From Users to Designers:
Building a Self-Organizing Game-Based Learning Environment

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Digital gaming as a new digital literacy

The simultaneous publication of Steven Johnson's *Everything Bad is Good for You* and appearance of media reports of X-rated content in the popular game *Grand Theft Auto* has renewed controversies surrounding the social effects of computer and video games. On the one hand, videogames scholars argue that videogames are complex, cognitively challenging and emotionally engaging — possibly the most compelling of contemporary popular art forms. Game scholars note how games are transforming government, industry and perhaps now education (Squire, forthcoming). Meanwhile, critics claim that games have little redeeming social value and may even be harmful. Even those sympathetic to new technologies are concerned that game players do not understand how games work as simulations. Sherry Turkle (2003) wonders if kids playing *Sim City* are primarily learning simplistic rules such as "raising taxes always leads to riots." To date, we actually know relatively little about the consequences of game play on the cognition of those who play them, and there are very few studies of "expert" game practice (Squire, 2004).

Questions of how games operate have important implications for the design of interactive learning systems. If a "serious games" market is going to mature, we need better theoretical models of how games function to produce learning, what kinds of understandings players take away from their games and how these understandings are (and aren't) taken up elsewhere (c.f. Games-to-Teach, 2003; Prensky, 2001; Squire, 2003). This design-based research study attempts to answer some of these questions by developing and investigating an after-school program for playing the computer game *Civilization III*. It offers a model for the design of after-school game-based learning environments and explores the cognitive and affective impact of participation in a gaming community.

Games as a new literacy

Whether or not educators decide to "turn all formal education into a game" is not the issue. The bigger and more relevant question is: "How will educational technologists respond to a generation of students who, raised on interactive games, expect the same kinds of interactive experiences from their educational media?" Immersive interactive technologies-— or "video games" — are now a powerful social, technological and cultural force that educational technologists are finding difficult to ignore (Squire, 2002). Not only do games push the boundaries of interactivity, consumer-grade simulation, artificial intelligence and virtual world design, but they initiate students into practices, literacies and cultures central to the information age (Gee, 2003). And, as surveys by Beck and Wade (2004) show, participation in games cultures is promulgating cultural values such as entrepreneurship, an increased appetite for risk and a valuing of expertise over formal credentialing, all of which align with the values of new capitalism (Gee, Hull & Lankshear, 1996)

Many games embody powerful principles of learning which educators might do well to emulate (Gee, 2003). Games "teach" concepts by immersing players in experiences by providing spaces where knowledge is useful — modeling expert problem solving, calling attention to key features of the problem through cues and structuring problems so that the player builds on previous understandings, all of which are features of our most powerful learning environments (Bransford, Brown, & Cocking, 1999; Gee, 2003; Squire, 2003). Crucially, games do not let players do whatever they want, but recruit a particular way of thinking through the careful construction of tutorials, scenarios and rules (Gee, 2004). After 40 hours, game players learn not only new vocabulary and concepts, but also systems of thinking — ways of seeing the world which could be applied toward academic domains. Already the United States Army and corporations like Chrysler are using the game medium's capacity for communicating ideologies, but mainstream educators have been much slower to respond (Squire, forthcoming).

Games' flashiness makes it easy to overlook the social contexts in which gaming is embedded and the out-of-game practices that also constitute expert game play. In addition to reading game magazines, manuals, strategy guides, websites and FAQs, gamers review games, write strategy

guides, develop models, create websites and mentor fellow gamers (Steinkuehler, in press). In short, game play, when viewed as an activity system, demands navigation of multiple information spaces and negotiation of multiple discourses. Apprenticeship and tutoring are common within games culture, even within single player games where players even develop online "Universities," replete with curricula and deans (Squire & Giovanetto, in press). Games communities such as apolyton.net provide compelling visions for what the future of online educational systems could be like (Gee, 2004; Wiley & Edwards, 2002).

The social models and attendant values and dispositions promulgated by gaming systems are at odds with the "grammar" of formal schooling (Beck & Wade, 2004; Gee, 2004; Squire, 2005; Tyack & Cuban, 1995). The World Wide Web, when coupled with search technologies (like google), makes the world's information available on-time and in-demand (we can get the world's information at the click of a mouse), rendering trivia-pursuit style educational systems obsolete (Perkins, 1994; Squire, 2003). Self-organizing learning communities and affinity spaces make expertise available irrespective of the background, class or geographical location of participants. Standardized tests of factual, written information may not capture students' capacities to work with digital tools; assessments calling for students to work alone may not capture their ability to perform within knowledge building communities. In short, digital technologies may not fit in the grammar of schooling, but they are drivers of "grammatical change" in business, entertainment and society writ large (Friedman, 2005; Gee, Hull, & Lankshear, 1996).

"To date, we actually know relatively little about the consequences of game play on the cognition of those who play them."

Previous studies of game-based learning environments have illustrated the difficulties in fitting game-based systems, with their internal logic and grammar, within the traditional grammar of school. In the two major studies of game-based learning units available to date Egenfeldt-Nielsen (2005) and Squire (2004) both found that students struggled to understand both basic game concepts and the idea behind a game-based learning unit. Squire describes three challenges raised by bringing games into formal and informal learning environments: (a) if students are required to play a game, the requirement to play could negate any of the motivational benefits of having "choice" in learning; (b) computer games like *Civ3* are more open-ended than many console games or other school-based learning experiences and (c) failure is endemic to learning with games so that students with low self-efficacy in complex computer games may blame themselves for not being smart enough to play. In studies of naturally occurring online communities of *Civ3* players, Squire and Giovanetto (in press) found that *Civ3* communities show how participation in them can: (a) introduce players to historical terminology, (b) provide deep understandings of the game as a simulation, (c) increase interest in history and (d) give players a framework for thinking about history. This design-based research study investigates if such a community can be built explicitly for learning.

Method

For the past few years, we have been conducting design-based research projects, iteratively building and researching world history learning programs using the computer game *Civ3* (Barab & Squire, 2004; Cobb, Confrey, diSessa, Lehrer & Schauble, 2003). *Civ3* allows players to lead civilizations in single or multiplayer games over an extended timeframe, ranging from 6 months to 6000 years, depending on the scenario. We constructed four unique scenarios that are designed to be geographically and historically accurate yet easy to learn. The rules underlying the simulation are derived from a geographical/materialist interpretation of history similar to the thesis posited in Jared Diamond's (1999) Pulitzer Prize winning *Guns, Germs, and Steel.* Using mixed methods including observations, interviews, saved-game files and written assessments, we examined the formation and evolution of this learning community, of individual participants' trajectories of participation through the community and of participants' emergent understandings about the game and world history. Through this reciprocal process of building a learning program and investigating how it operates, we hoped to gain basic insights into learning in digitally mediated environments, help advance digital game theory and construct an instructional theory for game-based learning environments (Reigeluth & Frick, 1999).

This paper focuses on the latter, creating a theory (or model) for designing game-based learning systems. Building on earlier research, we present a case study of a (reasonably) successful after school program for *Civ3*, designed to help underserved children become expert *Civ3* players. This paper includes a description of the program and an explanation for how the program works, which we hope will be helpful for others designing game-based learning environments. Although we can suggest areas in which it will affect participants school performance, future learning or lives, these are open questions for future study.

Context. This *World Civilizations Gaming* program began in the summer of 2005 for five weeks and is continuing throughout the school year meeting twice per week in two hour sessions. Thus far, we have had eight to fifteen youth participate per session, with eleven of those (four girls and seven boys) attending regularly. Eighty percent of participants identify themselves as African-American. The majority of participants qualify for free lunch. Those involved report diverse experiences with and interests in school: some perform quite well, others read and write at the

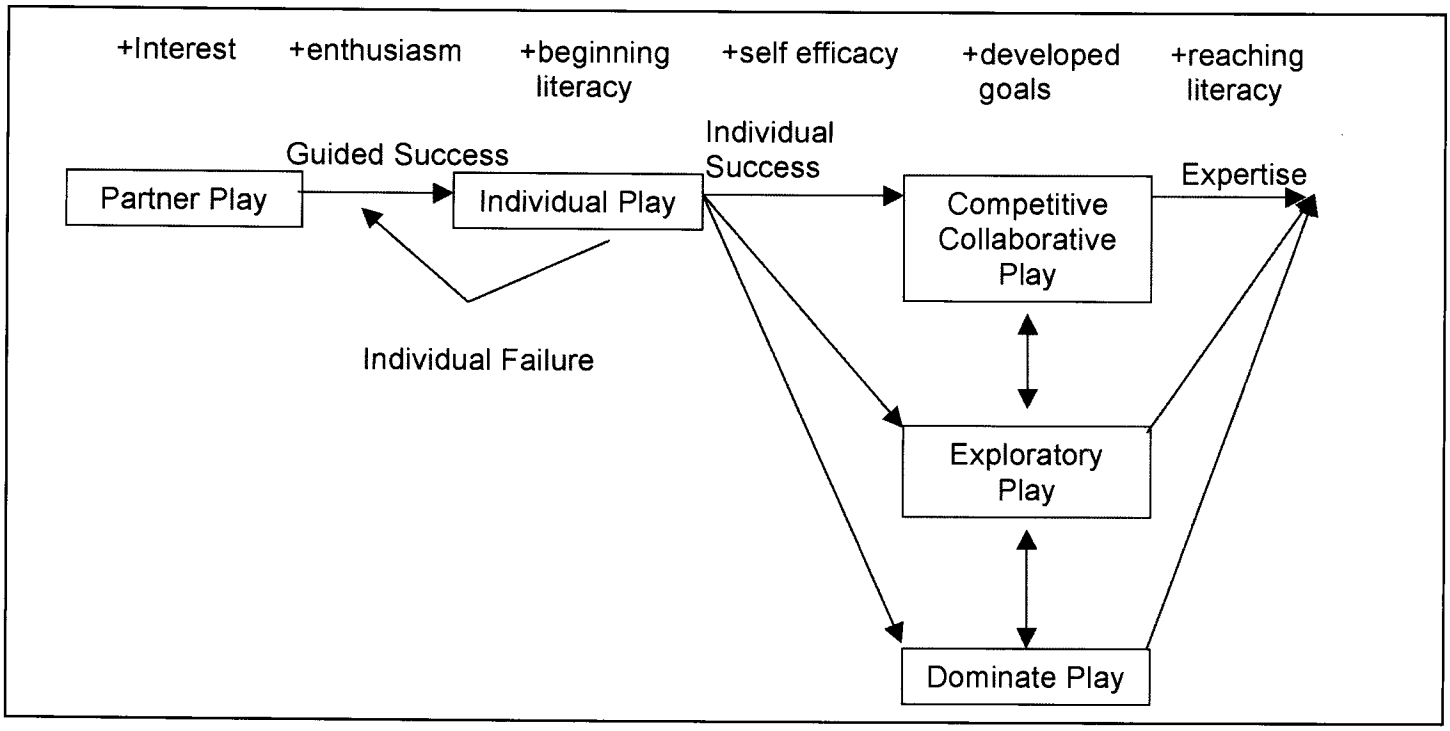

Figure 1 illustrates the process of how expertise and game literacy were formed over the summer program. Partner play aroused interest, which allowed for guided success that added enthusiasm. Guided success led to individual play which began literacy. During individual play, participants could experience individual success or individual failure. Failure led players to seek help from facilitators and again experience guided success (allowing them to move forward). Individual success began self efficacy. From here, participants began individualized play (be it the competitive collaborative multiplayer, the exploratory play online or with new scenarios, or the dominating play of successfully winning the game) as they developed goals. This finally led to expertise and a level where participants became game literate.

first grade level. The typical day begins with a small group discussion around what to do that day (i.e. should we start a multiplayer game, and if so, in what historical era?) followed by roughly two hours of game play and ending with a fifteen minute debrief on the day's events.

Data collection. A minimum of two facilitators (all of whom were expert *Civ3* players) and one researcher are attending each session during the three month period reported on here, observing interactions and taking field notes. Each session is also videotaped with three cameras allowing us to capture dialogue and review earlier sessions to investigate emergent themes.

Interviews. We are interviewing participants informally throughout the program in order to probe initial observations. Typical questions include "what are your goals for today" and "what do you like/dislike about the game?" Periodically, participants themselves document class sessions by videotaping the interactions of others and interviewing their peers. In addition, each child participates in formal, semi-structured interviews about their experiences in school, their experiences with media outside of school and their participation in the program more generally.

Survey instruments. Roughly every two months, participants complete survey instruments assessing their knowledge of game terminology and concepts, assessing their knowledge of world geography (by constructing world maps across time periods) and investigating their attitudes toward social studies.

Data analysis. The three facilitators and one researcher meet twice per week to discuss observations, identify emerging hypotheses and themes, discuss changes to the program and target future data collection. Every three months, they pool their field notes and write a narrative of events. Using Stake's (1995) case study methodology, this narrative describes important events and themes, provided as *assertions*--the researchers' final, most developed, most strongly stated understandings of a phenomenon.

Results

We report here our initial findings as a narrative of the case events, including *assertions* from the case study. We argue that through their participation in this program, these youth developed expertise in playing the historical simulation game *Civ3* — a form of digital literacy. Given recent controversy around games — specifically questions surrounding the social consequences of game play — we hope to shed light onto what becoming an expert gamer was like for these kids and unpack the kind of cognitive work goes into becoming an expert *Civ3* player. Most importantly, in telling the story of this *Civ3* camp, the narrative might help educational technologists design other game-based learning programs.

Developing basic knowledge of Civ3. We visited the Wisconsin Youth Company (WYC) a few days before the

program officially started to meet a few participants and set up equipment. We interviewed two boys who played *Civ3* in a previous after school program (Salinger, 2004). They described the game as hard, even though both play console games at home. When asked if they ever thought of becoming a game designer when they grew up, both said "no" because it was too difficult and complex, which we thought was interesting, given the popularity of games and our previous work with middle class kids, where many boys reported dreams of becoming game designers.

On the first day, we introduced the "curriculum" as a summer program in which they would learn to play *Civ3*, as well as learn more about how games are made. We set up a simplified, customized scenario for them to play set in the ancient Middle East in which they could play as the Egyptians, Sumerians, Babylonians, Phoenicians, Hittites or Medes. The kids sat down, two seated per computer, and began to play. Most participants chose to play as the Egyptians, although a few wanted to be Babylonians. The few kids who participated in a similar program the previous summer were most engaged; a few were less than interested, but all politely played along. No one seemed to mind having to share computers.

Kids playing in pairs led to increased engagement as they had (a) someone with whom to discuss strategies, leading to greater reflection and less confusion and (b) someone to share in struggles, leading them to not "blame themselves" for their confusion. In a marked example of this collaborative learning, on day two, two pairs of girls who had each been struggling (one with going to war, the other with expanding their civilization) switched computers so that they could help one another. At the end of the day, they swapped partners, so that now there was one girl from each group playing each game. Essentially, the girls spontaneously created a "jigsaw" structure in order to share their knowledge and expertise. This group of 4-5 girls played together throughout the unit, forming a small subcommunity with its own particular gaming practices. Participants in all groups talked as they played, asking questions, quizzing each other, offering suggestions and generally helping one another play. This talk allowed us to learn what they were thinking about, and created other opportunities for knowledge sharing between groups, since they overheard one another's strategies.

By the end of the third day, those male participants who become comfortable with the game split off to work individually. For most groups, this occurred when they arrived at a point where they wanted to restart their games and try a new strategy. For example, a number of groups, playing as the Egyptians, spent all of their resources creating warriors and sending them across the Sinai Peninsula to attack the Babylonians. Meanwhile, the computer-controlled Babylonians continued to research technologies, and eventually developed Bowmen which gave them a decided military advantage. With the help from the facilitators, most players realized that they needed to build more cities, a better infrastructure and a better defense system, which would require starting over.

Warring was the first obvious game goal for most participants and early failures at war led them to discover political and economic aspects of the simulation. For many players, their interest in warring was supplanted eventually by an interest in playing the political and economic components of the game. To illustrate, one pair of girls — Becky and Latoya — went to war because, in the words of Latoya, "we want barbarian blood." By day 3, Becky was more interested in building her civilization, so she split off to play with Mitzi (with whom she had previously played frequently). By the third week, Becky and Mitzi had created 31 cities in Egypt, by far the most of any group. Other pairs, like Joe and Jordan, enjoyed studying geography and placing their cities, quickly building a network of 8 cities. Everyone had mastered the basics of building settlers, roads and basic infrastructure by the end of the week. Most groups had 7-8 cities and could place themselves and other neighboring civilizations on the map in end of the day debriefings.

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Although learning Civ3 *was difficult and some participants were not immediately engaged, the modifications we made to the stock game design made it easier to learn and less frustrating to play, leading to less early failure and frustration and an increased motivation to learn more.* Using the scenario editor, we changed the basic game rules to reduce micromanagement, strengthen capital cities (making it harder for kids to be conquered) and speed up game play, thereby eliminating the most common sources of frustration for new players (reported in Squire, 2005). In one extreme case, one girl had just lost her game and was very frustrated. A facilitator quickly opened up the editing tool and created a custom scenario for her. He adjusted the scenario, giving her bonus resources and units which addressed some issues she had been dealing with. She played this scenario for two days before going back to the more difficult one. Over the first two days, the facilitators and kids played this custom scenario, discussed core game features, and modified this scenario file, recursively playing and redesigning the game to respond to suggested changes that the players made. Throughout, we emphasized that the

goal was not to necessarily "beat" the game, but to develop a "design-level understanding" of the game and its mechanics. In general, we saw the kids move along a trajectory from less to more difficult gaming scenarios, underscoring the idea that players were developing expertise through their play.

Because players did not experience crippling failures in the first few weeks, they persisted to a point at which they had a good understanding of basic game concepts (e.g. resources, citizen happiness, military unit types) and the underlying rule systems (i.e., cities grow more quickly in river valleys than in hills), and tools that they could use to solve later failures. In fact, not only did most players not "fail" right away, but most did not even have a real sense of their relative progress compared to other civilizations until they spent a few class sessions at war. This comparatively non-competitive environment created a "sandbox" for players to compete in with reduced consequences for failure. Losing in war (as opposed to having a city fall into disarray) was the direct consequence of a choice; therefore, most experienced failure as a result of something they did themselves, had better skills at the end than when they started and had plans for what they might do differently in a future game.

"Game play, when viewed as an activity system, demands navigation of multiple information spaces and negotiation of multiple discourses."

Game play was fundamentally a social experience and every participant showed a desire to share his / her game play with other people. By the third week, everyone was playing a multiplayer game in some form or another. The four girls attending all sat close together (sometimes literally on top of one another). They shuttled freely between games, to the point that they all shared joint ownership over their several games. For them, the entire gaming experience was cooperative/collaborative, even when they played single player games.

Similarly, a large group of boys wanted to play a multiplayer game in which they could play competitively in teams. We proposed that they could team with a facilitator, in an effort to ease any concerns about direct competition, but they showed as much interest in trying to beat the facilitators as in teaming with them. The three facilitators regularly joined multiplayer games (with two playing on any given day, while the other facilitator and the researcher stayed out to observe).

The multiplayer game format amplified interest for most male players. By the end of the third week a highly engaged, somewhat competitive culture arose among the multiplayer gamers. The amount of talk among boys increased dramatically. "Trash talking," negotiating, bragging and haggling were all common. Kids who arrived early would discuss who they were going to play and what plans they had for the day, while others began staying late to practice or hold games on their own.

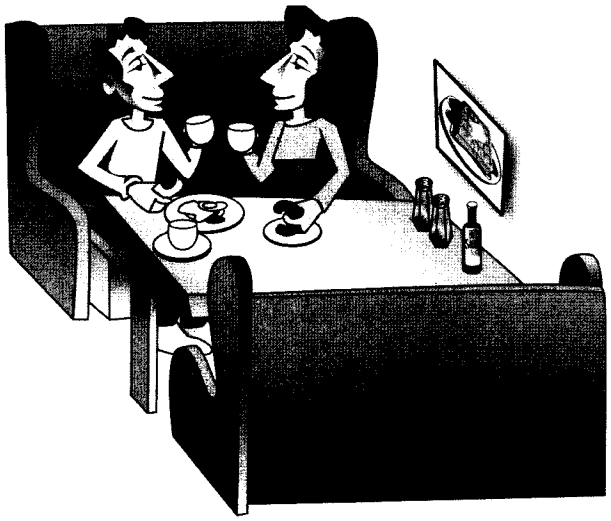
The multiplayer game transformed the space of the lab from a single player space to a collaborative game space where players collaborated, competed, discussed strategies and, most importantly, played out their games with real consequences. Games events became "talk-aboutable," as players planned, discussed and analyzed strategies. The kids particularly enjoyed forming alliances with and against one another and the facilitators. They negotiated formal and informal political treaties, traded technologies and traded resources. Many of these negotiations occurred via the text chat channel, a practice which facilitators encouraged and which was quickly taken up by players.

The female participants and some male participants were markedly *uninterested* in this form of play. For some, their disinterest may have been due to the competitive and somewhat male gendered nature of the play. There was also some belief among the girls that they were less competent than the boys, a perception which, based on comparisons of saved game files, was not true. However, and just as importantly, the girls did not want to give up their saved games, or break from the social gaming space that they had begun. In the third and fourth week when they finally did become bored with their games (which they had "won" for all practical purposes), they started new single player games, collaborated with facilitators in single player (or multiplayer, Internet) games and occasionally joined the class-wide multiplayer game. They particularly enjoyed partnering with facilitators playing against "strangers" on the Internet. Consistent with previous studies of *Civ3* players and research on girls' play, these girls enjoyed the prospects of multiplayer gaming, although it was a subtle form of multiplayer, in that the girls were frequently playing side-by-side in single player games (Laurel, 2001; Squire, 2004). The boys who did not want to join the multiplayer game tended to be less confident and comfortable with the game. Many of these players were reluctant, struggling readers or irregular attendees to the camp program.

The role of the facilitators as expert game players thoroughly mediated gamers' experience. We played very different roles in each stage of the program, suggesting a more complex, nuanced model of the facilitator in game-based learning environme\nts. Early in the program (days 1-2, which we call the "introduction phase"), facilitators were instrumental in helping players establish goals, setting rules and enforcing norms (i.e., "helping other players is encouraged") and giving just-in-time feedback. The facilitators' roles at this time might be described as teachers and cheerleaders. On the first day, each player was raising a hand to ask a question every 4-5 minutes. Pairing up players, and establishing a 3 : 1 player: facilitator ratio made fielding these questions relatively easy.

The low player : facilitator ratio also allowed us to spend focused time with struggling players these first few days, as in the case where the facilitator created a custom scenario for Mitzi on the fly. By the third day, most players had a good grasp of the game and the questions slowed to a trickle.

By the second week, the facilitators played a very different role (mentoring participants, cementing norms), although they were still central to the activities. By and large, they were mentors in the truest sense of the term; they played along side the kids, engaged in joint collaborative activity while playing together. Defeating and gaining the respect of the facilitators seemed to motivate many of the participants. Some participants vied for the facilitators' attention, tried to impress them with their knowledge of the game. One team of kids reported having a sleepover one evening, where they dug up maps to plot a secret attack on a facilitator (who was playing in the Americas) via Australia. On the final day, the kids revealed that they had planned a secret "kids vs. the adults" attack, and were secretly playing the adults off of one another in negotiations.



By the third and forth weeks, the facilitators were there more or less to play along with the kids, modeling expert game play, suggesting new activities and introducing high level strategy. Most often, this occurred within the context of collaborative play. For example, in week four, Mitzi tired of her game, and the facilitator suggested she play on the internet. They sat down and played together with the facilitator modeling how to log into a game and showing her some of the idiosyncrasies of online play (including explaining the changes from the main scenario). After 30 minutes of collaborative play, he handed over the reins to Mitzi, who proceeded to play for the next hour with good success. Playing together allowed the facilitator to create a cognitive apprenticeship situation in which he was able to help Mitzi: a) "see" the game space and problem in the right way, calling her attention to important details (like the strengths and weaknesses of the starting position); b) develop and take ownership over a strategy (such as rapid, early expansion and then a rush to a Republic government); and c) build her confidence as they played together, by giving Mitzi opportunities to ask questions and get feedback in the context of problem solving with a more able mentor. Part of this dialogue involved the facilitator and Mitzi debating different strategies; Mitzi, who had built 31 cities in her game the week before, was a big proponent of rapid growth, and the game allowed her and the facilitator to discuss how different variables (different start location, access to resources, access to trade networks) made various strategies more or less desirable given the context.

By the end of the fifth week, most players developed expertise in Civ3 play. The week before the last session a number of participants came into the lab on their own, set up a game and played independently on two consecutive days. One participant, who grew tired of his own game, decided to go online and play against a random opponent on the Internet in a 1-on-1 game. To the facilitators' surprise, he adopted a strategy we had not seen from him before; seeing that he was relatively isolated geographically, he changed his strategy from producing military units to focus almost exclusively on building cities, developing infrastructure and creating wonders. By the end of the period, he was well ahead of his competitor. Other kids also played in multiplayer games online, and took over games for facilitators, where they vocally critiqued facilitators' play. By the end, they were easily able to compete effectively with the facilitators, all of whom had logged hundreds of hours of play.

Discussion: Expert gaming cognition

Despite the speculation that game players are learning simple heuristics from games (e.g. "in *Sim City*, always lower taxes to spur growth,") this study shows that game expertise (at least as defined in this context) is much more complex. It is important to recognize that what constitutes "expert gaming" is context dependent; an expert in one community could be regarded as a newcomer in another, as in the case of an elite, or "133t" Player Killer in *World of Warcraft*, player who might be considered a "newbie" within a clan of role players. But in this case, we are arguing that these kids developed a general level of game expertise which is demonstrably different than that of a newcomer, and which could evolve into a higher level of expertise, such as an expert player on the hardest levels, a master military strategist and adept game modder, or a multiplayer champion.

This study suggests that expert strategy simulation game knowledge is a flexible, systemic level understanding of a game system rather than a simple heuristic understanding. Evidence reported here, as was the case for Jordan, suggests that in this environment, playing multiple scenarios from multiple perspectives forced them to understand the contingencies behind any strategy; placed on an isolated island (like Japan) players did not build a strong defense, but instead built trade networks. The same players, when playing from the Middle East or Europe, played with different strategies. In

post-interviews few players could articulate these patterns however, suggesting that, consistent with the literature on transfer of learning, more explicit exercises are necessary to encourage them to articulate these ideas. It is intriguing, however, that within the game context these players showed very flexible understandings.

All participants reported increased knowledge of maps, timelines and historical terms and, as has been hypothesized by game theorists (c.f. Shaffer, Squire, Halverson, & Gee, in press), factual knowledge "came for free" for these players. In post-tests, each participant could place Egypt on a map, could give a general definition of the term hoplite and could identify five military units of the ancient civilizations. These cases show how knowing and understanding the basic elements and representations in the game is crucial to game play. In a multiplayer space, understanding terms like hoplite, barracks or the Great Library is essential for building and for communicating strategy. In building strategies (such as plotting to take over the Americas via Australia) players were forced to learn names like "Man o' War" or hoplite. Indeed, the most proficient players perfectly matched quite a few historical terms to their respective definitions, terms which included monarchy, hoplites, galleons, barracks, Babylonia, Thebes, Great Library, despotism, cathedral, Colossus, iron working, aqueduct and war chariot.

Not surprisingly, the way that players responded to these questions was highly dependent on their game play, suggesting that we can build better game-based learning environments by starting with developing game mechanisms where players literally perform the kinds of understandings we want them to have. So, for example, players answered questions about hoplites, aqueducts or the great wonders, from the first person, describing these structures and features in rather vague terms, with little sense of their consequence or connection to other game systems. For example, one player wrote, "aqueducts brought fresh water for my cities" and "no one could attack my cities when I had hoplites." These players identified the game consequences, and with some scaffolding (which we did after the post-test) could probably build even more robust definitions. In contrast, players who built alliances or poured over which civilization to play (or attack) had more precise definitions. Jason's games were often about building alliances and engaging in team warfare. Even though Jason played as many different civilizations, he still had the most thorough understanding of the Hoplites. In the post tests, he wrote that hoplites were "an early important Greek defensive unit with 1.3.1 attributes (meaning attacks at strength 1, defends at 3 and has 1 movement per turn). This unit allowed Greece to dominate ancient times." There are certainly other intervening variables at play here; Jason's personal interests and tastes were a good fit with the game and he seemed to have acumen for technical terms. However, in these examples, at least multi-player gaming practices were tightly associated with players developing new vocabularies.

This finding suggests the potential value of collaborative / competitive multiplayer games for literacy. Those participants who played cooperatively, side-by-side, were good at associating terminology with images and icons and had some sense of the effects of game features for their play. So, for example, the girls playing in multiplayer were quite able to explain that "aqueducts help your cities grow" (and most also could tell you that it had to do with water). In contrast, players of the multiplayer game were more likely to know that it helped cities grow beyond the size 6** This example suggests how collaborative competitive games, games which force people into collaborative strategies where they and their groupmates are part of one larger system, encourages them to give precise definitions as a part of normal game practice. Such arrangements may or may not be educationally desirable for educators who want to use games like *Civ3* for teaching history, as educators may or may not care about players' ability to give technical game descriptions. It does suggest that declarative, factual knowledge (commonly called linear knowledge) is not at all contradictory to games, but can be "designed in" via multiplayer structures.

Week	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
1	6					
2	2	4				
3	1	2	3			
4	0	1	2	3		
5	0	0	1	2	3	
6	0	0	0	1	2	3

Table 1 illustrates how a network of after school sites might be created with six facilitators. A minimum of 3 facilitators are present for the introduction of the game to each new site with descending participation over time.

Implications for the design of game-based learning environments

This study suggests that building game-based learning programs may be feasible after all. Further research is needed (and will be the subject of subsequent studies) to investigate the consequences of participation in this program on students' academic performance. These game players developed new vocabularies and displayed complex thinking and negotiation skills while playing *Civ3*, although we cannot say what kinds of long term impacts the experience may have on their academic performance, self-efficacy or cognitive and

personal development. A challenge for educators pursuing game-based learning pedagogies seems to be that students' knowledge may not align well with traditional school-based practices. An underlying question many games researchers face is: Ought we to hold the contemporary grammar of schooling up as the model within which to frame our aspirations? Game-based pedagogies may not produce traditional literacies as efficiently and effectively as traditional approaches do, but they may help students develop literacies better suited for a digital age.

Indeed, the widespread use of games could require some rethinking and restructuring of the basic "grammar" of schooling. The first, perhaps most obvious, issue is the role of standardization in education. Any open-ended game-based learning scenario will involve participants in a range of different practices in any given moment on any given day. Games operate according to logic of choice. Removing choice from game-based environments renders them somewhat meaningless and threatens to nullify exactly that which makes them engaging. It should be acknowledged that, in the case reported here, participants did have the choice of participating in *World Civilizations* or not. We see the level of participation by kids who chose the program voluntarily as evidence for the success of the program given the well documented problems in recruiting sustained participation in informal learning programs (Brown & Cole, 2002). However, others could argue (justifiably) that operating a learning program where participants are there by choice is an entirely different situation than the one in schools, which operate according to a logic of compulsion.

"Game-based pedagogies may not produce traditional literacies as efficiently and effectively as traditional approaches do, but they may help students develop literacies better suited for a digital age."

Compared to past game-based situations under study, this program featured more choice of activities. Players could choose between single or multiplayer games and across multiple scenarios within those games. We also created a "documentarian" role for those participants with an interest in digital filmmaking as a way of focusing kids who may have become disengaged from the primary game play activity. We found it especially important to have alternative tasks for those kids who were growing frustrated with their game and simply (and we believe quite healthily) wanted to do something else for a while. Designing more ways of participating in the program to increase the choices available to participants is an area we will continue to explore.

Critics may note the low player : facilitator ratio in this program. In part, this was due to the needs of running a design research program (setting up cameras, documenting practices and so on). However, in the initial days, a low player : facilitator ratio seems to be essential for helping orient players to such a new type of experience. Not only are computer games such as *Civ3* extremely complex, challenging and confusing to beginners, but the whole idea of game-based learning unit (like constructivist instruction) can create angst in participants.

It is encouraging, however, that once participants got the basic idea of the game and mastered fundamental game concepts, their confusion, questions and need for help all decreased substantially. In fact, by the fourth and fifth week, the facilitators were more or less unnecessary in terms of managing interactions and helping participants play the game, although facilitators still played a critical role in scaffolding activity. By this point, the program was running more or less like a learning community, with all participants engaged in joint activity. Different participants had different expertise, and learning occurred as the participants interacted in the common game space, sharing ideas and strategies and testing them with one another. Participants' trajectories as learners of *Civ3* are now established and in the upcoming months, we expect learning to continue as the community evolves.

As we look toward building new after school gaming centers, we are moving toward a multi-phased model with heavy initial intervention which then wanes over time. We anticipate a large team of facilitators setting up the program, spending the first two or three sessions setting up games, answering questions, setting goals and generating enthusiasm for the project (which will help participants get overcome the initial, most difficult and frustrating, parts of the experience). We imagine this support tapering off over time, as participants become more comfortable and knowledgeable with the game. Our goal is to create self-sustaining learning communities so that within a month or two, these programs can function with relatively minimal guidance. Table 1 shows a hypothetical example of how a team of six program coordinators might establish six games centers in six weeks. Teachers and facilitators are freed to organize extension activities, build connections between game activities and other domains of interests and create bridges so that participation in these after school programs does not end here, but sets up trajectories of participation in other domains, like computer game design, historical modeling or the study of world history.

We envision a network of centers, their participants playing cooperatively and competitively online and continuing to generate and develop gaming expertise. We expect these centers to function as sites of collective intelligence, where game players can produce and access knowledge to support their play through online databases and forums. Building even further on the model of Apolyton University, one can imagine kids like Jason writing sections on "Chinese expansion in the early 21st century," using

screenshots and text to explain to other players how his "patented moves" work. Our hope is that some kids will even progress to building custom modifications, perhaps designing a scenario for other kids on a whole different era of history, like the Middle Ages, not covered in our scenarios. Such customization and modification is the norm at sites like Apolyton University, and a number of kids already have access to these social practices. Our aspiration is that through the *World Civilizations* Program, other, less fortunate, kids will have that access as well. We believe that the historical language, thinking and skills that participants develop will be valuable. More importantly, the kinds of literacies this program might engender--expertise in simulations and design--are essential to success in the 21st century world.

Kurt Squire is an assistant professor at the University of Wisconsin-Madison in the Educational Communications and Technology division of Curriculum and Instruction. He is a former Montessori and primary school teacher and, before coming to Wisconsin, was Research Manager of the Games-to-Teach Project at MIT and Co-Director of the Education Arcade. Squire earned his doctorate in Instructional Systems Technology from Indiana University; his dissertation research examined students' learning through a game-based learning program he designed around Civilization III. Squire co-founded Joystick101.org with Jon Goodwin and currently writes a monthly column with Henry Jenkins for Computer Games magazine. In addition to writing over 30 scholarly articles and book chapters, and he has given dozens of talks and invited addresses in North America, Europe, and Asia. Squire's current research interests center on the impact of contemporary gaming practices on learning, schooling and society. Along with several other University Wisconsin-Madison faculty, he runs the Games and Professional Practice Simulations (GAPPS) initiative located at the Academic Advanced Distributed Learning Co-Lab.

Levi Giovanetto is a graduate student working with Kurt Squire to study Civilization III, *its use by expert self-organizing communities such as Apolyton University and its potential use in after-school programs and the classroom. He is interested in how students' playing and designing historic simulation games can increase their interest and knowledge in social studies as well as digital literacies. Levi has built a series of custom scenarios for* Civilization III *to help new players learn the game more quickly, teachers explore specific eras and ideas (e.g. Dawn of Civilization: 4000 BC; A Road to China: AD 100; Rise of Nationalism in the Industrial Era: AD 1820), and students take over the world*

Shree Durga is currently a graduate student in the Department of Educational Communications and Technology at the University of Wisconsin, Madison because of her growing interest in understanding learning in technologically mediated environments, like games and simulated worlds. Ms. Durga works with Dr. Kurt Squire (who is also her advisor) in an after-school program where kids play a history simulation game Civilization III *and studies how gaming or bringing games to classrooms or classroom-like scenarios (basically, in real-world chaos!) get played out. Ms. Durga received her bachelors degree in computer science and engineering from India and worked as a software developer for over three years in the industry.*

Ben DeVane is a graduate student in the educational technology program of the Curriculum and Instruction Department at the University of Wisconsin-Madison. A student of Dr. Kurt Squire, his research investigates how identity, culture and learning intersect in digital game-based learning environments.

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