

Towards Incorporating Major Environmental Concepts into Science Education in South Asia

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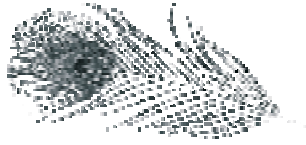
CEE

Center for Environment Education

Occasional Paper Series

This Series is an attempt to present the thinking behind, experiences of and learnings from CEE's programmes and projects. The papers in this Series also mark important milestones in the developments in the field of Environmental Education (EE) and Education for Sustainable Development (ESD).

The papers in this Series were written and presented by colleagues at various seminars, conferences, publications, etc. The papers are reprinted in the same format in which they were presented. Thus, they represent the context and thinking of the time when they were written or presented.



Towards Incorporating Major Environmental Concepts into Science Education in South Asia

The South Asian Region: An Overview

The 20th century is said to have been an extraordinarily eventful century. The world during this period has seen spectacular political, social, cultural, economic, scientific and technological progress. One of the challenges of this period has been the growing need to find ways of improving the prosperity and well-being of people, without compromising the environment.

This challenge is as serious in the South Asian region, maybe even more than in other parts of the world. The South Asian region covers almost one twentieth of the earth's surface, has about 5.4 per cent of the total land area, 16 per cent of agricultural land, and 3.2 per cent of forested areas, which amounts to about 131.184 million hectares. Over 30 per cent of human-kind inhabits South Asia. The economies of this region have witnessed improved growth rates in the recent years. Despite this, poverty persists. The countries of the region are among the richest in terms of biodiversity and in terms of traditions and practices that have a strong basis of conservation and wise resource use. Yet, the region is today faced with acute and serious environmental

problems. Industrial growth in the region has taken place at the cost of environment and the challenges to sustainable development are staggering in number, scale and complexity.

Sustainable Development: The Role of Education

Sustainable Development (SD) is a process of change in which the exploitation of resources, direction of investment, orientation of technical development and institutional change are made consistent with future as well as present social and economic needs.

The goal of SD is so enormous, complex and complicated that it requires strategic interventions at various levels and in various sectors of society. An effective strategy for achieving sustainable development would need to have several components—political will; comprehensive legislation; public participation; access to technology, finances, and education; and research processes and experimentation. Education is one of these many tools and has been recognized as an indispensable part of SD strategies.

"The challenge for South Asia region today is to travel the vast distance between its performance and its promise. On the one hand it has emerged as the poorest, the most illiterate...region in the world. On the other, it has all the potential to become the most dynamic region in the twenty first century if there is massive investment in Human Development."—Human Development in South Asia, 1998

One of the implicit implications of the above statement is that the region would have to make a good amount of investment in the education sector. Human Development in South Asia, 1998 further mentions that if the above goal is to be achieved then one of the important components in the proposed investment plan would need to be basic education for all. This opens a great opportunity for imparting environmental education through the school system.

Chapter 36 of Agenda 21 reaffirms this. It states that: "Education, including formal education, public awareness and training should

be recognized as a process by which human beings and societies can reach their fullest potential."

Thus it has been recognized the world over, by a number of countries and communities, that education has an important role to play in the conservation of environment and realization of sustainable development.

While education is described as a process of bringing about a desirable change in attitude and behaviour, Environmental Education (EE) is recognized as the process that would help individuals to acquire essential knowledge and skills to take positive action towards a better environment. Thus 'Action' distinguishes environmental education from the conventional concept of education.

Environmental Education is a process aimed at developing a world population that is aware of and concerned about the total environment and its associated problems and which has the knowledge, attitudes, commitments and skills to work individually and collectively towards the solution of current problems and prevention of new ones.

This need for environmental education has been explicitly recognized by government policies of the countries of the South Asian region and, in many cases, policy directives exist for the incorporation of EE into mainstream education. Many countries in the region have already initiated the process of re-orienting formal education to meet the needs of a sustainable future.

The objectives of EE established at the Tbilisi Conference (1977) are to develop the following qualities in individuals and social groups:

- An AWARENESS of the environment and its problems;
- Basic KNOWLEDGE and understanding of the environment and its inter-relationship with man;
- Social VALUES and ATTITUDES which are in harmony with environmental quality;

- SKILLS to solve environmental problems;
- A sense of responsibility and urgency towards environment so as to ensure appropriate ACTIONS to solve environmental problems.
- Consider environment in its totality;

If environmental education is to achieve the above objectives, it should:

- Be a continuous life long process;
- Have an interdisciplinary approach—drawing on the specific content of each discipline—with a holistic perspective;
- Examine major environmental issues from local, national, regional and international points of view, so that students receive an insight into environmental conditions in other geographical areas;
- Enable learners to have a role in planning their learning experiences and provide an opportunity for making decisions and accepting their consequences;
- Utilize diverse learning environments and a broad array of educational approaches to teaching/learning about and from the environment;
- Begin early beginning at the pre-school level and continuing through all formal and non-formal stages.

Based on the above understanding of EE, the following section looks at major opportunities and some limitations towards incorporating environmental concepts into science education.

Incorporating Major Environmental Concepts into Science Education: Opportunities and Constraints

Science underlies the process of understanding nature and natural phenomena. There exist great opportunities for incorporating and dealing such concepts through science. Both science and environment demand active teaching-learning methodologies. Some of the commonly used terms—learning-by-doing, outdoor teaching, experimental learning, data analysis, etc.—are very

closely associated with the two subjects. Similarly both the disciplines help students develop skills of observation, enquiry, analyzing, experimenting, and collecting and interpreting data, etc. Thus, there emerge several synergies that call for a special effort to infuse and integrate environmental concepts in science education.

However, it must be recognized that both environment as well as sustainable development go beyond the scope of the discipline of science. Thus, when we say incorporating major environmental concepts into science education, we refer only to a part of environmental education and that the ultimate aim of environmental education would be achieved only when relevant linkages to other sections and disciplines—political, economic, social, geographical etc.—are appropriately highlighted and emphasized. Though this is not a limitation to integration and infusion of environmental concepts into science stream, it is only a point that an educator must bear in the mind.

Some of the possible constraints to this infusion effort could be that while in lower levels, this approach would work more or less satisfactorily, but in upper grades there exists a lot of pressure in terms of overloaded curriculum, score based evaluation systems etc. and thus successful infusion could be hindered; at higher secondary level, the reach of such a programme could come down because the number of students in the science stream is generally low; the general perception of science education and environmental education being resource demanding could also be a barrier.

Incorporating Environmental Concepts into Science Education: Some Learnings

At formal level, all countries in the region have incorporated environmental concepts into school curriculum, generally as an area of study at the lower levels—environmental studies—and through the infusion approach at the upper-primary or middle school levels. It is the latter level, which is of relevance to our discussion. The following section briefly discusses some of CEE's projects that aimed at a similar outcome.

The Centre for Environment Education (CEE), a national institution, was established in the year 1984 as a Centre of Excellence in EE supported by the Ministry of Environment and Forests, Government of India. CEE's primary objective is improve public awareness and understanding of environmental issues with a view to promote the conservation and wise use of nature and natural resources. To this end, CEE not only creates expertise in the field of environmental education but also develops innovative programmes and educational materials, testing them for validity and effectiveness.

Recognizing that environmental education has to begin early, CEE develops, coordinates and conducts a number of educational programmes for school children. All such initiatives of the Centre are integrated into an umbrella programme called the National Environmental Education Programmes for Schools. CEE's thinking with regard to EE in schools can be briefly summarized as the following points:

The school is an institutional framework within which continuous interaction takes place between teachers, students and the curriculum. For meaningful learning to take place, this interaction needs to be optimized;

A four-pronged strategy would be required to strengthen EE in the school system. The four components of the strategy are strengthening of infusion of environmental concepts into the school curricula, introduction of environment as a separate subject, teacher training and the use of non-formal methods in EE. Efforts towards all four need to complement each other.

It would be required to use a variety of teaching methodologies, with special emphasis on active approaches, to effectively bring in the environmental dimension into the existing subjects;

Teacher is the key to reach out to children. The teacher faces a continual challenge--she is very busy, has to meet deadlines, and quite frequently attend to several non-teaching duties too. It is thus necessary that EE does not add to teacher's burden. It should instead

support and promote teacher's creativity by providing appropriate training, an enabling environment and reference educational material and ideas.

Based on the above thinking and considerations, most school-based programmes and material developed by CEE ensure that they are designed flexibly to permit suitable adaptation for use across the country and abroad.

Given the diversity—ecological, cultural, economic—of the country and the region, any programme aimed at developing uniform educational programmes and material is bound to run into difficulties. And thus the possibility for teachers to be able to adapt an EE programme or material to local situation is critical to its success. This does not mean that education is to be made parochial, but the logic behind this is that environment is best understood through experience in the immediate environment. Thus such references and examples should be made to which a child relates, which the child has observed and which is a part of student's life.

Similarly the resource requirements for a programme should be such that the teacher has access to it. As it is, science education, in general, is perceived to be a resource demanding one. This is true for many scientific concepts. But this perception has become so strong that sometimes very obvious and easily available options to complex equipments and aids do not get recognized and used. We must not forget that the while accuracy is one of the components of science education, when it comes to teaching environment through science, the primary aim shifts to teaching practical skills, problem solving ability and developing a sense of appreciation and responsibility to the environment.

The question of using immediate environment as a teaching medium also brings us to the point of relating environmental concepts to real life situation. Both the subject environment, as well as science, has several applications in real life situation. Thus even while being taught within the four walls of a laboratory or a classroom, it is important that necessary linkages of these concepts to the real life situation are drawn upon. This can be done by citing

examples, having case discussion, field exercises etc.

Finally, environmental education is not about teaching students whether a decision is right or wrong. Rather it is about informing them that any decision or action has a complex cause and effect relationship with numerous other factors. It is about developing among students to think analytically, examine a particular fact from different view-points, understand a phenomenon in a holistic manner and only then make an independent and informed decision. For instance it will be incomplete education to say that dams are bad. An environmental educator should rather discuss this on a case-to-case basis, both the economic as well as environmental cost of a dam, alternatives available, etc.

Some Case Examples

Water Quality Monitoring

Appropriate application of scientific knowledge and experimental techniques learnt in schools and colleges to real life situations would lead to greater awareness and understanding of environmental problems and a more scientific search for solutions. One such possible application is the monitoring of environmental quality.

In 1987 the Ganga Project Directorate asked CEE to develop a programme that would involve science students of secondary and higher secondary schools along the Ganga in monitoring river quality. The aim was to get a group from outside the government system to do work whose results would enhance public awareness about the Ganga Action Plan.

CEE saw this as an opportunity to promote 'learning by doing', bringing students to apply to a real-life situation in their immediate environment the science learnt in the classroom, and to interpret the environmental implications of their findings.

Towards this, CEE developed easy-to-use kits for water quality monitoring and teacher's manual on how to use the kit. CEE implemented the project in 100 schools in three states—Uttar Pradesh,

Bihar and West Bengal—on banks of the river Ganga. The programme was carried out in field conditions by students working under the supervision of teachers, with support from by the school administration.

Later a number of voluntary agencies from different parts of the country expressed interest in taking up water quality monitoring programmes in their areas on the lines of Ganga Pollution Awareness Programme developed by CEE. CEE selectively supported such agencies.

Monitoring the status and dynamics of environment involving educational institutions

The main objective of this programme was to create awareness among college teachers and students about environmental concepts, the status of natural resources and its impact on the quality of life. This was achieved through field studies and planning and management of natural resources at micro-level. Under the programme, students with the help of teachers monitored several environmental parameters through simple scientific techniques and the information thus collected was used in resource planning and management. Methodology manuals were prepared to guide monitoring groups. Based on the needs of the programme 60 teachers were trained in two batches. The training module concentrated on land use, soils and biomass monitoring techniques.

After the teacher training programme, the actual monitoring phase was undertaken for agro-ecosystems and natural ecosystems. Students, under the supervision of trained teachers, generated relevant data on the socio-economic situation, biomass production and utilization, soil conditions and biodiversity in selected areas through field-work.

The action programmes were monitored regularly. Some of the achievements of this project so far are that environmental education has been initiated at the tertiary level, and field manuals on monitoring land-use, soils and biomass have been developed. Status report from 16 ecosystems has been prepared, information analysis through GIS has been attempted, alternative energy technologies have been introduced in 2 agro-ecosystems.

Material Development

CEE, as a center of excellence in EE, implements a number of innovative EE programmes in the country. Recognizing the fact that lack of availability of good quality resource material is one of the major barriers to effective EE, most programmes at the Centre go hand in hand with development of appropriate resource material. Several of CEE's educational materials are aimed at helping educators incorporate environmental concepts into the teaching of their subjects, especially science. Some of these are:

The Green Reader: An introduction to Environmental Concerns and Issues This publication puts together major environment-development concerns to help higher secondary and undergraduate educators reflect them into their subject teaching. Topics covered include Ecology, Biodiversity, Climate Change etc.

NatureScope: Spotlight on Species This series of publications is meant for teachers to provide them with adequate information on various ecological and conservation aspects of that particular species which can be integrated in science education, especially biology. The first publication in the series focuses on Elephants.

Ozone 11 Package: This package has a book for teachers and a poster for children. The package gives basic scientific information and the current status of ozone in the atmosphere.

Enviroscope: Enviroscope is a series of single-topic modules designed to assist educators introducing environmental concepts, issues and perspective to under-graduate students. The modules include Biodiversity, Energy, Sustainable Urban Environment.

Energy Matters: A School Energy Education Guide This energy education manual focuses on energy and environmental concerns. It is meant for school-teachers to communicate science of energy, energy use and its consequences for the environment.

Learnings

The above projects and publications are model prototype projects to show and establish as to how can environmental considerations be incorporated into the teaching of science subject. However, such efforts, if done on ad-hoc basis, would not receive the weightage they deserve. Thus it is needed to formalize such efforts. While most countries in the region have already infused environmental concepts into school curriculum. There is however a need to strengthen these initiatives to realize the goal of EE. Some of the learnings that CEE has gained through experiments like the above and others include:

School System

The school system, especially at the higher secondary level, is oriented almost entirely to examinations and results and has very less space to those activities and projects, which do not match this orientation.

It is important to involve the school administration and keep them informed about the aims and purpose of the project. This helps reduce the administrative problems likely to be faced by such projects.

It would be effective to incorporate only those concepts which are being already dealt at that particular grade or level.

Text-book Analysis

The way environmental concepts are treated in textbooks plays a pivotal role in enabling the teacher to effectively communicate environmental concepts to student. If done in a compartmentalized manner then they would mar the very nature and essence of the subject. It is thus important to understand and identify what is being said through the text-book, how correctly is it said and with what possibility can it teachers contextualize the concepts?

On behalf of the Ministry of Environment and Forests, Government of India, CEE is coordinating a World Bank supported national level project under which school text-books of the various grades are being analyzed to find out what environmental concepts have been covered, how have these been interpreted, are there any gaps etc.

Evaluation

The conventional examination system is designed to test transfer of information. However, neither science nor environment as disciplines, are about transfer of information only. As a result, many teachers, students and parents do not perceive it as a curriculum priority. This, perhaps, is one of the biggest obstacles to EE. It is important to invent mechanisms in which abilities like decision-making, analytical thinking etc. can be evaluated. The website<www.comminit.com> gives information on several such evaluation methodologies, their findings and learnings.

Teacher Training

The key to any change in the formal education system is the teacher. It is therefore important that teachers are oriented to the philosophy with which environmental concepts are infused in the science curriculum and are trained to use appropriate methodologies towards communicating these concepts effectively. Conventionally, our systems do not see any difference between the teaching approaches to social science and science because traditionally school curriculum has emphasized the recall of content as learners' performance indicator. Also many a times, new innovative ways of teaching science and environment might require the teacher to go out of the classroom boundaries for which s/he may not find the school system very conducive to this.

Resources

Availability of good resource material, teaching opportunities and sufficient time are some of the factors that can affect the delivery of EE. Good quality teaching material to which the teacher has easy access and is easy to use, are some of the important pre-requisite for effective EE to take place.

What makes a resource material a good resource material is a question that needs to be answered by keeping the general school scenario in mind. For example in the water quality monitoring projects, complicated tests like Biological Oxygen Demand, Chemical Oxygen Demand etc. were avoided as these needed sophisticated equipments. Similarly while writing an activity to teach a

concept, it must be borne in mind that sometimes enrolment in a class goes to as high as 50-60, in such a situation it is obvious that the teacher would not use an methodology which would involve 10 students only. Thus it is important to create resources that are adapted to our situation and concerns. The other big question is the question of numbers. In several countries of the region the number of schools run into several thousands, and thus 200-5000 copies may not be sufficient. Also cost of an educational material has to be nominal, otherwise most schools will not be able to afford it.

Incorporating Major Environmental Concepts into Science Education: Role of Regional Cooperation

The South Asian Approach to Environmental Education

In South Asia, three main approaches have been used for the introduction of environmental education into the existing school curricula. These are the infusion, integration and separate subject approach. The infusion approach is more of an ad-hoc arrangement which involves enriching existing units by substituting examples into already existing course materials. This approach is currently finding the most widespread application at all levels of formal education in the region.

The integration approach involves a systematic incorporation of relevant environmental concepts into the syllabi. The curriculum of selected subjects is renovated to allow for the incorporation of new ideas. In the third approach, environmental education is taught as a separate subject.

Present Status

The countries of the region have a lot in common, in terms of history, culture, as well as environment and development programmes and problems. Several regional networks and joint programmes address these issues.

Country	Some Significant Efforts
Bangladesh	Grades 1-2: Environmental Studies offered Grades 3-5: Environmental Studies (Society) and Environmental Studies (Science) offered. Grades 6-10: Infused into General Science and Social Science.
Bhutan	The Education Division has incorporated environmental studies into the National School Programme. The New Approach to Primary Education has been developed using a national curriculum oriented towards observation of nature, conservation and sustainable use of renewable natural resources.
India	The infusion approach has been underway for several years. The University Grants Commission has made it mandatory for all states in the country to incorporate environmental education and training into the curricula of existing diploma courses as well as the new courses at the polytechnic level.
Maldives	EE is stressed in the teacher education curriculum. It is a compulsory unit for primary teachers. Public support for environmental improvement and increasing public awareness about the importance of improving the environment help efforts to strengthen EE in formal education.
Nepal	A separate course titled, 'Health, Population and Environmental Education' for grades 9-10 has been included in the national curriculum. The Faculty of Education in collaboration with IUCN/Nepal has developed courses on environmental education.
Sri Lanka	EE has been recognized in national policy documents including the National Conservation Strategy (1988). EE has been formally introduced as an integral element at primary and secondary levels of school education, while at tertiary level, environmental studies offered as a course in most universities.

Agenda 21 recognizes that no one nation can achieve sustainable living on its own.

"Countries should cooperate with each other to reproduce educational tools that regional environment and development issues and initiatives, using learning materials and resources suited to their own requirements."—Agenda 21

With particular reference to education and educational systems, many more common concerns and problems exist in the region today. Enabling all children to obtain a complete primary education of high quality is the key challenge faced by governments of South Asia. Unfortunately this challenge has been met only partially in the region.

"South Asia faces three interrelated challenges: low enrolment; low completion; and low achievement."—Human Development in South Asia 1998

The school scenario is more or less the same almost all over South Asia. Schools in the region have been unable to provide all school-age children, particularly girls, with the opportunity to attend schools. Secondly wherever students are enrolled, the situation more or less is the same—classrooms are over crowded, enrolment going up to as high as 50-60 in a class, teachers are over worked, accessibility to educational aids and resources is limited.

Thus we are discussing bringing about a change in a system that would require modifications in not just the school system but also in national and regional policies. A change that would demand huge investments—financial, time implications, and capacity building.

National Education system of all countries of the region have considered that it is essential to include important elements of environmental education in their school curricula. Many efforts and experimentation have already have been tried and tested in countries of the region (refer table), however it is the sharing of such experiences that needs to be strengthened to enable this initiative gain a momentum

There are many regional programmes which discuss conservation of mangroves, water bodies, mountain systems, but there are hardly any regional programmes looking at school education. If initiated, such a regional level programme will help us share our experiences and learnings with each other, avoid duplication of efforts and save a lot of time and resource.

Conclusion

Even though environmental concepts are being incorporated into primary, secondary and tertiary education, the approach needs to be more holistic and integrated. While the scope of infusing and integrating environmental concepts into science curriculum in the region is immense, there do exist few grey areas too. The biggest one of all is that there is not adequate documentation of such experiences (specific to science curriculum) in the region to support any call for a major policy level change. It is therefore suggested to put together the various efforts already made so far, study their implications and impacts and then suggest a larger regional level programme. Because while greening science education can ensure ecologically sustenance, the other two pillars of sustainable development—economic soundness and social justice—can only be achieved by an integrated effort of greening formal education on the whole.

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Centre for Environment Education

Centre for Environment Education (CEE) is a national institute established in 1984. It is engaged in developing programmes and material to increase awareness and concern, leading to action, regarding the environment and sustainable development. CEE is a Centre of Excellence supported by the Ministry of Environment and Forests, Government of India. CEE has, over the last two decades, explored the emerging models of development to identify and promote those which are contextually sustainable.

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