Click!: Pre-Teen Girls and a Mixed Reality Role-Playing Game for Science and Technology

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English abstract
Click! Urban Adventure Game was a mixed-reality role-playing game where girls worked in teams to solve a fictional mystery based on a real-world issue, using technology and science to conduct their investigation. In this article we describe the design of the experience and present evidence that the game increased girls’ confidence, interest, and knowledge of science and technology and helped to build a community of support and conversation-centred learning for girls. This example has implications for the design of informal learning experiences that bridge interest and identity with science and technology content.

Keywords: girls, technology, role-playing games, environmental education

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Introduction

The Click! Urban Adventure Game was a mixed-reality role-playing game where girls worked in teams with their friends to solve a fictional mystery based on real science-based issues in their city. Both participants and museum staff adopted personas of investigators and took on roles within the fictional Click! Agency, whereby the experience functioned as an immersive and pervasive game. To make the game environment convincing it needed to be pervasive, seamlessly blending reality and fantasy into a real-world environment, and to enable players to see their everyday world through the eyes of experts they were role-playing. This use of pervasive gaming enabled us to bring real-world issues, technology, and science into a playful environment. This paper examines how role-playing as Click! agents encouraged girls’ identity with, and interest in, science and technology, and considers whether the game structure succeeded in building a learning community for girls through conversations with their friends, families, and various science and technology professionals.

This project took place within a larger National Science Foundation project that was to develop informal learning experiences for middle-school girls (e.g. 11-13 years old). The Click! Urban Adventure was targeted at middle-school girls because research has shown that this period can be critical for either sustaining or losing girls’ interest in science and technology (summarized in AAUW, 1994; AAUW, 2000; NSF, 2003). Maltese and Tai (2010) note the importance of middle-school as a transition point in general for science interest and career development. This is the time of life when children are actively struggling to connect their personal and social identities with academic content and their future educational aspirations. Correlations have been shown between participation in science activities, children’s self-concepts and beliefs about science, and enrolment in advanced science courses (Simpkins, Davis-Kean & Eccles, 2006). While ethnographic research has shed light on factors that contribute to girls’ science and technology identity formation, such as social relationships, concepts of future selves, and experiences with their environment in their communities (Barron, 2006; Barton, 1998; Brickhouse & Potter, 2001), there is limited research that specifically examines how intervention programs can support productive dispositions towards science and technology for girls (NRC, 2009).

Scholars who examine the role of gender in education have argued that women are marginalized in science and technology education because stereotypical identities associated with science and technology professionals are perceived to be incongruent with feminine identities (reviewed in Brickhouse & Potter, 2001). Over the past fifty years, studies have shown gender stereotypes to be persistent, as students overwhelmingly assign male identities to their descriptions and drawings of scientists and technology experts (Mead & Metraux, 1957; Mercier, Barron & O'Connor, 2006). Our strategy in this project was to allow girls to play with positive stereotypes of high-school girls who liked science but at the same time were fashionable and popular.

Role-playing games are a promising educational environment because they provide interactive worlds where disciplinary practices can be modelled and mastered (Gee, 2003). Shaffer (2006) proposes that these types of games might provide ‘epistemic frames’, which allow participants to create an identity and participate in a community of practice. Epistemic frames are the lenses that participants use to view the game world; the player may take on the persona of a warrior or a healer, each of whom would have a different perception of the game world. In more realistic game simulations, players develop epistemic frames that transfer to real-world practices and disciplines.

At the time we were developing Click!, there had been a recent wave of work suggesting that, for boys at least, playing computer games or interacting in online communities can lead to more
confidence and expertise with technology (Davidson & Schofield, 2002; Laurel 2003; Margolis & Fisher, 2002). However, girls were less likely to be involved in the gaming culture (AAUW 2000; Chu, Heeter, Egidio, et al., 2004), perhaps because games most often are designed by and marketed to males (Heeter, 2000; Kafai, 1998), and can be perceived as being uninteresting to or inappropriate for girls (Funk & Buchman, 1996a,b). Research at the time suggested that role-playing, cooperative play, and female characters would encourage girls to engage with technology (Cassell & Jenkins, 1998; Subrahmanyan & Greenfield, 1998). More recent work suggests that games alone are not sufficient to lead to interest and learning. The key is to design a gaming experience that provides overlap between participant interest and relevant skills and content in technology and science (e.g., DiSalvo & Bruckman, 2009).

Click! – a mixed-reality game

We collaborated with the Carnegie Mellon School of Design on the development of a game targeted directly at middle-school girls. The core idea of the game was that we would develop an engrossing experience where girls would join with a group of friends and then the friend group would become more familiar with using and talking about technology. Our focus on friend groups in part reflects findings showing that having friends during adolescence is directly correlated with academic success in school (e.g., Bernt & Keefe, 1995) and findings that friends can influence identity and perceptions in science (e.g., Lee, 2002). Although girls joined in friend groups, at the same time, our game provided a structure to introduce these friend groups to other girls with similar interests, as well as mentors and professionals in science and technology fields. Our goal was to use the strong peer group dynamics of middle school by deepening and expanding girls’ social networks, emphasizing positive social capital based on knowledge and involvement in STEM (Science, Technology Engineering and Math) fields.

Knowing that technology and gaming were both topics that are often seen as stereotypically male, we designed Click! to be meaningful and engaging for middle-school girls. We used participatory and generative design methods that involved middle-school girls from diverse backgrounds, including lower-income urban neighbourhoods and upper-middle class suburbs (DiSalvo, Parikh & Crowley, 2006; Hughes, 2008). The process began with observations of girls engaged in peer group activity and focus groups where we encouraged girls to talk to each other about science, technology, the city of Pittsburgh, and game playing. An early outcome of the design research process was that girls preferred more realistic role-playing to the extreme fantasy of traditional role-playing games like Dungeons and Dragons™. Based on this finding we designed a mixed-reality role-playing game that would appeal to girls’ role-playing preferences and help them make personal connections between the game and their existing communities of friends, families and neighbourhoods. (See Hughes, 2008, for a detailed description of the formative design processes.)

The premise of the game was that girls were joining an all-girls crime-solving agency called Click! that had secretly been investigating mysterious events in the city for the past 20 years. The game revolved around the kidnapping of the lead character, Roxy Robin. Roxy was a high-school student, a pop singer in a fictional all-girl band called the Songbirds, and a secret agent in the Click! Agency. Roxy was kidnapped by a mysterious villain just as she was about to break open a science-themed case that concerned combined sewage overflow (CSO). CSO is an ongoing water quality issue facing Pittsburgh and other cities with aging infrastructure. After a few inches of rain in a short time, the storm sewers overflow and run straight into the river. The villains in the game created CSO events in the city’s rivers by constructing devices that would flush all the toilets along the river’s north shore.
at the same time. Through a story about how CSO had caused health-problems for a member of Roxy’s family, the girls saw an example of someone they admired, because of her pop-singer status, making a personal connection to science. Although the personal details of the story were fictional, the lessons about the environmental and health consequences of CSO were real.

The game comprised two distinct, yet connected parts: Agency Training and the Urban Adventure Weekend. Agency Training took place during five two-hour sessions in April and May 2005. The Urban Adventure Weekend was an overnight field trip experience at the local science museum. Agency training was conducted with approximately 20 participants at one of four community-based locations. During Agency Training the fictional game world was established through the review of closed Click! cases. These past cases served two goals in the game: first they were used to establish a pervasive game that blended the real world and fictional world of Click!; second, sessions were used to train girls on specific science and technology practices required to solve the game challenge. Girls were introduced to topics in biology, engineering, psychology, communication technology and information systems, by adult researchers and in some cases outside scientists, for example, learning about CSO from a professional environmental engineer who helped them brainstorm accurate practical and scientific solutions. Figure 1 provides an overview of training sessions for the Click! game.

<table>
<thead>
<tr>
<th>Week 1:</th>
<th>Week 2:</th>
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<tr>
<td><strong>Intro</strong></td>
<td><strong>Basic Training</strong></td>
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<td><strong>Icebreaker</strong></td>
<td><strong>Basic training protocol</strong></td>
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<td>introduction &amp; teamwork</td>
<td>scientific method</td>
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<td>Introduction to agency</td>
<td>Surveillance</td>
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<td>Introduction to game</td>
<td>Guest speaker</td>
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<td>Economy and rules</td>
<td>Clue analysis</td>
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<td>Team responsibilities</td>
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<td>Teamwork activities</td>
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By carefully developing the back-story around Click! we hoped that girls could see the application of science and technology to real-world situations while engaging in a playful social experience. When moving into the game world, players can shift from the practice of everyday life to the practice of scientist, technologist and problem solving. This becomes the ‘Magic Circle’ of the game – allowing players to accept the rules, language, and practices of a game world that would be difficult to accept in the real world (Nieuwdorp, 2005).

The final event brought all 83 participants together for an Urban Adventure Weekend in June 2005. Girls were all introduced to a mystery by Raven, another teen member of the up-and-coming pop group the Songbirds. Raven provided each of the six teams a unique first clue. The clue led them to one of eight locations along the city’s river bank, where actors and clues were staged to provide additional information on the mystery of unusual water-quality readings in river, bizarre devices that automatically flushed toilets, and a series of other colourful characters. Interpreting clues, understanding the motivations of the suspects, and ultimately unravelling the plot required that girls use the science concepts covered in Agency Training. Girls also used communication and information technologies introduced in training to track their location, communicate with other teams, and organize information gathered from clues, suspects, and witnesses.

Clues could take three forms – physical, character and key. Physical clues included items such as a brochure, business card, an email, a note with an encoded message, voicemail, or fingerprints. Each physical clue usually had a name or an address that led to another location in the field. Character clues were not tangible, but they were often valuable in giving teams details about suspects, as well as helping the game and story seem more realistic. Girls could find clues by interviewing witnesses and suspects they ran into in the field.
Physical and character clues were helpful but the main evidence was in the six key clues. These key clues were set up around the city, arranged so that no one team could find them all. Each time one of these key clues was found, all of the teams would be notified of its contents. This was a way to encourage collaboration and communication between all of the teams. It was expected that six different teams would find the six different key clues. Since all six clues were necessary in solving the mystery, all of the teams would have to work together to come up with a final solution.

In addition to the clues providing a game structure, a game economy was developed using Click! Cash. Our formative research found that girls enjoyed shopping and being rewarded for completed tasks. The use of ‘cash’ over points or another vocabulary for the economy was debated. We did not want to encourage the acquisition of material goods over skills as the word cash might denote. However, the girls’ response to the Click! Cash concept was overwhelmingly positive and they showed a much greater understanding of the word ‘cash’ versus the word ‘points’ which is often used in online gaming.

The use of the make-believe money, which was printed and bar-coded to help them keep track of it, proved to be effective as a reward during the training sessions. Teams were informed that they would earn money for attendance, answering quiz questions, and doing take home projects. Each team of four girls had to earn a minimum amount of Click! Cash in order to ‘rent’ their game equipment, which included a phone, tablet computer, a backpack, barcode scanner and a Global Positioning System (GPS) receiver. There were additional pieces of equipment that could be rented, including a ‘spy’ digital camera, a water quality testing kit, a digital video camera, a pocket microscope, a UV light, fingerprinting kit, spy pen set, tripod, snacks, calculator, handheld timer, map of Pittsburgh, and pen and paper. During the game weekend the girls could use the money to ‘bribe’ witnesses, ask extra questions of the science experts, and buy raffle tickets at the party.

Mixed-reality aspects of the game were built on multiple technology platforms in order to create a pervasive gaming environment. Because the game took place in the real world, to distinguish game and non-game objects, clues, participants, suspects, witnesses, and game money were bar-coded to identify them as game objects. Once scanned, these barcodes automatically entered into the team’s database. The database helped the players to keep track of, and organize their information. The primary interface was delivered to the girls on tablet computers. On the tablet computers they encountered the Click! Super Computer interface and a barcode scanner. Players scanned items to document clues, witnesses, and Click! Cash reserves. After a clue was scanned girls could insert additional notes by typing or writing with a stylus on the tablet computer and they could mark the location on the interface map with comments for other teams. This GPS-based map allowed girls to share information, adding to the collaborative game play experience. Figure 2 shows girls using barcode scanners and other technology in the Click! game.
Mobile phones with the Click! Headquarters pre-programmed number were also provided for the teams. When girls called this number, a Voice Over Internet Protocol (VOIP) system led them through a series of menus that would provide links to Click! technical support, science experts, and a general help line. Girls could also call other teams to exchange information or use the phones to gather clues by calling special phone numbers they found at the crime scene to hear pre-recorded clue messages and special hints. The use of a VOIP system gave the research team another advantage. The system recorded all calls and this provided a way seamlessly to embed another layer of research observation and evaluation into the game design.

The game weekend ended with a sleepover at the local science centre. Before they went to bed, teams worked on presentations that they would give to a supposed panel of experts from the Environmental Protection Agency (EPA). The presentations documented the team’s case and solution to the mystery. Girls found that Pittsburgh rivers were cleaner than EPA readings indicated because villains had been deliberately creating CSO immediately before the EPA took their pollution readings. After these final presentations, the game concluded with a party and concert by Roxy Robin. (One of the college-aged project team members happened to be a science major who was also part of a local band.)

Assessing impact of the experience

We received over 170 applications and were able to accommodate 83 girls in the Click! program. Eligible participants were females aged 11–14. Participants were asked to sign up in teams of four with their friends. Teams were primarily self-selected and the first 21 teams who registered were accepted into the program. Minorities comprised 57% of participants. Eighty-nine percent of all participants attended public schools. All of the girls lived in or near the city of Pittsburgh and...
represented both inner city and suburban teens encompassing 17 of 28 city and 2 suburban zip codes. Participants were recruited through flyers posted in the community, a website, through the Pittsburgh Public Schools and other partners of Click!.

At the first training session, each participant completed a multiple-choice survey about their interest in science and technology and their experiences using the different technologies featured in the Click! Urban Adventure. The survey also assessed the girls’ perceptions of science and technology with a fill-in-the-blank description of how scientists, engineers, and other professionals use science and technology in their work.

Individual interviews with open-ended questions were conducted with each participant before the first training session and after the end of the game. To embed the pre-test into the game, our researchers dressed in lab coats and conducted entrance interviews with the girls. Each girl also had an exit interview the evening after the Urban Adventure game. Most of the questions about science, technology, and community from the entrance interview were repeated and additional questions about their experiences in Click! were asked. Eighty-one participants completed the entrance interview and 78 completed the exit interviews. All interviews were videotaped. The interviews were later transcribed, and each question was individually coded and verified with reliability over 80% in all cases.

Findings

**Click! built on girls' interests in science and technology**

Pre-program attitudes were measured in two multiple choice questions on the entrance survey, where girls rated ‘Science’ and ‘Technology’ as ‘cool’, ‘okay’, or ‘boring’, and with two interview questions, ‘Do you like using technology?’ and ‘Do you like science class?’ Most participants entered the program with positive views of technology and science, with 72% indicating that technology was ‘cool’ and 64% saying the same about science. No girls found technology boring and only one girl answered that science was boring. Girls also generally reported that they liked using technology (82%) and science class (77%).

We had anticipated that most middle-school girls would be enthusiastic about technology, and we hoped to build upon this interest by introducing students to new technology and science content as part of the experience. In the entrance interview, we measured technology awareness with three interview questions:

1. **Tell me what you think of when I say the word technology to you?**
2. **Can you think of ways you use technology in school/outside of school?**
3. **Are there any kinds of technology that you wish you knew more about or you wished you knew how to use?**

Responses to these questions were coded and scored. Each item of technology or clear description of technology received one point. For example, the response ‘I think of computers, my CD player, and anything that is electronic’ received three points (two points for naming two technology items, and one point for a technology description). Vague and duplicate responses within each interview
question were ignored. Only participants with both pre and post interviews (n=77) were included in the analysis. Findings show that overall awareness of technology increased significantly, as the average combined score across the three questions increased from 5.62 (SD=2.61) in the pretest to 6.92 (SD=3.07) in the post test (t(76)=−3.88, p=0.0001).

In the entrance survey, girls were also asked about prior experience with technologies that would be used in Click! game play. Girls noted that they were familiar with computers, cameras and cell phones, but had very little exposure to GPS or barcode scanners. Ninety-six percent of girls were familiar with computers, 76% with cameras, and 63% with cell phones in contrast with only 4% who had used a GPS and 14% who were familiar with barcode scanners.

It is interesting to compare the girls’ attitude to learning about new technologies with their experiences using technology prior to and during Click! Initially, girls expressed interest in learning about technologies that were already fairly familiar, such as cameras and computers. After the Urban Adventure Game, GPS (a key technology used in the game) was the most frequently mentioned item that the girls wanted to learn more about. In addition to piquing interest through exposure to new technologies, Click! gave girls an opportunity to use familiar technologies in novel ways. For example, during the game, girls used computer applications to communicate with other teams, and to organize information from digital cameras, GPS and barcode scanners. Here, one participant describes the benefits of learning new uses of familiar technology:

Researcher: So do you like using technology?

Participant: Yeah, I love it.

Researcher: Yeah? You good at it?

Participant: Yeah, now… Before I couldn’t like, kind of like use a computer too well, but now I know how to like locate, use the computer, to use it as a map and stuff like that… And download things into a computer. I didn’t know how do that at first and now I know how to!

Click! changed girls’ perceptions of science

While most of the girls were interested in science, the entrance survey revealed that many had only vague ideas of what scientists do. Perceptions of science were assessed with a fill-in-the-blank where girls were asked to imagine themselves as scientists: ‘If I was a scientist, I would be a [kind of scientist], I would [activity], and use technology to [activity].’ This assessment was repeated at the end of the program. Only the responses of participants who completed both the pre- and post-surveys were analysed (n=72). Responses were coded by overall answer quality and nature of the science activities described. Quality scores were based on the number of accurate, original descriptions given. Two points were awarded for answers that contained two distinct, accurate descriptions (i.e. ‘I would [like to study planets] and would use technology to [get a closer look at the planets]’). One point indicated one accurate response. Vague responses received 0 points (i.e. ‘I would [do a lot of science] and use technology to [help people]’). Codes describing the nature of scientific activities were derived from the verbs in the responses. Some codes, such as teach and study directly reflect the words used in the response (i.e. ‘study planets’). Other codes include several verbs with a common theme. For example, solve includes responses that contain the word ‘solve’, but also those
describing problem solving techniques that require analysis or calculation, like ‘add the grams’. Each distinct answer received one code and the number of codes per answer ranged from 0 (answers that were too vague to interpret were not coded) to 4 (if a participant gave two answers in each section).

From pre to post test, the mean quality score increased from 0.81 (SD=0.76) to 1.22 (SD=0.74), $t(71)=-4.07$, p<0.001. The language used to describe the activities of scientists also changed. In the pre-test, many of the responses were general (e.g. teach or help) and did not describe the investigative nature of science. In the post-test, the use of words associated with inquiry and problem-solving (e.g. solve, discover) increased and the use of more general descriptors decreased. Figure 3 shows the number of participants whose answer contained each code. Significance was calculated using paired t-tests to compare the mean number of responses per participant for each code.

Figure 3. How girls describe the activities they would pursue as scientists in pre- and post-tests (n=72)

Girls’ perceptions of science changed in the context of their role-playing experience during Click!. Entrance interviews showed that many girls had expressed an interest in crime-scene investigation (albeit most seemingly had little to do with science per se, i.e. ‘I like to watch C.S.I Miami on TV.’). During the game, girls really engaged in the role-playing activity. They liked being Click! agents and this provided several outlets for learning that extended beyond the fictional world of Click! Our findings showed that through the game experience girls moved beyond the stylistic appeal of crime-scene investigation to engage in learning experiences that changed their perceptions of the nature of science. They also increased their familiarity with and curiosity for technology. It is interesting that they achieved these STEM outcomes while through the focus on science and technology came an indirect element of role-playing. Girls came to associate the investigative skills they developed as Click! agents with those suited for science.
Girls connected science themes from Click! to their city

One of the learning strategies for Click! was to engage girls with science and technology by drawing consequential connections between science topics and the girls’ own lives. The success of such an approach is difficult to measure, but several interesting indications surfaced when girls responded to questions about their city with statements about science. These results were encouraging, not only because the girls acknowledged without prompting that they learned about science during Click!, but because they associated science with Pittsburgh – their city and the community that they will continue to engage with once their experience in Click! is over.

Most commonly these connections emerged in response to the question, ‘If you could change something about Pittsburgh, what would it be?’ and ‘Did you learn anything new about Pittsburgh during Click!?’. The first question was asked in both the entrance and exit interviews. [Responses were analysed only for participants who answered the question in both the pre- and post- tests (n=76)]. The second question was asked only in the exit interview and responses were analysed for all participants (n=78). Responses were coded by topic and received multiple codes if several distinct topics were mentioned within a single response.

Despite the general nature of these questions, science emerged as the strongest theme. In the entrance interview, 41% of the responses to the question about changing Pittsburgh dealt with environmental themes (general pollution, green space and water pollution). This jumped to 72% on the post-test. Table 1 shows the number of occurrences of each code. Paired t-tests found significant differences for the increase in the reduce water pollution (t (75) = −6.09, p<0.0001) and fix sewer system codes (t (75) = −3.37, p=0.001), the two environmental topics that were at the heart of the game. The increase clearly correlates with the participants’ experiences in Click! since the mention of science topics that featured prominently in the game narrative (water pollution and sewer system) rose dramatically.

<table>
<thead>
<tr>
<th>Table 1. If you could change something about Pittsburgh, what would it be? (n=76)</th>
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<tbody>
<tr>
<td>Response</td>
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<td>---------</td>
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<tr>
<td>General Environmental topics:</td>
</tr>
<tr>
<td>Reduce general pollution</td>
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<tr>
<td>Increase green space</td>
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<tr>
<td>Click! Environmental topics:</td>
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<tr>
<td>Reduce water pollution</td>
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<tr>
<td>Fix sewer system</td>
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<tr>
<td>Other topics:</td>
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<tr>
<td>Reduce poverty</td>
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<tr>
<td>Reduce crime</td>
</tr>
<tr>
<td>Improve traffic conditions</td>
</tr>
<tr>
<td>Change people’s negative attitudes</td>
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<tr>
<td>Improve schools</td>
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</table>
As shown in Table 2, codes related to Click! science topics are also the most common responses to the question ‘Did you learn anything new about Pittsburgh during Click?’ One other interesting finding in Table 2 is that the third most popular response was that girls learned about new places in Pittsburgh. Pittsburgh is a city with very distinct neighbourhoods which, as a result of history, demographics, and the very hilly topography, often remain fairly isolated from each other. Particularly for our African-American girls from disadvantaged neighbourhoods, the game opened up the possibility of seeing for the first time the downtown museums, parks, and riversides of Pittsburgh. This is one of the reasons we chose to use a mixed-reality game rather than a purely online experience. We thought it was important for girls to come to know their city as a learning environment as well as to get to know girls from other neighbourhoods.

**Girls noticed their friends’ abilities in science and technology**

A number of participants indicated that they noticed their friends’ interests and abilities in science and technology during Click! In response to ‘Did you learn anything new about your teammates during Click?’ most (63%) girls replied ‘Yes’. Girls were asked to join the game with a group of their best friends, but they still learned something new about them. Girls mentioned that they learned more about their friends’ interests in science and technology, more about how smart they were, more about their personalities, and how they work in teams. For example:
Researcher: Did you learn anything new about your teammates?

Participant A: I didn’t know that they know this much about science because like, because most of the time we don’t talk about science in school. But I don’t know they knew this much. And they didn’t know that I know that much. So we was like, all surprised.

Researcher: Did you learn anything new about Pittsburgh during Click!?

Participant B: I learned that there are a lot of smart girls in Pittsburgh.

Researcher: Did you learn anything new about your teammates?

Participant B: … they were smarter than they seemed in school.

Conversations about Click! continued at home

By building the Click! community from existing groups of friends, our hope was that girls would continue conversations about science and technology beyond the training and game experience. When asked during the exit interview ‘Did you talk to your friends about Click!?’ and ‘Did you talk to your parents about Click!?’, 95% of girls reported talking to their friends and 85% mentioned talking with their parents. According to the girls, they talked about how much fun they had, but also about the activities and what they learned.

Researcher: Do you just talk to your friends who are in Click! about Click! or do you talk to other friends about it?

Participant: Other friends.

Researcher: And, can you tell me what exactly do you guys talk about?

Participant: Like we talk about... what we had just learned and stuff.

Researcher: All right. And, did you ever talk to your parents, teachers, anybody else about Click!?

Participant: Uh, I don’t know. I tell my grandma.

Researcher: What did you tell her?

Participant: I told her that we were having fun and that we were learning things.

Researcher: What sorts of things did you tell her you were learning?

Participant: How a toilet works and like where the water goes, and how the river could get polluted by the sewage.

Twenty parents completed a written survey with open-ended questions. Their responses confirm that Click! conversations continued at home:
“My daughter and her friends have been so excited about their involvement and it has created many animated conversations between them.”

“I always ask her what she learned each week and how she felt about each week. I always made sure she realized how powerful women are and their role in our world.”

Conclusion

This paper explores our ‘best bets’ about how a technology-rich informal learning experience might change middle-school girls’ interest and participation in science and technology. We designed Click! to test the idea that role-playing games would be an effective participation structure to build a learning community for middle-school girls. We also focused on identity and girls’ models for scientists and scientific practice as the primary outcomes, and we designed the experience to build upon girls’ existing social networks so that science and technology would become a more common topic of conversation and interaction among their friends and at home.

Our findings suggested that role-playing games can be an effective participation structure for informal science and technology learning. Much of the work exploring participation in science and technology has focused on creating communities where students could participate in legitimate disciplinary practices. For example, Lehrer, Schauble, and Petrosino (2001), demonstrate how elementary students can develop shared practices around representing, inscribing, and explaining biological phenomena in ways that are more consistent with authentic science than might be standard in most elementary classrooms. One of the challenges of informal education is that it often lacks the organizational dynamics that give educators control over how students participate. Although there have been many successful informal experiences where children are asked to play the role of a scientist, these tend to attract students who already see themselves as aspiring to that role. Click! was designed the other way round. We worked with girls to identify a role they would be motivated to play – secret agent rock star – and then designed a science and technology-laced narrative to surround that role. Findings suggested that the strategy was successful across the diverse group of girls who participated in Click!. In addition to the findings reported in this article, from a programmatic standpoint, we always noticed very high levels of engagement, almost no attrition across the six weeks of the program, and a unanimous response among the girls that they would do Click! again if they had the chance.

Beyond its success as a mixed-reality game, findings reported here suggest that Click! was successful at engaging girls with science and technology, promoting friend group interactions around science and technology, and teaching new science and technology content. Important to its success was designing the immersive experience of Click! so that learning about the core science and technology was a necessary goal to solve the game. Although the girls reported that they were interested in science and technology when they entered, our findings suggest that the experience gave them a motivating and comfortable atmosphere to explore these interests deeper with their friends and to meet other girls who shared their interests. In essence, we were designing a community of practice where science and technology could become common themes. Girls could develop and demonstrate their expertise in novel technologies. They could talk to each other about sophisticated concepts and they could help troubleshoot theories and technical applications in the course of solving the mystery. Each girl explored these connections from the perspective of the role they played in the game and the role they naturally assumed within their circle of friends. Gresalfi and Cobb (2006) have emphasized how students’ disposition towards a discipline will affect their ability to learn that...
discipline. They define disposition as how a student values, what they associate with, and how they see participating in a discipline. Click!’s use of role-playing created a narrative of what it meant to participate in a scientific community; a strategy that Barab et al. (in press) suggest is critical in establishing a positive disposition to a discipline.

The experience we report in this article is a proof of concept. It was a prototype experience that relied on heavy use of resources from the university design and educational research teams who built the program. At the time, we did not know if the ideas we were exploring could be scalable and sustainable as an ongoing educational experience. A community of practice model is not very strong unless it proves that it can take root outside the hothouse conditions of a federally-funded research and development project. In that sense, the true test of success here is whether Click! continued after the university researchers moved on to other projects. We are pleased to report that, in fact, Click! was taken up, extended, and sustained by the local science centre in Pittsburgh. For the last six years, the science centre has been running the program in a modified form as a summer camp for middle-school girls. Recently, the science centre won an award in the MacArthur Digital Media and Learning Competition, which will allow them to create Click!Online, a digital version of their current program that will extend the experience to girls beyond the Pittsburgh region.

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References


National Science Foundation. (2003). New Formulas for America’s Workforce: Girls in Science and Engineering (NSF 03-207), National Science Foundation (NSF), Arlington, VA.


