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The Sims as a Catalyst for Girls' IT learning

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ABSTRACT
This paper describes how the computer game *The Sims* and the virtual world *Teen Second Life* were used as starting points for developing girls' interests in and capabilities with information technology. One girl's learning trajectory is used to illustrate how gaming served as a catalyst for fostering her passion for computing, engaged her in sustained, proactive learning, and changed her view of computing as a potential career choice. The role of public recognition, fan communities, and changing family ecologies for IT learning are discussed. The paper ends with identification of strategies and issues related to the further use of games for girls' IT learning.

KEYWORDS
Gender; computer games; The Sims

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INTRODUCTION

Video games are receiving considerable attention as a means of introducing girls to computer science and technical skills in what is presumed to be a more engaging and motivating manner than traditional computer science instruction. In the United States, for example, the Federation of American Scientists (2006) issued a white paper calling for further investigation into the use of video game software for a variety of STEM-related educational goals, including learning about information technology (IT), and the National Science Foundation is exploring a new funding initiative devoted to games and virtual worlds (El Zarki & Scacchi, 2010).

In this paper, I describe an approach to engaging girls in IT-related learning that uses as a starting point the computer game *The Sims* and the virtual world *Teen Second Life*[1]. This approach has been developed and studied in several formats in the United States: as an afterschool club for middle-school age girls in a rural Midwest town; in weekly sessions at a Boys and Girls Club in an suburban neighborhood in the Southwest; and as part of an afterschool program for high school age girls from several Southwest urban high schools. Aspects of this work have been described elsewhere (e.g., Hayes & King, 2009 ; Gee & Hayes, 2010). Here my goal is to describe one girl's learning trajectory as a means of illustrating an 'interest-driven' approach to using *The Sims* and *Teen Second Life* to engage girls in computer-related learning. Key features of this approach include building on girls' existing experiences and interests; transforming these interests into passions; encouraging proactive, sustained learning; providing opportunities for public recognition; using fan communities as resources for learning; changing family learning ecologies, and facilitating transitions across contexts for future learning. I will use one participant as the focus for my discussion. While she is not representative of all girls who participated at each site, her story is particularly useful in illustrating these features.

WHY GAMES?

Perhaps the most popular (and least convincing) reason for using games in STEM education is that they are fun and familiar to children and teens. Gaming is indeed a widespread experience; studies estimate that for the vast majority of children, games are one of their first experiences with digital technology, and most children have played some kind of computer or video game by the time they attend school (Lenhart et al., 2008). More important, however, is how gaming can become a hub for the acquisition of skills, knowledge and interests that can lead to engagement in STEM more broadly.

The exploding popularity of commercial entertainment-focused video games over the last two decades has contributed to a parallel interest in the use of gaming technology for education (see, for example, Ferdig, 2009). The increasing sophistication of such games, with their capacity to engage

players in complex problem-solving, scientific reasoning, team work, and systems-thinking, has spawned a growing number of efforts to harness such technology for more formal learning (Squire & Patterson, 2009). Such efforts include recruiting the affordances of commercial-off-the-shelf (COTS) games for learning as well as designing games specifically for educational purposes. Examples range from the use of the COTS game *Civilization* to develop young people's affiliation with and understanding of history (Squire, DeVane, & Durga, 2008) to the design and use of games such as *Operation: Resilient Planet*, to engage youth in scientific thinking and solving ecological problems (National Geographic & Filament Games, 2008).

There is growing recognition that the learning potential of games is dependent not only on the game itself, but on both the face-to-face and distributed forms of social interaction that take place around the game (Gee & Hayes, 2009). Gaming is a social activity for many players, and it can involve collaborative play in face-to-face or online groups. COTS games have spawned robust and vibrant online fan sites where players can ask questions, problem-solve, and share a wide range of resources and artifacts, such as strategy guides, game modifications (mods), and player-created content. These fan sites, or affinity spaces (Hayes & Gee, in press) have features such as distributed knowledge systems, multiple routes to status, cross-generational mentoring, and public recognition for achievements that make them particularly supportive environments for learning (ibid).

Games as Hubs for IT Learning

Research has shown that, for some boys, video games can serve as a 'gateway drug' to the development of technical skills (Hayes, 2008a). However, simply playing games is not the crucial factor in developing these skills, although playing and enjoying games is obviously an important first step. What is important is how such boys develop an orientation to games and other digital technologies that involves tinkering, modifying, 'getting under the hood', and producing their own digital artifacts, including games, art, and software programs (DiSalvo & Bruckman, 2009). From such game-related activities, these boys acquire wider interests in computers and other digital tools, and some go on to major in technical fields in college (Margolis & Fisher, 2002; Tillberg & Cohoon, 2005). Games, since they involve so many different aspects of computer science, can spawn an interest in graphic design, animation, software development, computer engineering, and other related fields.

Thus, a critical feature of games is not simply that they are fun to play, but that they can engage players in other practices that require IT skills, serving as preparation for future learning and giving the players a purpose and goals for their initial forays into computer science education. Just as important, as I mentioned above, is the role of peer networks that develop around gaming and that serve as an additional source of motivation and knowledge sharing. These include face-to-face peer networks as well as the huge number of online fan communities that serve as repositories for a vast amount of game-

related information, problem-solving, and sharing of player-created content (Hayes, 2008a; Duncan & Hayes, in progress). In the case of IT learning, such resources include tutorials on how to use software tools, technical artifacts such as interface modifications created by other players that illustrate the application of computer-related skills such as programming, and lively online discussions on topics ranging from the best hardware specifications for gaming to debugging player-created games (Sotamaa, 2010).

Many young girls today play video games as avidly as boys. But still, many lose this interest around middle school, with the exception of playing 'casual' games on mobile phones or on the internet (Barker & Aspray, 2006; Gorriz & Medina, 2000). This is the same time that many girls give up or hide their interest in subjects like science and mathematics (Barker, Snow, Garvin-Doxas & Weston, 2006; Goode, Estrella & Margolis, 2006; National Science Foundation, 2007). There is not one simple explanation for this phenomenon. In fact, boys as well as girls tend to report spending less time on gaming as they enter high school, although girls' gaming drops off more preciptously (Lenhardt et al, 2008). This decrease is likely due to the increased demands of schoolwork and other extracurricular activities such as organized sports. One reason that girls give for spending less time on games is the need to devote more time to social relationships, suggesting that girls' peer networks may be less likely to use gaming as a focal activity than boys' peer groups. Furthermore, parents tend to restrict girls' internet activities far more than boys', potentially reducing their access to fan communities that could sustain an interest in game-related IT learning (Hayes, 2008b).

Games and IT Education

The potential of gaming to support various forms of IT learning has been explored across a wide spectrum of educational contexts, from relatively unstructured informal learning environments in afterschool programs to more highly structured classes in school. By far the most prevalent approach across contexts is to use simplified programming tools to engage boys as well as girls in designing simple computer games (Hayes & Games, 2008), emphasizing instruction in basic programming concepts. More recently, educators have begun to incorporate opportunities for students to modify games as a precursor to designing them, and have begun to build online communities for students to share and critique player-designed games (see, for example, Rosenfelt et al., 2010).

Educational programs using games that specifically target girls are still relatively few in number, likely due to the lingering sense that games are more appealing to boys than girls. However, girls do like to play games, though they report preferences for different kinds of game play than boys, particularly for games that involve social interaction, exploration and problem-solving (Lucas & Sherry, 2004). Surveys of teens' self-reported gaming indicate that girls tend to play a narrower range of game genres than boys. This difference can be attributed to girls' tendency to avoid games that

involve overt violence and combat, although some girls do play these games (Lenhart et al., 2008). Why girls avoid these games is open to debate, although it seems likely that a combination of gender norms, peer pressure, and the masculine imagery of more violent games deter them.

The relatively small number of game-centered IT programs for girls have attempted to appeal to their interests by focusing on nonviolent gameplay (i.e. dance, story-telling), and using approaches such as paired programming to foster supportive social interactions (Hayes & Games, 2008). Some programs use game design software designed specifically to appeal to girls, such as *Storytelling Alice* and *Rapunzel* (Flanagan & Nissenbaum, 2007; Kelleher, 2008). This prior work on games and girls' IT learning tends to emphasize (a) designing games as the primary source of IT learning, and (b) teaching girls fundamental principles of programming. The Girl Game Company (Denner et al., 2009) is representative of this approach. Funded by NSF, the project focused on teaching girls to design and program their own computer games and to produce 3D animations.

Implications for the Present Study

While such approaches have shown promising results, they are by no means the only way to use games as a starting point for IT learning. In fact, the kind of IT learning that occurs informally around COTS games does not start with or require players to make games, but rather with players becoming so engaged with an existing game that they want to create their own content, figure out how the game works, and share their expertise with other players. Furthermore, COTS games typically have robust online fan communities where players can learn from, share content with, and be recognized for their skills by peers, often from around the globe.

A growing number of researchers and educators have begun to investigate the affordances of COTS games and their respective fan communities for fostering learning in a variety of domains, including understanding historical concepts (Squire, DeVane, & Durga, 2008), city planning (Gaber, 2007), and literacy (Steinkuehler & King, 2009). A common concern across such programs is how to leverage such games for educational purposes, while not 'turning off' young people by making instruction too didactic or 'school-like' (Squire & Patterson, 2009). As Squire and Patterson argue, the best way to address this concern may be an interest-driven approach to game-based learning, in which learning goals are determined at least in part by participants, and in which the development of learner interest in and affiliation with the subject matter is a key goal. However, there is not an agreed upon model for interest-driven learning associated with gaming, and research is needed to ascertain the strategies and conditions that are most effective with different games and populations, and for different purposes (ibid).

The purpose of the project described in this paper was to develop and study an interest-driven approach to using COTS games for girls' IT learning. More

specifically, we sought to understand how *The Sims* and *Teen Second Life* might be used in the context of a peer-based affinity group to foster girls' engagement with technology and interest in IT-related learning. Questions that guided our efforts included: What potential IT learning trajectories for girls might be faciliated by gaming? What features of the learning environment might be most supportive of this IT learning?

METHODOLOGY

The TechSavvy Girls Club (TSG), was designed to engage girls in IT-related learning by building on the characteristics of informal learning associated with COTS games. Following principles of design-based research (Design-Based Research Collective, 2003), in which development and research take place simultaneously through continuous cycles of design, implementation, and analysis, our goal was to design learning experiences that instantiated and contributed to the development of learning theories, rather than to test the effectiveness of an educational intervention on a large scale (ibid).

TSG was aligned with broad principles advocated for successful technology-related education for girls, including introducing computing in an engaging way, drawing on learners' existing knowledge and interests, creating supportive learning environments where these students feel like they belong, and providing hands-on activities that involve collaboration and interaction (National Center for Women & Information Technology, 2007). Unlike more structured programs (ibid), and consistent with an interest-driven approach, we did not start with a predetermined curriculum or learning objectives. Our initial approach was exploratory, with the goal of letting the girls' own interests emerge as we jointly investigated the games and their affordances for IT learning. This approach is consistent with typical features of informal science education more broadly, in which educational goals are typically emergent, time structures are flexible, and uniformity of learning outcomes is not a priority (Squire & Patterson, 2009). Such an approach is not completely open-ended, however; a challenge is striking a balance between giving learners the opportunity to pursue their own interests while at the same time introducing them to new practices and concepts. Consistent with other interest-driven approaches to game-based learning (e.g., Squire, DeVane, & Durga, 2008), the adults in TSG served more as mentors than teachers, strategically introducing new concepts or skills as they became relevant to the girls' interests, in a 'just-in-time' approach to facilitating further learning.

This paper focuses on data from the initial 18 month program involving four participants. The number of participants was deliberately small to permit the collection of extensive data on individual girls' participation and practices. The girls were identified through preliminary focus group sessions conducted by the research team with local young people about their gaming practices. They were all friends at the time of the study, they attended 8th grade at the same middle school, and were approximately the same age (13 or 14 years old). They were invited to participate because of their interest in the project and their parents' support for their participation. While data on family

income was not collected, the girls all lived in the same rural community and their parents' educational levels ranged from a high school diploma to a four year college degree. The group met weekly or biweekly during the school year for 18 months, primarily at participants' homes, as well as attended monthly meetings at a university game laboratory. The girls also played games and engaged in other game-related activities independently. Attendance at group meetings varied, but typically all girls participated.

Here I will briefly describe the content of TSG; more details are integrated as relevant in the discussion of findings. Initially, the meetings consisted of free play, while the adult mentors observed the girls, asked questions to elicit their current knowledge of the game, and made sure all girls were conversant with basic game play strategies. In subsequent sessions, the mentors introduced the girls to *Sims* fan communities and the content available on such sites, helped the girls learn how to download and install new content into their games, and demonstrated how to use software tools such as Bodyshop (a tool for modifying Sims content) and Adobe Photoshop to create their own content. There were no 'required' assignments or activities. The girls were free to choose what skills they wanted to develop, and a good portion of every meeting included open time for them to individually or collectively work on their own creations or engage in free play.

After approximately six months, the girls presented what they had learned in TSG at the professional conference for educators and game designers. The girls' presentations covered topics such as using cheat codes to modify game play, customizing game content by using Photoshop to modify the textures and appearance of objects and clothing, creating simulations of real buildings and neighborhoods, and producing multimodal fan fiction with customized content and screenshots from the game.

During the next several months, the girls continued to develop more specialized skills with the support of mentors. Based on their interests, they created machinima (movies using Sims characters), designed reproductions of historical costumes and settings, and shared their own custom content on a *Sims* fan site. Approximately nine months into the project, the girls were introduced to *Teen Second Life*. A similar approach was used to introduce them to the affordances of this world: a combination of open exploration and free play along with the periodic introduction of new skills and tools by mentors. All of the girls became conversant with basic building and customization tools and created their own virtual buildings, furniture, and other objects. At the conclusion of the 18 month program, the girls again presented what they learned at the same professional conference.

Data was collected through multiple methods: individual and group interviews about gaming, knowledge of and attitudes towards IT, and other computing experiences were conducted prior to the start of TSG and at six month intervals; detailed field notes were used to document group meetings, and artifacts such as screenshots of game play and content created with

tools such as Adobe Photoshop were collected to document the girls' growing fluency with digital tools. Data were analyzed in several ways. To capture the divergent nature of individual interest-driven learning trajectories, narrative case profiles were constructed for each participant. Direct interpretation as well as categorical aggregation were used to identify key patterns in each girl's learning trajectory and the factors that affected those trajectories. Drawing on Stake's (1995) recommendations for case study reports, in the current paper, major findings are illustrated through narrative and situational descriptions of one girl's learning trajectory.

Why *The Sims* and *Second Life*?

TSG started with a game very much associated with girls and women: *The Sims*. *The Sims* is about building communities, social interactions, relationships, and virtual lives inside a simulation. The choice of *The Sims* was and continues to be controversial. *The Sims* involves players in designing clothes and houses and in having children and building families. Using this game as a focal point would seem to reinforce stereotypes about the interests of girls and women. At the outset, we were well aware of this potential concern, and considered a number of other games, including some more traditionally played by males. However, there were compelling reasons for choosing *The Sims*. One primary reason is that *The Sims* was designed to be readily modified by players, and Maxis, the company that produces the game, has successfully fostered a huge fan community (comprised of men as well as women) that shares player-created content and tools. Second, despite the game's ostensible focus on people and relationships, it also gives players the opportunity to design and build everything from furniture to houses to neighborhoods, requiring abilities such as spatial reasoning that are foundational to many STEM fields. Lastly, we realized that dismissing *The Sims* simply because it focused on families and relationships was, in effect, buying into the assumption that the domestic realm is indeed trivial, rather than using it as a means of connecting to the girls' current preoccupations. In addition, we discovered through focus groups that some girls had found ways to play with *The Sims* in unexpected and transgressive ways, illustrating its potential to be far more than the 'dollhouse' as it is often described.

In later stages of the project, we also introduced the girls to the virtual world *Teen Second Life (TSL)*. We wanted the girls to progress from the single player *Sims* game to a multiplayer environment where they could interact more directly with other players and take advantage of the additional affordances such a space might offer for IT learning. We also wanted to see how readily they could apply what they learned through *The Sims* to a new set of technical tools and challenges. *TSL* seemed well-suited for this purpose*. TSL,* like its counterpart for adults, *Second Life (SL)*, was a 3D virtual world like the internationally renowned game *World of Warcraft*, where hundreds or thousands of real people can be in the virtual world interacting together at the same time. *TSL* was not a game per se, with predefined objectives or game play. Rather, it was a virtual world with its

own building tools, and people have built a massive array of different environments in which participants can interact with each other (see SL's official Web site for more information).

In the following sections I will use excerpts from a case study of one participant, Jade (her name is changed for privacy) to illustrate some key findings, issues and questions elicited by this work to date. Jade is not representative; indeed, one thing that has become apparent through this work is the diverse and multifaceted nature of girls' engagement with gaming, their peers, and IT learning. Nor is Jade necessarily a 'success' story; as I will discuss, her learning trajectory was hampered by school-related barriers.

JADE

One afternoon, as the women who coordinated TSG watched a movie made by Jade, which featured Sims wearing vintage fashions that Jade had designed herself, it became clear that Jade was developing a wide range of digital skills through her experience in the club. She had taken pictures of real clothes from the internet, used Adobe Photoshop to modify them to her own taste, and transferred them to her game. She could then dress her Sims in these custom created clothes for the movie. She had not, of course, used a video camera or film to film her movie. Rather, her movie was a 'machinima', that is, a movie made with a game engine. Creating this machinima involved using a built-in movie-making tool in *The Sims* game as well as other video-editing software tools and various cheats to modify the movie 'set' and Sim actions (for examples of machinima made with *The Sims*, see Electronic Arts, 2009, as well as many that can be found on YouTube). The skill required to make a machinima with *The Sims* movie-making tool is both technical and artistic. Jade did a type of modding to create her machinima, the very sort of practice that many consider a key gateway for the development of high-tech skills among boys.

In her time in the club, Jade developed skills that were now beginning to push her beyond many of the other girls in the club. However, at the beginning it was by no means apparent Jade would be particularly successful. She did not have any special interest in computing, was not closely affiliated with school and did rather poorly academically. In addition, when Jade started TSG, she was the least enthusiastic of the girls about *The Sims*. Like many girls, she had played the game before, in an earlier version. The game no longer challenged or excited her. In the club, however, she would learn something new about being a gamer. She would learn to become proactive in her approach to *The Sims* and then in her approach to other digital tools. She would learn to be a producer and not just a consumer. Ultimately this learning would change her identity; she would come to see herself and her abilities to learn and use digital skills very differently.

BUILDING ON EXISTING EXPERIENCES AND INTERESTS

Young women today, even those who are not inclined towards STEM careers, typically have some experience with computers, and often are active users of a wide range of digital technologies. Building on familiar practices and tying new concepts such as programming to these practices has proven to be effective in engaging a broader spectrum of students, including higher proportions of women, with computer science (Margolis & Fischer, 2002). Such an approach builds on students' current interests, allows them to draw on prior knowledge and skills, and feel more confident about the subject matter. In the case of TSG, the girls' prior experience with games was one relevant factor, but the program also allowed the girls to utilize their other experiences and skills with digital technology.

Jade, for example, was an active computer user before joining TSG. In school her use of computers was limited to word-processing and a graphics program. Outside of school, her technology practices resembled that of many girls. She sent e-mail, surfed the Web, and was heavily involved with MySpace. She played online games, including *Heroes Online* and *Neopets*. She had also played the original version of *The Sims*. She played the games with her sister, her brother-in-law, and a male cousin about her age who had played *The Sims* for some time and who showed Jade how to use 'cheats' in the game (e.g., how to give your Sims lots of money so you can concentrate on building and buying, and not the drudgery of working your Sims up in life from menial circumstances).

One important factor in Jade's digital learning before and during her participation in TSG was her access to high-speed Internet at home, and the relatively few restrictions her parents place on her Internet usage. However, the computer was placed in the dining room of the house, which was in easy view of her parents. Jade used the Internet daily, predominately for MySpace, though she also visited fashion sites, gaming sites, and blogs. She wrote to her MySpace blog twice a week and 'hung out' on her MySpace page every day. Her MySpace site was the hub for her social-networking activities.

When Jade entered TSG and was asked if she considered herself to be a gamer, she did not consider herself to be one. She said that a gamer was someone like her brother-in-law "who plays 24/7"[2]. However, the TSG Club eventually began to elicit some of this late-night gaming behavior from Jade herself. When she got interested in creating clothing in *The Sims*, she eventually spent entire weekends on the computer and often stayed up most of the night.

The science educator Andy diSessa, a physicist by training, has argued that what prepared him for doing well at physics in school was the tinkering with mechanical devices he did with his dad in the garage. This tinkering did not teach him physics. Rather, it made him confident in his ability to handle technical and technological learning when he confronted physics in school (diSessa, 2000). Contrasted with diSessa's experience, the ways in which

girls like Jade play *The Sims*, blog, and interact socially on sites like MySpace are not seen as foundations for later important technological learning in the way tinkering in the garage or boys' game-related hacking practices often are (Forte & Guzdial, 2004). But, as I will indicate in the next sections, with appropriate scaffolding, they became just such a foundation for Jade and other girls like her in TSG.

FROM INTEREST TO PASSION

Although Jade had played *The Sims* before she entered TSG, she admitted that she had become rather bored with the game. When the club's leaders told the girls that they could, if they put in the effort to learn, actually design clothes in *The Sims*, clothes with distinctive styles and textures, this sparked Jade's interest. She was about to discover a passion.

Passions do not just happen. Jade had a long-standing interest in art. She once hoped to be fashion designer when she graduated from college. She had used computer drawing tools in a project for her 4-H club and earned a blue ribbon for her work. When she was younger she had used Paint Shop, a computer art tool that came with her computer. And, of course, fashion is not an uncommon interest for middle school girls. However, Jade was not a girl who seemed fashion conscious. She frequently wore a baggy sweatshirt and jeans instead of more trendy clothes, which she was, however, often wearing under her sweatshirt.

To the club coordinators, Jade commented on her feelings about wearing plus-sized clothing. She regarded the skinny girls as the 'pretty ones'. When she eventually became a designer in *The Sims*, she started by designing for slim, model-sized (virtual) girls. Eventually she found a player-created download that allowed her to design clothes for plus-sized Sims. Since she was already adept at design at that point, this allowed her to create a whole new line of clothing tailored to sizes that are not typically reflected in *The Sims* games.

Jade's interest in art, her early experience with computers and social networking tools, and her interest and concern about fashion and bodies had not previously led her to a passion, to something that was challenging and that she really wanted to learn to do well, something that consumed large amounts of time and required lots of practice. While other girls in TSG acquired new skills and knowledge about digital technology, only a few of them, like Jade, developed what we considered as real passion for some aspect of computing. This is likely to be true of even the most compelling interest-driven IT programs; only a small number of participants will become this highly engaged. The question is how to ensure that even this small number has the appropriate resources, conditions, and mentoring to ignite this passion.

Passions can be very consequential in today's world. STEM jobs that require only standard skills, whether low status (such as working in a call center) or

high status (such as computer engineering or radiology), can be done by workers in lower-cost locations like China and India, as long as they are not dependent on face-to-face contact. In a developed country like the United States, rewarding careers will require the ability to innovate and not just apply standard skills. Being able to innovate requires mastery, and mastery requires thousands of hours of practice (Gladwell, 2008). Mastery and thousands of hours of practice require the willingness to persist past failure. This persistence is fueled by a passion for the activity or goals to be achieved, a disposition that has been called "grit" (Duckworth, Peterson, Matthews, & Kelly, 2007). This combination of persistence plus passion is crucial for high achievement in any field, and particularly for success in the complex and challenging aspects of computing. We know far too little about how passions develop. Jade was, perhaps, prepared for her passion, but she still needed to identify it as well as to have access to mentoring and resources that would enable her to develop it. In Jade's case, passion was central to her willingness to engage in proactive, sustained learning.

ENCOURAGING PROACTIVE, SUSTAINED LEARNING

Traditional approaches to education, STEM or otherwise, typically depend on a predetermined curriculum, and teachers who are content area experts. In contrast, the TSG approach to game-based learning was intended to give girls the opportunity to pursue different learning trajectories, based on their own interests and skills. The girls were given considerable time for free play so they could explore the parameters of the game, master the in-game building tools, and explore the game's online fan communities. The club facilitators periodically introduced the girls to new practices associated with the game, such as using cheat codes, downloading custom content made by other players, and modifying content themselves with tools such as Adobe Photoshop. The girls were not required to master any particular set of skills; the goal was rather to expose them to possibilities and scaffold their learning as needed. What the girls chose to do varied considerably; for example, some girls developed a love for building and decorating houses whilst other girls used the game to create storyboards and learned how to take custom screenshots and modify images. Still others became intrigued with testing the parameters of the game's software, experimenting with cheat codes and creating humorous scenarios by exploiting glitches in the game. The facilitators supported the girls' learning by pointing them to the vast array of online tutorials, forums, and downloads associated with the game, helping them problem-solve, and encouraging them to share information and teach each other new skills. The assumption underlying this approach was that ultimately the girls needed to be able to take responsibility for their own learning, to locate and use resources, and to see themselves as teachers as well as learners. For the program to have lasting impact, the girls needed to develop their own goals and commitment to learning.

Jade, as I mentioned previously, became excited by the possibility of designing her own clothes for *The Sims*. She had seen clothes designed by other players on the Sims fan sites, but didn't think this was something she

could learn to do. The club facilitators, as part of their own efforts to better mentor the girls as beginning designers, found an introductory tutorial on a Sims fan site that described how to use Body Shop (a piece of software that comes with *The Sims*) and Photoshop together to recolor clothes that already exist in *The Sims*. They worked through it together and then walked through it with Jade. This was a signal event in Jade's experience with TSG. This experience gave her the confidence to go home and spend many hours perfecting her skills, locating and downloading new textures, applying them to Sims clothes. She had never devoted this much time to *The Sims* or to gaming before. Eventually she worked through other tutorials on her own, and spent hours practicing. Even a seemingly simple task like recoloring clothes (in *The Sims 2*) involved many steps. A particularly important part of mastering the use of this tool in connection with Photoshop was learning how to save files in the correct format and location so they will be recognized by both software programs.

When a clothing object file is opened in Photoshop, whether an item from *The Sims* or a photo of a real piece of clothing, it does not look anything like the original item. For the purposes of editing, the item is flattened and spread out (i.e., in two dimensions [2D]), something like how a piece of fabric would look when a dress pattern is cut from it. In the initial tutorial Jade used, the entire dress was simply changed to a different color. Using subsequent tutorials, and through trial and error, Jade learned how to recolor selective parts of a clothing item, how to change the texture of clothing by importing picture files she found on the web, and how to change the shape and style of clothing by editing several layers of the clothing 'mesh' [3].

Jade learned how to use photos of clothing she found online to create custom clothing. This is done by editing the photo, overlaying it on a plain *Sims* clothing item as a base, and then cutting away or coloring the base to make the clothing item fit. She learned how to add logos to t-shirts in a similar way. Initially, these were time-consuming tasks that required much attention to detail, but eventually Jade became quite adept at these modifications. She became a perfectionist, experimenting with different versions until her creations met her own standards and eventually the standards of the wider *Sims* design community.

Jade's proactive approach came to characterize her learning in the club as a whole. She was highly motivated to accomplish her own goals. For example, when Jade attempted to download content from the extended *Sims* fan community, her major obstacle was not knowing how to deal with compressed files. During one session in the club, she learned how to use WinZip and WinRAR, and soon she had over eight hundred downloads on her computer at home. Eventually, as we see later, she began to upload her own designs to the Internet to make them accessible to fans around the world.

Once Jade learned a skill, she readily transferred it to new areas. For example, after she learned how to create clothes, she observed a club

facilitator creating wallpaper and flooring, prompting her own interest in learning those skills. She observed the process a few times and then was able to apply the techniques she learned for clothing creation to making her own wallpaper. She articulated the process in this way:

> I did nursery wallpaper and you go and you select what you think you want to start with…and then I take it into Photoshop document, which is the same as I use for the clothes and I pretty much do the same steps that you do for making clothes…you have to select the object and paste it over and merge it down to get the image to actually show up in the game…you have to import it in order for it to actually show up in the game.

Jade stood out among her peers in TSG for her motivation and the time she devoted to content creation. The others girls were interested, but not enough to become passionate about creating their own content. Eventually Jade and her success, not the club facilitators, motivated the other girls. As Jade learned to create new things, she showed the other girls in the TSG Club how to do what she had learned. In addition, the desire to help her peers served as an additional motivation for Jade's learning. She became so proficient at design that the other girls in the club began asking her to make custom clothing for their Sims.

PUBLIC RECOGNITION

A further motivation was an opportunity for the girls to demonstrate what they were learning at a professional conference on games and learning. While each girl prepared a presentation that highlighted different aspects of *The Sims* and how they were developing new digital skills, all of the girls' presentations included content that Jade designed. For her own presentation, Jade created a Sim for each girl and created custom clothing for each one, as well as compiled images that documented the process she used to create this content.

In STEM education for girls, considerable emphasis has been placed on improving girls' self-confidence in science and technology, and providing them with female role models. Both were important aspects of Jade's experience, but perhaps even more important was how she was able to take on a new and valued identity within her immediate peer group as well as get positive recognition from an adult professional community. Preparing for the conference presentation took hours of work, not just creating the content but also putting together a polished set of slides and rehearsing the session in front of a class of graduate students. Of all the girls who presented, Jade was the most nervous. By the end of the session, however, as she demonstrated content creation techniques to clusters of admiring adults, she had relaxed and was clearly enjoying herself.

A crucial point about meaningful education, STEM-related or otherwise, is

that it is not primarily about acquiring knowledge, but about acquiring new identities (Gee, 2003). Also important is that within the context of TSG, the goal was not to prompt girls to make a leap from their current identities and interests to thinking of themselves as computer scientists or engineers. Instead, the goal was to cultivate their ability to shape their own identities as young women that incorporated new views of themselves as (in words Jade would later use), "good with computers;" and allow them to "try out" these identities in the context of the TSG and elsewhere. Another important context for this identity play was the online fan communities associated with *The Sims*.

FAN COMMUNITIES AS LEARNING RESOURCES

A key affordance of games like *The Sims* for learning is the myriad of online fan sites that can provide player-learners with information, tools, and models of content creation. There is a worldwide community of *Sims* designers, who design clothes, houses, furniture, environments, and even graphic novels and movies. Just as importantly, these sites also give players access to social groups who can serve as a potential audience for their creations and a source of social recognition and status. While educators often emphasize the creation of learning communities within the classroom or online, players of *The Sims* and other entertainment-oriented games often have created their own communities that are as supportive of learning as any formal educational program (Duncan & Hayes, forthcoming). Encouraging the girls not only to access information on these sites, but also to actively participate by sharing their own creations was a key part of the TSG approach.

Most sites allow players to upload content to share with other players; some sites, like EA's Sims 2 fan site, allow players to create their own 'Sim page' where they can not only upload content, but also receive comments and requests from other players. As not all of the parents wanted their girls to have an individual Web presence, no matter how well protected, the TSG facilitators created a group Sim Page on this site for the girls in the club. Jade had a significant advantage in this regard. As her parents did not restrict her internet activity as much as other girls' parents, she was able to create her own Sim Page[4] (with her parents' approval). One major reason Jade wanted to create her own clothes is that she saw what other players around the world were creating and uploading to fan sites. She saw there was a global community of Sims designers, and she wanted to be part of it. Jade uploaded a *Sims* video that she created as well as custom-designed Sims. She quickly received feedback from other players who downloaded her content. The comments were uniformly positive:

> I love your sim "Andy." I think she's really pretty. All your other sims are cool too. I rated it 5 stars. I would rate it 10 if I could, lol.
>
> I just downloaded Lisa the sim you uploaded, I LOVE her pajamas!! You did an awesome job!

> Hey, Your Sims Are Really Cool. I've Downloaded "Andy" & I Rated Her 5 Stars. =] I've Seen Your Others & You Make Awesome Sims! Keep Up The Good Work!

Jade also received requests from other players:

> *You do good work*
> I was wondering if you do uniforms I am doing military themes if so that would be great and keep up the good work.
>
> *I luv the pjs*
> I think you have done awesomely with your sims, did you make them your self? if so can u make a pair for me sayin: no dancing on this surface! thanx plz can you sign my guestbook to know you got the message thanx.

The last request referred to a series of pajamas that Jade created with different themes, such as "hot pajamas: these super cute lite pink pajamas have a cute cookie graphic on them and say 'one tough cookie'".

Jade developed an international audience of several hundred people who downloaded her creations, praised her, and gave her feedback that improved her work. While Jade had been active on social networking sites like MySpace prior to her participation in TSG, she had never interacted online with people she didn't know. Now she began to develop social connections outside her immediate geographical location, and began to see how technology could connect her with a global community.

There were many possible learning trajectories that Jade and the other girls could have pursued with this worldwide *Sims* community. Sims fans not only create and share new content for the game, they also design new software tools, programs and utilities. In a related study, I and my co-researcher found that participating in *Sims* fan communities alone enabled some women to develop or enhance sophisticated digital skills (Hayes, King & Lammers, 2008). However, after about six months we decided to introduce the girls to *Teen Second Life*, both as a means of keeping them engaged and to assess their ability to apply what they had learned through *The Sims* to another context.

FACILITATING TRANSITIONS FOR FUTURE LEARNING

TSL offered a host of features that could extend the girls' learning in new directions. Players in *TSL* could own and develop their own land. They could construct buildings and other objects if they mastered the building tools, or buy objects built by other players. Whatever a player builds in *TSL*, whether it is a house, clothes, buildings, vehicles, objects, or even games, is owned by the player, who can either give it away free or sell it for Linden dollars, the currency of *SL* and *TSL.* Linden dollars are legally tradable for U.S.

dollars, so people can make 'real' money in *SL* and many do.

TSL was open only to teenagers and had more restrictions on behavior and building than in the adult version (see http://teen.secondlife.com). We leased a private island, TechSavvy Isle, that was initially only accessible to the TSG participants and adult mentors, though later it was opened to other teens. The girls could visit other islands that were part of *TSL*.

We initially asked the girls to explore the teen world and take snapshots of places and objects they found interesting. Jade quite quickly replaced her standard avatar with a customized avatar 'skin' that she purchased and found a number of animations that she applied to make her avatar move in more varied and realistic ways. One of the girls' first building projects was to create their own home on the island. They also helped create a welcome area for visitors and other buildings. Jade became quite adept at locating interesting objects created by other teens and eventually started creating them herself. For example, she constructed a grill with hamburgers cooking on it, including an animation of smoke rising from the grill.

As the girls engaged with designing their own island, some of them became intimidated by the quality of the content created by other teens, content they had seen on their forays around the *TSL* world. This was not a concern that Jade shared. She had developed confidence in her content-creation abilities through her previous experience with content creation for *The Sims*. Even though many of the building tools were different from those in *The Sims*, she knew how to organize her own learning. She also knew when to ask for help. For example, she requested individual lessons in scripting and animation. Her work with *The Sims* served as good preparation for future learning for her work in *TSL*. Her identity transformation continued: she was now an entrepreneur with her own store.

Jade learned how to create many things in *TSL*, ranging from clothes to furniture. Some of this content was created by modifying existing objects or clothes provided by Linden Lab, using the in-world object editor. She also used Adobe Photoshop to edit clothes and import them into *TSL*, similar to what she did with *The Sims*.

The *SL* in-world object editor (a 3D building tool) is an intimidating graphical interface that allows players to manipulate geometric primitives (called prims) by stretching them into new shapes, changing their texture and physical qualities, and linking them to other prims. Everything in *SL* and *TSL* is built with prims. The object editor provides numeric information about the object, including size, rotation, and position, each in 3D. Objects are manipulated in the world with a set of 3D geometric coordinates.

Jade's travels in *TSL*, far from intimidating her, made her desperately want to open her own store to sell what she created. Since initially the club's island was not open to the public, to avoid vandalism and to give the girls a

private space to learn skills, Jade used her own babysitting money to buy Linden dollars so she could rent space in the shopping mall I mentioned previously. She learned how to use the currency-exchange tool, as well as how to locate an appropriate space and pay rent. She decorated the store herself and sold furniture as well as clothing. She had to learn how to set objects for sale, price them, and restrict modification or copying by other users. Jade's knowledge of copyright norms in *TSL* led her to intervene when another girl tried to label and sell content made by another teen as her own.

The transition to *TSL* served as a useful marker of Jade's trajectory of learning and identity transformation. It also prompted other girls to rethink their own level of ability and commitment. Some of the girls requested a return to working with *The Sims*, so they could improve their skills before returning to a public space. Indeed, moving from game to virtual world represented an opportunity for assessment of preparation for future learning (Bransford & Schwartz, 1999) that was as telling as any more traditional assessment of skills and knowledge.

CHANGING FAMILY LEARNING ECOLOGIES

Brigid Barron (2004; 2006) has written extensively about the role of what she calls 'learning ecologies' in young people's technology-related learning. A learning ecology includes both human and nonhuman resources, in and outside of formal education, which can facilitate particular kinds of learning. Learning ecologies are not static or given; rather, they can be actively shaped by learners. Indeed, the most successful learners are those who find ways to transform their material and social contexts into increasingly supportive environments.

Afterschool programs like TSG change the learning ecology of their participants in obvious ways. TSG gave girls access to mentors, peers, and new digital tools. Just as important, however, was what happened beyond the time, activities, and space of the club. The girls' family environments, for example, played a crucial role in supporting or inhibiting their further development of digital skills and the value they placed on this learning. The club facilitators made some direct attempts to enhance parental support, but enabling the girls' own efforts proved to be just as important.

Jade's parents, for example, initially offered little more than lukewarm support for her TSG activities. In fact, her mother began to object as Jade spent increasing time 'playing' on the computer. Like many parents, Jade's mother did not know the difference between playing *The Sims* and creating content for the game. She did not see that her daughter was building artistic and technical skills. Partly as a means of enhancing parental support, the TSG club facilitators asked Jade's mother to drive some of the girls to the conference and help them with their session. Watching the girls' presentations and the positive response from an adult audience changed her perspective completely, and she began to encourage Jade's digital activities.

After Jade presented at the conference, her father also began to take a real interest in what she was doing. She always had a close relationship with her father and, as a result, experienced a great deal of difficulty while he was stationed overseas in Iraq for a year. When he returned, he appeared distant and angry. One thing that brought them together again was Jade's growing interest in computers. Her father had been the one in the family who took care of the computer and made sure that Jade and her sister had what they needed to complete their homework.

Jade began to change the way she talked about what she was doing in TSG and her interests. The positive feedback she got from her peers, her parents, and the conference participants prompted her to develop an interest not only in designing for *The Sims* or fashion design, but in understanding and becoming more proficient with computing in general. As she said herself, "computers give you power", and she had a taste of this power as it enabled her to do things that her peers could not, and that were recognized as valuable by a wider community.

Jade's father took note of her growing interest in computing, encouraged this interest, and applauded her accomplishments. Jade reported:

> I was talking to my dad about [my interest in computers] and he supports me going to college for computer programming or something like that. He didn't really support what I wanted to do before. I wanted to go into interior design but since I've been doing all of this stuff on the computer it's made me realize how much I like working on the computer.

When asked to elaborate on the conversation, she replied:

> I was talking to him and people say I'm really good on the computer, so I told him I was thinking about taking as many classes as I could towards this. And he thought that'd be really good. He said 'That's where all the money in the future is going to be'.

Although Jade came into TSG with access to a computer and high-speed Internet, she did not have a computer of her own. The computer at home belonged to her family. When Jade was preparing for the conference, she began to express a desire for her own computer. Her father was well connected in the community, and, after he spread the word that he was looking for a used computer for his daughter, a neighbor offered to sell him a computer fully equipped with software for one hundred dollars. This was a bargain that Jade's dad could not pass up, even though they suspected that the computer would need serious upgrading.

Coincidentally, the neighbor had an associate's degree in computing and was eager to help Jade upgrade the computer. He sat down with her and

explained the components of the computer and what would need to be upgraded. Her father bought the necessary parts and had them installed. Once Jade had her new computer, she enthusiastically began to create even more new *Sims* content.

In addition to the computer, the neighbor gave Jade a flash drive and explained its capacities. After the conference, Jade bought several other flash drives and taught the other girls how to use them for transporting downloads and content from one computer to another. Soon, the second hand computer was not adequate; she wanted a brand new, state-of-the-art laptop. By this point, Jade's knowledge of computers had grown enough that she could talk about gigabytes, RAM, and graphics cards when she argued for a new laptop, which her father finally purchased for her. Shortly after receiving her laptop she commented, "If it wasn't for me being in this program, my dad would have never spent the money to buy me a computer like this!"

This story shows us one way in which learning for Jade began to change how people related to her and she related to them, including the central relationship she had to her father. Her family learning ecology for computing was enhanced as she obtained better material resources and increased emotional support from her parents.

Jade's experience with TSG, the encouragement she was getting from peers and Sims fans online, and her father's support began to change her attitudes to school. Now she saw a need for school, and she had specific goals she hoped to achieve. She wanted to take courses in computer programming and delve deeper into computers. In this way, her learning ecology at school would change to become more supportive of computer-related learning. This, however, is where Jade's story – and potentially that of other girls like her – becomes derailed.

Jade was in middle school when she participated in TSG. At the outset of TSG, all the girls were asked if they had any interest in studying computer programming, and all of them responded with a resounding "no". When Jade entered high school, her attitude towards computer courses had changed, and she desperately wanted to take a computer programming course. While she still didn't know much about what programming actually entailed, she knew this course was a first step towards her new goal of deepening her computer skills. However, she was barred from the programming class because her earlier math grades did not reach the minimum required for the course. Of course, programming might well have given her a context within which to understand mathematical thinking as useful and important. Still, no amount of petitioning on the part of Jade's parents or the TSG facilitators would persuade the school officials to make an exception and allow her in the class.

Instead, Jade enrolled in a course in graphic design. This course covered skills and topics she already had mastered and yet the teacher would not let

her move ahead in the curriculum. Jade was bored, frustrated, and began to question whether school could ever allow her to pursue her new academic and professional goals. The TSG facilitators began to investigate courses that she might be eligible to take at a local technical college, though tuition fees and transportation remained obstacles.

Once, after joining TSG, Jade and her father visited her oldest sister at work in a local Pizza Hut restaurant. As she watched her sister serve food, she told her father that she would never work in fast food restaurants. She felt that with the technical skills she was getting through TSG, and the skills she now hoped to gain in computer classes at school, she would never have to. Her sister herself had sworn she would never work in fast food, only to be forced into food service years later due to her limited schooling. For Jade, even with her new skills and ambitions, the question still remains whether skills gained out of school can sufficiently change her affiliation with school or even bypass school altogether as a route to success in society.

FURTHER DIRECTIONS

I have used Jade's story to illustrate the factors that were important to her and other girls' interest-driven, IT-related learning in the context of the TSG club: building on their existing experiences and interests (however gendered); transforming these interests into passions; encouraging proactive, sustained learning; providing opportunities for public recognition; using fan communities as resources for learning; facilitating transitions for future learning; and changing family learning ecologies. Ironically, despite the widespread acknowledgement that we need to encourage more girls and women to enter computer science, Jade was not able to pursue her interests in school. Clearly, as others have argued (e.g., Forte & Guzdial, 2004), there is a need for alternative routes into computer science in schools that allow students to build on their existing knowledge of digital media, and develop their computational skills in personally meaningful contexts.

My discussion is intended to stress that games alone will not lead to girls to greater enthusiasm for or skills with IT. However, all of this learning did start with a game; a complex piece of software that captured the girls' imagination, allowed them to tell stories, create people and places, and to appreciate the power of computing. Certainly there are many ways to introduce girls (and boys) to STEM that are exciting and meaningful, and certainly games are not the most efficient way to achieve a specific goal such as teaching girls how to build computers or to understand a programming language. What we ultimately did discover through TSG was that while games might not be as efficient for achieving such specific goals, they could be an effective way to introduce girls to a wide range of '21st century skills' that might prove just as critical to their choice to pursue STEM courses and careers. In our work, we have only begun to tap the full potential of games as a starting point for interest-driven IT learning; here are a few examples of further ways that games might be used to enhance girls' computational understandings and skills.

Cheating as programming
Cheat codes are commonly used in *The Sims* (and other games) to modify game parameters; for example, to get endless amounts of money, to remove restrictions on building, to modify Sim personalities, and so forth. Cheats are actually lines of computer code and were originally used by the game's designers during beta testing. They can be used to introduce players to some basic features of programming languages (such as syntax and semantics), give them a sense of how code relates to what happens in the game, and in general demystify programming by making it a more visible aspect of the game.

Mentoring within fan communities
In TSG, we encouraged the girls to use fan sites for information and inspiration, and to find an audience for their own creations. Fan sites might also provide girls with access to more experienced players and designers who could serve as mentors, guides, and collaborators. In a current NSF-funded program, we are recruiting women who are prominent content creators in Second Life (and some of whom are software designers) to meet with the girls in SL, teach them new skills, and at the same time talk about their real world experiences in computer science. Many game 'modders' (i.e., players who modify some aspect of a game's content) are also students in a computer science related field or working in a related area, and thus can provide real life role models of people whose interest in gaming led to further education or professional paths.

'Soft' modding
Among Sims fans, a popular practice is the design of 'challenges' for other players. A challenge consists of a goal that is to be achieved in the game and a set of rules that must be followed as a player attempts to complete the goal. Examples of popular challenges include 'The Legacy Challenge', in which a player must take a Sims family through 10 generations, and 'The Apocalypse Challenge', which requires the player to sustain a Sims family as their society recovers from a disaster. While creating and completing these challenges typically does not require sophisticated technical skills, players do need a deep understanding of how *The Sims* functions as a simulation, and how it might need to be modded for specific purposes, such as to create the experience of poverty. In designing these challenges, players also need to consider how a particular goal and set of rules will create a satisfying experience for other players. This soft modding (Gee & Hayes, 2009), that recruits social knowledge in combination with technical knowledge, can introduce girls to concepts of user-centered design in a fun and challenging way.

Sociotechnical analysis
Wing (2006, p. 33) argues that computational thinking includes "having the confidence we can safely use, modify, and influence a large complex system without understanding its every detail". All computer games are in essence, models of complex systems (Gee, 2003). Of course, they are simplified

systems; for example, *The Sims* does not model the full complexity of human behavior and needs. Thus, games can be used as a starting point for analyzing how simulations are constructed, for what purposes, and how they reflect particular beliefs and assumptions about the world. This process of sociotechnical analysis (Mumford, 1987) can help girls see how technology is embedded in social systems and also give them opportunities to think more critically about the decisions that go into the design of any technological artifact. This kind of critical reflection can be extended by asking the girls to test the limitations of the game. One example of this was Jade's discovery that plus size women were impossible to create in *The Sims2* without cheats. In recent groups, the girls used *The Sims* to tell stories of their own experiences, and in the process identified limitations in the game's ability to portray, for example, nontraditional households, life on an American Indian reservation, Mexican quinceanera parties, or girls who practice the sport of boxing. Such discoveries can motivate the girls to learn how to mod the game, as well as give them a sense of how the limited diversity among game designers as well as other computer science professionals might affect how technological artifacts are designed.

The last two examples in particular try to marry technical and social skills and knowledge, and emphasize design, creativity, and critical reflection. Games are particularly well-suited as a focal point for the development of such capacities, if embedded in a supportive social and material context.

I conclude with an admission. We began our work with TSG with somewhat of a 'deficit perspective' in regard to what girls and women are currently doing with games. Our ongoing explorations of what *Sims* fans (the majority of whom are women) are learning and creating, along with our work with girls, suggests that they have much to teach us about new ways of enhancing IT skills and interests through gaming.

ENDNOTES

[1] As of January 2011, *TSL* was shut down by its owner, Linden Labs, and teens were transferred to protected spaces within the adult version

[2] All quotes are from interviews with Jade while she was participating in TSG from 2007-2008.

[3] Mesh files determine the shape and other properties of an object.

[4] The Sim page template has sections for personal information such as location and age; Jade did not add any such information due to the concern all the girls had picked up from their parents about Internet stalkers.

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