WHAT ARE SERIOUS GAMES AND SIMULATIONS?
Serious games refer to any case in which games or simulations are used for more than pure entertainment, whether in a virtual tennis match where the player gets real exercise or a simulated procedure through which a future surgeon gains real practice.

WHY USE SERIOUS GAMES AND SIMULATIONS?
Advocates for using games in the classroom often argue that young people are passionate about games, which statistics certainly confirm: A PEW research survey (http://pewresearch.org/pubs/953/teens-video-games-and-civics) suggests that over half of college students are gamers, that most of them play online games, and that they spend as much time gaming as they do studying. Advocates also argue—again, with good evidence—that games can be intrinsically motivating and engaging (Gee; Schaffer).

But do students learn from games? They may like them, but enthusiasm and time on task don’t always make a learning activity successful. Fortunately, many of the aspects of games that make them so compelling also make them educational (Bell et al.; Gee; Harper et al; Papert; Schaffer).

HOW CAN I BEST EMPLOY SERIOUS GAMES AND SIMULATIONS?
Games are likely to be effective teaching tools when the gaming objectives are closely aligned with the learning objectives, for example, a traffic game in which future civil engineers must determine the best design to minimize travel time, congestion, and accidents parallels the outcomes of their program. However, the game need not simulate real-world practice to be effective. Serious games may involve scientific or historic theories that play out on a grand scale, for example. Others may immerse learners in a compelling story to teach literature, history, political theory, or foreign languages. Many science fiction and fantasy games require creative problem solving to succeed. The advent of multiplayer online games often as social as they are collaborative, requiring players to team up and collaborate if they want to succeed. Game advocates used to argue that games developed “eye-hand coordination,” but the possibilities for real physical and kinetic skills to be practiced and assessed are now much greater with the Nintendo Wii.

Students are likely to judge a learning game by the quality of the game, so instructors should be able to judge it on its own merits. Does it have a compelling story, good graphics, good audio? Can players choose their own characters, their own paths? Do player decisions affect the outcome of the game? Are instructions clear and easy to find? Better yet, does the game itself teach you how to play by scaffolding users through practice and orientation levels?

However, instructors should pay as much attention to how the game is embedded in the curriculum as the value of the game itself. For example, the learning purpose should be clear—particularly for learners who don’t game for fun. Learning is enhanced when students reflect on their experience, or when the class critiques the game. For example, a class might play a historical game, then decide the ways the game was accurate, the ways it was inaccurate, and how they might improve it.

The University of Minnesota is an equal opportunity educator and employer.
RESOURCES

- David Williamson Schaffer's "Epistemic Games" blog site – http://www.epistemicgames.com/eg/?cat=63
- 2008 "Games•Learning•Society 4.0" conference webcast archive – http://hosted.mediasite.com/hosted4/Catalog/?cid=b8aa7b8a-fac1-4e7b-80cb-9551d26a414c

RESEARCH

PLAY AND SELF-DIRECTED/INFORMAL LEARNING


Bruner sets out a useful summary of the characteristics that make play such a powerful learning experience for children, from diminished or absent consequences for 'failure' (pp. 60–61); to player agency, the freedom to change the rules or goals of a game on the spur of the moment or to "transform the [game] world according to [their] desires" (p. 61); to the motivational value of pleasure and challenge (ibid.). Although focusing primarily on the play activities of young children, the factors Bruner identifies point to some of the reasons games and simulations often provide powerful modalities for learning in adult students, affording players opportunities [1] to interact with the game world and (in many cases) other players in a setting where playing carries with it little of the risk of real-life professional activity, [2] to try out alternative strategies or alter the parameters of a game-world and observe the results, and [3] to immerse him- or herself in environment that is intellectually challenging and (ideally) fun.


Two ideas to come out of Papert's influential Mindstorms were his notion of the "microworld"—a discrete domain in which students are encouraged to experiment freely with a simulated world that [1] reduces the complexity of the real world by focusing on salient features or behavioral models that shape the range of actions possible in that space, [2] calls students' attention to relevant operational characteristics of the theory (or theories) that shapes a given microworld, and [3] provides an epistemic framework that, once internalized, students can carry with them beyond the simulation, providing a lens that will enable them to make sense of new experiences—and the value of the computers as a modality for mediating microworlds, providing users with an interface for manipulating and acting within theory-space.


Although Piaget wrote a number of works devoted specifically to the subject of play (covered most extensively in his 1962 Play, Dreams, and Imitation in Childhood), this brief study on the nature of knowledge-creation and its relationship to learning provides a neat encapsulation of how and why a well designed game or simulation can be a valuable tool for promoting learning:

Knowledge is not a copy of reality. To know an object, to know an event, is not simply to look at it and make a mental copy or image of it. To know an object is to act on it. To know is to modify, to transform the object, and to understand the process of this transformation, and as a consequence to understand the way the object is constructed. An operation is thus the essence of knowledge; it is an interiorized action which modifies the object of knowledge (p. 176).

By adapting or creating virtual spaces that operate according to theoretically significant rules and then affording learners the opportunity to act within or modify those spaces, encouraging them to reflect upon and theorize their actions, the nature of the game world, and the experience as a whole, instructors create an experiential laboratory

---

1 See especially pp. 117–119 in Mindstorms for a discussion of simplification and the value of diminishing complexity in favor of greater learner agency. Papert's later paper, "The Turtle's Long Slow Trip: Macro-educological Perspectives on Microworlds," is particularly useful for teasing out the various dimensions of the microworld concept (available online at http://www.iaete.org/soapbox/microworlds.cfm).

The University of Minnesota is an equal opportunity educator and employer.
in which students develop expertise that can be transferred to the real world (for more on the role of experience in Piaget's developmental model, see pp. 178–180). Importantly, for Piaget learning isn't simply incidental or spontaneous, it's "provoked" (p. 176)—it's not simply the experience of playing a game (for example) that's productive of knowledge; it's such an experience embedded in a larger context of metacognition, critical reflection, and social interaction with intellectual mentors and peers.


In Mind in Society, Vygotsky links expertise explicitly to a learner's ability to solve problems, identifying the concept of a "zone of proximal development" (ZPD), which he defined as

The distance between [a student's] actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under [expert] guidance, or in collaboration with more capable peers (p. 78).

By identifying a learner's level of problem-solving expertise; challenging her or him to solve problems that are soluble but just beyond her or his level of comfort; and providing structured information, expert/instructor guidance, and modalities for supporting expert/instructor/peer interaction, it is possible to create learning experiences that are both appropriate to a student's level of development and capable of scaffolding her or his movement toward higher levels of expertise.

For a young child, the imagined world of a play scenario "creates a zone of proximal development" in which he or she challenges him- or herself to perform beyond his/her age or level of ability (p. 102). Vygotsky further identifies the spontaneous development of structured play—the creation of ad hoc games with internally consistent rules—as the precursor to abstract thought (p. 103). Like the creation of childhood make-believe gameworlds, tasking adult students with developing games may help them to see disciplinary knowledge in a new light, encouraging them to theorize environmental and processual behaviors and construct rich explanatory models that help them develop as scholars and practitioners.

**SITUATED COGNITION AND ANCHORED INSTRUCTION**


Bransford and colleagues, Brown and colleagues, and the Cognition and Technology Group at Vanderbilt (CTGV) build on the work of Piaget, Vygotsky, and others who suggested that learning is most effective when embedded in a realistic (also called 'authentic') problem-solving context. They propose that cognition and learning are intimately bound with activity; i.e., the 'substance' of learning—the information, concepts, and relationships we commonly think of as constituting knowledge—is fundamentally inseparable from the situations in which it is learned and, later, practiced in real world contexts. Whereas traditional school activities have tended to emphasize conceptual/theoretical activities divorced from the real world contexts in which such theories are applied, these authors generally favor 'authentic' learning activities in which students address problems structured like those confronting real world expert practitioners. Using professional practice as a framework, they advocate using collaborative group work, peer learning, and iterative problem-solving activities. As microworlds in which disciplinary domain and procedural knowledge is embedded in a narrative context, games and simulations can provide authentic virtual laboratories in which students can undertake cognitive apprenticeships.

The University of Minnesota is an equal opportunity educator and employer.
EDUCATIONAL GAMES AND SIMULATIONS


Bell and his colleagues describe how they developed a system for contextualizing knowledge about genetics and sickle cell disease in which museum visitors played the role of genetic counselors. The inquiry process was supported by virtual laboratory tests, simulated client interviews, and an on-demand expert knowledge system that visitors consulted as required. This anchored instruction and provided a framework for improving both content understanding and concept retention. In their report, the authors provide a useful description of how to develop a simulation scenario and illustrations of how that scenario was enacted in virtual lab and interview interfaces.


Gee suggests that video games have a lot to tell us about how we might better teach important cognitive concepts like identity formation, the semiotic representations of identity in "embodied experience," etc. Although not specifically about the development of educational simulations, Gee's book includes a great deal of useful information about how to order and frame problems in simulations. For instance, he details how gradual increases in the level of challenge can motivate students without overwhelming them and how appropriately timing the release of background information can improve understanding and retention.


Harper, Squires, and McDougall describe an approach to designing and implementing hybrid learning simulations that embed appropriate didactic content in an authentic experiential context, illustrated with examples from two natural sciences simulations.


Shaffer describes learning games and simulations as epistemic frames (pp. 9–10 and 12) that may afford players the opportunity to "apprentice" (pp. 145–146) as professionals and to learn the distinctive ways of thinking that mark the practice of each discipline. As Shaffer points out, the 'fun' of games needn't be superficial; borrowing a concept from Seymour Papert, Shaffer describes a form of play that centers around mastering complex topics one is inspired to "care about" (p. 21), owing to the authenticity of both the game space—selectively reproducing defining elements of a real world operational environment (p. 29)—and the degree of challenge with which players are confronted, compelling players to challenge their preconceptions about how the "simulated world works," evaluate the degree to which their existing mental models do or do not account behaviors in the simulation space, and refine their beliefs accordingly (p. 67). For Schaffer, games become [1] frameworks for thinking about the world and [2] catalysts for metacognition—gameplay can become a crucial dimension in helping students move beyond "knowing that" to "knowing how," a metacognitive ability to identify alternative solutions or approaches to a problem, evaluate them, pursue one, and "justify" their choices to others—a key process in what, as Shaffer points out, Lev Vygotsky termed "reflection-on-action" (pp. 91–92 and 98). Although games for Schaffer represent powerful tools for enculturation and knowledge-construction, they're "only as good as the way they are played" (p. 14)—to get the best out of any game-play experience requires the assistance of an instructor/guide/mentor who can help students make sense of their experiences, challenge them to think and act reflectively, and connect experiences garnered in a game or simulation microworld to larger theoretical and practical concerns.