Chapter 11

The Impact of Instructional Simulation Use on Teaching and Learning:
A Case Study

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ABSTRACT

As simulation usage becomes more prevalent in education, it is important to analyze how teaching and learning is impacted by its use. We present here a case study of a specific computer-based instructional simulation, the Virtual Audiometer, and instructor and student perspectives regarding the simulation use's effects on teaching and learning. Specifically, findings are described within a model of five areas in which technology can effect education: visualization, authentic engagement, quality and quantity of practice and feedback, interaction and collaboration, and reflection. Although room for improvement was identified, data showed that in this specific case, the computer-based instructional simulation improved teaching and learning experiences in all five areas. An understanding of how simulations impact teaching and learning can help inform design of both the simulations produced for higher education and the implementation of these simulations within a course.

INTRODUCTION

Many consider simulations as potentially powerful educational tools (Aldrich, 2002; de Jong & van Joolingen, 1998; Lee, 1999; Winer & Vázquez-

Abad, 1981) or reported successful use of simulations in education (Cameron, 2003; Henderson, Kleme & Eshet, 2000; Lieberth & Martin, 2005; Windschitl & Andre, 1998). However, there have been conflicting reports about the effectiveness of simulations (Aldrich, 2002; de Jong & van Joolingen, 1998; Lee, 1999; Winer & Vázquez-Abad,

1981). While simulations hold great potential, there are several reasons reported for the discrepancy between the potential of simulations and the research results, for example, lack of instructional supports (Zhang, Chen, Sun, & Reid, 2004), poor implementation or integration problems (Weston, 2005), or mode of use—with some researchers claiming possible differences between the use of simulations for practice and the use of simulations to present instruction (Lee, 1999).

Although simulations often require instructional augmentation to truly facilitate learning (Gibbons, McConkie, Seo, & Wiley, 2002), West and Graham (2005) and Roschelle, Pea, Hoadley, Gordin, and Means (2000) argued that technologies such as computer–based simulations have the potential to be catalysts for more efficient and/or more profound student learning. Little research has been done, however, to show how simulations affect the dynamics of teaching and learning, especially from the perspectives of the instructor and students. As a research team, we set out to answer one question: how does simulation usage change what teachers and students do and how do those changes facilitate the learning process? An understanding of how instructors and learners use simulations holds the potential of helping inform the design and implementation of simulations in other contexts.

BACKGROUND

To provide a background for the study, the definition of computer-based instructional simulations and the strengths and limitations of their use in education are discussed.

Definition of Computer-Based Instructional Simulations

There are many types of simulations; in this chapter we focus on computer-based instructional simula-

tions (CBIS). A CBIS is a computer program that allows learners to actively explore a domain by manipulating input variables of a model of the domain (de Jong, 1991; Lee, 1999). Other researchers further differentiate between simulations and educational or instructional simulations (Gibbons et al., 2009; Lee, 1999; Winer & Vázquez-Abad, 1981) because they do not deem that all simulations are instructional. Gibbons et al. (2009) stated that for a simulation to be considered instructional, it needs to have the following characteristics:

1. The simulation contains one or more dynamic models of physical or conceptual systems. (These might include cause effect systems, human performance models, or environmental models.)
2. The model engages the learner in interactions that result in model state changes. (In other words, the model reflects the effects of the users actions on the system.)
3. The model state changes occur according to a non-linear logic. (Simulations may be based on mathematical models, decision trees, or other appropriate means of expressing the model complexities.)
4. The model experience is supplemented by one or more designed augmenting instructional function. (For example, instruction either within or external to the simulation helps direct student activities, attention, and provide just in time information, etc.)
5. The simulation is employed in the pursuit of one or more instructional goals.

It is not requisite that the "augmenting instructional functions" be embedded into the simulation. A teacher, instructor, tutor, or other individual may serve these functions. Thus how the simulation is implemented becomes even more important if it is to have a positive effect on students' learning.

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