the girl game company

Engaging Latina Girls in Information Technology

by Jill Denner, Steve Bean, and Jacob Martinez

It is 3:00, and school has just ended at Clarence Middle School.[1] Teresa rushes into the computer lab with three friends, all dragging large backpacks and talking about their day. They each choose a computer and log in while talking to each other in Spanish and English, checking their cell phone messages, and placing their iPod earphones.

Once logged on, Teresa goes directly into Whyville, the online community where students earn virtual money, dress up an avatar, play games, post their own games, and chat with peers. Her friends check email accounts, import images and animations to decorate their online office pages, finish homework, and visit music websites.

After 15 minutes of free time, the teacher calls the group of 20 girls to attention. She has to remind them to turn to face her, turn off their computer monitors, and take out the earphones. The teacher projects the day's agenda onto a screen and does a brief skill instruction. Today she demonstrates how to write clear titles for the "rules" of their game so they can easily tell what each rule is supposed to do. Rules are simplified pieces of code that make characters act in particular ways, such as moving right or left or going through a door into the next level of play.

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After the brief instruction, each girl sits with her partner at a computer. They log in to their online office, where they store their game and game design notes. The class is building rules for an arcade-style game, in which players earn points each time their character shoots an object. Many of the girls have creatively turned what is usually a "shooting game" into something different. In the game Teresa and her partner designed, a farmer throws pitchforks at his animals and turns them into food. Another pair of girls have made a game where spaghetti is thrown at meatballs that fall from the sky; in another game, a ghost shoots pumpkins while the main character shoots the ghost with flowers.

The girls work on their game for an hour. In each pair, one girl controls the mouse and keyboard, while the other makes suggestions, guides her partner on creating rules, and solves problems using teacher-designed handouts in Spanish and English. More experienced pairs are sometimes interrupted by other girls asking for help. The teacher encourages this interaction, often directing students to their peers rather than answering their questions herself.

As the girls put away their project binders and prepare to leave, the teacher hands out flyers about the family event next week, featuring a speaker on online safety and a free dinner. The girls rush out of the room and down the hall, shouting goodbyes to one another.

New information technologies (ITs) are changing the way we and our children live and learn. In the last five years, people have increasingly moved from simply being users of IT to adapting the content and functions of technology, often in the context of interactive, virtual worlds and game-like environments (Lenhart, Madden, Macgill, & Smith, 2007). Fluency with IT is essential for students to achieve success in a digital age. Such fluency includes the ability to sift through information, to think critically about content, and to adapt old strategies to new situations (Garmire & Pearson, 2006; National Research Council, 1999). However, young Latinas in the U.S. have few opportunities to develop IT fluency in the classroom (Margolis, Estrella, Goode, Holme, & Nao, 2008). Afterschool programs are filling a gap in technology education, using innovative strategies to engage youth and to build their capacity to participate in and contribute to the digital age. The Girl Game Company, described above, is one such program. Its goal is to increase the participation of Latinas in the IT workforce of the future. The program not only teaches Latina girls to design and program computer games but also builds a network of support to help them pursue IT courses and careers.

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Falling Short of Full Participation in IT

Despite the infusion of technology into our daily lives, females are still not full participants in the careers that are shaping the future of IT. In fact, the percentage of women in engineering, computer science, and related fields in the U.S. declined from 37 percent in 1985 to 22 percent in 2005 (National Science Foundation, 2007). As a result, women make up only 26 percent of workers in the areas of computer and mathematical operations (U.S. Department of Labor, 2007). While girls are active users of computers (Lenhart, Madden, & Hitlin, 2005), they are greatly underrepresented in computer science classes and in high-paying advanced technology careers. According to the College Board (2008), only 18 percent of students who took the lower-level Advanced Placement computer science test in 2008 were girls—the lowest percentage for any AP test. Latinas are even less well represented. In 2005, only 1.6 percent of all undergraduate computer science degrees were earned by Latinas (National Science Foundation, 2007). Meanwhile, computing occupations are projected to be the fastest growing in the decade 2006–2016 (U.S. Department of Labor, 2008).

Previous research has identified several factors that play a role in whether girls get and stay on paths to IT careers. Individual factors, including low confidence and negative attitudes toward technology and IT workers, limit girls' interest in computer courses and careers (Cooper & Weaver, 2003; Zarrett, Malanchuk, Davis-Kean, & Eccles, 2006). Girls who persist on this path must negotiate an identity that rejects negative stereotypes but maintains a sense of cultural identity (Bettie, 2003). Relational factors, such as gender role expectations held by family members, teachers, and peers, can support or undermine females' motivation to persist when faced with challenges (Margolis & Fisher, 2002; Meszaros, Lee & Laughlin, 2007). For example, some Latinas are motivated to succeed academically in order to define themselves in opposition to siblings (Bettie, 2003). Finally, institutional factors, such as limited access to computers among immigrant Latinos (Fairlie & London, 2006) and

ISTE National Educational Standards (NETS S)

1. **Creativity and innovation:** Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.
2. **Communication and collaboration:** Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
3. **Research and information fluency:** Students apply digital tools to gather, evaluate, and use information.
4. **Critical thinking, problem solving, and decision making:** Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
5. **Digital citizenship:** Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
6. **Technology operations and concepts:** Students demonstrate a sound understanding of technology concepts, systems, and operations.

Source: International Society for Technology in Education, 2007

to learning opportunities that go beyond typing skills, result in fewer urban African-American and Latino/a students being prepared to pursue computing careers (Margolis et al., 2008). These studies suggest that the middle school years are a key period in which intervention can influence students' critical choices regarding identity and perceived ability—choices that shape their educational and career paths (Brickhouse, Lowery, & Schultz, 2000; Tang & Cook, 2001).

Strategies to Help Latinas toward IT Careers

This article describes a program that aims to increase the number of Latina girls and women in computing fields. The Girl Game Company (GGC) is an afterschool and summer program for middle school girls who have grown up in the digital age but have had limited access to online technology. The goals of the program are to:

- Increase girls' IT fluency through a variety of computer-based activities
- Build peer, family, and other adult support to enhance girls' interest in and capacity to pursue and persist in computer courses and careers

GGC program strategies are based on the emerging truth that IT skills alone are not enough. For example, the Association for Computing Machinery K–12 Task Force (2003) states that students need to "be prepared to be knowledgeable users and critics of computers, as well as designers and builders of computing applications that will affect every aspect of life in the 21st century." (p. 7). GGC activities address the national educational standards (NETS S) that describe what students should know and be able to do with technology (International Society for Technology in Education, 2007). As shown in the box on this page, these standards emphasize the importance of creative thinking and innovation—using technology to learn rather than learning to use technology—as well as communication, critical thinking, and digital citizenship. GGC is playing a key role in developing this "IT fluency" by using innovative strategies to promote new ways of thinking and learning. GGC strategies are based on research in developmental psychology, education, and computer science. These strategies aim to overcome individual, relational, and institutional challenges to girls' participation in IT. This program was developed, implemented, studied, and refined over six years by a team of researchers, program developers, and educators.

The Girl Game Company is funded by the Innovative Technology Experiences for Students and Teachers (ITEST) program of the National Science Foundation. GGC serves girls from seven schools in a single district in a rural part of central California. Classes are offered on school grounds two days a week for one-and-a-half hours after school and during the summer five hours a day for two or three weeks. Students participate for up to 240 hours over one-and-a-half years. Strategies to recruit students into the program include peer invitations, pizza parties, teacher nominations, parent nights, and presentations at other student clubs in the schools. As of September 2008, 150 girls had participated in the program, and 32 had graduated. The graduates completed 60–250 hours in the program, averaging 192 hours over 14 months. The students, 11–13 years old, come from a range of socioeconomic situations. Eighty-four percent are Latina, mostly of Mexican descent; 24 percent are designated by their schools as English language learners.

GGC has a conscious approach to engaging Latina youth in IT activities in order to promote their interest and support them in pursuing higher education and possible careers in IT. Our approach has been guided by research on Latino culture and Latino youth identity, as

well as previous work on engaging and supporting girls and women in IT and on proven practices for engaging youth in informal learning environments—to which we add practices we are innovating. Our multifaceted approach includes three research-based strategies that have proven to engage participants and that appear to promote IT fluency:

- Building cultural connections
- Leveraging existing interests in IT
- Encouraging collaborative learning

Building Cultural Connections

The theory that immigrants students "bridge multiple worlds" (Cooper, Domínguez, & Rosas, 2005) guides our understanding of how Latinas build an IT-related identity on their path to college and career. Research suggests that, for Latinas, pursuit of higher education and careers in which women are underrepresented must not undermine their culture and ethnic identity (Ginorio & Huston, 2001). The Girl Game Company leverages cultural strengths and supports identity exploration by:

- Connecting girls with Latina women who work in IT
- Linking participants with culture brokers
- Supporting English language learners
- Involving families

The parents of most GGC participants work in service or agricultural fields. To connect participants with women who work in IT, the program offers such activities as field trips to technology companies, where participants learn about IT careers and meet role models. Participants also interact online with virtual mentors. These role models and mentors share stories of challenges and how they overcame them without sacrificing family connections, in keeping with the finding of Cooper, Domínguez, and Rosas (2005) that such challenges motivate some Latino/a students to succeed so they can give back to their family and community. One girl described her experience of visiting a tech company: "On the field trip I learned about the lives of some important people in Cisco. What they did to get to Cisco & what there [sic] problems were before they worked at Cisco. I told my family that I would like to work there and to get there I need to work hard." Pre-and post-participation surveys of 24 graduates showed significant increases in the beliefs that people who work with computers make really good money and that one has to work hard to get a computer job.

The social capital GGC creates helps girls to see themselves as the kind of people who can pursue high-tech careers.

Among isolated rural Latinos, a child's success often depends on what researchers have called the level of "social capital" that the family brings from its community and country of origin (Portes & Rumbaut, 2001). Youth programs that have successfully leveraged this capital share at least one common characteristic: adults who act as "culture brokers," affirming cultural traditions while linking students to resources for academic success (Cooper, Denner, & López, 1999). In the Girl Game Company, the culture brokers are teachers. As Rivera and Gallimore (2006) also found, these adults help girls develop an academic identity, challenging the low expectations they may encounter at school while helping them stay connected to their culture. The social capital GGC creates helps girls to see themselves as the kind of people who can pursue high-tech careers. An independent evaluation of the pre- and post-participation survey found statistically significant increases in graduates' intentions to use and learn about computers in school.

GGC also works hard to eliminate language barriers. GGC provides instructional support to help all students succeed, no matter their level of English language proficiency. Key strategies are aligned with the English language learner standards of the California Standards for the Teaching Professional (California Department of Education, 1999). For example, teachers use a variety of instructional approaches and resources to explain complex concepts, including graphics as well as handouts and overheads written in English and Spanish. The object-oriented programming software the girls use to build games includes images that visually describe key words and steps, so that students with a range of English proficiency levels can engage in problem solving. GGC nurtures self esteem and respects diversity by encouraging the girls to use both Spanish and English and by offering incentives for students who are more proficient in English to help their peers.

Preliminary data suggest these approaches have leveled the playing field for English language learners. Our survey of graduates found that language proficiency was not a factor in how students benefited from the program. All students demonstrated statistically significant increases in their perception of their computer skills,

such as how well they could copy and save a picture, create an avatar, or program a series of rules. The survey also showed a significant increase in graduates' confidence with computers, with higher agreement rates for such statements as, "I can make the computer do what I want it to," and "I could probably teach myself most of the things I need to know about computers."

The involvement of families is also critical for the success of Latino-focused programs (Ginorio, Fournier, & Frevert, 2003). GGC hosts monthly family dinner events, has regular phone contact with parents, gives take-home assignments that require parent input, and invites families to come on field trips. These activities help girls build bridges across sometimes divergent home and school cultures (Cooper et al., 1999) and may help families support their daughters in pursuing computing education and careers. There is some evidence to suggest these efforts are working in GGC. The pre- and post-participation survey of 24 graduates found statistically significant increases in the girls' belief that their parents wanted them to attend college and pursue science or IT careers.

Leveraging Existing Interests in IT

Girl Game Company strategies build on theories about how students enter and remain on career and educational paths. Research based in the expectancy-value model developed by Eccles-Parsons (1983) finds that girls are more likely to pursue non-traditional careers when they have high expectations for success and when they value and enjoy the subject (Goode, Estrella, & Margolis, 2006; Zarrett et al., 2006). Many young people enjoy and value digital games, seeing them as a "cool" way to be involved with computing. Thus, computer game design and programming have been used in several settings to engage students who would not otherwise be interested in IT-intensive programs (Denner, 2007; Kafai, 2006; Repenning & Ioannidou, 2008).

GGC uses game creation, in a way that offers much more than fun, to engage youth in IT. Programming a computer game helps students develop ways of thinking that position them to be competitive in an increasingly digital age (Hayes & Games, 2008). Creating games engages students in activities that map clearly onto the ISTE standards of creativity and innovation (see page 28) and promote critical thinking, problem solving, and decision making. In fact, "knowing how to put together a successful game involves system-based thinking, iterative critical problem solving, art and aesthetics, writing and storytelling, interactive design, game logic and rules, and programming skills" (Salen, 2007, p. 305).

Kid-friendly programming software provides early opportunities for success. *Creator* by Stagecast, Inc., is a visual programming language—that is, it uses picture-based rules, in this case in a movie metaphor. Students create and modify characters and then program them to move and interact in game genres as diverse as mazes, trivia games, and action games. Girls in GGC especially like to draw their own characters and to download backgrounds from the Internet. Because students are not required to learn complicated syntax, even those with limited computer experience can quickly learn the basics of making and personalizing games. However, this simple interface incorporates such key programming concepts as conditional execution, subroutines, iteration, and variables.

Denner and Campe (2008) suggest that game design allows students to create stories about issues that are important in their lives. GGC students have made games on a variety of relevant topics, some recognizably linked to their culture:

- In *Farm Craze* (see Figure 1), the game built by Teresa and her partner, the player is a farmer who throws pitchforks at animals. When the animals are hit, the player earns points and the animals change form: Cows turn into hamburgers and pigs into bacon.

Figure 1. The Farm Craze game, created by a Girl Game Company participant

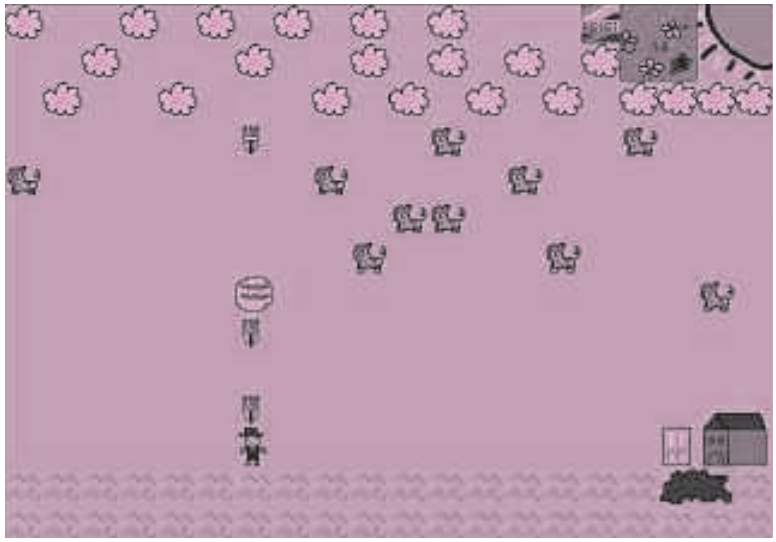

Table 1: NETS S Standards in Game Creation

Girl Game Company participants were asked what they liked most about making a game with Creator software. Their answers were coded to NETS S standards.

NETS S STANDARD	PERCENT OF ANSWERS
Creativity and innovation *e.g., creating characters*	34%
Communication and collaboration *e.g., working with a partner or friend*	12%
Technology operations and concepts *e.g., it was easy, playing games*	10%
Critical thinking, problem solving, and decision making *e.g., making characters move, making a timer*	10%
Research and information fluency *e.g., getting images or backgrounds from the Internet*	3%
Digital citizenship *e.g., making a game others can play, working with teachers*	2%
Don't know	13%
Other *e.g., likes everything*	15%

- In *Shincan*, the player is the grim reaper, who wants to take a girl to the prom. The player must dodge high school bullies to reach the goal.
- In *JNDC*, a doll called Miss Sunshine is searching for her lost dog. Ghosts and flowers shoot pumpkins at the doll to try and stop her.
- In *Flying Burritos*, the player is a girl who is eating burritos and trying to avoid being eaten by monsters.
- In the *Carnival* game, the player is a clown who throws pies. The goal is to hit all people and dogs before the pies run out.

Despite the prevalence of gaming among youth (Lenhart et al., 2008), few girls in GGC had regular access to games outside the program, and none had created a game before joining. Of 43 responses to a question about how they used computers outside the program, only 24 percent of participants said that they played games. Most of the 55 responses to the question, "What kinds of games are YOU hoping to make?" were general—for instance, "fun," "exciting," or "cool"—suggesting little prior knowledge of gaming culture. Respondents who were familiar with game genres expressed interest in making sports, racing, or adventure games.

To understand what students liked about making games, we asked them several times during the year to write responses to the questions, "What did you like about making a game using *Creator* software?" and "What was your favorite part about making a game in *Creator*?" We coded the responses using ISTE (2007) NETS S categories, as shown in Table 1. Of 162 responses, the most common were focused on creativity and innovation. For example, girls wrote, "that we got to design the game the way we wanted it," and "that I got to make my game really special with backgrounds and stuff." The game examples above show that participants' creativity took many forms.

However, making games was not the only reason girls joined GGC. As shown in Table 2, of 288 responses to the question, "What do you like (or like best) about Girl Game Company?" only 16 percent said that making a game was their favorite part. The most common response, "being with friends," is discussed later. Other responses reflect the opportunities GGC offered to explore aspects of IT that leveraged participants' interests in creativity and communication. For example, students used online offices that contained a calendar of events, a blog where they could exchange ideas, a forum for communicating with a virtual mentor, and a journal in which they planned game designs and responded to questions from adults and peers. Students enjoyed personalizing their offices by downloading images of themselves, friends, and famous people from the Internet. They also participated in an online virtual reality for pre-teens called Whyville, where they created avatars, chatted with other avatars, played games to earn virtual money, and taught peers about game design. The GGC clubhouse in Whyville served as a virtual meeting point for the girls. The more than four million members of Whyville could play the girls' games and give feedback.

Preliminary data from GGC are consistent with previous research (Barron, Martin, & Roberts, 2007) suggesting that offering a variety of fluency-building activities is essential to ensure the benefits of self-directed, socially networked learning (Lenhart et al., 2008; Ito et al., 2008). The independent evaluation of pre- and post-participation survey data from 24 GGC graduates found statistically significant increases in the frequency and range of what respondents used the computer for. The greatest increases were in journaling or blogging and in visiting online communities.

Encouraging Collaborative Learning

The ISTE educational technology standards include communication and collaboration using digital media—vital skills for the changing IT workforce. In Girl Game Com-

Table 2: Reasons for Persisting in Girl Game Company

Participants' answers to the question, "What do you like (or like best) about Girl Game Company?"

CATEGORY	PERCENT OF ANSWERS
Being with friends	20%
Making games	16%
Learning and working with computers	10%
Having fun	8%
Having free time on Whyville	6%
Field trips to IT companies and universities	5%
Experiences with teachers and mentors	5%
Everything	5%
Playing games	4%
GGC online office	3%
Free time	3%
Learning new things	2%

pany, students design, produce, and debug their games using pair programming (Williams, Kessler, Cunningham, & Jeffries, 2000). Two students share one computer according to clear roles: One is the driver, working the keyboard and mouse, while the other navigates. Pair programming is a particularly promising means to promote IT fluency because it encourages peer scaffolding, clear roles, and frequent feedback (Barker & Cohoon, 2008; McDowell, Werner, Bullock, & Fernald, 2003). It has been found to benefit the performance and persistence of university students in computer science courses (Werner, Hanks, & McDowell, 2005). Pair programming has also been used with middle school students in an afterschool program (Werner & Denner, in press). GGC activities are designed to help partners both support and challenge each other. Students are paired based on friendships and experience. Even in pairs with unequal experience, students benefit in ways that are similar to interactions off the computer: They describe their reasoning and ask thoughtful questions, identify and explain contrasting answers, and provide ongoing feedback and support (Rogoff, 1998; Schwartz & Bransford, 1998).

The opportunity to work with peers is one of the attractions of GGC. The single most popular response to the question "What do you like (or like best) about the Girl Game Company?" was some version of "being with friends" (see Table 2). One participant wrote, "I think it is very fun because I get to meet new people and talk to my friends! Also it's very interesting to learn about computers." Another wrote, "One thing I like about girl game is that we get to make more friends and it is fun making games." Of 66 students who answered a question about what it was like to work with a partner, 55 percent had positive responses, 21 percent were negative, and 24 percent were neutral. Students said they liked working with a partner because it gave them an opportunity to learn or work with a friend. Reasons they did not like working with a partner had to do with the other girl not sharing or cooperating.

Afterschool Helps Bridge IT Gaps

Recent reports show that girls are using computers in equal numbers to boys, but their representation in the computer science and computer engineering courses that prepare them for IT jobs has declined (Lenhart et al., 2005). School-based efforts to integrate technology into K–12 education have often focused on rote skills, such as typing, rather than on fluency (Goode et al., 2006). As a result, afterschool programs are filling a gap by engaging students who would not otherwise pursue IT-intensive classes, offering activities that combine hands-on, experiential learning with social interaction (Froschl, Sprung, Archer, & Fancsali, 2003). In particular, many afterschool programs aim to engage girls in IT in a way that prepares them to become *producers* rather than just *users* of technology. Programs that incorporate what is known about gender issues in youth development and afterschool programming have the most promise (Denner & Griffin, 2003).

> A focus on fluency, rather than mere computer literacy, is important because learning and working in any discipline now requires people to think critically and creatively with technology.

The research-based strategies the Girl Game Company employs to engage rural Latina girls in IT can support such girls on paths to computing education and careers. Several factors are needed to build an environment that will attract and teach Latina girls who have little prior computing experience. The most promising practices include building on cultural strengths, providing structure with creative freedom, and building a sense of community.

The first strategy involves building connections between program activities and cultural strengths.

Bilingual and bicultural materials and staff send the message that speaking Spanish is something to be proud of, rather than something to hide. GGC also builds on cultural strengths by giving most students their first opportunity to meet and interact with female and Latina IT professionals. From these women, participants learn that one can succeed in IT without leaving family behind. For example, as the keynote speaker at our program graduation, a Latina engineer from Google, addressed the girls and their families, her three-year-old son danced next to her onstage.

According to our surveys, the opportunity for creativity was an important factor in keeping participants engaged in GGC. While making a game was an attraction, it was not the primary reason that girls joined or stayed in the program. The most common responses to questions about what the girls liked best about the program focused on the opportunity to be creative in their games, avatars, and online offices. Since many of the students did not have computers at home and were rarely allowed to use the computers at school for anything other than schoolwork, GGC was, for many, their only opportunity to use a computer to work on their own creative projects.

Another important factor that engaged the girls was a sense of connection with other students. Although middle school students require a great deal of adult guidance to do pair programming effectively, working closely with a partner had direct benefits. Girls cited their friends as a reason for coming to the program. Working with a partner challenged girls to do things on the computer that they would not have tried alone. In addition, having free time to talk with students in the program and with peers in the virtual world of Whyville was a major attraction for many GGC participants. Kafai (2008) has recently identified the importance of the social interactions that occur simultaneously in physical space and in virtual spaces like Whyville.

Afterschool programs like the Girl Game Company can fill an important gap by providing opportunities for underserved youth to build IT fluency. A focus on fluency, rather than mere computer literacy, is important because learning and working in any discipline now requires people to think critically and creatively with technology. However, the skill-focused technology education prevalent in U.S. schools has not engaged students in a sustained way, as shown by declining interest in IT careers. The early findings from the Girl Game Company suggest that computer game design and programming, combined with activities to explore identities and build a network of support that affirms cultural identity while promoting high academic expectations, appears to hold promise for engaging an underserved group of Latina girls and setting some of them on paths to IT-intensive careers.

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References

Association for Computing Machinery K–12 Task Force. (2003). *A model curriculum for K–12 computer science: Final report of the ACM K–12 Task Force Curriculum Committee*. Retrieved from http://csta.acm.org/Curriculum/sub/CurrFiles/K-12ModelCurr2ndEd.pdf

Barker, L., & Cohoon, J. (2008) *Promising practices: Pair programming: Retaining women through collaborative learning.* Retrieved from the National Center for Women and Information Technology (NCWIT) website: http://www.ncwit.org/images/practicefiles/PairProgramming_RetainingWomenCollaborativeLearning_Practice.pdf

Barron, B., Martin, C. K., & Roberts, E. (2007). Sparking self-sustained learning: Report on a design experiment to build technological fluency and bridge divides. *International Journal of Technology and Design Education, 17,* 75–105.

Bettie, J. (2003). *Women without class: Girls, race, identity*. Berkeley: University of California Press.

Brickhouse, N. W., Lowery, P., & Schultz, K. (2000). What kind of a girl does science? The construction of school science identities. *Journal of Research in Science Teaching, 37*, 441–458.

California Department of Education. (1999). *English-language development standards, July 1999*. Retrieved on May 2, 2008, from http://www.cde.ca.gov/be/st/ss/documents/eldstandards.doc

College Board. (2008). *AP data 2008.* Retrieved from http://professionals.collegeboard.com/profdownload/ap-data-2008-Program-Summary-Report.pdf

Cooper, C. R., Denner, J., & Lopez, E. M. (1999). Cultural brokers: Helping Latino children on pathways toward success. In M. B. Larner (Ed.), When school is out. *The Future of Children, 9*, 51–57.

Cooper, C. R., Domínguez, E., & Rosas, S. (2005). Soledad's dream: How immigrant children bridge their multiple worlds and build pathways to college. In C. R. Cooper, C. T. García Coll, W. T. Bartko, H. Davis, & C. Chatman (Eds.), *Developmental pathways through middle childhood: Rethinking contexts and diversity as resources* (pp. 235–260). Mahwah, NJ: Erlbaum.

Cooper, J., & Weaver, K. D. (2003). *Gender and computers: Understanding the digital divide*. Mahwah, NJ: Erlbaum.

Denner, J. (2007). The Girls Creating Games program: An innovative approach to integrating technology into middle school. *Meridian: A Middle School Computer Technologies Journal, 1*(10). Retrieved on December 28, 2008, from http://www.ncsu.edu/meridian/win2007/girlgaming/index.htm.

Denner, J., & Campe, S. (2008). What do girls want? What games made by girls can tell us. In Y. B. Kafai, C. Heeter, J. Denner, & J. Sun (Eds.), *Beyond Barbie and Mortal Kombat*: *New perspectives on gender and gaming* (pp.128–144). Cambridge, MA: MIT Press.

Denner, J., & Griffin, A. (2003). The role of gender in enhancing program strategies for healthy youth development. In F. A. Villarruel, D. F. Perkins, L. M. Borden, & J. G. Keith (Eds.), *Community Youth Development: Programs, Policies, and Practices* (pp. 118–145). Thousand Oaks, CA: Sage.

Eccles-Parsons, J. S. (1983). Expectations, values, and academic behaviors. In J. T. Spence (Ed.), *Perspective on achievement and achievement motivation* (pp. 75–146). San Francisco: W.H. Freeman.

Fairlie, R., & London, R. (2006). Getting connected: The expanding use of technology among Latina girls. In J. Denner & B. Guzman (Eds.), *Latina girls: Voices of adolescent strength in the U.S.* (pp. 168–184). New York: New York University Press.

Froschl, M., Sprung, B., Archer, E., & Fancsali, C. (2003). *Science, gender, and afterschool: A research-action agenda.* New York: Educational Equity Concepts, Inc., Academy for Educational Development.

Garmire, E., & Pearson, G. (Eds.) (2006). *Tech tally: Approaches to assessing technological literacy*. Washington, DC: National Academy Press.

Ginorio, A. B., Fournier, J., & Frevert, K. (2003, February). The Rural Girls in Science Program. *Educational Leadership, 61*, 79–83.

Ginorio, A., & Huston, M. (2001). *Si, se puede! Yes, we can: Latinas in school*. Washington, DC: American Association of University Women.

Goode, J., Estrella, R., & Margolis, J. (2006). Lost in translation: Gender and high school computer science. In J. M. Cohoon & W. Aspray (Eds.), *Women and information technology: Research on underrepresentation* (pp. 89–114). Cambridge, MA: MIT Press.

Hayes, E. R., & Games, I. A. (2008, in press). Making computer games and "design thinking:" A review of current software and strategies. *Games and Culture*.

International Society of Technology Education. (2007). *National Educational Standards for Students,* 2nd ed. Retrieved from http://www.iste.org/Content/NavigationMenu/NETS/ForStudents/2007Standards/NETS_for_Students_2007_Standards.pdf

Ito, M., Horst, H., Bittanti, M., Boyd, D., Herr-Stephenson, B., Lange, P. G., et al. (2008). *Living and learning with new media: Summary of findings from the Digital Youth Project.* Chicago: The John D. and Catherine T. MacArthur Foundation.

Kafai, Y. B. (2006). Playing and making games for learning: Instructionist and constructionist perspectives for game studies. *Games and Culture, 1,* 34–40.

Kafai, Y. B. (2008). Gender play in a tween gaming club. In Y. B. Kafai, C. Heeter, J. Denner, & J. Sun (Eds.), *Beyond Barbie and Mortal Kombat: New perspectives on gender and gaming* (pp. 111–124). Cambridge, MA: MIT Press.

Krajcik, J. S., & Blumenfeld, P. C. (2006). Project-based learning. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (pp. 317–333). New York: Cambridge University Press.

Lenhart, A., Madden, M., & Hitlin, P. (2005). *Teens and technology. Pew Internet & American Life Project.* Retrieved from http://www.pewinternet.org/pdfs/PIP_Teens_Tech_July2005web.pdf

Lenhart, A., Madden, M., Macgill, A. R., & Smith, A. (2007). *Teens and social media. Pew Internet & American Life Project*. Retrieved from http://www.pewinternet.org/pdfs/PIP_Teens_Social_Media_Final.pdf

Lenhart, A., Kahne, J., Middaugh, E., MacGill, A. R., Evans, C., & Vitak, J. (2008). *Teens, video games, and civics. Pew Internet and American Life Project*. Retrieved

from http://www.civicsurvey.org/PIP_Teens_Games_and_Civics_Report_FINAL.pdf

Margolis, J., Estrella, R., Goode, J., Holme, J. J., & Nao, K. (2008). *Stuck in the shallow end: Education, race, and computing.* Cambridge, MA: MIT Press.

Margolis, J., & Fisher, A. (2002). *Unlocking the clubhouse: Women in computing*. Cambridge, MA: MIT Press.

McDowell, C., Werner, L., Bullock, H., & Fernald, J. (2003). The impact of pair programming on student performance, perception and persistence. *Proceedings of the 25th International Conference on Software Engineering*, pp. 602–607. Retrieved on January 7, 2009, from http://ieeexplore.ieee.org/xpl/tocresult.jsp?isnumber=27042&isYear=2003

Meszaros, P., Lee, S., & Laughlin, A. (2007). Information processing and IT career interest/choice among high school students. In C. J. Burger, E. G. Creamer, & P. S. Meszaros (Eds.), *Reconfiguring the firewall: Recruiting women to information technology across cultures and continents* (pp. 77–95). Wellesley, MA: A K Peters.

National Research Council Committee on Information Technology Literacy. (1999). *Being fluent with information technology*. Washington, DC: National Academy Press.

National Science Foundation (2007). *Women, minorities, and persons with disabilities in science and engineering.* Division of Science Resources Statistics. Special tabulations of U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey, 1985–2005. Retrieved on January 7, 2009, from http://www.nsf.gov/statistics/wmpd

Portes, A. & Rumbaut, R. G. (2001). *Legacies: The story of the immigrant second generation*. Los Angeles: University of California Press.

Repenning, A., & Ioannidou, A. (2008). Broadening participation through scalable game design. ACM Special Interest Group on Computer Science Education Conference, Portland, OR. Retrieved on December 18, 2008, from http://www.cs.colorado.edu/~ralex/papers/PDF/ScalabeDesign_SIGCSE2008.pdf

Rivera, W. & Gallimore, R. (2006). Latina adolescents' career goals: The resources they use to overcome obstacles in their paths. In J. Denner & B. Guzmán (Eds.) *Latina girls: Voices of adolescent strength in the U.S.* (pp. 109–122). New York: NYU Press.

Rogoff, B. (1998). Cognition as a collaborative process. In D. Kuhn, R. S. Siegler, & W. Damon (Eds.), *Cognition, perception, and language: Vol. 2. Handbook of child psychology* (pp. 679–744). New York: Wiley.

Salen, K. (2007). Gaming literacies: A game design study in action. *Journal of Educational Multimedia and Hypermedia, 16,* 301–322.

Schwartz, D. L., & Bransford, J. D. (1998). A time for telling. *Cognition and Instruction, 16*(4), 475–522.

Tang, M., & Cook, E. P. (2001). Understanding relationship and career concerns of middle school girls. In P. O'Reilly, E. M. Penn, & K. deMarrais (Eds.), *Educating young adolescent girls* (pp. 213–229). Mahwah, NJ: Erlbaum.

U.S. Department of Labor, Bureau of Labor Statistics (2007). *Women in the labor force: A databook.* Retrieved from http://www.bls.gov/cps/wlf-table11-2008.pdf

U.S. Department of Labor, Bureau of Labor Statistics (2008). *Occupational outlook handbook, 2008–09 edition*. Retrieved on December 2, 2008, from http://www.bls.gov/oco/oco2003.htm

Werner, L., & Denner J. (2009, in press). Pair programming in middle school: What does it look like? *Journal of Research on Technology in Education*.

Werner, L. L., Hanks, B., & McDowell, C. (2004). Pair-programming helps female computer science students. *Journal of Educational Resources in Computing, 4*(1). Retrieved from http://doi.acm.org/10.1145/1060071.1060075

Williams, L., Kessler, R. R., Cunningham, W., & Jeffries, R. (2000). Strengthening the case for pair programming. *IEEE Software, 17*(4), 19–25.

Zarrett, N., Malanchuk, O., Davis-Kean, P. E., & Eccles, J. (2006). Examining the gender gap in IT by race: Young adults' decisions to pursue an IT career. In J. M. Cohoon & W. Aspray (Eds.), *Women and information technology: Research on underrepresentation* (pp. 55–88). Cambridge, MA: MIT Press.

Notes

[1] Names of schools and students have been changed.