CURRICULA DEVELOPMENT FOR UNDERGRADUATE UNIVERSITY STUDENTS

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Contents

Summary

Today's university students are future politicians, decision-makers, leaders of industry, business managers, and so on. Clearly, therefore, both as future professionals and members of society they must know how human activities for economic development have been degrading the natural environment and life-support systems without which life on earth cannot exist — how man has been and continues to be the greatest enemy of nature. They must also know why, in the interests of both present and future generations, current environment-degrading behavior of human societies must change to one that promotes sustainable development and environmental protection.

There appears to be a growing trend in West European universities, and so presumably in developing country universities too, to include sustainable development as a subject in undergraduate curricula, especially in engineering. This development is, however, less than satisfactory for three main reasons: First, in order to achieve meaningful global

sustainability, the prevailing grossly exploitative human behavior and attitude to the natural environment must be changed to one of *genuine* respect and care. This calls for a radical re-orientation of our moral values *vis-à-vis* the environment. For this we need moral philosophy, not science or technology, however clever. Yet, little or no reference is made in formal curricula to environment-respecting moral values, or how they could be instilled or promoted. Second, sustainable development appears to be taught almost exclusively in terms of what can be done to reduce pollution with science and technology, with emphasis on the so-called "end-of-the-pipe" strategies, whereas what is needed for global sustainability are "before-the-pipe" strategies. And third, arguably sustainable development, including essential moral philosophy, ought to be taught to *all* undergraduate students. It is not at present.

With a view to addressing these deficiencies, a generic undergraduate environmental curriculum is proposed, including essential moral philosophy, and suggestions made for which parts of it ought to be taught to different degree programs. It is argued that, if we are at all serious about achieving even a modest degree of global environmental sustainability, moral philosophy must be given the same emphasis in curricula as soft sciences, hard sciences or technology.

1. Introduction

"The greatest happiness of the thinking man is to have fathomed what can be fathomed, and quietly to revere what is unfathomable."

Johann Wolfgang von Goethe (1749-1832)

1.1. Growing Multi-disciplinary Trend in University Education

In general, undergraduate students at a university or an equivalent institution are characterized by their greater maturity than secondary school pupils, and also by the disciplinary choices they make eventually to qualify as doctors of medicine, engineers, lawyers, economists, and so on. Historically, there have been fairly rigid inter-disciplinary boundaries. However, there has been a growing trend, especially since the 1970s, for multi-disciplinary studies in response to market demand for the same. As a result, in many instances the hitherto rigid inter-disciplinary boundaries are either becoming blurred or disappearing altogether. Consequently, today it is not uncommon to find undergraduate students reading Biology with Management, for example. As a logical consequence of this development, in many countries the growing trend is for university degree courses to be based on what is called the "modular scheme", similar to that which has been and continues to be the norm in North American universities, rather than a prescribed course of mandatory subjects to be taken for a given degree course. The main advantage of the modular scheme is that it offers the individual student considerable flexibility to choose a customized multi-disciplinary program of study by mixing subject modules taken from a wide range of disciplines such as the exact sciences, the social sciences, the arts, and engineering.

However, in the case of a degree course that leads to a particular vocation (e.g. medicine, engineering or law), flexibility of choice is often restricted by the specific requirements of the professional body, organization or institution responsible for

overseeing that vocation. For example, the Institution of Mechanical Engineers in the UK stipulates a number of subjects that must be taken throughout the degree course by all students aspiring to qualify as professional mechanical engineers. The time-constraint imposed by such stipulation can limit students' flexibility to choose subjects (or modules) from other disciplines, even as optional subjects.

Even so, the multi-disciplinary trend is much to be welcomed because environmental studies are (or ought to be) truly multi-disciplinary in character, combining as they do the sciences (exact and social), engineering, and even the humanities. This is a reflection of the fact that the natural environment is a delicately balanced organic "whole" of many different aspects and their mutual and complex interactions that have implications for nature's life support systems, environmental integrity, and quality of life of human societies.

1.2. Need for Environmental Education at the Undergraduate Level

In all societies decision-makers act on behalf of society at large to decide whether or not a certain technology is to be used for economic development, or a certain policy or legislation implemented aiming to bring about a targeted change, benefit or welfare. In democratic societies such decisions are usually made by the ruling political party whose interests (and sometimes ideology or dogma), and the interests of its supporters (vested interest groups), can transcend those of the environment. In such societies the political process is an art of the possible and of compromise — and above all it is about power and how to get it by manipulating public opinion. And so, of necessity it has to focus mainly on bread-and-butter issues to which the public can easily relate, and not on environmental issues and problems that are remote and perceived as little more than inconsequential by the proverbial "man-in-the-street". This is symptomatic of the "ecology versus economy" struggle in which "economy" often triumphs over "ecology", even in the rich developed nations. Consequently, the environment continues to be degraded by human activities for economic development notwithstanding the rich rhetoric of politicians proclaiming their strong commitment to environmental protection and sustainable development.

Decisions affecting both the lives of people and environmental integrity are usually made by politicians whose forte is politics. By training they are predominantly political scientists, lawyers and the like. Seldom are they engineers, technologists or environmentalists by training. Of necessity, therefore, they have to rely on the advice of relevant experts in making decisions that may have environmental implications affecting all. Moreover, there is now increasing emphasis on public consultation and participation in making decisions on projects and activities that can potentially or manifestly impact on human health and/or the environment. In many instances public consultation or participation is no longer an option. It is mandatory and increasingly so. The main purpose of public participation is two-fold: to involve the public in matters and decisions affecting their quality of life; and to make decision-making both inclusive and transparent.

Yet, in spite of expert advice and public participation, declared commitment of the political establishment to environmental protection and sustainable development, and

local, national and international initiatives, the natural environment continues to be degraded at an accelerating pace. (The "natural" environment comprises nature's benediction of air, water, biodiversity, etc. that make life on earth possible). It is indeed a matter of particular concern that degradation of the global environment continues unabated in spite of a plethora of environment protection initiatives, agreements, protocols etc. undertaken since the UN Conference on Human Environment held in Stockholm in 1972 which, for the first time, concentrated the international community's collective mind on the urgent need not to degrade the environment any further. Information given in Box 1, *which is by no means exhaustive*, illustrates this well. Such relentless degradation, and its extrapolation even to the next 30 years, does not augur well for environmental protection let alone global environmental sustainability. Current consensus is that if we are at all serious about achieving a degree of global environmental sustainability, however modest, much greater emphasis than before must be given to environmental education at all levels and to raising environmental awareness. And, as we will demonstrate in Section 4 of *Curricula Development for Graduate Students*, achievement of global environmental sustainability and sustainable development is contingent upon the willingness of the affluent to adopt less consumptive and less polluting life-styles. Clearly therefore, the goal of environmental education must be to curb relentlessly rising production and consumption of goods and services to supply the demands of increasingly profligate and hedonistic life-styles of the affluent (also see Section 3 of *Need for Environmental Research*).

Biodiversity

Animals endangered by the progressive removal of their habitat:

- Gorillas in Nigeria, Cameroon, Congo, Guinea and Rwanda.
- Asian elephants in India, Sri Lanka, Sumatra and Borneo (only 50,000 left).
- Black rhinoceros across Africa.
- Amazon River dolphin (drowning in fishing nets).
- Florida Manatee (only 2,000 left).
- Brown pelican in North, Central and South America.
- Humboldt penguin in Chile and Peru.

Population

- World population has increased from 3.7 billion in 1972 to 6 billion today.
- Current population growth rate is 1.4% (85 million per annum).
- World population is expected to increase by 2 billion in the next 30 years.

Global warming

- Temperatures in the Arctic are up by 0.6^{o}C. Arctic sea ice is down in spring and summer by 10-15% in surface area, and around 40% in thickness.
- Average sea-level has risen by 10-25 cm in the last 100 years, and rising levels are threatening to swamp some Pacific islands.
- Global carbon dioxide (main greenhouse gas) emissions have increased from 4 billion tons a year in the mid seventies to 6.6 billion tons a year at present.
- Europe's Alpine glaciers have shrunk to half their volume in 1850.
- North American glaciers have been shrinking; the state of Montana is expected to lose all its glaciers by 2030.

Water

- Eighty countries, including 40% of the world's population, suffer serious water

shortage

- Half the world's land is degraded by soil erosion.
- Some 1.1 billion people lack access to safe water.
- An estimated 2.4 billion people have no basic sanitation.

Forests

- Sixteen percent (140 million acres or 56 million ha) of Amazon rainforest has been cleared since logging and farming began.
- Since 1972 world's forests have declined by 12%.
- Every second an area of the rainforest equal to the size of a football pitch is being destroyed.

Source: *The Daily Mirror*, London, 24 July 2002.

Box 1: Some key indicators of global environmental degradation

Box 2: Proposal for the "content" element of a generic environmental curriculum for undergraduate students

In Box 3 a proposal is made for which parts of the generic content are to be included in the formal curricula of different undergraduate courses. What is proposed is for guidance only.

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Biographical Sketches

Professor Bhaskar Nath received his Bachelor's degree in Civil Engineering from the Indian Institute of Technology, Kharagpur, India, in 1960, followed by the Ph.D. degree from the University of Wales, UK, in 1964. In 1983 he was awarded the D.Sc. degree by the University of London for his outstanding original research (according to citation) in numerical mathematics. In 2001 he was awarded the *Doctor Honoris Causa* (Dr.H.C.) by the University of Chemical Technology and Metallurgy, Sofia, Bulgaria, for his contribution to environmental education.

After having taught at the University of London for more than 27 years, currently Professor Nath is Director of the European Centre for Pollution Research, London; Executive Director of International Centre for Technical Research, London; Editor of *Environment, Development and Sustainability* published by Springer; visiting professor to several European universities, and consultant to a number of international companies and organizations. Professor Nath's research interests include Numerical Mathematics, Elasto-Hydrodynamics, Philosophy, Environmental Economics, Sustainable Development, and Environmental Education. He has more than 100 scientific publications in these and related areas including 13 books.

Dr. İlkden Talay received her Bachelor's degree in Landscape Architecture from Ankara University, Turkey, in 1987, followed by the Ph.D. degree from the same University in 1997. She has been teaching at this University since 1998. During 1993 and 1995 she played an important role in two international projects at Ankara University sponsored by the Commission of the European Communities. Dr. Talay's research and teaching interests include, Landscape Planning, Landscape Management, Environmental Education, Coastal Zone Management, and Indicators of Sustainability. She has several publications on these and related areas. Consultant and adviser to a number of enterprises, currently Dr. Talay is Associated Professor at Ankara University.