Chapter 15
Blended Learning in Engineering Curricula Through the Meaningful Use of ICT Tools

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ABSTRACT

Blended learning, which combines various ICT tools into conventional face-to-face classroom activities, has proved to be more effective in enhancing the learners' motivation, communication skills and learning achievement than teaching by employing a single approach. The meaningful use of ICT tools is critical to the successful promotion and implementation of blended learning. This case introduces a study of blended learning using the WIRE model that links pre-class warm-up, interaction in class, and review as well as post-class exercises into a continuous learning experience with basic to advanced mental skills. The WIRE model has been experimented in the Department of Information Management of a university of science and technology in Taiwan. The findings from the learning achievement, questionnaire, and focus group interview revealed some significant differences between the experimental and control groups in the degree of motivation, interaction between teacher and students, and collaboration among students. The WIRE model can thus help enhance learning motivation, interaction between teacher and students and among students, and learning achievement.

BACKGROUND

With reference to recent literature, Graham (2006) has defined blended learning into three perspectives: (1) combining instructional modalities or delivery media (such as Bersin & Associates, 2003), (2) combining instructional methods to gain an optimal learning outcome with or without instructional technology (such as Driscoll, 2002), and (3) combining online and face-to-face instruction (such as Rooney, 2003; Osguthorpe & Graham, 2003). In this study, the third perspective is more appropriate for considering the implementation of blended learning research. The emphasis on blended learning as described in this chapter refers particularly

DOI: 10.4018/978-1-61520-869-2.ch015

to the meaningful use of technology as a way of effectively achieving educational objectives.

Can blended learning serve as an important strategy for technology enhanced learning both at present and in the future? Interestingly, in Kim and Bonk's (2006) survey on the future growth (continuing up to 2013) of online teaching and learning in higher education, the respondents expected future emphasis to be placed more on blended learning than on full online courses. Up until the present, this trend has continued in the same direction and seems to be increasingly common. These investigators also suggested that follow-up studies might focus on the types of blended learning, design of activities, and instructor training with respect to the blended-learning situation (Kim & Bonk, 2006). Yet, even in the context of corporate training, many organizations remain confused about what blended learning involves and how it is implemented (Kim, Bonk, & Oh, 2008). More empirical studies should therefore be undertaken for the blended learning models that will be needed in the future.

According to the literature regarding the implementation of blended learning on campus, the use of Information Technology and Communication (ICT) tools within teaching and learning has generally been encouraged. Moreover, most campuses (more than 90%) have deployed commercial or homegrown course management systems (CMSs) or learning management systems (LMSs) for teaching and learning (Hawkins & Rudy, 2008); however, most tools provided in these systems are merely used for message broadcasting, the sharing of learning resources, homework management, and online quizzes rather than being closely integrated into an instructional model (Hartman, 2008).

This chapter presents a study of blended learning model—the WIRE model, which was proposed by Juang in the book "*Web-based engineering education: Critical design and effective tools*" (Juang, 2009). The WIRE model comprises four learning activities within three stages—a pre-class warm-up, interaction during class, and post-class review and exercises. The first letter of each activity forms the basis for the WIRE acronym. Under this simple concept, instructional plans can be designed using various combinations of the four learning activities in order to obtain the best learning outcome. The WIRE model has experimented with in the Department of Information Management of one university in Taiwan. The preliminary findings from the learning achievement, questionnaire, and focus group interview show some significant differences between the experimental group and control group, including the degree of the motivation, interaction between teacher and students, and collaboration among students. The following sections introduce the basic concept of WIRE model, describe the research design, research results and discussion, with final comments being made in the conclusion.

INTRODUCTION TO THE WIRE MODEL

The WIRE model is an instructional model for implementing blended learning and suggests that the instructional design should include the following three essential elements throughout the process of instruction:

a. The development of students' mental skills: The whole process should be designed with appropriate serial learning activities suitable for the current level of mental skills of students that spans the simple to the complex according to Bloom's Taxonomy (Bloom, 1956).
b. Meaningful adoption of educational technology: A successful adopter of educational technologies for the design of blended learning should meaningfully integrate the ICT tools into each various learning stages by answering the following essential questions: (1) What technologies are easy to use? (2) What