



Developing the curriculum for a new Bachelor's degree in Engineering for Sustainable Development



Francisco J. Lozano^{a,*}, Rodrigo Lozano^{b,c}

^a Tecnológico de Monterrey, Monterrey Campus, Mexico

^b Copernicus Institute for Sustainable Development, Utrecht University, Utrecht, Netherlands

^c Organisational Sustainability Ltd., Cardiff, UK

ARTICLE INFO

Article history:

Received 30 December 2012

Received in revised form

8 August 2013

Accepted 20 August 2013

Available online 2 September 2013

Keywords:

Engineering for sustainable development

Curricula assessment

Sustainability Tool for Assessing

UNiversities' Curricula Holistically

(STAUNCH[®]) system

Concept maps

Tecnológico de Monterrey

ABSTRACT

With a growing interest in sustainability, a number of universities have engaged in educating the future leaders, decision makers, scientists, and engineers on how their decisions can help societies become more sustainable. This paper presents the process for developing the Bachelor's degree curriculum in Engineering for Sustainable Development at Tecnológico de Monterrey, Mexico. The process was initiated in response to a request from top management of the university to a small committee of faculty members to prepare a draft of the degree's curricular structure. Subsequently, a wider committee was appointed to design the courses' content and to refine the degree's structure. The process of developing a new degree posed a number of challenges, such as connectivity of courses and the curricular contribution to sustainability. These challenges were overcome by: using Concept Maps to help characterise and to overcome the challenges of inter-connecting courses by providing a systemic framework through a qualitative graphical tool titled, the 'Sustainability Tool for Assessing UNiversities' Curricula Holistically' (STAUNCH[®]). This tool helped the faculty team to develop a quasi-quantitative approach to the courses' coverage and their individual and collective contribution to education of their students for sustainability. The two methods provided a broader, more holistic, and systemic approach when developing a degree, because it allowed assessing the needed connectivity among curriculum courses from a systemic perspective, as well as evaluating the contribution of environmental, economic, and social issues in the degree. The systematic process followed in developing this degree curriculum can help other institutions to design and implement their own sustainability curricula. This can ensure that they develop sustainability-educated and empowered students, who can be change agents in making societies more sustainable.

© 2013 Elsevier Ltd. All rights reserved.

1. Introduction

The need for education about, and for, the environment and sustainable development (SD) has been recognised since the Stockholm conference in 1972 (see [Abdul-Wahab et al., 2003](#); [Thomas, 2004](#); [UNEP, 1972](#); [Verbitskaya et al., 2002](#)). During the last decade an increasing number of universities have been engaging with sustainability by incorporating sustainability concepts into their systems (including curricula, research, campus operations, outreach, as well as into their assessment and reporting ([Calder and Clugston, 2003](#); [Cortese, 2003a](#); [Lozano, 2006a](#)). Such efforts have ranged from involvement in regional development (for

example [Dlouhá et al., 2013](#)), to reduction of greenhouse gas emissions ([Klein-Banai and Theis, 2013](#)), and to leaders' perceptions of the topic ([Lee et al., 2013](#)). This has reinforced universities' commitment to sustainability, as called for by the different declaration and charters (e.g. Talloires Declaration ([ULSF, 1990](#)), the Swansea Declaration ([IISD, 2003](#)), and the Barcelona Declaration ([EESD, 2004](#))). At the same time, leading companies have been increasingly demanding that universities more adequately prepare their graduates in Education for Sustainable Development (ESD), which has become an important driver for academics to become more actively involved in developing and providing courses and curricula on these facets of interdisciplinary knowledge (see [WBCSD, 2010](#)).

In general, sustainability efforts have been focused on campus operations, research, assessment and reporting, and outreach (please refer to the Journal of Cleaner Production volume 17 issue

* Corresponding author.

E-mail addresses: fjlozano@itesm.mx, fjlozanog@gmail.com (F.J. Lozano), r.lozano@uu.nl, rodlozano@org-sustainability.com (R. Lozano).

12, volume 18 issue 7, volume 48, and volume 49). By comparison, limited research has been done in attempting to explain the incorporation of SD in universities' curricula (Capdevila et al., 2002; Lozano and Peattie, 2011; Martin et al., 2005; Velazquez et al., 2005). Some of the main reasons for this have been: (1) ignorance or lack of awareness upon the relevance of SD (Lozano, 2006a; Velazquez et al., 2005); (2) lack of proper settings and support to effect change (Velazquez et al., 2005); (3) insecurity and threat to lack of academic credibility for teachers and professors who teach in interdisciplinary courses that are needed for ESD. (Peet et al., 2004); (4) over-crowded curricula (Abdul-Wahab et al., 2003; Chau, 2007); and (5) teachers who might prevent or support the diffusion (Barab and Luehmann, 2003).

In spite of these challenges, integrating sustainability into diverse academic curricula has been recognised to be essential for providing students with the skills and insights to help societies become more sustainable (Lozano, 2010); where sustainability science is becoming an important topic in university education under the term "metadiscipline" (Mihelcic et al., 2003).

In this context, addressing the issues raised by Agenda 21 chapter 35 (UNESCO, 1992a) and 36 (UNESCO, 1992b) and UNESCO's Engineering Initiative (UNESCO, 2012a) and Sustainable Engineering (UNESCO, 2012b) initiatives and through their own accord, some engineering schools have been pioneers in incorporating sustainable development and sustainability science into their curricula (Fenner et al., 2005; Glavic et al., 2009; Segalàs et al., 2012). This is evidenced by the efforts of faculty at Chalmers University of Technology (Sweden), Tecnológico de Monterrey

(Mexico), Technical University of Catalonia (Spain), TU Delft (the Netherlands), and ETH Zurich (Switzerland). Other European examples can be found in The Observatory (The Alliance for Global Sustainability, 2006). In addition, among the different declarations, charters and initiatives for SD in universities, the Declaration of Barcelona, focused on engineering education for sustainable development. This declaration provides one of the most complete coverage in the crucial elements of the university system, which must be engaged in helping to catalyse the transformation to sustainable societies. (Lozano, et al., 2013).

In spite of increasing recognition of the importance and need for integrating SD and holistic perspectives into engineering curricula, the number of bachelors' degrees focussing on Engineering for Sustainable Development is still limited. This is illustrated in Table 1, which shows the engineering degrees that focus on sustainability, with 26 Bachelor's degree and 11 Master's degrees. These programs have been implemented in Australia, Europe, and the USA. Most of them focus on environmental engineering or on energy. Table 1 also shows that the social issues are not explicitly mentioned within the degree titles, which points to an implicit understanding of sustainability, in this context, as environmental sustainability.

Tecnológico de Monterrey, a leading private higher education institution in Latin America, decided to develop the BSc in Engineering for Sustainable Development (EngSD) to educate engineers who are versed in sustainable development for the Mexican and Latin American labour markets. This paper presents the process of the design and development of that EngSD degree. The paper begins with a review of SD in universities' curricula, and then a brief

Table 1
Examples of degrees in engineering and sustainable development.

Degree	Level	Institution	Country
Bachelor of Engineering in Sustainable Electrical Power Engineering	Bachelor	University of Greenwich	UK
Bachelor Sustainable Energy	Bachelor	Copenhagen University, College of Engineering	Denmark
BSc Chemical Engineering – Sustainable Chemical Technologies	Bachelor	Berlin International College	Germany
BSc Environmental Engineering	Bachelor	California Polytechnic State University	USA
BSc Environmental Engineering	Bachelor	Cornell University	USA
BSc Environmental Engineering	Bachelor	Drexel University	USA
BSc Environmental Engineering	Bachelor	Florida State University	USA
BSc Environmental Engineering	Bachelor	Johns Hopkins University	USA
BSc Environmental Engineering	Bachelor	UBC	Canada
BSc in Environment and Energy	Bachelor	Rhine-Waal University of Applied Sciences	Germany
BSc in Environmental Engineering	Bachelor	Novia University of Applied Sciences	Finland
BSc in Sustainable Electrical Technology	Bachelor	Institute of Technology Blanchardstown	Ireland
BSc EnvE Environmental Engineering	Bachelor	Georgia Institute of Technology	USA
Business Engineering Sustainable Energy Systems	Bachelor	Hochschule Luzern	Switzerland
Civil Engineering: Sustainable Building Engineering	Bachelor	Helsinki Metropolia University of Applied Sciences	Finland
Civil, Environmental and Sustainable Engineering and Construction	Bachelor	Arizona State University	USA
Engineering (Mechanical and Sustainable Systems)	Bachelor	University of South Australia	Australia
Engineering (Sustainable Systems Engineering)	Bachelor	Royal Melbourne Institute of Technology	Australia
Engineering in Sustainable Energy	Bachelor	Cork Institute of Technology	Ireland
Engineering in Sustainable Energy Engineering	Bachelor	University of Adelaide	Australia
Engineering Sustainable Energy Systems	Bachelor	Australian National University	Australia
Engineering with an Alternative Energy Technology Concentration	Bachelor	Wayne State University, College of Engineering	USA
Mechanical and Sustainable Energy	Bachelor	University of Adelaide	Australia
Sustainable Design Engineering	Bachelor	Dundalk Institute of Technology	Ireland
Sustainable Energy	Bachelor	Cork Institute of Technology	Ireland
Sustainable Energy Engineering	Bachelor	Athlone Institute of Technology	Ireland
Alternative Energy Technology Master of Science Degree Program	Master	Wayne State University	USA
Civil, Environmental and Sustainable Engineering, Master of Science (M.S.)	Master	Arizona State University	USA
Clean Energy	Master	UBC	Canada
Construction Management and Sustainability	Master	University of Pittsburgh	USA
Engineering Sustainable Systems (MSc and MScE)	Master	University of Michigan	USA
Mining Engineering, Specialisation in Mining Sustainability and the Environment	Master	UBC	Canada
MSc Sustainable Energy Technology	Master	TU Delft	The Netherlands
MSc Sustainable Process and Energy Technology	Master	TU Delft	The Netherlands
MSc Civil, Environmental and Sustainable Engineering	Master	Arizona State University	USA
Sustainable Energy Engineering	Master	Royal Institute of Technology	Sweden
Civil, Environmental and Sustainable Engineering and Construction	Master/PhD	Arizona State University	USA

Source: (Adapted from Organisational Sustainability, 2013).

Download English Version:

<https://daneshyari.com/en/article/8106919>

Download Persian Version:

<https://daneshyari.com/article/8106919>

[Daneshyari.com](https://daneshyari.com)