



15th Global Conference on Sustainable Manufacturing

Perspectives for International Engineering Education:
Sustainable-oriented and Transnational Teaching and Learning

Tim Stock*, Holger Kohl

Chair for Sustainable Corporate Development, Technische Universität Berlin, Pascalstraße 8-9, 10587 Berlin, Germany

Abstract

A global transformation from an economic towards a sustainable development is promoted by current policies from the United Nations and the European Union. Young engineers must be trained to anticipate the sustainability challenges for contributing bottom-up to a global sustainable development. Besides, they must be capable of performing in a more and more dynamic, transnational, and intercultural global working environment. Consequently, new perspectives for teaching and learning in higher engineering education are required, providing the competencies for coping with the sustainability challenges and for working within the dynamic global society. A transnational and project-oriented teaching and learning framework is outlined, which provides the future key competencies for young engineers. Based on this framework, the inter-university master course “European Engineering Team” is presented. The master course fosters the development of sustainable and entrepreneurial initiatives by leading the students through the development phases of a start-up company grounding on a sustainable innovation. A first evaluation of the master course shows, that most of the students’ key competencies have been improved significantly.

© 2018 The Authors. Published by Elsevier B.V.

Peer-review under responsibility of the scientific committee of the 15th Global Conference on Sustainable Manufacturing (GCSM).

Keywords: Sustainable Development; Transnational Teaching and Learning; Higher Engineering Education

1. Introduction

A global transformation from an economic towards a sustainable development is promoted by current policies from the United Nations and the European Union. Young engineers must be trained to anticipate the sustainability challenges for contributing bottom-up to a global sustainable development. Besides, young engineers must be

* Corresponding author. Tel.: +49-030-314-24457.

E-mail address: tim.stock@tu-berlin.de

capable of performing in a more and more dynamic, transnational, and intercultural global working environment. Consequently, new perspectives for teaching and learning in higher engineering education are required, providing the competencies for coping with the sustainability challenges and for working within the dynamic global society.

Throughout this paper, perspectives for teaching and learning in higher engineering education are described taking into account these frame conditions. First, the state-of-the-art for Sustainable Development and Sustainable Innovations is discussed. Second, key competencies for young engineering professionals are derived and teaching and learning approaches in higher engineering education are analyzed. Third, a framework for the transnational and project-oriented master course “European Engineering Team” (EET, <http://www.engineering-team.net>) for training the key competencies is outlined. The master course aims at developing sustainable innovations based on a solution finding procedure as well as on a procedure for the integrated development of the product and business model. Last, the learning and teaching outcomes of the first cohort of the EET is reported and an evaluation of the course is presented.

2. Sustainable Development and Sustainable Innovations

Sustainability is considered to be the key driver for innovation in the 21st century [1]. The concept of sustainability-driven innovations was firstly introduced by Keeble et al. [2]. Adams et al. introduced a three-stage model for sustainable-oriented innovations (SOI) [3]. The development of Sustainable Innovations is planned and controlled by entrepreneurs. In this context, the term of Sustainable Entrepreneurship was coined by [4], [5], and [6]. The development of innovations can be structured into an early and late stage. The early stage, also known as the Front End of Innovation aims at finding and specifying a first idea for the innovation and is characterized by a fuzziness and uncertainty of the development process. The development process itself can be structured into a task definition phase followed by a generation and selection of solution ideas for the task [7]. Methodologies for the early stage of the innovation development are e.g. the TRIZ methodology [8] or Design Thinking [9]. The late stage of the innovation development addresses the more structured phases for the detailed design of the innovation. Elements of sustainability can be integrated into the innovation during the early and late stage of the development. The integration of sustainability elements during the early stage of the innovation development can be realized during the generation of solution ideas as presented by [10], [11], or [12]. For the selection of solution ideas, different approaches for their evaluation are presented by [13], [14], or [15]. In this context, the Life Cycle Sustainability Assessment (LCSA) is described as most viable framework for the evaluation of ideas, products, and processes [16]. For integrating sustainability elements during the later stage of the innovation development, approaches addressing the business model and product development can be distinguished. [17], [18], [19], and [20] established concepts, methods, and tools for enabling the development of sustainable business models. [21] and [22] describe concepts for the sustainable product development.

The development of sustainable innovations by young entrepreneurial students should be provided as a key competency in higher engineering education. By doing so, the future young professionals are aware of the sustainability challenges and are capable to contributing bottom-up to a global sustainable development.

3. Teaching and Learning Competencies in Higher Engineering Education

The more and more dynamic, transnational, and intercultural working environment in Europe coined by new social, economic, and environmental trends set new requirements for teaching and learning in higher engineering education. In terms of the required competencies for young professionals, different organizations propose similar sets of relevant competencies. The UNDP promotes leadership, innovation, people management, communication, and delivery as core competencies [23]. Learning to learn, social and civil responsibility, initiative and entrepreneurship, cultural awareness, and creativity are horizontal key competencies defined by the European Commission, which is also highlighting mobility as an essential competence [24]. In terms of teaching and learning methodologies in higher education, John proposes a student-centered, project-oriented approach for an effective learning program [25]. The concept of experimental learning presented by Kolb and Kolb provides an effective and

Download English Version:

<https://daneshyari.com/en/article/7544910>

Download Persian Version:

<https://daneshyari.com/article/7544910>

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