

Educational Technology (in press)

Games and (Preparation for Future) Learning

Jessica Hammer

jh2354@columbia.edu

Graduate student

Teachers College, Columbia University

John Black

black@tc.columbia.edu

Cleveland E. Dodge Professor of Telecommunications and Education

Teachers College, Columbia University

www.tc.columbia.edu

WWW.ALHASSANAIN.ORG/ENLGIH

Table of Contents

[Preface]	3
Evidence for Learning from Games	4
The PFL Approach	5
Implications for Education	7
Implications for Design	10
Call to Action	12
References	14

[Preface]

Our generation is not the first to consider games and play as tools for learning. Play has often been framed as a crucial element in child development (Sutton-Smith, 1997), and therefore has been welcomed into the classroom, particularly for young children. While games have had a somewhat less friendly reception, this is rapidly changing. Driven by a multi-billion-dollar digital game market, games are receiving more serious critical attention from both academics and educators - and, correspondingly, more serious thought about how they can be deployed for learning.

Clark (2007) and others have called for a deeper investigation of the educational value of “serious” games, which claim to provide learning value. If we intend to use these games to teach, we owe it to our students to understand their educational merits. However, such an investigation must go beyond the simple question of whether students can learn from games. We must consider the models by which we expect such learning to occur, which games we consider “serious,” what makes particular games effective, and how we can take advantage of the “gameness” of games (McLuhan, 1964). By this last, we mean not only the passionate engagement with which people play, but also the game’s ability to model systems and the vicarious experience that players gain during play.

This paper outlines one possible approach to learning from games, which builds on the *preparation for future learning* model developed by Bransford and Schwartz (2001). We argue that games can support classroom learning, given proper attention to the deep structure of games and how players genuinely engage with that structure. Given the results of our first research study exploring this theoretical model, we make recommendations for how this theory can shape our educational practices around games.

Evidence for Learning from Games

The evidence for learning from games is distinctly mixed. A recent review of the literature found highly equivocal evidence for games and classroom learning (Chen and O'Neil, 2005). However, when learning is considered more broadly, there is strong evidence that game-play can help players learn.

Spatial and attention skills, for example, correlate positively with game-play (De Lisi & Wolford, 2002; Green & Bavelier, 2003; Greenfield, deWinstanley, Kilpatrick & Kaye, 1994), while game-playing surgeons completed laparoscopic surgeries 27% faster than their non-game-playing peers, and with 37% fewer errors (Rosser & Lynch, 2004). Game-players, like bilingual people, surpass mono-lingual people at mental flexibility and switching between cognitive tasks. These skills correlate with life-long mental acuity and ability (Bialystok, 2006).

Games designed to teach specific skills have yielded some positive and some mixed results. Games have been quite successful at teaching children how to cope with chronic diseases, for one (Lieberman, 2001). Barab's work with *Quest Atlantis* has had promising results, increasing students' learning of science and social studies (Barab, Dodge, Jackson & Arici, 2003). Squire's work on *Civilization* also seems promising for fostering engagement and learning (Squire, 2004). However, other research on games teaching history in a classroom setting has yielded mixed results (Egenfeldt-Nielsen, 2005). While the game-playing group of students showed more engagement with the topic, they performed worse on the final learning measures than a control class.

The bulk of these studies are tied to particular models of *how* games support learning - whether through situated cognition, participation in communities of practice, anchored learning or role engagement. But there are also questions of *in what context* games support learning. Are games a replacement for classroom learning, as Prensky (2005) suggests? In that case, the standard of proof must compare learning from games to learning in traditional classroom formats.

The classroom, however, is not where most play takes place. People choose play games on their own time as a leisure activity, and do - some for upwards of forty hours a week! Few individuals similarly commit their time to, for example, reading history textbooks. Our model, therefore, chooses to look at the academic benefits of naturalistic, in-the-wild game-play. We must reorganize our theories, and our notions of what makes good research, to match.

The PFL Approach

We recognize that there are serious structural challenges to bringing games into the classroom. Some are practical: for example, games are expensive to build and take a long time for students to master. Others have to do with the differing agendas of games and classrooms, and the structural and institutional differences between them (Hammer & Crosbie, 2005). However, there is no reason why learning activities cannot leverage what games already do remarkably well: encourage people to play them in their leisure time.

Rather than argue that games belong in the classroom - an argument we leave to others - we choose to investigate the value of leisure play. Can leisure play support classroom learning? And if so, how does it do so? Games clearly do something *different* from, say, a lecture or a problem set. How can we leverage the unique advantages of play to help people learn in more formal settings?

In addressing the question of whether games support future learning, we have chosen to use the theory of "Preparation for Future Learning," or, for short, PFL. This theory is articulated by Bransford & Schwartz (2001), who argue for a reconceptualization of transfer. Rather than focusing on the ability to transfer specific information to a new context, they suggest that active experiences with a domain - even in an informal context - prepare students effectively for future formal learning. This draws on the work of Dewey (1938), who argued that learners constructed knowledge based on their former experiences in the real world. By providing an enriched set of experiences, learning as well could be enhanced.

We believe that leisure game-play can provide meaningful prior experiences that directly support players' later academic learning. This argument is based, not on a game's "face validity" for academic concepts, but rather on the underlying processes that games incorporate. Building on theories of game-play as process-oriented (Zimmerman & Salen, 2005; Lindley, 2002), we propose that players focus not only on the *apparent* content of a game, but also on the processes and systems that underlie it. Players develop a body of knowledge about how *systems* work that they absorb from games, but cannot necessarily articulate.

Measures of future learning, therefore, should include not only the obvious tests of whether students have adopted the language and content that appears in a game. It must also measure the complexity and sophistication of their ideas about how the learning domain works. If games support future learning at all, they are likely to support learning that is deep and sophisticated, providing players with new ways of thinking and constructing knowledge.

From a PFL point of view, game-play enriches future formal learning experiences. Time spent playing the game is both valuable and pleasurable - but the positive learning effects come about when the game's virtual experience is later evoked in a formal context. The game allows students to get more out of their classroom time. It heightens the impact of formal learning, precisely because students are better prepared for it.

Our research model builds on this understanding of future learning (Hammer, Black, Andrews, Zhou & Kinzer, 2006). We examined two games which connect closely to particular knowledge domains - *Civilization*, which explores the domain of history, and *SimCity*, which relates to the domain of urban planning. By comparing the learning rates of *SimCity* experts and *Civilization* experts in each domain, we were able to directly examine whether game-play prepared students for future learning. We found that playing *Civilization* did indeed prepare students to learn history - though, equally interesting, we found that playing *SimCity* did *not* prepare students to learn about the domain of urban planning. Both of these learning effects built on leisure play to support learning from an academic text.

Implications for Education

There's an easy tendency to dismiss leisure play as meaningless. For this reason, we believe it is crucial to emphasize the central point of this study. Games do not have to be inserted into a classroom setting to support learning. Leisure play can be a productive and fruitful activity in its own right - given the proper follow-up in terms of formal learning. In fact, leisure play can amplify and deepen the formal learning experience.

Players' experiences in games give them intuitions, models and ideas about how the world works. Often, these are experiences they cannot have in other circumstances. Where else can an ordinary person lead a country to greatness, or lay out the plan of a city for themselves? Games can be - and are! - designed to encourage players to engage with the complex structures and models underlying play. Players' engagement, on their own time, with these kinds of experiences can only represent an educational advantage.

Equally important, though, is the role of formal learning. Formal learning helps students organize and access the knowledge they derive from their experiences. On our experiment's test of prior knowledge, we found no difference between *Civilization* and *SimCity* players in their knowledge of either history or urban planning. The benefit in history to expert *Civilization* players only came about *after* the formal learning occurred. In other words, a game can provide organizing experiences and support for a given learning domain - but it, alone, is not enough to understand the domain at hand. There must be some kind of formal structure (though, of course, this does not necessarily have to occur in the classroom) to help students make sense of their learning experiences in the game.

Of course, this is an argument that can be made for many forms of media, including books, films and even lectures. Games are hardly the only medium where formal structure helps students make sense of their experience. However, given our research results, we believe that formal support may be particularly important for games.

First, games for learning are a relatively immature medium. Books, for example, have had hundreds of years of deliberate design for accessibility and usability. Innovations ranging from the table of contents to the index have made books sophisticated textual delivery systems (Manguel, 1997). In schools, students receive years of education on how to use these innovations and learn independently from books. Books are a highly mature learning technology! Comparable work on games is only now beginning, and students certainly do not receive equivalent training in learning from games as a medium. Formal support, then, must fill in these gaps.

Second, players of games have far more idiosyncratic experiences than readers of books, viewers of films or listeners to lectures. Even if two readers understand a book differently, the words on the page ultimately remain the same. However, two players of a well-designed game - one in which players are confronted with meaningful choices - are not guaranteed to have a common base of experience. Tying these diverse experiences together requires developing meaningful common abstractions, a challenging task.

Finally, games function by creating a “magic circle,” a self-contained world in which the rules of the game are paramount (Huizinga, 1971). The magic circle is an essential part of the “game-ness” of games. Players may need extra help understanding how to apply their knowledge outside the deliberately set-apart context of play.

The role of formal support for games, however, is hardly the only question at hand. When it comes to games, there is always the question of “How much,” and “How long?” We often expect children to learn from games (or other media) after brief periods of exposure. However, we found that the preparation for future learning effects only came into focus for expert players - ones who played more than 25 hours a week at the peak of their play.

What this suggests is that games may not be a good way to deliver superficial knowledge, knowledge that could be acquired easily in some other way. Players must develop expertise with the game’s system before the preparatory effects become clear, and this takes both time and concentrated attention. Because players must be game experts in order to benefit their future learning, we should concentrate on developing learning activities that build on expert activities and knowledge.

In addition, we should consider how to use game expertise as effectively as possible. Rather than build just one lesson around students’ expert knowledge of games, we must consider how to use the shared common experience of play in a variety of classroom applications. For example, *Civilization* is most obviously used to teach history, as our study demonstrates. However, the game can also be used to teach programming, math, and logic. It could even be used to teach literacy skills, particularly if extra-game activities such as walkthrough use are included. With this approach, the time investment required for students to become expert has a much larger payoff.

Alternately, we can investigate ways to move game-play outside of the classroom. Although game-play benefited *Civilization* players in learning history, we believe the benefit does not justify twenty-five hours of classroom play a week. However, just as a teacher might assign reading to be done at home and discussed in class, students may play games outside the classroom and then return to the classroom with a fund of additional knowledge. Teachers could assign “summer playing” assignments, just for example, and then build on those in-game experiences during the school year. Students might also play in after-school programs, where teachers or staff are available to supervise and support play (Squire, 2005). Both these forms of leisure play do not directly compete with classroom time or with formal learning experiences.

Active support by teachers provides another option for addressing the time issue, by helping players achieve expertise in shorter periods of time. Teachers might intervene during play, or create directed exercises designed to build specific skills. However, scaffolding can also take place on its own, outside the classroom: players often achieve a significant level of expertise with the help of peers, for example. Teachers can bring this informal scaffolding into the classroom by encouraging students to take advantage of

pre-existing game communities, or by asking expert students to teach their less-expert peers.

Given the time investment required to benefit from play and the many pressures on classroom time, these solutions can make learning from games more feasible. Our findings about the time commitment required for PFL effects to appear do not mean games cannot be used in the classroom. We believe, however, that educators do need to consider how to get the most educational return on their time investment. That might mean building multiple lessons around the game, shortening the time to expertise through scaffolding, or offloading the time required to build expertise onto students' leisure play.

Finally, there is a tendency to frame the debate about 'games' as if they were some kind of unitary category. In reality, though, games are wildly diverse objects, and such generalization undermines any possibility of understanding the way that games function in practice. When we consider games as diverse as *Guitar Hero*, *Pokemon*, *Making History* and *Settlers of Catan*, it makes less and less sense to assume that all games will be equally good for learning, or that they will be good in the same way.

Even among games that are apparently similar, it's clear that specific design decisions may support or undermine future learning opportunities. We chose games that appeared quite similar to us. Both *Civilization* and *SimCity* are relatively open-ended simulation games which involved making strategic choices about the allocation of resources within a geographic area. Nonetheless, we found the games produced quite different results! *Civilization* helped experts learn history, while *SimCity* did not support experts' future learning of urban planning.

We argue that specific differences in game design made players more or less likely to learn from their experiences in the game. If small differences in design, even between games that appear quite similar, can impact the game's educational success, it becomes even more important to consider individual games on their own merits rather than to talk about 'games' generically.

Implications for Design

If a game's design can have such a strong effect on its learning potential, it becomes doubly important for us to consider our study's implications for design, as well as for educational practice.

We believe that the core design difference between *Civilization* and *SimCity* has to do with how the game handles winning and losing. *Civilization* has multiple pathways for players to win the game; however, the game provides clear and focused goals, and players can evaluate their actions in terms of short- and long-term consequences. *SimCity*, on the other hand, is often cited as an example of 'sandbox' play. While players can run out of money or have their virtual city destroyed, most goals within the game are player-initiated rather than explicitly supported or enforced by the game system.

Clear goals, as opposed to sandbox play, may allow players to engage in directed practice within the game system. When players must evaluate their actions in the context of larger success and failure, they are encouraged to use their knowledge of the game's system to make good decisions as opposed to just "messaging around." They begin to see their knowledge of the game's system as being designed for use - a use which has direct feedback and immediate consequences for play. Lobato (2006) discusses how usable (or "generative") knowledge best supports transfer. We would agree with this, and argue that *Civilization*'s clear goals encourage players to make active use of their expertise more often.

Another significant difference between the games is in how they use specific, as opposed to generic, knowledge. *Civilization* contains specific references to historical events, characters and objects. Players can lead the Aztecs, negotiate with Queen Isabella, or build the Great Wall of China. *SimCity*, however, largely contains generic knowledge. While players can build fire stations or raise taxes, it does not provide the fruitful specificity that *Civilization* does.

We had initially dismissed this consideration, because we expected the games to support systemic rather than factual learning. However, we discovered that *Civilization* players were better able to learn facts, not just systemic knowledge, from the academic text they read. At the same time, informal interviews with *Civilization* and *SimCity* players revealed players talking about how the specifics that *Civilization* provided sparked their imagination. Just what was the Hagia Sophia? Could they win a game where all the American cities were in the right geographical locations?

Given these factors, we have come to believe that the "outward pointers" of *Civilization* may have been a second crucial factor in its successful preparation for future learning. Some players explicitly use these "outward pointers" to think critically about history; for example, one player interviewed described learning about Chinese city-naming schemes in order to name his cities appropriately in the game. Even players who do not use this knowledge explicitly, however, may have been affected by it. We believe these specific references may have primed players to connect their game experiences to their existing knowledge, even though the factual information was not explicitly being taught by the game.

Finally, the choice of what domain to represent is a significant difference between the two games we examined. History is taught in schools, while most people encounter urban planning as part of their day-to-day experience. Players may have continued to draw on their naturalistic understandings of urban planning when exposed to just one formal text, despite whatever grounding the game may have given them. When it comes to history, on the other hand, students rarely have the opportunity to experience it viscerally, personally and actively. The degree of difference between how students normally encounter history and how *Civilization* is played may be precisely what allows players to benefit from it - because the two approaches may complement each other, as opposed to overlapping.

When designing a game to prepare students for future learning, therefore, it is important to understand the ways in which the domain is ordinarily taught, and what academic experience students are likely to have with the domain. This interaction with the domain is likely to influence whether the game experience supplements, or is redundant with, the prior experiences students are acquiring elsewhere.

Call to Action

Taken together, these ideas suggest that we can use leisure game-play to support students' formal learning - but that it must be a conscious effort on our part to do so.

First, we must find ways to determine which *specific* games provide good preparation for future learning, and what domains they connect to. Some of this may be possible by careful inspection of the games themselves, and certainly research on particular titles can provide concrete answers. However, it is important to begin to generalize learning features that are directly tied to game-play, so that we can begin to understand *why* certain games are more effective at preparing students for future learning than others.

Second, we must find ways to convey to teachers how they can build on players' experiences in games. It requires significant expertise in game-play to understand the learning content of a particular game, and developing such expertise takes time. We cannot expect our nation's teachers to become experts in each of the thousands of games that are available. Without access to such expertise, teachers can rely only on surface knowledge of a particular game, if they have the time to investigate the games their students play at all.

Teachers who have access to deep expertise about games, on the other hand, can make meaningful connections between play experiences and classroom learning. Even if teachers are not play experts themselves, we can help them learn which lessons and standards a given game embodies. This becomes doubly important when building on leisure play; if not all the students have played a particular game, the teacher must not only find ways to connect the game to the classroom, but also to make the game experience intelligible to those who have not played. As game researchers, therefore, we owe it to teachers to expose the things that experts may experience and know - including the misconceptions the game may promote, and the culture of supporting activities that surround play.

Finally, we must address issues of inequality in game-play. We know that girls and boys tend to play different games, as do children from high-SES and low-SES backgrounds (Andrews, 2007). If only some children have access to the games which successfully support future learning, we may continue to advantage certain cultures of play. Changing the perception among players of what games are socially acceptable is, of course, a complex undertaking. But awareness of which students are advantaged, and which disadvantaged, by their leisure choices about play is a place to begin.

The students who are advantaged and disadvantaged by play, however, may be *different* students from those who succeed in more traditional school activities. Students who do not thrive in traditional classrooms can take the lead as game-play experts, as several studies have found (Thalheimer et. al., 1992; Squire, 2005). This difference is an immense opportunity: if we build on struggling students' play expertise in the classroom, the PFL effect can help them succeed in school. The challenge, of course, is to understand which games struggling students play, and how those particular games can support their future learning.

Given actions like these, we can turn students' passion for leisure play into preparation for future learning. Given how much time, energy and effort kids spend playing games, that can only be a good thing. Rather than try to shoehorn games into limited classroom time, we can build on games *as they are currently played* and still provide good learning outcomes. The question is only whether we are willing to try!

References

Andrews, G. (2007). Digital gaming divide: Differences in the game literacy practices of low- and high-income students. Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.

Barab, S. A., Dodge, T., Jackson, C., & Arici, A. (2003). *Technical report on Quest Atlantis, Volume I*. Bloomington, IN: Center for Research on Learning and Technology.

Bialystok, E. (2006). Effects of bilingualism and computer video game experience on the Simon task. *Canadian Journal of Experimental Psychology*, *60*(1), 68-79.

Bransford, J.D. & Schwartz, D.L. (2001). Rethinking transfer: A simple proposal with multiple implications. In Iran-Nejad, A. & Pearson, P. D., Eds. *Review of Research in Education*. (24) pp. 61-100. American Educational Research Association (AERA): Washington, DC.

Chen, H. H., & O'Neil, H. F. (2005). Training effectiveness of a computer game. Paper presented at American Educational Research Association (AERA), Montreal, Canada.

Clark, R. (2007). Learning from serious games? Arguments, evidence and research suggestions. *Educational Technology*, *47*(3), 56-59.

De Lisi, R. & Wolford, J. L. (2002). Improving children's mental rotation accuracy with computer game playing. *Journal of Genetic Psychology*, *163*, 272-282.

Dewey, J. (1938/1997). *Experience and education*. New York: Touchstone.

Egenfeldt-Nielsen, S (2005). *Beyond edutainment: Exploring the educational potential of computer games*. Unpublished doctoral dissertation, IT-University of Copenhagen.

Green, C. S., & Bavelier, D. (2003, May 29). Action video game modifies visual selective attention. *Nature*, *423*, 534-537.

Greenfield, P. M., deWinstanley, P., Kilpatrick, H., & Kaye, D. (1994). Action video games and informal education: Effects on strategies for dividing visual attention. *Journal of Applied Developmental Psychology*, *15*, 105-123.

Hammer, J., Black, J., Andrews, G., Zhou, Z. & Kinzer, C. (2007). Games and learning: A process/PFL approach. Paper presented at Serious Games Summit, Game Developers Conference, San Jose, CA.

Hammer, J. & Crosbie, W. (2005). Seven tensions between schools and games. Paper presented at Serious Games Summit, Washington, DC.

Huizinga, J. (1971). *Homo ludens: A study of the play element in culture*. Boston: Beacon Press.

Lieberman, D. A. (2001). Management of chronic pediatric diseases with interactive health games: Theory and research findings. *Journal of Ambulatory Care Management*, *24*, 26-38.

Lindley, C. (2002). *The gameplay gestalt, narrative, and interactive storytelling*. Retrieved March 3, 2006, from <http://zerogame.tii.se/pdfs/CGDClindley.pdf>.

Manguel, A. (1997). *A history of reading*. New York: Penguin.

- McLuhan, M. (1964). *Understanding media: The extensions of man*. Cambridge: MIT Press.
- Prensky, M. (2005). Engage me or enrage me: What today's learners demand. *Educause, September/October*, 61-64.
- Rosser, J. C. Jr., Lynch, P. J., Haskamp, L. A., Yalif, A., Gentile, D. A., & Giammaria, L. (2004, January). *Are video game players better at laparoscopic surgery?* Paper presented at the Medicine Meets Virtual Reality Conference, Newport Beach, CA.
- Salen, K., & Zimmerman, E. (2005). *Rules of Play*. Cambridge: MIT Press.
- Squire, K. (2005). Changing the game: What happens when video games enter the classroom? *Innovate, 1(6)*.
- Squire, K. (2004). *Replaying history: Learning world history through playing Civilization III*. Unpublished doctoral dissertation, University of Indiana.
- Sutton-Smith, B. (1997). *The Ambiguity of Play*. Cambridge: Harvard University Press.
- Thalheimer, W., Wilder, H., deSoto, D. and Black, J.B. (1992). Hierarchically anchored educational systems: Simulations, simulation experiences and the bigger program. In M.R. Simonson and K. Jurasek (Eds.) *Proceedings of selected research and development presentations at the 1992 national convention of AECT*. Washington, DC: AECT.

**All rights reserved for Al-Hassanain (p) Network Imam Hussain (p)
Foundation**

Alhassanain (p) Network for Islamic Heritage and Thought

www.alhassanain.org/english