Chapter XIII

Iterative Design and Evaluation of a Web-Based Experimentation Environment

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Abstract

Nowadays, Web-based experimentation environments provide an excellent instrument to add flexibility in traditional engineering curricula. This chapter presents a model for the evaluation of such environments. The proposed model relies on an iterative evaluation paradigm. It allows the integration of different analysis methods including quantitative and qualitative analysis, and social network analysis. The chapter also describes the iterative user-centered design and development of the
eMersion environment developed at the Ecole Polytechnique Fédérale de Lausanne (EPFL), as well as the results and analyses of the evaluation process carried out in the automatic control laboratory courses using the eMersion environment from the 2002 winter to the 2005 summer semesters at the EPFL. The evaluation was performed to study different aspects relevant for an online learning community in engineering education, such as participation, flexibility, learning performance, collaboration, and community social structure.

Introduction

Automatic control is a mandatory course offered to various engineering degree programs including electrical, mechanical, and micro-engineering curricula at the Ecole Polytechnique Fédérale de Lausanne (EPFL). In automatic control, as in other engineering domains, laboratory activities—or hands-on activities in general—play an essential role in theoretical knowledge reinforcing and know-how acquisition. Hands-on activities also help in increasing students’ motivation.

For about a decade, academic institutions have tried to meet the increasing student needs for professional competencies, personal development, and career planning, including the necessary skills for teamwork and lifelong learning. Furthermore, engineering departments have had to solve the logistical dilemma of educating more students with fewer resources while maintaining the quality of education. Within this challenging context, the so-called flexible learning paradigm (Gillet, 2003; Kazmer & Haythornthwaite, 2005; Mosterman et al., 1994) happened to be helpful. This paradigm is leading towards the development of a hybrid-learning scheme in which the traditional courses are combined with online activities that can be carried out at anytime and from anywhere. In addition to providing students with new online resources, the flexible learning paradigm also sustains the development of a learning community. All people involved in a course, including the educators, the tutors, the teaching assistants (TAs), and the students, who synchronously and asynchronously interact with each other and with laboratory resources, form what is called an online learning community.

Web-based experimentation is one of the online activities that plays a key role in the development and deployment of the flexible education paradigm in engineering education. Web-based experimentation stands for hands-on activities carried out online using either simulators (virtual experimentation) or remote connection to real laboratory equipment (remote experimentation). Typical Web-based experimentation sessions are mediated by tutors and TAs. There might be some face-to-face (f2f) sessions in which the students work in the laboratory with the presence of the tutor and/or TA (see Figure 1 as an example), but most of the learning activities take
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