Chapter 10

Competitive Design of Web-Based Courses in Engineering Education

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ABSTRACT

Developing engineering study programs of high quality, able to satisfy customized needs, with flexible paths of study, with easy and rapid access to the most appropriate educational facilities and lecturers is a critical and challenging issue for the future of engineering education. The latest developments in communication and information technologies facilitate the creation of reliable solutions in this respect. Provision of web-based courses in engineering education represents one of these solutions. However, the absence of physical interactions with the training facilities and the specificity of remote collaboration with lecturers rise up additional challenges in designing a high-quality web-based engineering course. In order to define superior solutions to the complex set of requirements expressed by several stakeholders (e.g. students, lecturers, educational institutions and companies), a comprehensive planning of quality and an innovative approach of potential conflicting problems are required during the design process of web-based engineering courses. In this context, the present chapter introduces a generic roadmap for optimizing the design process of web-based engineering courses when a multitude of requirements and constrains are brought into equation. Advanced tools of quality planning and innovation are considered to handle the complexity of this process. The application of this methodology demonstrates that no unique, best-of-the-world solution exists in developing a web-based engineering course; therefore customized approaches should be considered for each course category to maximize the impact of the web-based educational process.

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INTRODUCTION

Today's evolutions in science and technology lead to a rapid depreciation rate of knowledge in engineering. There are areas where this rate is less than one year; however, countless opinions consider an average depreciation rate of knowledge in engineering around three years. Producing companies operate in environments influenced by globalization, emphasising horizontal integration, innovation and customer satisfaction, while focusing on small number of business areas. In this very demanding economic environment, producing companies expect from engineers to excel from graduation to retirement. Therefore, continuous training of engineers is vital for ensuring business competitiveness from technological perspectives, this issue subjecting engineering education to tremendous pressures, either directly or indirectly.

The very wide areas in engineering study rise up many challenges on how to approach properly the educational process. Experience clearly shows there is no general pattern for success. Depending on the subject area, personalized models and means are required to maximize the impact of the educational process (Barros, Read & Verdejo, 2008; Brad, 2005; Ogot & Okudan, 2007; Popescu, Brad & Popescu, 2006). It should be also noticed that specific engineering theory needs to be reformulated and often interrelated with elements from other theories, with practical knowledge and with skills development before it can be applied in real-life problem solving (Brackin, 2002; Kolmos & Du, 2008; Yeo, 2008). For example, in engineering education, skills development includes many other aspects than technical or technological ones, like: team working, communication, project management, learning to learn, visioning, change management, leadership (Hutchings, Hadfield, Horvath & Lewarne, 2007; Kaminski, Ferreira & Theuer, 2004).

Dynamics of changes in the economic environment determines both undergraduate and postgraduate students in engineering to look for flexible, high quality and financially affordable paths of study, for easy and rapid access to the most appropriate educational facilities and to the most appropriate lecturers and trainers to satisfy specific needs. A good opportunity in front of such expectations stands in web-based education, which exploits the facilities provided by the latest developments in communication and information technologies to remotely access, either off-line and/or on-line, real and virtual labs, libraries, documentation, tutorials, seminars, courses, etc. (e.g. Bhatt, Tang, Lee & Knovi, 2009; Callaghan, Harkin, McGinnity & Maguire, 2008; Du, Li & Li, 2008, Ebner & Walder, 2008; Helander & Emami, 2008).

Provision of web-based courses is not a simple task (Finger, Gelman, Fay & Szczerban, 2005; Lau, Mak & Ma, 2006; Li & Wang, 2007). Beyond the immanent technological challenges, there are other issues that require meticulous treatment. In this respect, a web-based course should be viewed as an educational product that asks for high quality on four generic development axes: need-requirement axis, education provider axis, study program axis and teaching-learning process axis (Popescu, Brad & Popescu, 2006). The needs and related requirements are closely linked to the challenges that students encounter onto the workforce market, characterized by high fluidity and volatility. The education providers should permanently adapt their study programs to the latest technological developments and to the newest approaches in education. The teaching-learning process should be strongly directed towards students, offering them the possibility of customising the learning process and its outcomes. The four axes should be simultaneously tackled and the process should consider the dynamics of the need-requirements axis. Because the life-cycles of most engineering courses are very short, there is a major concern on designing and developing high-quality courses from the very first time; that is, a concern for effective and efficient engineering course design. Web-based engineering courses rise up supplementary

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