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Learning Theory, Video Games, and Popular Culture

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INTRODUCTION

Today, children's popular culture is more complex than ever before (Johnson, 2005). A game like *Yu-Gi-Oh* – a card game played by children as young as 7, either face-to-face or on a *GameBoy* handheld game machine – involves the sorts of complex language, vocabulary, and thinking skills we associate with the advanced grades in school (Gee, 2004). Children today 'multi-task' across multiple modalities, playing a video game like *Age of Mythology*, reading and writing about mythology, researching it on the internet, and, maybe, even contributing to websites devoted to the game and wider topics in mythology (Jenkins, 2006).

Concentrating on good modern video games, I will argue that children today often engage in cutting-edge learning in their popular cultural practices, learning of a sort that fits well with what the Learning Sciences have discovered about optimal human learning, but not necessarily well with how current schools operate (Bransford *et al*., 2000; Gee, 2003, 2004, 2005). At the same time, good video games (like contemporary research in the Learning Sciences) challenge us to truly integrate cognition, language, literacy, affect, and social interaction in our ideas about learning and the organization of learning inside and outside schools (Damasio, 1994; Gee, 1996, 2004).

Much of what I have to say here about video games is equally true when comparable games are played face-to-face with no digital technology involved, whether this be *Yu-Gi-Oh* or *Dungeons and Dragons*. However, digital technology does add certain features to the learning, features that are, we will see, reminiscent of how scientists use simulations to learn and to produce new knowledge.

But we need to discuss two points before starting our discussion of games and learning: content and technological determinism.

First, content. Media discussions of video games often focus on the content of video games, especially if that content is violent (though many games are not violent, including the best-welling game of all time, *The Sims*). More generally, non-gamers tend to view video games in the same way in which they view films and novels: content is what determines the nature and value of the work. However, in video games (unlike in novels and films) content has to be separated from game play. The two are connected, but, to gamers, game play is the primary feature of video games; it is what makes them good or bad games (Salin and Zimmerman 2003; Koster, 2004; Juul, 2005).

The content in a game like *Grand Theft Auto: San Andreas* involves poverty, an African-American community, and crime. However, the game play involves solving problems strategically, problems like how to ride a bike through city streets so as to evade pursuing cars and follow a map to end up safely where you need to go. In games like this, elements of content could be changed without changing the game play; for example, in some cases, taking pictures of people instead of shooting them or secretly planting a message rather than a bomb in their car would leave the problem solving and its difficulty pretty much the same. Critics of games need to realize that players, especially strategic and mature players, are often focusing on game play more than they are on content *per se*.

Content in a game sets up, but does not fully determine, game play. It is also determines the basic themes, metaphors, and emotional valences of the game, beyond the emotions of challenge, frustration, competition, and accomplishment that are determined by game play. However, the two interrelate in complex ways; for example, in a role-playing game one's pride in accomplishment or regret for poor decisions can easily be projected onto the character the player is playing in the game. Equivalently, the power, problems, or fascinating features and accomplishments of a character in a game can be transferred as emotions to the player (e.g. feeling 'cool' while being Solid Snake in *Metal Gear Solid* or empathy with the main character in *Grand Theft Auto: San Andreas*).

Then, too, video games, like most popular culture media, reflect back to us, in part, the basic themes and even prejudices of our own society. The *Grand Theft Auto* series is made in Scotland, but it clearly recycles US media images from television and film. In this respect, games are no different than popular films and television. Some people think they are more powerful than these other media, because the player acts in games. But the fact is that while humans react emotionally to images (television, film, games, even pictures) in much the way they do to real life (Reeves and Nass, 1999), this does not mean they are tempted to act on these emotions in real life: people do, after all, have higher thought processes in terms of which they make decisions and decide what is and is not real.

We also need to realize that video games involve content in a quite broad sense. Video gaming has turned out (despite early predictions to the contrary) to be a deeply social enterprise (Steinkuehler, 2006; Taylor, 2006). Even single-player gaming often involves young people in joint play, collaboration, competition, sharing, and a myriad of websites, chat rooms, and game guides, many of them produced by players themselves. But the social nature of gaming goes much further. Multiplayer gaming (i.e. games where small teams play against each other) is very popular among many young people. And massively multiplayer games (i.e. games where thousands or millions of people play the same game) have recently (thanks, in part, to the tremendous success of *World of WarCraft*) become mainstream forms of social interaction across the globe. Such games are introducing new 'states' (six million people worldwide for *World of WarCraft*) or 'communities' into the world. In such games, people are learning new identities, new forms of social interaction, and even new values, which is a broad form of 'content' indeed (Steinkuehler, 2006; Taylor, 2006).

There is, indeed, much space for critique and critical theory in regard to video games, though that is not my topic here. My remarks about content are meant to suggest some of the issues particularly germane to video games as media that need to be considered for such a critique, not to mistake games for books or films. But there is another issue relevant to anyone who wants to engage in critical theory in regard to games, and that is technological determinism.

The media often discuss video games as if they are inherently good for people or bad for them. This is a form of technological determinism. Technologies (including television, computers, and books, as well as games) are neither good nor bad and have no effects all by themselves, though, like all tools, they have certain affordances (Greenfield, 1984; Sternheimer, 2003). Rather, they have different effects, some good, some bad, some neutral, depending on how they are used and the contexts in which they are used (Hawisher and Selfe, 2007). As I have already mentioned, one important aspect of use is the way in which the player engages with the game's game play as opposed to its content or graphics ('eye candy'). Players can be more or less reflective, strategic, and focused on game play rather than content or graphics. Critics of games need to consider how games are 'consumed' by different people in different contexts. Blanket general claims (either for the good or the bad effects of games) are close to useless.

Finally, let me say that my discussion below, about the powerful ways in which video games can recruit learning as a form of pleasure, is as much about the potential of games as we spread them to new contexts and design new types of game as it is about the present games. Video games are a relatively new form of popular culture, and no one should mistake their present state (for example, deeply influenced as it is by a Hollywood blockbuster mentality that often drives out innovation) for their future potential in the context of a diverse array of new technologies, designers, players, and learning and playing situations.

VIDEO GAMES ARE GOOD FOR LEARNING, BUT NOT JUST BECAUSE THEY ARE GAMES

Video games are good for learning (Gee 2003, 2005; Shaffer *et al.*, 2004). What I mean by this is that good commercial video games build in good learning principles, learning devices that are supported by recent research in the Learning Sciences (Gee, 2003; Sawyer, 2006). Of course, how these learning principles are picked up will vary across users and contexts, as I pointed out above. This claim does not just mean we should use video games for learning in and out of schools. It also means that we should use the learning principles built into good video games in and out of schools even if we are not using games. These learning principles can be built into many different curricula.

What makes video games good for learning is not, by any means, just the fact that they are games. Furthermore, the video games that are most interesting for learning are not just any video games. Different types of game can have different effects. Puzzle games like *Tetris* and *Bejeweled* may very well exercise pattern recognition capacities; *Trivial Pursuit* games may well make learning facts fun. But these are not, in my view, the sorts of video game which are most interesting in regard to learning.

Before I say what makes video games good for learning, let me be clear about just what type of video game I am interested in in this chapter. First, consider simulations in science, say a digital simulation of an electromagnetic field, a solar system, or an ecological system. Sometimes scientists use such simulations to test hypotheses, but very often they use them to examine systems that are so complex that it is hard to make specific predictions about outcomes ahead of time (take weather, for example). In this case, they design these simulations ('virtual worlds'), 'run them' (i.e. let many variables interact across time), and see what happens. Then they seek explanations for the outcomes, build new theories about the complex system being simulated, run the simulation again and again in order to improve the theory, and, maybe, eventually, get better at making actual predictions.

These scientific digital simulations are not video games. However, the video games in which we are interested here – for example, in the case of commercial games, games like *Deus Ex*, *Half-Life*, *The Sims*, *Rise of Nations*, *SWAT IV*, *Civilization*, *The Elder Scrolls III: Morrowind* – are, indeed, simulations. They are worlds in which variables interact through time. What makes them interestingly different from scientific simulations is that the player is not outside, but, rather, inside the simulation (the virtual world). There are also cases like flight simulators and games like *Full Spectrum Warrior* which are used, in one form, as professional training devices and, in another form, as games for the commercial market.

The player has a surrogate in the simulation (game), namely the virtual character or characters the player controls in the virtual world (e.g. Solid Snake in *Metal Gear Solid*, a Sim family in *The Sims*, or citizens, soldiers, and buildings in *Rise of Nations*). Through this character or characters the player acts and interacts within and on the simulation. The player discovers or forms goals within the simulation, goals that the player attributes to their surrogate in the world. In order to reach these goals, the player must recognize problems and solve them from within the inside of the simulated world. This essentially means that the player must figure out the rule system (patterns) that constitutes the simulation (the rules that the simulation follows thanks to how it is designed). The player must discover what is possible and impossible (and in what ways) within the simulation in order to solve problems and carry out goals. Achieving these goals constitutes the win state for the player.

So the video games in which I am interested, the ones that I think are most interesting for learning, are digital simulations of worlds that are 'played' in the sense that a player has a surrogate or surrogates through which the player can act within and on the simulation and that have 'win states' (reachable goals that the player has discovered or formed through their surrogate). By the way, in augmented reality games, a person can be playing a virtual role (e.g. urban planner, toxic spill specialist, detective) in a rule system that is designed to play out partly in a virtual world and partly in the real world (Klopfer and Squire, in press).

Take *Thief: Deadly Shadows* as an example. *Thief* is a simulated world that is built around light and dark spaces, places good for hiding (dark) and places where one is exposed to detection (light). The world is medieval, filled with police and guards, as well as citizens, some of them well armed. Players must move through this world to accomplish specific goals, but they have little physical power and no powerful weapons for melee combat. Face-to-face confrontations are possible, but difficult and can quickly lead to defeat. The player plays the master thief Garrett, the player's surrogate in the virtual world. Using Garrett's body (which comes equipped with the ability to meld into the shadows), players must move carefully and hide often, engaging in stealth. All the while they are trying to figure out how best to get where they need to be and how best to accomplish their goals; for example, infiltrating a museum and stealing a well-protected precious object. Using and understanding this world (spaces, light conditions, virtual people and objects) and understanding the rule system it incorporates – a system that facilitates some actions, defacilitates others, and makes some others downright impossible – to accomplish various smaller and bigger goals successfully is the win state for the player.

So why would a learning theorist be interested in video games like these? For all sorts of reasons. A good number of these reasons have nothing to do with the fact that video games are games. I will first discuss a few such reasons that have little to do with the fact that video games are games and then turn to some reasons directly connected to the fact that video games are games.

EMBODIED EMPATHY FOR A COMPLEX SYSTEM

Let us go back to those scientific simulations – simulations of things like weather systems, atoms, cells, or the rise and fall of civilizations. Scientists are not inside these simulations in the way in which players are inside the simulated worlds of games like *Thief: Deadly Shadows*. The scientist doesn't 'play' an ant in his or her simulation of an ecosystem. The scientist doesn't discover and form goals from the perspective of the ant in the way I do from the perspective of Garrett in *Thief*.

However, it turns out that, at the cutting edge of science, scientists often talk and think *as if* they were inside not only the simulations they build, but also even the graphs they draw. They try to think from within local regions of the system being simulated, while still keeping in mind the system as a whole. They do this in order to gain a deeper feel for how variables are interacting with the system, for the range of possibilities and impossibilities in the system. Just as a player becomes Garrett, a scientist can talk and think as if they were actually an electron in a certain state or an ant in a colony. For example, consider the following from a physicist talking to other physicists while looking and pointing to a graph on a blackboard (Ochs *et al*., 1996: 328–369):

> But as you go below the first order transition you're
> (leans upper body to right) still
> in the domain structure and you're still trying to get
> (sweeps right arm to left) out of it.
> Well you also said
> (moves to board; points to diagram) the same thing
> must happen here.
> (Points to the right side of the diagram) When
> (moves finger to left) I come down
> (moves finger to right) I'm in
> (moves finger to left) the domain state (pp. 330–331).

Notice the instances of 'you' and 'I'. The scientist talks and acts as if he and his colleagues are moving their bodies not only inside the graph, but also inside the complex system it represents. In reality he is talking about atomic particles and the states they can be in. So, though video games and scientific simulations are not the same thing, a video game can, under the right circumstances, encourage and actually enact a similar 'attitude' or 'stance'. This stance involves a sort of 'embodied empathy for a complex system' where a person seeks to participate in and within a system, all the while seeing and thinking of it as a system and not just local or random events. Squire's (Squire and Jenkins 2004; Squire, 2005) work on *Civilization III* and other games has shown that even young learners can enter a game as a complex system and learn deep conceptual principles about history and the social sciences. Halverson (2005) is designing a video game in which adult educational leaders can use the game to understand modern principles of school leadership within a framework that sees schools as complex systems interacting with a variety of other complex systems.

'ACTION-AND-GOAL-DIRECTED PREPARATIONS FOR, AND SIMULATIONS OF, EMBODIED EXPERIENCE'

Video games don't just carry the potential to replicate a sophisticated scientific way of thinking. They actually externalize the way in which the human mind works and thinks in a better fashion than any other technology we have.

In history, scholars have tended to view the human mind through the lens of a technology they thought worked like the mind. Locke and Hume, for example, argued that the mind was like a blank slate on which experience wrote ideas, taking the technology of literacy as their guide. Much later, modern cognitive scientists argued that the mind worked like a digital computer, calculating generalizations and deductions via a logic-like rule system (Newell and Simon, 1972). More recently, some cognitive scientists, inspired by distributed parallel-processing computers and complex adaptive networks, have argued that the mind works by storing records of actual experiences and constructing intricate patterns of connections among them (Clark, 1989; Gee, 1992). So we get different pictures of the mind: mind as a slate waiting to be written on, mind as software, mind as a network of connections.

Human societies get better through history at building technologies that more closely capture some of what the human mind can do and getting these technologies to do mental work publicly. Writing, digital computers, and networks each allow us to externalize some functions of the mind. Though they are not commonly thought of in these terms, video games are a new technology in this same line. They are a new tool with which to think about the mind and through which we can externalize some of its functions. Video games of the sort I am concerned with are what I would call ‘action-and-goal-directed preparations for, and simulations of, embodied experience’. A mouthful, indeed, but an important one, and one connected intimately to the nature of human thinking; so, let us see what it means.

Let me first briefly summarize some recent research in cognitive science, the science that studies how the mind works (Bransford *et al.*, 2000). Consider, for instance, the remarks below (in the quotes below, the word ‘comprehension’ means ‘understanding words, actions, events, or things’):

> … comprehension is grounded in perceptual simulations that prepare agents for situated action (Barsalou, 1999a: 77)

> … to a particular person, the meaning of an object, event, or sentence is what that person can do with the object, event, or sentence (Glenberg, 1997: 3)

What these remarks mean is this: human understanding is not primarily a matter of storing general concepts in the head or applying abstract rules to experience. Rather, humans think and understand best when they can imagine (simulate) an experience in such a way that the simulation prepares them for actions they need and want to take in order to accomplish their goals (Clark, 1997; Barsalou, 1999b; Glenberg and Robertson, 1999).

Let us take weddings as an example, though we could just as well have taken war, love, inertia, democracy, or anything. You don’t understand the word or the idea of weddings by meditating on some general definition of weddings. Rather, you have had experiences of weddings, in real life and through texts and media. On the basis of these experiences, you can simulate different wedding scenarios in your mind. You construct these simulations differently for different occasions, based on what actions you need to take to accomplish specific goals in specific situations. You can move around as a character in the mental simulation as yourself, imaging your role in the wedding, or you can ‘play’ other characters at the wedding (e.g. the minister), imaging what it is like to be that person.

You build your simulations to understand and make sense of things, but also to help you prepare for action in the world. You can act in the simulation and test out what consequences follow, before you act in the real world. You can role-play another person in the simulation and try to see what motivates their actions or might follow from them before you respond in the real world. So I am arguing that the mind is a simulator, but one that builds simulations to prepare purposely for specific actions and to achieve specific goals (i.e. they are built around win states).

Video games turn out to be the perfect metaphor for what this view of the mind amounts to, just as slates and computers were good metaphors for earlier views of the mind. Video games usually involve a visual and auditory world in which the player manipulates a virtual character (or characters). They often come with editors or other sorts of software with which the player can make changes to the game world or even build a new game world (much as the mind can edit its previous experiences to form simulations of things not directly experienced). The player can make a new landscape, a new set of buildings, or new characters. The player can set up the world so that certain sorts of action are allowed or disallowed. The player is building a new world, but is doing so by using and modifying the original visual images (really the code for them) that came with the game. One simple example of this is the way in which players can build new skateboard parks in a game like *Tony Hawk Pro Skater*. The player must place ramps, trees, grass, poles, and other things in space in such a way that players can manipulate their virtual characters to skate the park in a fun and challenging way.

Even when players are not modifying games, they play them with goals in mind, the achievement of which counts as their 'win state'. Players must carefully consider the design of the world and consider how it will or will not facilitate specific actions they want to take to accomplish their goals. One technical way that psychologists have talked about this sort of situation is through the notion of 'affordances' (Gibson, 1979). An affordance is a feature of the world (real or virtual) that will allow for a certain action to be taken, but only if it is matched by an ability in an actor who has the wherewithal to carry out such an action. For example, in the massive multiplayer game *World of WarCraft* stags can be killed and skinned (for making leather), but only by characters that have learned the skinning skill. So a stag is an affordance for skinning for such a player, but not for one who has no such skill. The large spiders in the game are not an affordance for skinning for any players, since they cannot be skinned at all. Affordances are relationships between the world and actors.

Playing *World of WarCraft*, or any other video game, is all about such affordances. The player must learn to see the game world – designed by the developers, but set in motion by the players, and, thus, co-designed by them – in terms of such affordances (Gee, 2005). Broadly speaking, players must think in terms of 'What are the features of this world that can enable the actions I am capable of carrying out and that I want to carry out in order to achieve my goals?'

The view of the mind I have sketched argues, as far as I am concerned, that the mind works rather like a video game. For humans, effective thinking is more like running a simulation in our heads within which we have a surrogate actor than it is about forming abstract generalizations cut off from experiential realities. Effective thinking is about perceiving the world such that the human actor sees how the world, at a specific time and place (as it is given, but also modifiable), can afford the opportunity for actions that will lead to a successful accomplishment of the actor's goals. Generalizations are formed, when they are, bottom up from experience and imagination of experience. Video games externalize the search for affordances, for a match between character (actor) and world, but this is just the heart and soul of effective human thinking and learning in any situation. They are, thus, a natural tool for teaching and learning.

As a game player you learn to see the world of each different game you play in a quite different way. But in each case you see the world in terms of how it will afford the sorts of embodied actions you (and your virtual character, your surrogate body in the game) need to take to accomplish your goals (to win in the short and long run). For example, you see the world in *Full Spectrum Warrior* as routes (for your squad) between cover (e.g. corner to corner, house to house), because this prepares you for the actions you need to take, namely attacking without being vulnerable to attack yourself. You see the world of *Thief: Deadly Shadows* in terms of light and dark, illumination and shadows, because this prepares you for the different actions you need to take in this world, namely hiding, disappearing into the shadows, sneaking, and otherwise moving unseen to your goal.

While commercial video games often stress a match between worlds and characters like soldiers or thieves, there is no reason why other types of game could not let players experience such a match between the world and the way a particular type of scientist, for instance, sees and acts on the world (Gee, 2004). Such games would involve facing the sorts of problems and challenges that type of scientist does and living and playing by the rules that type of scientist uses. Winning would mean just what it does to a scientist: feeling a sense of accomplishment through the production of knowledge to solve deep problems.

I have argued for the importance of video games as 'action-and-goal-directed preparations for, and simulations of, embodied experience'. They are the new technological arena – just as were literacy and computers earlier – around which we can study the mind and externalize some of its most important features to improve human thinking and learning.

DISTRIBUTED INTELLIGENCE VIA THE CREATION OF SMART TOOLS

Consider how good games distribute intelligence (Brown *et al*., 1989). In *Full Spectrum Warrior*, the player uses the buttons on the controller to give orders to two squads of soldiers (the game *SWAT 4* is also a great equivalent example here). The instruction manual that comes with the game makes it clear from the outset that players, in order to play the game successfully, must take on the values, identities, and ways of thinking of a professional soldier: 'Everything about your squad', the manual explains, 'is the result of careful planning and years of experience on the battlefield. Respect that experience, soldier, since it's what will keep your soldiers alive' (p. 2). In the game, that experience – the skills and knowledge of professional military expertise – is distributed between the virtual soldiers and the real-world player. The soldiers in the player's squads have been trained in movement formations; the role of the player is to select the best position for them on the field. The virtual characters (the soldiers) know part of the task (various movement formations) and the player must come to know another part (when and where to engage in such formations). This kind of distribution holds for every aspect of military knowledge in the game.

By distributing knowledge and skills this way – between the virtual characters (smart tools) and the real-world player – the player is guided and supported by the knowledge built into the virtual soldiers. This offloads some of the cognitive burden from the learner, placing it in smart tools that can do more than the learner is currently capable of doing by themselves. It allows the player to begin to act, with some degree of effectiveness, before being really competent – 'performance before competence'. The player thereby eventually comes to gain competence through trial, error, and feedback, not by wading through a lot of text before being able to engage in activity.

Such distribution also allows players to internalize not only the knowledge and skills of a professional (a professional soldier in this case), but also the concomitant values ('doctrine' as the military says) that shape and explain how and why that knowledge is developed and applied in the world. There is no reason why other professions – scientists, doctors, government officials, urban planners (Shaffer, 2004) – could not be modeled and distributed in this fashion as a deep form of value-laden learning (and, in turn, learners could compare and contrast different value systems as they play different games). Shaffer's (2004, 2005) 'epistemic games' take this principle much further and demonstrate how even young learners, through video games embedded inside a well-organized curriculum, can be inducted into professional practices as a form of value-laden deep learning that transfers to school-based skills and conceptual understandings.

'CROSS-FUNCTIONAL AFFILIATION'

Consider a small group partying (hunting and questing) together in a massive multiplayer game like *World of WarCraft*. The group might well be composed of a Hunter, Warrior, Druid, Mage, and Priest. Each of these types of character has quite different skills and plays the game in a different way. Each group member (player) must learn to be good at his or her special skills and also learn to integrate these skills as a team member within the group as a whole. Each team member must also share some common knowledge about the game and game play with all the other members of the group – including some understanding of the specialist skills of other player types – in order to achieve a successful integration. So each member of the group must have specialist knowledge (intensive knowledge) and general common knowledge (extensive knowledge), including knowledge of the other member's functions.

Players – who are interacting with each other in the game and via a chat system – orient to each other not in terms of their real-world race, class, culture, or gender (these may very well be unknown or, if communicated, made up as fictions). They must orient to each other, first and foremost, through their identities as game players and players of *World of WarCraft* in particular. They can, in turn, use their real-world race, class, culture, and gender as strategic resources if and when they please, and the group can draw on the differential real-world resources of each player, but in ways that do not force anyone into preset racial, gender, cultural, or class categories.

This form of affiliation – what I will call cross-functional affiliation – has been argued to be crucial for the workplace teams in modern 'new capitalist' workplaces, as well as in contemporary forms of social activism (Gee *et al*., 1996; Beck, 1999; Gee, 2004). People specialize, but integrate and share, organized around a primary affiliation to their common goals and using their cultural and social differences as strategic resources, not as barriers.

Let me say here, too, that what is really important about today's massive multiplayer games, like *World of WarCraft*, *Lineage*, *EverQuest*, *City of Heroes*, and *Guild Wars*, is the ways in which, sometimes for better and sometimes for worse, people are creating new ways to build and share knowledge. They are also forming new forms of learning communities. We have much to learn from these games about new ways to organize learning socially in tomorrow's classrooms, libraries, workplaces, and communities (Steinkuehler, 2005, 2006).

SITUATED MEANING

Words have different and specific meanings in different situations in which they are used and in different specialist domains that recruit them (Gee, 2004). This is true of the most mundane cases. For instance, notice the change in meaning in the word 'coffee' in the following sentences which refer to different situations: 'The coffee spilled, go get the mop' (coffee as liquid), 'The coffee spilled, go get a broom' (coffee as grains), 'The coffee spilled, stack it again' (coffee in cans). Or notice the quite different meanings of the word 'work' in everyday life and in physics (e.g. I can say, in everyday life, that I worked hard to push the car, but if my efforts didn't move the car, I did no 'work' in the physics sense of the word).

A good deal of school success is based on being able to understand complex academic language (Gee, 2004) – like the text printed below from a high-school science textbook. Such a text can be understood in one of two different ways: either verbally or in a situated fashion. When students understand such language only verbally, they can trade words for words; that is, they can replace words with their definitions. They may be able to pass paper-and-pencil tests, but they often cannot use the complex language of the text to facilitate real problem solving, because they don't actually understand how the language applies to the world in specific cases for solving such problems. If they do understand how the words apply to specific situations and for specific problem solutions, they understand the words in a situated fashion. We have known for years now that a great many school students can get good grades on paper-and pencil-tests in science, but they can't use their knowledge to solve actual problems (Gardner, 1991).

> The destruction of a land surface by the combined effects of abrasion and removal of weathered material by transporting agents is called erosion. … The

production of rock waste by mechanical processes and chemical changes is called weathering.

People acquire situated meanings for words – that is, meanings that they can apply in actual contexts of use for action and problem solving – only when they have heard these words in interactional dialogue with people more expert than themselves (Tomasello, 1999) and when they have experienced the images and actions to which the words apply (Gee, 2004). Dialogue, experience, and action are crucial if people are to have more than just words for words, if they are to be able to cash out words for experiences, actions, functions, and problem solving. They must be able to build simulations in their minds of how the words are used in talk and action in different specific contexts. As they can do this for more and more contexts of use, they generalize the meanings of the word more and more, but the words never lose their moorings in talk, embodied experience, action, and problem solving.

Since video games are 'action-and-goal-directed preparations for, and simulations of, embodied experience' they allow language to be put into the context of dialogue, experience, images, and actions. They allow language to be situated. Furthermore, good video games give verbal information 'just in time' (i.e. near the time it can actually be used) or 'on demand' (i.e. when the player feels a need for it and is ready for it) (Gee, 2003). They do not give players lots and lots of words out of context before they can be used and experienced or before they are needed or useful. This is an ideal situation for language acquisition, for acquiring new words and new forms of language for new types of activity, whether this is by being a member of a SWAT team or a scientist of a certain sort.

OPEN-ENDEDNESS: GOALS AND PROJECTS THAT MELD THE PERSONAL AND THE SOCIAL

We need to say more about goals, since this leads to yet another good reason why video games are good for learning. In a video game, the player 'plays' a character or set of them. The player must discover what goals this character has within the game world and carry them out, using whatever abilities the character has (remember affordances and smart tools). In *Thief: Deadly Shadows*, the player comes to realize that Garrett has specific goals that require stealth, for which Garret is well suited, to carry out. These are the 'in-game' goals the player must discover and carry out.

But in good open-ended games, games like *The Elder Scrolls III: Morrowind*, *Arcanum*, *The Sims*, *Deus Ex 2*, *Mercenaries*, *Grand Theft Auto*, and many more, players also make up their own goals, based on their own desires, styles, and backgrounds. The player must then attribute these personal goals to the virtual character and must consider the affordances in the virtual world (psych out the rule system) so as to get these personal goals realized along with the virtual character's more purely 'in-game' goals.

For example, in *The Elder Scrolls III: Morrowind*, a player may decide to eschew heavy armor and lots of fighting in favor of persuasive skills, stealth, and magic, or the player can engage in lots of face-to-face combat in heavy armor. The player can carry out a linear sequence of quests set by the game's designers or can make up his or her own quests, becoming so powerful that the designer's quests become easy and only a background feature of the game. In *Grand Theft Auto III* , the player can be evil or not (e.g. the player can jump in ambulances and do good deeds), can do quests in different orders, and can play or not play large pieces of the game (e.g. the player can trigger gang wars or avoid them altogether). Even in less open-ended games, players, even quite young ones, set their own standards of accomplishment, replaying parts of the game so that their hero pulls things off in the heroic fashion and style the player deems appropriate.

This marriage of personal goals and 'in-game' goals is a highly motivating state. When a person is learning or doing science, they must discover and realize goals that are set up by the scientific enterprise as a domain and as a social community. These are equivalent to 'in-game' goals. But they also, when effective, marry these goals to their own personal goals, based on their own desires, styles, and backgrounds. They try to be scientists of a certain type. When they do this, there is no great divide between their scientific identity and their 'life world', their personal and community-based identities and values. Good video games readily allow such a marriage; good science instruction should, too.

This issue of marrying personal and 'in-game' goals leads to the issue of identity. Video games are all about identity. The player 'plays' some character; the player takes on, carries out, and identifies with some special identity in a virtual world. When I have married my personal goals and values to the virtual character's 'in-game' goals, I see the game as both a *project* that the game designers have given to me and, simultaneously, I *project* my own goals, desires, values, and identity into the game world, melded with the 'in-game' identity and goals of the virtual character. The 'project' now becomes 'mine' and not just something imposed on me, because I have 'projected' myself into it.

Good science instruction should involve, as well, a marriage of *science's* goals and mine. I should see the project given to me by the classroom or the current state of science as something into which I can also project my own goals, values, desires, and identities. Good science instruction should, then, be 'open ended' in the way in which some good video games are.

LEARNING FEATURES CONNECTED TO GAMES AS GAMES

In addition to the learning features we have discussed thus far – features that are not directly connected to the fact that video games are games – there is a bevy of learning features (features that make video games good examples of good learning) that are more directly connected to the fact that video games are games. I will briefly discuss some of these features here.

First, good learning requires that learners feel like active agents (producers), not just passive recipients (consumers). In a video game, players make things happen. Players don't just consume what the 'author' (game designer) has placed before them. Video games are interactive. The player does something and the game does something back that encourages the player to act again. In good games, players feel that their actions and decisions – not just the designers' actions and decisions – are co-creating the world they are in and the experiences they are having. What the player does matters, and each player, based on their own decisions and actions, takes a different trajectory through the game world.

The Elder Scrolls: Morrowind is an extreme example of a game where each decision the player makes changes the game in ways that ensure that each player's game is, in the end, different from any other player's. But at some level this is true of most games. Players take different routes through *Castlevania: Symphony of the Night* and do different things in different ways in *Tony Hawk's Underground*.

Second, people cannot be agents of their own learning if they cannot make decisions about how their learning will work. At the same time, they should be able (and encouraged) to try new styles. Good games achieve this goal in one (or both) of two ways. In some games, players are able to customize the game play to fit their learning and playing styles. In others, the game is designed to allow different styles of learning and playing to work. For example, *Rise of Nations* allows players to customize myriad aspects of the game play to their own styles, interests, and desires. *Deus Ex* and its sequel *Deus Ex: Invisible War* both allow quite different styles of play and, thus, learning, to succeed.

Third, deep learning requires an extended commitment, and such a commitment is powerfully recruited when people take on a new identity they value and in which they become heavily invested (diSessa 2000), whether this be a child 'being a scientist doing science' in a classroom or an adult taking on a new role at work. Good games offer players identities that trigger a deep investment on the part of the player. They achieve this goal in one of two ways. Some games offer a character so intriguing that players want to inhabit the character and can readily project their own fantasies, desires, and pleasures onto the character. Other games offer a relatively empty character whose traits the player must determine, but in such a way that the player can create a deep and consequential life history in the game world for the character.

For example, *Metal Solid Gear* offers a character (Solid Snake) that is so well developed that he is, though largely formed by the game's designers, a magnet for player projections. *Animal Crossing* and *The Elder Scrolls: Morrowind* offer, in different ways, blank-slate characters for which the player can build a deeply involving life and history.

Fourth, given human creativity, if learners face problems early on that are too free-form or too complex, they often form creative hypotheses about how to solve these problems, but hypotheses that don't work well for later problems, even for simpler ones, let alone harder ones (Gee, 2004). They have been sent down a 'garden path'. The problems learners face early on are crucial and should be well-designed to lead them to hypotheses that work well, not just on these problems, but as aspects of the solutions of later, harder problems, as well. Problems in good games are well ordered. In particular, early problems are designed to lead players to form good guesses about how to proceed when they face harder problems later on in the game. In this sense, earlier parts of a good game are always looking forward to later parts.

Fifth, learning works best when new challenges are pleasantly frustrating in the sense of being felt by learners to be at the outer edge of, but within, their 'regime of competence' (diSessa 2000). That is, these challenges feel hard, but doable. Furthermore, learners feel (and get evidence) that their effort is paying off in the sense that they can see, even when they fail, how and if they are making progress. Good games adjust challenges and give feedback in such a way that different players feel the game is challenging but doable and that their effort is paying off. Players get feedback that indicates whether they are on the right road for success later on and at the end of the game. When players lose to a boss, perhaps multiple times, they get feedback about the sort of progress they are making so that at least they know if and how they are moving in the right direction towards success.

Sixth, expertise is formed in any area by repeated cycles of learners practicing skills until they are nearly automatic, then having those skills fail in ways that cause the learners to have to think again and learn anew (Bereiter and Scardamalia, 1993). Then they practice this new skill set to an automatic level of mastery only to see it, too, eventually be challenged. In fact, this is the whole point of levels and bosses. Each level exposes the players to new challenges and allows them to get good at solving them. They are then confronted with a boss that makes them use these skills together with new ones they have to learn, and integrate with the old ones, to beat the boss. Then they move on to a new level and the process starts again. Good games create and support the cycle of expertise, with cycles of extended practice, tests of mastery of that practice, then a new challenge, and then new extended practice. This is, in fact, part of what constitutes good pacing in a game.

Seventh, failure works very differently in good video games than it does in school, for example. In a good video game, players are encouraged to take risks, explore, and try new things, because the price of failure is not terribly high. If the player fails, then they can start back at the last game save or checkpoint. Furthermore, failure in games is seen by players as crucial to learning. No player expects or even wants to beat a boss on the first try. Rather, the player expects to learn from failing to kill the boss initially what patterns to look for and how to do better on the next chance.

CONCLUSION: BEYOND COMMERCIAL GAMES

None of this is to say that video games do these good things all by themselves. It all depends on how they are used and what sorts of wider learning systems (activities and relationships) they are made a part of. None of these reasons why video games are good for learning stems primarily from a game's great three-dimensional graphics and many of them do not stem from the fact that a video game is a game in the general sense of 'game'. The cutting edge of games and learning is not in video game technology – although great graphics are wonderful and technical improvements are important. The cutting edge is realizing the potential of games for learning by building good games into good learning systems in and out of classrooms and by building the good learning principles in good games into learning in and out of school whether or not a video game is present.

Our discussion has centered around commercial games. However, thanks to the fact that commercial industry is part of the larger global media entertainment complex, such games stress content that is, for the most part, not academic or socially activist (though there are exceptions like *Civilization*). So called 'serious games' devoted to such content are beginning to appear, games like *A Force More Powerful* (devoted to the spread of democracy), *Re-Mission* (a game to help and inform young cancer patients), or *Dimenxian* (a shooter recruiting algebra learning). One key question for some educators has been whether the learning principles in commercial games can be moved effectively into games teaching more school-based content, though not in ways traditionally associated with formal schooling.

One of many current examples of such games, and the research associated with them, is an 'epistemic game' designed by David Shaffer called *Madison 2020*. In this project, Shaffer and Kelly Beckett at the University of Wisconsin have developed, implemented, and assessed a game and accompanying learning system that simulates some of the activities of professional urban planners (Beckett and Shaffer, 2004; Shaffer, 2007; see also Shaffer *et al*. (2005)).

Shaffer and Beckett call their approach 'augmented by reality', since a virtual reality (i.e. the game) is augmented or supplemented by real-world activities, in this case further activities of the sort in which urban planners engage. As in the commercial game *SimCity*, students in Shaffer and Beckett's game make land-use decisions and consider the complex results of their decisions. However, unlike *SimCity*, they use real-world data and authentic planning practices to inform those decisions.

Shaffer and Beckett argue that the environmental dependencies in urban areas have the potential to become a fruitful context for innovative learning in ecological education. Cities are comprised of simple components, but the interactions among those components are complex. Altering one variable affects all the others, reflecting the interdependent, ecological relationships present in any modern city. For example, consider the relationships among industrial sites, air pollution, and land property values: increasing industrial sites can lead to pollution that, in turn, lowers property values, changing the dynamics of the city's neighborhoods in the process.

Shaffer and Beckett's *Madison 2020* project situated student experience at a micro level by focusing on a single street in their own city (Madison, Wisconsin):

> Instead of the fast-paced action requires to plan and maintain virtual urban environments such as *SimCity*, this project focused only on an initial planning stage, which involved the development of a land use plan for this one street. And instead of using only a technological simulation [i.e., the game, JPG], the learning environment here was orchestrated by authentic urban planning practices. These professional practices situated the planning tool in a realistic context and provided a framework within which students constructed solutions to the problem (Beckett and Shaffer, 2004: 11–12).

Professional urban planners must formulate plans that meet the social, economic, and physical needs of their communities. To align with this practice, students received an informational packet addressed to them as city planners. The packet contained a project directive from the mayor, a city budget plan, and letters from concerned citizens providing input about how they wished to see the city redesigned. The directive asked the student city planners to develop a plan that, in the end, would have to be presented to a representative from the planning department at the end of the workshop.

Students then watched a video about State Street, featuring interviews with people who expressed concerns about the street's redevelopment aligned with the issues in the informational packet (e.g. affordable housing). During the planning phase, students walked to State Street and conducted a site assessment. Following the walk, they worked in teams to develop a land-use plan using a custom-designed interactive geographic information system called MadMod built into a *SimCity*-like game.

MadMod allows students to see a virtual representation of State Street. It has two components, a decision space and a constraint table. The decision space displays address and zoning information about State Street using official two- or three-letter zoning codes to designate changes in land use for property parcels on the street. As students made decisions about changes they wished to make, they received immediate feedback about the consequences of changes in the constraint table. The constraint table showed the effects of changes on six planning issues raised in the original information packet and the video: crime, revenue, jobs, waste, car trips, and housing. Following the professional practices of urban planners, in the final phrase of the workshop, students presented their plans to a representative from the city planning office.

Students are gaming at two levels in *Madison 2020*: within a virtual *SimCity*-like world and via role-playing in the real world. Of course, *Madison 2020* in some respects stretches the notion of a game. In my view, video games are simulations that have 'win states' in terms of goals that players have set for themselves. In this case, the students have certain goals and the game lets them see how close or far they are from attaining those goals. At the same time, the game is embedded in a learning system that ensures that those goals and the procedures used to reach them are instantiations of the professional practices and ways of knowing or urban planners.

Shaffer and Beckett show, through a pre-interview/post-interview design, that students learning through the game were able to provide more extensive and explicit definitions of the term 'ecology' after their learning experience than before it. The students' explanations of ecological issues in the post-interview were more specific than they were in the pre-interview about how ecological issues are interdependent or interconnected. Concept maps that the students drew showed an increased awareness of the complexities present in an urban ecosystem. Thus, students appear to have developed a richer understanding of urban ecology through their work in the project.

All of the students said the workshop changed the way they thought about cities, and most said the experience changed the things they paid attention to when walking down a city street in their neighborhood. Better yet, perhaps, Shaffer and Beckett were able to show transfer: students' responses to novel, hypothetical urban planning problems showed increased awareness of the interconnections among urban ecological issues. All these effects suggest, as Shaffer and Beckett argue, 'that students were able to mobilize understanding developed in the context of the redesign of one local street to think more deeply about novel urban ecological issues' (Beckett and Shaffer, 2004: 21).

We seem now far from a commercial game like *Thief*, though not so far from *SimCity*; but, in reality, all these games cause players to look at and live in a world in a distinctive way, to find patterns, and to solve problems. And these games give players the tools with which to accomplish these goals. *Madison 2020* simply builds a more comprehensive learning system around the game and more integrally relates the game to the real world. In the end, however, it is an open research question as to how far we can go in moving the learning principles in good commercial games outside the entertainment sphere those games inhabit and the distinctive pleasures they offer.

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