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Are Video Games Good for Learning?

A new research field is emerging around the hypothesis that video games are good for learning (Shaffer, Squire, Halverson & Gee, in press; Gee, 2003; 2005). This hypothesis amounts to two claims. First, good commercial games are built on sound learning principles (Gee, 2003), principles supported by research in the Learning Sciences (Bransford, Brown & Cocking, 2000). And, second, video game technologies hold out great promise, beyond entertainment, for building new learning systems for serious purposes in and out of school.

There are, of course, different types of video games, types which may well be better or worse suited for different learning goals. We can make a distinction between two major types of games, what I call "problem games" and "world games", though the distinction is not air-tight. Problem games focus on solving a given problem or class of problems (e.g. *Tetris*, *Diner Dash*), while world games simulate a wider world within which, of course, the player may solve many different sorts of problems (e.g. *Half-Life*, *Rise of Nations*). Classic early arcade games like *Super Mario* sit right at the border of this division.

The features of video games that hold out promise for good learning lead to key questions for research in the emerging field of games and learning. I will sketch some of these features and the accompanying research questions to which they lead. Some of the features that appear to make video games good for learning have little to do with the fact that they are games. Other features are more directly related to the "gameness" of video games. I start with features which have little to do with the fact that video games are games and then turn to features more directly connected with video games as games of a certain sort. However, we have to keep in mind that the "non-game" features may not work as well for learning if they are detached from the "game" features. This, at least, is one key question for research.

1. Empathy for a Complex System

Consider 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*. The scientist doesn't "play" an ant in his or her simulation of an eco-system. The scientist doesn't discover and form goals from the perspective of the ant in the way a player does 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 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 to gain a deeper feel for how variables interact with the system. Just as a player becomes Garrett, a scientist can talk and think as if he or she were actually an electron in a certain state or an ant in a colony. For example, consider the following well-known example of a physicist talking to other physicists while looking and pointing to a graph on a blackboard (Ochs, Gonzales & Jacoby, 1996, pp. 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 "you's" and "I's". The scientist talks and acts as if he and his colleagues are moving their bodies not only inside the graph, but inside the complex system it represents, as well.

A key research question that arises here, then, is this: though video games and scientific simulations are not the same thing, can video games, under the right circumstances, encourage and actually enact a similar "attitude" or "stance" to the one taken by scientists studying complex systems? 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. This does, indeed, seem to be the stance players take when they play as Garrett in a game like *Thief* and seek to figure out the rule system that underlies the virtual world through which Garrett (and they) moves. We can go on to ask whether video games could create such empathy for the sorts of complex systems relevant to academic and other domains outside of entertainment (e.g., urban planning, space exploration, or global peace).

2. Simulations of Experience and Preparations for Action

Video games don't just carry the potential to replicate a sophisticated scientific way of thinking, they may actually externalize the way in which the human mind works and thinks in a better fashion than any other technology we currently have. Consider, in this regard, some recent research in the Learning Sciences [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, p. 77)

> … higher intelligence is not a different kind of process from perceptual intelligence. (Hawkins, 2004, p. 96)

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 (Barsalou, 1999b; Clark, 1997; Glenberg & Robertson, 1999). Effective thinking is about perceiving the world in such a way 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 are external (i.e., not mental) simulations of worlds or problem spaces in which the player must prepare for action and the accomplishment of goals from a particular perspective. Gamers learn to see the world of each different game in a quite different way. But in each case they must learn to see the virtual world in terms of how it will afford the sorts of actions they (where "they" means a melding of themselves and their virtual character) need to take to accomplish their goals (to win in the short and long run).

For example, players see the world in *Full Spectrum Warrior* as routes (for a squad) between cover (e.g., corner to corner, house to house), because this prepares them for the actions they need to take, namely attacking without being vulnerable to attack. They see the world of *Thief* in terms of light and dark, illumination and shadow, because this prepares them for the different actions they 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 offer worlds in which players prepare for the actions of soldiers or thieves, the question arises as to whether other types of games could let players prepare for action from different perspectives or identities such as a particular type of scientist, political activist, or global citizen, for instance. If games could play this role, they would speak to one of the deeper problems of education, the fact that many students who can pass paper and pencil tests cannot actually apply their knowledge to real problem-solving (Gardner, 1991).

3. Distributed Intelligence via the Creation of Smart Tools

Good video games distribute intelligence (Brown, Collins & Dugid, 1989) between a real-world person and artificially intelligent virtual characters. For example, 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 professional 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 him or herself. 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. This suggests an important question for research: whether and how other "professions"—scientists, doctors, government officials, urban planners, political activists (Shaffer, 2004)—could 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" already give us a good indication that 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. However, much work remains to be done here in making the case that the knowledge, skills, and values that good games offer transfer to school and, in particular, to students' learning in traditional content areas.

4. "Cross-Functional Teams"

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 character types has quite different skills and plays the game in a different way. Each group member 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 (for better or worse) 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 pre-set racial, gender, cultural, or class categories.

This form of affiliation—what I 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, for example, in the Green movement (Beck, 1999; Gee, 2004; Gee, Hull & Lankshear, 1996). People specialize, but integrate and share, as well. They organize around a primary affiliation to their common goals and use their cultural and social differences as strategic resources, not as barriers. The crucial research questions here are whether such collaborative work in commercial games transfers to collaborative abilities in other settings and whether good video games designed around other sorts of content can teach collaboration and cross-functional teamwork for institutions like schools and workplaces. The Army, in particular, has made this assumption in regard to games like *America's Army*, but it remains to be empirically demonstrated in other domains.

5. Situated Meaning

Words do not have just general dictionary-like meanings. They 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 utterances 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 can't 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. But if and when they do come to understand how the words apply to specific situations and for specific problem solutions, then 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, for example, but 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 relate words to actual experiences, actions, functions, and problem-solving. 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 simulations of experience, they can put language 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"—near the time it can actually be used—or "on demand", when the player feels a need for it and is ready for it (Gee, 2003). They don't 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 would seem to be an ideal situation for acquiring new words and new forms of language for new types of activity, whether this be being a member of a SWAT team or a scientist of a certain sort. Given the importance of oral and written language development (e.g., vocabulary) to school success, it is crucial that this assumption be tested both in terms of the language players pick up from commercial games (e.g., young children playing *Yu-Gi-Oh*, a game that contains very complex language, indeed) and in terms of how games can be made and used for the development of specifically school-based (or other institutional) language demands.

6. Open-Endedness: Melding the Personal and the Social

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. In *Thief*, the player comes to realize that Garrett has specific goals that require stealth (for which Garrett 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 (figure out the rule system) in order 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 (for example, he or she 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 people are 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. 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. The research question here, then, is whether and how we could use video games to better achieve this marriage of "in game" goals (i.e., the goals that flow from an academic area or from the teacher) and personal goals and learning styles for school learning and learning in other sites.

7. Games as Games

So far I have discussed features of good video games that I believe facilitate good learning, but which are features not closely tied to the fact that video games are games. These features were:

1. Video games can create an embodied empathy for a complex system.
2. They are simulations of embodied experience.
3. They involve distributed intelligence via the creation of smart tools.
4. They create opportunities for cross-functional affiliation.
5. They allow meanings to be situated.
6. They can be open-ended, allowing for goals that meld the personal and the social.

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 embedded within. And this, indeed, raises one of the most important research questions for the field of games and learning: What sorts of wider learning systems ought games to be embedded within if we are to leverage their powers for learning to the greatest degree? With what other activities—in game and out of game—ought they to be paired? What are the most effective roles for teachers in these learning systems?

The features we have looked at don't speak directly to video games as games (and games of a certain sort) and, indeed, these features all seem to be somewhat removed from the pleasures that games as games give us humans. However, it is certainly a leading question for research whether these features will work for learning well, or as well, if they are not embedded in video games that not only have these features but are good games, as well. What are the features that make a video game a game and a good game? What are the sources of the pleasures people draw from video games? How do these features relate to learning?

Hardly anyone has failed to notice how profoundly motivating video games are for players. Players focus intently on game play for hours at a time, solving complex problems all along. In an "attentional economy", where diverse products and messages, not to mention school subjects, compete for people's limited attention, video games draw attention in a deep way. It is clearly a profoundly important subject for research to understand the source or sources of this motivation. Such motivation is clearly foundational for learning.

Oddly enough, one hypothesis here is that it is problem-solving and learning, as well as the display of mastery, that are themselves a key source of motivation in good video games. If this is true, then, we need to know why learning and mastery is so motivating in this context and not always as motivating in school. Here another hypothesis would be that learning and mastery are motivating in good video games precisely because they use the sorts of deep learning principles we have just discussed above, as well as others. But, of course, we need to know whether, when the content of a video game is based on more academic or specialized learning goals, the same sorts of effects can occur. Some people assume that things like science can never be made as enticing as fighting fictional wars in *America's Army* or running a family in *The Sims*, for example—but I know of no good scientist who does not find science motivating, entertaining, and life enhancing.

There are certainly features connected with video games as games that help explain both the motivation they recruit and the learning they enable. First, the role of failure is very different in video games from what it is in school. In good games, the price of failure is lowered—when players fail, they can, for example, start over at their last saved game. Furthermore, failure—for example, a failure to kill a boss—is often seen as a way to learn the underlying pattern and eventually to win. These features of failure in games allow players to take risks and try out hypotheses that might be too costly in places where the cost of failure is higher or where no learning stems from failure.

Every gamer and game scholar knows that a great many gamers, including young ones, enjoy competition with other players in games, either one-on-one or team-based. It is striking that many young gamers see competition as pleasurable and motivating in video games, but not in school. Why this is so ought to be a leading question for research on games and learning. One thing seems evident, namely that competition in video games is seen by gamers as social and is often organized in ways that allow people to compete with people at their own level or as part and parcel of a social relationship that is as much about gaming as winning and losing. Furthermore, gamers highly value collaborative play, for example, two people playing *Halo* together to beat the game or the grouping in massive multiplayer games like *World of WarCraft*. Indeed, collaboration and competition often seem to be closely related and integrated in gaming, though not in school.

Beyond issues of motivation, failure, competition, and collaboration, the very ways in which games are designed as games seem to give them features that enhance both learning and a sense of mastery. This is a hypothesis that needs testing. Nonetheless, there are some features of the very design of video games that appear to be closely associated with well-known principles of learning. I list some of these design features below:

1. **Interactivity:** In a video game, players make things happen; they don't just consume what the "author" (game designer) has placed before them. In good games, players feel that their actions and decisions—and 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 his or her own style, decisions, and actions, takes a somewhat different trajectory through the game world. The more open-ended a game is the more true this is, though in a more limited sense it is true of all games, since players must play them and play is a form of simultaneous "reading" (interpreting) and "writing" (producing). All deep learning involves learners feeling a strong sense of ownership and agency, as well as the ability to produce and not just passively consume knowledge.
2. **Customization**: In some games, players are able to customize the game play to fit their learning and playing styles, for example through different difficulty levels or the choice of playing different characters with different skills. In others, the game is designed to allow different styles of learning and playing to work (e.g., there are multiple ways to solve the problems in the game), for example, in the *Deus Ex* games and role-playing games like *Arcanum*. Customization, in the sense of catering to different learning styles and multiple routes to success, is an important learning principle in many different areas.
3. **Strong identities:** Good games offer players identities that trigger a deep investment on the part of the player. This identity is often connected with a specific virtual character, though sometimes it is attached to a whole "civilization" (as in *Civilization* or *Rise of Nations*). When gamers are playing characters, strong identities are achieved 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 (e.g., Solid Snake in the *Metal Gear Solid* games). 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 (e.g., in role-playing games like *The Elder Scrolls III: Morrowind*). Furthermore, in games, the identity of the character one plays is very clearly associated with the sorts of functions, skills, and goals one has to carry out in the virtual world. Many people have argued that identity (e.g., "being-doing a scientist" in order to learn science) in this sense is crucial for deep learning (e.g., Gee, 2004; diSessa, 2000; Shaffer, 2004).

4. **Well-ordered problems:** 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. This is part of what good level design is all about. Work on the mind and learning which takes a connectionist approach has argued that such ordering is crucial for effective learning in complex domains (e.g., Elman, 1991a, b).
5. **Games are pleasantly frustrating:** Good games adjust challenges and give feedback in such a way that different sorts of 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 to 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. DiSessa (2000) has argued that such pleasant frustration is an optimal state for learning things like science.
6. **Games are built around the cycle of expertise:** Good games create and support what has been called in the Learning Sciences the "cycle of expertise" (Bereiter & Scardamalia, 1993), with repeated cycles of extended practice, tests of mastery of that practice, then a new challenge that leads new practice and new mastery. This is, in fact, part of what constitutes good pacing in a game.
7. **"Deep" and "fair":** These are terms of art in the gaming community. A game is "fair" when it is challenging, but set up in a way that leads to success and does not design in features that virtually ensure failure over which the player has little or no control. A game is "deep" when game play elements (e.g., a fighting system in a turn-taking game) that initially seem simple, and, thus, easy to learn and use, become more and more complex the more one comes to master and understand them. Such terms, it would seem, would make good terms of art in the Learning Sciences as well.

These are all basic features of the way many games are designed. They also appear to be important features for effective learning. Thus, they raise the question as to whether the sorts of features we discussed earlier—the ones less connected with games as games—are rendered more effective when in the presence of these more directly game-like features.

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