Chapter 5.8
Simulation Technologies in Global Leaning

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ABSTRACT

Improving learning in a global environment is major goal for advanced technology growth. Web-based instructional systems offer learners simultaneous information regardless of their home environment. As the world cultures become more integrated, instruction designs can bridge the information gap and enhance world learning. Management strategies include a learning climate that encourages diversified workers to participate in active learning situations that reflect the global nature of their work. This chapter focuses on the role that simulations can provide in both the effectiveness and efficiency of training and education. Simulations offer the means to improve learning by enhancing initial and on-the-job learning. Simulation approaches are presented within the framework of learning sciences. These include technical simulations, business simulations, modeling, role-playing exercises, case studies, micro-worlds, and animations.

INTRODUCTION

Simulations have been an area of interest and development since the early days of computer-based instruction and learning (1960s). Biological, physical, economic and social phenomena have been depicted within *simulation models* that are executable on a computer. Such phenomena can be derived from a real, a theoretical or a fictitious context. Regardless of context, a more or

less sophisticated interaction component enables learners to access the model, to change parameters, to modify routines, or even to modify the structure; and, to receive feedback on the status of the model reflecting the various types of interventions (Lierman, 1993; O'Neil & Perez, 2008). The interaction between the learner and the model occurs in a sequence over time. From interactions over time, the learner acquires knowledge, skills, and/or strategies about the content depicted and its dynamics (Breuer, Molkenthin, Tennyson, 2006)

From those early simulations, there has been a continuous stream of developments enhancing and creating new design approaches (de Jong 1991; Edwards, 1995; Kass, Burke, & Fitzgerald, 1996; van der Boom, Paas, van Morriënboer, & van Gog, 2004). Outcomes of these efforts over the past decades are readily seen in the application of simulations in technical skills education and training. For example, railroad engineers are trained to run today's high-speed trains via simulators. Mechanics are certified for the utilization of CNC (Computer Numerically Controlled)-technologies based on exercises with simulators. Business executives improve their decision making in complex, dynamic markets based on business market simulators. Students acquire knowledge and skills in subject matter domains based on (simulated) micro-worlds. There is application variance in respect to levels of fidelity between simulations. The successful integration of analogue media into the digital format is an example of contemporary differences. The level of fidelity presented within simulations has been extended to the full multimedia repertoire.

In addition, improved learning based on simulations is shown by the growing use of simulations as research and development tools (Mayer, 2006). An example from research is given in the studies on complex problem solving abilities performed in educational psychology (Tennyson & Breuer, 2002). Experimental subjects are requested to cope with complex, dynamic environments represented by means of micro-worlds. The research end is not findings in instructional design but the study of human problem solving abilities. This includes the study of learning activities within problem solving activities, but not primary from an educational perspective.

Given the above background and the growing technological milieu, there is no surprise about the extension of simulation-based instructional approaches into web-based formats. The formats allow the dissemination of simulations throughout the Internet to users at any workstation within the web environment. The lower level application formats provide for downloading of simulation programs. This makes use of the Internet as a distribution platform. More enhanced approaches target the interactive use of a simulation via the Internet. The technical solution has been achieved since the development of the World Wide Web in the early 1990s.

Learning Theory Foundations

At its core, the interactive solution comprises three basic elements: A simulation model is run as a resident on a central server. A data exchange process is established via the Internet or an intranet providing the necessary interaction between the user and the model. The network-connection makes use of a standard browser providing a Graphical User Interface (GUI). The GUI represents the status of the model and the variables on which the participant can make her or his decisions. The three elements, a model on a server, a network-connection, and a GUI within a browser, establish the necessary technical basis for using simulations at any workstation on the web or on any notebook in a wireless LAN. The realization of such a set-up is not a trivial task but from the authors' perspective it does not provide an educational asset in itself. The technical platform is a necessary prerequisite; any educational approach is dependant from its functionality. Meaningful instructional and learning activities however need more than a technical platform. They require a

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