Chapter 3.19
Simulation and Gaming in IT Education

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INTRODUCTION

The rapid change in information technology presents several serious problems to IS educators. In particular, the number of basic ideas that must be mastered is constantly increasing while the time available is not. This makes it essential to use class time efficiently as well as effectively. Simulations and simulation games provide an interesting and useful tool to help in this effort.

BACKGROUND

Simulation, case studies, role playing, and gaming are related teaching methods based on experiential learning. They permit experience or experimentation with a situation modeling the real world (Senge, 1990). On a deeper level, simulation is claimed by some to be a fundamentally new way of studying the world (Pagels, 1998). The idea that students learn better by doing goes back at least to Dewey (1938). The key idea underscoring this approach is that people learn better from experience

than from reading or listening (Corbeil, Laveault & Saint-Germain, 1989). By compressing time, the simulation allows the students to experience the consequences of their own actions or to see how a system operates.

Simulation as a teaching tool suggests several approaches. Perhaps most obvious in an information systems curriculum is computer simulation, a tool well known in the information systems community. Using this technique, a computer program is written which exhibits behavior that models the behavior of the system under study. Butterfield and Pendegraft (1998) described a spreadsheet simulation of a Fourier Series, adding sine wave to construct a square wave, thus demonstrating how bandwidth limits data rates. Simulation can be easily used in the information systems classroom by having students operate or create simulations of relevant technology. Campbell (1996) created a simulation of a computer and had his students write assembly language programs to execute on the simulation. Englander (2003) uses Little Man Computer, a simple paper simulation of a CPU, as an example to explain basic CPU architec-

ture, CPU operation, and machine language. In an extension of that idea, Pendegraft and Stone (2003) had their students develop a Visual Basic simulation of a Little Man central processing unit on which they ran programs mandated by the instructor. In addition to having to execute simple programs written in Little Man's machine language, their simulation had to deal with other architectural issues like input and output.

Case studies are a time-honored approach of instruction in strategy courses (see for example, Burgelman, Maidique & Wheelwright, 2001). Barker (2002) suggests that they can also be very valuable for teaching technical skills such as software development. In some sense, a case study is a role play, with the student acting the part of an analyst examining the case situation.

Role playing and simulation gaming are similar approaches in that they use simulated worlds, but instead of creating or observing or analyzing that world, students are immersed in it. Role playing is a method in which students are presented a scenario simulating some real situation, and assigned roles in that scenario. The scenario can be based on real or simulated situations (Barker, 2003). Participants then assume the roles of relevant persons in the scenario and act out the situation to see what happens. Role playing is a commonly and successfully used tool in IS education (for example, Christozov, 2003).

According to Greenblat (1988), simulation gaming includes role playing as an element, Whereas role playing allows participants to play the roles as they please, simulation gaming emphasizes the interactions of the roles and constraints of various types on the players. In some sense, a simulation game strives to teach about a specific situation, while a role play or game may have a more general lesson. The additional structure allows us to focus the students' attention on key issues. Dennis (2002) and Pendegraft (2002, 2003) both developed classroom gaming exercises to help students understand TCP/IP from the inside.

Their exercises will be examined in more detail later in this chapter.

After many years of using such exercises at all levels (undergraduate, graduate, and executive), it is the author's opinion that they are very useful and that major benefit accrues to the instructor in preparing the simulation as well as to the students when they play the game. Simulation and gaming are student-centered learning, that is, the student is actively involved in the learning rather than passively observing the instructor (Greenblat, 1998). The student does the work, makes decisions, and sees the impact of the decisions. Role playing and simulation gaming attempt to take advantage of this by creating a situation in which a student may "play a game" in which time is compressed and attention can be focused on a few key ideas. Finally, these kinds of exercises are fun. The class gets to move around, talk, and frequently laugh. Simulations and games epitomize the idea that learning should be fun.

USING A GAME TO TEACH TCP/IP

TCP/IP is a layered protocol for controlling data flow in a packet switched network. For a more complete discussion of TCP/IP see, for example, Hunt (1998). Figure 1 lists the layers. TCP/IP uses packet switching, which means that each message is broken into pieces (called packets), each of which contains part of the message. Each packet is augmented with a header that contains (among other things) the addresses of the source and destination machines. At each step along the way, a router looks at the header, determines the address of the next host along the way, and forwards the packet to that next host.

Understanding the addressing presents a major hurdle to understanding TCP/IP. There are two types of addresses in each packet. The IP header includes the IP addresses of the source and destination machines. These do not change

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