

Do Engineering Students Need Sustainable Development Courses?

F.Pacheco Torgal
Civil Engineering Department
Castelo Branco Polytechnic Institute, Portugal
fernandotorgal@est.ipcb.pt

Said Jalali
Civil Engineering Department
University of Minho, Portugal
said@civil.uminho.pt

Abstract - Traditional Portuguese engineering curricula suffers from a handicap which has already been noticed in other countries. It has been designed to ensure that engineering graduates possess a strong scientific based knowledge. This leads to close minded engineers that are unaware of the world's problems such as the major importance of environmental degradation, with all the consequences for life on earth. This subject cannot be overcome by adding to traditional engineering curricula a course related to sustainable development, but instead by an integrated vision of engineering curricula, that can emphasize the importance of humanism above all. This paper provides some insights about the importance of addressing sustainable development subjects in a holistic manner.

Key Words – Engineering curricula, sustainable development, scientific knowledge.

INTRODUCTION

Nowadays Our planet faces a major challenge that if it is not solved or if its just postponed, it may lead to the end of our civilization as we know it. Environmentally speaking, the human action has been worse than a grasshopper's plague. At least grasshoppers uses renewable resources in an igualitarian way without pollution. Humans use any kind of resources, including non renewable ones, leaving a trace of pollution in the consumption process and, to get things worse only some human consume the majority of resources. The final result is a polluted planet that ironically seems to walk towards a new age of ice [1-3]. It is as if nature realized that its future depends on the elimination of human species.

Never before the immediate effects of civilization consumption patterns reveal intergenerational and intergeographic dimensions, with consequences in to other countries and also in future generations. A famous Portuguese writer named Eça de Queirós (1845-1900), once

wrote a book intitled "O Mandarim", a very rich Chinese person. In his book the Eça de Queirós writes about the dilemma faced by a common person which may get very rich if he accepts that his choice will mean that the Mandarim (someone he does not know and lives thousands kilometers away), would get killed. The modern version of this dilemma is brought to us by Peter Singer [4]. According to him, a driver of a jeep in an western country is indirectly responsible for the death of a peasant in Bangladesh, because he contributes with a high level of CO₂ to climate change, that is responsible for the ruin of his harvests, the increase of the water level of the sea and the dissemination of tropical illnesses.

A recent report of the Intergovernmental Panel on Climate Change [5] mentioned that sea rise will bring as a consequence about 200 million refugees. The importance of that subject will require an awareness of each and every one; mainly of those who will have a major role in climate change issues has is the case of future engineers. Some authors [6] had already report the receptiveness of the inclusion of environmental courses in engineering showing that is an important subject. Amoeda [7] analyzed civil engineering curricula having reported that environmental issues related to the construction sector are not properly addressed.

ABOUT SUSTAINABLE DEVELOPMENT

Environmental worries of modern society have increased since 1972 when the United Nations Conference about the Environment took place in Stockholm. But it was only in 1987 that they gained a wider impact after the publication of the report "*Our common future*", also known as the Bruntland report [8], in which it the concept of sustainable development first appears as the one "*that alllows the fullfillment of current needs whithout preventing the needs of future generations*". In 1992 the Rio summit took place, with the presence of 176 countries. They unanimously

approved the Rio Declaration about Environment and Development, the Declaration about Forests, the Agenda 21, as well as the Agreement about Climate Change and Biologic Biodiversity [9]. The next year, the European Union developed the 5th Program for the Environment and Development, urging for a wider reach in environmental policies. In that context Portugal established the program National Strategy for Sustainable Development (NSSD) which has recently been updated for the period of 2005/2015 [10]. The NSSD program is made of a coordinated set of actions in a three dimension model, Economic, Societal and Environmental foreseeing “*an economic growth with increase societal cohesion and the protection of the environment*”. Concerning the environmental dimensional, the threats to sustainable development in Portugal are the following ones:

- Inefficient waste management;
- Biodiversity at risk;;
- High energy dependence;
- Inefficient water resources management;
- and high greenhouse gás emissions (GGE)

Portugal waste generation is usually divided in two major groups. The urban solid wastes (UWS) and the waste generated by the industry (IW). The USW amounted for 4,5 million tons in the year 2000 [11], for IW the last data reports 29,2 million tons. Danger wastes represent only 0,9% do total industrial wastes which are comparable in a favourable manner with similar wastes generated in the rest of Europe by Gross Domestic Product.

As for the preservation of biodiversity it is beneficial and crucial for mankind. Beyond the ethical reasons due to the importance of all living species independently that may serve the human needs, the biodiversity is very important because is a source of food resources as well of vaccines and anti-biotic. There is no certainty about the number of species living on the planet Earth. Although almost 1,75 millions have already been identified, some believe that number could be a lower estimate suggesting a number close to 15 millions. The current pace of species extinction is 100 times higher than the natural pace. According to the World Union for Conservation, Portugal is the European country with the highest number of endangered species [13]. To prevent that scenario, large areas of Portuguese land must be protected. Currently Portugal protected areas represent only 7,2% of the total area. The recent Natura 2000 Network (Directive Birds and Habitats) [13] proposal means a protected area of 14,1%. So that would mean a protected area of 21,3% for conservation purposes. Still the areas under the Natura 2000 Network, are no more than a balance measure between the areas needed for urban planning and for forest and agricultural production. In fact, some authors believe that to prevent species extinction in an effective manner, much more protected area would be needed, about 50-70% of the total area. Portugal needs to protect 77% of is land area in order to prevent species extinction. That represents an area much bigger than the area needed for Natura 2000 Network [14].

As for GGE some studies reports that CO₂ is responsible for the increase in air temperature of the planet Earth. In the beginning of the 18th century CO₂ concentration was 280 ppm, currently it is 430 ppm and is growing 2ppm/year, which means that in the year 2050 the CO₂ concentration can rise to 550 ppm [15]. To prevent that in 1997 several countries gathered in Kyoto and subscribed the Kyoto Protocol, meaning that until the year 2012 they must reduce GGE by 5,2 %, taking the emissions in the year 1990 as reference [16], so that air temperature of the planet Earth could be kept below the 18th century temperature plus 2 °C [12]. However, other authors believe that in order to achieve such a goal, emissions needed to be cut by at least 25% [15]. In that context the European Community agreed to reduce GGE by 8% ((burden sharing agreement). Within this overall target differentiated emissions limitation have been agreed for each EU-15 members [17]. For Portugal, a Kyoto commitment implies a reduction of greenhouse gas emissions to no more than 27% above base-year level until 2012. However, in 2001 emissions were 36%, above Portuguese individual greenhouse gas reduction targets, and according to greenhouse gas emissions trends for EU-15 members in 2002, Portugal emissions reached 41% above 2010 target emissions. Since developed countries which represent only 20% of the world population were responsible for 51% of CO₂ emissions, the only way to conciliate worldwide emissions cut backs, with the right that less developed countries have to become more developed, will lead to major reduction emissions in developed countries such as Portugal.

THE ROLE OF ACADEMIA

Accordingly, education and more specifically higher education and future engineers (engineers are the class of people who contribute most, and most directly, to the changing face of the earth [18]) should be the ones who must champion a shift in the current education model of science and technological courses widening the engineering curricula to non technical subjects. And above all, that could enlighten them with a vision of a cleaner world, a more just world, a more sustainable world. However, such a task cannot be achieved, by just replacing one of two traditional courses by courses containing some ecologic insights. That could only operate a trivial change in the current “status quo”, and it would be just a mere cosmetic change. It would be totally insufficient to perform a real change that could address the worst challenge ever faced by the humankind, as we know it. Some authors, like the environmental scientist and Fellow of the Royal Society, James Lovelock, do believe that the point of no return have already been reached, followed by a never ending cycle of natural catastrophes that in just 100 years will kill 80% of the world population [19]. Admitting, however that the Lovelock’s scenario can still be avoided the authors believe that the solution needs for a radical change in engineer curricula, so that all the courses, or at least the majority of them, could

become rays of the same wheel, the wheel of sustainable development. Let us take for instance the case of the Construction Materials course in a Civil Engineering curricula. What is more important, to lecture the properties of raw materials or about waste based materials? What is more important to keep on lecturing about non renewable resources or to lecture about life cycle assessment, waste reuse, energy efficiency? The answer seems clear; all the “old” courses must be reformed in the light of a new paradigm. This task will lead to a major change in all the engineer courses in order that sustainable development could permeate all the curricula. The final result can be only one: to educate the future engineers in order to change the current “status quo”, based in an endless resource consumption, into a new one, a sustainable one in all its dimensions: economic, societal and environmental. Besides curricula reform, the engineer skills must also be redefined, because the traditional scientific and technologic based competences are not enough in the new world. Holistic problems need holistic solutions, so “ a new engineer is needed, one who can think broadly across disciplines and consider the human dimensions..” [20].

The United Nations [21] have declared the years 2005–2014 as a decade of promoting education for sustainable development. The common goal of the UN and its member states is that the principles of sustainable development are incorporated in the national curricula of the whole education system. Some countries such as the countries in the Baltic sea region [22] have already embrace that cause. In February 2006, the Ministry of Education’s Committee published its strategy on education for sustainable development (ESD), which now serves as Finland’s national action plan for the UN Decade of Education for Sustainable Development [23].

Portugal should now fully start its walk into an awareness that a revolution in the education is needed, especially in engineering education. In order to properly place the discussion about the sustainable development.

CONCLUSIONS

Mankind faces a catastrophe of unprecedented size (climate change) which demands clear actions without delay. The most urgent is education for sustainable development, already taken by some countries. However, education for the sustainable development must be seen as a global issue, that must seriously permeate all the curricula and not in a cosmetic manner just by adding to the traditional curricula of one or two courses containing some ecologic insights.

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