SIMULATION AS A COMPONENT OF ONLINE LEARNING

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ABSTRACT

Simulations can be engaging tools for e-learning and should be considered as a component of course design. New tools are making simulation development and online deployment much easier. SimWriter Simplicity from NexLearn is one such tool. This article describes simulation integration into an online course and provides Simplicity-based examples demonstrating how computer simulation can become an integral component of a sustainable online education solution. The course developed in this example does more than use a simulation, the entire course is delivered in a training simulation context. Included are motivations for using this approach, design considerations, and critical decisions around simulation development.

Keywords: Training simulation, NexLearn, Simplicity, online learning, scaffolding, e-learning

1 INTRODUCTION

Simulation-based course material can provide a bridge between classroom learning and real-life experience. The use of simulation technologies can help students use their current knowledge base and extend it through experiential trial and error. A simulation environment provides students with a safe space to examine their strengths and weaknesses without the concerns and potential consequences of a real-world situation. The end result is a more experienced individual with better skills for facing challenges in the real world.

A wide variety of simulation games have been developed for incorporation into educational environments. Among these is the Beer Game, a role-playing simulation of a production and distribution process. It was developed to introduce management students to the concepts of economic dynamics (Sterman, 1989). Other simulation games also are being used in higher education. An example from information systems is called ERPSIM. This simulation helps students learn to operate computing platforms using complex software systems typical of Fortune 500 Corporations. ERPSim was developed at the international business school, HEC Montréal. According to the ERPsim.net website, “The ERP Simulation Game is an innovative ‘learning-by-doing’ approach to teaching ERP concepts. Using a continuous-time simulation, students are put in a situation in which they have to run their business with a real-life ERP (mySAP ECC 6.0) system. Teams of five to six students operate a firm in a make-to-stock manufacturing supply chain and must interact with suppliers and customers by sending and receiving orders, delivering their products and completing the whole cash-to-cash cycle. A simulation program (ERPsim) was developed to automate: (1) the sales process, so that every firm receives a large number of orders in each period of the simulation, (2) part of the production process in order to account for production capacity, and (3) part of the procurement process to account for delay in delivery and payment. Using standard and customized reports in SAP, students must analyze their transactional data to make business decisions and ensure the profitability of their operations (ERPsim, 2010).”

This simulation uses the actual SAP/R3 software from SAP AG (SAP, 2010) together with custom developed simulation software to create a realistic game experience. A competition between student teams allows them to develop the best approach to conducting business. Numerous other examples of simulations developed for use in education exist. Table 1 provides examples.
### Table 1  Examples of Simulation Use in Education

<table>
<thead>
<tr>
<th>Simulation</th>
<th>Purpose</th>
<th>Provider</th>
</tr>
</thead>
<tbody>
<tr>
<td>River City</td>
<td>This simulation is aimed at science students to help teach scientific inquiry and 21st century skills. Students use a virtual environment with a videogame feel that challenges them to work collaboratively to solve a health mystery</td>
<td>Harvard University</td>
</tr>
<tr>
<td>Physics Education Technology</td>
<td>Uses fun, interactive computer simulations of physical phenomena to engage and teach students about physics.</td>
<td>University of Colorado-Boulder</td>
</tr>
<tr>
<td>PublicHealthGames.com</td>
<td>This system provides games and simulations for public health workers and emergency responders to help train for catastrophic scenarios</td>
<td>University of Illinois-Chicago</td>
</tr>
<tr>
<td>Real Lives</td>
<td><strong>Interactive</strong> life simulation game that enables students to live one of billions of lives in any country in the world. Uses statistically accurate events to enact different cultures, human geography, political systems, economic opportunities, personal decisions, health issues, family issues, schooling, jobs, religions and so forth.</td>
<td>Educational Simulations</td>
</tr>
<tr>
<td>Technology Learning Simulations</td>
<td>Simulation used in a class structure developed in Active Worlds where students enter the virtual world, learn various technology lessons, and complete related assignments in-world (Tashne, Riedl and Bronack, 2005).</td>
<td>Stephen Bronack of Clemson University</td>
</tr>
<tr>
<td>Field Research in Second Life</td>
<td>Students learn applications of field research methods by conducting research in-world in a Second Life based simulation (SL Education, 2007).</td>
<td>Bradley University</td>
</tr>
</tbody>
</table>

In another example, the Ann Myers Medical Center uses a virtual clinic simulation to educate medical students and nurses. The platform is constructed in Second Life. Using the simulated environment, students learn from educators through interactive 3-D case presentations (Ann Meyers Medical Center, 2010). The University of Kansas teaches medical students bedside manners and patient interaction through a Second Life simulation interface. According to Chris Collins, “…many educators see [simulation] as a tool that might help instructors connect students to the real world through the technology of the virtual world….it gives students the ability to play, to practice, to pretend, to be creative and imaginative, and to do things that they [can’t] in real life (Collins, 2008).”

The term ‘simulation’ when applied to training situations can best be regarded as “a set of techniques – not a technology per se – to replace or amplify real experiences with planned experiences, often immersive in nature, that evoke or replicate substantial aspects of the real world in a fully interactive fashion (Stanford School of Medicine, 2011).” The Stanford School of Medicine lists three advantages associated with the use of simulation-based learning. Included are: a range of repeatable learning experiences; the freedom to make mistakes and learn from them; the ability to scale in complexity to match a learner’s experience; and availability of detailed feedback and evaluation.

To leverage these advantages, an undergraduate information systems course, *Storage Systems Management* was designed using simulation technologies as a central pedagogical approach. This differentiates it from courses that incorporate a simulation (such as the Beer Game) as a learning tool. For the Storage Systems Management class, the entire online course delivery was structured using a simulation tool. Several motivations were responsible for approaching course development from this perspective. First, the course was to be offered only online and in a compressed time frame. Second, the technologies being described in the course required expensive, high end storage systems that were not physically available for experimentation, particularly for online students living in geographically...
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dispersed areas. Third, some technical portions of the curriculum originally were developed by the EMC Corporation to train their internal employees and could be easily adapted to a simulation approach. For these reasons, it was decided to provide online instructor-based material using Nexlearn’s Simplicity system for developing the majority of the course material.

2 TRAINING SIMULATIONS

A training simulation is a virtual medium through which real world skills can be acquired (Gopinath & Sawyer, 1999). These simulations have been used to develop a wide variety of skills from areas such as: the medical field, flight and transportation, innovation and change management, operations and production management, manufacturing, leadership, problem solving and decision making, communication and relationship management, business awareness, marketing, management, team development, and analytical skill development. These skills may be discipline specific, for example learning the proper sequence in a medical procedure or the checks to perform prior to an aircraft taking off. Or these skills may be more general such as promoting confidence, reducing nervousness, developing faster reaction times, or understanding role expectations.

In general, simulation can be defined as: “Using a computer to imitate the operations of a real world process or facility according to appropriately developed assumptions taking the form of logical, statistical, or mathematical relationships which are developed and shaped into a model (McHaney, 2009).” A basic premise of a computer simulation is that it will provide an experience similar to what might encountered in the real world (McHaney, 2011). Using simulation as training is consistent with Lev Vygotsky’s (1978) idea called the zone of proximal development. Vygotsky suggested effective learner development involves two aspects: (1) actual developmental level and (2) potential developmental level. Vygotsky suggests the zone of proximal development is “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving…in collaboration with more capable peers.” He further describes the zone of proximal development as what a learner can do by himself and that which can be attained with the help of a ‘more knowledgeable other.’ Through extrapolation, and by adding modern technologies, it is no longer necessary to rely on the proximal presence of a knowledgeable other. Rather, aspects of a virtual ‘knowledgeable other’ can be embedded in technology which forms the basis for scaffolding in learner instruction (Duffy & Cunningham, 1996; Hartman, 2002). Indeed this seems to be the case as evidenced by numerous reports of successful use of computer simulation as a training tool (Lunce, 2006).

3 SIMWRITER SIMPLICITY

SimWriter Simplicity is an example of a simulation tool that enables the development of simulation-based training material and provides infrastructure for the scaffolding. Simplicity was first released on February 4, 2011 by NexLearn, a developer of immersive learning simulations and e-learning courseware. This software system is a scaled version of NexLearn’s, SimWriter Professional. It can be classified as custom simulation authoring software aimed at small- and mid-sized business simulation development. Its intent is to provide an easy mechanism for integrating immersive learning simulation technology into curriculum and training design without requiring expensive production facilities.

Traditionally, high-end training simulations require a number of expenses resources often including: a writer, a director, a film crew, a sound stage, software developers and testers. By allowing users to replace these roles with alternate software and hardware solutions, Simplicity permits development of high quality, low cost training material. Users can import PowerPoint slide material; record audio via digital microphones, import video created with webcams or digital video cameras, and import digital images. Simplicity uses a reduced version of SimWriter Professional’s interface (See Figure 1).

The software permits the development of customized in-house simulations that utilize NexLearn’s instructional design experience coupled with users’ subject expertise to create immersive, interactive learning simulations. Simplicity relies on a storytelling motif. Simulation developers have the ability to customize user experiences through decisions made at various points throughout the experience.
Based on the decisions, various consequences or learning moments can occur. These can be communicated in text, graphic, audio, or video forms. Users recreate real-life events, time-scaled to enhance training and shorten the experience curve. According to representatives of NexLearn (2011), “Simplicity puts the power of simulation in the hands of training managers who otherwise have never had the opportunity.” Kansas State University became the first user of the new Simplicity Software in 2011 (Blanco, 2011).

Figure 1 Simplicity’s Interface

4 CASE STUDY: USE OF SIMPLICITY IN ONLINE COURSE DEVELOPMENT

Simulations are regularly used as tools to supplement classroom learning. For the Storage Systems Management course, it was determined that Simplicity would be used in the following ways: (1) as a tool to construct lectures to provide students with a more personal touch and (2) as a mechanism to reinforce student knowledge at the end of each unit of material. Additional simulations of computer system configuration and use were provided by EMC and also incorporated into the course to further demonstrate the use of storage management hardware systems.

4.1 Lecture Construction

As a simulation starting point, Simplicity permits the importing of PowerPoint slides. All training material used in the Storage Management Systems course had previously been developed in PowerPoint. By importing the slides, a sequential series of informational ‘stages’ was created (See Figures 2 and 3).

Figure 3 further provides an example of a path through the simulation that can be controlled by answers to questions or other logic based on student reaction and inputs. The path is shown on the left side of the image. Following the import of PowerPoint slides, the instructor can add material in text, audio, or video form. Most of the informational portions of the lecture material for the Storage Management course used a combination of voice and text inputs. Videos were also added to the stages. Figure 4 provides an example of how audio can be captured and added to a stage.
Figure 2 Importing PowerPoint slides as Stages

Figure 4 Example Stage
Once recorded, the audio track can be used to guide the students’ choices and experiences as well as provide information. By adding paths between stages, students are guided through the material. Visual enhancements on each stage can provide relevant background and visual clues about the student’s choices (see Figure 5) to make the experience more engaging. Incorrect or unsure choices can lead to more lecture-type information to enhance the student’s understanding.

**Figure 5** On Left, Instructor Pleased with Choice; On Right, Instructor Disappointed with Choice

### 4.2 Reinforcement of Student Knowledge

The course structure initially was derived from PowerPoint-based lectures. However, Simplicity’s underlying simulation constructs were used to transform the material from a linear experience to a more realistic and dynamic training simulation.

The entire course was structured as a sequence of related simulations. Each simulation was pedagogically developed to provide information to the students and then immediately ask them to apply this knowledge to reinforce the learning. The first portion of each simulation would describe the expected learning outcomes for the current simulation module. These outcomes would be stated both verbally and in written form. Students would then move through the simulation which was structured to first deliver material from a variety of sources, which might represent characters in a typical business setting or role. The material was delivered in a variety of ways including the instructor’s voice, text-based information, video-based information, figures, models of systems, and experiential sequences.

At the end of the material delivery portion of the training simulations (which coincide with portions of a textbook they had been asked to read), students were moved into a situation requiring them to make decisions based on the learning objectives. Figure 6 provides an example of a typical simulation’s logic. At each decision point, students were given behavioral choices. Their decisions moved them into various branches of the simulation depending on the accuracy of their choices and other incorporated system logic. If the students did not acquire enough knowledge to progress through the behavior portion of the simulation, they would be redirected back to an appropriate location in the information delivery section. The choices were structured to ensure students understood the material they had experienced. They would have to repeat certain steps until correct choices were made consistently. This approach is called gating and students that did not achieve a satisfactory performance would not be allowed to move forward in the simulation. The combination of information delivery, behavior choices and resulting consequences provided a basic pedagogy to support the learning objectives. Simplicity provides a number of tools that enable tracking student progress and viewing the paths students took through the simulation.
As technology advances, the ability to create realistic, immersive simulations will improve. The simulation discussed in this article is the first iteration in a process to make the student learning experience more interactive, more realistic and more engaging. It is our expectation to continually improve the Storage System Management simulation’s sophistication with added video, audio, background images, and decisions. We have a good starting point that is useful to the students but we know it can be made even better. Virtual reality can be used in education to scaffold learning without a content expert being within physical proximity. This becomes particularly important in specialized arenas were expertise may not be readily available.

The simulation has been piloted by a group of students. They report enjoying the experience and see it as an engaging, modern approach to learning. From a teacher’s perspective, it is observed that the initial construction of the course required a large time commitment. Recording video and audio, developing the behavioral questions and creating scripts for each learning objective was difficult and rigorous. Once the material is developed, tracking student progress is relatively straight-forward. Student learning appears to be good with the simulation and post-experience examination shows promising results. One drawback to using this approach is the distance between teacher and student. Since most material is delivered via a computerized system, the personal interaction aspect of a classroom is reduced. A possible solution to this situation is to build in live interaction components where students either meet with the instructor in a live classroom or are required to visit chatrooms at regular intervals throughout the course.

In general, we believe that the use of simulation permits learning to occur in ways that previously was only possible with real world experience. While we are not suggesting simulation should replace real world experiences, but it can provide an additional level of effective education and help bridge the gap between theory and practice. Students each experience the simulation individually so the learning experience becomes personal and relies on their own acquisition of knowledge.
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