Scientific and Technological Literacy for Sustainable Development in the 21st Century

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ABSTRACT

During the past decade an urgent need has been recognised for a world community of scientifically and technologically literate citizens. This is essential in order to sustain the natural environment of the world and to enhance the overall quality of life of its population during the new millennium.

Project 2000+ was initiated in 1993 to promote and guide the implementation of mechanisms for nurturing scientific and technological literacy for all. Its goal was that by the year 2001, structures and activities to foster scientific and technological literacy will be established in all countries, based on a partnership between UNESCO and other major INGOs.

This paper compares various definitions of scientific and technological literacy and describes some of the processes used in attempts to promote and enhance STL on different continents. Materials developed in Nepal are examined in order to illustrate the anticipated link between STL and some of the essential factors in sustainable development.

The nature of short-term and long term research studies to evaluate the efficacy of such teaching/learning materials and the implications for science teacher education are also discussed.

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1. The Global Village

An International Forum on Science and Technology Education for All was held at UNESCO, Paris, in 1993. All the keynote speakers addressing that forum emphasised the interdependence of all the inhabitants of our "global village" and the need for an infusion of scientific and technological culture into society.

At that forum Captain Jacques-Yves Cousteau said : “Isolationism is unacceptable. The world can no longer survive without the help and total commitment of us all. Scientists themselves are absolutely vital to translate highly technical issues to all those who will elect or choose decision-makers. The public needs help. Citizens of the world must understand the consequences of - and the alternatives for - every course of action. But just the factual knowledge is insufficient by itself. There are moral and ethical issues which cannot be ignored.”

The message was clear. Science and technology are here to stay. They must be harnessed for the preservation of our global village and not allowed to become a means of its destruction.

2. Sustainable Development

The history of the human race is the story of human development and our present level of sophisticated scientific knowledge and technological capacity are testimony to that progress.

However the possible consequences of these developments have not always been apparent.

Sustainable development has been defined as :

“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs”; and

“A process of change in which exploitation of resources, the direction of investments, the orientation of technology development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations.”

A concern for conservation of nature and its protection is ingrained in most world cultures and spiritual traditions. Each in its own way, offers a unique set of moral values and norms to guide humanity in its relationship with nature. But nevertheless, people everywhere have always exploited and manipulated natural forces in the name of development with greater intensity than any other living being on earth. In order to achieve a sustainable world, there is perhaps a need for a rapid and constructive change in human behaviour.

Bhatta has argued that sustainable development is both a view point and a course of action- a policy instrument and a global movement. Or it may be considered as a new international order based on enlightened spiritual principles aiming at enhancement of quality of life of the entire cosmos (not just of human beings). It is this change which can bring the proper basis for sustainable development. But the goals of sustainable development can only be achieved by making changes in present educational, political, economic and technological systems.

If sustainable development at global level can only be achieved by making major changes in the management of the planet earth, it will be necessary to evolve a new global psychology

We require a fresh way of thinking about economic change and our society's relationship with nature. We also need a coordinated drive by international environmental organisations to strive for the sustainable development of planet earth. Appropriate technology needs to be developed and implemented to conserve resources, prevent unnecessary pollution and helps to restore environment. The greatest responsibility for saving, safeguarding, protecting and conserving the natural environment rests on human beings everywhere. The environment and development are synergic with human development. Our survival depends on the carrying capacity of the planet and its the life supporting eco-systems.

3. Project 2000+

Most of us would support the recent Dakar Action Plan - a Framework for Education initiative to promote global basic education for all. Some would argue that science and technology education should be a further phase in this process. However, in order to promote sustainable development, basic education and education for scientific and technological literacy should perhaps proceed in parallel. Moreover, basic education itself could be the vehicle for promoting scientific and technological literacy, as defined below.

Project 2000+ was initiated in 1993 to promote and guide the implementation of mechanisms for nurturing scientific and technological literacy for all. Its goal was that by the year 2001, structures and activities to foster scientific and technological literacy will be established in all countries, based on a partnership between UNESCO and other major INGOs. It is a collaborative partnership between eleven major international agencies and inter-governmental organisations (*) with particular concerns and responsibilitiesfor research and development in the field of science and technology education. The Project 2000+ Declaration pointed out that sustainable development is dependent upon a scientific and technologically literate population and called on governments, industry, public and private sector interests to review educational provision. Priority should be given to providing equal access for all boys, girls, men and women to science and technology. It called for continuing provision for teacher education in this field and for tasks forces to be set up to foster scientific and technological literacy for all by developing educational activities designed to set science and its applications in a wider social and cultural environment.

Governments are called to work together to advance the capability of countries for designing, planning and implement programmes to enhance scientific and technological literacy for all. UNESCO is assisting countries to do this by promoting, worldwide :-

(a) understanding of the nature of, and need for, scientific and technological literacy in relation to local culture and values or to national social and economic needs and aspirations;
(b) identification of issues of special importance for personal, local & national development;
(c) establishment of suitable teaching and learning environments and structures;
(d) formulation of guidelines for on-going professional development and leadership;
(e) development of effective communication, assessment and evaluation strategies;
(f) support for non-formal, informal and life-long learning strategies.

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4. Scientific and Technological Literacy

Scientific and technological literacy, in its broadest sense, means much more than simply being able to read, understand and write about science and technology, however important these are. STL also includes the ability to apply scientific and technological concepts and process skills to the life, work and culture of ones own society. It therefore includes attitudes and values enabling one to distinguish between worthwhile or inappropriate uses of science or technology. Hence scientific and technological literacy implies : -

(a) the development of scientific and technological attitudes, approaches and skills which are necessary to cope with a rapidly changing environment and which are useful for problem - solving and decision - making in daily life; (b) an appreciation of the nature of science and technology, and the development of positive attitudes and values relating basic science and technology to other areas of human activity ;

(b) exposure to effective teaching strategies and relevant examples of science and technology (at primary, secondary, tertiary or adult education) either within a formal programme, or through non-formal or distance education methods); and

(d) familiarisation with processes of accessing and communicating science and technology information and willingness to use it to meet personal, local or global requirements.

It follows from the above definition that a person becomes scientifically and technologically literate by some involvement with applications of science or technology which interest them, or are intimately related to their everyday life, or which they perceive as being significant or important to them beyond the requirement of examinations. Attitudes and confidence are usually most effectively developed by significant first hand or contrived experiences.

5. Promotion of STL in the "North"

The Science-Technology-Society (STS) initiatives in North America were some of the early attempts to bring meaningful scientific experiences to a wider population - science for all. These STS programmes were characterised by having .....

- students identify with problems of local or personal interest
- local resource materials and real-life problems
- active involvement by students in seeking solutions to problems
- an emphasis on process skills of use to the students
- opportunities for students to adopt decision-making roles
- a focus on the impact of science and technology on everyday life.

In Britain there were programmes on Integrated Science (SCISP), Science in a Social Context (SISCON), Science in Society, and the ASE's Science and Technology in Society (SATIS). The latter developed curriculum modules with a strong sociological emphasis , often involving students in decision-making, role-play, simulation activities. SATIS has now

produced a considerable bank of units, suitable for various stages, which link major science topics to important social and technological applications. Each unit contains students materials and teachers' notes, written by authors from schools, universities, industry and many professions.

6. Promotion of STL in the "South"

ICASE and UNESCO have been in the fore-front of the development of materials for the promotion of scientific and technological literacy in the developing world. STL workshops have now been held in Argentina, Brazil, Estonia, Ghana, India, Nepal, Nigeria, Philippines, Thailand and many other countries of the "South."

The STL units developed in these countries bear the local flavour and characteristics of the effects of science and technology in their own regions, which we can illustrate from Nepal. Nepal is a land locked mountainous developing country, with a population of 22 million and a per capita GNP of $200 (1% of that of a developed country). It is suffering environmental degradation and the effects of global warming, with a rapidly growing population.

The following STL units have been written and are being trialled in Nepal :

	Nepal STL Units	Related developmental issues
1	Allow me to Breathe Comfortably	Atmospheric pollution
2	Improving Kerosene Lamps	Efficient use of fuels
3	Let's Enjoy the Music	Sound pollution
4	Pineapple Shaped Waste Bins	Disposal of solid waste
5	Safe, Clean Drinking Water	Conservation of water resources
6	The Naulogaon Free Sweets Story	Environmental pollution and health
7	What Food Do You Like Best ?	Nutrition and contamination of food
8	Which Fertiliser Shall We Use ?	Productivity and natural fertilisers

7. Schools, STL and Sustainability

"…environmental concerns are relatively unknown among the sizeable populations in the region who remain functionally illiterate..." (Kazi F. Jalal)

An appropriate vehicle to promote sustainable development would be a code of conduct for human behaviour, i.e. an economic, social , technological and administrative system. Education is a key to bring about change in society as it is an effective tool to create awareness and consciousness in people concerning the disastrous effect of ruthless

exploitation in nature. But traditional education about environmental issues may not be effective unless teachers are trained to become change agents capable of bringing about positive attitudes. Illiteracy is a major constraint for environmental education as well as being an obstacle to development. A high level of awareness can be created through formal and non-formal education activities. The methods advocated for scientific and technological literacy provide a vehicle which can promote and provide opportunities for all people to become involved in sustainability.

It is necessary to promote education and awareness among such target groups as students and the local population.. As people's participation is also necessary for sustainable development, it is obvious that the goals of sustainability cannot be achieved by using a "top down" approach. Leadership for environmental protection has been mostly from the middle class, but true sustainable development is dependent upon a scientific and technologically literate population.

8. Evaluation of STL

In order to evaluate STL materials it is necessary to establish if any of the following goals have been achieved among the target population :

- educate children on matters concerning the environment to the extent that upbringing itself will be an example of sustainable development.
- persists to create environmental awareness, insure public participation
- adopt a more sustainable approach to life and transmit this to the family community and particularly the up-coming generation.
- perceives a common future for society
- acts both individually and as a group towards that end
-.realises that individuals have a moral obligation to support towards the common goals of the community.

As far as we know, no instruments have yet been developed precisely for this purpose.

9. Teacher Education for STL

Initiation into methods of promoting scientific and technological literacy for sustainable development are only slowly coming into teacher training courses. The Harare Generator materials developed in Zimbabwe have had a small impact in some African countries, notably Nigeria, Malawi and South Africa. Some recent work for an in-service science teacher extension programme in Namibia has included a teacher education unit about STL. But these are the exception rather than the rule. Much still remains to be done.

10. Research Priorities

In order to see the goals of sustainability achieved it will be necessary to promote monitoring and evaluation of the STL programmes. In the short-term, by designing and conducting limited pilot studies some evidence can be provided about the immediate impact

on the students attitudes and the apparent effectiveness of the materials.

But only long term research studies can give an overall picture of the scene in order to measure the level of achievement (through the vehicle of STL materials) of the objectives directed towards the goals of developmental sustainability. Only then can necessary modification or revision .of the whole programme itself be made. The future implications such as applications to informal and non-formal education, to the different target groups, at different levels can also only be established by suitable trials and evaluation. It is clear that much work remains to be done in this direction and we would urge individuals, institutions and donor agencies to give the matter priority attention.

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