Chapter 14
Designing an E-Learning Curriculum

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ABSTRACT

In this chapter, the authors propose to look at the empirical findings that will be useful for instructors, who wish to improve their understanding on how to design an e-learning curriculum that will take into account the different learning needs of their engineering students. The studies surveyed in this chapter will focus on gender and game-based learning, which will offer insights as to how to improve the level of participation and learning outcomes for females in male-dominated fields. In particular, the authors will focus on gender issues and how learning in an e-learning curriculum can be designed to engage female students and to improve retention of female students. The authors propose the following change in an engineering e-learning curriculum: mixed-sex groups, use of collaborative activities, blended learning, and communication tools, and mixed-sex curriculum design team.

INTRODUCTION

The purpose of this chapter is to offer ways of designing an e-learning curriculum so that it engages students, both female and male, and leads to an increase in the level of participation and motivation towards engineering among female students. If more female students move into industry to become practicing engineers and scientists, society will ultimately benefit more from innovations in products that have been designed by a more equally balanced inclusive team composed of male and female members, rather than by a team of male members alone. Indeed, Wuchty, Jones, and Uzzi (2007) have argued that most important scientific innovations have been produced by collaborating teams, and Woolley, Chabris, Pentland, Hashmi, and Malone (2010) have argued that the presence

DOI: 10.4018/978-1-4666-8803-2.ch014

of females in a team greatly improves team collaboration. Hence, having female members helps team collaboration which in turn results in greater scientific innovation and discovery. In order to have inclusive engineering teams in the workplace, there must be enough female qualified engineers. However, currently female engineering graduates are outnumbered by their male counterparts. To attract more females into engineering and to retain females who minor or major in engineering, the authors propose that the engineering curriculum should be redesigned to engage female students.

In this chapter, the authors will look at empirical findings that will be useful for instructors, students, and professionals who wish to improve their understanding of how to design an e-learning curriculum that takes into account the learning needs of their students. The studies surveyed in this chapter focus on gender as well as game-based learning, which offer insights into how to improve the level of participation and learning outcomes for females in male-dominated fields. In particular, the authors will focus on gender issues and how learning in an e-learning curriculum can be designed to minimize gender differences in learning outcomes and raise the levels of participation of female engineering students.

BACKGROUND

Stoilescu and McDougall (2011) highlighted the presence of the gender digital divide in computer science undergraduate programs in Canada. They found that the female undergraduate students were not lacking computer resources, but what was lacking was equity in instruction with computers and opportunities to participate in the computer culture. The latter two issues gave rise to the female students' high anxiety levels, low confidence, and ultimate underachievement. These female students needed to have more valuable experiences in the field. Stoilescu and McDougall (2011) proposed giving them more opportunities to access the computer culture in formal and informal settings. One way of improving opportunities in informal education was to allow female students to have more opportunities to practice writing code.

The current level of participation in engineering education by women is low compared to that of men. Schiebinger and Schraudner (2011) argued that although much had been done to try to achieve gender equality in educational institutions, there was the need for "gendered innovations in scientific knowledge and technology design" (p. 157). They argued that a gender analysis must be present as a control from the beginning of a project to ensure rigor in science, engineering, and medicine research, policy, and practice. In the design of an e-learning curriculum, as Schiebinger and Schraudner (2011) have pointed out, it is paramount that a checklist be created that helps technology designers to identify key gender components for operationalizing sex and gender analyses for designers. Some components suggested in the article can be applied in the design of an e-learning curriculum. These are rethinking language and visual representation, rethinking stereotypes, analyzing academic disciplines, redefining key concepts, and rethinking theory.

Game-based learning is an emerging pedagogical paradigm that could represent an alternative approach to achieving both the goals of developing engineering practices and gender equality in engineering education. This is because games allow students to experience what practicing engineers do in the real world and to take on the identity of an engineer. Regarding commercial games with affordances for players to develop social identities, Squire (2006) saw games as sites where learning could be looked at both as "(a) interaction in the social and material world, where learners participate in open and closed problem solving; and (b) participation in distributed social organizations such as self-organizing learning communities" (p. 22). To add, Jan (2013) distinguished between games as "technological innovation" and "pedagogical innovation." Observing that commercial