions and international action; and (iv) bibliography.

This document was prepared at the national Council of Educational Research and Training (NCERT) New Delhi by Dr. D. Lahiry, Dr. Savita Sinha, Dr. J.S. Gill, Dr. U. Mallik and Professor A.K. Mishra. Unesco circulated the first draft of the document to several teacher educators for comments and critiques which were used in its revision. The revised version of the document was edited at Southern Illinois University, Carbondale, Illinois, U.S.A. by Patricia R. Simpson, Dr. Harold Hungerford and Dr. Trudi Volk.

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CHAPTER ONE

INTRODUCTION

In spite of international efforts, including those of the IEEP and other organizations, the progress of environmental education (EE) on the world scene does not present a very satisfying picture. It seems that EE has been more accepted than actuated in the school and teacher training curricula, particularly in the developing countries. A cursory survey of school curricula in 20 countries and teacher training curricula in 12 countries (mostly belonging to the developing world) shows that most of them have included EE only to a limited extent. Even in this, the implementation is scrappy and the thrust falls far short of realizing the objectives of EE.

Some of the difficulties within educational systems which have hindered the progress of EE in school education are the dearth of committed educational planners, properly oriented curriculum developers, and expert teacher educators as well as trained teachers. There are few suitable locale specific, well structured teacher training programmes available. Similarly, curricular materials are also in short supply.

Unesco has brought out a number of very useful documents which provide guidelines for teacher training and curriculum development. Several modules have also been prepared for pre and inservice teachers and their supervisors, which could be adopted for various training programmes at national levels. The present document is another step in the same direction. It discusses various aspects of the process of curriculum development with special reference to EE and the process of environmentalization of for preservice teacher training curricula.

The existing situation of preservice teacher training both for the primary and secondary stages is extremely disparate not only from country to country but also in different institutions within a country. The programmes differ grossly in structure, approach, constraints, facilities and even in duration. In some countries preservice teacher training does not exist at all.

Therefore, this treatise, without trying to be prescriptive, intends to present several alternatives as examples which curriculum developers and teacher trainers can use or adopt for developing an environmentalized teacher training curriculum for specific situations. The document discusses the various considerations and components relevant to the process of curriculum development and its environmentalization.

There are ten chapters, each dealing with different aspects of curriculum development. The first chapter is an introduction to the entire document.

The second chapter deals with the development of EE and highlights the special efforts of IEEP to make it a world education movement.

The third chapter mentions internationally accepted criteria, goals, objectives and guidelines as have been endorsed by the Intergovernmental Conference on EE (Tbilisi 1977)

The fourth chapter discusses the importance of teacher training, particularly in view of the special needs of EE.

The fifth chapter mentions the essential components and competencies to be dealt with in a teacher training course and discusses the essential knowledge and problems of the environment which form a core in the development of an environmentalized curriculum.

The sixth chapter outlines the essential steps in the process of curriculum development. It discusses environmentalization of general education components and a content framework illustrated by a few case studies.

The seventh chapter delineates teaching methods and strategies already in use, and explains how they could be adopted to impart EE knowledge and skills. In order to develop EE competencies among trainees, appropriate methods and strategies are illustrated with environmentally centered activities.

Chapter eight discusses the essential elements of a foundation education course with a special reference to EE. Since it outlines the course content of foundation education, the concepts indicated therein are basic to all learning processes. An attempt has been made to bring out a rationale for inclusion of the views of educational philosophers, opposing theories, and finally, their implications in the education process. Special references have been made when theories are correlated with practices relevant to EE.

The ninth chapter mentions different aspects of evaluation in the context of EE. Various evaluation tools relevant to the assessment of environmentally based content have been included with examples. Factors influencing evaluation schemes are also discussed.

Chapter ten discusses various aspects of the mechanisms of curriculum development. They include issues such as the agencies to be involved, mode of development, format consideration, tryout and preparation, production of instructional materials and mode of implementation.

CHAPTER TWO

DEVELOPMENT OF ENVIRONMENTAL EDUCATION

Environmental education has emerged as a new dimension in the educational sphere only recently. Perhaps in the history of education, no other single movement has progressed so fast with as much acceptance in such a short time. Only 25 years ago, the term 'environmental education' was relatively unknown and poorly understood. But now, it has grown into a world-wide movement. Unprecedented interest and activity have ben generated not only among educators, but also among conscious citizens, social, and political leaders. Therefore, the development of environmental education constitutes a fascinating subject of research within the history of education. It is essential for educational practitioners to understand the origin, course, and future of EE to appreciate its nature, character, and progress. A study of the development of EE reveals that it is by no means an upstart movement. On the contrary, its explosive growth is due to its strong connections to basic human needs and emotions. The awareness, knowledge, approach and methods have gradually been acquired from other streams of education, and now EE has become an enterprise with a multifaceted personality of its own. Its growth is largely due to revolutionary changes in environmental conditions, our intellectual response to those changes, and the various international and national activities which began in the 1960's and continues today.

The Evolution of Environmental Concern

Man is a creature of his environment, but the degree of this perception of his place in the environment has varied. His attitudes toward the environment have always been determined first by his contemporary perception and degree of knowledge, and secondly by the type of consciously felt interactions which have existed between man and the environment in different ages.

Concern in the Remote Past

The essentials of environmental education are rooted in man's feelings, knowledge, and perception of nature from ancient times. The near total dependence of primitive man on the natural environment for food, shelter and security and his vulnerability to natural calamities, gave rise to feelings of awe and wonder toward the environment. His limited knowledge about environmental factors was handed down to subsequent generations in the form of taboos and totems.

Ancient civilized man, having learned more about the ways of nature, still had a sense of subordination to nature. He had profound respect and attachment to the environment. The ancient Greeks and Indo-Aryans personified natural objects and phenomena like the sun, the moon, the earth, and the river as gods. Their knowledge, emotions, and aesthetic appreciation were transmitted as hymns and legends, which even today form a part of our rich heritage.

The oriental religious teachings of Buddhism, Jainism, Taoism and others, contain messages about the importance of the environment, how to live harmoniously with our surroundings as well as many principles and practices about the preservation of plants and animals. The Greek philosopher Plato tried to discern some of the effects of population pressure on human habitation.

Recent Developments

It is difficult to place the beginning of modern concerns about the environment at any one time or within one country. Different aspects of problems related to the environment, such as vegetation, population, housing, health, and sanitation must have been felt in various countries at different times. The response depended upon the degree to which these factors affected the life of the people. Probably, the historical development of environmental concern has no one single root, it is polyphylatic in origin. Lowe and Goyder (1983), consider the first national environmental group to be The British Commons, Open Space and Footpaths Preservation Society, dating back to 1865. However, one of the earliest historical evidences of organized environmental action can be traced back to an even earlier 17th century mass movement of the people in some villages of the Thar Desert (India). Inspired and organized by local religious leaders, the people sacrificed their lives to save trees from wanton felling (Cowshish,1985). Lowe and Goyder (1983) identify major periods when concern for the environment was being articulated in the West. These periods were the 1890's, late 1950's and the 1970's. These periods grossly coincide with the developmental phases of American environmental education as described by Kirk (1985).

The present environmental education movement, which apparently emerged as an outcome of the turmoils of the 1960's, had its roots in the Nature Study Movement. A movement which was introduced into the school curricula of many countries. However, the content, approach, and curricular activities were not the same everywhere, and the intensity of the movement and the time of introduction also varied from country to country.

Evolution of Environmental Education

Kirk (1985) has tried to analyze how two separate movements, namely, the Conservation/Nature Study Movement and the Outdoor Education Movement have acted as the foundation of modern environmental education in the United States. He has described a few major chronological phases. Developments in each phase have contributed to the evolution of the next phase. The four phases and a brief description of each follow.

1) Awareness Phase (1860-1890): This was the initial phase in which various powerful writers awakened many to recognize that man was not a single and solitary figure above all other living and non-living systems, but rather an integral part of the system.

2) Preservation Phase (1890-1910): In this phase, several writers popularized a need for the conservation of natural resources. The National Conservation Commission of the USA was established. Forests were considered not merely as resources for their products, but also resources for recreation, relaxation, research, and study.

3) Nature Study Phase (1910-1932): The greatest catalyst during this period was the establishment of the American Nature Study Society (1908). In this phase, efforts were made to develop an understanding and appreciation of the beauty, majesty, and mystery of nature. Valuable materials were also prepared which served as a tool and guide for teachers and aspiring naturalists.

4) Education Phase (1937-1950): In this latest phase, the Civilian Conservation Corp was established in which many young people had an opportunity to learn the value of forests and woodlands. People became more aware of the importance of learning about the interrelationships of and interactions between living and nonliving things.

Efforts were made to train teachers in the use of natural areas as an extension of their classrooms. Several conservation agencies were established which began to publish educational materials for the conservation of forests, wildlife, and soil.

In 1933, Aldo Leopold explained his concept of conservation ethics and pointed out that the acceptance and formulation of ethical principles is actually a process of ecological evolution. All of these activities led to the development of the curriculum phase that began to form after the fifties.

Environmental education began to emerge in its present form due to the enormous technological growth which has embraced every field of human knowledge and its applications resulting in a drastic transformation of the environmental situation. Examples of this include nuclear physics, with its devastating capacity and potential for long term pollution. Agriculture, which uses pesticides and fertilizers indiscriminately. Medical science whose life saving drugs have reduced the mortality rate and produced a consequent rise in population. These areas along with a change in the outlook of the social sciences have all contributed to a drastic transformation of the human environment. Many of these impacts took place after World War II.

In the United States and some other countries, a few isolated groups of educators started facing these problems. A stunning blow came in 1962 with the publication of Rachael Carson's famous book, Silent Spring. It made Western countries sit up and review their position in regard to the human environment.

Global Concern for Human Environment

The Commission on Education of the International Union for Conservation of Nature and Natural Resources (IUCN) was established in 1949 (Cook and Weidner, 1977). This organization is concerned with the promotion of environmental conservation education. The IUCN has produced a number of significant publications. It conducted a Symposia on Conservation Education at Lucerne, Switzerland (1966); held a Conference on Conservation of Renewable Natural Resources in Bariloche, Argentina (March, 1968); called a conference on Environmental Education in Nevada (1970); conducted the European Working Conference on Environmental Conservation Education in Ruschlikon, Switzerland (December, 1971) and held the International Workshop on Environmental Studies in Higher Education and Teacher Training at London, Ontario, Canada. In the same year, this group also outlined a programme for secondary education was also outlined in Zurich.

In 1968, the Swedish delegation to the UN drew the urgent attention of member nations to the rapidly growing crises in the human environment. As a result of many debates and discussions, the UN continued to evolve a global attitude towards the environment and set priorities in relation to an environmental crisis in the face of the conflicting desires and needs expressed by developed and developing countries. Highly industrialized nations stressed the dangers of pollution, degradation of natural environments, and conservation of wildlife. This, in contrast to the needs of poorer countries which yearn for the quick development of industry, agriculture, and better living conditions to aid in the fight against poverty, hunger, disease and illiteracy. It took four years, during which a main working paper was prepared reconciling the contradictory views and positions of various nations and then to formulate a comprehensive document reflecting global aspirations and the imminent environmental threat.

Stockholm Focus on Human Environment

On June 5, 1972, the First United Nations conference on the the Human Environment was opened at Stockholm. The conference was attended by 113 nations, UN agencies, and nongovernmental organizations. The conference discussed the various aspects of environmental problems, adopted the Declaration on Human Environment, and approved a wide ranging action plan.

Results of the Stockholm Action Plan

This Conference. . .

. . . recognized that man is a creature and shaper of the environment and that he has a special responsibility to protect and improve the environment, while safeguarding natural resources, air, water, plants, and animals.

. . . proclaimed that man should work for the generation, maintenance, and improvement of renewable resources for the benefit of all of mankind.

. . . urged that all efforts should be made to halt any sort of pollution which creates hazards to living resources/marine life.

. . . identified underdevelopment as a major danger to the environment and welcomed planned national development with international cooperation in the field of economic and social development.

. . . acknowledged the importance of planning without any racist domination in demographic and organizational issues.

. . . recognized that science and technology should be encouraged to grow in order to solve environmental problems, and that scientific and technological advancements should be used judiciously and shared by all for the improvement of the environment.

. . . emphasized the need for maintenance of peace and harmony between nations through fair dealing, through sharing and disarmament, and through the avoidance of nuclear weapons.

The role of international cooperation in every field was urged again and again. The Nations as well as nongovernmental and international agencies were called upon to work not only within their own spheres but also harmoniously between themselves for the benefit of the environment. The role of education in environmental matters for both young and adults was also acknowledged as being of great importance.

An upsurge of activity in environmental education was generated from the Stockholm Conference recommendations. One recommendation resulted in the formation of a special agency, the United Nations Environmental Programme (UNEP). Another (No. 96) contributed to the foundation of and framework for a cooperative effort in international environmental education. As a result, the International Programme in Environmental Education (IEEP) was launched bu Unesco and UNEP in January of 1975.

The Belgrade-Tbilisi Focus on Environmental Education (and Beyond)

Much of the multidirectional development in the field of environmental education was due to the constant efforts of the IEEP. Their major activities include (1) setting up pilot projects on Environmental Communication Systems, (2) the publication of a newsletter, Connect, (in five languages) which reaches thousands of individuals and organizations, (3) conducting a worldwide study of needs and priorities in environmental education, (4) studying trends in environmental education, and (5) the study, trial and development of innovations in environmental education. Another domain of activities concerns the sponsorship of a large number of discussions allowing for an exchange of views and information related to the policies and strategies needed to facilitate assessment, conceptualize all aspects of environmental education, and train individuals throughout the world.

Experts met in a series of meetings culminating in an International Workshop held in Belgrade (October, 1975) which was attended by educational leaders from 65 countries. This was followed by regional and subregional meetings which covered the major regions of the world. These meetings were conceived as part of the ground work for the Intergovernmental Conference on Environmental Education to be held at Tbilisi in October, 1977.

The Tbilisi Conference was the climax of the initial phase for development in environmental education. It gave a global thrust to environmental education, recommending further intensification and expansion of environmental education. It endorsed the goals and objectives formulated by the Belgrade Workshop. On the basis of regional and subregional meetings, the guidelines for environmental education were expanded and reinforced. The Conference also charted an action plan at national and international level for the promotion and development of environmental education. Important developments which followed from the Tbilisi Conference included intensive and extensive actions on the part of the IEEP, and the emergence of distinct entities of environmental education in different countries according to their own needs, aspirations, and situations.

The IEEP intensified and expanded its multidirectional efforts for the promotion of environmental education through: (1) systematic integration of an environmental dimension into national education policies, (2) promotion of interdisciplinary and inter-institutional cooperation, (3) reorientation of curricula and educational materials by injecting interdisciplinary, problem solving approaches, (4) incorporation of environmental education in pre and inservice training of teachers and other educational functionaries, (5) development of multimedia programmes for all, (6) research and experimentation on all aspects of educational process and dissemination, (7) reinforcement of international, national and regional cooperation among governmental and nongovernmental organizations, (8) financial and technical support for a number of national training activities of key personnel in various regions, and (9) assignment of consultants for each of the four regions (Unesco, 1982).

An attempt to define and modify environmental education according to different national needs, perceptions and situations was revealed through the various national reports in the Tbilisi Conference, but this was only a natural trend, especially since no real pattern had existed earlier. The first feature to become obvious was an attempt at unidisciplinary, multidisciplinary, transdisciplinary or crossdisciplinary EE treatments. Another feature in some countries was the inclusion of various groups (i.e., consumers, manufacturers, distributors and other professionals) to influence the pattern and policy of societal environmental action. Also in some cases, the importance of a search for concrete effects relating EE to citizenship action for the learner was apparent. Children experiencing a succession of widening environments--homes, the village or city , then the country and beyond was also stressed so that the study of the environment should become an easier and more meaningful experience.

Another idea came from an international meeting on science education held in Holland in 1978. There experts observed that science education and environmental education were often overlapping but not identical. It would therefore be worthwhile if the overlapping areas, in which science education is to be environmentalized, would consider real problems and not abstract situations.

The Stockholm-Belgrade-Tbilisi (1972-1977) phase is neither the beginning nor the end of environmental education or of a concern for the environment. But surely this is a crucial catalytic phase in both of these areas. Without prejudice, it can probably be said that the Tbilisi Conference was the beginning of a world wide movement, and perhaps, there could not have been a better beginning.

Concern for and knowledge of the environment have gained both momentum and expansion ever since. Intensive efforts both at national, international, and individual levels have produced a mass of literature, reinforcing contemporary knowledge about various local and global environmental issues and their implications. Diverse interpretations of the issues as well as their proposed solutions exist in the literature.

One of the most important contributions reflecting international efforts is the formulation of The World Conservation Strategy (1980). It aims at safeguarding the earth's natural resources, not only for today, but for future generations as well. The World Conservation Strategy was drawn up by the IUCN, UNEP and the World Wildlife Fund in collaboration with Unesco and FAO and was launched simultaneously in thirty countries. The Strategy document is the culmination of intensive efforts involving 450 government agencies and more than 700 eminent experts from 100 countries over a period of two years. The document deals with the problems of deforestation, desertification, depletion of fisheries, soil erosion, misuse of croplands, and genetic diversity. It spells out the various objectives of conservation and the conditions required for their achievement as well as priorities for national action. It includes aspects of training, research, participation, and education as well as priorities for international action.

Entering the Twenty-first Century is a US interagency report prepared by the Global 2000 Study (Barney, 1980) in response to a directive from President Carter (USA). The document considers various issues relating to population, G.N.P., climate, technology, food, environment and many others having long term global implications. The report comprises three volumes: (1) an interpretive report that summarizes the findings in non-technical terms; (2) the technical report, which presents projections and related analyses in greater detail and (3) a voluminous basic documentation of the models studied.

Another important document with a bearing on environmental conditions is North-South--A Programme for Survival: The Report of the Independent Commission on International Development Issues (Brandt, 1980). The report mainly reviews global economic issues and various dimensions of development such as population growth, disarmament, industry and world trade with special reference to the mutual cooperation between developed and developing countries. It also contains recommendations to reduce mass hunger and malnutrition.

The World Development Reports (1983,1985) of the World Bank are highly useful documents on global economic issues. A wealth of information is presented here through tables, figures, and discussions on various dimensions of the world economic scene.

The historical, philosophical and ideological aspects of Environmentalism were presented by David Pepper (1984) in a stimulating treatise entitled, The Roots of Modern

Environmentalism. The bibliography of this book covers a wide range of literature which may be very useful to students of environmental education.

Some world experts are not happy with the impact of past efforts. They feel that the pronouncements and recommendations of past meetings have not brought about any real changes in the kinds of decisions made nor in the schools (Aldrich,1980). While some of their observations may be valid, these experts must realize that the success of an international environmental education programme has to be assessed in terms of the existing realities of the various national educational systems, and the limitations of the educational process itself. In much of the world, education has not been able to meet its most basic challenge, that of literacy for all citizens. Therefore, in these countries, the entry of a global perspective of environmental education is bound to be limited, regardless of its urgency.

CHAPTER THREE

GOALS, OBJECTIVES AND GUIDING PRINCIPLES OF ENVIRONMENTAL EDUCATION

Education is a strong instrument of conservation and change in social thinking as well as the most organized means for the transmission of psychosocial heredity. Therefore, attempts have always been made to use education in serving the aims of dominant groups, forces, or ideologies,within a society despite their usefulness to society as a whole. For this reason, environmental education may be a unique exception. Since it is one of the major movements which has been consciously conceived and formulated in response to the urgent needs of all mankind. It did not arise out of the special interests, thoughts, or aspirations of any particular individual, group, or nation but later out of environmental compulsions. Every stage and aspect of environmental education (i.e., the context and criteria, the aims and objectives, and even the broad strategies) have been determined with deep international introspection and through the formal approval of the entire international community. EE has subsumed all the broader aims and many of the general features of the education process itself. Environmental education was conceived not merely to hand down a new culture, but to develop one. Therefore, both a thorough understanding and an assimilation of all aspects of EE as propounded by the Stockholm-Belgrade-Tbilisi endeavors are essential for the planning and implementation of a new curriculum and the review of an existing educational programme. Otherwise, the very spirit of EE may be distorted during its introduction or implementation due to the pressures of different external and internal forces within various existing educational systems. Moreover, understanding and acceptance often go together. Thus a deep understanding about the nature and character of a new educational dimension is even more important in producing a flexible program or adapting one to the diverse patterns and priorities of existing systems without losing its main aims.

The Intergovernmental Conference on Environmental Education (1977) formulated criteria for EE on the broadest base of global identity possible with loyalty to the cause of mankind yet not at the cost of other living things (UNESCO), 1978). In fact, the rights of existence and protection for other living things were fully recognized. The Conference recommended the following Criteria to help guide efforts in developing all aspects of environmental education at the national, regional, and international levels.

1) Whereas it is a fact that biological and physical features constitute the natural basis of the human environment, its ethical, social, cultural, and economic dimensions also play their part in determining the lines of approach and the instruments whereby people may understand and make better use of natural resources in satisfying their needs.

2) Environmental education is the result of the reorientation and dovetailing of different disciplines and educational experiences which facilitate an integrated perception of the problems of the environment, enabling more rational action, capable of meeting social needs, to be taken.

3) A basic aim of environmental education is to succeed in making individuals and communities understand the complex nature of the natural and the built environments

resulting from the interaction of their biological, physical, social, economic, and cultural aspects and acquire the knowledge, values, attitudes, and practical skills to participate in a responsible and effective way in anticipating and solving environmental problems, and the management of the quality of the environment.

4) Another basic aim of environmental education is clearly to show the economic, political, and ecological interdependence of the modern world, in which decisions and actions by the different countries can have international repercussions. Environment should in this regard, help to develop a sense of responsibility and solidarity among countries and regions as the foundation for a new international order which will guarantee the conservation and improvement of the environment.

5) Special attention should be paid to understand the complex relations between socio-economic development and the improvement of the environment.

6) For this purpose, environmental education should provide the necessary knowledge for interpretation of the complex phenomena that shape the environment, encourage those ethical, economic, and aesthetic values which, constituting the basis of self-discipline, will further the development of conduct compatible with the preservation and improvement of the environment; it should also provide a wide range of practical skills required in the devising and application of effective solutions to environmental problems.

7) To carry out these tasks, environmental education should bring about a closer link between educational processes and real life, building its activities around the environmental problems that are faced by particular communities and focussing analyses on those by means of an interdisciplinary comprehensive approach which will permit a proper understanding of environmental problems.

8) Environmental education should be regarded as a continuing process providing its recipients, through the constant renewal of the approach, content, and methods, with knowledge that is always attuned to the changing conditions of the environment.

9) Environmental education should cater to all ages and socio-professional groups int he population. It should be addressed to (a) the general non-specialist public of young people and adults whose daily conduct has a decisive influence on the preservation and improvement of the environment; (b) to particular social groups whose professional activities affect the quality of the environment; and (c) to scientists and technicians whose specialized research and work will lay the foundations of knowledge on which education, training, and efficient management of the environment should be based.

10) To achieve the effective development of environmental education, full advantage must be taken of all public and private facilities available to society for the education of the people; the formal education system, different forms of nonformal education, and the mass media.

11) To make an effective contribution towards improving the environment, educational action must be linked with legislation, policies, measures of control, and the decisions that governments may adopt in relation to the human environment (UNESCO, 1978, p. 24-25).

The Conference recognized that environmental education should promote the strengthening of peace, the further relaxation of international tensions, and mutual understanding among the

States. It should become a real instrument for international solidarity and for the elimination of all forms of racial, political, and economic discrimination.

The Conference also noted that the concept of "the environment" includes a complex of natural, built, and social components in the life of man. The social components constitute a set of cultural, moral, and personal values, as well as interrelations among people in labour and leisure activities. The Conference considered all the works and studies made by various expert bodies, workshops, and regional meetings and concluded that it should be the right of every citizen to receive environmental education. It endorsed the following as goals and objectives of environmental education:

The goals of environmental education are:

-- to foster clear awareness of, and concern about, economic, social, political, and ecological interdependence in urban and rural areas;

-- to provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment;

-- to create new patterns of behaviour of individuals, groups, and society as a whole towards the environment.

The categories of environmental education objectives are:

Awareness: to help social groups and individuals acquire an awareness of and sensitivity to the total environment and its allied problems.

Knowledge: to help social groups and individuals gain a variety of experience in, and acquire a basic understanding of the environment and its associate problems.

Attitudes: to help social groups and individuals acquire a set of values and feelings of concern for the environment, and the motivation for actively participating in environmental improvement and protection.

Skills: to help social groups and individuals acquire the skills for identifying and solving environmental problems.

Participation: to provide social groups and individuals with an opportunity to be actively involved at all levels in working towards resolution of environmental problems (UNESCO, 1978, p. 26-29).

Some of the guiding principles for environmental education recommended by the Tbilisi Conference were that it should:

-- consider the environment in its totality - natural and built, technological and social (economic, political, technological, cultural, historical, moral, aesthetic);

-- be a continuous lifelong process, beginning at the preschool level and continuing through all formal and nonformal stages;

-- be interdisciplinary in its approach, drawing on the specific content of each discipline in making possible a holistic and balanced perspective;

-- examine major environmental issues from local, national, regional, and international points of view so that students receive insights into environmental conditions in other geographical areas;

-- focus on current and potential environmental situations, while taking into account the historical perspective;

-- promote the value and necessity of local, national, and international cooperation in the prevention and solution of environmental problems;

-- explicitly consider environmental aspects in plans for development and growth;

-- enable learners to have a role in planning their learning experiences and provide an opportunity for making decisions and accepting their consequences;

-- relate environmental sensitivity, knowledge, problem solving skills, and value clarification to every age, but with special emphasis on environmental sensitivity to the learner's own community in early years;

-- help learners discover the symptoms and real causes of environmental problems;

-- emphasize the complexity of environmental problems and the need to develop critical thinking and problem solving skills;

-- utilize diverse learning environments and a broad array of educational approaches to teaching/learning about and from the environment with due stress on practical activities and first-hand experience.

CHAPTER FOUR

NEED FOR ENVIRONMENTAL EDUCATION IN TEACHER TRAINING

Although the importance of introducing Environmental Education has almost universally been accepted as a policy, its real impact in schools remains to be seen. There is a persistent and genuine feeling that in spite of international efforts, the environmentalization of school education has been far from satisfactory. There are many reasons for this. The availability of funds, inflexibility of existing curricula, and the determination of policy makers and planners are only a few. But the most important factor has been the inadequacy of personnel trained in environmental education. This lack of personnel exists even in countries in which policy makers and planners are sympathetic to EE and teacher educators are enlightened. Unfortunately, it is also a fact that in many countries these groups are blissfully unaware of both the IEEP's efforts and a need for teacher training in environmental education. There needs to be a more intensive effort to reach these countries. In many countries another problem exists because preservice teacher training is not a prerequisite for entering the profession since no one realized this to be a need in the educational process.

The need for teacher training in environmental educational programmes can hardly be overemphasized. Today's education is a highly structured and organized activity through which necessary knowledge and understanding, mental and physical skills, and attitudes and values are imparted to pupils. In the teaching/learning process no factor, other than curriculum, is more important than that of the teacher. The instructor is the sole arbitrator of curriculum and the central figure in the classroom. The teacher not only motivates learning, but also organizes learning sequences and situations, and carries out the whole programme of education. Teachers are important professionals and like any other group of professionals, they require a proper background in the subject, along with necessary training and commitment to effectively impact desired skills and attitudes on the learner. Without proper training, much energy is wasted and efficacy diminished. In order to become a good professional, teachers need knowledge of how children grow, develop, and learn as well as knowledge concerning how children can best be taught thus bringing out their innate capacities. Special training and commitment is also important in bringing an environmental thrust to education and . For, this is a new focus which requires specific awareness, knowledge, and skills, along with an outlook which might not have been developed in the rest of their educational career.

A great need for both teachers and teacher educators trained in environmental education has been felt in both developed and developing countries. Even in the most advanced countries, like the USA where educators have wide support for incorporation of an environmental dimension in education, the percentage of teachers trained in EE is far from adequate. The picture in developing countries, particularly those having large populations, is even worse. In a 1975 international survey conducted by the IEEP, the majority of member States reported a very high need for the training of personnel. The various regional meetings of experts, sponsored by UNESCO in 1976-77, also expressed a need for teacher training as an essential requirement in the development of environmental education. Experts urged the strengthening of existing programmes and creation of new ones. In most countries, conditions have not improved much since that time.

The Tbilisi Conference considered the training of personnel, including preservice and inservice teachers and all others connected with education and environmentally linked matters, as a priority activity. The Conference Report requested that States establish national level programmes of action, whose purpose was to familiarize teachers, educational administrators, and planners with the different aspects and problems of the environment (UNESCO, 1978P). These programmes should also provide individuals with a basic level of training, both inservice and preservice, enabling them to incorporate environmental education effectively in their respective spheres of activities.

The Tbilisi Conference, considering the need for all teachers to understand the importance of environmental emphasis in their teaching, recommended that:

-- environmental science and environmental education be included in curricula for preservice teachers;

-- the staff of teacher education institutions be associated in this respect; and

-- teachers should get appropriate environmental training relating to the area, either urban or rural, where they are going to work.

The Conference also recognized that a great majority of existing teachers had graduated from teacher training colleges at a time when the importance of environmental education was not so apparent. Their training courses were also deficient in environmental issues and the methodology of environmental education. In view of the above, the conference recommended to Member States that:

-- they take the necessary steps to make inservice training of teachers in environmental education available to all who need it;

-- the implementation and development of inservice training, including practical training in environmental education be made in close cooperation with professional organizations of teachers, both at the international and national levels;

-- inservice training take account of the area, either urban or rural, where the teachers are working.

-- teachers and learners should be involved in preparation and adaptation of instructional materials for environmental education; and,

-- teachers in training should be given an understanding of the widest possible range of educational materials and aids, with special reference to low cost materials and to opportunities for adaptation and improvisation according to local circumstances (UNESCO, 1978, p. 30-36).

The need for professional training of educators further arises from the fact that even topics related to the environment which are covered in present subject curricula, both in schools and teacher training programmes, do not place a real emphasis on environmental education. At best they may lead to more environmental literacy. Definitely, knowledge about personal hygiene and environmental sanitation, water pollution, energy, material resources, forestry, climate and weather, and population are topics related to environmental education. But environmental education is all these and a great deal more. It is not enough to cite problems, realistic solutions must also be attempted. Even if there is an awareness that environmental matters are legitimate concerns of society, there should also be the conviction that environmental education is an important response. EE can offer answers to some of these concerns from both a local and global

perspective. This realization on the part of decision makers could lead to development of meaningful environmental education courses.

It must also be understood that environmental education seeks to achieve a great change in formal education by adopting a new approach. This approach not only gives a few pieces of information on environmental concerns but also brings about a new personal and individualized behavior based on a 'global ethic' which can be realized only through the enlightenment and training of education professionals.

Intensive teacher education, not merely orientation, is essential if the present fragmented approaches of traditional education are to be transcended in favour of a holistic, global approach. Interdisciplinary and multidisciplinary treatment of issues would require a thorough change in both the outlook and content preparation of teachers and teacher educators.

This task is far more complex than putting environmental content into existing curricula. A need for the development of environmental education policy at local, national, and international levels is also needed and has been accepted in many cases. But policy is only a guideline or blue print for action, to create effective changes large scale preservice and inservice teacher training programmes in EE must be organized.

CHAPTER FIVE

ESSENTIAL ELEMENTS OF ENVIRONMENTAL EDUCATION IN TEACHER TRAINING

Any effective environmental education programme for preservice and inservice educators should consist of three basic elements. First, the educator needs a functional knowledge of environmental sciences. This would include familiarity with major facts and forces in the environment, problems of the environment, and an ability to seek and acquire knowledge into particular aspects of those problems, if required. The second essential element is a grasp of the educational methods and professional skills needed to impart cognitive, affective, and psychomotor skills to the learner. This should particularly include value clarification and action oriented abilities. Finally, the educator's training should expose him to actual situations in which learners can further strengthen their reservoir of skills.

The imperative areas of environmental education in regard to teacher preparation programmes have been discussed by various experts. Some have identified content and approach in terms of the effect of local situations on particular programmes and thus very specific strategies tare suggested for adoption. But the views of educational experts dealing with global or wider perspectives are very similar in regard to teacher training. Stapp (1975) has provided a scheme for preservice teacher training which has also been cited by Selim (1977). This scheme seems to form an accepted frame of reference in almost all subsequent discussions (UNESCO, 1980). Of course, some of the areas have been modified, extended or elaborated. Stapp's scheme groups the competencies required of a teacher into the following levels:

1) Environmental science competencies comprising (i) Ecological foundations, (ii) Economic foundations, and (iii) Human ecosystem foundations.

2) Educational competencies comprising (i) Psychological foundations, and (ii) Educational foundations.

3) Environmental educational skills comprising (i) Problem-solving, (ii) Handling of values and controversial issues, and (iii) Use of materials and local situations pertaining to the environment.

4) Methods of teaching environmental education comprising (i) Aims and objectives, (ii) EE methods and techniques, (ii) Resources for learning and group dynamics, (iv) Curriculum design, and (v) Field work and environmental ethics.

It is evident then, that training courses in environmental education should be based on the same criteria and minimum content that teachers are expected to use. But, as conditions vary widely in regard to status, structure, duration, resources of teacher training programmes and also classroom and curricular situations, a uniform course can neither be prescribed nor considered desirable. The situation becomes further complicated because EE components may be taught by various subject area teachers (i.e., science, history, language) all with different depths and kinds of training in both general education and background knowledge of the environment. Therefore, a teacher training programme in EE should contain some essential knowledge about the environment,

its problems, and other dimensions which are common to all although the depth of treatment should of course vary.

It should also be realized that the prospective teacher may often have misgivings about both the environmental movement and EE picked up from stray or biased writings and discussions. The training programme should therefore take cognizance of these notions and try to put them in correct perspective. Some problems and possible corrections are discussed below:

1) The term environment in the present context does not merely mean 'surrounding'. It includes all nonliving and living objects, happenings and forces, both natural and man-made, which influences the life of an organism. The relationship of organisms (including man) to the environment is indivisible and interdependent to the extent that any organisms is a part of its environment.

2) Perception of the environment and its realities depends upon the developmental stage of people and their pool of knowledge.

3) The environment is a continuum extending from the medium (air or water) in which one lives to distant objects like the sun or moon, and possibly even beyond. All aspects of this continuum influences an organism. The medium influences breathing, the sun supplies energy, and the sun and the moon are responsible for the tides. The internal condition of the body is also an important part of this continuum.

4) The words 'environment' and 'nature' are often used as synonyms. Although overlapping, strictly speaking, they are not synonymous. Environment has an implied reference point to an individual, some object, or a living form in space and time. Nature, in its widest sense, would include all of the universe with its phenomena and forces both known and unknown, irrespective of any reference point. The environment is a part and product of nature and is governed by natural laws and principles. Some natural occurrences can create, alter, or destroy an environment. Man, through his understanding, can modify the environment but cannot change natural laws.

5) It should be realized that man's present concern for the environment has not arisen from a romantic love for nature, although natural beauty is an essential factor of human culture and aesthetic satisfaction, but instead has grown from a wise realization and concern for the survival of man and other organisms.

6) Environmentalists recognize change as a universal process, needed for the development and progress of mankind. But at the same time, they are conscious of scientific studies which suggest that too drastic a change, natural or man-made, is harmful. Present threats to the environment are the result of too rapid technological developments and their injudicious use. This realization of a crisis is the result of human knowledge and wisdom in one or more components of the environment.

7) Man has profoundly modified the environment through his understanding and application of natural laws and principles, but he cannot make modifications beyond the limitations imposed by nature. He has to look forward to his own ever widening knowledge and understanding of developments in science and technology to maintain and strengthen his environment.

8) Energy and matter are the two most fundamental components of a natural system. Everything in the universe is the manifestation of energy and matter with differences in form and phenomena due to the process of change and the interactions of matter and energy. This is true at all levels of the environment from the cosmic (universe) to ultramicroscopic. Energy and matter form the basis of all systems both natural and man-made.

9) Life is a natural phenomenon. As far as we know today, the phenomenon of life is limited to this planet because it has all necessary conditions of energy and material for the genesis and continuation of life.

10) There is strong evidence to suggest that the entire universe is the product of a continuing process of change, a cosmic evolution. After its formation, the energy and material conditions of the earth began to undergo changes. When conditions became suitable, life originated on the earth . Most life today is formed from pre-existing life. Evidences also suggest that diverse life forms gradually arose through millions of years of organic evolution. Among the different life forms, man appeared most recently as a product of biological evolution. With the appearance of man on earth a new course of evolution, psychosocial evolution, began as a part of biological evolution. This type of evolution is continuing through changes in the mind and thinking and through the formation and progress of society.

Therefore, it follows that (1) all living forms including man are related to one another either closely or remotely through common ancestry and (2) probably each species of plant and animal today is the result of millions of years of biological evolution. Thus once a form of life is lost from the Planet, it cannot be created anew. These aspects have profound ethical implications in environmental education.

Earth - A Life Support System

The earth is the third planet from the sun in our solar system, orbiting around the sun in space. It has its own material composition pattern with a central core, upper crust, and a gaseous envelope. The earth, and all its subsystems are determined by the interactions of energy and matter presenting a dynamic equilibrium of conditions. These conditions are caused by the gravitational forces of the sun, the earth, the moon, and other celestial bodies. The rotation and revolution of the earth and the revolution of the moon around the earth are due to gravitational forces. The main source of radiational energy (light and heat) for the earth is the sun. The inclination of the earth's axis to the ecliptic and the elliptical orbit of the earth around the sun cause variation in the duration of day and night in different parts of the earth. This in turn causes seasonal and climatic changes in factors such as temperature, humidity, movement of wind, ocean currents, and the formation, movement, and condensation of clouds. Tides are caused by the gravitational attraction of the moon and the sun. Physiographic factors like mountains and oceans, influence the interrelated climatic and biological factors.

The earth perennially receives radiational energy from the sun basically in the form of heat and light. Some of the harmful radiations are filtered out by different layers of the atmosphere. Only a small quantity of the total energy received on Earth is utilized by organisms, including man, for their energy needs. An enormous quantity of energy is radiated back into space.

On the other hand, matter is involved in an almost closed system on the earth. There is very little inflow of matter from outside so that the sources of materials are, therefore, finite. The forms in which matter is usable to organisms is even more limited and exhaustible if overuse occurs.

The essential physical conditions necessary for the continuance of life on Earth include (1) availability of light for the synthesis of organic compounds by green plants which are in turn used as food for both plants and animals, (2) the presence of chemical elements in a usable form, (3) an atmosphere protecting the earth's organisms from the harmful solar and cosmic radiation

and also containing those gases in a proper mix needed to support life, and (4) the presence of water.

Optimal conditions for the sustenance of life are not available everywhere on the earth. Only limited areas provide the congenial conditions necessary for life. Neither can all types of environments support every kind of organism. Only one organism, man, has crossed this environmental barrier with an ability to carry his 'environment' along with him.

The global environment consists of three main subdivisions: (1) the lithosphere which includes the solid components (i.e., rocks, soils, minerals) of the continents and other land masses; (2) the hydrosphere which comprises all the water of the oceans, seas, rivers, lakes, and atmosphere; and (3) the atmosphere which is the gaseous cover composed of the layers enveloping the lithosphere and the hydrosphere. These three parts in which life exists, comprise the biosphere.

The atmosphere, as mentioned earlier, is a gaseous envelope made of several layers. Just surrounding the surface of the earth is the first layer called the troposphere which extends 8-16 Km. from the surface. This is the layer containing mostly air composed of nitrogen, oxygen, and carbon dioxide, as well as traces of other gases.

Beyond this layer is the stratosphere which extends up to 80 Km. The air is thinner here and the temperature is constant throughout. It is devoid of turbulence and contains an ozone layer in the area between 30 to 50 Km. This ozone layer is formed by the action of solar ultra-violet rays produced by the sun and to a great extent protects the living world against such radiation.

Extending hundreds of Kilometers beyond the stratosphere is the ionosphere. It contains a large number of ions and free electrons produced by the bombardment of short wave solar radiation on atoms. This layer also protects life on earth by filtering out harmful radiation and burning off falling meteors.

The composition of the air varies in the vertical layers of the atmosphere. Although generally uniform it becomes rarefied with increases in altitude.

The Biosphere

Looking closely at the biosphere as a complete system also allows one to see the subsystems called ecosystems of which it is made. Each ecosystem has a definite organization with both structural and functional components. The various structural components of the environment can be classified into two main groups, the physical or abiotic and the biological or biotic. The flow of energy and the cycling of matter are the two main functional components which tend to achieve some stability through self-regulation.

Abiotic factors include all the physical and chemical factors of the environment. These include climatic factors like weather, season, light, temperature, humidity, rainfall, snowfall, cyclones, wind, and edaphic factors like the presence or absence of topsoil, soil texture, soil pH, soil temperature, moisture retaining capacity of soil and inorganic and organic content of the soil. All of the these factors together determine the nature of vegetation, the animal life, and both the habits and habitats of human populations.

The biotic component consists of all organisms. These organisms are made of matter, use energy, and have a unique organization. Biotic factors can be divided into three levels of organization; individuals, populations, and biotic communities. Biotic factors in an ecosystem include the

various interrelationships and dependences between plants and animals for food, shelter, reproduction, and diseases.

Functionally, however, the biological components are a part of the larger physical environment and are dependent on it for energy and materials. These two interactive components, biotic and abiotic form the basic structure of the environment and can be found at any level from the biosphere to its smallest units. Sunlight and heat provide energy for both living organisms and the physical world but within the living world, this energy must be connected to food energy for life processes.

The Structural Components of the Biosphere

Green plants absorb carbon dioxide and water to capture the energy of sunlight in photosynthesis. Carbohydrates are produced in this process with the help of the green pigment, chlorophyll. Plants can then synthesize necessary proteins and fats from these carbohydrates. Because they make their own food,plants are called autotrophs or producers.

Animals cannot produce their own food. They must obtain food from plants and may be called heterotrophs or consumers. Herbivores are first order consumers, they feed directly on plants. The animals which feed on herbivores are called second order consumers or carnivorous. The animals which feed on the carnivores are third order consumers and so on.

The organisms, plants and animals, which produce food for each other in a series constitute a food chain. Each step in a food chain represents a trophic level.

Organisms like fungi and bacteria are also incapable of preparing their own food. They live on the dead or decaying parts of plants and animals from any trophic level and are consumers of a special kind, called decomposers.

The Functional Aspect of the Biosphere

The energy of the sun enters the living world through green plants and then passes from one organism (trophic level) to another in the form of food. At each level, some energy is used for the life processes of an organism and some is lost from the system in the form of heat. Only a portion of the energy produced or consumed at each trophic level is passed on to the next level. At each stage of energy transfer, a considerable amount of energy goes back to the physical environment.

Matter in living things is different from that in the nonliving world. It differs not only in the proportion of various elements but also in the type of compounds that are used by living forms. Some materials are selectively incorporated into the bodies of living beings. All material requirements are drawn from the physical environment and they again move back to the nonliving environment as the body wastes and eventual decaying body of an organism. Thus materials are again available to the living world. This kind of transfer of materials between the living and nonliving world is known as cycling of matter. However, within the living world, materials are transferred from one trophic level to another in the form of food. The study of the water cycle, carbon cycle, oxygen cycle, nitrogen cycle, and some other mineral cycles is very important in a study of life and the environment. The recycling of matter is a natural phenomenon.

Food is the means of transfer of both energy and matter in the living world. Therefore, awareness of food relationships is an important aspect of environmental knowledge. A food relationship in its simplest form, is found in a food chain represented by a producer, a primary consumer, and a second consumer. But in nature, food relationships form a complex web because both

the primary and secondary consumers, or tertiary consumers for that matter, usually derive their food from more than one source according to the availability and choices of food at any particular point in time.

In any one chain at successive levels, organisms are usually, though not invariably, smaller in number. That means a graph of the number of organisms existing at successive levels of the food chain assumes the shape of a pyramid. Similarly, as stated earlier, the amount of energy and matter transferred through food also decreases at each successive level. Numbers of individuals and their energy can be measured and graphed. The resulting graphs would show a pyramidal shape, both a pyramid of energy and a pyramid of biomass.

The efficiency of food relationships in a system is determined by the proportion of energy and matter transferred to each higher level. The system which allows a higher degree of transfer and a lower proportion of loss at each step is known as an efficient system.

The number of organisms at any one level depends on the availability of food organisms at the preceding level. This results in a balance of food influencing exchange rates of materials and energy and thus producing a grand balance of nature. This balance is flexible enough to allow for variation within a limited range at each level.

Within the biosphere, any structural and functional unit which can be identified and studied is known as an ecosystem. As long as the major structural components of the environment, that is the abiotic and biotic factors, operate together to achieve functional stability for even a short time, the total entity may be considered an ecosystem. An ecosystem may be artificial or natural. Examples of ecosystems include a large grassland, a forest, any part of the ocean, a pond, an aquarium, a city, a village, a dead log or even a manned spaceship.

The Ecosystem

The structural components of an ecosystem are the abiotic factors which include the physical and chemical conditions, and the biotic factors which are the producers, consumers, and decomposers. If comparatively stable ecosystems are taken from very different parts of the biosphere say, one terrestrial and the other aquatic, the same structures are found to be operative, although the details of the physical conditions and kinds of organisms would vary widely. Regardless of the size of the ecosystem, an increase in diversity at each level of organization results in more self-regulation and greater stability.

The functional component comprises the flow of energy and matter in the system. The rate of flow determines the efficiency of the system. Since ecosystems are primarily functional units, it is difficult to exclusively separate one ecosystem from another and the biosphere is actually the sum total of all ecosystems integrated as a series of gradients to produce a universal environment.

A particular sequence of ecosystem development, related to a particular set of physical and chemical conditions, is called a succession. Succession is composed of a number of seres with organisms replacing each other through the course of time. The last sere in a succession is known as the climax or climatic climax. The biotic components of an ecosystem can be divided into the following levels of organization; individuals, populations, and biotic communities.

Individuals

An individual is a distinctly organized unit of life composed of systems, organs, tissues, and cells which are capable of functioning independently. Individual organisms can be recognized as belonging to different groups called species. Examples of species include cats, dogs, deer, roses,

corn, and man. The members of a species usually live in a group but not all are necessarily restricted to one area. All species share the following features . They are capable of naturally breeding among themselves to produce fertile offspring. They have a common habitat and also a distinct way of living in and reacting to the environment (ecological niche).

Populations

A population is a group of individuals living in a specific geographic area at any particular time. In describing a population several parameters should be considered. They are the type of species, the amount of area or space they occupy, the time of reference, and the number of individuals. The number of individuals of a species per unit area or space denotes its population density. This is a measurement used only in relation to some purpose, problem, or study. Both the size of a population and the population density of an area or space can vary.

Individuals are added to the population in one of two ways, through natality (birth, hatching, or germination) and immigration. A population tends to decrease by either mortality or emigration. Population size is also affected by changes in the environment. If the environment remains the same a population will often maintains a balance between the number of individuals lost and gained. A population tends to increase in size as long as individuals get enough food and space. The resulting increased population pressure tends to decrease the amount of food and space available to individuals which may in turn lead to a fall in natality (birth rate) or to emigration. Food and space are two major limiting factors of population growth. Biotic factors chiefly influence a population through food relationships or disease. But population may also be affected by abiotic factors. Small, gradual fluctuations in any factor are adjusted for quickly. However, a sudden change in the environment, likea drastic decrease in food supply or habitat destruction, results in large scale death or even extermination of the population.

Biotic Communities

A biotic community is comprised of the smallest number of interrelated populations, living in a a particular environment, which can survive in nature. Different populations of both plant and animal species are found in a community. The most important relationship between the various populations in a community is the food relationship known as trophic organization. This type of relationship between one organism and another has historically evolved through interactions based on requirements for both food and shelter, as well as the habits of organisms living in the community. These relationships can be classified based on the interactions which exist. Five examples follow.

1) Predation - a relationship in which one animal captures and feeds on another. Examples: frogs capturing insects, snakes feeding on frogs.

2) Scavenging - a relationship in which one animal feeds on the dead body of another. Example: a vulture feeding on a dead bird or snake.

3) Parasitism - a relationship in which one organism (a parasite) not only derives its food from another organism but spends a part of its life living in the organism (the host). Examples: the malarial parasite on man and mosquito; tapeworms and liver flukes on vertebrates.

4) Commensalism - a natural relationship between two organisms which live together without harming one another. Examples: the hermit crab and sea anemone.

5) Mutualism - a relationship of two associated organisms in which both organisms derive benefit from each other. For example, hydra or sponge with Zoochlorellae, or the the alga and fungi which compose a lichen.

6) Competition - a relationship between organisms which involves a struggle for the same type of food, shelter, nutrients or sunlight. Example: mice and man compete for grain.

There are many other types of relationships where the association is apparently not as close or exclusive but still exists for the purpose of shelter, pollination of plants, dispersal of seeds or fruits, among others.

Man and the Biosphere

Man is the dominant organism in the biosphere. He has had a greater effect in modifying both life and environments on the earth than any other organism. In fact, he himself has changed so much through psychosocial evolution that it is difficult to recognize man as a biological being. Similarly, man has modified his environment so profoundly, through tools, skills, and social institutions that his environment deserves to be studied as a special entity called the social environment. In the process of changing his immediate environment, he has in turn affected almost the whole of the biosphere. The proportion of his influence has grown gradually over thousands of years. But in the last 150 years his influence has increased drastically due to population growth, our ever increasing techno-scientific power, and their consequences. All human influence has not been favorable and is not likely to be. On the contrary, human activities are posing serious threats not only to the survival of other organisms in the environment, but also to man himself.

Again, it is evident that the man-made environment is part of and dependent upon the natural environment. Therefore, man's activities and his relationship with the environment have to be understood in light of the serious problems already created in order if future crises are to be avoided.

Sociocultural Environment

The sociocultural or man-made environment consists of everything around us that is developed by the human brain, hand, tools, skills, and social institutions. The man-made environment has the same basic structure, both physical and biological, as the biosphere. The fundamental functional components and needs related to energy and matter are also similar although much more complicated.

The man-made environment includes all man-made structures, all means of agricultural and industrial production, all means of transport and communication, complicated societies, and social activities originating from human culture.

The human society, like that of any other social animal (i.e., bees, termites), is a closely integrated group of individuals held together by mutual dependence and division of labour. It is organizationally highly structured and complicated. It normally furnishes protection, continuity, security, and identity for its members. The structure of human society has grown gradually from learned behavior in the various forms such as traditions, values, customs, norms, and folklore. These behaviors are transmitted through socialization and cultural communication and not by genetic inheritance. The behavior patterns are established gradually and form social institutions, such as, the family, religion, education, the economy, and politics. These behavior patterns are outlined on the next page.

1) A Family is a unit of the human community. It consists of individuals who have a bond of kinship arising from marriage. Marriage is also related to birth, child care, and the protection of young. Therefore it also relates to population growth and the health of a community. The norm of marriage varies among communities. The size, composition, and traditions of a family differ and the roles of the various family members affect the environment and behavior of each.

2) Religion is a very powerful social institution usually consisting of a set of beliefs relating to the cause, nature, and purpose of the universe and its creation. The origin of these beliefs is often considered to be the result of a supernatural force. Religion involves devotional and ritual observances, moral codes, conducts, institutionalized beliefs, and practices generally accepted by members of the religion. Religion is a very ancient force determining ethics, attitudes, and values and thus demands special attention from the stand point of environmental education.

3) Education in modern society, is the strongest means of socialization and transference of knowledge and skills from one generation to the next. It is an organized and planned activity for achieving social goals. Education, therefore, can act as a powerful tool for social progress, including proper attitudes, values, and action skills needed to improve the quality of the environment and life.

4) Economy probably is the strongest social institution guiding man's own means and mode of production and management. Economics relates to the study of production, distribution, and use of commodities, as well as energy and material resources, income, and wealth.

In modern societies, the economy is quite a complex basic social institution comprising activities such as planning, investment and management, profit and consumption, as well as financial and banking operations at both national and international levels. Although ownership patterns for production and distribution vary in different societies, every activity mentioned above is guided by economic considerations in a modern civilized society. Biologically man is a consumer who uses food energy produced by other organisms. But socioculturally he may be considered as a producer because man, through his tools, skills, and technology has developed his own means of production, agriculture and industry. Through agriculture he has vastly increased the productivity of the ecosystem. He has produced goods in his factories both for his protection and comfort.

Any action oriented environmental education programme, therefore, should have an appropriate component of economics, particularly related to the cost-effect relationship between resource management, conservation, cost of pollution control, and its economic benefits on a long term basis. Population and economic considerations should also be taken into consideration as well as other factors such as planning of consumption patterns, poverty or affluence, and the ultimate risk of environmental degradation and its resulting cost of a nation in terms of the national economics, the global future, and a new economic order.

5) Politics is a social institution relating to the evolution and structure of the State and Government, their power and activities of law making, and law enforcement within their jurisdiction. The politics of a society are supported to reflect its collective desires and decisions even though a loss of some individual activities, not considered to be desirable by the society as a whole, may occur. Political systems and activities vary from country to country according to their stage of development. As a social institution politics can help improve the status of the environment through legislation.

Besides the social institution of politics there are several other factors which determine social environment. They are history, art and aesthetics, entertainment and recreation. A brief consideration of these areas follows.

6) History All the social institutions mentioned above are the products of history. A society is shaped by the events, experiences, and achievements of the past. History determines the norms, emotions, identity, and attitudes of the present and future. Evidence concerning the achievements and activities of the past are found in the records and the archaeological objects which form our human cultural heritage and are an important part of our environment. Many environmental concepts can be dealt with through the teaching of history.

7) Aesthetic sense of the appreciation of beauty is a unique human attribute constituting an important cultural component of our environment. Drawing, painting, dance, music, literature, and sculpture are some of the art forms which are sources of mental satisfaction and joy. These art forms are also used as a means of communication of human feelings, emotions, and perceptions. Since art is a part of most modern curricula, many aspects of environmental education, mainly related to awareness and action, can be imparted through the teaching of art.

Man and the Food Chain

As a biological being, primitive man had to compete with other organisms for food and shelter. Man, as a hunter, had been primarily a second order consumer living on herbivorous animals and fishes. At times he was also a first order consumer, eating fruits and other plant products. With the development of agriculture however, man became more efficient both as a primary and secondary consumer. He grew plants for his own consumption and as fodder for domestic animals. The growth of agriculture helped man shorten his food chain and partially liberated him from the uncertainties of hunting and food gathering.

Man and Energy

Man as a biological being is only a part of the energy flow mentioned earlier. He obtained energy for his life processes through the food chain and kept himself warm by depending on the sun. Later he discovered fire, which he used primarily for warmth but gradually started using for various other purposes. As a civilized being, man uses much more energy than any other organism and his pattern of energy consumption has greatly changed. A tremendous amount of energy is now required for agriculture, industry, transportation, comfort, communication, and war. But not only has his requirements for energy increased but also his capacity of deriving energy from different sources has increased. He has been extracting additional energy from both wood and charcoal and has trained draught animals to do work for him.

At present, the use of fossil fuels like coal, oil, and gas has dramatically increased. Fossil fuels are the products of a transformation from solar energy into chemical energy through photosynthesis and exist in limited supply. Blowing wind and flowing water (which are again derived from solar energy) are also used for energy. The only non-solar energy source that man has begun using is nuclear energy which has considerable radiation hazards. The energy profile of our present civilization has grave environmental implications for the future.

Man and Materials

Today modern societies need food, shelter, health, and comfort for ever increasing populations of different tastes. To meet man's desire for greater technology society requires many types of materials in enormous quantities. Man has altered many existing chemical cycles by supplying

nitrates and phosphates as fertilizers and using chemicals as pesticides in modern agriculture. He has also destroyed some natural habitats and polluted others with industrial wastes. In other words, the whole biosphere, and its subordinate ecosystems, has been changed from a self-sufficient system into a resource for its dominant inhabitant, man.

Man and Resources

Resources are any source of help, energy, or material, which is needed for some purpose. Resources therefore, would vary from society to society, depending on the time, space, and the stage of development in a specific culture. Energy, air, water, soil, minerals, vegetation, and animals are all important resources. All resources required for man are derived from the natural environment. These resources can be classified as renewable and nonrenewable.

Resources which have the inherent capacity to reappear due to rapid recycling, reproduction, or replacement, or can maintain themselves if managed and used judiciously, are considered to be renewable resources. Plants and animals, both domestic and wild, may be considered renewable if they can maintain their normal population levels. Land and soil, if well managed, as well as water, derived from normal water cycle, are also renewable resources.

Resources which do not have an inherent capacity to maintain themselves by replacement, reproduction, or recycling in practical terms, are considered to be nonrenewable resources. Fossil fuels, most underground water, and metals are examples of nonrenewable resources.

Yet there is no strict line between renewable and nonrenewable resources. Energy sources such as wood and charcoal are renewable resources, but through large scale deforestation, they have become nonrenewable in many areas. Similarly, soil, a renewable resource, can become nonrenewable due to large scale erosion and degradation. Underground water also can become a nonrenewable resource if used too fast or severely polluted.

Resource Distribution

The availability of resources and their capacity for utilization are not uniform in all parts of the world. Therefore, competition exists between nations for obtaining these resources. Also because of a wide disparity in the distribution and productivity of goods and services among various sections of people within a country, most resources are consumed by comparatively few people both nationally and internationally. This leads to grave economic disparity and unequal standards of living, ranging from abject poverty to wasteful affluence, both between and within nations. Since the needs of individuals or societies have no absolute end, the present situation calls for value clarification and a new ethical order for human species as a whole.

Human Population

Like individuals and societies, human populations have their own uniqueness in many respects. Population growth depends on many complex factors. Besides climatic factors, other factors like location of natural resources, and socioeconomic factors also influence the size and rate of growth within a population.

Birth rate in a human population is regulated, as in any other population, by biological factors, like reproduction behavior of the species, environmental factors, and social factors. These three factors cannot be strictly delineated in the case of man for it is evident that often social factors are more important than biological ones. This is because some important environmental factors have been basically neutralized by sociocultural achievements. For example, man,

unlike most other animals, has a perennial reproductive season and it is not really known whether or not this attribute might be the result of sociocultural evolution.

Taken as a whole, the human population is growing at an enormous rate. Unlimited population growth has serious environmental implications leading to problems in overcrowding; decrease of per capita income; decreases in the supply of food, shelter, energy, consumer goods, and services; and a decrease in standards of living for many people. Thus a culture's aspirations, economic growth, and social development are limited by population growth.

The rate of growth is not uniform in all countries or among different groups within a country. Populations in developed countries are more stable than those in developing countries, since both birth rates and death rates are lower in the former.

The study of trends in human population and the prediction of future developments constitute a specialized discipline known as demography. Considerations in demographics include birth rate, death rate, immigration and sensitive measures, the number and proportion of different age groups, sex groups, and the economic status of a state. These considerations are important for developmental planning regarding education, training, employment, and health care for members of a state.

There is an increasingly obvious relationship between population growth rate and the level of economic development, industrial development, and education of people. These relationships are also generally true for the various sections of people within a country. Rapid urbanization is another factor affecting the quality of like, particularly in developing countries where economic development is not keeping pace with population growth.

Man and the Biotic Community

With the progress of civilization, man has gradually changed both abiotic and biotic features of the landscape and has become the dominant species within a large part of the biosphere. On the one hand, he has reduced the uncertainty and hazards of his dependence on particular biological communities and on the other hand, he has replaced many 'natural' communities with man-made communities, suiting his needs and desires.

The present human population could not be supported without the help of domesticated plants and animals. Man has developed many special types of relationships with plant and animal populations because of his unique ways of living and thinking. These relationships may be categorized in the following ways.

1) Fish and meat yielding animals serve as prey.

2) Tigers, leopards, and lions still serve as predators of man.

3) Man serves as a host for parasites like tapeworms and flukes.

4) Roaches live as inquilines in man's home.

5) Robins and weeds have become opportunists because of our cultivated lawns.

6) Cats and dogs serve as cultigens and pets.

7) Rodents serve as pests to man and his pets by competing for food.

Man has also changed the geographic distribution of plants and animals by introducing them into new areas. The water hyacinth in India and the Indian mongoose in Hawaii are two examples of this. This creates disturbances in established populations and causes readjustments in relationships within the various regions.

Man has largely contained his predators and partially controlled pathogenic parasites and pests through the use of fire arms, medicines, and chemical pesticides. But the most unique feature of man is his intense effort toward an intraspecific struggle resulting from his sociocultural development. This special type of competition is commonly called war. Man has developed enormous war machinery for the defence of any territorial or group interest of nation-states which far exceeds the measures he has taken against enemies of other species. The global war efforts involve far more manpower, energy, and material resources than are employed on health care or welfare schemes. A tremendous amount of trained manpower, research effort, and energy and material resources which are locked up for war purposes could be released for removal of poverty, improved welfare, and better education. The result being an improvement in the quality of human life on the earth requiring deep human introspection and thinking to work out a new world order.

Environmental Problems and Probable Solutions

The study of environmental problems and their solutions is the most essential component of any EE Curriculum. This is a very complicated area. The biosphere is a global ecosystem consisting of innumerable subsystems. Different problems in the environment are not mutually exclusive and most are causally interrelated. Finding effective solutions may involve many sociocultural factors. It is neither possible nor necessarily needed to discuss all the complexities of these interrelationships, however, some problems and their probable solutions are mentioned here. They are included to indicate an outline of the essential coverage necessary for a teacher training course. The solutions or actions suggested below are only possibilities and are not meant to be prescriptive.

Man's intervention in all aspects of the environment has caused great disturbances, but the effect has not always been harmful. Man has made many areas of the earth more productive than they were in their natural state. For example by irrigating dry regions and draining wet marshes he has reclaimed new lands. But some of his activities have also created new problems. In the past, man has not always made the best use of our resources, probably due both to ignorance and to the apparent bounty of the natural world. But this realization has changed and now humanity as a whole is aware that the environment, of which man is a part, is facing grave problems owing to our ever increasing human demands. These demands emanate from a desire to fulfill not only basic human biological needs like food, shelter, and health, but also human cultural needs such as education, employment, individual freedom and comfort. These needs ultimately involve resources and the prevailing social orders which control distribution and consumption patterns. If man is to survive, it is essential that he becomes aware of the limitations and carrying capacities of resources and then undertakes corrective measures both at the individual and the community levels.

Problems of Resources and Possible Solutions

Environmental resources which are undergoing problems include energy, air, water, soils, minerals, plants, and animals. Some of these resources are being depleted due to over-exploitation, injudicious utilization, or wasteful use. Some are in the process of serious degradation due to ignorant use. And others are in serious trouble due to pollution and the secondary effects of other human activities. These resources will be discussed in detail on the following pages.

Energy

Our greatest sources of energy are perennial solar radiations, stored solar energy in the forms of fossil fuel, fuel wood, solar energy obtainable as hydroelectric wind power, tidal energy, geothermal energy, and nuclear energy. Most perennial solar energy is wasted and so we must depend on the other sources. Man's energy needs have grown tremendously in recent times continue to grow everyday in all societies. This is serious because energy is the pivot of economic progress.

The Problem

An imminent energy crisis is mainly due to an overdependence on fossil fuel energy for the ever increasing demands of modern industry, irrigation, transport, war, and human comfort. Fossil fuels are extremely limited in supply and it is estimated that oil and gas may be exhausted within the next twenty-five years with coal disappearing in 300 years. A shortage in oil and gas resources is already being felt.

The wide disparity of consumption, availability, and sources of energy between countries and communities is also a problem. Thirty per cent of the global population who live in industrialized countries, consume eighty-four per cent of the available energy. On the other hand, the largest populations live in developing countries, and do not even meet minimum energy needs. A disparity also exists between different economic groups living within a country. Privileged nations are using energy lavishly and often wastefully. People in many countries, in the absence of any other source of energy, depend upon firewood for cooking. This dependence is one of the causes of deforestation which is not only deepening the energy crisis, but also removing the vegetative cover which leads to heavy soil erosion and desertification.

Some Solutions

Our present critical energy position calls for vigorous organized efforts at all levels. Individual and government action should be considered in light of these suggestions.

1) The wasteful and lavish use of energy, particularly fossil fuels should be minimized.

2) Dependence on fossil fuels should be reduced through the incorporated use of alternate sources of energy for industry, irrigation, transportation, and household use.

3) Existing facilities for the tapping and use of direct solar energy must be expanded and made both convenient and economical for all kinds of activities. Solar panels, solar cookers, and solar battery driven cars have to be popularized. Photovoltaic power systems for communication, solar pumps, and solar water heating systems must be properly developed.

4) The production and use of biogas has to be expanded. The manufacture and maintenance of biogas plants and biogas engines must be improved.

5) An increased use of and generating capacity for windmills, tidal power, and hydroelectric power have to be accomplished.

6) Community actions like social forestry programmes and alley cropping practices should be increasingly adopted, particularly in rural areas of developing countries.

Air Resources

Air is a basic requirement of life on earth and is therefore indispensable. The composition and concentration of the various gaseous ingredients in the air are maintained by natural cycles. For example, the return of carbon dioxide to the air in respiration is balanced by its withdrawal during photosynthesis.

The Problem

The natural balance of gas concentrations in the air is being disturbed by the industrial activities of man. A few of the many problems which result are considered below.

1) The concentration of carbon dioxide is increasing due to the excessive burning of fossil fuels in homes, factories, and in vehicles. Carbon dioxide traps heat which radiates out toward space tending to raise the average temperature of the atmosphere, particularly in large industrial areas.

2) The release of sulphur and nitrogen oxides from industries increasingly result in pollution. These gases also undergo atmospheric chemical changes to form acid rain which has harmful effects on the soil, surface water, buildings, and living systems.

3) Vastly increased amounts of nitric oxide and chlorine produced from anthropogenic sources break down the natural ozone-oxygen cycle. The effect of supersonic aircraft and chemical industries also causing increased accumulation of nitrous oxides which damage the ozone layer of the higher atmosphere.

4) Various industrial effluents like sulphur dioxide, nitric and nitrous oxides, carbon monoxide and dioxide, hydrogen sulphide, and fluorides in gaseous or dust form pollute the air. This causes damage to plant and animal lives as well as serious hazards for human health. Air pollution also results in corrosion, cracks in buildings, monuments, and other metallic and non-metallic structures.

Some Solutions

Possible actions which may be to taken regarding gross air pollution include the following measures.

1) Constant monitoring of the levels of air pollution and detection of the main sources of pollution.

2) Determination of proper criteria for evaluating standards and air quality based on the harm it does to plants, animals, human lives, buildings and monuments, and other natural resources. Depolluting and preventive measures like precipitators, and the planting of trees must be adopted.

3) Enforcement of laws and legislation to minimize emissions or movement of these industries away from vulnerable areas should be considered.

Water Resources

Water is one of the most essential resources for life. Man needs an adequate fresh water supply of standard quality for:

-- the physiological processes of the individual;

-- domestic or household needs important to healthful living (i.e., cooking, bathing, washing);

-- industrial and commercial needs;

-- agricultural needs such as irrigation of farmlands and orchards; and

-- power generation plants of all kinds, hydroelectric, thermal, and nuclear.

The total volume of water present in the hydrosphere is 1360 million Km. Of this amount, 97.2 percent is found in oceans. The rest is contained in ice caps, glaciers, lakes, rivers, streams, underground water and as vapor. Man is mainly dependent upon fresh water from surface flows like rivers, lakes, and ponds as well as subsurface ground water. Direct rainfall and water obtained by desalination are rarely used. This usable water supply is only about 0.3 per cent of the total volume which man must also share with the rest of the living world.

The distribution of this usable water exhibits great regional disparities. Rainfall and therefore, the amount of water in surface run off and inland water bodies is seasonal, restricted mainly to monsoons in many areas. Erratic behavior in duration of a monsoon and the intensity of rainfall often causes flood and drought side-by-side in the same region. Many areas, particularly arid zones, suffer perennially from a scarcity of water both for drinking and irrigation. Though various populations have adapted to regional climatic conditions including rainfall, the availability of usable fresh water often acts as an important limiting factor.

The Problem

Man's water resources present several problems in relation to the following areas.

1) Limited supplies of water are available to satisfy a need for enormous amounts of water.

2) The quality of water used is often poor. Water may be contaminated by natural impurities making it unfit for drinking or use in industries. Some sources are polluted and in turn affect the soil.

Pollution of water sources has been occurring for a long time. Cities on the banks of rivers have been discharging large volumes of sewage. Bathing in water and washing of domestic animals also makes the water unfit for drinking and other uses. Increasing populations and modern drainage systems produce a huge quantity of sewage which is released both into the sea and into rivers. Most of this remains untreated. A large number of water sources, including parts of the ocean are further polluted by oil spills, which makes them unfit for aquatic life. The discharge of harmful industrial effluents also account for pollution of rivers. Due to rapid industrialization in developing countries, some fear that all yearly run off may be polluted within the next two decades.

Most water sources (i.e., rivers, canals, ponds, and wells) in rural areas of developing countries are contaminated with pathogenic organisms which cause the following types of disease.

1) Water born diseases. Examples: cholera, typhoid, hepatitis.

2) Water washed disease. Examples: scabies, conjunctivitis, etc.

3) Diseases spread by water related vectors. Examples: malaria, yellow fever.

4) Diseases spread by aquatic vectors. Examples: guinea worms.

5) Diseases related to faecal disposal. Examples: amebic dysentery.

Another problem is due to the increasing use of pesticides and fertilizers. Break down residues from these compounds pollute rivers and other inland water sources as well as underground water in various parts of the world.

Some Solutions

Management of water resources will be more efficient and water use will be more judicious if the following measures are adopted.

1) The rate at which underground water is used must be slowed.

2) Greater use of surface water from the natural water cycle should be made.

3) Sewage should be properly treated to make it harmless before it's release into rivers.

4) Industrial effluents should also be treated to minimize their pollution before draining them into rivers, the ocean, or onto soil.

5) Potable water sources should be protected from harmful contaminants to ensure safe drinking water for populations in both urban and rural areas.

6) Agricultural use of water should be optimized.

7) Water loss through seepage and evaporation from irrigation canals, dams, and other reservoirs should be minimized.

8) Efforts should be made to purify contaminated or polluted water.

Soil Resources

Soil is also an essential resource for the living world. It originates from the decomposition of rocks as pure mineral material. In the course of time, decaying organisms that lived within or on the surface of the developing soil enter into its composition. The fine space, called interstices, between particles of soil of various sizes are filled by water containing a variety of minerals and inorganic substances along with air containing relatively high concentration of carbon dioxide. That makes the soil system a complex of solid, liquid, and gaseous phases of different composition and texture. The exact condition of the soil is determined by the mineral composition of the parent rock, time, topography, climate, and biotic factors.

The following determine the physical and chemical properties of the soil; texture, structure, bulk, density, porosity, water retentivity, salt content, pH, available nitrogen, phosphorus, potassium, different organic and inorganic nutrients. Each of the above parameters can be estimated by proper analysis of soil samples. There are several means for improving the productivity of soil such as deep tillage, altering the composition, manuring, and application of chemical fertilizers.

The Problem

Soil is not as abundant as it appears. About 20 percent of the total land area of the globe has no soil cover and the increasing population is always placing a greater demand on soil. At the same time, degradation of soil is taking place at a rapid rate due to indiscriminate human activity. The main categories of soil degradation follow.

1) Soil erosion: Large scale soil erosion is the greatest danger to soil. Erosion can be caused by wind, running water, ocean waves, and glaciers. Grass sod, forest cover, and the roots of plants act as binding materials for soil. Deforestation, overgrazing, overcropping, and inappropriate ploughing make soil vulnerable to wind and water erosion. Erosion caused by running water may result in surface erosion, finger gullying, gully erosion, or stream erosion. Soil erosion also causes frequent floods and silting of river beds, dams, and canals.

2) Desertification: Desertification is also a danger to soil as a resource. Much of the present desertified areas of the world are man-made. Removal of the vegetative cover by overgrazing, deforestation, or poor modes of cultivation are the biggest causes of desertification. Expansion of desert areas may also be caused by deposition of sand on fertile soil .

3) Shifting cultivation: Shifting cultivation is yet another example of gross soil resource mismanagement . This harmful practice is still used in many areas of the globe. Only a long interval of twenty years or so can bring back fertility. This method, usually restricted to one crop, can lead to the depletion of some minerals. It is a less productive mode of cultivation.

4) Salinity: Higher salinity caused by accumulation of soluble salt in soil may be both natural or man-made. About 15 percent of the total land area of the earth, mainly in the semiarid and arid areas, are uncultivatable owing to their high saline content. Widespread secondary salination of the soil can result when the same piece of land is repeatedly used for cultivation with intensified irrigation, improper drainage, heavy use of fertilizers, and water logging.

5) Water logging: Improper irrigation of land from canals without proper drainage results in water logging and damage to the soil. This type of soil degradation is increasing at a rapid rate in some areas .

6) New development activities: Developmental activities are also causing a rapid depletion of productive soil These activities include the construction of dams, roads, buildings, airports, and mines, urban encroachment, extension of railways, growth of human settlements, and establishment of industries also lead to soil problems.

Some Solutions

Proper management of land which includes efforts to maintain, restore, and improve the soil are essential. Examples of these techniques include those listed below.

1) The removal of vegetative cover must be grossly reduced to check soil erosion . Vegetation and other life forms preserve the humus of the soil. Reforestation programmes should be intensified, while erosion on hill slopes is minimized by resorting to techniques such as contour tillage, terracing, gully reclamation, and strip cultivation. Planting trees for wind breaks should also be undertaken.

2) Various antidesertification measures such as widespread planting and proper irrigation should be intensified.

3) Shifting cultivation should be avoided in favour of crop rotation and mixed cropping practices.

4) Provisions for adequate drainage and the practice of artificial chemical amending measures should be encouraged. These include the use of green manuring to improve alkaline, acidic, and saline soils.

5) Water logging can be controlled through the use of underground drains to improve drainage.

6) Mulching of areas undergoing desertification should be completed by planting suitable plants in small squares to check extension of desert sand.

Mineral Resources

Minerals of various kinds are essential for the survival of the organic world, but man needs greater supplies than ever before for the sustenance and progress of a technology based civilization. Not only are human needs increasing in terms of the number of minerals used, but also the quantity of each mineral needed is dangerously accelerating. Man needs only a few minerals growth and development, but he needs a great many different minerals to fulfill the needs of technology. Technology uses minerals for construction, to power industry, to transport materials and for the manufacture of materials like paints, fertilizers, pesticides, insulation, arms, and many others. Minerals currently needed by man include coal, lignite, natural gas, iron, copper, manganese, cobalt, magnesium, gold, silver, platinum, chromium, tin, tungsten, molybdenum, nickle, vanadium, columbium, lead, zinc, aluminium, titanium, zirconium, iridium, radium, corundum, feldspar, asbestos, sodium, potassium, phosphates, sulphur, uranium, and thorium to name a few.

The Problem

Minerals are nonrenewable resources and exist in a finite supply. An enormous quantity of minerals have already been used for war, agriculture and transport since the industrial revolution began. The use of these materials has been increasing rapidly causing depletion of many. The use and distribution of the various minerals also shows a great disparity. Developed countries use more minerals than the developing world. To gain access to the minerals of weaker nations, stronger ones have created great international tension and even wars. Nations which had surpluses of some minerals are now deficit in those items and with rapid industrialization, the developing world will only increase their rate of manual use. Minerals such as lead, tin, zinc, copper, and petroleum will be exhausted if their present rate of use continues.

Some Solutions

The following global measures need to be initiated immediately to check the wasteful use of minerals.

1) The adoption of conservation measures for better management of resources and improved recycling through use of better technology and improved design.

2) Inaccessible areas should be explored and transfer deep sea mining, and mining from deeper layers of the earth's crust attempted.

3) Global disarmament should be sought through international negotiation.

4) Substitute materials for the most scarce minerals should be identified.

Plant Resources

Plants are producers in all food chains and provide food for all members of the animal kingdom including man. They also provide shelter and have many other interrelationships in the biotic environment. In addition, man derives various other benefits from the plants including their use for fuels, medicine, spices, clothes, timber, decorative materials, and furniture to name just a few.

Four types of global land areas exist in terms of their plant cover. These biological systems are forests, grasslands, croplands, and deserts. There is great variation and disparity in the distribution of these terrestrial biological systems in different regions of the world and in their potential use to man. The forests of the world, taken as a whole, have the potential to meet the needs of a much larger population than they are now but grasslands, on the other hand, currently provide food for 3000 million domestic animals.

The Problem

Plant life is being severely degraded by the following causes.

1) Deforestation is the biggest problem in this area. It is estimated that closed forests are disappearing at the rate of ten million hectares annually. Overgrazing, logging, and indiscriminate felling are the main causes of forest depletion. Trees are felled for fuel, timber, paper, and matches.

2) Grasslands are being depleted by overgrazing. Domestic animals, unlike wild ungulates, remain close together to rapidly overgraze a small area.

3) Croplands have been established by man replacing grasslands and forests. These croplands are in turn depleted by rapid urban encroachment, as well as the various effects of industrialization and soil degradation.

4) Over 25,000 species of flowering and nonflowering plants are currently on the endangered species list due to habitat deterioration and clearance.

Some Solutions

The following measures might be used to halt the deterioration of plant resources, and to restore all types of biological systems like grasslands, forests, and deserts.

1) Prevention of the extinction of endangered species, preservation of crops, forage plants, and timber trees species, as well as on site preservation of economically useful plants must be instigated.

2) Vegetation should be restored through better management to stabilize soil and conserve water. Other measures such as resorting to social and agroforestry, recovery of wastes and denuded land by growing grasses and other suitable plants, and an organized campaign for the planting of trees are needed as individual and community action.

3) Better management of grasslands and their judicious use by regulated grazing, reseeding with superior species should be required.

4) Semideserts and desert areas should be reclaimed.

5) More economic land use through better management techniques with broader ecological considerations must be implemented.

6) Use of wood and timber should be discouraged wherever substitution is possible with provision of alternate sources of fuel and energy being made to the rural poor.

Animal Resources

Animal resources including wildlife are an integral part of the biosystem. Wild animals must live in harmony with their environment. This is essential for maintaining the balance of nature and to preserve species on a stable yield basis. Wildlife is a great heritage of the planet.

The Problem

Wildlife of all sorts have been tremendously affected and widely exterminated. If immediate measures are not taken, 25 percent of all species will have been lost within the next 25 years. More than a thousand types of vertebrates and a large number of other animals are dangerously threatened because of these factors, among others.

1) Habitat destruction caused by extensive exploitation of forests, deforestation, and clearing of grasslands.

2) Large scale poaching for to obtain commercially important animal products.

3) Hunting for sport or to protect agriculture, domesticated animals, and man.

4) A dependence on meat protein which ultimately puts pressure on the natural biosystems.

Some Solutions

The value of wildlife in nature and its role in the survival of man has to be realized. The following measures may be useful to help conserve wild animals and improve their present conditions.

1) Existing natural ecosystems must be conserved by an international effort.

2) Wildlife management and administration should be modernized. Reserve forests, wildlife sanctuaries, and national parks should be established and properly maintained.

3) Mass education programmes and active campaigns should be launched to convince people of wildlife's value.

4) Strict legislative measures must be enforced against poachers and others who harm wildlife.

5) Active efforts should be made to improve the position of threatened species by providing extra care and captive breeding programs.

6) Legislative measures should be taken to restrict national and international trade in wild animals and their products.

7) Access to resources must not exceed the resource's capacity to sustain exploitation.

8) Natural habitats have to be maintained.

Sociocultural Problems

Population Problems

The main environmental problem here is one of increasing numbers which causes population pressure and creates greater demands for food, housing, water, energy, and other resources. These cause depletion of resources and degradation of natural environments reducing the quality of life. Again, the effects of population growth are felt more in developing countries whose a capacity to ensure quality of life is even more limited. Educational facilities and health services, employment opportunities, and the capacity of providing goods and services are inadequate. This is further complicated by the fact that more and more people are now settling in places that are vulnerable to cyclones, hurricanes, tornados, and floods.

Rapid Urbanization

Increased industrialization and an influx of people to work in these industries is causing overcrowding in cities and marginal urban areas. The results include environmental deterioration, social tension, and cultural degradation in large sections of the society, especially in developing countries.

Modernization of Agriculture

Modernization of agriculture is essential for the sustenance of a growing human population. It depends upon the use of capital intensive mechanization, high yielding varieties of crops, and greater use of irrigation, energy, fertilizers, and pesticides. This in turn creates problems such as the utilization of more nonrenewable resources, water logging and increased salinity, and degradation of soil and water resources. Further problems result due to our excessive dependence on hybrid crops rather than the wide range of traditional varieties previously used. This leads to depletion of valuable genetic resources.

Socioeconomic Disparities

Unequal socioeconomic development in different parts of the world is a historical phenomenon. But since the industrial revolution, it has been gradually accelerating and become acute in recent times. In addition, rapid advancements in transport, communication, growth of knowledge, and sociocultural perceptions have given rise to a new realization about this inequality and its effect on both the global and local environment. Greater affluence, achieved through modernization of agriculture and industrialization, has led to higher standards of living, both in advanced countries and in some socioeconomic groups of poorer countries. This has changed value systems and made people both of affluent countries and affluent sections in poor countries, crave for more and more comfort and material resulting in a lavish and wasteful way of life. This consumption pattern, using much more energy and material than is required, has put tremendous pressure on local and global resources, ultimately affecting the environment.

In contrast, masses of people in poor countries suffer from malnutrition, inadequate housing, and a lack of clothing and proper sanitation. These problems give rise to infection, diseases, and a poor quality of life. In quest of basic needs they are compelled to depend on materials which could be used in a more economically viable ways. For instance, rather than burning cattle

dung, it could be used as a fertilizer to replenish lost nutrients. Major problems due to socioeconomic disparities include those in the following list.

1) Malnutrition,the worst enemy in the developing world where a considerable number of people live below the poverty line. It in turn gives rise to various disorders including stunted development of the body and brain, marasmus, kwashiorkor, and also decreases resistance to disease.

2) Poor environmental sanitation causes widespread epidemics of communicable diseases.

3) Scarcity of basic human needs such as shelter, clothing, and fuel cause felling of trees and degradation in many other aspects of the environment.

Towards Solutions

The environment is not merely a conglomeration of different physical and biological factors with simple linear causal relationships. It is a complex network of dynamic systems. Economic, political, ethical, and technological factors make it even more complex. Any intervention in a natural system has multidirectional effects. Moreover, experts who belong to different schools of thought often give conflicting views on the diagnosis of problems as well as their solutions. In the past, solutions to environmental problems have been sought through scientific, technological, economic, philosophical, or social change. Though many of these can be used to solve specific problems, an approach from one area invariably involves a large number of other factors such as lifestyle, ethics, and social conditions. Any simplistic approach may be counter productive. Therefore, a realistic understanding of basic environmental problems and a search for effective solutions should entail a dynamic systems framework. A listing of major areas of concern and general recommendations follow.

Population Growth

1) Growth of population is a key global environmental problem which can elucidate the above point. It is directly related to problems of resources, pollution, degradation of the environment, and the destruction of forests. Problems with malnutrition, starvation, lack of education, poor health facilities, inadequate provision of other goods and services are largely determined by the socioeconomic and political factors relating to population.

   The population problem is especially acute in developing countries where birth rate is high and the carrying capacity of the land and economy is low Therefore, governments and non-governmental organizations must give high priorities to population control by reduction of birth rates. Some studies have shown it to be far simpler and cheaper to prevent a birth, even by taking foreign aid, than to make provision for an extra person. Countries, like India and Japan, have tried to use birth control techniques on a large scale. Programmes have been adopted to introduce these techniques through both campaigns and economic incentives. The results were not spectacular. Attempts to impose administrative compulsion for birth control also proved counter productive in India. Therefore it has been found that the provision of propaganda, free subsidized birth control methods, and economic incentives to help overcome pronatalist social pressures are not sufficient. The desire to have children, especially male children, is tied up in many cases with special social conditions such as ignorance, religious beliefs and traditions, and old age security, or a desire for extra working hands. These conditions are further coupled to high child mortality rate, indifference to child welfare, and a lack of consideration for the standards and quality of life. Attempts are being made to evolve birth control programmes which integrate with other developmental objectives. Efforts are being made to improve survival rates and provide better care and

for children, and better health facilities. Other efforts being used to decrease birth rates include raising the age of marriage and encouraging longer intervals between births, as well as the generation of a desire in people for a better quality of life.

2) Food production and distribution should be made a focal point of developmental plans, both at national and international levels.

3) The Health for All Programme, as accepted by the World Health Organization, should be executed through national action and international cooperation. This plan includes universal immunization, improved environmental sanitation, and other health programmes both curative and prophylactic.

4) Safe drinking water should be provided for all. Educating people about proper and judicious use of water should help to ensure an adequate, regular, and timely supply of uncontaminated water. Special efforts should be made to achieve this goal for the most vulnerable sections of society.

5) Fuel for cooking and minimum energy needs should be guaranteed by all governments through planning and management of conventional and nonconventional sources of energy.

6) Environmental awareness and understanding should be generated in all sections of the community through formal and nonformal educational programmes and through appropriate cultural entertainments, both by recreational means as well as print and electronic mass media.

After considering these issues the World Conservation Strategy has recommended a set of priorities and actions (See Appendix III). Some of which are mentioned below.

1) Every country should have a conscious population policy to avoid overpopulation and eventually to achieve a balance between numbers and environment.

2) The affluent must constrain their demands on resources and preferably reduce them, shifting some of their wealth to the deprived. To a significant extent, the survival and future of the poor depends on conservation and sharing by the rich.

3) Trade must be liberalized, including the removal of all trade barriers on goods from developing countries.

4) The flow of finance and development assistance from developed countries must be increased, including as a minimum, the renewal of the objective require 0.7% of the gross national product of developed countries for official development assistance.

5) The proportion of development assistance going to low income countries must be increased by at least two-thirds and preferably to three-quarters.

6) The international monetary system must be reformed.

7) A code of conduct for transnational companies must be adopted.

8) There must be much more rapid progress on disarmament.

9) Economic and social growth must be accelerated, especially in the poorest countries. Economic and social goals should be mutually supporting, with an emphasis on better health, better housing, and higher educational levels and skills.

10) Conservation is entirely compatible with a growing demand for people centered development to achieve a wider distribution of benefits for whole populations. This development should make a fuller use of people's labor, capabilities, motivations, and creativity and should be more sensitive to our cultural heritage.

In Closing

Although the preceding discussions apparently have been presented more in global terms, each factor is equally valid at each of the local levels. The discussion is expected to help present ideas about the essential components of the environment and requirements for environmental education.

The task of any environmental education course is to impart the basic knowledge and skills needed to: identify environmental problems; perceive associated issues, their alternative beliefs and values; evaluate solutions, use a number of different criteria implications and considerations (i.e., social, legal and political, technological), and; attempt to initiate actions. How some of these tasks can be accomplished in a teacher training course will be discussed in subsequent chapters.

CHAPTER SIX

THE PROCESS OF CURRICULUM DEVELOPMENT IN EE FOR PRESERVICE TEACHER TRAINING

Curriculum is one of the most commonly used words in education although its definition varies. One possible definition relates to all the educational experiences of a learner in an institutional environment. Whatever other definitions it may have, for our purposes we will refer to curriculum as a broad structure of organized learning experiences. It is based on theory, research, and past professional practice, in a programme of education whose purpose is to achieve broad goals and their related specific objectives.

The foundations of curriculum planning are social forces, human development, the nature of learning, and the nature of knowledge and cognition. Programmes in education aim at transmitting the culture and values of the society into children amidst social and economic pressures and change. In the modern world, a knowledge explosion has made it almost impossible to teach everything. It is, therefore, necessary for educators to select from a growing number of options those which are most appropriate and important for a child to know. There are be three basic sources from which the content of the curriculum is drawn in schools. They are (a) age old disciplines, (b) emerging disciplines, and (c) the contemporary world (Inlow, 1966). Another educator, Goodlad (1966) lists the three sources as societal pressure, the learner, and the specific discipline.

Thus, in elementary schools, language, social studies, science, and mathematics form an academic core for curriculum because of their long history and strong public support. Physical education, art, and music are generally seen as peripheral activities in the curriculum. As a result, the physical and aesthetic development of the child, though highlighted as one of the goals or purposes of elementary education, remains virtually at the periphery.

In secondary programmes the goals of education are citizenship, intellectual development, spiritual or ethical growth, vocational skills, and both personal and interpersonal growth. Although subject areas are the same, content matter enlarges and an effort is made to develop the above mentioned skills. It is assumed that the citizens of tomorrow, are prepared by such a program to face the challenges of society.

One important purpose of education is to provide an understanding of the world from a physical, social, economic, and political standpoint. This understanding also requires the study of the innumerable problems which mankind confronts today. An understanding of these problems can be developed by first creating an awareness of the various kinds of problems, then developing proper perspectives in relation to their origin, and finally providing alternatives for their solution. The education system must provide opportunities for incorporating problems and developing competencies to deal with them. This can be done through implementation of a well developed curriculum to help solve these problems.

Today, determination of world environmental quality is a significant problem. This problem has resulted in a global effort to include aspects of environmental education in school curriculums at all levels in an appropriate manner. However, the objectives of environmental education cannot be realized simply by infusing environmental concepts into existing curriculum.

The effective infusion of EE curriculum into a school programme is possible only when teachers themselves possess the knowledge, skills, and affective attributes which they will impart to students. Preservice teacher training programmes therefore, should include all aspects of environmental education, which teachers will in turn pass to students. It is thus necessary that teachers are made aware of the following, the goals and objectives of environmental education, the scope of curricular content and subject matter, proper methodologies to transfer knowledge and skills to pupils, and evaluation methods necessary to assess the effectiveness of learning outcomes.

Infusion of EE into schools will also require the environmentalization of existing preservice and inservice teacher training curriculum. An international review of the status of environmental education has revealed that existing teacher training programmes, both preservice and inservice, are deficient in effectively preparing teachers to achieve EE goals in their classrooms (Connect, 1978). Efforts are, therefore, being made by IEEP to overcome these deficiencies through development of suitable strategies to incorporate EE into the content and teaching methods of teacher training programmes.

But, infusion of EE into formal education is not enough. It has also been emphasized that environmental education should be a continuous life-long process and hence should be included in nonformal education as well.

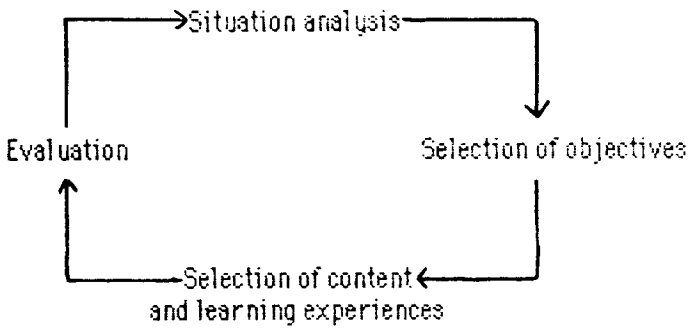
Recognizing a need to environmentalize teacher training curriculum, the next step becomes knowing what the curriculum development process is and how EE competencies can be developed in existing teacher training programmes.

A curriculum for preservice teacher training generally has three components, general education, professional education, and the foundation education. General education usually contains the subject matter of various disciplines. Professional education helps to develop necessary skills in the preservice teacher to make the teaching/learning process more effective. Foundation education provides the basic understanding necessary to recognize the goals of education in a particular education system. Balanced content at the teacher training level should help to equip the preservice teacher quite well in performing his/her job successfully.

Teacher training curriculum must be relevant to students and so, must be dynamic and able to incorporate contemporary vital issues. Curriculum development, therefore, is a continuous process. It should have built in mechanisms to identify the needs of society in a dynamic environment and take these mechanisms into account in the development process. This is also true with a programme of preservice teacher training curriculum development, which involves the following stages; situation analysis, selection of objectives, selection and organization of content, selection and organization of learning experiences, and evaluation.

Situation analysis would include two areas, first identification of society's changing needs, and second, a review of existing training programmes to determine the nature of deficiencies and then select suitable ways and means to overcome those deficiencies on the basis of available facilities and constraints. For example, global concern about environmental degradation has compelled us to think about the environment for our own survival. Hence, this has become a crucial contemporary social issue which needs to be highlighted in our education systems. The next step becomes both identification of environmental problems at the national, regional, and local levels, and a means to solve these problems with the help of experts. A review of existing teacher training programmes would also help in identifying the nature and extent of deficiencies in a curriculum in terms of realizing modified goals and objectives needed to meet changing social needs. Selection and organization of content and learning experiences would come next followed by evaluation. Thus one cycle ends and another cycle begins. This continuous process of curriculum development is illustrated by the diagrams on the following page.

Fig. 6.1: Curriculum Development Process



Efforts are being made at different levels to environmentalize teacher training curriculum. Unesco published two documents in 1980. They are "Strategies for the Training of Teachers in Environmental Education" and "Strategies for Developing an Environmental Education Curriculum". They provide a useful basis for environmentalization of a preservice teacher training curriculum.

A Global View of Preservice Teacher Training Programmes

Preservice teacher training programmes vary greatly from country to country as well as from institution to institution. Aware of a necessity to introduce environmental dimensions in preservice teacher training curriculum, some countries have introduced EE training for teacher certification. For instance, a few countries like the USA, the USSR, and Thailand have made courses in ecology and conservation of natural resources compulsory for teacher certification. In other countries like Bulgaria, training in ecology is a requirement for the qualification of teachers and instructors in science subjects particularly those having links with the environment and there are many countries in the world, which do not offer EE courses in their teacher training colleges in any form. Nevertheless, with few exceptions, training courses do not provide sufficient background to develop desirable competencies in preservice teachers to enable them to infuse an environmental dimension into their teaching.

Diversity also exists in the nature of EE courses offered by various education departments. While some colleges and universities offer very specialized EE courses which may serve as an elective, a large number simply infuse EE concepts into existing teacher training curriculum. In fact, very few teacher training programmes have been designed to develop all desired competencies in preservice teachers to prepare them for acquiring and transferring EE knowledge, skills, and attitudes successfully and effectively in classroom teaching.

Because there is such a great diversity in the needs of people from different parts of the world it is almost impossible to provide one or two models which are suitable for all conditions. Realizing this, our attempt has been only to present two case studies which have been developed. For our purposes, we use case studies representing two approaches of environmental education. One has a separate course content for achieving EE goals and objectives (interdisciplinary model)

and the other follows the infusion model (multidisciplinary model). For details of these two models refer to Figure 6.2 and Table I on the following pages.

It would be desirable at this stage to point out that selection of a particular model depends upon the prevailing situation of a particular country. It is therefore important to have a prior assessment of certain aspects which help in the selection process. These aspects are the:

-- socioeconomic background of the preservice teacher,

-- academic background of the preservice teacher, keeping in view the specific level for which they are being trained, i.e., the primary level or secondary level as well as the area of specialization,

-- desirable competencies, both general competencies for a teacher and specific competencies required for environmentally biased teaching,

-- analysis of the school curriculum in terms of course content, teaching-learning strategies being practiced, and evaluation techniques as well as the school environment in general (i.e., administrative aspects, the teacher's role in planning curriculum, and the geographical location of the school), and

-- community resources available in terms of teaching materials, content specialists and experts, and other resources required for making teaching-learning more effective.

Environmentalized teacher training programmes should be able to help teachers acquire the knowledge, skills, and affective attributes needed to impart environmental education and enable teachers to transfer the same to students. It is therefore necessary that preservice teachers should have the same training in environmentalized curricula as that which they are to practice in primary and secondary schools after joining the teaching force. It would therefore be desirable to follow certain guidelines while developing preservice teacher training programmes. Some of the guidelines, as mentioned in the UNESCO's document "Strategies for Developing an Environmental Education Curriculum" follow:

Teacher preparation in EE should . . .

. . . focus on and reflect the many faceted and interdisciplinary nature of EE. While doing this, teachers should be provided with opportunities to acquire and apply the knowledge, skills, and attitudes inherent in environmental education. At the vary minimum, this preparation should include:

-- basic training in ecology,

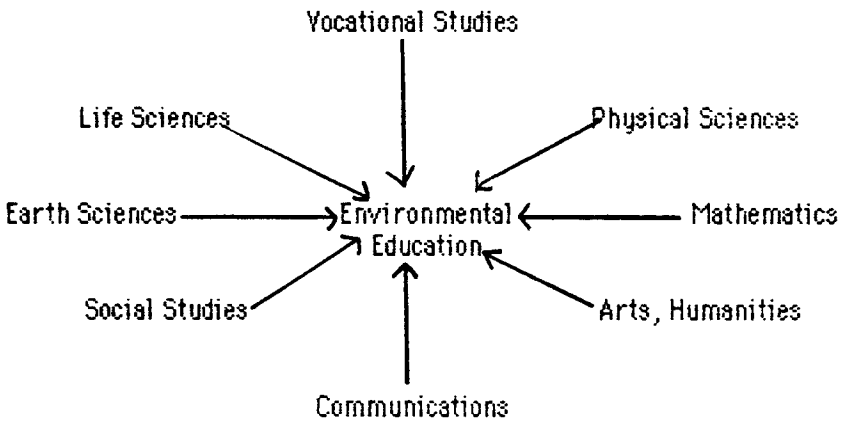
-- field and/or laboratory experiences for teachers in the area of environmental science,

-- knowledge of environmental issues and problems of resource management,

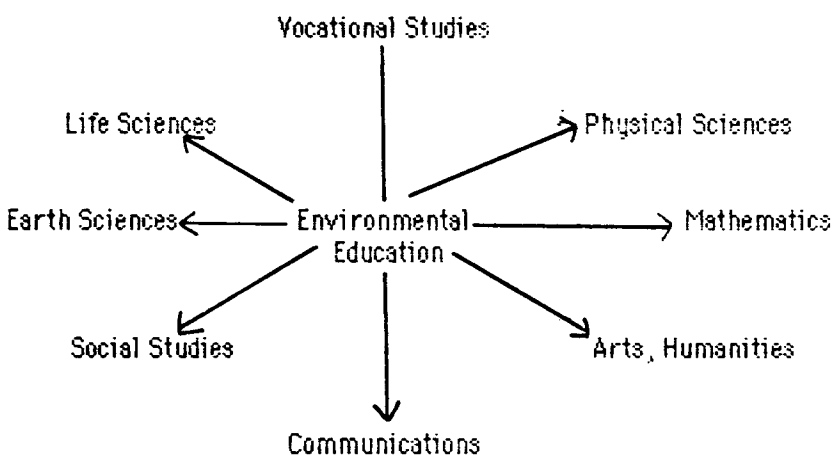
-- competencies in environmental problem-identification, problem and issue investigation, issue evaluation, evaluation and citizenship action, and

Figure 6.2

Two Conceptual Models of EE Curriculum



(A) Interdisciplinary Model (Single Subject)



(B) Multidisciplinary Model (Infusion)

In (A) relevant components of many disciplines are drawn upon to create a distinct EE unit, course, or module. (B) Illustrates the infusion of EE components into other established disciplines where appropriate (taken from Hungerford, H.R. & R.B. Peyton, Procedures for Developing an Environmental Education Curriculum, Paris, UNESCO, 1986, p. 13).

Table I. Interdisciplinary vs Multidisciplinary (Infusion) Formats for EE: Advantages and Disadvantages.

Considerations	Interdisciplinary (Single Subject) Characteristics	Multidisciplinary (Infusion) Characteristics
1. Ease of Implementation.	Easier to implement as a single subject if time permits in the curriculum; teacher training is less of a problem.	Requires that more teachers be trained; greater coordination of curriculum necessary; requires less time/content in the existing curriculum.
2. Teacher Competencies.	May require fewer teachers but with more in-depth training in EE; thus teacher training is less demanding in terms of teacher numbers but more demanding in terms of level of competencies required.	Requires that teachers of all disciplines be competent to adapt and/or use EE materials, although perhaps not to the same depth as in single subject approaches.
3. Demand on Curriculum Load.	Requires addition of this discipline to an already crowded curriculum.	May be effectively implemented with minimal demands on existing curricular load.
4. Ease of Curriculum Development.	Components easier to identify and sequence.	Components must be effectively identified, sequenced, and accommodated by the existing curriculum.
5. Evaluation.	A comprehensive evaluation is much easier to accomplish in a single subject curriculum.	Comprehensive evaluation difficult due to the number of variables involved.
6. Age Level Appropriateness.	May be more appropriate at secondary than elementary levels. For some types of EE goals, may be essential at secondary and tertiary levels.	Appropriate at all age levels with some exceptions at secondary and tertiary levels.

Continued . . .

Considerations	Interdisciplinary (Single Subject) Characteristics	Multidisciplinary (Infusion) Characteristics
7. Effectiveness in Teaching for Transfer.	More difficult to use in effectively teaching for transfer. Requires special efforts to do so.	Teaching for transfer is inherent in this approach when properly used. Infusion permits decision-making to take place in other disciplines in an environmental context.
8. Ability to Provide In-Depth Coverage of Environmental Issues	Budget consideration entirely dependent on the nature of the course being developed. A highly sophisticated course demanding many field excursions or laboratory equipment could prove costly.	Monetary considerations very dependent on the nature of the curriculum being developed. Monies required could be greater than in a single subject curriculum due to numbers of learners involved across numerous grade (age) levels.

Source: Hungerford, H.R. and Peyton, R.B. Procedures for Developing an Environmental Education Curriculum. Paris, UNESCO, 1986, pp. 14-15.

. . . opportunities to develop value clarification skills and knowledge of the roles of human values in environmental issues.

. . . provide instruction and experiences with model EE curricula as well as instructional activities and methods similar to those they might utilize in their own classrooms.

. . . provide an opportunity for preservice teachers to experience a multidisciplinary or infusion model in their own training, i.e., be a receiver in a tertiary multidisciplinary or interdisciplinary model of EE.

. . . provide instruction on the philosophy and goals of EE and the nature of interdisciplinary and multidisciplinary EE curricula. Further, teachers should be trained in the implementation of these models.

. . . provide specific training particularly at the primary level in the use of EE content as a vehicle for teaching basic general education skills, e.g. in languages, arts, reading, and mathematics.

. . . provide opportunities for teachers to develop skills in identifying, inventorying, and evaluating local resources for use in EE.

Environmentalization of a Preservice Teacher Training Curriculum

Keeping in mind the general guidelines for developing teacher training programmes in EE and the competencies required, we are ready to initiate the process of environmentalizing preservice teacher training curriculum. This process can be discussed with the help of a few case studies taken from countries, which do not provide specific courses in EE methods and need to environmentalize existing teacher training curriculum. This has been done with the view that those countries who have already introduced specific courses in EE would probably not need this kind of material.

Our first example is from India. Here we will look separately at the available training models and programmes for preservice teacher training separately for primary and secondary school teachers. India serves as a good representative sample of countries in this region.

Preservice Teacher Training at the Primary Stage: An Indian Case Study

Generally, teachers at the primary level get one to two years of additional training after completion of ten to twelve years of schooling. Teacher training curricula are prescribed by education departments and boards, and include courses in educational psychology, educational methods, and teaching aids. The school curricula, with which the preservice teacher would deal in the school, forms the basis for his/her professional training. For our purposes, we have taken an extract from the Primary School Syllabus which was prepared by the National Council of Educational Research and Training. This can be analyzed in view of the broad objectives in education at the primary level. This analysis together with the preservice teachers' background (academic as well as socioeconomic), helps us to analyze the existing teacher training curriculum and locate deficiencies, if any, in terms of realizing the goals and objectives of environmental education. This analysis follows the sequence mentioned above.

A. Objectives of Education at the Primary Stage

This stage of education covers roughly children of age 6 to 11 who study in Classes I to V. Keeping in mind the social, intellectual, emotional, and physical maturity levels of children in this age group on the one hand, and the basic minimum competencies to be

achieved through education towards their overall development, the objectives of education have been stated as follows:

The child should. . .

. . . develop a national feeling by way of respecting national symbols and inculcating the values of national integration.

. . . learn the method of scientific inquiry and understand the application of science and technology in the life of the community.

. . . develop abilities in the four fundamental numerical operations and be able to use them in his everyday life.

. . . learn the first language, which is generally his mother tongue, with reading, writing, and speaking abilities to a level where he can communicate easily with others.

. . . learn to do some useful work and acquire a healthy attitude towards human labor and its dignity.

. . . develop habits of cleanliness and healthful living and an understanding of proper sanitation and hygiene of its neighborhood.

. . . acquire a taste for the good and the beautiful and should take care of his surroundings.

. . . be able to develop desirable qualities of character and personality, such as initiative, leadership, kindness, honesty, responsibility, and cooperativeness.

. . . be able to express himself freely in creative activities and should acquire habits of self-learning.

B. Scheme of Studies

Class I and II

1) The First Language

2) Mathematics

3) Environmental Studies (Social Studies and General Science)

4) Arts

5) Work Experience and Games

6) Health Education and Games

Class III, IV, V

1) The First Language (A Second may also be started.)

2) Mathematics

3) Environmental Studies I (Social Studies)

4) Environmental Studies II (General Studies)

5) Arts

6) Work Experience

7) Health Education and Games

Some of the general objectives, item numbers 2, 6, and 7 for instance, can be realized through the teaching of Environmental Studies. It has also been suggested that since the environment and the experiences of children outside the school vary from place to place, the activities provided in the school should be based directly on the local environment We are, therefore, reproducing an extract from the eh Primary School Environmental Studies Syllabus meant for Classes I & II as an example of this.

C. An Extract from the Environmental Studies Syllabus for Classes I & II

Class		Content
I	Unit I - Our Family	Structure of the family; Functions of family members; Food in the family; Celebration of festivals in the family; Pets and domestic animals in the family.
	Unit II - Our Homes	Need for shelter; Houses; Facilities provided by a house; Heat, light and ventilation in the house; Things and equipment in the house; Clothes we wear in the house.
	Unit III - The School	School building; Organization and management of the school; Nature, use and care of items in the school; Development of orderly habits and good manners; Cultivation of health and safety habits; School lawn and garden.
	Unit IV - Our Neighbor-hood	Concept of space (distance and direction); Concept of time; Geographical setting and natural objects of the neighborhood; Life in the neighborhood; Production of commodities in the neighborhood; Sanitation in the neighborhood.
	Unit V - Our Earth	Materials on the surface; Diversities of living things; Three states of matter; Atmosphere; Man changes the face of the earth; Under the ground.
	Unit VI - Our Sky	Sun, moon, and stars; Weather; Living objects in the sky; Air transport.
	Unit VII - Stories	Stories of early man, childhood, great men and women; Stories based on the syllabus i.e. Man and the moon, festivals and food habits.

D. Preservice Teacher Training Curriculum for Primary Schools

Primary school teacher training programmes in India and some other countries in the region have been designed to keep in mind the broad objectives of school education at the primary level. As such, the general objectives of teacher education for the primary stage are as follows.

The primary preservice teacher should...

- ... possess competence in the first and the second language of the area, mathematics, and in the topics of natural and social sciences related to environmental studies I and II respectively.
- ... develop skills in identifying, selecting, and organizing learning experiences for teaching the above subjects in formal and nonformal situations.
- ... possess sufficient theoretical and practical knowledge of health, physical and recreational activities, work experience, art and music, and skill for conducting these activities.
- ... develop an understanding of the psychological principles underlying the growth and development of children, ages 6-10.
- ... acquire theoretical and practical knowledge about childhood education, including integrated teaching.
- ... develop an understanding of the major learning principles which help to promote cognitive, psychomotor and attitudinal skills.
- ... understand the role of the home, peer group and community in shaping the personality of the child, and help develop an amicable home/school relationship for mutual benefit.
- ... conduct simple action research.
- ... understand the role of the school and of the teacher in changing society (NCERT, 1978).

It may be noted that the duration of a primary preservice teacher education course would be four semesters (72 credits) for those teachers who have already completed their 10 year schooling. These 2 year courses are in vogue in India. However, this course blocks the mobility of the preservice teachers for higher education. Therefore, the course may need to be offered as an academic course at the plus two level in a higher secondary stage with two further semesters (36 credit-hours) of work in education combining all three major areas, (i.e., pedagogical theory, working with the community, and content/methodology) and practice-teaching. A third and fourth alternative are offered based on the rationale developed and on the cognizance of a national pattern previously suggested for the +2 level. These two independent, but mutually complimentary sets of courses, i.e., education as a vocation and education as a discipline, have been suggested to exploit the existing system which merges simultaneously at the +2 stage because of the two streams of courses, i.e., academic and vocational. A fifth alternative has been suggested based on an argument similar to that given for the second alternative, that is it allows mobility for preservice teachers in higher education. Thus five alternative programmes, ranging from 1 to 3 years, are available for preservice teachers depending upon their academic background.

Since our task is restricted to the general education component of the teacher education programme, we shall concentrate primarily on the content course and to some extent work with the community portions of the curriculum. Emphasis in the curriculum has been placed on the development of a variety of package programmes, grouping them as the core skills which are indispensable for all types of teachers and the specific skills necessary for teaching different subjects at different age levels. As such, packages for stage III and IV have been developed which are directly related to Environmental Studies.

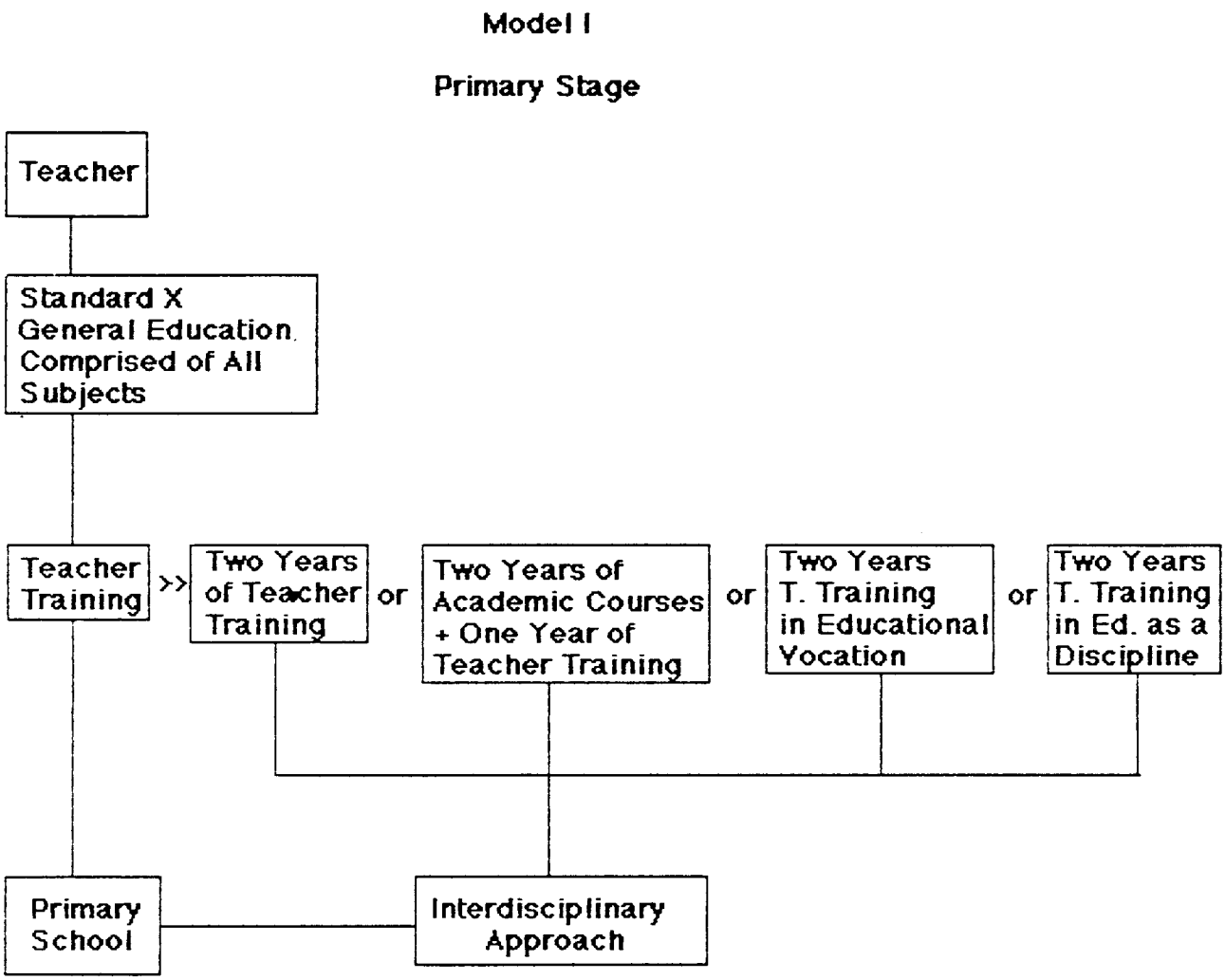


Figure 6.3: Schematic model for a preservice teacher training course. The duration of this course is the same as those in India.

Table II: The Structure of a Primary Teacher Education Programme and Possible Alternatives (see Figure 6.3)
Courses are Given with Weights

Area	Four Semester Professional Ed. Courses after	Six Semester Courses after Standard X	Four Semester Voc. Education courses	Four Semester courses in Ed.	Two Semester Professional
1	2	3	4	5	6
1)A. Pedagogical Theory	A.1.The teacher and Education in the emerging Indian society. 2.Child Psychology 3.Special courses according to the needs and facilities available.	A. 20% as in column (2)	A. 25% Language, General studies (Social, Economic, Scientific, etc.)	A. 25% as in Column (2)	A. 20% as in column (2)
2)B. Content/ Methodology and practice teaching including repeated practical work.	B. 4.Core Training Programme Package (10%) 5.Special Training Programme (10%) 6.Package II: Math (5%) 7.Package III: En. Studies I (5%)	B. Same as in column (2)	B. 50% Vocational and practical work. (Pedagogy and practice teaching)	B. A combination of academic and ed. courses are possible in terms of major and minor	B. 60% combining 4 and 5 as in columr (2).

(This table continues on the next page.)

Area	Four Semester Professional Ed. Courses after	Six Semester Courses after Standard X	Four Semester Voc. Education courses	Four Semester courses in Ed.	Two Semester Professional
1	2	3	4	5	6
	8. Package IV: En. Studies II (5%) 9. Package V: Work Experience and Art (10%) 10. Package VI: Health, Physical Ed. and Recreational Activities (5%) 11. Related practical Work (10%)	(Courses A, B & comprise 36 hours each.)			
3) C. Working with the community.	C. 20% work situations related to 1, 7, 8, 9 and 11.	C. 20% as in column (2). D. A 72 credit hour course is recommended in academic subjects at the +2 level.	C. 25% Science, Social Science, and humanitities courses designed to understand the basis and scope of education as a vocation.	C. 75% Science Social Sciences, and humanities including lit. and ed. Ed. and related subjects should equal 25%.	C. 20% as in column (2).

Note: Although items for different structures seem to be identical, the emphasis and consequently the quatum of knowledge will differ according to the entry level of the students trainees (NCERT, 1978, p25-26)
10+2 refers to 10 years of general education, i.e., Std. X, + 2 years of specialization in teacher training.
10 +2 +1 refers to 10 years of general education + 2 years of academic training at higher secondary + 1 year of graduate work. +1 refers to 2 years of graduate work and 1 year in a professional teaching course.

The Curriculum Development Goals in EE

A set of goals, validated by a panel of EE experts, are given here. These goals and objectives may be translated into an effective EE curriculum, provided an intermediate set of goals for curriculum development is also adopted. Thus, it would be possible to communicate specific goal statement which are easily translated into instructional objectives. If goal statements are developed logically and are then validated, they make the task of curriculum development easier. They provide appropriate developmental syntax and check programme development error. The given model can be modified by curriculum developers in different parts of the world to meet local/national needs. Organization of these goals into four levels is hierarchical with respect to the development of knowledge, skills, and attitudes. But they need not be restricted to any particular grade level. For instance, certain goals meant for a higher level may be taken at a lower grade and vice-versa. Similarly, it is not necessary that all goals be taken care of at each stage. Curriculum development in EE has to take place in a spiral way meaning that components of knowledge, skills, and attitudes are taught with greater thoroughness as the maturity level of the receiving population increases. Level I goals are related to ecological concepts and Level II goals address information concerning human environmental behavior. Level III and IV are related to skill, the former focusing on skills necessary for issue investigation, evaluation, and value clarification, and the latter focusing on environmental action skills.

Level I Goals: Ecological Foundations Level

This level includes ecological concepts, whose knowledge should help the receiver make social decisions with respect to environmental issues:

A. Individuals and populations.

B. Interactions and Interdependence.

C. Environmental influences and limiting factors.

D. Energy flow and biogeochemical cycling.

E. The community and ecosystem concepts.

F. Succession.

G. Homeostasis.

H. Man as a member of ecosystems.

I. The ecological implications of man's activities and his communities.

Level II Goals: Conceptual Awareness Level - Issues and Values

This level should develop a conceptual awareness of ways in which individual and collective actions can influence the relationship between quality of life and the quality of the environment leading to awareness of environmental problems and also ways to solve them.

Goals at this level may provide conceptual awareness regarding. . .

A. . . . how man's cultural activities influencing the environment.

B. . . . the impact of an individual's behavior on the environment.

C. . . . a wide variety of environmental issues and their implications, ecological and cultural.

D. . . . alternative solutions for environmental issues and their sociological and cultural implications.

E. . . . a need for environmental issue investigation and evaluation as a prerequisite for sound decision making.

F. . . . differences in human values and the need for personal value clarification as an integral part of environmental decision making.

G. . . . the need for responsible citizenship action in the solution of environmental issues, particularly at local levels.

Level III Goals: Investigation and Evaluation Level

This level provides necessary knowledge and skills allowing the receiver to investigate environmental issues and evaluate alternative solutions for resolving these issues. These goals aim at developing. . .

A. . . . the knowledge and skills needed for identification and investigation of issues using primary and secondary sources of data and synthesis of the gathered data.

B. . . . an ability to analyze environmental issues and associated value perspectives with respect to their ecological and cultural implications.

C. . . . an ability to identify alternative solutions to environmental issues and the value perspectives associated with these solutions.

D. . . . an ability to evaluate alternative solutions to environmental issues and associated value perspectives with respect to their cultural and ecological implications.

E. . . . the ability to identify and clarify their own value positions related to these issues and their associated solutions.

F. . . . the ability to evaluate, clarify and change their own value positions in light of new information.

Other goals in this level aim at providing opportunities for receivers to. . .

A. . . . participate in environmental issue investigation and evaluation, and

B. . . . participate in the valuing process in a manner so as to permit the receiver to evaluate the extent to which his/her own values are consistent with the major goal of achieving and/or maintaining a dynamic balance between quality of life and quality of the environment.

Level IV Goals: Environmental Action Skills Level Training and Application

The goals here aim either at developing. . .

A. . . . skills which will permit receivers to effectively work toward ends consistent with their values and take either individual or group action when appropriate.

or providing opportunities for receivers to. . .

A. . . . make decisions concerning environmental action strategies to be used with respect to particular issues.

B. . . . apply environmental action strategies to specific issues.

C. . . . evaluate the actions taken with respect to their influence on maintaining the dynamic balance between quality of life and quality of the environment (Hungerford and Peyton, 1980).

These goals may all be translated into instructional objectives keeping in mind: 1) the scope and sequence of the curriculum under development, 2) the expected behaviors of the students subsequent to instruction, 3) the capacity of students at the beginning of the instruction, and 4) the available resources. Instructional objectives should be stated in performance terms so that achievement can be measured during or after instruction. One example from each of the four levels mentioned above, is given to clarify this point.

Goal Levels and Objectives: Examples

Goals	Performance Objectives
Level I: Part F	1) Subsequent to a unit on energy flow and biogeochemical cycles the preservice teachers will be able to: -- explain the circulation of energy and matter within the earth's ecosystem; -- define various terms such as energy flow, ecosystem, food chain, natural cycles or biogeochemical cycles; and -- discuss the ecological balance and its importance for the continuation of life.
Level II: Part A	2) Subsequent to a unit on the impact of man's cultural activities on the environment, students will be able to give a few examples from their immediate environment to show the adverse effects of human activities on the environment.
Level III: Part B	3) Following a unit, students will be able to take an environmental issue (preferably from the local newspaper) and the associated value perspectives to analyze the ecological and cultural implications.

Level IV: Part A

4) After completing a unit, students will be able to discuss the need to take political and legal action against those industries which do not abide by government regulations to check environmental pollution. It would be possible for the student to cite a few examples in which such actions would help to check environmental pollution.

Observations concerning Primary Education

Based on an analysis of objectives for primary education, primary school curriculum, objectives for primary school teacher training programmes, the primary school teacher training curriculum, and the objectives of EE the following observations have been made.

1) Primary education in general aims at providing certain basic knowledge and developing skills and attitudes in children which are necessary for the overall development of a child. Keeping in mind the requirements of developing countries, special emphasis has been placed on aspects of cleanliness and sanitation in the neighborhood. Nevertheless, specific objectives at different grade levels correspond with the objectives of EE.

2) It is, however, felt that a mere statement of objectives and a spelling out EE content in terms of themes or topics, are not enough. Teachers need intense training to transfer this knowledge and skill to children in classrooms through the use of available resources in the best possible manner. So far as the content of EE is concerned, not much is new, and most of it is available in traditional subjects. In fact, the real difference is not in content, but in the approach. Teachers, therefore need training to develop abilities which follow an interdisciplinary approach in their classroom teaching. In other words, teachers may select those learning experiences from the existing curriculum which help to accomplish the goals of EE and use them with necessary modifications in an environmental context.

3) Preservice teacher training curriculum for primary schools aims at developing certain competencies which are necessary to achieve the general objectives of primary education If we refer back to the objectives listed on an earlier page, the first objective is to provide competencies for dealing with topics of natural and social sciences related to environmental studies. As such, environmental studies content and methodology including practice work, has been assigned a weight of 10% in the overall structure of the primary teacher training programme. Besides, in the area designated as 'working with the community', topics such as environmental studies, education in the Indian Society, work experiences health and physical education would provide work situations for preservice teachers. As far as the coverage of topics is concerned, the given structure seems adequate. But effectiveness depends upon careful planning and effective articulation, both vertically and horizontally, in the classroom situation. In fact, EE objectives can be used to accomplish the objectives of the existing curriculum. Similarly, existing disciplines can also accomplish the EE objectives. Teachers are, therefore, required merely to synthesize their experiences in various disciplines into a meaningful EE context. For developing these competencies, preservice teachers would require more practice. and the present scheme does not provide enough scope to develop all the required competencies.

4) Two alternatives exist for improvement of the existing programmes, either to develop a special course giving more weight to environmental studies content/methodology or a strengthening of existing programmes. Since often primary schools have a single teacher for all subjects, and the primary school curriculum also follows an integrated approach to teach science and social studies, it would be easy to have a separate course on environmental

studies (Fig. 6.3) as has been done in the given curriculum. But in order to develop required competencies, more weight will have to be given as it is crucial at this stage that teachers are able to synthesize the various concepts and present them in a simple way through different classroom activities. Although it would be better to have a specific course to provide all necessary preservice teacher competencies for the provision of an environmental dimension, we have to consider the following factors.

a) Most preservice teachers who join training programmes choose the teaching profession due to some compulsion, i.e., economic factors such as a necessity to earn a livelihood or an inability to get any other job.

b) There may be a dearth of well qualified environmental educators who would be able to do justice to the special course.

c) There are few incentives, in terms of the primary teacher's job and the long training period which is necessary in this case, may further affect the number of students joining these programmes.

Preservice Teacher Training at the Secondary Stage

Preservice training of secondary school teachers has different dimensions, both in structure and in relation to academic requirements. At present, there are two kinds of teacher training programs available for secondary school teachers. Generally, after graduation and postgraduation, one could go on for a one year B.Ed. course with certification as a secondary school teacher. However, it is becoming apparent that one year of teacher training is not adequate to provide all the competencies required in a secondary school teacher. As such, a four year integrated course with certification is now also available in a few universities. These curricula are prescribed by universities which have faculties of education. This training course includes theories of child development, teaching methodologies and use of teaching aids. The preservice teachers are exposed to the school curriculum as part of a content/methodology course which also includes practice-teaching.

As we have seen earlier in the case of primary school curriculum, the secondary school curriculum also includes aspects of EE. It would thus require an ability in the preservice teacher to provide an environmental dimension in their classroom teaching. For our purposes, we can look at the secondary school curriculum on one hand and preservice secondary school teacher training curriculum on the other. This would help to analyze EE goals and objectives in reference to the stated objectives of existing teacher training programs. Based on the above analysis, we can then identify areas in which infusion of environment related knowledge, skills and attitudes are possible and suggest a course of action to overcome the deficiencies, if any.

A. Educational Objectives at the Secondary Stage

The secondary stage covers two classes, IX and X and completes ten years of general education. Besides maintaining continuity in the objectives of education from previous years, emphasis has also been placed on academic subjects as well as the knowledge and skills required for doing productive and socially useful work. Hence, in addition to the objectives mentioned for earlier stages, some other objectives include the following:

The secondary child should. . .

. . . continue instruction in the three languages previously learned .

. . . have competencies in science and mathematics and be able to apply his knowledge to the solution of problems around him. He should have an understanding of the technological advancements and economic activities in his surroundings. He should be able to contribute meaningfully to environmental conservation, reduction of pollution, development of proper nutritional habits, health and hygiene in the community.

. . . develop an understanding of the socio-cultural phenomena in India and other countries.

. . . develop of desirable social attitudes and values such as kindness, cooperation, team spirit, fellow feeling, leadership, courage, sincerity, and honesty.

. . . be able to understand the value of national and civic property and be able to take care of them.

B. Scheme of Studies: Classes IX and X

1) A First, Second and Third Language

2) Mathematics

3) Social Science including History, Geography, Civics, Economics

4) Science including Physics, Chemistry and Biology

5) Arts

6) Work Experience

7) Physical Education

In regard to the social sciences, it has been emphasized that the major objective of teaching in this area is to acquaint children with their past and present, physical and social environment. Social science should help pupils to take keen interest in the ways people live and function through various socio-economic and political institutions. It should further help children to develop an insight into human relationships, societal values and attitudes which are essential to allow tomorrow's citizens to participate effectively in the affairs of the community, state, country and the world at large.

C. Secondary School Syllabi in the Sciences and Social Sciences

Since the teaching of different subjects at this stage is more discipline oriented than in previous stages, all subjects do not have the same scope with regard to EE content. In other words, some subjects such as geography and life sciences do contain a substantial amount of EE content, whereas others like mathematics and literature do not generally have the same amount of EE content. Nevertheless, it is assumed that some general objectives realized through the teaching of these subjects, may be helpful in achieving certain EE goals and objectives because they provide

essential knowledge, skills and attitudes for a good citizenship education. This can however, be achieved only when teachers are properly trained to apply their knowledge and skills in teaching other related areas.

D. EE Goals and Objectives

EE goals and objectives, as mentioned earlier, remain more or less the same at this stage. The only difference is the expected level of information and skills. Also, some knowledge and skill components cannot be discussed at the primary level because of receiver maturity . As a result, another difference in the nature of EE infusion at these two levels is quite significant. At the primary level, environmental studies become a composite area of instruction which draws information from different areas. But at the secondary level, some of subjects deal with the environment and its related issues in much greater detail, whereas other subjects lend a hand in clarifying interrelated issues. It is, therefore, necessary that preservice teachers be trained properly to handle these two kinds of approaches efficiently according to the requirements of the various subjects and the maturity level of the the students at these two levels. In some subject areas at the secondary level, teachers may not directly deal with EE components and they therefore may not have enough awareness, knowledge or skill in EE. It is, thus, all the more important that these individuals receive proper training in EE during a preservice teacher training program so that they can use it at a proper place in their classroom teaching.

E. Preservice Teacher Training Curriculum for Secondary Schools

In some countries, a one year teacher training program after graduation which leads to the degree of Bachelor of Education (B.Ed) is the requirement for a secondary school teacher. We can take, for example, the syllabus and course of study for the B.Ed. examination of one of the Indian Universities as a case study from a developing country and analyze it from an environmental education point of view. It exemplifies the aims and objectives required for the teacher training program, the nature of the course and other details.

General Aim

To prepare effective secondary school teachers who are capable of responding to the changing needs of modern society.

Objectives of the B.Ed. Program

The secondary preservice teacher should...

. . . develop competency to teach effectively in accordance with the accepted principles of teaching/learning and use modern technology in teaching.

. . . develop skills in identifying, selecting, innovating and organizing learning experience for teaching.

. . . acquire knowledge of the Indian Education system and the way of its functions.

. . . develop an understanding of psychological principles of growth and development, learning and transfer of training.

. . . develop necessary skills, understandings, interests and attitudes, enabling him to foster the all around development of children under his care.

. . . develop an awareness among the preservice teacher about the role of education in building a democratic, secular and socialistic pattern of society.

Model II

Secondary Stage

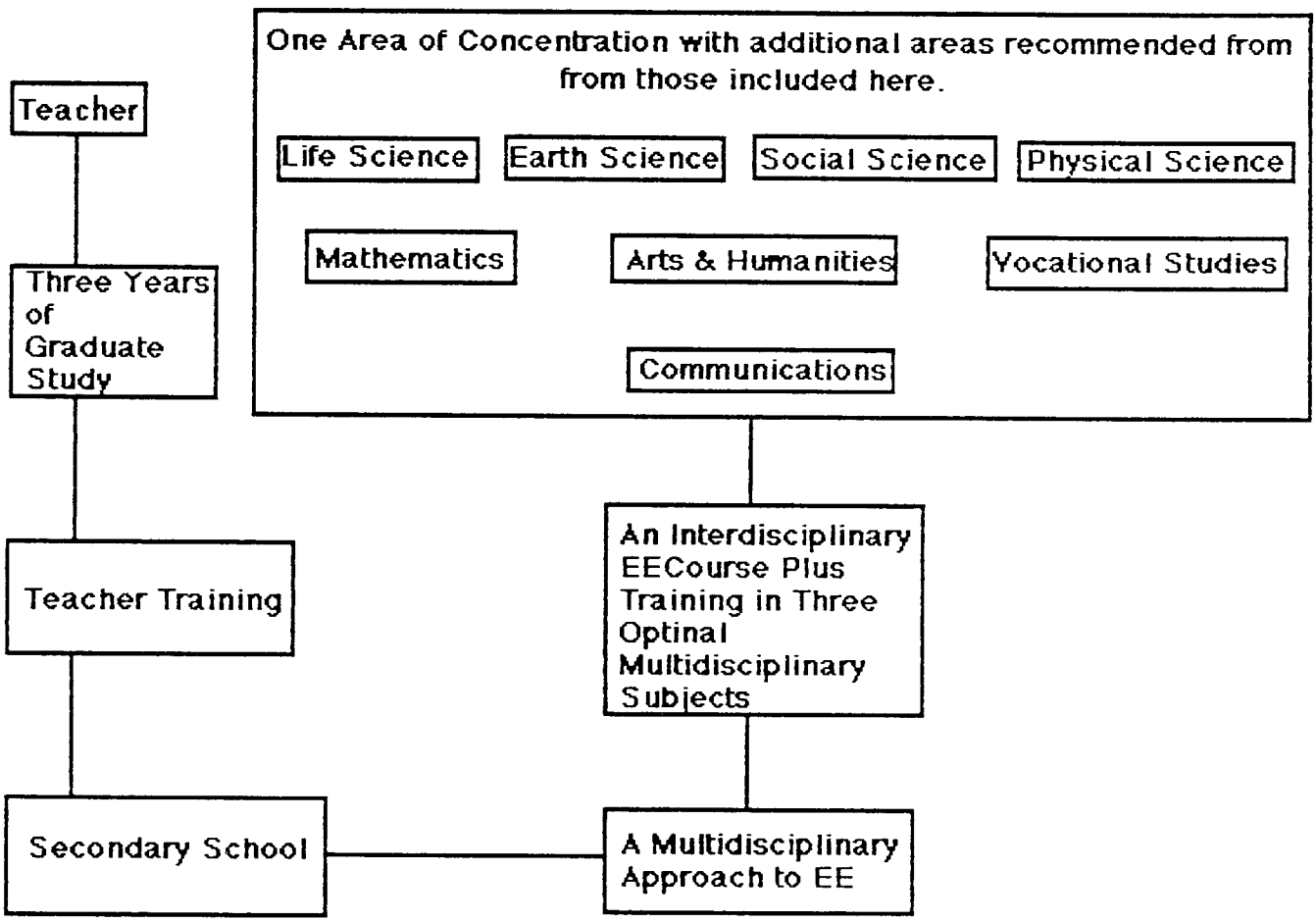


Figure 6.4: Schematic model for a preservice teacher training course.

. . . acquire appropriate professional behaviors and develop commitment to the teaching profession

. . . acquire desirable social attitudes and become an effective instrument of social change and develop an understanding of his role in the modernization of the society.

. . . possess sufficient competency and skills to guide pupils under his care in health education, recreational activities and work experience.

. . . develop skills and competencies in guidance and counseling.

As we are concerned here only with the general education component, we shall discuss the teaching of those subjects which are related to EE directly, i.e., Life Sciences, Geography and Social Sciences.

Secondary School Syllabi in the Sciences

Course:Teaching of Life Science

Specific Objectives:

The preservice teacher will be able to. . .

. . . appreciate the role of the life sciences in day to day living.

. . . develop skills in using different methods of life sciences effectively in the teaching of life sciences.

. . . develop competency in organizing physical facilities and equipment.

. . . develop abilities and competency to organize curricular activities in life sciences.

. . . develop a scientific attitude.

. . . develop abilities and competency to effectively organize teaching/learning experiences, evolving maximum involvement of students.

Contents :

Unit 1: The place of Life Science--Inclusion, present position in the school curriculum.

Unit 2: Aims and objectives of teaching of the Life Sciences

Unit 3: Methods of teaching Life Science--Lecture method, discussion method, problem solving method and development of projects.

Table III
Weights of different curricular areas

Area	Course	Weight
1) Pedagogical theory	1) Education in the emerging Indian Society	34%
	2) Educational psychology and statistics	
	3) A) Indian education system: structure and problems	
	B) Any one of the following:	
	1) Health education, physical education, recreation	
	2) Educational and vocational guidance	
	3) Audiovisual education	
	4) Social education	
	5) Curriculum and textbooks	
	6) School library organization	
	7) Mental hygiene and education	
	8) Yoga education	
	9) Basic education	
2) Content/Methodology and practice teaching, including related practical work.	4) Essentials of teaching/learning	54%
	5) Content/methodology of I teaching subject	
	6) Content/methodology of II teaching subject	
3. Working with the Community	7) Working with the community (work situations)	11.2%
	8) Work experience	
	Total	100%

Table IY
Allocation of time to different curricular areas

Area	Course	Time Allotment in Hours
1. Pedagogical theory	1) Education in the emerging Indian society	100
	2) Educational psychology	100
	3) A. Indian educational system	50
	B. Any one of the following:	50
	1) Health, physical education and recreation	
	2) Educational and vocational guidance	
	3) Audiovisual education	
	4) Social education	
	5) Curriculum and textbooks	
	6) School library organization	
	7) Mental hygiene and education	
	8) Yoga education	
	9) Basic education	
2) Content/Methodology and practice teaching including related practical work.	4) Essentials of teaching learning	100
	5) Content/Methodology of I teaching subject	200
	6) Content/Methodology of II teaching subject	200
3. Working with the Community	7) Working with the community (work situations)	50
	8. Work experience	50
	Total	900

Note: Every specific method of teaching life sciences is to be demonstrated by selecting some appropriate content.

Unit 4: Evaluation in Life Science
Nature, purpose and techniques, preparation of objective based and objective type test, evaluation of practical experiments. Assessment of project and sessional work.

Unit 5: Cocurricular activities in Life Science--Science clubs, hobbies, fairs, and field trips.

Unit 6: Teaching aids in Life Science-- Charts, diagrams, models, their use and importance.

Unit 7: Problems connected with teaching of Life Science--Identification and use of remedial enrichment.

Unit 8: Professional growth of the Life Science teacher--New trends, journals, NTSU.

Unit 9: Content Portion--Biology and health, cell structure, contributions of Dr. Har Gobind Khurana

Practical Work: Any two of the following:

a) preparation of an objective based test on a topic of class IX or X.

b) collection of science articles and pictures from newspapers and science magazines.

c) arranging at least five demonstrations of biological experiments.

d) one group project to be completed by students.

e) improvisation of four items related to school stage topics and use of them in discussion sessions.

Course: Teaching of Geography

Specific Objectives:

The preservice teacher will be able to...

...understand the important concepts used in the discipline.

...prepare unit and lesson plans for different classes.

...critically evaluate existing school syllabi and textbooks.

...prepare achievement tests and diagnostic tests, administer them, and analyze the results for further research.

...prepare suitable teaching aids and use them effectively in the classroom.

Content:

Unit 1: Modern concept of geography--Human geography and its importance.

Unit 2: Aims and objectives of teaching geography. Geography and international understanding.

Unit 3: Place of geography in the school curriculum, syllabi for primary and secondary schools and principles of their construction.

Unit 4: Methods of teaching geography in the primary, middle and high school classes: story telling; regional inductive and deductive methods.

Unit 5: Study of Home, region and local geography and its place in the higher secondary stage. Importance of excursions.

Unit 6: Geography room--Equipment, apparatus and appliance, geography library, museum.

Unit 7: Teaching aids of different kinds: maps, models, pictures, audiovisual aids, atlases and wall maps.

Unit 8: Practical geography inside and outside of the classroom--The nature and content of work in different classes.

Unit 9: Correlation of geography with other school subjects.

Unit 10: Geography textbooks and their qualities at different stages of education.

Unit 11: Evaluation of student achievement in geography.

Course: Teaching of Social Studies

Specific Objectives:

The preservice teacher will be able to...

...explain the meaning and scope of social studies.

...state the aims of teaching social studies.

...use different methods to teach social studies effectively in an actual classroom situation.

...explain the procedure of utilizing community resources for the teaching of social studies.

...prepare and use various aids which are appropriate in the teaching of social studies.

...plan a lesson in social studies.

. . . explain the evaluation procedure in social studies teaching and prepare an objective based tool of evaluation.

. . . describe the natural resources of India, its fundamental rights and duties, and the causes and events of the first war of Independence.

. . . critically examine existing curricula in social studies.

Content:

Unit 1: Social studies, its meaning, nature and scope.

Unit 2: Aims of teaching social studies.

Unit 3: Social Studies curriculum--Selection and organization. A critical study of curriculum for primary, middle and high classes.

Unit 4: Methods of teaching social studies--Project methods, lecture method, discussion method, problem method and discussion unit method.

Unit 5: Social Studies teacher.

Unit 6: Social Studies laboratory.

Unit 7: Utilization of community resources for the teaching of social studies.

Unit 8: Audio-visual aids in the teaching of social studies.

Unit 9: Lesson planning in social studies.

Unit 10: Evaluation in social studies.

Unit 11: Fundamental rights and duties, India's first war of Independence (1857).

Besides these, the area "Working with the community" provides an excellent opportunity to identify local problems and find ways to solve them.

Course: Working with the Community

Specific Objectives:

The preservice teacher will be able to. . .

. . . acquire awareness regarding the emergence of social problems and work out their solutions.

. . . develop skills required for identifying community problems and community resources.

. . . develop skill for planning and executing projects at different operational levels.

. . . develop human engineering skills such as establishing rapport in the community, social communications, human relations and group participation.

An analysis of the B.Ed courses of study and a secondary school curriculum suggest the following:

1) Secondary school curriculum provides some content which is EE based. Following a multidisciplinary approach,in the primary school, this may help to achieve EE goals and objectives.

2) A one year teacher training program has attempted to include environmentally biased content to some extent as a part of its pedagogical theory, but in general education EE is totally absent.

3) A one year period is not enough time to acquire sufficient EE knowledge and inculcate values and skills relevant to the profession.

4) Secondary school teachers are to teach two or three subjects but specialize in only one subject area during their one year training . Hence, necessary competencies in other subjects should be offered at the graduate level as well, as the training level may not be adequate to teach those subjects. It is, therefore, appropriate that preservice teachers acquire sufficient specialization in two or three subjects as part of preservice training.

5) The role of the teacher as an agent of social change, for all practical purposes is generally understated in the teacher training curricula.

6) It is quite evident that preservice teachers are not exposed to environmentally biased subject teaching in their general education courses and they may not, therefore, be able to help students in their classrooms meet the goals and objectives of EE. It is thus necessary to identify areas in which EE content can be infused, or if possible to suggest an additional course to help bridge the gap between the expected outcome of EE and the training provided for achieving that target (Fig. 6.5). Since all subject areas cannot easily infuse EE concepts into its own content, teachers in these areas would need a course as background for their classroom teaching. It is better to develop an additional course in EE incorporating all essential elements and skills of EE, which should then be made compulsory for all preservice teachers. A model syllabus and list of selected activities are given in the Appendix which could be utilized for infusion of EE concepts.

Model III

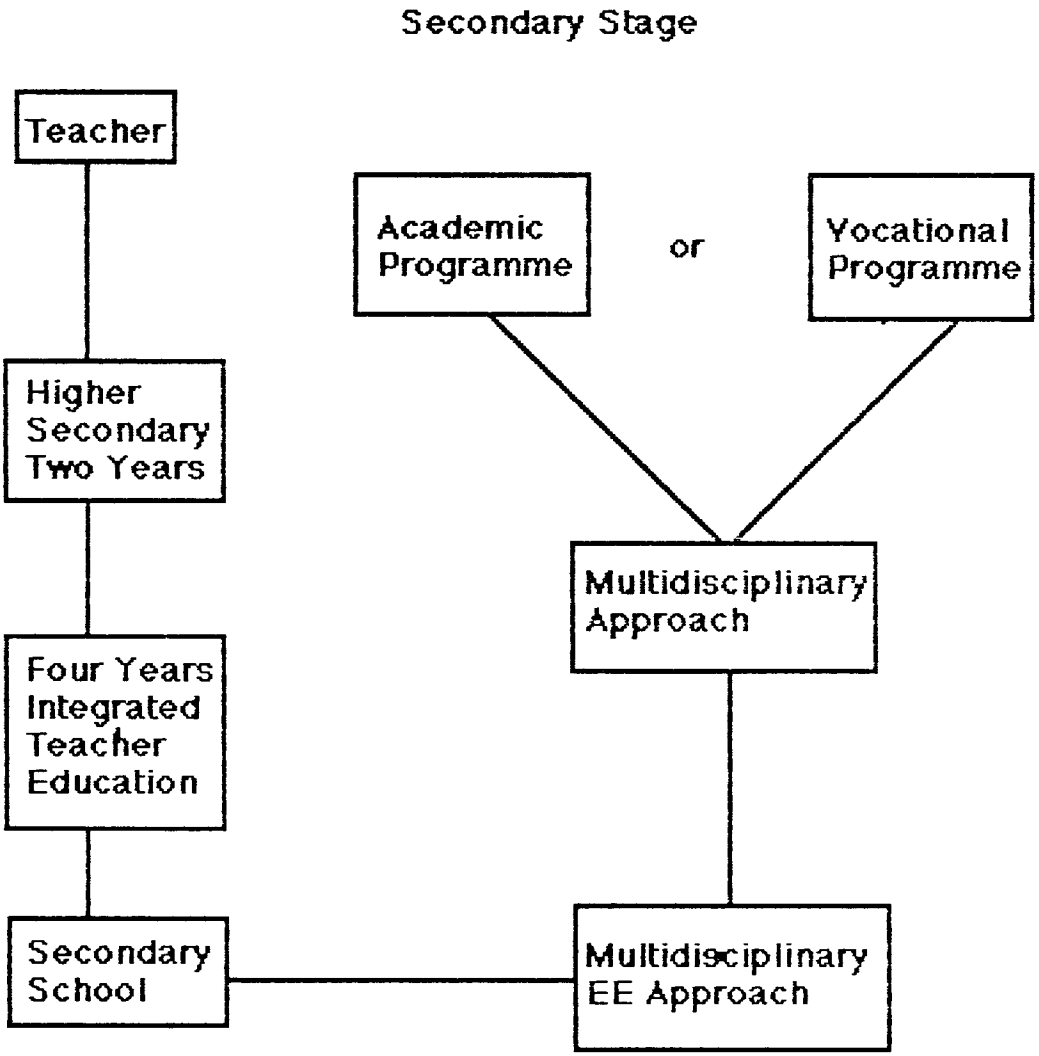


Figure 6.5: Models I and II suggest alternative courses for preservice teacher training programmes. Duration of teacher training courses are based on the existing situation in India, but the course component is suggestive. A one year course in Model I should be raised to two years to cover EE concepts.

CHAPTER SEVEN

TEACHING METHODOLOGIES AND STRATEGIES

Teaching methods are mechanisms employed to transfer information and skills which are reflected, hopefully, by a change in learner behavior after the instruction has been given. Different strategies are adopted for enhancing the effectiveness of teaching methods. They are essential components in curriculum transaction and hence constitute a significant phase in the process of curriculum development. Teaching methods revolve around the teacher, a practitioner, and successfully involve the teacher educator who has the responsibility of preparing and training teachers. The teaching/learning process focuses on both teacher and learner, where the former delivers the curriculum prepared by curriculum designers. The teacher is expected to achieve the objectives of cognitive, affective and psychomotor domains by adopting different means in the form of methods and strategies. The method is a structural presentation of the content or concepts whereas strategy may help in the effective transfer of structured instruction through method. Sometimes the words "method" and "strategy" may appear to be synonymous. They may be considered as tools very similar to the ones used by a craftsman, mechanic or electrician in their professions. Another important aspect is that a person with the tools still may not be of much help if he lacks manipulative skills or is not capable of using these tools for getting an expected outcome. Similarly, a teacher will not be able to employ methods and strategies appropriately if he lacks:

-- an awareness about the availability of different methods and strategies,

-- confidence in practicing various methods and strategies,

-- an ability to overcome the constraints, both educational and administrative, for the practice of methodologies and strategies, and

-- an ability to adapt himself to the conditions in which the methods and strategies are to be practiced.

Need for Strengthening Teaching Methodologies

Training and experience in teaching methods, through both preservice and inservice teacher training, are a must for successful implementation of a curriculum. Most countries accept only those teachers in elementary and secondary schools who have received professional preservice training (Unesco, 1985). However, there are countries which do not insist on professional training to join a school. The need for trained or professional teachers arises mainly with...

...a shift in the emphasis, both in content and approach, of a curriculum at the school level (environment centered curriculum at present).

...new expectations of the social system from schools as reflected in a changed school curricular emphasis (with EE as an approach, to work for an

improved quality of both life and environment).

. . . the advent and advance of technologies and scientific knowledge available in order to meet the needs of society.

. . . the expansion of research and resulting innovations in methods of imparting instruction

. . . the availability of appropriate teaching/learning aids (audiovisual equipment and materials).

The strengthening of preservice training curriculum, with EE as part of a life long education, would provide not only trained teachers but also minimize or reduce pressure on the financial and the manpower resources of inservice training.

It may also prove more fruitful to prepare prospective teachers in light of the expectations of EE through a preservice program rather than training untrained or once trained practicing teachers. Even inservice training would be more effective if the training of previously trained teachers was reinforced.

Status of Teaching Methodologies in Existing Teacher Training Programs

Teaching methodologies go hand in hand with content. Existing preservice training curricula in a large number of Asian and Pacific countries (which prepare science and social science teachers for elementary and secondary schools) offer pedagogical courses with emphasis on different educational aspects of subject disciplines. These courses include teaching methods as a component. For elementary teachers, preservice courses include less content (general and liberal education) about science or social science and foundation education and more of a methods component as compared to curricula for secondary school preservice training. In the latter case content with methodology and foundation components expand proportionately.

In a recent Unesco Regional Conference it was proposed that preservice training curriculum for science teachers at elementary and secondary levels should comprise; professional education (40% in elementary and 35% in secondary), liberal or general education (50% in elementary and 15% in secondary), and content (10% elementary and 50% secondary). In the above, the foundations of education segment includes components of psychology, philosophy and sociology while liberal education includes the social sciences, humanities, and language. Content refers to a discipline of science in respect to its history, concepts, principles and laboratory experiences (Unesco, 1985).

Teaching methodologies and strategies for science or social science (presented in the environmentalized form or centering around environmental problems or issues under the umbrella of environmental education) aim at developing certain abilities and competencies among preservice teachers. Preservice teachers are equipped with knowledge and skills which enable them to identify and study environmental issues/problems scientifically and make responsible decisions. In the preservice training curriculum, teaching methods assume importance because the teacher educators are required to teach trainees who in turn will be responsible for transferring information and skills to children in primary and secondary schools.

Teaching Methods Presently Employed

There are a variety of teaching methods and strategies available which are employed for teaching disciplines like science, the social sciences and humanities. Some are mentioned below:

1) Lecture method

2) Lecture-demonstration method

3) Problem-solving methods

4) Investigatory/experimentation

5) Survey-project methods

6) Field studies

7) Case studies

8) Discussion methods

These have been tested by educators and researchers using teaching concepts from different disciplines. Some have been found to be more appropriate than others for particular concepts. To illustrate this point further, investigations through scientific methods have been found helpful in the learning of science concepts and principles. Similarly, case studies have become more popular and useful in studying social aspects or social issues and actions. At the same time this document should not create an impression that case studies are not applicable to the learning of scientific knowledge or experimental methods for social science. In regard to environmental learning, certain teaching methods should definitely be preferred over others. Some methods, particularly the lecture method, often resorted to in schools or even in training institutions may include either the use of talk, chalk and black board, or of talk accompanied by demonstration with the help of specimens, charts and models. Teaching or delivering content related to environmental concepts, issues and problems (especially the factual information with numerical data) may result in rote memorization with little assimilation. This delivery system may prove to be less useful than the actual involvement and participation of learners. Lecture, interspersed with demonstration and investigation of issues and problems (e.g., pollution, population growth, cultural heritage, nutrition, health, sanitation etc.) by students may result in better learning. A lecture on weather, though illustrated with visuals, may not prove as interesting as learners themselves using specific instruments to measure various weather parameters such as temperature, humidity, wind speed and direction. These activities also help in developing certain skills.

Information related to the environment may not be accessible to learners or they may not be able to locate or use the available information as expected. In such cases, lectures by specialists working on different aspects of the environment such as health, nutrition, sanitation, cultural heritage, agriculture, industry, etc. may be essential. Lectures on forest, wildlife, etc., illustrated with films, filmstrips, and audiovisual programs may be assimilated more easily by the learners than only lecture.

Most teaching methodologies and strategies useful for teaching science and social science are equally applicable to environmentalized or environmentally based content. These have also been found to be quite relevant to EE especially to create interest, motivation, curiosity, active participation and an unbiased approach among learners as far as the environment and its allied

problems are concerned. Piaget found that overt or covert participation of learners facilitates learning. Educators have found that teaching methods and strategies would enhance learning as well as the transfer of knowledge and skills if they:

--maximize learners' participation, either directly or indirectly,

--provide a large number of situations and diverse experiences,

--enable learners to analyze situations provided and discard irrelevant components from the information collected,

--help learners arrive at or make decisions based on study, and

--enable them to apply the knowledge they have gained to problems, similar or different from the ones experienced.

Preservice teacher education will be more meaningful if trainees learn and experience the different teaching methodologies and strategies and are taught to transfer these to their students.

Any method employed by teacher educators or preservice trainee is ultimately aimed at helping pupils achieve cognitive and affective objectives and psychomotor skills. Methodology would be successful if it involved the learner's participation in different steps of scientific investigation such as observation, study of measurement, analysis, synthesis and inference. This would help lead to the formation of decision making ability.

Preservice teacher training is an opportunity to: (1) create an awareness about the availability and appropriateness of different teaching methodologies and strategies; (2) give actual practice or experience in methodologies to the trainees; (3) develop the confidence needed to repeat the methodologies and strategies in different situations; and (4) enable trainees to evaluate the effectiveness of methodologies and strategies especially with reference to the content of environmental education.

Factors Determining Implementation of Teaching Methods

Inclusion and coverage of teaching methodologies and strategies in preservice training curriculum depends on a large number of factors. Some determine choice and adoption while others would largely influence success of the methodology and strategy adopted. Broadly speaking, preservice training institutions, schools in which trainees complete internships, and schools in which they eventually work, play a major role in the options available for teaching methodologies and strategies. Training institutions have a great responsibility for equipping their trainees with all possible and relevant choices, keeping in mind the objectives of environmental education. Relevant teaching methods and strategies must be included and employed in teacher training institutions so that the trainees are aware of, and have greater choice in achieving the objectives of EE.

The following factors determine the choice and adoption of teaching methodologies and strategies in preservice training institutions for both primary and secondary level trainees.

1) Content and instructional objectives

2) Characteristics of the learner

3) The learning process

4) Resources

5) Institutional support

A detailed discussion of each area follows.

1) Content and Instructional Objectives The choice and appropriateness of a teaching methodology is largely determined by the nature of the content being taught and the objectives to be achieved. Even the approach prescribed during curriculum formation (e.g., interdisciplinary, or multidisciplinary in the case of EE) would influence teaching methods and strategies. An interdisciplinary mode of instruction may require the use of team teaching methods. The goals of environmental education are to provide environmentally based content or concepts at the preservice training level. The specific objectives of developing skills, attitudes and value systems, or environmental ethics are made possible by matching specific environmentally based content with instructional objectives. Preservice trainees must be provided with a large number of situations related to environmental problems and issues in order to achieve specific objectives related to EE. Expected outcomes in terms of objectives are reflected in the behavior of prospective teachers after they have experienced the issue situations provided.

If the specific objective of instruction is to develop value attributes, one may adopt value clarification strategies through question/answer or discussion methods. Similarly, the use of the discussion method with role playing on the issue of locating a factory near residential areas would help in the development of appropriate attitudes and environmental ethics among the learners. In addition, attitudes could be strengthened through a discussion with community participation on this issue.

2) Characteristics of the Learner Learner characteristics also determine and influence the teaching methodology and strategy to be adopted. The characteristics of the learner include age, stage of child development, academic background, aptitude and relevance of content to daily life experiences.

The preservice teacher training curriculum keeps in focus two kinds of receivers, preservice trainees as well as their future students. In preservice training, the trainees come with different academic backgrounds for primary and secondary levels. Preservice trainees for the primary school have either 10 or 12 years of schooling, or a college degree, while the secondary level trainees are either graduates or post graduates. The teaching methods to be adopted would be similar but vary in depth. For example, primary school trainees would not be able to do experimental investigations to the same depth and extent as secondary level trainees. Primary level trainees would need skills to locate and identify information from various sources but not to the same level as secondary level trainees. Moreover, library resources would not be as rich in primary schools as in secondary schools and also in respective training institutions.

It has further been found that learning is more of an individual affair than a collective one. All learners in a group do not undergo the same degree of learning. Some are slow learners while others learn faster. It is a common experience that some are keen readers and learn by reading. On the contrary, some are good at experimental investigation and learn faster by doing. Individual learners have specific requirements. Each one may require additional experience and skills over and above the skills, knowledge and understanding common to the whole group. These additional needs and abilities vary in degree. Individualized methods of instruction promote learning but constraints surrounding the development and printing of instructional materials would limit their

application. Similarly, computer assisted learning programs could be quite useful for self-learning, but the availability of hardware and software would influence the use of this method.

The aspects of preservice teachers which determine the teaching methodology, are their interest, curiosity and liking of a particular teaching style. Learners feel encouraged if a teacher participates and works with them as a partner both in project work and investigatory studies of environmental problems. They will be curious to know more about an environmental situation if it concerns or affects them or the community in which they live. This may require stimulation of their motivation through films and visual displays of the local environment and its problems. It would be easier for teacher educators to motivate, involve and create interest among preservice trainees by employing similar strategies. Allowing independent investigation and encouraging individuals to present their findings to others could facilitate and consolidate learning.

3) Learning Process Knowledge of child psychology and learning theories also helps determine selection of teaching methodology. Psychologists are of the opinion that learning is facilitated if the learner; experiences a variety of situations, applies knowledge gained to a study of these situations (including environmental problems) and rejects irrelevant components, and applies the same knowledge to situations similar or different from the ones experienced.

4) Resources The adoption and practice of teaching methods are severely limited by an availability of resources which include instructional materials, equipment for experimental studies and audiovisual aids. As far as preservice trainees are concerned, their practice of particular teaching methods and strategies would be determined by the resources in the teacher training institutes and also in the schools where practice teaching is carried out. If a teacher educator wants to provide a learning situation through a film or slides, the availability of films and a projector are most certainly determining factors. A field studies approach would depend on the number and quantity of simple items like compasses, thermometers, and hygrometers in proportion to the number of trainees involved. The same limiting factor would also operate in schools.

Preservice trainees who are expected to work with primary school children should be prepared to practice different methods using the resources available in the environment. They should be trained to improvise and develop low cost teaching aids for promoting the study of environmental concepts and issues.

5) Instructional Support The success of different teaching methods depends upon the educational organizations involved (teacher training institute, schools identified for practice teaching, and the primary and secondary schools which the trainees join after training). Availability and adjustment of time in the schedule would determine and influence the adoption of teaching methods like field studies, discussion, debates and community participation.

The duration of the existing training, especially practice teaching in teacher training institutes which prepare science and social science teachers, might not allow the trainees to opt for teaching methods relevant to EE. These call for more time in practice teaching if environmentalized content is to be taught and transferred effectively. The short term contact of trainees with the school does not encourage or allow them to involve the community in the teaching/learning process and opt for the investigation of environmental issues and problems. The use of field studies, even in a subject like biology in teacher training institutes, is practiced to a limited extent because of time.

Sometimes administrative restrictions, such as problems in taking children out of school or a lack of available transport may also influence the teacher's choice of suitable teaching methods. Primary schools have more flexibility with time, but the same may not be true for trainees at the training institute level. Group discussion, debates and seminars in TTIs and schools could be organized on common environmental topics, especially on controversial issues and problems.

Expected Abilities and Competencies to be Accomplished by Teaching Methods

The teaching method/strategy in preservice teacher training with an environmental dimension would need to be participatory in nature encouraging the development of sound decision making abilities. The achievement of these objectives could be facilitated by adopting teaching methods and strategies in teacher training which would enable the trainees to...

...identify environmental and allied problems/issues in the immediate vicinity and in other places.

...equip themselves with knowledge and skills to locate relevant information related to environmental issues and problems from different sources like the library, media, research and social institutions.

...develop the skills needed to investigate environmental issues and problems.

...assess and evaluate their investigation in terms of its local, regional and global implications both from social as well as environmental points of view.

...think of alternative solutions, if any, resulting from the investigation done by them.

...evaluate alternative solutions.

...successfully argue the decision based on a completed investigation in order to convince others that the decision is a good one.

...participate in group discussions and seminars to promote the results of their study.

...motivate others to conduct similar studies on diverse environmental issue situations.

A general methods course for preservice training programs in science, social science and the humanities should equip professionals with certain basic competencies needed to translate content, keeping in mind child development, theories of learning and theories of learning transfer. Once learners have gained these competencies and knowledge about their environment and its problems, they should be able to to apply their skills as well as teach them to others.

The environmental education competencies and abilities which must be developed among preservice teacher trainees have been identified and grouped into four levels. (Unesco, 1980).

1) The ecological foundation level

2) The conceptual awareness level

3) The investigation and evaluation level

4) The environmental action level

These have been further detailed as specific instructional goals for EE in terms of the performance of learners. They may be worked out for any environmentally related instruction and written in performance terms to help in the evaluation of learners.

Trainees should possess ecological knowledge and an understanding of basic ecological principles so that they can investigate environmental situations and arrive at possible solutions to different environmental problems. They should be able to evaluate social aspects of human impact on the environment and evaluate the alternatives available. Ultimately, they would be able to take either individual or group action after investigation to prevent or work for the solution of environmental problems and contribute to maintaining an equilibrium between quality of life and quality of the environment.

In order to equip preservice trainees with competencies and abilities which promote EE, a variety of teaching methods and strategies should be used during training. Trainees must be made aware of and given a thorough drilling during practice teaching in order to develop their confidence in the use of methods with appropriate strategies to promote the learning of environmental concepts and problems. Certain strategies followed during practice teaching would specifically contribute to the construction of value attributes and positive attitudes towards environmental issues. This aspect should become clear in the next few pages. The training curriculum should prepare trainees to utilize the following teaching methods and strategies in the context of environmental education.

1. Problem solving
2. Experimentation
3. Case studies
4. Out of classroom activities or Field studies
5. Projects
6. Surveys
7. Simulations and role playing
8. Buzz sessions
9. Brain storming sessions
10. Discussion or debates involving local resources and issues including community participation.

These would be in addition to the lectures and lectures with demonstrations commonly practiced both during preservice training and in actual school teaching. Training in methods should make trainees realize that a method can be successfully employed by choosing appropriate strategies and suitable teaching aids.

The above list is suggestive only and does not cover all available methods and strategies. Definitely these should be included wherever possible in the preservice training curriculum but not at the cost of others (the lecture method for example). Sometimes, when information is not available or not accessible to learners or even to teachers one may have to use illustrative lectures by an expert on a particular aspect of the environment.

The knowledge, experience and practice of a large number of methods and strategies are necessary because:

1) One method will not achieve all instructional objectives. A combination of two or more may be required. For example, one can develop investigatory skills by organizing a field trip to investigate a particular environmental situation, say, contamination of water. Analysis would lead to inference and decision-making. The latter could be better achieved through a strategy of organized group discussion to clarify different points or decisions, especially on controversial issues. Similarly, combining lecture with demonstration or experimental investigation may prove more useful for teaching pollution than a simple lecture.

2) All learners may not learn equally from a particular method. Also, learners of different age groups would respond differently to teaching methods teachers use. Primary school children may gain more from simple demonstrations using models or exploration of concrete situations around them. The secondary school students would learn more through first-hand investigation of food chains in the environment and should be able to construct both food chains and webs.

3) The nature of environmental concepts would also differ. A specific concept could possibly be taught better with one method rather than another. For example, for teaching about the past environment, a field trip to nearby historic places would give the learners first hand experiences and might motivate them to look for more information from elders and other sources.

Scope at Primary and Secondary Level Training

While dealing with different teaching methods and strategies for preservice trainees, it may be extremely difficult to draw a line indicating the method to be employed specifically for the primary or secondary level. Therefore, various teaching methods have been illustrated using one or two examples of environmental concepts/problems. At appropriate places, indications have been made as to how the same method and strategy could be extended from primary to secondary level. The application of a method would differ in degree of depth only. Variance in depth may also be essential as the objectives of EE in primary and secondary schools would slightly differ in emphasis. It may be necessary to create awareness and motivation among primary school children and provide more content and involvement for secondary children in the investigation of the environment and its problems. Even otherwise, it may not be feasible to suggest teaching methods for primary and secondary level training separately. However, trainees at both levels must be given practice in the methods and strategies which promote environmental education and help to achieve its goals and objectives. They should be capable of applying any method or strategy to explain concepts and environmental situations they are expected to deal within primary and secondary schools.

In the succeeding pages, methods from both categories (individualized and group method) which aid in learning have been covered using examples of environmental concepts likely to be included in the proposed environmentalized training curriculum. These are illustrative examples

only and are not exhaustive. These are mentioned here not to be prescriptive but only as guidelines for curriculum developers.

1. Problem solving method

Problem solving in a real sense, is an approach to teaching/learning which centers around an environmental issue or problem and generally involves investigation. It encompasses teaching strategies like project work, surveys, experimentation (field studies, laboratory exercises), case studies and many others which are investigatory in nature. This method is pursued through either discovery or expository approaches. In the former, the teacher provides guidance to formulate and work out problems, while in the latter the solution of a problem is demonstrated and learners are required to apply the same principles to other situations. The force field approach proposed by Meyer (1979) and referred to by Hornandoz (1980) is quite relevant for the study and investigation of environmental problems through problem solving methods. According to them every problem has a positive or driving force operating for positive change, i.e., towards improvement or minimization of the problem. At the same time there is a negative aspect, or force of the problem which works for maintaining of the status quo, or restatement of the positive forces. One may have to consider and study both the positive and negative aspects of environmental problems and issues. It is necessary for achieving positive output through the former and at the same time to soften the impact of negative forces. Generally one observes that the negative side of an environmental problem is discussed especially in case of pollution and deforestation etc. Sometimes this leads to a false impression that issues like conservation are anti-development. Further, projecting the negative side only does not provide a balanced picture of environmental issue/problem being investigated.

Investigation of the problem identified by trainees or learners themselves would also develop the following skills and competencies:

--Determining priorities to implement the investigation of environmental problems;

--Adopting scientific methods (observation, study or measurement, analysis, synthesis, inference, hypothesis formation, verification etc);

--Experimenting with manipulation of equipment or apparatus, as required;

--Assessing and judging the efficiency and precision of methods and techniques employed;

--Employing mathematical abilities if required;

--Developing a scientific way of looking at issues and problems;

--Developing and improving decision making ability;

--Accepting attitudinal alteration as it develops through the investigation;

--Constructing or altering certain value system attributes without any bias;

--Propagating the values developed.

Clarifying Strategy

The adoption of clarifying strategies through values analysis, discussion or question/answer sessions for teaching about the environment serves specific purposes. The development of specific competencies and skills, especially value clarification and decision making ability through investigation of problems, has already received support from the studies of Coombs and Meaux (1971). Their work on teaching values suggests that the following steps are essential for the success of value analysis as a teaching strategy.

--Identification and classification of questions relating to value;

--Arranging the available facts collected for value analysis;

--Assessment and evaluation of the validity of the facts considered;

--If necessary, seeking clarification and determining the relevance of facts and values under consideration;

--Ultimately constructing value attributes as a result of 1-4; and

--Making a decision about the value attributes constructed and testing the principles which helped in reaching the decision.

Blum (1979) and other educators have emphasized the role of investigatory methods through case studies, cost-benefit analysis, games, role playing and kits (These are packages on the environmental problems of a community such as pest control or oil spills). They feel that all strategies aim at community environmental problems though the specific steps in each may be different. Moreover, these also help to develop proper attributes and values towards the environment.

Another example of employing a particular content for the teaching/learning process of value clarification is the 'land-use' unit developed by BSCS (1979). It contains about 100 questions and statements related to different aspects of land use which include impact on community life and environment. Receivers are required to express their opinions in three options titled; agree , disagree, and do not know. The class selects certain statements which have an equal number of respondents in each of the three categories and then discusses each category in their respective groups. Each group then determines reasons for responding in a particular way and this gives an idea about the views and options held by individuals or groups. It would also reflect the attitudes and values possessed by individuals in the class.

Clarifying Responses

Value clarification through clarifying responses and critical response help in changing value attributes. A teacher's response to questions raised by children is a main factor in motivating learners to question further. A simple yes or no, or too precise a response, sometimes discourages learners from continuous questioning to seek clarification on a particular environmental concept or issue. For example, a learner informs the teacher that his family has purchased water heating equipment for the house. A teacher's response may be; Fine, but how will it help you and your family? Or, alternatively, a brief indifferent response. The first response would help to continue the dialogue as well as invite the learner to ponder more information. Further questions might include:

--What does this machine consume?

--Would this machine add to energy consumption in your house and locality?

--Do you know of alternative means available to obtain hot water?

--Which alternative is preferable and why?

Pupil reaction sheet

Learner centered sheets can be prepared to provide learners with a provoking environmental situation, or problems may be provided through films, slide shows, or news reports. This would stimulate learners to ask questions which are answered as far as possible by the teacher and discussed in a group to assess learner views and attitudes.

Critical incident sheet

Another tool for value clarification is the use of critical incident sheets on which learners are encouraged to look for news related to the environment, issues and problems. They would identify and explain briefly their roles as individuals and list actions to be taken by them in the environmental situation reported. It is not necessary that news reports contain the environmental problems exemplified in the prescribed curriculum. The teacher may try to establish the problem's relationship to concepts that learners have covered. For example, reports on environmental problems or hazards like the leakage of a poisonous gas at Bhopal (India) could be discussed to explain related topics such as environmental pollution, industrial planning and urban development. These issues would encourage development of value systems and positive attitudinal approaches to environmental issues specifically those which are controversial such as pesticide use, construction of dams and land use.

Open ended Questions

The value clarification strategy could further be strengthened by interaction using Open-ended questions/answers between the preservice teacher and teacher educator. Partial answers to each question would lead to further questions. It would help the teacher to discover the attitudes and beliefs possessed by learners. This may be more true for environmentally related content as the specific environmental problems generally have more than one solution. For example, to control air pollution one may either opt to restrict the number of vehicles, limit usage to vehicles with fuel efficient engines or both. This would encourage divergent and critical thinking and formation of decisions based on consideration of the alternatives.

II. Experimentation

In experimentation, a learning situation is investigated under controlled conditions which help to test and establish a hypothesis or discover some factor or natural phenomenon. Investigation of the environment, which may be community centered, would motivate learners to investigate problems with interest and concern. They may eagerly seek the teacher's help and guidance and also involve community elders in the study. Community participation may be necessary if the investigation calls for individual or group action to reach the environmental solution they have chosen.

Activity: Study the role of plants in the prevention of soil erosion.

Target group: Primary level preservice teachers

Objectives:

The preservice teacher will be able to. . .

. . . set up a simple experiment.

. . . collect the right type of soil for planting grass.

. . . prepare soil and plant grass for the experiment.

. . . measure amounts of water before and after the experiment.

. . . analyze runoff by examining water collected from two boxes.

. . . quantify the amount of soil lost from each.

. . . recognize the role of roots in binding soil.

. . . recognize plants which are soil binders.

. . . identify or establish water as an agent of soil erosion.

. . . appreciate the need of plant cover for protection of soil from erosion.

. . . look for other factors responsible for soil erosion.

. . . determine the water retaining capacity of soil.

. . . suggest means for improving the water retaining capacity of soil.

. . . establish the relationship between soil erosion, floods and climatic changes.

. . . locate sources of information about soil loss from books, journals and agencies in the area.

. . . understand the relationship between soil erosion and irrigation methods.

. . . appreciate the need of preventing soil loss through faulty irrigation methods.

. . . discuss with the community soil erosion and means of prevention.

. . . suggest plants which provide vegetative cover to check soil erosion.

. . . promote terracing and other means to minimize soil loss.

Materials required:

Two metallic boxes or plates, soil, grass, beakers, measuring cylinders, thick paper.

Procedure:

1) Fill two boxes with soil after removing stones and litter from the soil.

2) Plant grass in one of the boxes and let the grass grow for some time.

3) Place both boxes in a slanting position. Pour equal amounts of water using paper so that the water does not fall directly on the soil. Separately collect the water below the boxes in beakers.

4) Observe the color and amount of soil in both beakers and draw inferences. Water in the beaker placed below the box with grass should contain less soil as compared to the other beaker. What inference can you draw from this simple experiment?

Results may be discussed in class allowing others to react to the study. It may be used to explain the role of plants in prevention of soil erosion or in binding soil. The following related questions would be useful: 1) What would happen as a result of the large scale removal of plants from soil? 2) What other factors are responsible for soil erosion? 3) How does soil erosion affect community life?

Target Group: Secondary level preservice teachers

The same experiment may be conducted on other aspects of erosion, such as soil erosion by wind, use of different soils etc. Trainees may attempt to determine:

--the amount of soil removed,

--the amount of soil retained by the soil,

--the water retaining capacity of soil,

--how water retaining capacity can be increased, and

--which types of plants are good soil binders.

During discussion, learners may be encouraged to look for information from various sources. For example information relative to the impact of soil erosion on the environment in the form of floods, climatic changes, and the relationship between the process of soil erosion and the community might be sought. Information relating to the actions learners can take at this level and initiation of action among community members due to creation of an awareness about the problem of soil erosion may also be encouraged.

III. Case Study

The case study is another investigatory strategy which can be used as a problem solving method to teach environmentally based content. It is initiated with teaching/learning through discussion of environmental issues/problems which appear as newspaper stories, television programs, magazine reports and other media events. The discussion creates interest and motivation leading to the trainee's participation in the identification of the environmental issues involved in the situation. The class discusses the different issues and problems in small groups. Group members are free to express their opinions, feelings and even personal beliefs. It may lead to a situation for alteration of beliefs or changes in opinions. Each group would present its view point to the class and group members would present their decisions and recommend actions based on their reasoning. The teacher educator would be present throughout the activity to provide guidance during discussion both in groups and also in the general discussion. Moderation of group work by the teacher educator would help to complete the activity and achieve its objectives.

A case study generally involves listing objectives, collecting information, study, analysis, and discussion to process the information gathered, followed by the compilation of information from different groups and attainment of a generalization for action. The strategy promotes environmentally based learning and enables learners to...

... be curious and look for environmental issues/problems which appear in the media.

... be eager to bring articles to the notice of others including the teacher.

... develop skills in the planning and collection of information through interviews and questionnaires.

... develop habits of meeting people in the community and interacting with them.

... use skills in analysis and pursue discussions through communication.

... classify and interpret the information gathered.

Activity: Study of the food habits of local people.

Target group: Primary level preservice teachers.

Objectives:

After carrying out a case study, the preservice teacher will be able to...

... design questions and interview people using questions to elicit information on the food habits of people in the area.

... tabulate the information collected to identify food items consumed.

... draw graphs showing patterns of food consumption, including frequency and amount of consumption.

... discuss the information collected with fellow colleagues.

. . . derive relationships or relate food habits to consumption of food items, their supply and distribution.

. . . generalize the food habits of people as vegetarians, nonvegetarians, rice eaters, etc.

. . . group people into meat eaters, egg eaters and vegetable eaters.

. . . identify food fads and work for promotion of a scientific view toward diet and food.

. . . relate food habits with work habits such as sedentary, manual or hard labor.

. . . communicate the information collected using charts, posters and models to interact with the community.

. . . promote the adoption of good food habits to meet the body's requirements.

. . . relate food habits with food shortages and identify the factors responsible.

. . . explain the need for proper disposal of waste.

. . . develop interest and locate information in newspapers and magazines about the food habits of people in other areas.

Procedure

At the primary level this investigation may be limited to collection of simple information on food items, grouping the items and deriving food habits accordingly. Secondary level trainees may carry out the case study in more detail as described below.

1) The teacher educator would explain an event for case study from a newspaper report about shortages of bread and vegetables in the market, to create interest and curiosity for further investigation.

2) The learners may propose to study the food consumed in terms of supply, demand and other related aspects.

3) Small groups would visit different areas and meet people of different age groups. It is possible that young people may be either at school or at work outside the home. Elderly people may also be a good source of information.

4) A questionnaire may be prepared to elicit written or oral responses through interviews. The learners will visit the localities at a convenient time. Information might be collected regarding the following topics:

   --type of food items people consume,

   --the items consumed in the morning, at midday, or in the evening,

   --the form in which food items are consumed, cooked or raw,

   --the frequency of consumption of food items (to elicit the amount of consumption of different items) in order to compare specific items,

--the mode of supply for items in the town/village,

--the means of waste disposal,

5) Each group may collect information either in a particular locality or in certain families. Each group can be assigned to gather information on food items consumed at a particular time of day.

6) The groups would process the information. After discussion and compilation of the data recorded by all groups, information could be classified in terms of consumption of each item; availability through supply; factors responsible for shortages; and steps needed to ensure regular supply.

7) The group may then propose action which suppliers, sellers and consumers would undertake to ensure a proper balance between supply and consumption.

After the case study, the preservice teachers would be able to identify food habits of people, factors responsible for shortages and the need for proper distribution of food items. The discussion may cover the global implications of food shortage, means to increase food production, and the role of ecological knowledge in solving food problems vis-a-vis population issues.

Out of Classroom Activities

These are the outdoor education methods in which studies are carried out both outside as well as inside the school. The activities, done as part of the teaching/learning process, provide first hand experience of the environment and helps in understanding natural relationships, environmental principles and phenomena. The experience also helps learners to conceptually consolidate the information that they read in books, newspapers, magazines and other media sources. These methods include field studies, project work and surveys. They provide an opportunity for the learners to...

...investigate individually or in groups.

...share information collected during an investigation.

...present one's own view arrived at through investigation.

...evaluate other view points and change one's value attributes, if necessary.

The out of school activities sometimes mentioned as out of wall experiences also help learners develop...

...An awareness about environmental problems.

...Skills like observation, planning, experimentation, collection of information, analysis of information and drawing inferences based on the study.

...Abilities in arguing, attitudes for listening to other view points and appreciation for logic.

. . . Temper and patience for modification of one's own information, attitudes and values if required.

In addition, these methods promote the general ability of trainees to organize out-of-school activities and help learners to investigate their own environment and related problems.

IV. Field Studies

Preservice trainees, in order to develop confidence must undertake field studies to study environmental concepts and related issues and problems. Skills to organize a field trip ans steps to optimize its output in terms of learning, need to be developed during preservice training. The following steps are necessary for successful field outings to study environmental issues, ecological principles, natural resources, and the role and impact of man's activities on environmental systems.

A survey of content in the syllabus: The teacher educator/trainee should analyze the syllabus and identify specific environmental topics/concepts.

A survey of the area selected for study: Keeping in mind the topics identified in the survey, the teacher educator should investigate an area before taking the trainees there for field studies. Knowledge of the study area would help the organizer plan the actual work which the trainees would undertake. The teacher educator would have to identify and carefully specify the work to be pursued both in the field and in the laboratory after the trainees undertake the field work.

The listing and collection of materials required: The next step would be preparation of a list and collection of items required to carry out the field work. The requirements would be determined by the mode of operation and the resources available. For example, if the aim of the field study is to know the biota and abiota of an area, one compass, a thermometer for temperature measurement, plastic bags and old newspapers would serve the purposes of the whole class. But if different aspects are to be studied in smaller groups, more of these items may be necessary.

A discussion on the scope of field study: The teacher educator, being the organizer of the field trip, must discuss with the trainees the work to be done and information to be collected. Responsibilities may be assigned to each group, if group work has been planned. The method of transport and other points important in reaching the site may be explained and the teacher educator should accompany the trainees to the sight. An adjustment of timetables in the teacher training institute will have to be made for field studies. If the organizer feels it is necessary to broaden the scope of study, he may take with him other faculty members with academic backgrounds in areas like Geography or History. He may also involve them in the planning so that they are able to help trainees on the spot. A holistic approach to study of the environment through field work which will thus be more interesting and fruitful requires a need for participation and planning by staff members with expertise in different disciplines.

The analysis and interpretation of the data collected during field work: Each group will analyze the information collected in the field and draw inferences. The groups will present their findings to the class and seek responses. They may have to modify their inferences in light of class discussions. The teacher educator would guide the discussion and try to develop a consensus on the different environmental issues or problems covered by the study. A report may be prepared by compiling group work and discussions.

The display of findings and initiation of further discussions: The class would display the materials collected and details of the study, to motivate and create interest among others. Similarly, a display could be put up to seek the reactions of community members and initiate action at the community level, if required in respect to the investigation of problems like control of air and water pollution, use of pesticides, unplanned urbanization and environmental sanitation.

More activities can be planned to give experiences to preservice trainees so that they are able to plan field studies for teaching the environment to their target group in primary and secondary schools.

As primary school children are very curious, enthusiastic and carry unbiased opinions the trainees may organize simple field studies in their practice teaching to maintain childrens' interest in the immediate environment. An activity should be utilized to develop simple skills in such areas as observation, collection of data, classification and drawing.

Activity 1: Study of the living and non living components of the immediate environment.

Target group: Primary level preservice teachers

Objectives:

The activity would enable preservice teachers to. . .

. . . observe non living and living objects in their environment.

. . . distinguish living from non-living objects based on such traits as locomotion, and structure.

. . . identify plants and animals in the area as flowering, non flowering, insects, birds and larger animals.

. . . list and group the plants as herbs, shrubs and trees.

. . . distinguish plants from animals found in the area.

. . . explain biota of the area.

. . . relate the number of living and non living objects observed in the area.

. . . collect information about living organisms of other areas from newspapers and magazines.

. . . study population of different plants and animals occurring in the area.

. . . discuss the features of living organisms by relating them with their environment.

. . . collect samples of water and soil for testing.

. . . study the characteristics of soil and rocks in the area.

. . . identify pollutants in air, water and soil.

Procedure:

1) The teacher educator will select an area in the immediate vicinity.

2) Groups will be formed for different assignments. One group should collect living objects while others identify and collect nonliving materials. Another group should record general information about the study area.

3) Each group will display their collections and present and their records. The class will discuss and arrive at simple inferences, e.g. the environment has more nonliving objects, or live animals outnumber plants; among the plants, most are trees or other groups are in abundance; the area is free of smoke or garbage.

This may motivate the preservice teacher to show interest and curiosity in the study of biota and nonliving materials in other areas.

Target group: Secondary level preservice teachers.

The same activity could be planned for secondary level preservice teachers by extending the study to the investigation of various types of living organisms and population studies of certain species. Similarly, the nonliving components could be studied further with details of water and soils. The learners would collect samples, analyze them in the laboratory and find contamination if it exists. This is possible because the older children have developed manipulative, experimental and interpretative abilities and skills to carry out these field investigations. They also may organize a discussion and exhibit at the community level, if required.

Activity 2: Study of the structure of different objects in the environment and recognition of patterns.

Target Group: Primary level preservice teachers

Objectives:

Through this activity the preservice teacher will be able to. . .

. . . locate different objects such as buildings, parks, streets, trees and animals.

. . . work in a group to collect information on the design of particular objects such as buildings used for different purposes.

. . . draw the shapes of various objects such as trees or animals to arrive at generalizations as to contours and shapes.

. . . discuss the observations collected on shapes of different objects and relate them with functions.

. . . draw maps to show means of transport and location of factories .

. . . derive common designs for buildings and shapes of trees.

. . . relate the design of objects such as buildings to their purpose.

. . . relate the number of people who use an object to the number and design of the object.

. . . relate architectural design of buildings to climate and function.

. . . appreciate the need for parks and green areas in overcrowded places.

. . . recognize the role of different designs in providing better functions and healthy surroundings.

Procedure:

1) The teacher educator will select an area and give hints to trainees to note the designs of buildings, streets, parks, and shapes of plants and animals.

2) Trainees in different groups are assigned to record the design of a particular group of objects like buildings or the shapes of trees and animals.

3) Trainees would also sketch the objects, if required to identify various shapes.

4) Each group will present their records and the class will arrive at certain generalizations with the help of the teacher educator. The points arrived at towards the end of discussion may relate to, common designs of buildings, common shapes of trees, designs common to school buildings, hospitals or markets and similarities between schools and other buildings.

The teacher educator may help the trainees relate this study with other factors like rain, season, sunlight, shade of trees, and functions such as life in the area, professions, study, medicine or business.

Target group: Secondary level preservice teachers

The same activity may be further investigated with respect to factors such as the number of buildings (overcrowding), number of inhabitants or ratio of buildings to green areas. This would help in developing environmentally related attitudes and values. The trainees may develop explanations of the necessity for maintaining green areas, changes required in designs of buildings to save energy spent for lighting, and planning of parks, streets and buildings from an environmental point of view. If the field studies indicate a few green spots, the trainees may initiate action at all levels involving the inhabitants of the buildings to maintain green areas in the locality.

5) Project Work

Project work is one of the strategies or techniques employed for strengthening outdoor education studies as well as the investigatory approach for learning about the environment and its problems. The activity in this strategy has a defined goal, and the scope of the investigation may apply to many aspects of an environmental problem or situation. Moreover, in project work, the means of investigation may change as a result of necessity, but the broader aim generally remains the same.

This strategy encourages independent investigation by learners and has scope for involvement of a community and its resources. It may be carried out individually or in groups. For example, a project to study air pollution may answer the following questions:

--How does air get polluted?

--What are the pollutants?

--How can pollution be prevented?

--What measures are necessary to minimize pollution of the air?

--What role do human beings play in causing and preventing air pollution?

Project work may sometimes be restricted to preparation of mechanical models to demonstrate pollution of air,or show equipment used to minimize pollution. Project work thus develops the following among learners...

...skills for investigation, including observation, collection of samples, collection of information from sources for inference and preparation of reports.

...confidence needed to present information to the community and to approach the community and different agencies for information.

...group spirit or team work if the project is carried out by a group.

...skills in arguing the viewpoint developed from the study.

...the power needed to justify the findings and decisions arrived at the the project report.

...an ability to take appropriate action either individually or through the community to protect the environment.

...courage to speak for the right cause, free of any biased personal prejudices.

Activity: The study of the various means of transport in a locality to assess its impact on the environment.

The activity as a project may be undertaken by a group to investigate the different means of transport used by people, the types of vehicles used on roads, categorization of the vehicles into powered and muscle driven, and determination of the relationship between number of vehicles and number of people in the area.

Target group: Primary level preservice teachers.

Objectives:

The project study will help preservice teachers to...

...identify vehicles releasing smoke.

. . . distinguish the different types of vehicles in the area.

. . . group vehicles based on criteria such as power driven, muscle driven, four wheelers, three and two wheelers.

. . . relate the number of vehicles to number of people.

. . . recognize vehicles as a source of contamination of the air.

. . . identify and establish the areas or spots with more automobile smoke.

. . . identify fuels and their consumption in different vehicles.

. . . collect information about types of air pollutants in the locality.

. . . list the health hazards of air pollution.

. . . compare the air pollution information of the locality or area with other areas and identify areas with more or less pollution.

. . . look for sources of air pollution other than vehicles.

. . . display the information collected on air pollution with the help of charts and posters.

. . . prepare cartoons, posters and models to highlight different aspects of air pollution.

. . . appreciate the need for preventing air pollution by improving the efficiency of engines.

. . . share information on air pollution with others including the community.

. . . discuss with community elders efficient use of fuels and conservation of fuels through means such as sharing of vehicles or transport.

Procedure:

1) Preservice teachers will divide into different groups. Each group will collect information related to type of vehicle and observe the frequency of these vehicles at some traffic junction.

2) Before the start of work, the group will prepare a list of common vehicles, prepare a table, and enter the observations made at the observation spot.

3) Groups will exchange information and compile it.

4) Generalizations will be made after class discussions.

5) The class will discuss the role of vehicles in air pollution and means to prevent or control pollution.

6) The class will identify the roles they are expected to play as citizens in controlling pollution.

Target group: Secondary level preservice teachers

The same project work may be undertaken in an extended form by secondary school preservice teachers. They may determine the consumption of fuel in different types of vehicles, the daily consumption of each and relationships of this to pollution in the air. They may collect information from pollution monitoring stations set up at busy traffic junctions and petrol pumps. They may involve the community to collect information and invite the community to participate in planning. Display of observations through posters, charts and models to initiate action at the community level may also be used.

6) Survey Work

This strategy helps to involve learners in carrying out simple data collection exercises which provide basic information for planning other related activities. Based on the survey record and project work, experimental investigations are carried out to learn more about the environmental problems of the area and to understand the totality of the environment.

A survey is generally carried out to gather information through questionnaires, opinion sheets or personal interviews and to elicit opinions, feelings and attitudes of individuals on various environmental issues/problems. For example, if one wants to know about water pollution in an area, a survey would aim at determining sources of water, drinking water supplies and agencies involved, water treatment plants, polluting agents in the area, the role of human beings in water pollution, and measures that the community feels should be taken to prevent water pollution.

Target group: Primary level preservice teachers.

The survey of sources of drinking water, their sources of contamination, the purposes for which the water is used and personal hygienic habits for keeping drinking water clean may be used in a survey by primary level preservice teachers. However,it may be difficult to design questionnaires and interview questions for learners in the primary school. The teacher may either design or help the children in preparing the questionnaires, opinionnaires or interview sheets.

Objectives:

The survey information will enable the preservice teachers to. . .

. . . locate different sources of water in the area.

. . . identify the agencies involved in supply of water especially for drinking purposes.

. . . relate a source of water with its uses.

. . . recognize the sources or agents of drinking water pollution.

. . . identify and relate the role of man in contamination of different sources of water.

. . . identify water borne diseases and preventive measures.

. . . acquire knowledge of water treatment plants if any are being used for the purification of water.

. . . appreciate the role of personal and community hygienic habits in preventing water contamination.

. . . design a questionnaire to elicit information from the community about different aspects of water.

. . . interview community members to get information about water sources, sources of contamination, preventative measures and personal hygienic habits.

. . . share information with others on water sources and the use or misuse of water.

. . . display the information collected to mobilize opinion against contamination of water.

. . . involve the community to get their opinions and feelings.

. . . develop concern and positive attitudes for protecting the quality of drinking water.

. . . prepare models of water treatment plants.

Procedure

1) The preservice teachers would determine aspects to be surveyed.

2) Simple questions for questionnaire, opinion sheets and interviews may be prepared based on the following examples:

   --From which source does a family obtain drinking water?

   --How long has the family been living in the area?

   --Have thy found any change in the water supply source or quality of water?

   --Have they faced water shortages? If so, generally in which season?

   --What factors do they feel are responsible for water shortages?

   --How much water on average is used in their home?

   --How do the residents feel about the quality of water?

   --What are the contaminating agents/agencies responsible for pollution of drinking water?

3) Trainees would divide themselves into groups and each group should take responsibility for surveying a particular locality.

4) Trainees would visit the assigned areas and collect information.

5) The community people to be covered in the survey should be of all age groups.

6) After collection of information, the group would compile the data and identify the main issues related to quality of water and judicious use would be emphasized during discussions.

7) Trainees may put up displays (showing sources of water, pollution, polluting agents, precautions at all levels) and invite people from the community to participate in action for maintaining quality of drinking water.

8) The whole group would plan actions to prevent and control pollution of water.

Target group: Secondary level preservice teachers

Further related activities for studying different water pollutants, their amounts and chemical testing of samples may be planned in the form of project work especially for secondary level preservice teachers.

7) Simulation Method

This is a method in which a simulated learning situation is provided to learners. The assumed replica reflects the real world. It links the class with environmental situations in reality. It has been found to be quite suitable for EE. Environmentally related simulated situations include location of factories and airports near residential areas, construction of a dam, population growth and conservation of wildlife or its habitats. Such situations would cover important environmental issues and problems involving fundamental environmental principles. These could be designed from information available in the media. The teacher educator/trainee can simulate situations on topics like pollution, land use, meteorological information, deforestation and afforestation and encourage the active participation of both learners and the teacher.

Skills and Competencies

This process aims at developing:

--skills of investigation involving observations, analysis, synthesis and interpretation,

--decision making abilities,

--comprehensiveness and realization of the consequences of decision making abilities,

--evaluation of alternatives, and

--construction of value attributes.

The learning situation provided by the teacher educator can be studied through role play techniques and games played by the preservice teachers. Recent studies (Connect, 1985) have categorized simulation and games into four types; role playing, case studies, games and mechanical (usually computer). The mode of presenting simulations is different in each type. For example, in the case study technique a situation is presented through selected information from printed materials like reports, while role playing expects improvisation by learners on the role being played. Computer simulations are better at providing answers than in helping to understand the processes involved in arriving at answers.

The simulation activity is carried out by identifying the following rules and procedures.

1) Learners are assigned roles or positions. These can also be determined by drawing lots, or by learner preference. One preservice teacher would act as a conductor as well as the moderator.

2) Learners are briefed about their roles, so that they may gather more information related to their roles.

3) While playing their respective roles each one will present his views before the group. The order of presentation is either determined by draw or by the moderator in order to meet the content structure of the simulation provided.

4) The participants would participate in discussions with the consent of the moderator.

5) The moderator would guide discussions on different issues keeping track of time.

Activity: Role Play

The government has proposed to construct a dam over a river at a particular site. A committee has been set up to hold hearings involving different representatives. The committee has to view the different aspects involved and advise the government about the feasibility of the project.

Target group: Secondary level preservice teachers.

Objectives:

The preservice teacher will study different aspects of dam construction like. . .

. . .The economic aspects of the dam.

. . .The environmental considerations.

. . . The general development of the area.

Procedure:

Trainees would assume different roles and each one would be assigned the role of say, an economist, an environmentalist, an engineer, a government representative or a social worker. The positions or roles each one undertakes can be further elaborated as mentioned below.

Role of an Economist

With this role, the task of the representative is to explain economic gains to the population in the area through employment opportunities, linkage of the area by better transport means, power availability and educational facilities. These issues would be presented effectively to seek approval of the project.

Role of an Environmentalist

The task of this representative would be to answer questions involving highlight the environmental implications of the project. Questions addressed by this individual might include:

--Will it provide better environmental and living conditions to a few or to all?

--Are there long term implications that could prove detrimental to people of the area?

--Will the clearing of land by felling of trees for construction of roads and other structures disturb the natural balance?

--How much of the productive land would be converted for infrastructure facilities?

--What new environmental problems would arise?

Role of the Social Worker

This individual may raise the point that all people in the area will not gain from the new project. Some will lose their cultural heritage, traditions, beliefs, customs, and professions. It may take time for local people to adapt to new professions.

This exercise would help the preservice teacher develop skills for collecting and organizing information and arguing their respective roles. It would help them accept others' view points without any bias. The details of this simulation situation related to an environmental issue has also been designed for the study of populations and is suggested to be included as part of a social studies methods course at the elementary and secondary level. (Unesco, 1980).

Games

Use of games is a strategy to provide a simulation in the form of a game which learners are required to play. Games emphasizing cultural, economic, and political aspects of the environment with holistic approaches have been designed. A game is played with set rules and procedures. It is a variant of role playing. The game and its rules are introduced by the teacher educator. He must define the purpose and rules to be followed by the players. The players know their roles, responsibilities and that they have to obey the rules of the game. The player would develop abilities and skills to plan moves and understand the roles and moves of other players.

The game playing method of learning has flexibility in that teacher educators can cater to the needs and interests of a particular group. It also helps the learner review learning by playing the game.

Activity: Concept of a food chain and food web.

Target group: Primary level preservice teachers.

Objectives: Study of the living components of an environment and the different steps constituting food chains.

Procedure:

The teacher educator will explain the structure of a food chain. All chains are interconnected thus constituting a food web. The trainees may be given a simulated deck of cards bearing the pictures and names of different organisms both plant and animal and showing their relationship as predator or prey.

Each player has to expose a card one at a time. In every move he indicates the name of the plant or animal on the card and also indicates whether it is prey or predator. The player can then use any card from his hand and arrange the cards sequentially to form a food chain showing predators and prey. Ultimately the learner may construct a food chain with each card serving as an appropriate step in the chain. The player using all his cards first, and constructing a correct food chain will be the winner.

After the game is over the learners are involved in a discussion on the importance of a food chain in an ecosystem, definitions of predator and prey, and the number of steps in the food chain. It should motivate them to observe food relationships in their immediate environment.

Target group: Secondary level preservice teachers

At this level, the number of cards in the game should be increased to include more examples of predators and prey. The trainees should attempt to construct webs and work out the number of food chains operating in each. Similarly, it may be extended to the construction of pyramids indicating quantity in terms of number and biomass. The class, in groups, may also discuss the role of man in the food chain. Related questions, such as; Are the activities of man shortening the food chains? and, How could this be checked?, would further maintain the interest of learners.

8) Discussion or Debate Method

The discussion method is a group of strategies generally adopted to promote team work and develop abilities for analysis, value clarification and positive attitudes among learners. The environmental issues/problems to be discussed by the preservice teachers are presented through films and slides or explained by the educator/teacher. Points are explained without stating solutions. This method helps to motivate and arouse interest and curiosity among learners. For example, beginning with a new report about leakage of gas from a factory, a class discussion, either teacher guided or with one of the learners leading the group, could be used to discuss controversial environmental issues such as the location of hazardous factories near residential areas, historical monuments, or near water sources.

A discussion on local environmental issues like air and water contamination, garbage disposal, unplanned urbanization, or clearing of forests provides opportunity for learners to observe, study and discuss their own surroundings and work toward maintaining clean and healthy environments. The discussion method develops the ability to. . .

. . . understand the issue or question being raised.

. . . react or respond to the points of others.

. . . participate in guided and orderly learning.

. . . speak, communicate and present points based on reason.

. . . clarify values.

. . . evaluate arguments and change one's own value position if necessary.

. . . work in a group.

Discussions on particular environmental topics, especially controversial issues also contribute to the development of skills in;

--oral communication,

--organization and verbalization of thoughts,

--discrimination between relevant and irrelevant information,

--questioning and cross-questioning techniques, and

--Converting others to one's own view point through logical reasoning based on factual information.

Guided discussion can be gainfully organized to involve the class or small groups of pre-service teachers only if deliberate efforts are made for involving each and every learner. In addition, to make the discussion more orderly in terms of the relevance of questions, answers, and time, the expected outcome must be visualized by the moderator to guide participants in the right direction. The chances of raising a controversy because of personal beliefs, superstitions, or other biases may lead to a waste of time and irrelevancy. But at the same time, learners must get an opportunity to put forward their points of view and feel involved in the teaching process.

Debate

This is another form of group work in the teaching/learning process. Controversial issues related to the environment and allied problems are presented to the audience (other members of the class or community) by groups, each comprised of three or more members depending on the time available. One group speaks in favor and another against the issue under debate. Each member gets a few minutes to present his view point. Ultimately the teacher educator as a referee would summarize the points. The need for proper environmentalized action as a probable or appropriate solution to the problem must be brought out by the person summarizing the proceedings. The activity helps in developing skills related to. . .

. . . thought organization and precise presentation.

. . . developing differences in attitude and presentation of logical thought.

. . . an ability to focus on the main points.

. . . analysis of others' viewpoints and presentation of terse responses.

. . . identification of the values and attitudes possessed by others.

Debates can be organized on topics such as the role of trees in an environment, or population growth at the elementary level. Topics like urban development, problems with high rise buildings and the effects of tourism on the environment would be appropriate at the secondary level.

9) Buzz Activity

This is a group exercise used as a teaching strategy to influence learning through participation. Small groups of learners discuss among themselves an environmental issue/problem which was presented by the teacher. The learning situation may be provided in the form of a pamphlet, a film, slides or even a folder concerning such topics as fuel conservation, wildlife conservation or endangered species. The learners would discuss the topics in their respective groups for a short time and one member of each group would then present the information discussed. The moderator or guide may note the points on the blackboard and at the end, identify the important points related to the problem.

The strategy of buzz sessions can also be helpful in determining the previous knowledge of learners before starting a lesson/topic in the class. Materials in the form of written paragraphs, folders, pictures or words related to environmental problems/concepts are distributed among groups of four or five learners each. Each group would then discuss the topic for two or three minutes, and the leader of each group would briefly present information about the topic. If the preservice teachers are not responding well, the teacher educator must explain the topic to them and help them recall information related to the topic previously learned. For example, before starting a discussion on an ecosystem, its structures and function, the teacher educator may distribute pictures of a riverside with tourists, a forest, and a paragraph containing information on the food chains of the ecosystem. This allows the teacher educators to determine whether learners are familiar with the topic and are able to recall simple information about it. A buzz session enables learners to...

...critically examine the information provided in a short period of time.

...share information with other members of the group.

...assume leadership roles to present precise and accurate points.

It also develops skills in...

...observation and analysis of the issues.

...clarifying one's own values and attitudes while working on a team.

...evaluating the values and attitudes of other members of the buzz group in light of the information discussed.

10) Brain Storming Session

This teaching strategy is employed to elicit the responses of learners about the environmental issues/problems presented in the shortest period of time. Responses may not be up to the expectations of the teacher educator and some may even be irrelevant, but it will generate interest among the learners and help to assess strengths and weaknesses.

The preservice teachers are provided with different aspects of an issue through various means, a slip of paper, a paragraph elaborating the environmental situation or perhaps a slide. Learners are given four to five minutes or more depending on the complexity of the environmental issue/problem being examined and are then required to present their point of view quickly and precisely to the class. These points may then be written on the board. This technique can be used if time is not available for critical analysis and sound reasoning as the exercise aims only at

involving the learners, getting whatever information they possess, and discussing the same before instruction begins.

This strategy can also be useful during teaching of a particular topic/concept. Even before the lesson begins, the teacher may conduct a brief brain storming session to assess the learner's background on the topic and initiate one's lesson accordingly. For example, in starting a lesson on environmental pollution, a brain storming activity may include numbered slips of paper with words such as physical environment, abiotic factors, ecosystem, natural resources, and food chain which are distributed to the preservice teachers. After a minute or so, the bearers of these slips are asked to speak about their words. Points may be recorded on the board by the teacher educator with the word they describe. Afterwards, these points are arranged serially. After this brief session, the teacher educator would know where to start the actual concept of pollution. If learners do not respond favorably, the teacher educator will have to explain the environment and its components first, before going on to its pollution aspects.

The brain storming session enables the teacher educators/teachers to deal with the lesson accordingly after learning the background information the preservice teachers possess: It also helps the preservice teachers learn how to...

- ...respond quickly.
- ...overcome shyness and present ideas even if they are not closely related to the main issue.
- ...avoid making premature judgements.
- ...be cautious in making judgements within specific time limits.
- ...be free and frank while participating in the activity without finding personal weaknesses.

The Role of Teaching Aids in Teaching Methods and Strategies

The success of a particular teaching method and strategy can be ensured to a large extent by the use of suitable teaching aids. The latter vary in nature and range from sophisticated devices like computers to simple low cost aids prepared from the environment itself. Environmental concepts, issues and problems can be better explained through the use of films, tape/slides and photographs. These days a large number of films on environmental situations such as wildlife, air and water pollution, deforestation and afforestation and the flora and fauna of different regions are available.

The preservice trainees must be prepared to use various teaching aids like slide projectors, audiovisual equipment, computers, and media to impart environmentally related topics. Certain films developed to highlight social programs such as drug addiction, environmental sanitation, nutritional problems, urban development, and agricultural crops can be used to employ the investigatory and discussion methods of teaching.

Teaching Aids for the Primary Level

These days postal stamps, first day covers, publicity campaigns through match boxes, pamphlets, posters, newspapers and magazine reports all directly relate to the environment.

Flora and fauna, means of transport, food habits, and other topics can be taught through the collection and classification of postal stamps and matchbox covers. These are appropriate aids for buzz and brainstorming sessions. The environment itself provides numerous teaching aids. Environmental studies can be taught effectively by using the environment as a laboratory and further investigations may be carried out in the school after bringing in materials or samples from the field. Learners would become acute observers in the study of their immediate environment.

Teaching Aids for the Secondary level

The teaching aids employed appropriately also add to the effectiveness of teaching methods at the secondary level. But in view of the financial and resource constraints prevailing in teacher training institutions and schools, especially in developing countries, trainees should be given experience and encouraged to use low cost materials as aids for teaching environmental content.

A variety of aids such as charts, models and maps are quite useful in teaching about the environment. Some of the materials can be prepared by the trainees, not only during training but also once they begin teaching. Some aids which are easily available or which can be prepared by classroom teachers are discussed below.

Charts

These can be used effectively for teaching topics such as the components of forest ecosystems, food chains, food webs, comparative information on the structural and functional aspects of pond, grassland and forest ecosystems. They save time needed to draw information on the blackboard. Neatly drawn sketches or even photographs can be used in the preparation of charts. They also help to summarize and review important concepts taught.

Graphs

Graphs of different types may be used to present and discuss topics like weather and population. These would also be quite useful to illustrate changing patterns. Graphs can be prepared using information which appears in newspapers and in magazines.

Flip Charts

Flip charts, prepared with the help of diagrams, pictures and graphs are useful in teaching concepts showing sequential development like ecological succession. These charts are also helpful in developing a particular theme like conservation of natural resources.

Posters and Cartoons

The concepts related to environmental problems of hygiene,environmental sanitation and soil erosion can be taught with the help of poster and cartoons. These are generally prepared and used in public awareness campaigns on environmental issues. Pamphlets prepared by the departments of health, agriculture, animal husbandry, and petroleum can be used to teach curricular content especially to motivate learners. Cartoons on the use of pesticides, fertilizers, pollution and other topics can help to initiate discussions and imaginative thinking. Three dimensional pictures, posters, models, and display panels like those used in natural history museums are also

useful for presenting environmental issues, for instance, water supply systems, and transport systems might be illustrated with these. Other means of arousing learner interest could be the involvement of popular folk singers, use of puppet programs on wildlife, and folk dances or plays written on such topics as the importance of trees and the role of people in protecting the environment.

Maps

A map is another easily available type of teaching aid which is especially effective for teaching geographical relationships in various ecosystems, distribution of natural resources, distribution of water systems and transport means. Learners may map an area of study during a field trip using different symbols, or maps can be used in a discussion of the geomorphology of the earth, or distribution of plants and animals. Trainees should also learn to use a compass and other simple mapping tools.

Low Cost Aids

Low cost aids can also be developed with pictures available from calendars, magazines or periodicals which illustrate various environmental situations. These may prove to be quite useful and also abundant. Topics which they may depict include, distribution of water sources, transport means, historical monuments, agricultural practices and health services.

Along with information about low cost teaching aids, trainees may also be given experience in using more sophisticated audiovisual aids such as a tape/slide programs, slide presentations and videotapes on topics like wildlife, natural resources, pollution, and the impact of human activities on environmental quality to name a few. These aids are available from different departments and can be obtained on loan or rented from educational film libraries or from the department of health, agriculture or environment. The availability of slide projectors, overhead projectors, and cassette players are possible constraints in this area. The experience of using these aids during the training schools would enable trainees to make use of these aids if they are available in schools. They are also commercially available at a reasonable cost.

Computers

These days teaching aids such as computers are becoming more common. Computer assisted teaching and learning is quite relevant to the environmentally related topics of population, ecological interrelationship, natural resources, their uses and danger of depletion. Computer programs are quite useful in the production of graphics and also for mathematical expressions and the use of numerical data and its extrapolation. For instance, information on population growth in relation to food supply and nonrenewable resources can be extrapolated on a computer. This helps to predict the carrying capacity of the environment. Such predictions of population increases over long periods can help in making decisions about food production and supply. These studies also help in planning limits to population growth. The extrapolation of data is otherwise difficult in the classroom. Relationships such as predator-prey, disease causing organisms, crop production and fertilizer and pesticide use can also be taught with the help of computers. A computer program demonstrating predator-prey relationships can help to study the effects of an increase in prey population on both the number of predators and prey, as well as the effect of an increase in predator number on both prey and their populations. A means to stabilize predator and prey populations might also be predicted.

Chapter Eight

Foundational Education and its Environmentalization

Basic psychological concepts underlying education affect classroom practice. The more the teacher knows about learners, their growth patterns and the unique stages through which they pass, the better he can adapt his teaching to meet the individual needs of learners.

Any course of training for teachers, therefore, should incorporate relevant theories and acquaint the trainee with research in child development, motivation of the learner and evaluation of learning outcomes. In other words, a teacher training course has to make room for learning theories and their application.

Fields of study and interests of educational psychologists, however, are varied. But essentially, educational psychologists design and conduct experiments for educational purposes and apply the findings of general psychology to understand the process of education. These two domains of activities of educational psychologists, therefore, are within the area of a foundational education course. The study of educational psychology and theories of learning, however, are not meant for the advocacy of one particular method of teaching, but for providing a variety of ideas which might help one understand student behavior and improve teaching techniques. What follows is an outline of a proposed course and the essentials of theoretical content befitting that outline. A foundational course, as its name suggests, need not be restricted to teacher training for environmental education alone. Hopefully, the foundational course outline here should be applicable for any teacher training program.

A Historical Overview of Theoretical Trends

Major theoretical issues in child development can be divided into two main categories, those dealing with control and regulation of development, and those dealing with nonregulatory properties of the developmental process. The regulatory properties are related to factors that determine development, their interaction and their relative influence. The nonregulatory class of theoretical issues is concerned with such problems as continuity and discontinuity in the maintenance of developmental individuality.

These issues can be understood and comprehended at various levels, and some of these levels may be beyond the scope of this teacher training course. The present section, therefore, is devoted to a historical survey of various currents of thoughts dealing with the nature of the child and the control of development. It is intended to be a conceptual introduction to the issues which are mentioned above and which are often referred to in developmental research.

The regulation of human development has long been a controversial issue. Recent theoretical writings, however, indicate that the nature/nurture controversy has somewhat abated. Nature (hereditary endowments) and nurture (the environment) are not regarded today as mutually exclusive factors. Yet, for an understanding of contemporary complications within each theoretical position, an explicit consideration of the historical roots of various theoretical positions is necessary.

Preformationist Approaches

As we analyze the theories of development, we find that one extreme position is a preformationist approach, which emphasizes the contributions of endogenous and innate factors in learning. The fundamental thesis of preformationism denies the importance of development in human ontogeny. A man's personality, his cognitive, perceptual, emotional and social reaction tendencies, even his values and motives, do not undergo a qualitative differentiation with time, according to the preformationist theory. Instead, all these are presumed to exist preformed at birth.

The preformationist position is obviously related to a theological conception of man's instantaneous creation. A prescientific embryological counterpart of this point of view was the homuncular theory of human reproduction. It was once believed that a miniature man, fully formed, was embodied in the sperm. Implanted into the uterus, the sperm simply grew in size until full term fetal size was attained at the end of gestation.

In a modern context, in the realm of cognition, preformationism was represented by the doctrine of innate ideas, i.e. ideas existing independently of individual experience. Freud's (1935) "phylogenetic unconsciousness" included an inherited identification with the like-sexed parent as the basis for resolving an Oedipus complex, prior to any opportunity for interpersonal experience.

"Tabula Rasa" Approaches

Developmental theories which evidence the opposite extreme, include such movements as humanism, behaviorism, "situational determinism", etc. If preformationist approaches were at one end of a continuum embracing the various theories concerned with the regulation of human development, these ideological movements would have to be placed at the other end of the same continuum. Hence, collectively they are said to represent "tabula rasa" approaches (literally "blank slate"), indicating that they regard no fundamental predispositions as inherent in the raw material from which behavior and personality develop. Underlying all these approaches is the emphasis on the preeminent role in determining the outcome of development.

The most basic feature of the "tabula rasa" approach is its emphasis on the plasticity of human beings. In its extreme form, this approach emphasizes the importance of environmental determinants of development. Lamarkism is an example of the extreme environmentalist position in biology. This theory is based on the assumption that the genotype as well as the phenotype can be altered by prolonged exposure to certain environmental conditions.

The humanistic movement in education is a "tabula rasa" approach which has championed an environmentalist position . Humanism maintains that, given proper environment or conditions of nurturance, the potentialities of human development are almost unlimited in scope and direction.

Predeterministic Approaches

Somewhere between the above two extremes is the predeterministic position on which rest many a current theoretical proposition. Predeterministic doctrines satisfy the minimal criteria of a developmental approach in that they suggest that successive stages of development of an organism are an outcome of a process of qualitative differentiation of form. On the other hand, predeterminists recognize interaction between an individual and his environment and acknowledge, in varying degrees, the influence of the environment on development.

The first definite theory of child development with predeterministic orientation was proposed by the famous French philosopher of the eighteenth century J.J. Rousseau. He suggested that development consists of a series of internally regulated sequential stages, which are transformed from the less differentiated to the more differentiated form according to a prearranged design. The importance of the environment lies in its interference with or facilitation of the process of self-regulation and spontaneous maturation.

The educational implications of predeterminism were in its recognition of 1) the child's contribution to his own development, 2) the influence of expressed interests and spontaneously undertaken activities, and 3) the importance of an unstructured, noncoercive instructional climate. These implications have had considerable influence on all subsequent educational theories and practices, and are the predecessor of the present day, nondirective, child centered approaches to education and training.

One historically significant offshoot of Rousseau's conception of development was the theory that while progressing through various stages of growth toward maturity, the child recapitulates the phylogenetic and cultural history of the human race. G. Stanley Hall (1846 - 1924), (Hall, 1904), elaborated on this theory in great detail. However, in light of emerging data in comparative child development, and of changing concepts of interrelationship between cultural environment, genetic endowment and individual development, the recapitulation theory is no longer accepted as a fruitful approach to problems in developmental psychology.

A more widely accepted predeterministic position was Arnold Gesell's theory of maturation (1933). Gesell proposed an embryological model for all those aspects of human development, structural, physiological, behavioral and psychological, which "are obedient to identical laws of developmental morphology." In all these areas, Gesell argued, endogenous factors determine the basic direction of differentiation and patterning. Environmental factors support and modify, but do not generate the progressions of development.

This embryological model finds some support when applied to the development of structures, functions and behaviors which are phylogenetic in nature. But for the postnatal development of humans, which is influenced by individual experience and cultural environment, Gesell's theory is found wanting.

Jean Piaget's theory of cognitive development is one of the most remarkable among all modern developmental theories. While his theory might be characterized as predeterministic, it also emphasizes an interaction between heredity and the environment.

Piaget postulated that cognitive development proceeds through a fixed sequence of stages from infancy to adulthood, including four main stages and various substages. The stages and substages are:

1) Sensori-motor (birth to two years).

2) Preoperational (two to seven years), which is sub-divided into the earlier preconceptual stage (two to four years) and later intuitive stage (four to seven years).

3) Concrete operational (seven to eleven years) and

4) Formal operational (eleven to sixteen years).

The development through these stages moves from concrete thinking to more abstract thinking. What is more important about these stages is not their correspondence to particular age levels (cultural differences, social class, intelligence, etc. change the age parameters of these stages), but their fixed order of succession. Hence, Piaget's theory might be considered predeterministic.

Piaget also subscribed to an interactional position, as he suggested that there are some factors which affect transition through his stages of intellectual development. Those factors and their respective influence are described below.

1) Maturation, in Gesell's sense, is important because postnatal development is a continuation of embryogenesis. "Maturation of the nervous system can do no more than determine the totality of possibilities and impossibilities at a given stage. A particular social environment remains indispensable for the realization of these possibilities" (Inhelder and Piaget, 1958).

2) Social interaction influences intellectual development through transmission of language and education.

3) Physical experience contributes to cognitive knowledge through an individual's ability to act upon objects and to formulate abstractions about them.

4. Equilibration (self-regulation), which Piaget considered to be the most fundamental of all four factors, is the progressive interior organization of knowledge in a stepwise fashion.

Equilibration, according to Piaget, is to be considered within the framework of intelligence, which is merely a process of adaptation and organization. Cognitive acts are acts of organization of and adaptation to the perceived environment. Organization entails the integration of what Piaget called schemata (singular: schema) or mental structures, structures that are mental counterparts or biological means of adaptation. Adaptation, on the other hand, is a move toward equilibrium in the organism's interaction with the environment. Organization and adaptation, therefore are not separate processes.

Equilibration also can be described as the balance between two invariant processes of assimilation and accommodation. Assimilation is a continuous cognitive process by which a person integrates new stimulus events into existing schemata. Assimilation does not initiate the development of schemata, but affects the growth of an existing schema.

When a child is confronted with stimuli which cannot be assimilated into existing schemata, the child either creates new schemata into which he can place a new stimulus, or he modifies an existing schema so that the stimulus fits. Both of these processes are forms of accommodation. Accommodation is the creation of new schemata or modification of the old.

The processes of assimilation and accommodation are necessary for cognitive growth and development. A balance between assimilation and accommodation is as necessary as the processes themselves. This balance is what Piaget called equilibrium . Disequilibrium, then, is imbalance between assimilation and accommodation. Cognitive development is marked by a series of equilibrium-disequilibrium states.

Summary

The above account more or less summarized different past theoretical concepts regarding the mental development of the child. This may well serve as an introduction, in a teacher-training course, to addressing the actual implications of theoretical concepts for education in general. Some of the theoretical postulates described earlier in the foregoing portion are obsolete and are only of historical importance. Therefore, the rest of the course may be directed towards fuller accounts of more current and widely accepted ideas, their critique and their possible applications in the classroom.

More Recent Theories

It is more generally accepted today that the intellectual development of the child is a complex affair and is the resultant expression of interactions between physical, intellectual, social and emotional factors. The following section of the course is intended to provide a resume of the work of some renowned theorists on development and to interpret their theories for classroom teachers.

Theories of Cognition

1) Piaget's Theory

The question of intelligence always attracted Piaget. Intelligence, according to Piaget, has three components; content, function and structure. Content is the observable behavior which changes with age and speech is an example of content. Function refers to the invariants, assimilation and accommodation, which are stable throughout life. Structure refers to the schemata which explain the occurrence of particular behaviors.

To sum up the basic Piagetian premises: environmental stimuli filter through the functions (invariants) resulting in structure, which changes with age and which accounts for the content. Content also changes with age and, together with structure, is organized into schemata.

Action and Cognition

Cognitive development, according to Piaget, requires action. The development of cognitive structures is ensured only if the child assimilates and accommodates stimuli in the environment. An infant learns to differentiate between a nipple and the edge of a blanket as he acts on them both. Experience alone, however, does not ensure development, but development cannot take place without it. Children develop three kinds of knowledge: physical, logical mathematical and social arbitrary. Each kind of knowledge, for different reasons, requires the child's action.

The child develops physical knowledge about an object by manipulating the object. Knowledge of objects can only be acquired by personal experience and cannot be acquired by reading or listening to what others have to say about those objects.

Like physical knowledge, logical mathematical knowledge can develop only if the child acts on objects. But the difference between physical and logical mathematical knowledge is that the latter is not inherent in objects, but is constructed from th actions of the child on objects. In the development of this kind of knowledge, the nature of the object is not critical. Rather, it is the child's physical manipulations of objects which permits him to generate logical mathematical knowledge.

Social arbitrary knowledge includes knowledge of rules, laws, morals, values, ethics and language systems. Social arbitrary knowledge cannot be extracted from actions on objects in the same manner that physical and logical mathematical knowledge can, but is constructed by children from their action (interactions with) on other people. As children interact with each other, and with adults, opportunities develop for the construction of social arbitrary knowledge.

Piaget differed from other theorists and especially from classical behaviorists in that he rejected the notion of extrinsic "needs" (external forces) as being responsible for motivation. Therefore, reinforcement, which is central to behaviorism, does not find a place in Piagetian theory. The "need" to engage in cognitive activity, according to Piaget, is an intrinsic factor. Motivation comes from within the organism. Piaget argued that once developed, cognitive structures perpetuate themselves by more functioning. Therefore, there is an intrinsic tendency to assimilate and accommodate the environment.

Piagetian Periods of Development

For purposes of conceptualizing cognitive growth, Piaget divided intellectual development into four broad periods. Each of these periods has several developmental characteristics which might provide data for the formation of optional learning conditions. Together with some of his other works, information on the Piagetian periods offer definite guidelines for teaching and curriculum construction. Therefore, our course content should include a brief description of these four periods as outlined by Piaget.

a) The period of sensori-motor intelligence (0-2 years)

Mental development begins the moment the child is born. Sensori-motor behaviors that occur from birth onward are necessary for and instrumental in later cognitive development. During this period the behavior of the child is primarily motor. Piaget divided the sensory motor period into six stages in which progressively complex patterns of intellectual behavior evolve. Further details may not be directly relevant in the present context.

b) The period of preoperational thought (2-7 years)

The preoperational period is a time of transition when the child evolves from one who functions primarily in a sensori-motor mode to one who functions increasingly in a conceptual and representational mode. The thought of the preoperational child is more advanced than the thought of the sensori-motor child. It is no longer restricted to immediate perceptual and motor events. Thought is representational but when conflicts arise between perception and thought, children using preoperational reasoning make judgements based on perception. Again, the child at this stage is unable to reverse operation and cannot follow transformation because perceptions are centered. These characteristics result in slow, concrete and restricted thought. However, language is acquired very rapidly between the ages of two and four.

Some of the characteristics of preoperational thought, which in fact are obstacles to the development of logical thought, are egocentrism, inability to tend to transformation, centration, and reversibility. Egocentrism is manifest in all the behavior of the preoperational child and is the tendency to center on the self. For example, the thought patterns of young children are primarily egocentric, meaning that children are unable to take into account another person's point of view.

Inability to attend to transformation means that the child focuses on the elements in a sequence of any transformation, rather than on the transformation per se. For example, if a pencil is held upright and is allowed to fall, it passes from an original vertical state to a final hori-

zontal state through a series of successive stages. The preoperational child, after viewing the pencil fall, cannot draw, or reproduce in any other way, the successive steps of the transformation. They usually reproduce only the initial and final positions that the pencil assumes. At the preoperational stage, when a child is presented with a visual stimulus, he tends to center or fix his attention on a limited perceptual aspect of the stimulus. The child seems to be unable to explore all aspects of the stimulus, or decenter his visual perception.

Nonreversibility is yet another characteristic limitation at the preoperational period. Reversibility means that an individual can follow the line of reasoning back to where it started. If a child without reversible thought is shown two equal-length rows of eight coins each, he agrees that each row has the same number of coins. If one of the rows is lengthened, the child does not agree that there are the same number of coins in each row. Part of the child's problem is that he is not able to reverse the act of lengthening. He cannot conceive the equivalence of number when there is a perceptual change in dimension even though the latter is irrelevant. As cognitive development proceeds, the child develops his construction of reversibility.

Logical thought first appears toward the end of the preoperational period, as an individual develops the ability to conserve. Conservation is the conceptualization that the amount or quantity of a matter stays the same regardless of any changes in an irrelevant dimension.

There are several types of conservation suggested by Piaget; conservation of number, conservation of area, or conservation of liquid. A large number of research studies have been made on conservation learning meaning the transformation from nonconservation to conservation thoughts. Some of these studies may be reviewed as a part of the course work [e.g, those by Urgiris (1968), Elkind (1961), Gruen (1965), and Wohlwill and Lowe (1962)].

c) The period of Concrete Operations (7 to 11 years)

During the period of concrete operations, a child develops logical operations. These operations are thought processes that can be applied to concrete problems. In other words, the concrete operational child makes cognitive or logical decisions as opposed to perceptual decisions. He decenters his perceptions and attends to transformations. More importantly, the concrete operational child attains reversibility of operations. In Piagetian terms, schemata for the operations of seriation and classification appear and superior concepts of causality, space, time and speed evolve.

However at this period, the child generally cannot yet apply his logic to problems that are hypothetical or abstract or purely verbal. But if those same problems are presented in terms of real objects, the child can apply his logical operations and solve the problems. Therefore, the concrete operational period is a period of transition, between preoperational (prelogical) thought and completely logical thought. More specifically, liberation from egocentrism, progressive socialization, decentralization, ability to focus on successive steps in a transformation and ability to solve conservation problems characterize a concrete operational child.

While the thinking of the preoperational child is dominated by egocentrism, the concrete operational child is aware that others can come to conclusions that are different from his. Simultaneously the child becomes increasingly social. Decentering, which means taking into account all the salient features of objects, permits the child to think of logical solutions to concrete problems. The concrete operational child becomes able to coordinate and focus on successive steps in the transformation. He views successive steps in a transformation as distinct and independent events. The concrete operational child also gives an understanding of reversibility as can be illustrated by the following example. A child is shown three balls of the same size, but each of a different color

(A,B and C). The balls are placed in a cylinder in the order A, B, C. Now, if the cylinder is rotated 180 degrees, a preoperational child would expect that the balls existed in the same old order A,B,C. A concrete operational child, however, would not have any trouble with the above problem, so concrete thought is reversible.

During the period of concrete operation, the abilities to decenter, to follow transformations and to reverse operations are instrumental in developing conservation skills. Usually the conservation of (1) number problems, (2) area and mass problems and (3) conservation and volume problems, which are put here in increasing order of complexity, are approached correctly with progressing age within the period of concrete operations.

Cognitively, the attainment of logical operations is the hallmark of the concrete operational individual. If a preoperational child is shown two sticks of slightly different lengths (A and B), he can visually determine that A is shorter than B. If he is then shown sticks B and C (where B is shorter than C), he can again determine that B is shorter than C. But if the child is then asked to compare A to C (while A is hidden), he cannot make the appropriate deduction (A < B, B < C, therefore A < C). The concrete operational child can mentally order this type of series regarding length, weight and volume. The abilities to classify, to determine causality, and to solve simple problems involving time and speed are also examples of other cognitive attainments which characterize the concrete operational child.

d) The period of formal operations (11 to 16 years)

According to Piaget, the child's cognitive structures reach maturity during this period. From the end of the period of formal operations, changes in intellectual abilities are quantitative and no longer qualitative, with respect to logical operations and structures. During the period of formal operations, the child is better able to organize data, to reason scientifically, and to generate hypotheses or solve problems involving inverse reciprocal relations, complex verbal problems, combinatorial logic, proportions and conservation of movement and other hypothetical issues. However, one should not assume that all adolescents and adults fully develop formal operations.

Combinatorial thought may be exemplified by the following situation. Suppose there are five beakers containing colorless liquids. A combination of three liquids (1, 3 and 5) produces a yellow color. The child is shown the colored liquid but he is not told how it is produced. When he is asked to produce the yellow color, a concrete operational child may start systematically by mixing two liquids at a time but as he proceeds without result, may lose patience and resort to wild guesses. In contrast, the child with formal operations will note all the logically possible solutions.

Hypothetical problems, which require formation of assumptions, can be handled only by the formal operational child. Similarly, the inverse of a reciprocal, which often borders on the hypothetical, requires formal operations to be comprehended. Suppose a child is told to assume that if a woman is fair, she is pretty, and is asked the following questions.

1) If a woman named Sally is not pretty, is she fair?

2) If Sally is not fair, is she pretty?

Whereas a concrete operational child may have problems in handling such questions, a formal operational child does not.

The concept of proportion can be seen in the action of a child using a seesaw balance. Before the age of seven, the child has difficulty equalizing weights on a balance. She is aware that a

balance of two sides is possible but then can do the balancing only on a trial-and-error basis. After age seven, children discover that a small weight on one side can balance a larger weight on the other if the former is placed at a greater distance from the fulcrum than the larger weight. They learn to balance weights on two sides in a more systematic manner,but cannot coordinate the two functions of weight and length in a definite proportion. The formal operation child appreciates the proportion principle (W/L = 2W/2L) which states that an increase in weight on one side of the fulcrum can be compensated for by an increase in distance from the fulcrum on the other side.

Conservation of movement can be exemplified with a pendulum problem. A pendulum can be made to swing faster by adjusting the length of the string. The shorter the string, the faster the movement. When asked to adjust the speed of a pendulum, the concrete operational child insists on adjusting the weight of the pendulum. During the period of formal operations, children learn to separate weight and length.

Implications of Piaget's theory for Education

Although Piaget's research was not directed toward education and teaching, his theory regarding how children learn has considerable relevance to education. Therefore, the application of his theory to educational practice requires that it be translated into applied settings.

Invariance of concept acquisition

According to Piaget, cognitive structures or schemata develop in an invariant sequence. That means, the course of development is the same for all children, although the ages at which they attain particular structures may vary with intelligence and social environment. Piaget, however, described cognitive development,and did not determine how it should proceed. Other sequences may be possible although those sequences should meet the criteria that successive structures incorporate previous structures in an integrative and hierarchical fashion.

If we assume, as Piaget did, that concept acquisition is invariant, then the Piagetian model of invariance has tremendous educational significance in determining when to teach specific concepts. Curriculum sequences however, should be designed with childrens' changing cognitive status in mind. Children will learn, i.e. develop schemata, only when they have prerequisite cognitive skills. Readiness to learn, according to Piaget, appears when a child is ready to develop a particular concept using the schemata that are necessary.

How knowledge is acquired

Of still greater significance than the above is the Piagetian idea that children construct knowledge through actions on objects. A meaningful concept of an object can only be acquired from or elaborated upon by a child's action on an object. Pictures of the object, stories about the object or reading about it are all inadequate for development of knowledge concerning that object for the child.

Logical mathematical knowledge is also developed from actions on objects. But the important precondition here is the nature of the child's action on the object and not the nature of the particular object. Number, length and area concepts cannot be developed by reading about them. Children have to manipulate objects to comprehend these concepts. Similarly, the construction of social/arbitrary knowledge is possible through the child's action on, and interaction with, other people. This form of knowledge, like the other types, cannot be transmitted through words or other symbols.

II. Bruner and Cognitive Growth.

Jerome Bruner (1915) is another notable cognitivist whose work has produced notable educational change. Therefore, a discussion of Bruner's interpretation of the learning processes should be included in a teacher training course, especially because Bruner's major assumption is that teaching is an effort to assist growth. Cognitive growth, according to Bruner, has the following essential characteristics.

1) Freedom from environmental control Intellectual growth, according to Bruner, involves gradual independence of a child's response from an immediate stimulus. This is a vital point of distinction between Bruner and behaviorists. Much of a young child's behavior can be predicted if the stimuli around him are known. However as children grow mentally they increasingly maintain a desired response although stimuli change.

2) A Model of the World Intellectual growth depends upon the child's construction of a model for the world around him. This mental image of the world, actively constructed by the child, enables him to use new information for comparison, judgement and prediction.

3) Symbolism Intellectual development involves a growing skill in symbolic activity. Children begin to use propositions or statements reflecting a logical mathematical capability which did not previously exist.

4) Interactions Development is the outcome of interactions between a teacher and learner.

5) Language Language facilitates learning, not only through communication but also by assisting the child to create order in his environment.

6)Competence Intellectual development is marked by anincreasing competence in attendance to several possibilities. An example of this may be Piaget's conservation experiments in which the growing child rightly points out that the quantity of liquid remains the same and does not change when that quantity is moved between containers of different shape and size.

The relevance of these ideas to teaching is obvious. Bruner believes that these characteristics help the learner pass through three distinct cognitive phases which are described below.

1) Very young children know the world only through acting on objects, otherwise the objects do not exist. Bruner calls this the enactive mode of representation, which is the first level of representation.

2) The second level is what Bruner terms the iconic mode of representation which involves perceptual organization. It helps the child discover a pattern in apparently unrelated ideas. Children at the iconic level need concrete objects and activities so they can absorb them perceptually.

3) The third and highest level is the symbolic mode of representation which involves symbolic activities such as those underlying mathematics and language. Children at this level achieve ability in problem solving and they engage in creative thinking.

Learning of any subject, according to Bruner, involves three processes, which are almost simultaneous processes. They are:

1) Acquisition of new information This allows the child to incorporate environmental stimuli using a mode of representation that he is capable of for instance by physical action, by forming images or by abstracting and comparing.

2) Transformation of information: Going beyond the information given, the learner transforms new information by manipulating or changing it to meet new tasks.

3) Evaluation of information: The final phase is evaluation by which the learner attempts to judge whether his manipulation of information has been adequate or correct.

All this forms the basis for Bruner's idea of a spiral curriculum. This means that the teacher can introduce apparently difficult ideas (or those ideas which are traditionally introduced to older children or young adults) to younger children, if a conscious effort is made to determine the representational level to which these children belong. In other words, the subject matter can be divided into small units that match the mode of representation of the respective target groups and then be introduced to children at different times with increasing awareness.

III. A Comparison Between the Theories of Piaget and Bruner

There are remarkable similarities, and also marked differences between the theoretical postulates of Piaget and Bruner.

A. Both believe that mental development occurs in phases (see table below) although there are differences in the details of those phases.

Piaget's Phases	Bruner's Phases
Sensori-motor	Enactive
Preoperational	Iconic
Concrete Operations	
Formal Operations	Symbolic

B. Both agree that mental development involves qualitative changes in cognitive structures and that action in infancy is the primary prerequisite for normal intellectual growth.

C. Bruner believes that language facilitates mental performance, while Piaget states that language is an outcome of mental competence.

D. Bruner stresses, more than Piaget, the role of a culture in mental development.

E. Piaget's theory is highly formal, mathematical and logical, while Bruner's emphasis is more on psychological formation.

In conclusion, both offer insights into cognitive growth at different ages. They agree that the child's early activities require considerable manipulation of objects. At higher levels, authentic cognitive activity may occur through advanced abstractions and reflections. Directly or indirectly, their work influences the content and techniques of teaching. Therefore, some examples have been cited above which may be tried by an alert teacher in his/her classroom.

IV. Other Considerations

The important questions involving these theorists, on the one hand, and the practice of teaching on the other are:

1) Are there ideal times for the teaching of certain topics/ideas/subjects?

2) Is there an ideal sequence for a subject that matches descriptions of cognitive development?

In trying to adapt educational practices according to modern cognitivists, we should not forget the lessons that great innovators of the past also taught us.

Perhaps one of the greatest educational philosophers of all times, John Dewey (1859-1952) emphasized learning by doing, an idea which has gained wide support from many educators today. At the heart of the learning process, according to Dewey, is the child's growing ability to define a problem, form hypotheses, decide which solution is best and finally test the choice. The role of the teacher here is to present children with meaningful problems. The child is active and learns in the process to think whether he is genuinely involved in the solution of pertinent problems.

It is not suggested here that there is any intellectual lineage from Dewey through Piaget or Bruner. Many of Dewey's ideas, however, are as vital today as they were when he first proposed them. Therefore, they should find a place in a training course for teachers.

Theories of Associationism (also called Behaviorism, S-R Theory or Conditioning)

On the preceding pages we discussed two prominent cognitive theorists (Piaget and Bruner) and the implications of their theories for classroom teaching. Associationism reflects a more or less conflicting line of thought. Both cognitivism and associationism have distinct followings and, together, they represent modern ideas about learning. In order to understand the present state of the behaviorist position, we can summarize its general premises.

Associationism emphasizes a relatively mechanical model of human learning and recognizes the control of stimuli and responses as basic to learning. There are differences that divide associationist theories but generally they all agree that because the learner reacts to stimuli, those who manipulate stimuli, i.e. teachers or parents, should be able to control behavior (which is the manifestation of learning). A number of outstanding psychological researches have aided the advancement of education, and a number of theorists have influenced our understanding of the process of human learning. The major theorists are briefly described below.

It is more or less well known that saliva flow occurs in one's mouth when food is actually served. Pavlov observed that a dog's mouth started watering before food was given to it. He suggested that the sight of the attendants, or the sound they made, caused salivation. This phenomenon was called classical conditioning and can be represented as follows.

A. US----------> UR

B. CS----------> US--------->UR

C. CS----------> CR

Where	US	=	Food
	UR	=	Saliva
	CS	=	Sight of attendant
	CR	=	Conditioned response (saliva)

A natural unconditioned stimulus, (US) causes a natural response (UR). Some neutral stimulus (CS) associated with the US gradually also acquires the ability to elicit the conditioned response. In other words, a conditioned stimulus (CS), according to Pavlov, gives rise to a conditional response (CR) through the course of time.

Inspired by Pavlov's studies, John Watson (1878-1958), an American behaviorist concluded that there was no need for a mind (or mental structure) to explain human behavior. Learning, said Watson, was mainly conditioning. An eminent contemporary of Watson, Edward Lee Thorndike (1874-1949) concluded that the three major factors listed below determine learning.

1) Readiness of the child The child has to be prepared to meet new learning experiences.

2) Exercise of a learning experience Repetition of an experience leads to better acquaintance.

3) Effect Success increases the strength of an act, whereas punishment weakens it.

Thorndike's connectivism is at the vary base of today's behaviorism. His theory states that all learning results from the connection between a stimulus and response.

B.F. Skinner, the most well known among modern behaviorists, rejects classical conditioning as an inadequate explanation for behavior modification. He advocates operant conditioning, which does not depend on identification of a stimulus as a cause of behavior. A desirable response should be reinforced by the learning environment, while an undesirable response is better ignored or punished. The process eventually leads to learning, or in Skinner's terms, the learner emits a desirable response.

Robert Gagne is a behaviorist and thus approaches the question of learning from a different theoretical position than the cognitive theorists. But what Gagne has in common with the latter, Piaget, for example, is that both conceptualize learning as taking place in a manner that is orderly, sequential, integrative and hierarchical.

Gagne (1962, 1977) views all learning as a function of prior learning, or prerequisite learning. Learning of a concept can occur only if concepts that are prerequisites have been acquired. Every piece of learning generates a hierarchy in which prerequisite learning can be identified and prerequisites have to be learned before learning at the top of the hierarchy can occur. This hierarchy can be derived logically in the case of arithmetic, science and environmental studies. Hierarchies can be derived by beginning with a final learning task and then trying to determine what kind of capabilities would be required for an individual to perform this task successfully. Through systematic analysis, hierarchies of learning can be derived in which lower stages in the hierarchy serve as prerequisite learnings to higher stages which finally serve as prerequisites to the final learning.

The similarities in Gagne's and Piaget's writing, in spite of the fact that they belong to two very different positions as theorists, can yield useful ways to view conceptualizing and learning, and for determining the level at which children can learn particular concepts. Gagne and Piaget both see knowledge as accumulating in an orderly, sequential and hierarchical manner. Both suggest that there is an invariant order in which concepts may successfully be acquired.

The differences between the two theorists are striking also. Organization of experiences is internal, according to Piaget and since this is true, external organization of learning experiences cannot ensure internal organization. On the contrary, Gagne would argue that external organization is a necessary condition to optimize learning. Thus, the cognitivist assumes that organization lies within the individual while the behaviorist assumes organization is external.

Theories of Learning and Environmental Education

The foregoing theories of learning do not meaningfully contribute to a course until the preservice teacher is able to interpret them in regard to actual classroom situations. Thus, the theories should be discussed in a teacher training course and correlated with curriculum content for EE on the one hand and curriculum transactions on the other. But what do Piaget's stages, or Bruner's stages, or Gagne's hierarchical structure of knowledge, have to teach us about the sequence of activities for children? A great deal, it seems! The facts that there are so many theories of learning and that some of them are quite diverse in nature indicates that it is not very clearly understood how people learn. But the knowledge of these theories should ultimately lead us in the direction of (a) sequencing activities, (b) methods of instruction and (c) the contents of teaching. A number of the major ideas which emerge are discussed below.

1) Active interactions of the child with the environment, both physical and social interactions, are seen as the most important school related factor in cognitive development.

2) Through the period of concrete operations, manipulation of objects and materials dealing with concepts to be learned are most important. For example, seriation schemata ($A < B, B > C$ thus $A < C$) can best be developed in concrete operational children if they visually and manually manipulate objects, employing the concepts to be learned. In a similar manner, equivalence concepts can be learned if the child acts on objects that embody the concepts. Through the concrete operational period, concrete experiences generate conceptual development.

3) Dewey's contention that there should be more emphasis on doing, and less on talking, during the elementary school years holds true and is upheld by most educators.

4) With the attainment of formal operations, the activity of a child can be purely representational and independent of any concrete exposure. Conceptual development can proceed based on the child's actions on written and verbal materials.

5) Instruction in controlled experimentation should be introduced only when young people can deal with multiple simultaneous variations.

All types of situations in school that involve peer interactions are useful, for example, games, play, and role playing. Since they all stimulate peer interactions these interactions can be centered on pertinent concepts. Concept development can also be facilitated through use of peer activities. Role playing can be a powerful method for simulating situations which promote social arbitrary knowledge. Role playing introduces actors and observers to the situation with dramatic results. It draws the group from a purely intellectual exercise into an emotional exercise. The entire meeting is pulled into a stream of events which the members can feel and hear. To really involve persons, only these emotional reactions can produce a meaningful exercise.

Access to Research Studies

Finally, a part of the teacher training course should be devoted to acquainting preservice teachers with research studies in the field of educational psychology. This field is as crucial to teacher education as physics is to engineering or as anatomy is to medicine. The preservice teacher should know what research has to say to him personally.

The major question is one of familiarity with pertinent sources. A part of the training therefore should be to acquaint the trainee with means by which he can secure information, interpret it and decide if it is applicable for his particular interest or requirement.

Foundational Competencies and their Environmentalization in Professional Education

The final question examined here is one of addressing how the various foundational competencies, which pertain to knowledge, attitudes, behavior and/or skills and are relevant to the content of this chapter, are to be integrated into the training course. The following was excerpted from Strategies for the Training of Teachers in Environmental Education (Wilke, et al, 1980) and is an outline of relevant foundational competencies. Also included are suggestions on how to correlate these competencies with an EE teacher training course. It incorporates samples of content and instructional strategies as well as the foundational competencies that are thought to be essential for professional education.

The EE teacher should be able to...

...select effective instructional methodologies which are appropriate for desired cognitive and affective outcomes, receiver characteristics and available facilities.

...effectively implement the following methodologies to achieve EE goals:

A) Outdoor education methods.

B) Affective education methods (e.g., values clarification, Bank's inquiry model, moral dilemma model).

C) Simulation games (including role playing).

D) Case study methods.

E) Community resource use (ecological, issue related, human resources).

F) Methods of independent student and/or group investigation, evaluation and action planning for resolving environmental issues.

G) Appropriate teacher behaviors while handling controversial environmental issues.

. . . effectively evaluate EE curricula and methods achievement with receivers in both cognitive and affective domains.

The methods component should include emphasis on assessing the readiness of the learner. and this in turn should assist the preservice teacher by environmentalizing the foundation education with respect to theories of learning.

Content Considerations:

A) Both physical and intellectual development in the planning of EE experiences for the learner.

B) Characteristics of cognitive knowledge with special emphasis on concept development.

C) Characteristics of cognitive process, i.e., intellectual skills such as inferring, hypothesizing, data collection and analysis, drawing of conclusions.

D) Characteristics of attitudes and values.

E) Relationships which exist between knowledge, skills, values and human behavior.

F) Principles associated with the transfer of learning and implications for EE.

G) Implications of special student populations for EE, e.g., the disadvantaged, gifted, or disabled.

Sample Instructional Recommendations

A) An analysis of existing EE curricula by preservice teachers, to determine the consistency of curriculum materials with accepted learning theory.

b) Lecture or assigned readings on characteristics of cognitive knowledge, cognitive processes and affective components including actual EE experiences illustrating the development of these components.

c) Lecture or assigned readings on the relationships which exist between knowledge, values, and human behavior with special emphasis being given to critical EE implications.

d) Lecture and discussion on the transfer of learning and its critical EE implications.

e) Lectures on special populations and EE with subsequent emphasis on a review of EE materials developed for or usable with special populations.

CHAPTER NINE

EVALUATION IN THE CONTEXT OF EE LEARNING

Evaluation is a process which assesses the relevance of the input, impact and efficiency of a system, through the measurement of output. It provides feedback which aids in making decisions concerning changes in the planning and execution of an activity. Educational evaluation has a specific connotation. It is used to measure the achievement of learners through outcomes which are reflected by changes in their behavior. Evaluation is an essential component in the process of curriculum development. It is completed to assess either the success or failure of the total curriculum or that of any specific instruction. Therefore, it is a significant and necessary component which provides feedback and help to make changes in other curriculum components.

In the context of teaching/learning, both in schools and teacher training institutions, evaluation plays a significant role. It has generally been used as a means of collecting information to judge learner merit. Unfortunately, the results of evaluation are used only to award certificates and degrees which enable learners to obtain a job and fulfill requirements of different professions. Learners are graded based on tests of their knowledge rather than the abilities and skills they have developed by undergoing a variety of teaching/learning situations. Examination centered evaluation needs to be totally incorporated in the implementation of any curriculum and especially in the present context of EE. Evaluation is even more important in EE because expectations here are much greater as compared to those of curriculum in a particular discipline.

Evaluation and Preservice Training

Teacher training with EE orientation is important and has a distinct role in preparing trainees to familiarize themselves with the different aspects of evaluation. Use of evaluation in EE training is also necessary to equip future teachers with the ability to design evaluation tools so that they can use them appropriately to measure learning outcomes in terms of environmental concepts, issues and problems. They must be able to carry out evaluations which assess learning outcomes and also apply corrective or remedial measures for improving both. The trainees, during practice teaching, do not actually use evaluation tools although they do read about the theory. Because they do not use evaluation tools, they are not able to adopt corrective measures and the result is mechanical completion of lessons by teachers rather than an effort to have meaningful teaching and learning take place.

The prevailing practice in educational systems gathers information for evaluation by examining the trainee at the end of a particular course, say after a two year training course for primary or secondary level prospective teacher, or after eight to ten years of schooling for children. In terms of evaluation, this kind of assessment (summative type) does not help much in determining the skills and competencies one has developed after going through a specific curriculum. Although educational institutions may also conduct intermediate evaluations, they are either not considered or just done for practice. This kind of evaluation leaves no scope for assessing the development of knowledge, proper attitudes, skills for issue investigation and evaluation, participatory action or decision making abilities expected under EE.

There is a method for continuous assessment (formative type) throughout a learner's involvement in the teaching/learning process especially in primary schools as evaluation here is

done by concerned teachers. At the secondary stage, the prospective trainees would also get an opportunity to evaluate pupils taught by others. This occurs when they serve as examiners for the evaluations conducted by an examining board.

The Nature of Evaluation

The available models of evaluation are either goal oriented or goal free. In the former, evaluation is directed toward measurement of the relative achievement of goals identified for instruction. In the latter case, the evaluator uses tests to measure a variety of effects without knowledge of the goals set for different teaching/learning activities. In the case of EE curriculum, the trainees should be given practice in goal oriented evaluation since the goals of EE, important in preparing environmentally conscious and concerned citizens, have been identified by the Tbilisi Conference and other earlier conferences. These goals place an emphasis on obtaining knowledge of the environment, the impact of man's activities and on taking action at the individual or group level for protection of the environment. In the case of EE even specific goal statements have been developed from the Tbilisi goals and validated through research. However, such an evaluation must take into account extraneous factors, like home or community, which can influence both goal-oriented instruction as well as learning.

Planning an Evaluation Program

Two models are given for the development of an evaluation program. The training curriculum, in general and also in the context of EE should familiarize trainees with the essential steps needed to carry out meaningful evaluation of learning. These are outlined below and can be used for planning an evaluation program (Fig. 9.1) for an environmentally oriented curriculum.

1) The learner's needs, in respect to education about environmental concepts, issues and problems, should be identified keeping in mind the age and environment in which the learner lives. Assessment is also important concerning the knowledge which is to be provided by relevant environmental content mainly through provision of problem solving /learning situations. Learners may be interested to know about the immediate environment and how their own interactions affect it. The needs and expectations of society will also influence the nature of an evaluation program.

2) The next step would be the drafting of objectives aimed at fulfilling the requirements and needs of learners and society.

3) The drafted objectives are then translated into behavioral objectives, as a change in behavior reflects the extent of learning

For example, a learning activity might be aimed at familiarizing learners with living organisms, their characteristics and habits. These instructional objectives could then be translated into the following behavioral objectives. The activity would enable the learners to. . .

. . . acquire knowledge about different organisms and their traits.

. . . describe important features of organisms as observed in their environment.

. . . classify the organisms based on similarities and dissimilarities.

. . . draw and label diagrams of plants and animals.

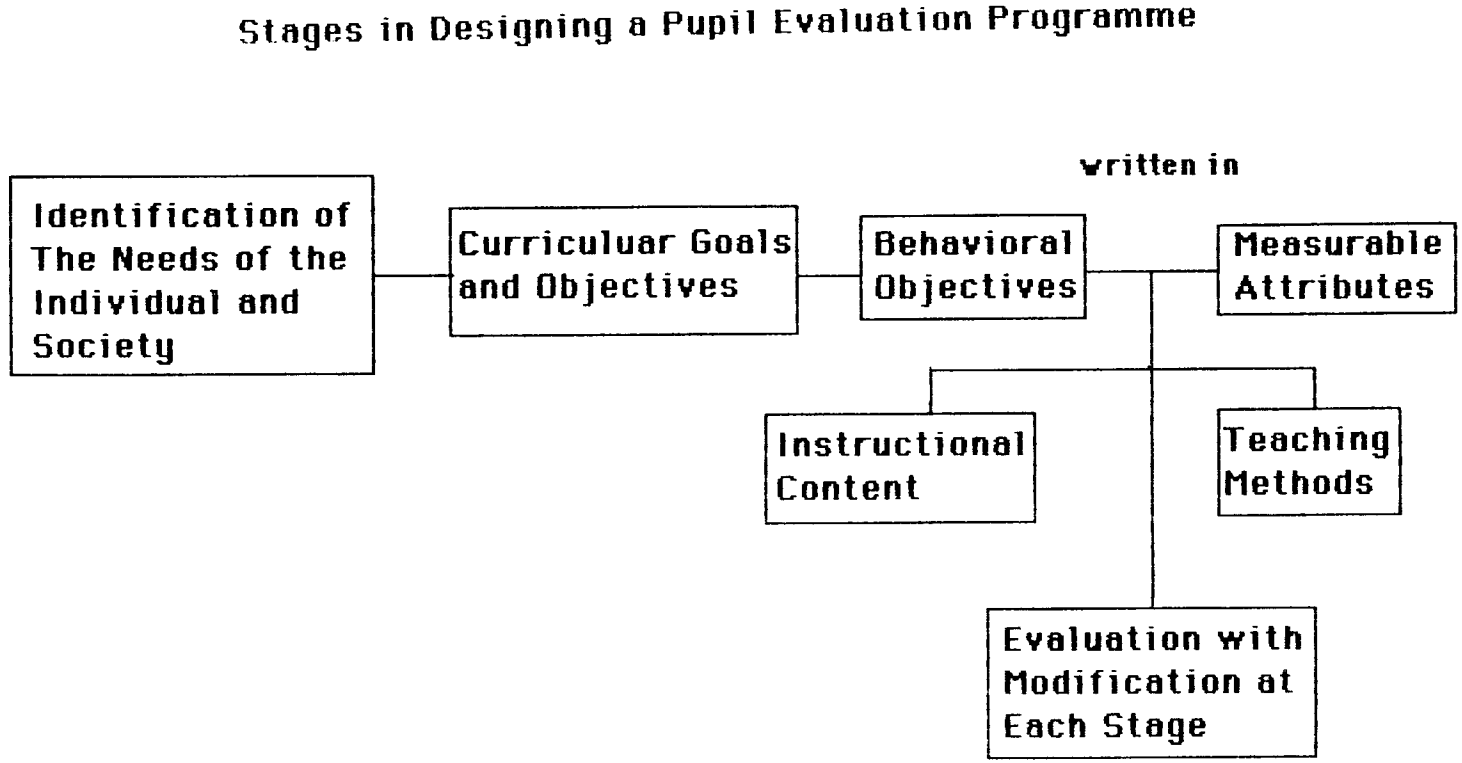


Figure 9.1 Schematic diagram showing the stages in designing a pupil evaluation programme

. . . recognize the gross habits of organisms related to food, migration, behavior towards light and other external stimuli, and environmental changes which have occurred in the area.

. . . categorize plants as trees, shrubs, herbs, climbers etc.

. . . categorize animals as worms, insects, reptiles, birds, mammals etc.

. . . identify different habitats as aquatic, terrestrial (pond, grassland, open field, forest) etc.

. . . classify organisms according to their respective habitats as aquatic or terrestrial organisms.

4) The behavioral objectives are then written in measurable attributes or terms which help to identify necessary inputs.

5) The identification and selection of relevant concepts and appropriate teaching methods or teaching/learning situations which provide environmentally centered activities must occur. This depends upon the instructional objectives identified in earlier steps.

6) The learning outcomes selected from the teaching/learning situation next require design of evaluation tools to measure the extent of achievement for the instructional objectives.

7) The assessment results obtained help in making decisions for improvement in the teaching/learning process.

An Instructional Model

A functional instructional model has been suggested depicting the place of evaluation in the curriculum development process (Fig. 9.2). The model is based on the research undertaken by Hungerford and Peyton (1986). It suggests the adoption of an intermediate set of goals from the general goals identified at Tbilisi. Intermediate goals are written in the form of specific goal statements which can then be translated into instructional objectives. These objectives are the basis for selection of appropriate content and teaching methods to impart the content. Evaluation subsequent to instruction would be completed in terms of the expected changes in learner behavior. Evaluation is facilitated if the instructional objectives are written in the form of performance objectives for each of the goal levels identified for EE by Hungerford et. al.(1986). According to them, objectives written in performance terms effectively communicate expected outcomes between the developers, teachers and learners.

The model suggests pretesting instructional objectives and also instructional content and teaching method. This testing is useful to the evaluator, whether teacher educator or teacher, especially when the unit or content is new. It is not necessary in every learning situation. For example, while teaching pollution, pretesting may not be necessary if the learners are already familiar with terms like biotic, abiotic, ecosystem, food chain and biosphere.

Another component in the model deals with posttesting, this is evaluation after instruction is complete. In the case of EE the teacher makes observations about behaviors, attitudes and value clarification throughout the course of study as learners take part in such activities as

Relationships Between Process, Goals, and Evaluation in Curriculum

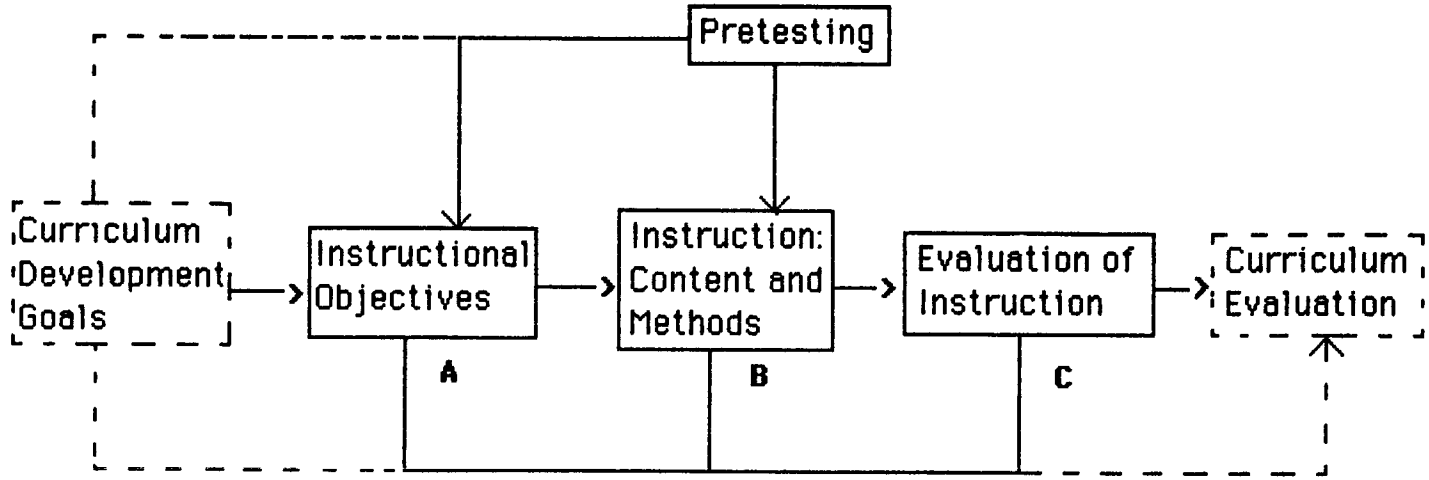


Figure 9.2: Schematic Diagram Showing the Relationships Between Instructional Process (A,B, & C), Curriculum Development Goals, and Curriculum Evaluation.

investigation, experimentation and debates. The evaluation towards the end of a particular course of instruction must be made entirely in light of the stated instructional objectives. This evaluation would depend largely on how accurately the instructional objectives were prepared, how well the content was identified, and if a suitable mode was adopted for imparting instruction.

An evaluation program based on the above model indicates the relationship and interdependence of curriculum components and would be useful in assessing the:

-- exactness and feasibility of general goals, curriculum development goals and instructional objectives visualized;

-- relevance and suitability of the content identified for instruction;

-- effectiveness and appropriateness of teaching methods and strategies adopted for transferring instruction; and

-- strengths and weaknesses of the whole curriculum.

Thus the feedback outlined above, obtained through evaluation would help to identify the strengths and weaknesses of each curricular component. It may, therefore, necessitate decisions resulting in the following actions:

-- the redrafting and redefining of instructional objectives;

-- the rearrangement or alteration of the content/concepts;

-- the exploration of alternative teaching methods and strategies; or

-- the reexamination, for strengthening or diluting, of curriculum goals.

Factors Influencing Evaluation

The success of an evaluation exercise depends on a large number of factors which actually emerge from the essential steps used in evaluation which were mentioned earlier. Therefore trainees, in the present context, should be familiar with the following factors which influence design of an evaluation program. They should be able to answer questions regarding the following topics:

1) The nature of the curriculum which is prevalent in primary and secondary schools. For example, does the teaching of basic environmental concepts motivate learners to study and understand their environment?

2) Educational approaches suggested in the school curriculum. For example, do EE studies, through a topical approach, facilitate knowledge of the holistic nature of the environment? Similarly, does a knowledge of interdisciplinary or multidisciplinary approaches (infusion) to environmental concepts, issues and problems help in effective transfer and meaningful evaluation?

3) Basic educational considerations such as the matching of instructional objectives to the evaluation tools employed. For example, if the objective is to create awareness and provide fundamental knowledge about the environment to a learner, would an appropriate evaluation tool use oral or written tests and questions? Similarly, if

the objective is to assess skills and competencies, should the evaluator resort to practical tests to determine if the learner can handle equipment like a microscope, hand lens, or magnetic compass?

It is necessary to elaborate on the first factor, the nature of the curriculum prevalent in the schools where the trainees will work. The efforts of the IEEP subsequent to the Tbilisi Conference on Environmental Education (1977) and other new thrusts have raised EE to the status of a distinct curricular area. Thereby, it has assumed its own characteristics some of which could be identified as; problem centered, community based, value oriented, life long, interdisciplinary, holistic nature and environmentally-learner directed (Bennett, 1977; NCERT, 1980 p.59). These descend from the goals outlined by various EE conferences including Tbilisi.

Educational expectations in EE as a curricular area, in terms of its goals and objectives, are wider and slightly different from the ones in so called traditional curriculum. Environmental education visualizes specific competencies and skills which learners should develop and apply towards finding solutions for environmental problems. The abilities attained through environmentally based learning should (in addition to basic skills like observation, identification, experimentation, measurement, analysis, interpretation, generalization, communication of results) bring about desirable attitudinal changes and build value attributes on environmental ethics. Since the EE curriculum development goals and instructional objectives mentioned earlier aim at all three domains (cognitive, affective and psychomotor) the evaluation program should also help to assess learning outcomes not only at the knowledge level of ecological principles and problems but also assess the skills necessary for investigating issues and evaluating alternative solutions. Further, it should help to evaluate skills needed to take positive environmental action for the maintenance of both the quality of life and the quality of the environment.

In summary, keeping in mind the characteristics of EE as a curricular area and the curriculum development goals at the four levels identified for EE, the evaluation program should focus on learner assessment throughout a course rather than at the end of instruction or a course.

Evaluation Techniques

A process based evaluation approach has been found useful when curricular content is problem based and requires a stepwise investigation of the environment and with identification of problems and issues related to components of the environment. There are environmental issues which can to be investigated through experiments, surveys, project work, and case studies. Individual investigations may require skills in experimentation, collection of data from an experimental design, and analysis of the data or information collected. This would lead learners to discard irrelevant information. The resulting information would help in the examination of alternatives before final decisions are made and positive actions are taken as a remedial measure for the protection of environmental quality. The process based approach helps to develop skills of enquiry at different levels. An extension of this approach to EE can lead to the evaluation of both process and product and ultimately reflect the learner's decision making ability and development of proper attitudes.

Evaluation of learning mainly involves curricular goals and instruction. Once the instructional objectives have been developed in behavioral terms as suggested by Hungerford and Peyton, planning of instruction and learning situations would facilitate eventual evaluation of these learning outcomes when the activities are planned in light of instructional objectives. The activities should involve group work aimed at the development of problem solving skills and competencies at all four goal levels. This planning of learning activities and use of appropriate teaching methods should be flexible enough so that one or more objectives could be achieved

through a single activity. The same activity can also be employed for different age levels, by switching the emphasis from simple observation at primary levels to analysis and synthesis at secondary levels. For example, an activity based on the study of familiar living organisms could focus on familiarizing primary learners with observation. It could also include the study of an organism's body parts and ask learners to identify, classify and draw the organism. At the secondary level, population studies, or studies of organisms' interactions with the environment could be used to meet EE objectives. The result of this study may be the development of a loving attitude towards organisms and a desire to protect them., as well as the acquisition of basic content.

The Tools of Evaluation

The next important consideration in evaluation is the type of evaluation tool used to measure the instruction provided by a teaching/learning activity. The tool should provide a degree of objective attainment which is reflected by the specific behaviors of the learner. A large number of tools are available to measure the specific learning outcomes intended by the objectives.

If the purpose of the performance objective is only to evaluate the amount of environmental knowledge gained by the learner, one may use oral or written tests. But if one is measuring learner attitude, value alteration, or environmental action, then these tests would not be of much help. An evaluation tool which provides continuous observation of a learner's behavior during his participation in individual investigation or group work would facilitate evaluation of the abilities developed. In this case, the most helpful times for evaluation of the development of skills and competencies would be both during the process and at the end. Therefore, instructional objectives determine when evaluation tools would be used. The tools employed for evaluation of learners are expected to be, objective based, valid, reliable and usable in collecting the information needed to correctly apply measures for improvement of both teaching strategies and activities. The evaluation techniques and tools used also depend upon the purpose of the objective involved. The techniques or tools can be used to evaluate the following:

-- academic achievement, mainly concentrating on the measurement of gains in knowledge and understanding about environmental concepts, issues and problems;

-- affective domain gains like interest, curiosity, attitude and values;

-- development of skills for investigation, experimentation display and communication; and

-- decision making abilities and citizenship action as individuals or voluntary groups.

In the following pages, certain techniques and tools are examined in detail using EE concepts, issues and problems as illustrative examples.

Evaluation Tools for Measuring Academic Achievement

Tests

Testing with questions either in oral or written form generally helps to evaluate outcomes in terms of ecological or environmental knowledge and in terms of the extent of awareness of environmental issues and problems at EE curriculum development goal levels I and II. The questions seek quick or structured responses to help in evaluating an understanding of environmental principles, interrelationship between living and nonliving components, and the interdependence of these two. Different types of items can be designed which will help the continuous, concept to

concept measurement of learning outcomes. Generally, the test questions are either criterion referenced or situation based. Again, depending upon the instructional objective being tested, different types of items are used. A mere recall of information could be done through completion type questions, fill in the blanks or true-false type questions. In the following examples, the learner has only to recall information and indicate whether it is true or false.

1) Carbon monoxide pollutes the air.

2) The tiger is not on the endangered species list.

3) Increased use of land for nonagricultural purposes is not harmful to the environment.

The following multiple choice question can also be designed to test knowledge and understanding of ecological principles.

Four plants are listed below, which is a typical xerophyte?

a) Acacia
b) Papaya
c) Bougainvillea
d) Opuntia

Learners may also be asked to match structures like root, stem and tendrils from Column I, with their functions mentioned in Column II. The purpose of these questions is to measure their learner understanding of relationships between structures and their respective functions. Structured questions, with a learning situation given in paragraph, form help to assess the understanding and application of knowledge gained. In learning situations, essay type questions help to evaluate the awareness of sequential development of an issue under investigation, the study of alternatives and the expected role of individuals, group or government agencies.

Using the environment as a teaching/learning resource provides many opportunities for oral questioning while learners are involved in activities. The use of oral questions may be unavoidable for lower age groups as problems in written communication may arise. However, tests in oral and written form help make quick assessment and allow for adoption of remedial measures. Check lists of questions which observe and evaluate skills for both issue investigation and the evaluation of environmental action can be prepared on many environmental issues. For example, given that a new tool has been introduced to improve agricultural technology, the following check list of questions might be used for evaluation:

1) What other tools will need modification as a result of the introduction of this new tool?

2) What other tools may be required as a result of this new tool?

3) What will the cost be for development of the new tool in view of current social conditions?

4) Will the introduction of this tool lead to unemployment?

5) Who will fill new occupations?

6) Who in society will benefit from the new tool?

7) Will these benefits create economic advantages?

8) Who is likely to suffer as a result of the new tool?

9) How will a shift in occupations influence the job market?

10) What roles in society will the affected people fill?

Other environmental issues related to curricular content might include the following: the implications of selective breeding for increased food production; the impact of urban growth on the environment; investigation of the environmental decision making process at political levels; desertification as a result of man's activities; and, identification of national health problems.

Another form of tests can be used when learners are given a practical investigation in the form of a project of field study. For example, if children are to investigate pollution of water in their locality, experimental skills can be assessed both through oral and written questioning as well as through observation of actual learner performance during experiments and activities. The teacher may closely observe skills related to an experiment. These skills may include the collection of various types of samples, preparation of solutions which require the use of a chemical balance, pipette or measuring cylinder, and the estimation of color change intensities in chemical tests to check for pollution of water, soil, and air. When the learner is completing investigations which use secondary data, the skills of locating information and identifying information relevant to the environmental issue under investigation may also be observed.

Use of Written Records for Evaluation

Use of written records like reports of field work, case studies, experimental investigations and assignments on environmental topics would help to evaluate the learner's academic gain both in terms of knowledge and simple manipulative skills. For example, lessons on means of transport and communication in a particular area, can be evaluated by giving assignments first, to identify areas like parks or sanctuaries of interest to tourists. Learners then collect information on modes of travel, time required for a visit to the site and general information related to the places to be visited. The possible routes taken can be traced on a map. and this map study could also help to assess skills in drawing as well as map reading. Similarly, a simple excursion to a bus stop would help to assess learner attitudes toward traffic rules and the types of vehicles used for transportation.

Reporting as an Evaluation Tool

Self-reporting is another form of evaluation. It collects evidence about the actions of learners related to environmental areas such as personal hygiene, cleanliness in the locality, and management or protection of plants and animals in the area. But it only helps in assessing outcomes to a limited extent. Learners are encouraged to prepare self-reporting charts and fill in the environmental actions they have taken. They may mention the frequency of such actions and show a variety of situations. The impact of their actions on the environment, on themselves or other persons encountered in environmental situations may also be recorded. Although self-reporting may be less reliable, it will be valid up to a certain point and it can at least be added to the other information collected by the teacher educator/teacher to create a total picture.

Evaluation for Affective Domain Objectives

The emphasis in EE curriculum on development of attitudes, values and specialized competencies and skills in the affective domain are difficult to evaluate with tools suitable for cognitive domain objectives. Assessment of a change in attitude is more difficult to see with oral questions, because responses may be quite vague and given without proper thought. The tools of inquiry and observation found suitable for the primary stages could well be extended to secondary levels. Trainees at both levels should be provided with practical experience in observation of their pupils during practice teaching so that they gain confidence in using these same tools in primary and secondary schools.

Given the nature of EE in which learning outcomes are influenced by factors like home, community and schools, the use of appropriate tools such as observation and inquiry are most important. These tools help in making an objective assessment through continuous evaluation rather than short term summative type evaluations and there are also valuable because they involve community elders, parents, other teachers and sometimes even fellow classmates.

Observation as an Evaluation Tool

Systematic and continuous observation made by a teacher during a learner's participation in various teaching/learning activities can help to assess attitudinal changes and value systems reflected by specific behaviors. As discussed in Chapter Seven, teaching methods like field studies, discussion, and buzz or brain storming sessions facilitate the development of issue investigation and evaluation skills, and decision making abilities in regard to the particular actions to be taken on environmental issues. But it may be difficult to depend upon observations about behavioral changes, as far as an objective assessment is concerned, because often little interaction between teachers and learners is possible due to the large number of pupils in class and the small amount of time available. Teachers would be better observers and judges if they compared information received from other sources of observation like parents and community elders to what they already know. Certain observations can be quite realistic and dependable in assessing behavioral changes. Examples of the sort of observation parents might make about their children are listed below.

-- The child enjoys playing alone with toys.

-- The child feels tense and nervous in a gathering.

-- The child generally keeps quiet and feels shy in front of others.

These would indicate that the child may learn little through group work or discussion. These examples should show that the information collected from parent observations would be helpful in assessing classroom.outcomes.

Observations made by community elders can also be reliable to a certain extent. Statements that the child pleads with everyone for cleanliness in the house and local area or feels concerned about destroying green plants, can be helpful in an overall observation. Similarly, if elders report that a child dislikes smoking, takes care of his pets, and takes an interest in growing plants, these observations reflect a favorable attitude toward a clean environment and show that a child values the environment.

Thus, observations made by teachers can be valid and reliable, and used to assess affective and psychomotor EE objectives. In order to immediately measure citizenship actions taken after encountering an environmental issue, the teacher may resort to on the spot observations. In many cases, learners can take quick action considered to be appropriate in the environmental situation. For example, while walking in a group with smokers, the learner may resort to action by expressing a dislike for the smoke, by refusing to get close to the smoker, by pleading with smokers to stop, or by telling the group about the health hazards of smoking. To facilitate observations and use information to judge the attainment of goals with respect to issue investigation skills, attitudes, values and the skills and abilities needed for taking positive action, a 'Behavior Tally Chart' can be prepared by the teacher to identify the common and observable behaviors. A chart observing behaviors during field studies can be prepared on the following lines:

Behavior Tally Chart

Name of the learner:_____

S. No.	Specific behaviors to be observed	Tally	
		Yes	No
1)	Moves in the field without a specific task.		
2)	Breaks plants without purpose.		
3)	Moves from group to group even though not required.		
4)	Only questions the teacher or group members.		
5)	Sits and watches others work.		
6)	Avoids carrying out the work assigned by the group.		

The behavior charts can be developed by teacher educators/teachers who then record observations on the chart itself, but this may be difficult when the number of pupils is large. However, once the teacher has identified the behaviors to be encouraged or discouraged, he can prepare checklists resulting in corrective measures.

Generally the information collected by a teacher through check lists and rating scales can be used to make decisions about the remedial steps required. The former would provide an opportunity for quick recording of the behavior in a teaching/learning situation and the latter shows the extent of a particular behavior. A sample checklist of behaviors which could be observed during a pond visit is given on the following page. Similar check lists can be prepared for learner participation in laboratory work.

Behavior Checklist

Name of the learner:_____

Class - Primary

Activity - Study of a pond ecosystem

S. No.	Behavior to be observed	Yes	No
1)	Lists, and then requests items needed for study.		
2)	Carries the items with him.		
3)	Collects samples carefully.		
4)	Makes a record of field information.		
5)	Counts and packs items in the field.		
6)	Separates and labels samples in the laboratory.		
7)	Prepares solutions accurately.		

To evaluate the extent of a specific behavior, a rating scale can be made in which the teacher educator/teacher has to record the degree to which a specific behavior is met on a five point scale indicating the learner's standing. A sample rating scale is also provided for an activity like a field trip. If a learner was not observed for some reason, indication should be made by writing not observed (N/O).

Activity:

Field work to study the environment

Name of the learner:_____ Class:_____

Sr. No.	Behavior	Rating A	B	C	D	E	N/O
1)	Interest of learner in field work.						
2)	Level of learner participation in field studies.						
3)	Extent of participation in group work in the field.						

A - Excellent, B - Very Good, C - Good, D.- Satisfactory, E - Fair

The reliability of teacher observations collecting information on the behavior and skills of individual learners is unbiased, real and reliable and its use for grading the learner on the basis of abilities developed is dependable. These evaluation tools in EE would be quite useful because it is environmentally centered, child centered and activity based. This type of evaluation provides a good opportunity to observe learners while they are actually investigating the environment.

Inquiry as an Evaluation Tool

Evaluation of learning outcomes through such techniques as inquiry using face to face interviews and discussions also helps to assess the attitudes and values possessed by learners. These evaluations could also be based on information provided by parents or community elders.

Specific attitudes like interest in field studies and experimental investigation but not in group discussion, would indicate that an ability to promoting one's opinion and values are lacking. These could be considered for corrective measures. Sometimes learners may show preferences for certain situations as when (during a debate) learners want to speak in favor of but not against the use of nuclear energy. Similarly, with respect to conservation of energy, one may be prepared to speak only against the idea. Behavior here reflects personal considerations for more comfort rather than environmental concern.

Suggested Examples for Use of the Inquiry Mode

Learner attitude toward and appreciation of the relationships between recreation and the environment can be assessed through a series of simple questions. The learning situation used involves an identification and listing of recreational activities for individual learners and the subsequent compilation of this information for the whole class.

The list may possibly include activities such as playing games, reading, going to the movies, watching television, gardening, keeping pets, visits to places of historical interest, participation in social functions and so on. Suitably framed questions would help to assess learner attitudes towards recreation and the environment, their values about the environment and the appreciation given by them to relationships between recreation and the environment. Questions which could be used to probe learners follow.

-- What are your favorite recreational activities?

-- Are these activities also enjoyed by your friends?

-- Are the necessary recreational facilities available in your school or home?

-- Does this recreation involve the natural environment? If so, how? (i.e., Are playgrounds needed for recreation? Is the park open for evening social functions?)

-- Who maintains the recreation places used by you and your friends?

-- If these places are maintained by government agencies, are you satisfied with their maintenance?

-- Do you think you, your friends and relatives have some role to play in maintenance of these places?

-- Were these recreation places in the same condition when your parents and grandparents were young?

-- How have these places changed?

-- Do you feel that recreation requires a healthy environment?

-- Do you have suggestions to keep the environment clean thus improving recreation for you and your friends?

Some learners may list and consider social functions as sources of recreation. The questioning trend may then try to explore and assess their attitudes and environmental values in judging the impact of social function on the environment. Sample questions are listed below.

-- Should a loudspeaker be used at social functions? If so, in what way?

-- Do you feel that use of a loudspeaker has something to do with noise pollution?

-- Does proper disposal of wastes during social functions add to improvement of the environment?

Considerations for Developing an Evaluation Scheme

While designing an evaluation scheme for the assessment of EE outcomes, proportionate weights should be given to the use of different tools employed in evaluation. This weighting would be determined by the specific environmental topic/lesson and the specific instructional objectives envisaged. As most teaching/learning situations would involve both local and global aspects of environmental issues, curricular topics like nutrition, personal hygiene, environmental sanitation and resource problems would be better evaluated through use of the various evaluation tools discussed in this chapter.

CHAPTER TEN

MECHANISM OF DEVELOPMENT

In this document, the preservice training of teachers in environmental education has been given a detailed treatment from the perspective of various considerations regarding curriculum development. But to initiate an appropriate program of curriculum development in teacher training some serious consideration ought to be given to the mechanism used.

In some countries, the mechanism for curriculum development is highly decentralized. Schools or institutions themselves are responsible for developing their curricula with little or no support from an outside agency. In such situations, much is left to concerned faculty or teachers themselves who develop their own curriculum and instructional materials based on the treatment of subject matter from previous chapters.

However, in other countries, the process of curriculum development follows a more elaborate pattern. The system here may involve a multitier institutional mechanism. In these countries, the entire process of curriculum development is often centrally directed. In the account which follows, an attempt has been made to identify the agencies involved in this process showing their functions and interrelationships at various levels. The mode of development will be discussed to show the nature of participants at different levels and the modes employed in terms of the various types of workshops conducted at each level. The need for a variety of instructional formats will be examined with examples given to highlight the context of previous chapters. Evaluation of process will take into account the efficacy, the product and the utility of the curriculum. A scheme of summative evaluation by an outside agency is presented at the end of the chapter.

Agencies Involved

The mechanism of curriculum development involves the functions of various agencies at different levels. The presentation below details these agencies and their functions. A schematic representation of this information is given in Fig. 10.1 showing the functions and interrelationships of these agencies.

National Level Council (National Environment Education Council)

Environmental education is inherently multidisciplinary in regard to the nature of its content. An apex council may be conceived at the national level for the purposes of policy formulation and coordination in this area. In addition, there must also be involvement by various agencies, departments and action groups who are involved with environmental concerns in a general sense and specifically in regard to education.

Accordingly such a council should have among its membership, departments concerned with the environment, housing, urban development, irrigation, river valley projects, energy, science and technology, forestry, coastal management, general and technical education, health, agriculture, rural development, voluntary agencies and others in the context of a given country.

Agencies Involved

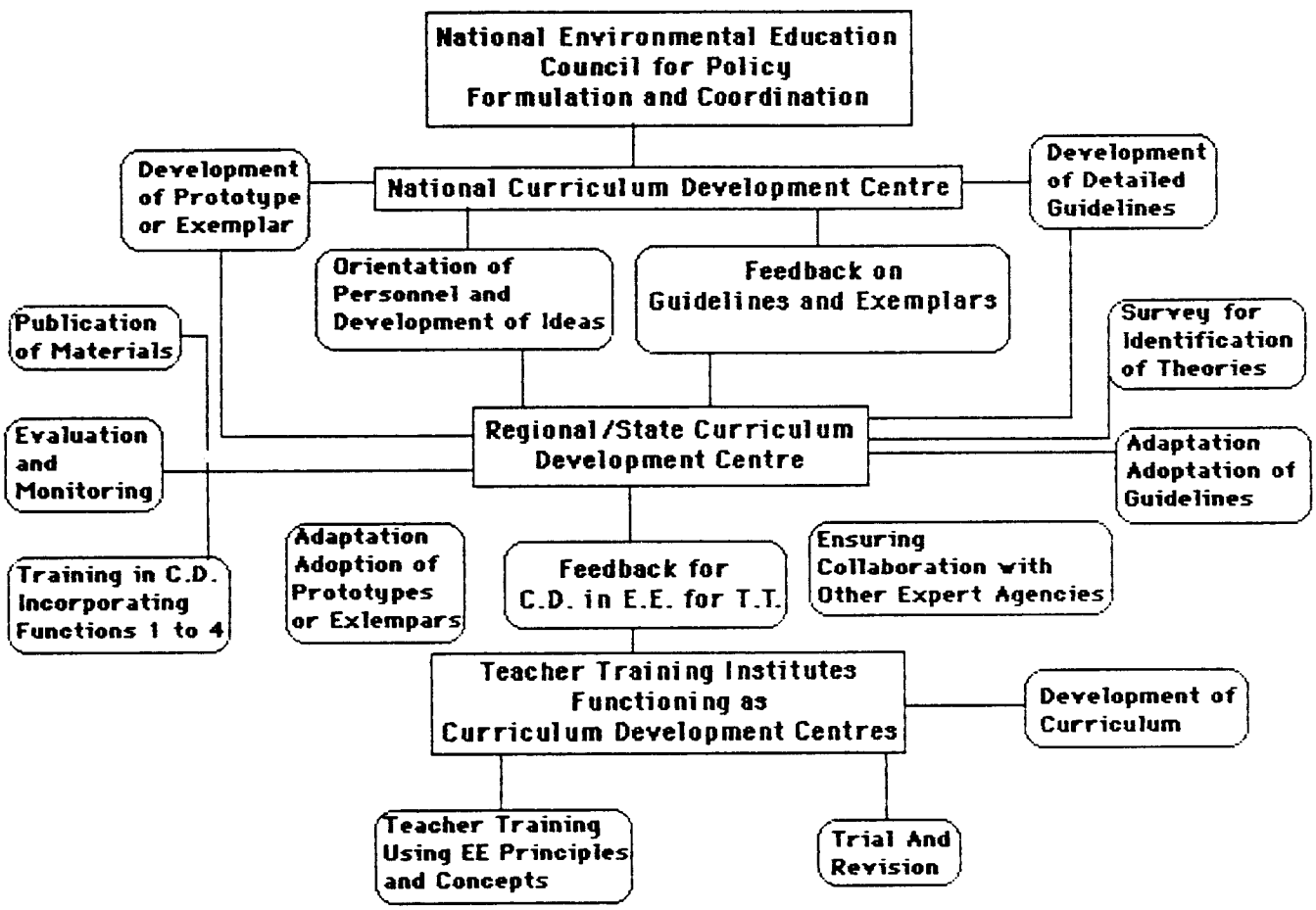


Figure 10.1 A Schematic representation showing the functions and interrelationships between agencies involved in EE curriculum development for teacher training.

As a part of its function the "National Environment Education Council (NEEC)" will establish guiding principles for environmental education in the process of curriculum development for teacher training . Other factors to be determined by the Council include the functions of various agencies and the standards of achievement needed to facilitate the provision of manpower and assistance from various agencies/departments. It would also make final decisions on evaluation reports and issue suitable guidelines for remedial measures. The entire institutional framework presented below would be expected to function under the overall coordination of the NEEC. But, the NEEC is not visualized to be a council working only in curriculum development for teacher training in environmental education. As a matter of fact, this may be only one of its many activities.

National Curriculum Development Center (NCDC)

A National Curriculum Development Center could be a functional unit located in an apex level institution concerned with curriculum development for general education. Such agencies already exist in many countries in one form or another. There may also be autonomous bodies performing these functions in some or coordinating and regulating the work of other agencies which do so. The NCDC must function as an integral part of these bodies, drawing support from various pedagogical areas but also with its own component of specialized staff representing the various major disciplines which converge on a theme of the environment and environmental education.

Some of the important functions which the NCDC may have are outlined below. The methods for meeting these functions are given in a subsequent section.

1) Development of detailed guidelines for curriculum development in teacher training relating to EE.

   Experts at the NCDC will examine in depth the various parameters and requirements of EE as elaborated in the preceding chapters of this volume. These requirements relate to the objectives, guiding principles, needs of environmental education in teacher training, and elements of environmental education. They will also take into account social, content and pedagogical considerations.

2) Development of prototypes or exemplars.

   The guidelines in themselves would tend to be abstract unless they are backed by a variety of exemplar materials. They would demonstrate, in concrete terms, how the guidelines could be translated into real curriculum packages developed by a decentralized network of teacher training institutions which serve as curriculum development centers.

3) Orientation of personnel

   To further strengthen the process, the NCDC will be required to train and orient curriculum developers and associated personnel both at the state and the Teacher Training Institution (TTI) level. Face to face interactions with personnel at each successive stratum will minimize erosion of the conceptual framework, aims, and objectives so commonly witnessed in the implementation of educational processes in general.

4) Collection and processing of the feedback

In order to perform the three functions outlined above, the NCDC will have to possess a mechanism for collecting feedback on the guidelines and exemplars not only from the State Curriculum Development Centers (SCDC) but also from both the teacher training institutions which function as SCDC's as well as from teacher training institutions involved with the testing and ultimate use of curricula for training purposes.

Regional/State Curriculum Development Center (R/S CDC)

The R/S CDC may be located in an agency in a similar manner as that suggested for the NCDC. Its functions are visualized to be more comprehensive and concrete than the NCDC as these mark the first stage in a decentralization approach to curriculum development. The personnel at the R/S CDC would be expected to have parallel expertise to those in the proposed NCDC. The R/S CDC may be assigned the following general functions.

1) Conduct a survey for the identification of EE themes for teacher training.

The identification of EE themes for TT would be done at the regional and state level on the basis of a comprehensive survey of the region. Such a survey would be expected to bring out specific themes which exemplify globally identified principles and elements of environmental education. While this is necessary for the exploration and problem solving approach in EE curriculum development, it may also be beneficial because it gives a more generalized presentation of principles which do not have direct relevance to the existing environment, but are significant in other environments in space and time. It does so by extrapolating from the concrete to the abstract.

2) Adaptation/adoption of national guidelines

It is necessary to make guidelines developed at the national level, intelligible, relevant and applicable to micro level situations. For this purpose, national guidelines would inevitably have to be modified to some extent. The extent of modification would depend upon the diversity of environments and environmental problems. Therefore, the degree of modification and elaboration for the guidelines would be an important function of the R/S CDC.

3) Ensuring collaboration with other expert agencies/institutions

The R/S CDC being the most important R & D institution in the whole framework, would have an important task in pooling the expert resources available in other institutions, departments or agencies. It is not advisable to have a large base of expert personnel as permanent staff of the R/S CDC, this would be too expensive. Besides, an expert base created as a permanent staff would not be as competent on a long term basis as those available at any particular point in time from other expert institutions. A proper mechanism for institutionalizing the collaborative arrangements would have to be worked out depending upon the administrative practices of a country.

4) Adaptation/adoption of prototype or exemplars

Like the guidelines, prototypes or exemplars developed at the national level would also have to be subjected to regional/state level scrutiny and modification. In larger countries with many languages and cultures, the materials would have to be brought out in local languages and may have to be made more culture specific.

5) Training in curriculum development in environmental education for teacher training

By far the most important function of the R/S CDC can be visualized as the training of personnel in teacher training institutions which function as curriculum development centers and which have actual curriculum developers in EE teacher training. These individuals will have to be trained in all aspects of the program from planning to evaluation, with revision of the materials they developed. The faculty of the R/S CDC would be expected to work closely with these people in view of the obvious limitations of the teacher training institution faculty in EE curricular development. This is because the role of the teacher training institutions has traditionally been quite other than curricular development. In a centralized process for curriculum development, this process has worked well but the format would have to be reviewed due to the intrinsic demands created by decentralization of the process.

6) Trial evaluation and monitoring

The process of development will involve trial of the materials and the collection of feedback for revision of curricular materials. It would also involve an evaluation of the implementation process and curricular transactions, both its monitoring and evaluation. The data thus obtained will then be passed on to the R/S CDC for proper utilization in the whole process.

7) Publication of curricular materials

The R/S CDC would also be responsible for the publication of curricular materials and their production at the desired scale.

The Functions of Teacher Training Institution as Curriculum Development Centers (CDC)

Preservice teacher training is conducted by a variety of training colleges, schools, or institutions in different countries. It is also sometimes the responsibility of the pedagogical division of faculty in specialized disciplines such as chemistry, physics, English or history. There may or may not be a separate training institution for elementary and secondary stage teachers.

This wide variety of prevailing patterns must also be reflected in the flexibility that is desired in respect to EE curriculum development for teacher training. It is quite likely that in most countries there is not a separate faculty for environmental education in TT institutions. This would necessitate establishment of a nucleus staff with a suitable mechanism for collaboration. Some possible functions of such a nucleus are listed below.

1) Development of environmental education curriculum for teacher training

After closely studying the guidelines and making use of survey studies, the CDC would launch a program of curriculum development. In this process, the prevailing course curricula and a country's desired model for environmental education will have to be kept in view. For this purpose, multidisciplinary groups may have to be constituted for actual writing of materials.

2) Trial and revision of curricular materials

The CDC will also prepare tools and questionnaires to be used in trials of materials in teacher training courses and then utilize this information for revision of the materials before final production.

3) Teacher training which uses the environmental education curriculum

CDC's and other such institutions in a local area will then conduct actual teacher training using the environmental education principles and concepts outlined here.

Mode of Development

The mode of development may be divided into two components the nature of participation and the modes of implementation. The participation of personnel with varied backgrounds and expertise in the context of EE curriculum will be needed. Such participation must be ensured at all of the levels outlined in the preceding section. The nature of participation at these levels of operation is presented schematically in Fig. 10.2. The modes of curriculum development have been conceived in terms of a wide range of workshops, seminars and other programs. These have been detailed at the various levels in the second part of this section.

Nature of Participation

A. National and Regional/State Levels

At the national and regional/state levels the types of participants may be very similar. These would include the following groups.

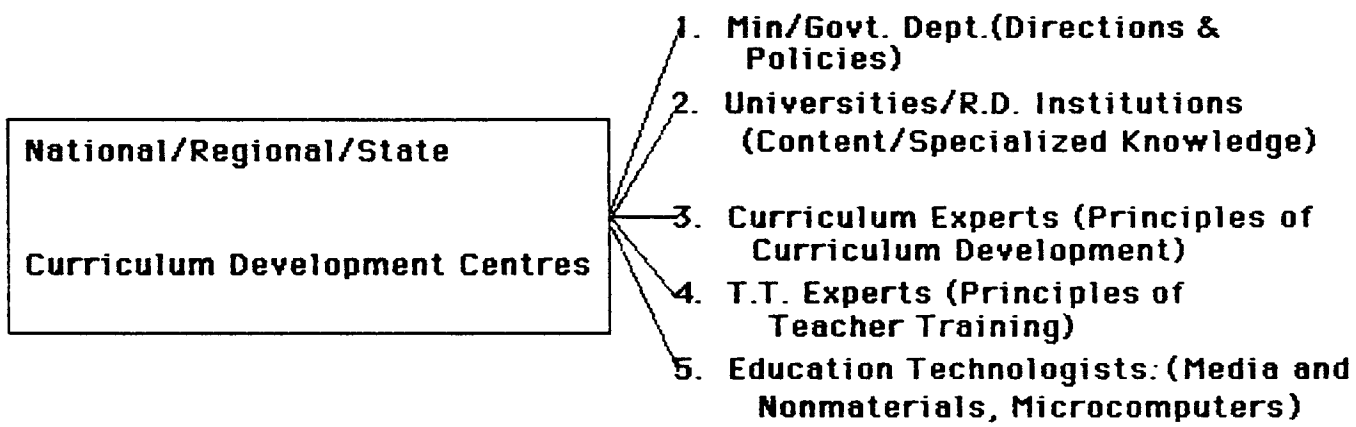
1) Ministries and government departments

Various ministries and government departments will be represented in the national level council for policy formulation and their participation will also be needed during the process of formulating guidelines and for effective program implementation.

2) Universities, research and development institutions

The Nature of Participation in the Developmental Mode

Participation at the National and State Levels



Participation at the Institutional Level

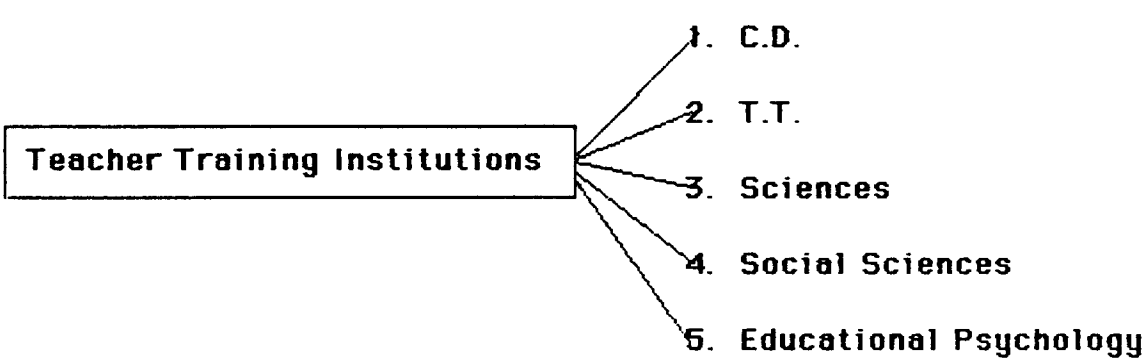


Figure 10.2

Essential knowledge of content, concepts, and principles could be provided by the participation of experts from various departments concerned with the environment in general. This would be necessary both at the national and regional/state level.

3) Curriculum experts

The involvement of experts in curriculum development with a pedagogical background would be helpful in the overall process of curriculum development. As a feature of the educational process, certain abstract concepts and principles of environmental education may have to be subjected to scrutiny in light of the intellectual abilities of children at different grades who are the ultimate beneficiaries in the entire process. In this regard, it would not be desirable to lose sight of the principles of curriculum related construction processes.

4) Teacher training experts

For reasons quite similar to those stated above, the participation of method masters and other experts who constitute the faculty of any teacher training institution would be most essential in the process of curriculum development for teacher training.

5) Educational Technologists

The active participation of people from the field of modern educational technology must be ensured in this process. In the present context of advancements in the use of modern educational technology, curriculum development should make use of a wide variety of formats beyond the conventional ones commonly in vogue for printed literature. A variety of software for microcomputers may be cited as the most promising area demanding immediate attention but a proper manpower base will have to be expeditiously drafted if this resource is to be developed.

B. Teacher Training Institution Level

In teacher training institutions which function as the CDC, the type of participation may be somewhat different allowing for the nature and level of expertise commonly available. After high level input from specialized institutions, experts in the natural and social sciences will assimilate ideas to produce curricular units by working through constant interaction with other available experts in curriculum development, teaching/learning methodologies and educational psychology. Based on the curricular units developed, the Regional/State level and national level would then work to produce software providing nonprint technology in education. It may also be kept in mind that the qualitative diversification and numerical strengthening of existing faculties of elementary and secondary level teacher training institutions may be necessary to give a proper place to environmental education in preservice training of teachers.

Mode of Implementation

The institutions for curriculum development at the three levels presented above will perform their functions through a series of workshops, seminars and orientation programs of

varying duration. The objective participation and expected outcome at each level in respect to these programs is as follows.

National Level

1) Sensitization workshops

One or two sensitization workshops may be organized for the benefit of the various types of personnel involved in the formulation of guidelines and exemplar literature, and later in conducting the orientation programs for individuals at other levels. These workshops, being interactional in character, should be limited to two or three days and should lead to the clarification of ideas and role expectations of project personnel from various institutions.

2) Developmental workshops

The number of workshops here may be large depending upon the volume of the task undertaken. The participants for each workshop will be selected based on consideration of the materials to be developed. Keeping in mind the ideas and considerations presented in preceding chapters and also the basis of a policy framework laid down at the national level, the following materials would be developed;

a) Guidelines,

b) Curriculum framework,

c) Exemplar instructional materials; both print and nonprint, and

d) Orientation/training packages.2

The wide variety of suggestive formats on which these materials may be developed is dealt with in a subsequent section.

3) Research workshops

These workshops would again involve a selected group to collect and evaluate the feedback data and insure their proper incorporation in the whole process of curriculum development. There may be two or three such workshops in a year with a duration of three to four days for each.
Besides the set of workshops suggested above, the publication and dissemination of the literature developed by these workshops will also be the function of the NCDC.

Regional/State Level

A variety of workshops will have to be conducted at the regional/state level. A suggestive list follows.

1) Workshops for the identification of themes

The R/S CDC will have to identify themes concerning environmental problems, environmental degradation and the steps necessary for environmental improvement around which development of curricula and instructional materials will be centered. In order for environmental education to be locally relevant, such workshops should be preceded by surveys.

2) Workshops for the adoption/adaption of guidelines

With adoption/adaption being one of the functions of the R/S CDC a few workshops may have to be organized for this purpose after the identification of environmental themes. The participants at these workshops may have to be drawn from amongst the various types of experts identified earlier.

3) Workshops to evolve means of collaboration and cooperation

As presented earlier in this chapter, a great deal of collaboration and cooperation among the regional/state level agencies working in the environmental area is expected. For this purpose, methods will have to be worked out for the participation of all concerned. This may be achieved by conducting a workshop of experts and high level administrative officials from these various institutions and later officially ratifying the collaborative arrangements so worked out.

4) Workshops for the adoption/adaption of exemplar materials

The exemplar materials developed at the national level may be reviewed at the regional/state level through the participation of concerned experts. This should make the exemplar materials more directly applicable to local conditions.

5) Workshops for training in curriculum development procedures

Most of the personnel to be involved in the EE curriculum development process may lack sufficient background in this area. For this reason, it would be essential to conduct group training programs for them at the regional/state level. More than one cycle of training is needed which may either precede or run concurrently with the actual curriculum development work.

6) Workshops for orientation in evaluation and monitoring

For the reasons stated in the case of the CD, training workshops and similar orientation programs may also be necessary for the proper exposure of teacher-raining institution faculty to these programs.

7) Research

Research activities will constitute an important element of the functioning of the R/S CDC. All programs and functions envisioned for the R/S CDC will have to be backed by a sufficient amount of research data to be generated at each R/S CDC.

8) Publication and materials

The R/S CDC will be responsible for the publication and supply of materials it develops in its areas of operation. Some modules/themes may have wider applicability and may be printed in larger volume but for most others the volume required may be limited. A variety of production techniques which are now available may be employed to maintain quality in the publications.

Teacher Training Institution Level

At the level of teacher training institutions which work as curriculum development centers the following activities are suggested.

1) Development of instructional materials

Instructional materials will be developed in a variety of formats. This will be done by the local faculty with the involvement of suitable experts. However, they will work under the constant guidance and supervision of the R/S CDC. Periodic meetings and joint work sessions may have to be organized at the CDC in which R/S CDC personnel will also participate.

2) Trial and revision of instructional materials

CDC faculty will carry out trials for the materials they develop at their own, as well as other project institutions identified for this purpose. The R/S CDC will provide the necessary guidelines, schedules and statements for these trials.

3) Exchange of ideas/supervision

The CDC faculty will also convene discussion sessions with the faculty of the project institutions. Thus, the faculty of CDC who are concerned with the environmental education project at one institution will also be aware of proper academic supervision and guidance in other project institutions.

Format Considerations

The curriculum and instructional materials to be developed in respect to the environmentalization of various components of teacher training would have a wide variety of formats which vary not only according to the subject matter being environmentalized but also according to the stages of education for which teacher preparation is planned. A few suggestive units are placed below which have been adopted/adapted from various sources.

The Curriculum

Like various other subjects, the teacher training curricula for both elementary and secondary stages would present the scope of the course. In this case, it would include a need for and justification of the environmentalization of various components of teacher training program. The various approaches, alternative or complementary, must be discussed with a sufficient amount of clarity. For example, if the teaching/learning strategy is to be environmentalized and not the subject matter, it must be so stated. In certain areas, however, the content itself may have to be environmentalized along with the teaching/learning strategy. In other instances these approaches may have to exist side by side but one may not necessarily depend on the concurrence of the other.

Objectives, in general terms, must find a place in the curriculum. These should highlight, in clear terms, what is to be attained by the end of the course. The content of the course should provide concrete and substantive parts of the curriculum and should be intelligible to teachers, writers of the textbook and other instructional materials, and also examiners. Along with the content, the general methodology of instruction which reflects the overall philosophy of environmentalization for teacher training should be highlighted. The specific methodology which corresponds to various content areas may be dealt with in teacher guides or other related materials. The scheme of evaluation as well as the details of tools and techniques employed would form an integral component of the curriculum. These should properly reflect the overall philosophy of environmentalization. This would also necessitate proper treatment being given to process and cognitive learning as well as consideration of the affective domain both with formative and summative evaluation.

Textbooks

Some textbooks may need revision to reflect the new content included and to highlight a particular approach to teaching. Some specific examples of possible changes are outlined below.

Chapter One

Energy: Consumption and Pollution

	Topic	Suggestions
1.1	Energy	Diagrams, tables and graphs which show energy consumption by people.
1.2	Environmental problems caused by mining	Photographs showing mining, strip mining and underground mining.
1.3	Energy consumption and pollution	Photographs and diagrams or tables which show pollution of air and water.
1.4	Energy from plant and animal wastes	Photographs of biogas projects and diagrams of illustrative principles.
1.5	Use of solar energy	Diagrams and photographs showing various devices for which solar energy may be used.

1.6	Other renewable sources of energy	Photographs of hydro electric projects, geothermal energy trapping, tidal and wind energy.
1.7	Energy conservation	Tables of the energy requirements of transport systems, pumps, and industrial energy consumption.
1.8	Electricity	Diagrams and charts showing uses of electricity, wiring, household safety, etc.
1.9	Thermal pollution	Diagrams and case studies showing thermal pollution.
1.10	A case history	How to conserve energy at home.
1.11	Experiments wherever required	Varies with grade level.
1.12	Problems	Theoretical problems to be solved in respect to 1.1 to 1.9.
1.13	Suggested reading (A compilation of easily available related literature)	Varies with grade level.

The textbook should be made as region specific as possible. Language in the text may require careful attention, keeping in mind the language abilities of elementary and secondary school teachers and also the pupils they would eventually be teaching.

Modules

Much textual material on EE subjects may have to be written in modular form. The size of the module will vary depending on content and depth of coverage. Formats may also vary to some extent. The following format is suggested as one possibility.

I. Introduction

   A. The scope of the module

   B. The target audience

   C. Prerequisites for implementation of the module

II. Objectives

   A. General objectives

   B. Specific objectives

III. History and Philosophy

A. Early history

B. Recent developments

C. History of the present discipline or problem

D. Philosophy

E. Social implications

F. Tests of knowledge

IV. Subject Matter

A. Title

B. Recent developments

C. Experiments

D. Suggested reading

E. Tests of knowledge

(Subject matter may be provided in a repetitive pattern and contain information, charts, diagrams, tables etc. besides the written presentation).

V. To the teacher/supervisor

VI. Appendices

Teacher's Guide

A teacher guide could be independent of a textbook and self contained, or written to explain each chapter of the textbook. For the former type the following layout may be used.

Chapter Ten

I. Introduction

II. Major concepts

III. Content and its presentation

A. Structure of the ecosystem

B. Functional aspects of an ecosystem

C. Classification of ecosystems

D. Biosphere

E. Balance in nature

F. Conservation of nature

G. Activities

H. List of national parks/sanctuaries

IV. References

A. Books

B. Films, videotapes

C. Filmstrips

D. Computer software

Another format for the teacher guide which aims at explaining how to teach a chapter in the textbook might have the following elements.

Chapter 32

Pollution

1) Overview

2) Learning outcomes

2.1 Key terms

2.2 Major ideas and explanatory notes

2.3 Activities

2.4 Relevance to daily life

3) Evaluation

4) Reference materials

Evaluation Items

Evaluation items would be required for formative as well as summative evaluation of the trainees. It is important that these items contain guidelines to test the various domains, cognitive, affective and psychomotor.In the domain of cognition, various levels should also be tested and test items will have to be developed carefully. These items can be of various types for example, true or false, fill in the blanks, terminology, multiple choice, master key, short answer or essay to name a few. An explanation of the details involved in each type is beyond the scope of this section. During the process of instructional material development, the experts may concentrate on these aspects and provide training for the personnel.

Other Materials

A variety of nonprint materials may also be produced including supportive kits and kit guides, charts, panels, audio cassettes, audiovisual cassettes, tape slides and computer software. Because these are nonprint items, their format could not easily be described in the present print form. However, a variety should be kept handy as exemplars at the various levels of curriculum development outlined earlier.

Trial Preparation and Production

The developed materials will have to be tested in selected institutions under conditions similar to those in which they will be used. This may be done under the overall supervision of the CDCs at the teacher training institution level. Each CDC will adopt a given number of preservice teacher training institutions, either elementary or secondary, with the number corresponding to its own sphere of work.

The Scale of Production

The number of copies needed for trials will depend upon the number of institutions to be used. In any case, since most of the literature would be region specific the number of copies to be printed may be only on the order of a few hundred. However, for those materials which may have state/region wide applicability several thousand copies may be needed. This will also depend upon the number of years the trials will last.

Since teacher training institutions may not be adequately provided with technical or managerial skills for the production of these materials, the production work may be conducted at the state/region level. A models infrastructure may be created at each R/S CDC for this purpose. Many of the materials, which are produced in smaller numbers, may be processed on a word processor or a photosetting machine. For a larger number of volumes, a regular printing may have to be assigned to large commercial or state owned presses. It may not be desirable to provide technical details on the matter at this stage since these will be subject to a great deal of variation from country to country.

Data Collection and Processing

A questionnaire, opinionnaire, or a schedule for responses by teacher/trainers or trainees placed in each volume of the instructional material in the form of perforated pages might be useful for data collection. Clear instructions for completing the forms should also be included.

However, the CDC personnel may have to move from institution to guide the respondents in filling up these forms. Besides these evaluations, there may also be a need to conduct sample checks of the returns. This may be done through visits to certain institutions for sample checking. Visits of CDC personnel to project institutions may further be necessary to conduct interviews of teachers and trainees on certain aspects to determine their views on the materials under trial.

The data collected through the above mechanism would have to be processed in consultation with experts in the field of data processing with final interpretations being produced in a form that could be used for revision of the materials by the CDC or R/S CDC before final production of materials.

Nonprint Materials

Software for radio, television and audiovisual cassettes may be prepared in limited numbers. These can be tested with responses being personally collected for quick corrections. Their final production may therefore take a much shorter time. The volume of production will depend on the number of institutions, the mechanism for circulation, the hardware available and other factors. Very often the production of these materials may not be possible at the CDC or at the teacher training institution level, and therefore, the R/S CDC needs to have adequate facilities for this purpose.

Agencies Involved in Implementation

The foregoing account presents details in regard to the agencies involved in EE curriculum development for teacher training, the mechanism of development and other related aspects. It is based on a plan with a three tier system operating at the national, regional/state and teacher training institution level. The account that follows aims at proposing various alternative mechanisms for preservice teacher training in environmental education.

Existing Institutions through Existing Programs with Some Modifications

While the incorporation of environmental education in schools is now widely accepted, the preservice training of teachers in EE is a rather new concept for which proper methods and institutional arrangements are almost nonexistent in most countries. In such situations the path of least resistance would be to partially modify the existing curricula, either by adding optional units or by slightly reorganizing the time allocation for the various disciplines so as to accommodate concepts in environmental education. No major structural modifications in the system of teacher training may be called for.

Existing Institutions to Offer New Programs

If this alternative is accepted, the institutional arrangements for teacher training at both elementary and secondary levels may be left more or less unaltered with the addition of a new environmentalized course of teacher training being introduced as a new alternative program on a limited scale. Phased expansion, with a goal of eventually replacing the old programs over a period of five years or so would be expected. This strategy would involve the teaching of new parallel courses, whose acceptance would determine future events.

New Chain of Teacher Training Institutions

An expensive mode of teacher training would be the establishment of a completely new chain of institutions which offer a new curriculum of environmental education or an environmentalized curriculum. These institutions could be limited in number to try out the newly developed curricula, but once the curriculum has been tested by these institutions and it has become generally accepted, then both the new and old will be done away with. While initially requiring higher investment, their later integration with older institutions will justify the initial expenditure. In many developing countries the number of teacher training institutions already is increasing and the extra cost so incurred may be more apparent than real. However, initial trials through a new set of institutions would be more rewarding since the new courses would be spared from becoming the victims of conservatism in the existing system which may greatly damage a fair trial and objective acceptance by the system.

Vocational Courses to Incorporate New Curricula for Teach Training

In some countries the incorporation of a wide variety of vocational courses at the upper secondary or undergraduate levels of education is an emerging trend. These courses aim at developing entry level competencies and desired proficiency in a wide variety of trades. Various approaches to curriculum are in existence but they all allow for the testing of innovative content and methodologies. In India, an elementary school teacher can be prepared through vocational courses offered at the higher secondary stage of education since 10 years of schooling is the only required level of general education for teaching in primary grades. However, in other countries where a degree is needed for teaching in elementary and secondary schools, similar vocational courses at the degree level may be considered. The courses could be offered in any existing higher secondary/degree level institution providing their graduates are granted professional recognition by the employing agencies. The strategy of combining the environmentalization of various dimensions of teacher training with vocationalization of education has the potential of being a low cost alternative to the other mechanisms proposed above. A few salient features of the vocationalization approach merit consideration.

In regard to curriculum, the design of a course as a vocational option will allow for language proficiency and a base in certain areas of general education provided through only about 20-25% of the total curricular time. This leaves the rest, 75-80%, for theory and practice in the new course. In a two year program the latter may occupy 100-1600 hours. Such a program of study would allow the individual to go into the teaching profession or into a degree program immediately upon completion of this course of study. It would also enable the student to go for vertical educational mobility and professional advancement even after a lapse of some years in a teaching career. Such an opportunity may not be available through other existing conventional teacher/training programs at the elementary stage. A professional program as offered now may, in many instances, be a dead end.

Another advantage to the philosophy of vocationalization involves the importance of using high level expertise on a part time basis. For multidisciplinary teaching of an environmentalized program a great deal of new expertise may be infused into the system through such a provision. This would have a marked effect on the improvement of preservice teacher training in an environmentalized pattern.

The Coexistence of Various Mechanisms

It may be suggested that none of the various mechanisms suggested above may operate in isolation or at the exclusion of others. As a matter of fact, all strategies given may be tested concurrently so as to gather enough data to make a final selection of one or the other system.

APPENDIX I

An Outline for Preservice Teacher Training Courses in EE at Elementary and Secondary Stages

The major components of a Preservice teacher training course in EE for both primary and secondary levels should include instruction in general education (content), foundation education (theories of child development, and transfer of learning), teaching methodology, evaluation, and curriculum (the processes and mechanisms of curriculum development). A general outline of the material to be included under each of these headings is included in the text which follows. The information is separated into two sections, one for the primary stage and one for the secondary stage.

Primary Level

I. General Education

A course in general education should include the following components.

A. The history of EE, its origin and development.

B. Goals, objectives and guidelines in EE.

C. Essential knowledge about the environment and its problems including:

1. A definition of the environment; a general idea of the environment as an expanding the environment; rotation and revolution of the earth; seasons; weather and climate; matter; interdependence of plants, man, and animals; natural resources; renewable and nonrenewable resources; human population and its special characteristics and needs; the influenced by local and global environments. Some material in this section may be taught in other courses of specific content, for example, physical components of the environment may be taught in a geology class.

2.Problems in the environment; man as a shaper of the environment; resource depletion and degradation of the environment; problems of population, nutrition, health, human habitation and shelter; fuel and energy for use in agriculture and industry; and investigation of local environmental problems.

3. The rights and responsibilities of all for both essential needs and good quality of life for all; maintenance of the environment for all.

4.Action for solution of environmental problems, such as: the idea of conservation and judicious use of resources; reasonable use of drinking and irrigation water; controls on soil erosion; and conservation of minerals and wildlife.

5.General ideas about the solution of global environmental problems; the mode of community involvement in finding solutions for local environmental problems and initiation of suitable individual and societal actions.

II. Foundation Education

A. Historical development of learning theories

B. Opposing views and basic premises , i.e., preformationist, predeterministic, interactionist and environmental positions. J.J. Rousseau and his influence on the development of theories of learning. John Dewey and his views on educational methodology, and the idea of "learning by doing".

C. Current theories and their basic premises. Introduction to the work of Jean Piaget; views of Jerome Bruner on the spiral curriculum; implications of these theorists on EE methodology; content organization and distribution among different grade levels; Ivan Pavlov and modern behaviorism (classical conditioning); operant conditioning; implications of behaviorism in classroom teaching; stimulus response and reinforcement.

III. Teaching Methods and Strategies

Commonly used teaching methods and strategies (lecture, demonstration, investigation, surveys, project case studies, field work) with special emphasis on the practical exploration of the immediate environment and experiences of the child. Teaching aids should also be investigated.

IV. Evaluation

Definition; needs; special requirements of evaluation under EE; types of evaluation; mode of evaluation; evaluation tools; designing a scheme of evaluation.

V. Curriculum Development

Definition of curriculum; process and essential elements of curriculum; mechanism of development with special reference to the role of the agencies involved in development and evaluation of EE. Curriculum approach and EE content infusion in different school subjects.

Secondary Level

Since future teachers join the training programme after graduation and are expected to teach higher level classes with children of a greater maturity, it is important that here more emphasis is laid on the knowledge of basic concepts related to the following: the environment and its problems; basic skills of investigation; issue investigation; the problem solving approach; development of attitudes; and values and decision making abilities.

I. General Education

A. The history of EE, its origins and development.

B. Goals , objectives and guidelines in EE.

C. Essential knowledge about the environment, both global and local.

1. A brief outline of the solar system.

2.The earth as a system of matter and energy; day and night, change of season, weather, and climate; tides; the earth s an open system for energy; matter as finite; earth as the

environment for life; origin and nature of life; biosphere; flow of energy on the earth; cycles of matter; structure and function of the ecosystem (both biotic and abiotic components); flow of energy and transfer of matter through food; man as an organism within the living environment; the uniqueness of man as a species; modern man with conceptual thinking, tool making ability and language; man as social being; human population dynamics; human habitats, urban and rural; man and the ecosystem; man and agriculture; man and industry; man made environments; man's relationship to other organisms; resources, and their role; problems of resource depletion from industrial effluents and agrochemicals; deforestation, soil erosion, problems of poverty; and basic human needs.

3.Environmental ethics; individual and social responsibilities of maintaining the quality of the environment; value clarification related to environmental and economic development; the rights and responsibilities of all for assuring the essential human needs and good quality of life for all; the right to life for all organisms.

4.Environmental action; conservation and judicious use of resources; increased use of renewable resources; reduction of all sources of pollution in the environment; planting of trees and afforestation; control of soil erosion; modification of agricultural and industrial practices to prevent and control environmental degradation; regulation of wastes; control of lavish lifestyles and over consumption; and the probable involvement of the community in environmental action.

II. Foundation Education

Detailed study of the development of learning theories; social and biological implications of these theories; the shades of differences between preformationists, predeterminists, interactionists and environmentalists; J.J. Rousseau and his views on the innate potentialities of the child; John Dewey and his influence on contemporary educational methodology. Current theoretical positions; cognitivist theory and its variations. Jean Piaget's theory of cognitive development; Piagetian stages of development and characteristics child behavior at each stage; implications of Piaget's work in term of EE on both content and method. Jerome Bruner's ideas on cognition and his theory of the spiral curriculum. Hierarchy of knowledge in Gagne's terms; similarities and dissimilarities between Piaget and Gagne. Behaviorism; Ivan Pavlov's work on classical conditioning and operant conditioning; implications of the behaviorists approach to EE.

Trainees may be assigned one or more of the following tasks:

Specific tasks in designing lesson plans for a particular grade level keeping in mind the expected operational level of children at those grade levels.

Specific tasks in designing lessons for selected EE concepts for ascending grade levels following the idea of the spiral curriculum according to Bruner.

Responsibility for analysis of a given task related to EE and determination of the hierarchy of tasks involved under the final task.

III. Teaching Methods and Strategies

Various teaching methods; lecture; demonstration, field studies, project work, survey. case studies, methods and strategies which help in developing affective and psychomotor abilities. Experimental investigation, simulation methods, value clarifying strategies for controversial environmental issues; issue investigation and evaluation. The above strategies should stress

citizenship and make use of the following teaching aids; overhead projectors, slide projectors, computers, stamps, magazines, and newspapers.

IV. Evaluation

Definition, need, and special requirements for evaluation in EE; types of evaluation ; modes of evaluation; evaluation tools; designing of different tools; preparation of behavior tally sheets, check lists, and rating scale charts; design of evaluation schemes based on identified instructional objectives in behavioral terms both for formative and summative evaluation.

V. Curriculum Development

Definition of curriculum; process of development of curriculum and essential elements of a curriculum; mechanism of development with special reference to the role of the various agencies involved; development, implementation and evaluation of an EE curriculum approach and EE content infusion in different school subjects.

APPENDIX II

Suggested Activities

A number of activities are suggested below which may be included in teacher training programs depending upon the nature of the course and its requirements. As such, the activities suggested for the primary school teacher training would differ from those of the secondary school teacher training programs. These activities would enable the teacher-pupils to develop necessary EE competencies.

A. Suggested Activities for a Primary School Teacher Training Program

1) Make a map of school surroundings and show the features of the area. Mark the direction, legend, and approximate scale on the map.

2) Identify features on the map drawn, and classify them as natural or man made.

3) Examine the diversity of plant forms at the school with reference to the following characteristics:

   -- the shape of the tree--height, branch pattern

   -- habits of growth--tree, shrub, climber

   -- other characteristics--flowering, medicinal or any other characteristic.

4) Examine the diversity of animal life at the school and classify them. Make sketches or take photographs of the animal life and properly label them.

5) Investigate the dietary habits of people in the area. Include information regarding the consumption of cereals, vegetables, poultry and meat products, milk and milk products, cooking oil, and also identify the methods used for cooking each food. With the help of an expert, make a list of food items from this list which could produce a balanced diet. Be sure to give necessary amounts of food and supplement the list with any items which have been omitted. The exercise may be done with different age groups.

6) Answer the following questions regarding the water supply in your locality. What sources of drinking water are available in your area? Is the water safe for drinking? What efforts are made to purify the water to make it safe for drinking? If water is found not to be safe for drinking, what authorities should be approached to take proper action?

7) Examine the different kinds of buildings in the area. Classify these buildings according to the materials used in their construction and the sources of their supply.

8) Visit a market place and observe the kind of activities which take place there. Investigate the market and make an inventory of the different kinds of products being sold there. Classify them based on their place of production, (local or import).

Which products are imported and why? Try to develop a food chain using the items consumed, producers of these items, and consumers.

9) Study the local newspaper carefully for a month and cut out news items which are related to environmental issues and problems. Classify them on the basis of impact, (i.e. local, regional, national and global). In each group, what kind of environmental issues and problems predominate? Do environmental problems from your area get coverage in the local daily? If so, find out what efforts are being made to solve these problems and as an individual determine what you can do to help. If not, take an initiative to direct the attention of local authorities towards these local problems by writing to local newspapers.

Similarly, more activities in this pattern can be created on environmentally related topics, such as, fuel, method of transport, crop care, animal husbandry, diseases, ecosystems (lake, ponds, river, forest), air pollution, noise pollution and others. Activities on environmental topics, if planned with identified instructional objectives in mind would help to promote EE.

B. Activities for Secondary School Teacher Training Programs

The suggested activities are only examples to help preservice trainees make learning in environmental education more meaningful. This would help them in the design of other activities suited to the local needs and abilities of students. Mainly three kinds of activities have been suggested, question and answer sessions, class discussion and project work.

Question and Answer Sessions

Suitable questions may be framed to clarify the basic concepts and issues involved in environmental education for example, questions related to the need for and basis of environmental education; essential knowledge about the environment; and the causes and nature of environmental problems and their solutions. These would help preservice teachers assess their own understanding in these areas and develop an insight for investigation of environmental issues.

Sample Questions

1) Why was the Intergovernmental conference on the human environment called in Stockholm in 1972?

2) What are the main features of environmental education?

3) Compare the definition of environmental education as given by IUCN with the major goals of environmental education as specified in the Tbilisi Conference and describe how they are similar and different.

4) In what respects does the teaching of different science and social science subjects help in the realization of EE objectives.

5) Select any invention of science or technology which has influenced modern life. What are the benefits to society from this invention? What kinds of environmental problems are associated with this development?

6) What are the different components of environment?

7) What is an ecosystem? How have man's activities created an imbalance in this system?

8) Explain the action of a soapy detergent and how this action is affected by the hardness of water.

9) What is an environmental ethic? Why is it necessary?

10) Do you feel concerned about environmental problems in your locality? How can you contribute to solving these programs?

11) Describe the environmental problems caused by the extensive use of fertilizers.

12) What are the main forms of wastes? Discuss the methods used for waste disposal.

Class Discussions

This area includes group discussions or debate in class followed with discussion by the entire class.

Sample discussions

1) Take any news item, real or fictional, related to an environmental issue and organize a class discussion examining the various aspects of that specific issue or problem.

2) Scientific and technological developments and their effect on society may be a useful topic to elaborate upon the ways in which science and technology interact and influence society.

3) Any environmental problems of a local nature may be taken up by the class. In small groups, as many solutions as possible could be examined and with the help of the class teacher, the class may determine all possible consequences to each solution and then choose the one which seems to be most desirable ecologically as well as to society as a whole.

4) The class of preservice teachers discuss the role of science teachers in EE, or the role of science teachers in encouraging social action and being personally involved in various types of social action.

Examples of Project Work

1) A project may be undertaken by the class to gather information regarding natural resources in a neighborhood and the ways they are exploited. Suitable questionnaires should be prepared before an actual survey is conducted. On the basis of the gathered information, a report may be prepared, including photographs and diagrams to illustrate the facts. Appropriate strategies to solve the problems found may also be developed.

2) A developed area of the neighborhood may be surveyed. Information could be collected regarding types of buildings according to their use, materials used in construction, present condition of buildings with regard to their maintenance, causes for the

deterioration (if it has occurred), and the attitudes of people towards maintaining cleanliness in common areas of the building like staircases and boundary walls.

3) A project may be undertaken by the class on consumption in the locality. Information may be collected on different sources of energy, amount of consumption by each family,size of the family, cooking methods used, various other uses of energy in the household, attitude of people in homes towards the energy crisis, and non conventional sources of energy. A report may be prepared based on an analysis of the survey sheets and suggestions for energy conservation should also be provided.

4) Projects, surveys or case studies on the following topics would also be useful: (i) Energy sources; (ii) energy consumption rates; (iii) energy flow through an ecosystem (energy pyramids); (iv) food chains and food webs in specific local ecosystems; (v) population studies of plant and animal species in different ecosystems like ponds, grasslands, forests and gardens, (vi) lists of endangered species; (vii) human population dynamics; (viii) land use management; (ix) water resource management; (x) crop specific agricultural practices; (xi) animal products like honey, silk, milk and poultry; and (xii) study of local industries, their raw materials, products, and pollutants.

Although in many cases the environmental issues and problems to be investigated may be the same for both primary and secondary stages, the depth of study would increase at the secondary stage.

APPENDIX III

A Checklist of Priority Requirements, National Actions and International Action, Taken from the World Conservation Strategy

PRIORITY REQUIREMENTS

1) Reservation of prime quality cropland for crops .

2) Adoption of management practices to maintain the productivity of cropland grazing land and forests.

3) Prevention of soil degradation, and restoration of land where soils are already degraded.

4) Protection of watersheds, especially upper catchment areas.

5) Maintenance of support systems of fisheries.

6) Control of pollution.

7) Prevention of species extinctions.

8) Preservation of as many varieties as possible of domesticated and other economic or useful plants, animals and microorganisms and their wild relatives.

9) Establishment of a comprehensive network of protected areas, securing the habitats of threatened, unique and other important species, securing unique ecosystems, and representative samples of ecosystem types.

10) Regulation of living resource utilization so that it is sustainable.

11) Reduction of incidental take.

12) Habitat maintenance of utilized species.

13) Careful allocation and management of timber concessions.

PRIORITY NATIONAL ACTIONS

1) Preparation and implementation of national and/or subnational conservation strategies.

2) Adoption of anticipatory environmental policies.

3) Adoption of a cross-sectional conservation policy.

4) Inclusion of non-monetary indicators of conservation performance in national accounting systems.

5) Preparation of ecosystem evaluations.

6) Advance assessment of likely environmental effects for all major actions.

7) Adoption of a procedure for allocating land and water uses based on ecosystem evaluation and environmental assessment.

8) A review and strengthening of legislation concerning living resources to ensure that it provides sufficiently for conservation, with particular attention to enforcement.

9) A review and improvement of the status, organization, funding and staffing for agencies with responsibilities to living resources.

10) Establishment of new organizations or special measures to coordinate existing ones for the comprehensive management of marine living resources.

11) A review and strengthening of training facilities at professional, technician and user levels.

12) Increased research to improve the management of living resources.

13) Greater public participation in decisions concerning living resources.

14) Environmental education campaigns and programs, particularly for users of living resources, legislators and decision makers, school-children and students.

15) Rural development combining short term measures to ensure human survival with long term measures to safeguard the resource base and improve the quality of life.

PRIORITY INTERNATIONAL ACTIONS

1) A review of the coverage and effectiveness of international law relevant to living resources, and the development of new laws to remedy any deficiencies.

2) Implementation of international conservation conventions.

3) Multilateral and bilateral assistance for reforestation, the restoration of degraded environments, and the protection of the support systems of fisheries and of genetic resources.

4) Multilateral and bilateral assistance for the design and implementation of ecologically appropriate policies and the establishment and maintenance of effective conservation procedures, laws and organizations.

5) Cooperative programs for the conservation of tropical forests.

6) Cooperative programs for conservation of drylands.

7) A cooperative program for the on site protection of the wild relatives of economic or useful species, of threatened species, and of ecosystems of exceptional diversity.

8) Conservation of the species and ecosystems of the open ocean.

9) Implementation of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, of the Convention on the Regulation of Long-range Transboundary Air Pollution, and of analogous regional conventions.

10) Control of deep sea mining.

11) Support for the World Climate Program.

12) Conservation of the living resources of Antarctica and the Southern Ocean.

13) Regional strategies for the conservation of the living resources of international river basins.

14) Regional strategies for the conservation of the living resources of international seas.

Appendix IV

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