



PART ONE

What Are Games, Simulations, and Virtual Worlds Really, and Why Should I Care?

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Understanding Highly Interactive Virtual Environments

Imagine that you get a phone call at two in the morning, and you are told that you won a thousand dollars. But there is a catch. You have to spend it all before sunrise.

I don't have a profound analogy here, but wasn't it easy to imagine that situation? Humans effortlessly create virtual situations all the time. In our minds, we simulate shaking hands with the person we are scheduled to meet, and we plan different things we might say. Runners imagine the track and plan where to conserve energy and where to spend it. As we drive into a gas station, some of us visualize on what side our car's gas tank is. When we are given a new job, we plan for it by playing out scenarios, trying to understand our goals and foresee our potential actions and our barriers.

We also use virtual environments to do experiments. Einstein made progress towards his second theory of relativity by imagining he was riding a light beam. Programmers review steps of code in the shower, trying to figure out unintended consequences.

Schools, naturally, have long used highly interactive environments, if only a tad virtual. In classrooms, teachers use short games to introduce difficult topics, and mock trials have been the staple at law schools for decades. On sports fields, student athletes practice dozens of hours for every hour spent in a game.

Some of this practice is lighthearted and open-ended; other practice is intense and focused.

DO HIGHLY INTERACTIVE VIRTUAL ENVIRONMENTS WORK BETTER?

But do Highly Interactive Virtual Environments (HIVEs) work better for formal learning programs? Are they a fad, or are they the future? Are they the pet rock or the Internet?

The early evidence, both rigorous and anecdotal, seems to strongly suggest that highly interactive virtual learning is a permanent transformation of the educational landscape, coming out of its somewhat awkward adolescence and entering early maturity. This is due in part to interactive environments' ability to produce better traditional academic results.

Here is one well-documented typical example: Researcher Kurt Squire tested a simulation/game called *Supercharged*, developed at MIT by John Belcher and Andrew McKinney, to teach about electromagnetic forces. Using pre- and post-tests with control groups, he found that the participants in the control group receiving interactive lectures improved their understanding by 15 percent over their pre-test scores, while those who played with the game improved their understanding by 28 percent (Squire et al. 2004).

In another case, Dr. John Dunning, professor of organizational behavior at Troy University, discovered that students gave high marks to a popular required capstone public administration organizational behavior class using traditional linear media. However, when he surveyed multiple classes six months after the course was over, the knowledge and theories learned were not being applied in the workplace. To test the use of simulations, Dr. Dunning ran two organizational behavior classes. One class used the traditional curriculum based on case studies and term papers, and the other class used a leadership simulation. Six months after both classes were over, he again polled the students. The differences between the two classes were significant. Students who took the traditional class using case studies and reports, as was consistent with the earlier surveys, could recall some portion of class material. But the students who took the class that used the leadership simulation had significantly greater occurrences of being able to explain the material and, most importantly, being able to apply it (Aldrich 2009).

THE “WHY”

But it is still not clear *why* highly interactive virtual environments work. I suspect that we will be debating this for centuries. Here is a list of some current arguments, looking at the different components of interactivity.

Argument 1: Games as a Learning Tool

Games are a more natural way to learn than traditional classrooms. Not only have humans been learning by playing games since the beginning of our species, but intelligent animals have as well. Otters and African grays alike have been seen exhibiting what appears to be game-playing behavior. Lepper and Malone’s “Making Learning Fun: A Taxonomy of Intrinsic Motivations for Learning” (1987) is a good high-level framework for fun elements. Games researchers Habgood, Ainsworth, and Benford (2005) explain that challenge, one of the motivations in Lepper and Malone’s taxonomy, “depends on engaging a player’s self-esteem using personally meaningful goals with uncertain outcomes. Uncertainty can be achieved through variable difficulty levels, multiple level goals, hidden information and randomness.” Thus, the motivational effect of digital games comes from “the emotional appeal of fantasy and the sensory and cognitive components of curiosity.”

Chris Crawford, in his book *The Art of Computer Game Design* (1984), suggests that games are “the most ancient and time-honored vehicle for education. They are the original educational technology, the natural one, having received the seal of approval of natural selection. We don’t see mother lions lecturing cubs at the chalkboard; we don’t see senior lions writing their memoirs for posterity. In light of this, the question, ‘Can games have educational value?’ becomes absurd. It is not games but schools that are the newfangled notion, the untested fad, the violator of tradition. Game-playing is a vital educational function for any creature capable of learning.”

The optimal learning state is that of being in “flow.” The term, coined by psychologist Mihaly Csikszentmihalyi (1990), refers to a mental state of immersion and clarity. Athletes call it “being in the zone,” and the term has made its way into a number of fields including video game research. (For more information on flow’s role in gaming, see Kiili 2005). Writers and computer game players alike talk about losing track of time for hours at a time.

Argument 2: Context and Emotional Involvement

Knowledge is useful only in context, and virtual environments provide a context, ideally similar to the context in which the content will eventually be used. (Gee 2003) This context can be specific or abstract, and it can also be emotional. For example, if the goal is to teach anti-bullying behavior when a person is highly stressed and feeling threatened, mirroring and simulating this emotional context is necessary for the new content to be absorbed.

Only if we have an emotional stake in the content does our brain release the chemicals in the amygdala and hippocampus necessary for memory (Ledoux 1998). This is why we remember a good novel better than a bad textbook. And in school, we best remember content when there is the fear of an impending test.

Combining the context and emotional arguments, many have argued that failure is necessary to learn (Klein et al. 2007; Keith and Frese 2008). Experimenting in environments where failure is acceptable is therefore necessary to learn and ultimately to develop cognitive resiliency.

Argument 3: Participation

Participation with content may be necessary for learning. In a famous experiment, Held and Hein (1963) exposed two kittens to nearly identical visual information. This was done by placing one of the kittens (the passive kitten) in a little gondola and linking it to a harness worn by the other (the active kitten) so that as the active kitten moved about and explored its environment, the passive kitten was moved in exactly the same manner. The result was that only the active kitten developed normal depth perception. The passive kitten, even though its visual sensory input had been nearly identical, did not.

The process of converting experiential expertise into linear material such as books and lectures strips out most of what is valuable in the content to begin with (Barrie 2001; Aldrich 2005). An analogy is that white flour, once bleached, loses much of the nutritional value of the original whole wheat. One can't learn to ride a bicycle, the saying goes, from a great lecture. And what is true for riding a bicycle might also be true of negotiating or stewardship.

CLARIFYING WHAT WE MEAN BY *HIGHLY INTERACTIVE VIRTUAL ENVIRONMENTS*

Of course, the more vague we are, the easier it is to generalize supporting evidence, but to less effect. Talking about *interactive virtual learning* broadly is like

talking about television broadly. One could have said convincingly a few decades ago, “Television programs are a great way of entertaining a mass of people,” but you or I, with hours of hard-earned experience under our belts, might now ask, “When you say television is entertaining, do you mean situation comedies, or dramas, or news, or commercials?”

Similarly, we need to get much more specific about different types of interactive experiences. As its title indicates, this book focuses on educational simulations, games, and virtual worlds. This, however, puts us in the epicenter of general confusion among students, professors, administrators, and, well, just about every one else. I have argued that they are connected, even nested. I would like to now argue that they are also very distinctive.

It is hard to have a conversation about either virtual worlds or educational simulations without someone inaccurately equating the two. And the person does this without even realizing it. For example, a classics department head may say, “Simulations are transferring the way people are learning. Just imagine *The Sims*, but around Greek politics. That is why we are looking into an island on *Second Life*.” This is using a computer game as an example and putting forth an unstructured virtual world as a solution.

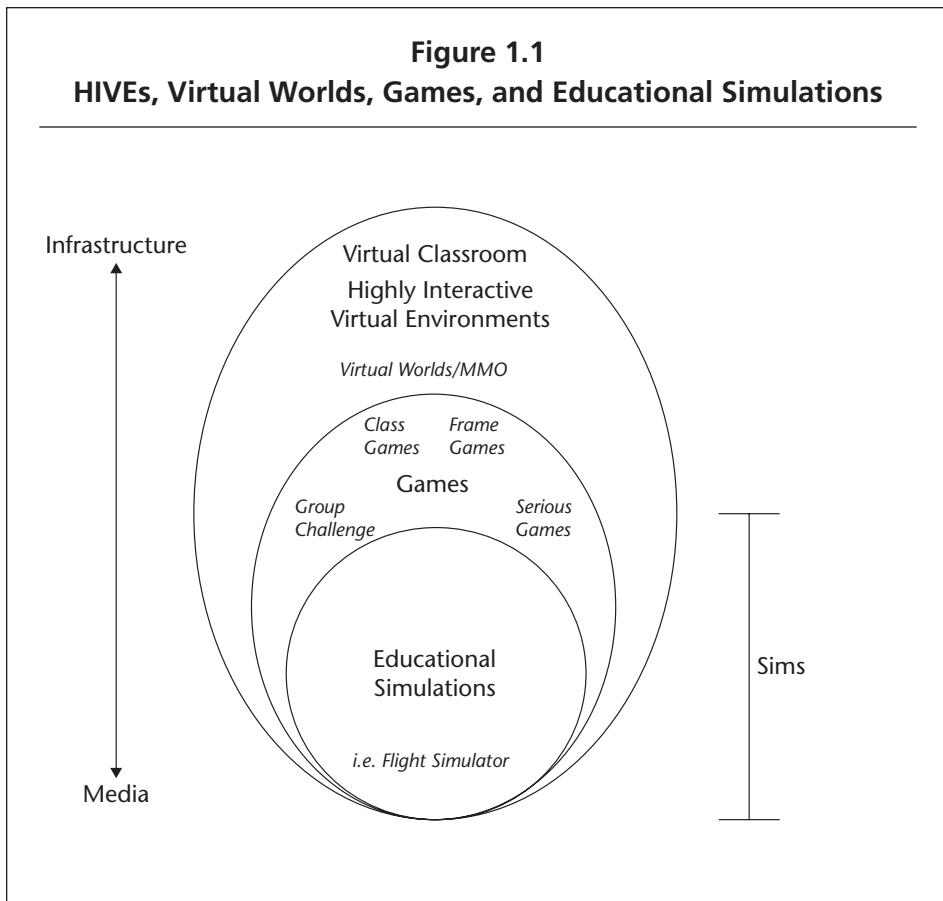
Figure 1.1 diagrams the relationship of virtual worlds, electronic games, and educational simulations. *Highly Interactive Virtual Environments (HIVEs)* is the encompassing term for the combined areas of educational simulations, games, and virtual worlds.

Virtual worlds are an infrastructure, analogous to a telephone or television system. Although some games are created and structured by instructors using an open-ended environment, the term *sims* in this chart applies to the portion of games (especially serious games) and educational simulations that are prepackaged media, closer in application to movies or magazines, and that try to influence students’ behavior in the “real” world.

There are other vague terms floating about in Figure 1.1, including *educational simulations*, *virtual worlds*, *virtual classrooms*, *serious games*, *frame games*, *class games*, and *group challenge*. So here are some definitions and comparisons (we will define even more terms and get even more specific in Part Three).

Educational Simulation versus Virtual World

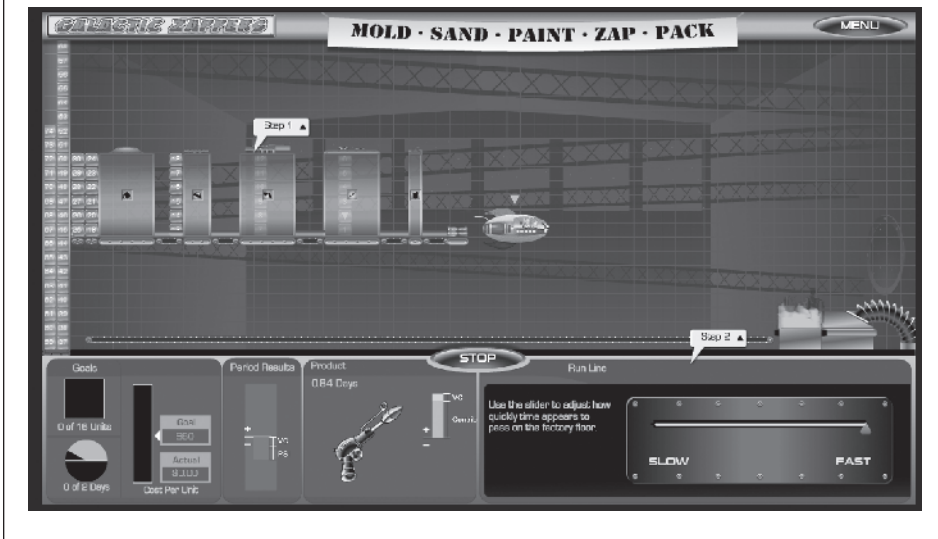
Educational simulations are structured environments, abstracted from some specific real-life activity, with stated levels and goals. They allow participants to practice



real-world skills with appropriate feedback but without affecting real processes or people. For example, the Acton School of Business uses a rigorous educational simulation to teach students about designing effective production lines (Figure 1.2).

Virtual worlds are 3-D environments where participants from different locations can meet with each other at the same time. These environments can capture and convey enough social cues, such as body language, interactive props, and the look and feel of “real” surroundings to convince some part of the participants’ brains that they are physically in this other world. Increasingly important, some virtual worlds also enable participants to build and otherwise change the environment. Linden Lab’s *Second Life* is the best-known example of a virtual world, although many students have more experience with other examples, such as Active Worlds, Whyville, and ProtoSphere.

Figure 1.2
An Educational Simulation of a Production Line



More like e-mail than Citizen Cain, virtual worlds are flexible but natively unstructured infrastructures in which many different activities are supported. These activities, as listed by Bloomsburg University's Karl Kapp, include the following:

- Entertainment
- Classes
- Meetings
- Virtual events
- Data visualization
- Prototyping/self-expression
- Replicating real-world facilities
- Virtual walkthroughs and tours
- Virtual mentoring
- Virtual recruiting
- Experiencing a disease state
- Creating machinima movies

People, once aware, seem comfortable with the differences between virtual world and educational simulation. The differences between the two types of sims—serious game and educational simulation—can be harder. These are obviously much closer than virtual worlds and educational simulations, but the differences between the two media are critical.

Serious Game versus Educational Simulation

Serious games are interactive experiences that are easy and fun to engage while building awareness, and *educational simulations* are more challenging experiences that rigorously develop skills and capabilities. Serious games usually require no coaching or outside help and even spread through word of mouth, promoted by people who enjoy playing them. (A *frame game*, a type of serious game, puts traditional academic content into an engaging interface such as a game show format.) An educational simulation, in contrast, often requires a coach or facilitator of some type and is part of a defined curriculum.

Perhaps the difference between educational simulations and serious games can be made clearer by their origin examples, the first examples that inspired the fields, as shown in Table 1.1.

The best example of an educational simulation, and also its earliest success and justification, is the flight simulator for training pilots. Flight simulators have many of the attributes desired in all educational simulations today. They are first person (what you see in the simulation is what you would see in real life); they directly relate to the needed skills; and their value is self-evident (in this case, to keep both pilot and plane from crashing).

Flight simulators impressively deal with both simple actions such as turning a flap or putting down landing gear and nuanced actions such as using the throttle. These actions are interfaced into complicated, dynamic, and intertwined systems such as wind shear and flying with a broken engine or landing gear. And these actions and systems are all coordinated toward the goal of landing a plane safely—and ideally at the right airport.

The hope and promise of the educational simulation movement are simple, if still somewhat speculative—namely, to use this interactive model increasingly for more academic and higher-level skills such as “understanding the decisions of a historical leader” or even “applying leadership.”

In contrast, the prototypical serious game is Will Wright’s brilliant *SimCity*. Players are highly entertained while designing and nurturing the cities they

Table 1.1
Comparisons of Educational Simulations, Games, and Virtual Worlds

	Educational simulations	Serious games	Frame games	Class games	Virtual worlds
Origin or Common example	Flight simulator	<i>SimCity</i>	<i>Jeopardy!</i>	<i>Rocks, Paper, Scissors; Scavenger Hunt</i>	<i>Second Life</i>
Primary learning goal	Deep skills	Awareness	Review	Ice breaker Microcosm/lab	Participation in and identification with real-time community, presentation of 3-D interactive models
Primary success criterion	Accuracy	Engagement	Fun and relevance	Increased comfort level	Immersion
Technology requirements for students to access	Medium–High	Medium–High	Low	Low	High

evolved. It was intended to be (and published as) a game, and yet it has found its way into many academic curricula. It is easy to use (originally, it had a simple interface like a model train's), yet it presents complicated and interesting systems. Players have immense (albeit unrealistic) power, and they eventually become proud of their city in a way that few are proud of their homework assignments. They even view their cities as an extension of their own ethics and priorities.

Figure 1.3
An Influencing-Skills Sim



While playing *SimCity*, players also gain insight into urban planning. However, no mayor has ever prepared for his or her job by playing it. The content is abstracted to a point of high engagement, not transfer. The hope and promise of the serious-games approach is that many more examples will emerge that are just as addictive and perhaps a bit more educational.

So, in a nutshell, what is the difference between educational simulations and serious games? Serious games are how *you* want to learn, and educational simulations are how you want *your doctor* to learn.

Class Games

The next term it may be useful to define in this first chapter is *class game*, or *class activity*. This is a short activity to engage students (usually five to ten minutes, but

sometimes as long as twenty minutes), typically “living off the land,” or taking advantage of existing technology and infrastructure in the course environment. For example, an instructor might ask students to brainstorm what they want to get out of an upcoming class using only words that start with *P*. A class in *Second Life* might use a treasure hunt to help students learn about searching and teleporting. Or a virtual class using Adobe Acrobat Connect might ask students to text each other using the one-to-one messaging tool to learn three facts about their assigned buddy.

These class activities usually have one of the following goals:

- Ice-breaker, increasing comfort level between students
- Revealing current student knowledge (used either before a class to customize the content or after a class to diagnose the amount of content learned)
- Giving the students practice using the infrastructure
- Acting as a lab or microcosm for subsequent discussion and review

Ice-breaker, by the way, is considered an almost-derogatory term. Practitioners like to focus on how class games support *learning objectives*.

Other Terms

The last two terms are *virtual classrooms* and *group challenges*.

Virtual classroom tools provide an infrastructure for synchronous (same time, different location) classes and meetings, integrating voices, slides (including multi-student “mark-up” capabilities), text chat/instant messaging, application sharing, and various community control tools. They are commonly used today when students in a class are geographically dispersed. Virtual classrooms are highly interactive and are currently used as a platform not only for traditional lectures but also for many types of games and simulations.

Group challenges are activities where people have to work together to accomplish some finite activity. Typically, the activity requires participants to take on different roles and discover, rather than just apply, a solution.

The Importance of Using the Right Idea

We may have spent more time defining terms than some readers might prefer. But getting comfortable with the distinctions, and yes, even practicing using all

of the defined concepts, will help you choose the best HIVE for your learning goals and will also facilitate conversations with all stakeholders.

Some people may ask, “Why isn’t what we’re doing in our online teaching and learning enough?” The next chapter will explore the importance of interactivity in the learning process and how HIVEs can be used to foster that sense of interactivity.