The Simulation-Game Controversy: What is a Ludic Simulation?

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ABSTRACT

Games use the same base technology and design strategy as do simulations, but add a few items to the mixture. Understanding this gives new (read borrowed) tools for game creation and testing. The idea that simulations are implementations of a model, for instance, leads to a focus on the model rather than the code when designing a game. Similarly, the verification/validation pair used in simulations can be extended by adding playtesting for games, thus giving an educational game (for example) viable, demonstrable educational characteristics as well as playable (and thus engaging and motivating) characteristics. Productive work on improving games for specific purposes (serious games) can be advanced if the authors can agree on a common terminology and concept set (Shaw & Gaines, 1989), and if games can be seen as a valuable extension of a simulation that has specific characteristics that make them useful in specific circumstances. The idea of fun is often thought of as the enemy of learning in educational literature, and this needs to change if progress on serious and educational games is to be made. This paper will describe the hierarchy of computer simulation objects within which ludic simulations can be understood.

Keywords: Computer Simulation Objects, Digital Objects, Games, Ludic Simulation, Simulation Game Technology

INTRODUCTION

All computer games are simulations, but not vice versa. They are part of the same class of computer program and are implemented using the same kinds of algorithms. Rather than being at opposite ends of a spectrum, simulations and games lie on a hierarchy of digital objects, the base of which is simulation. This hierarchy builds up from simulation, to ludic simulation and games (Figure 1). In order to understand this hierarchy, it is necessary to understand the foundation, namely computer simulations. In order to fully appreciate this hierarchy, it is necessary to peel back the covers of each layer in the hierarchy and look beyond the interface, which is the only part visible to most of us. We begin by defining this foundation, followed by the apex and then we fill in the middle parts.

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A workable definition of computer simulation is a computer program that is intended to represent some system at a specified level of detail, so that the input to the program will generate an output that corresponds to the output of the system when given that input. The intention is to have the program in some sense represent the actual system and to have the computer pretend to possess all of the parts and interactions implied by that system. Sometimes the terms simulation and model are used interchangeably, but that’s really a mistake. A model is normally (in simulation terminology) a mathematical description of the target system (Fishman, 1978; Franta, 1977; Zeigler, 1976). The simulation is an implementation of that model. So, a simulation really is based on a model, which is based on observations and measurements of some system. The system itself, which is a complex set of objects and interrelationships, may be well known, but may not be fully understood, or may be largely hypothetical. The goal is to allow the simulation to produce the same results as does the system given the same inputs. The way that the simulation accomplishes this is by the evaluation of the mathematical model at a succession of times so that an observer can look for patterns of interest. A simulation can largely be seen as simulating the passage of time, or at least it simulates things that can happen during time intervals over a specified period.

As an illustration of this, let’s imagine a simulation of a predator-prey situation. We can imagine a population of coyotes and one of gophers, both of which occupy a fixed size geographical region – this is the target system. A model of this system can be created by observing a region in the real world and measuring the population of coyotes and gophers on a regular and frequent basis, or by doing a mathematical analysis of similar systems. This has been done for this kind of system, and a differential equation, the famous Lotka-Volterra equations (Lotka, 1925; Volterra, 1931), has been devised that models it:

\[
\frac{dx}{dt} = c_0 x(t) - c_1 x(t)y(t)
\]

\[
\frac{dy}{dt} = -c_2 y(t) + c_3 x(t)y(t)
\]

A simulation of this system would be a computer program that solved these equations for any value of time \( t \), giving values for populations of coyotes and gophers at that time.
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