Chapter 21
Web Conferencing and Remote Laboratories as Part of Blended Learning in Engineering and Science: A Paradigm Shift in Education or More of the Same?

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ABSTRACT
The purpose of this chapter is to provide an overview and subsequent application of research into the impact web conferencing and remote laboratories have on engineering and science education within the context of blended learning. The impact is examined especially in assessing the reaction and achievement of learners in using these new technologies compared to that of a traditional classroom or (the currently popular approach of) asynchronous e-learning. In recent years, there has been a significant increase in the level of remote or distance learning (or e-learning) using the Internet. One of the gaps in current research is the examination of the impact of web conferencing and remote science and engineering laboratories on the learning experience. The chapter is commenced by defining e-learning, synchronous, asynchronous and blended learning. Hereafter, web conferencing and remote laboratories are then defined and reviewed in detail. The impact that web conferencing and remote labs have on the e-learning experience as compared to the classroom and asynchronous approaches is then examined. The chapter is concluded by an examination of our research into what the perceived requirements are for web conferencing and remote laboratories and suggestions are given on how to apply web conferencing and remote labs to engineering and science education.

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INTRODUCTION

Over the past decade, there has been a proliferation of remote or distance learning using the internet (often referred to as e-learning or online education) in the technology, engineering and industrial automation education areas (Allen & Seaman, 2006; Bersin, 2004; Bonk & Graham, 2006; Ma & Nickerson, 2006; Rossett, 2001). Some years ago, Kazmer and Haythornthwaite (2004) quoted from Pew Internet and the American Life Project (The Internet and education, 2001) that “On any one day, at least one million people in the U.S. are online taking a course” (p. 7). Claims have been made by early pioneers such as Whalen (2000) on the improved learning achieved and cost effectiveness and by extension, return on investment (ROI) of this form of training compared to that of traditional classroom based training. Zhang, Zhao, Zhou, and Nunamaker (2004) indicated that learning using information technologies was rapidly growing due to the increasing demands for quicker time to gain competency in a subject and the issues of globalisation and accelerating competition. Kanyongo (2005) referred to Smith (2001) who listed the benefits of e-learning as being “accessibility, flexibility, participation, absence of labeling, written communication experience and experience with technology” (p. 1). On the other hand, Smith (2001) listed the problems for e-learning as “team building, security of online examinations, absence of oral presentation opportunities and technical problems” (p. 1). Brown and Lahoud (2005) noted the remarks of Moore and Kearsley (1996) that courses delivered at a distance can be as good as that of traditional classroom instruction.

There are two main categories of e-learning: asynchronous which is web based; and streaming interactively over the internet which is referred to as synchronous (Rossett, 2001). As synchronous e-learning allows direct live interaction (and often video conferencing) between instructor and students, it is often able to provide a powerful learning experience due to the close contact between all parties.

There has been some conjecture about the best blend between online education and traditional classroom instruction (Banks, 2004). Blended learning (Bersin, 2004; Mackay & Stockport, 2006) is a combination of the different training media, such as classroom instruction, on-the-job training and e-learning. Harding, Kaczynski and Wood (2005) noted that in blended learning “…the conveniences of online courses are gained without the loss of face-to-face contact” (p. 56).

One method of creating a more interactive hands-on approach but which is somewhat challenging and of increasing interest in e-learning (and blended learning) is the use of remote laboratories or simulation software in improving the learning experience. Some observers may be surprised as to why the subject of labs (and remote labs) is discussed in some depth, but the authors believe that they have a considerable contribution to make to e-learning and blended learning for engineering training in providing a hands-on experience. Coupled with live interactive synchronous web conferencing, a powerful learning experience is possible no matter where the instructors and students are located in the world.

This chapter will be commenced with a review of the growth of e-learning. The different forms of e-learning comprising asynchronous, synchronous and blended learning are defined. This will be followed by clarifying the different types of synchronous e-learning with a focus on virtual and remote labs. Contemporary research in e-learning within the engineering and science areas will then be detailed. Finally, a few suggestions will be made as to future research directions.

A REVIEW OF THE GROWTH OF E-LEARNING

Van Dam (2004) quoted from a report of the respected IT research organization, Gartner, which