Engaging Youth with STEM Professionals in Afterschool Programs

Melissa Koch, Annie Georges, Torie Gorges, and Reina Fujii

Abstract

The interplay between youth development staff and STEM (science, technology, engineering, and mathematics) professionals can influence girls’ interest in STEM careers. Build IT, an afterschool and summer youth-based curriculum for middle school girls, uses design, communication technologies, and structured interactions with IT professionals to encourage girls’ IT fluency, interest in mathematics, and exploration of STEM careers. A mixed method, pre-post test design to evaluate the program revealed that even with limited interactions, girls’ expectations of success and attitudes about STEM careers were influenced when they interacted with female professionals, and these interactions increased the value that girls placed on STEM careers. Moreover, the development facilitator’s support during implementation—especially activities before, during, and after a visit with a professional—was critical. We share implications for practice on how to encourage girls’ interest in technology careers.

Introduction

Women constitute 46% of the US workforce but hold just 27% of computer science and engineering jobs, with minority women holding roughly 7% of these jobs (National Science Foundation, 2007). The fundamental obstacles to girls entering the STEM (science, technology, engineering, and mathematics) workforce today are the value they place on STEM careers, their interest in STEM topics, and their perceived success in STEM fields (Barman, 1996; Brickhouse, Lowry & Schultz, 2000; Chambers, 1983; Eccles, 1994, 2006, 2007). To increase girls’ perception of the value and success in pursuing STEM careers, they need to see their interests reflected in STEM courses and in informal learning opportunities so that science, technology, and mathematics become a central part of the “girl they are” (Brickhouse et al., 2000). Research suggests to overcome these fundamental obstacles, girls should participate in tasks that are relevant to their lives and have a larger social impact, connect with role models in STEM professions, and receive feedback and encouragement (Eccles, 1994; Halpern et al., 2007; NCWIT, 2007).

Many organizations provide guidelines on how to plan and implement successful classroom visits or field trips with STEM professionals. This is vital because interactions with STEM professionals are viewed as important in overcoming the obstacles girls face in entering STEM professions (e.g., Expanding Your Horizon [www.expandingyourhorizons.com] and Techbridge’ s Guide for STEM Role Models. The Techbridge guidelines (Countryman, Kekelis, & Wei, 2006), for example, encourage STEM professionals to be personal, passionate, and communicate how their work matters when they visit
classrooms or conduct field trips. Even though STEM programs, whether implemented in K-12 classrooms or during afterschool programs, often incorporate activities with STEM professionals, few if any programs collect the kinds of data needed to determine how staff and facilitators should connect and integrate professionals’ roles in these programs to effectively influence girls to enter STEM fields. We contribute to the literature by presenting findings on a youth development program for middle school girls that successfully integrated information technology (IT) professionals into the curriculum and supported youth development staff in providing positive experiences that affected the girls’ attitudes and interests in IT careers. We present findings from the implementation and evaluation of Build IT, an afterschool and summer youth-based curriculum for middle school girls, from 2005 through 2009.

We describe the key factors required to effectively integrate IT professionals (a subset of STEM focused on technology, computer science, and engineering) into STEM programs for girls. Our work provides research-based evidence on the type and quality of activities with IT professionals and girls’ interactions with youth development staff that correlate with girls’ increased interest in IT careers. We addressed two research questions: (1) What are the changes in attitudes and interests in IT careers among participants? and (2) In what ways do interactions with IT professionals and the youth development facilitator influence participants’ attitudes and interests in IT careers?

Below, we describe the Build IT program and then present the data from our interviews and observations that show IT professionals can be effectively integrated into afterschool programs in ways that could increase the value that girls see in IT careers. We then discuss the lessons learned which can guide youth development programs to support girls’ interest in IT careers.

**About the Build IT Program**

The Build IT curriculum is a collaborative effort between SRI International, Girls Incorporated of Alameda County (GIAC), and the national Girls Inc. network of affiliates. It is an afterschool and summer youth-based curriculum for low-income middle school girls (sixth through eighth grades) intended to develop IT fluency, interest in mathematics, and knowledge of IT careers. The curriculum capitalizes on girls’ interest in design and communication technologies and incorporates performance tasks for formatively assessing IT fluency. The Build IT curriculum helps girls explore existing information technologies (e.g., web-based tools, collaboration tools, wireless and mobile devices) and create their own information technologies using simple programming tools. The curriculum consists of six units in which the girls critique and critically frame problems, engage in guided practice in which they participate in a software engineering process, and have opportunities to redesign and troubleshoot available technologies. Each unit builds on the previous one.

The curriculum includes structured interactions with IT professionals that provide opportunities for professionals to share their career paths, education, and the interests they had as middle school students and to co-lead an activity with the youth development facilitator. In addition to field trips and visits with IT professionals, the curriculum has five additional elements: (1) participating girls make presentations to IT professionals, peers, and the community during Family Tech Night; (2) staff refer to careers throughout the curriculum (e.g., give girls trading cards that feature women in IT professions); (3) staff co-lead the field trip or visit sessions with IT professionals, making connections to the curriculum for the girls; (4) girls use tools and practices similar to those that IT professionals use (e.g., design process, HTML, object-oriented programming); and (5) girls work on topics and issues similar to those confronting IT professionals (e.g., designing, programming, user research).

Participants also engage in mathematics activities that directly relate to the IT content, such as exploring graph theory to understand networks, using combinatorics to find the number of color combinations available for a website, and using logic models and algorithmic thinking to program a computer game. These activities are meant to give girls exposure and practice with applied mathematics and address specific middle school mathematics concepts noted in the NCTM (2001) Principles and Standards for School Mathematics.

**Methods**

**Participants**

Build IT was implemented first at GIAC for 3 years and then at six other Girls Inc. affiliates in the United States and Canada for 2 years. During that period the Build IT program reached approximately 800 middle-school girls who completed one or more units of the curriculum. There were two stages of recruitment into the program. In the first 3 years Build IT was part of GIAC’s All STARS program, an afterschool program for middle school girls in the San Francisco Bay area. The All STARS program provides academic enrichment, homework assistance, social support, and health and fitness development for participating girls. Build IT was added to GIAC’s All STARS as the technology component. Teachers and administrators from middle schools near the GIAC sites recommended girls to attend the All STARS program, parents encouraged their daughters to attend, and the girls themselves chose to participate. Recruitment at other Girls Inc. sites varied. Four of the affiliates have a model similar to GIAC, in which girls join an
afterschool program that includes Build IT as one of several components; the other two affiliates recruited specifically for Build IT. Thus, overall the participants in Build IT are not predisposed to have a positive attitude towards technology or interest in IT careers. The participants were 43% Latina, 22% Black, and 7% Asian. With respect to grade level, 37% were in grade 6, 41% in grade 7, and 22% in grade 8.

We conducted a yearly evaluation at each site where the program was implemented for each of the units of Build IT. Table 1 shows the number of participants and the comparison group for each of the five years we conducted the evaluation. Of the 800 girls who experienced some aspect of Build IT and who may have participated in all six units, 316 unique girls completed pre- and post-test surveys over the five years we conducted the evaluation. The first 3 years of the implementation included a comparison group of middle school girls in other afterschool programs near the GIAC affiliate site that served a similar demographic. Of the 123 girls in the comparison group, 17% were Latina, 38% were Black, and 21% were Asian.

<table>
<thead>
<tr>
<th></th>
<th>Build IT</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>Year 1</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Year 2</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>Year 3</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>Year 4</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Year 5</td>
<td>150</td>
</tr>
<tr>
<td>316</td>
<td>123</td>
<td></td>
</tr>
</tbody>
</table>

Note. The number of participants and comparison group includes those who completed both the pre- and post-test surveys.

Table 1

We conducted two classroom observations, interviews with six girls, and staff interviews at each site where Build IT was implemented for each of the units. Over the five-year period we interviewed 170 girls and 21 Girls Inc. staff. We completed more than 50 classroom observations of the program's implementation.

Procedures

We used a mixed-method, pre-post test design to evaluate the program. We chose this mixed-method approach to achieve deeper understanding of the factors that influence girls' attitudes and knowledge building and to have a mechanism for aligning data collected from qualitative and quantitative sources. In other words, when observations, interviews, and surveys told the same story, we had a deep understanding and rich descriptions of the program's implementation. When they did not align, we investigated the data further. We evaluated the curriculum's implementation, including the structured interactions with IT professionals, by collecting both qualitative and quantitative data. The data collection occurred each year at affiliate sites where the program was implemented and focused on girls' IT fluency, interest in pursuing IT careers, and plans to take mathematics courses. Regarding IT career interest, both sources of data provided information on engagement of IT professionals with girls during field trips and visits and girls' interactions with the youth development facilitator during implementation of the program.

The qualitative data were collected through observations of the curriculum's implementation and observations of IT professionals' visits and field trips. Interviews lasted approximately 30 minutes. Some interviews occurred via e-mail. All interviews and observations were semi-structured, allowing for comparison among sites but also giving evaluators the freedom to adapt, as needed, to local conditions at each affiliate. Qualitative data comprised pre- and post-interviews with key stakeholders (i.e., program manager, program coordinators, and group leaders), weekly group leader feedback forms, and girl participant feedback forms.

Sources of Data
In the interviews girls were asked questions ranging from general career interest to more specific questions about careers and interest in IT careers. For example, evaluators asked:

- What do you want to be when you grow up?
- What helped you make that decision—something in school? Something in Girls Inc.?
- Are you interested in careers that include science, math, or technology?

If the girls indicated they were interested in a technology-based project, then the evaluator asked a follow up question: “Did making this project make you interested in a technology job?” The staff interviews covered questions about the IT professionals’ visits as well as questions about what girls learned relative to IT career possibilities.

A survey was administered as a pre- and post-test at the start and end of each Build IT unit implemented at each participating Girls Inc. affiliate in each year. In the first 3 years, the girls in the comparison group also completed the survey. The IT Attitudes Survey was developed in collaboration with GIAC staff and an independent evaluator. Some of the survey items were adapted from Teasdale and Lupart (2001), Barron (2004), and Girl Games Company Survey (Denner, 2005). The IT Attitudes Survey included a series of questions on girls’ comfort and interest in computers, thoughts on computer and technology careers for themselves, and thoughts on women in IT careers. The survey also covered the topics of academic plans, interest in and attitudes regarding IT careers, and the perceived skills of respondents. Examples of survey questions are: “What do you think about computer-related jobs like web-designers, software developers, or computer engineers?” and “Is the statement, ‘women are as successful as men in science and engineering’ very true, sort of true, don’t know, not really true, or not at all true?”.

We created three composite scores from survey items. A composite score from 11 survey items captured an overall attitude about computer- and technology-related jobs. The survey items included positive statements (e.g., it would be pretty fun to work in these jobs, people in these jobs make lots of money, and I would like one of these jobs because they are challenging); negative statements (e.g., I would not like these jobs because I don’t like computers, mostly men work in these jobs, it would be pretty boring to work in these jobs, people in these jobs are not very cool, and I would not like these jobs they are too difficult); and neutral statements (e.g., people in these jobs have to know how to program computers, I might be willing to try one of these jobs but I don’t think I would like it, and I have no opinion about these jobs). The scale ranged from 0 (most negative possible attitudes) to 1 (most positive possible attitudes). The reliability coefficient of this scale is .75. The second composite score was the Attitudes toward Computers and Computer Work scale using six survey items with a reliability coefficient of .76. The third composite score captured girls’ views of women in IT careers using four items with a reliability coefficient of .72.

The Build IT research website includes the quantitative and qualitative evaluation protocols used in the program

Data Analysis

The interviews and observations data were recorded then transcribed using both an emergent coding scheme in the tradition of grounded theory (Charmaz, 1983) and coding for predefined themes based on the program’s goals, such as girls’ interest in IT careers. Two evaluators transcribed the interview and observation data. Both evaluators discussed with a senior researcher how they transcribed the interview and observation to come to agreement on the conclusions drawn about the themes.

We reviewed the transcribed interviews and observation data over the 5 years of implementation to assess the girls’ interactions with professionals and the youth development facilitator. At each site we mapped these interactions. We included interviews and observational data of the youth development facilitator during classroom interactions. We then counted the number of positive and negative interactions with the professionals and the youth development facilitator. We noted the context in which each type of interactions occurred including girls’ statements and reactions regarding technology careers. The data obtained from interviews and transcriptions is primarily qualitative and helps to explain the variation in the quality of interactions between professionals and participants among the sites.

Survey responses were coded and descriptive statistics were computed for each item as well as the composite scales. Descriptive statistics included estimating means and frequencies. Pre-post test comparison with tests of statistical significance were completed. Paired t tests were used to assess change within the participants and within the comparison group. Independent group t tests were used to determine whether the change in the experimental group was significantly different from that of the comparison group. We performed correspondence analysis to examine patterns of responses when several items were used in making comparison.

Results
Our quantitative survey data measured girls’ attitudes and interest in IT careers from participating in Build IT. Qualitative data obtained from observations and interviews showed what girls were saying and doing regarding careers in technology. This qualitative data provided a rich context for the quantitative data and also highlighted the importance of the youth development facilitator in fostering quality interactions between the girls and the professionals and supporting girls’ interest in IT careers throughout the program. From analysis of the qualitative data, we described the interactions between IT professionals and participating girls and how these interactions may have influenced girls’ attitudes towards IT careers.

Attitudes About and Interest in IT Careers

During the Build IT program, participating girls’ views of IT careers improved, with girls either recognizing IT careers as possibilities for women or specifically believing that IT careers were possible for them. There was modest but consistent interest among the girls in pursuing IT careers, and the girls who participated in several of the units of the curriculum had positive views of women in IT careers. An important milestone that emerged from the data was the girls began to understand the possibility they could pursue IT careers.

The quantitative survey data showed moderate positive changes in attitudes about and interest in IT careers among participating girls relative to the comparison group. On the pre-test, 37% of participants felt technology jobs were fun, compared to 56% of the comparison group. On the pre-test, nearly 17% of participants agreed with the statement that they did not like computers, whereas only 3% of the comparison group agreed with this statement. However, there was a 13-percentage point decline in agreement with this statement among participants on the post-test, placing participants slightly lower at 3% compared to the 5% in the comparison group that agreed with the statement on the post-test. Participants differed from the comparison group in their initial gender perceptions of technology jobs. On the pre-test, 20% of participants and 3% of comparison girls felt that these jobs were dominated by men. By the post-test, however, 10% of participants and 7% of the comparison group felt this way. We performed a multiple correspondence analysis to assess the similarity and dissimilarity of responses to the survey items. We found the comparison group tended to have more agreement with the positive attitudes questions than participants. However, there was substantially more positive growth among participants than the comparison group. For example, on the post-test, participants demonstrated positive attitudes similar to the comparison group. Approximately 44% of participants agreed with the positive attitudes questions on the post-test, which was an increase from 30% in the pre-test. In contrast, 50% of the comparison group agreed with the positive attitudes questions on the post-test, which was a decrease from 59% in the pre-test. Also participants, on average, declined in the number of negative job type statements over the course of the year. By contrast, negative job type perceptions increased for the comparison group.

Participants had stronger positive views of IT careers relative to the comparison group. Table 2 presents results from the survey on 11 statements regarding computer- and technology-related jobs and the people who work in them. On average 22% of participants on the pre-test had negative attitudes about these careers, such as not liking computers, these jobs were not very cool, and the jobs were too difficult. On the post-test, negative attitudes toward these jobs declined 7 percentage points to 15% among participants. In contrast, on average 24% of the comparison group had negative attitudes toward these jobs, which declined 3 percentage points on the post-test. Moreover, Build IT participants had an 8 percentage point decrease in their perception of male dominance in IT fields compared with 5% for the comparison group.
Table 2

<table>
<thead>
<tr>
<th>Positive Statements</th>
<th>Build IT</th>
<th></th>
<th></th>
<th>Comparison</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>It would be pretty fun to work in these jobs</td>
<td>50.9</td>
<td>49.1</td>
<td>-1.8</td>
<td>37.9</td>
<td>51.7</td>
<td>13.8</td>
</tr>
<tr>
<td>People in these jobs make lots of money</td>
<td>60.4</td>
<td>62.3</td>
<td>1.9</td>
<td>58.6</td>
<td>72.4</td>
<td>13.8</td>
</tr>
<tr>
<td>I would like one of these jobs because they are challenging</td>
<td>22.6</td>
<td>24.5</td>
<td>1.9</td>
<td>24.1</td>
<td>34.5</td>
<td>10.4</td>
</tr>
<tr>
<td>Positive average</td>
<td>44.6</td>
<td>45.3</td>
<td>0.7</td>
<td>40.2</td>
<td>52.9</td>
<td>12.7</td>
</tr>
<tr>
<td>Ambivalent Statements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>People in these jobs have to know how to program computers</td>
<td>44.6</td>
<td>45.3</td>
<td>0.7</td>
<td>40.2</td>
<td>52.9</td>
<td>12.7</td>
</tr>
<tr>
<td>I might be willing to try one of these jobs, but I don’t think I would like it</td>
<td>58.5</td>
<td>56.6</td>
<td>-1.9</td>
<td>86.2</td>
<td>65.5</td>
<td>-20.7</td>
</tr>
<tr>
<td>I have no opinion about these jobs</td>
<td>41.5</td>
<td>30.2</td>
<td>-11.3</td>
<td>37.9</td>
<td>37.9</td>
<td>0</td>
</tr>
<tr>
<td>Ambivalent Average</td>
<td>48.2</td>
<td>44</td>
<td>-4.2</td>
<td>54.8</td>
<td>52.1</td>
<td>-2.7</td>
</tr>
<tr>
<td>Negative Statements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would not like these jobs because I don’t like computers</td>
<td>26.4</td>
<td>17</td>
<td>-9.4</td>
<td>17.2</td>
<td>24.1</td>
<td>6.9</td>
</tr>
<tr>
<td>Mostly men work in these jobs</td>
<td>42.1</td>
<td>34.6</td>
<td>-7.5</td>
<td>47.1</td>
<td>42.5</td>
<td>-4.6</td>
</tr>
<tr>
<td>It would be pretty boring to work in these jobs</td>
<td>5.7</td>
<td>3.8</td>
<td>-1.9</td>
<td>10.3</td>
<td>6.9</td>
<td>-3.4</td>
</tr>
<tr>
<td>People in these jobs are not very cool</td>
<td>17</td>
<td>3.8</td>
<td>-13.2</td>
<td>10.3</td>
<td>10.3</td>
<td>0</td>
</tr>
<tr>
<td>I would not like these jobs they are too difficult</td>
<td>18.9</td>
<td>15.1</td>
<td>-3.8</td>
<td>34.5</td>
<td>20.7</td>
<td>-13.8</td>
</tr>
<tr>
<td>Negative Average</td>
<td>22</td>
<td>14.9</td>
<td>-7.1</td>
<td>23.9</td>
<td>20.9</td>
<td>-3</td>
</tr>
</tbody>
</table>

Note: The percent of respondents who agree with given statement. The question asked was: "What do you think about computer-related jobs like web-designers, software developers, or computer engineers?" The response was for the girls to check which of the listed statements they agreed with. The data presented in this Table are from year 2 of the implementation of the Build IT program. In the second year of implementation GfAC implemented Build IT for 67 girls, of which 50 girls completed the entire school year program.

Table 3 shows the composite career attitude score toward computer- and technology-related jobs. Participants had higher overall scores in their attitudes about IT careers relative to the comparison group. However, the participants’ overall average score was not statistically different from that of the comparison group.
Excerpts from interviews in the qualitative data illustrate the change in attitudes about and interest in IT careers from the girls’ perspectives. The most common statements were:

- I might be able to do that.
- You could do amazing things.
- I thought [the jobs] were hard but seemed kind of fun.

The observations and interviews also provide illustrations of the girls’ views of IT careers. For example, during the summer program when there were more opportunities to participate in several IT fieldtrips for 3 to 4 hours each and to reflect on these IT careers, there was more enthusiasm for IT careers. In one instance, toward the end of a 2-week summer program, participating girls brainstormed a list of jobs they had learned about and came up with a total of 17 careers, including engineer, producer, “computer fixer,” interpreter, and accessibility tester. They went through the list as a group, explaining (with a fair degree of accuracy) what each job entailed, and then said what kind of job they would like to have. Only one girl said the jobs on the list did not interest her. The girls’ discussion and level of understanding of IT careers indicated a marked difference from their responses at the start of the program when they had typically said that although the IT jobs they learned about sound “okay” or “interesting,” they did not want those jobs. The fact that one girl indicated that she was not interested in these jobs shows that the girls did not necessarily feel they were required to choose an IT job.

Some girls expressed a general interest in STEM careers (e.g., doctors, nurses, veterinarians) but did not always envision themselves in technology careers. When prompted, some of the girls said they would consider IT careers. When unprompted, however, the girls’ responses indicated career choices that were often jobs their family members had, jobs they had seen in action (e.g., teachers), or jobs they had seen on TV (e.g., crime scene investigators). The survey data showed participants with the most exposure to Build IT — those who had at least 1 year of exposure to the curriculum — had stronger positive attitudes about IT careers than newer participants and the comparison group. For example, 54% of the girls who completed more than one unit of the curriculum agreed that they would like computer- and technology-related jobs because these jobs are challenging compared with 20% of newer participants and 40% of the comparison group. In addition, these girls had weaker negative attitudes about not liking computers or perceiving IT jobs as not cool or too difficult. Given that girls in the sample are choosing to participate in a broader afterschool program, of which Build IT is only one of the components, the girls with the most exposure to Build IT were not necessarily those predisposed to have a positive attitude toward technology or IT careers.

The interviews showed, however, that a positive change in attitudes about and interests in IT careers was not universal among participants, often because of strong stereotypes about women in IT careers. Staff at one site heard one girl tell another who had just named an IT career that she could do, “Oh, you can’t do that, guys do that.” Staff said that comment started a 10-minute discussion among the girls on women being able to do what men can do. The staff

<table>
<thead>
<tr>
<th></th>
<th>Pre M</th>
<th>Pre SD</th>
<th>Post M</th>
<th>Post SD</th>
<th>Change M</th>
<th>Change SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Build IT Participants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cohort 1 (Retuming participants, N = 15)</td>
<td>0.66</td>
<td>0.1</td>
<td>0.74</td>
<td>0.15</td>
<td>0.08</td>
<td>0.13</td>
</tr>
<tr>
<td>Cohort 2 (New participants, N = 39)</td>
<td>0.68</td>
<td>0.14</td>
<td>0.71</td>
<td>0.16</td>
<td>0.02</td>
<td>0.19</td>
</tr>
<tr>
<td>Comparison Group (N = 29)</td>
<td>0.62</td>
<td>0.22</td>
<td>0.69</td>
<td>0.19</td>
<td>0.07</td>
<td>0.21</td>
</tr>
</tbody>
</table>

Note: the composite score is created from the items in Table 2. The score ranges from 0 to 1. None of the means for Build IT participants were statistically significant from that of the comparison group. The data presented in this Table are from year 2 of the implementation of the Build IT program. In the second year of implementation GIAC implemented Build IT for 67 girls, of which 50 girls completed the entire school year program.
person said, "It just sailed away. The girls were trying to explain to the one girl that anything they can do we can do better." In this way, a moment that could have led a girl to lose her aspirations toward an IT career became one in which she was reaffirmed by her peers.

The shift in attitude about women in IT careers is also captured in the survey data. We measured computer and technology skills and views of women in computer and technology careers. As shown in Table 4, the scale on attitudes toward computers and computer work (reliability = .76) slightly increased, except for two of the items that showed a decrease. We also examined the scale capturing girls’ views of women in IT careers (reliability coefficient of = .72). Overall, girls’ views of women in IT careers improved (Table 5). For instance, the survey item "It is difficult for women to have successful IT careers," changed from 3.42 to 3.70, where a higher score indicates that more girls disagreed with this statement.

<table>
<thead>
<tr>
<th>Attitudes toward Computers and Computer Work (Scale, $\alpha = .765$)</th>
<th>N</th>
<th>Pre (Mean)</th>
<th>Post (Mean)</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning about computers is important.</td>
<td>145</td>
<td>4.32</td>
<td>4.30</td>
<td>↓</td>
</tr>
<tr>
<td>Knowing how to work with computers will give me more job choices.</td>
<td>145</td>
<td>4.20</td>
<td>4.25</td>
<td>↑</td>
</tr>
<tr>
<td>I know what types of classes to take in high school if I want to have a career in technology and computers.</td>
<td>142</td>
<td>3.70</td>
<td>3.87</td>
<td>↑</td>
</tr>
<tr>
<td>I will use computers in my life.</td>
<td>143</td>
<td>4.50</td>
<td>4.30*</td>
<td>↓</td>
</tr>
<tr>
<td>Careers in computers and technology are exciting.</td>
<td>141</td>
<td>3.70</td>
<td>3.79</td>
<td>↑</td>
</tr>
<tr>
<td>I would like a job working with computers or technology.</td>
<td>142</td>
<td>3.27</td>
<td>3.47</td>
<td>↑</td>
</tr>
</tbody>
</table>

* $p < .05$, ** $p < .01$

Note: The question for these items was “How much do you agree with each of the following statement?” The responses were strongly disagree, disagree, neutral, agree, or agree strongly.
Factors Related to Girls Attitudes and Interests in IT Careers

Research suggests that interactions with STEM professionals could be important in overcoming obstacles girls face in entering STEM careers. Our analysis of the patterns of responses from the interviews and information recorded from classroom observations showed two factors might have contributed to the change in girls’ attitudes and interests in IT careers: (1) exposure to and the quality of the girls’ interactions with IT professionals and (2) the quality of the girls’ interactions with the youth development facilitator during implementation of the curriculum and visit with IT professionals. We use the interviews to illustrate how the two factors operated in relation to the girls’ attitudes about and interest in IT careers.

**IT Professionals**

Support in the Build IT curriculum for developing girls’ interest in IT careers came from contact with IT professionals. These professionals share their job experiences, duties, the salient life, and education decisions that helped them obtain their job. We observed greater enthusiasm from the girls when site visits with IT professionals were interactive; that is when there were opportunities to engage with tools, technology, and activities as well as when the professionals presented concepts and gave examples related to the curriculum. Comments from interviews with girls and staff illustrate the influence of the girls’ interaction with the professionals.

In describing the experience with an IT professional that met these criteria, one group leader said:

> The girls really enjoyed the guest speaker...[she] came prepared with design notebooks for review, a sample design room, and gifts (design tools).

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**Table 5**

Factors Related to Girls Attitudes and Interests in IT Careers

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Pre (Mean)</th>
<th>Post (Mean)</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender-neutral Views of Careers (Scale, $\alpha = .721$)</td>
<td>145</td>
<td>4.13</td>
<td>4.16</td>
<td>↑</td>
</tr>
<tr>
<td>It is difficult for women to have successful IT careers.</td>
<td>144</td>
<td>3.42</td>
<td>3.70**</td>
<td>↑</td>
</tr>
<tr>
<td>Women are as successful as men in IT careers.</td>
<td>142</td>
<td>4.18</td>
<td>4.25</td>
<td>↑</td>
</tr>
<tr>
<td>Women are as good as men in science and engineering.</td>
<td>142</td>
<td>4.42</td>
<td>4.32</td>
<td>↓</td>
</tr>
<tr>
<td>Women are as good as men in math.</td>
<td>144</td>
<td>4.49</td>
<td>4.39</td>
<td>↓</td>
</tr>
</tbody>
</table>

* $p < .05$, ** $p < .01$
Another group leader described a field trip to Yahoo! and noted the trip came at a perfect time for the girls because they were working on communication tools. Another site visited Electronic Arts, and the leader was pleased with the trip:

It was well structured, the girls enjoyed it, and it helped change girls' views. A lot [of the girls] wanted to become engineers after the trip.

During field trips, several girls drew parallels between what IT professionals did and what they were doing in Build IT. For instance, one pair of girls talked about how the IT professional worked with a team, just as they had worked as a team on their Perfect Hangout. In the Perfect Hangout project in Unit 1, two girls as a team designed and built a physical model or an electronic 3D model using Google Sketchup of a technology-rich hangout for two other girls in the program. In their teams, girls assigned responsibilities based on their skills and abilities. Often the visits with professionals had a greater impact on the girls who started the program with the least confidence. For example, one girl who was not confident about her drawing abilities thought the IT professional's job was:

…pretty cool…because she didn’t know how to draw that well, but she had other people to work with to draw her stuff.

Another girl shared:

You know how girls normally don’t do that stuff? She gets to know more about it. She said it’s not boring. I thought it was boring, but it’s not boring, because you get to…have fun with it.

Yet some of the girls did not change their views about IT careers after interacting with the professionals. One girl said,

“You have to build a whole bunch of stuff and I don’t have patience to do that.”

Another site took their girls to the University of Massachusetts at Amherst, which was organized by CAITE (Commonwealth Alliance for Information Technology Education), an organization within the university’s computer science department. The trip provided the girls with the opportunity to visit the campus and to understand what is offered at the university. They met with several women in the Office of Information Technology, including a design coordinator, graphic designer, and instructional design coordinator. The girls also had the chance to fix websites and computers and to learn binary code. The women professionals discussed how they integrated their personal lives with their IT work. During the presentation, the professionals connected their work to the Build IT curriculum. The group facilitator and the girls in separate interviews reported positive feedback on the trip. Several girls mentioned in e-mail interviews that they had enjoyed it. However, while some of the girls expressed interest in IT careers after the trip, others conceded that their interest in those careers might be temporary. One girl wrote:

Maybe right now I am interested because I am in Build IT and it is fun if I have a job like this and doing the design process I would like it.

Some of the girls also remarked:

It’s nice to work around technology, but not something I want to get into.
It’s too much patience because if you make a rule and it doesn’t work, it’s frustrating to figure out what’s wrong.

These statements suggest the girls were beginning to think through what it means to have an IT career.

To confirm formats that work well for girls we contrasted successful interactions with IT professional with unsuccessful interactions. Some field trips demonstrated the importance of relationship building between the youth development staff and the professional to achieve good experiences for the girls. For example, one group leader reported on a field trip to Leapfrog that the group leader described as a well-planned tour that kept the girls well engaged. The group leader reported that the girls commented that:

I liked how we got to see the design that they put together.
I learned about games and how much speed they need to make them go faster, and how the professional got to fix things.

In contrast, one group leader observed the same girls were less engaged at a local technology company because of the tour-like style, and they were less attentive when they had to sit and listen to presentations that lacked meaningful hands-on activities. She noted that at this local technology company that while some girls enjoyed the environment, met with women in IT careers, and took the opportunity to ask questions of the IT professionals over lunch, others...
seemed inhibited by their shyness.

While some girls gained an interest in pursuing an IT career after participating in Build IT, almost all the girls who participated in Build IT gained an understanding of the importance of IT and the need to have IT skills for other jobs. One girl said that IT is important to her career because “it helps get information and helps you find ideas.” Many of the girls interested in veterinary medicine recognized they needed a strong background in science and technology to pursue that career:

> They have a lot of high-tech instruments in veterinary hospitals like heart monitors. You need a lot of science and to know computers to look up medicines and stuff.

*Youth Development Facilitator*

The second factor that might have contributed to girls’ attitudes about and interest in IT careers was the girls’ interaction with the youth development facilitator during implementation of the curriculum, especially in doing activities before, during, and after a field trip or visit from IT professionals. The role of the facilitator has not been considered in existing guidelines for integrating professionals as role models to encourage girls to consider STEM careers.

The youth development facilitators’ preparation for a field trip or visit from IT professionals and their activities with the girls after such visits can improve the quality of these experiences for the girls. Field trips to the San Francisco Museum of Modern Art (SF MoMA) and the Tech Museum in San Jose, California demonstrated how youth development facilitators can support the professionals in interacting with the girls. They can also reinforce the curriculum through conversations with the girls after each IT professional’s visit. For the SF MoMA and the Tech Museum trips, the professionals prepared questions related to the curriculum, extended conceptual understanding, and added new vocabulary. During the SF MoMA visit, the IT professional picked up on a line of questioning from the group leader, who had asked the girls:

> Where is the navigation on this page? and Where is the contact information?

The IT professional then asked the girls:

> What is an icon and where do you see one on this page? and What is a rollover and what’s its purpose?

This support from the group leader during the visit demonstrated the importance of the group leader’s preparation. Preparing questions can support the professionals in making the visit a good experience and providing opportunities for the girls to connect their classroom activities with real life work experiences. In addition, the IT professional chose online exhibits and materials of artists of color (Kara Walker and Frieda Kahlo) that helped to make the content of her presentation relevant to the girls. The group leader reported during the interview that the visit to the SF MoMA concretized many of the concepts of web design and navigation of web pages for the girls and extended their understanding and vocabulary in talking about web pages. Similarly, the IT professionals at the Tech Museum helped to explain some important concepts presented in the curriculum with concrete examples for the girls to understand. For example, the IT professional had an example of the wheel as an innovation that led to many inventions. She then asked the girls what inventions the wheel enabled, giving them the example of a car and water wheel for generating power.

In addition to supporting the IT professional during fieldtrips and visits by prompting girls with questions, another way facilitators affected girls’ attitudes and interest in IT careers was their implementation of the curriculum. For the Build IT program, when facilitators were comfortable using technology and had confidence in their understanding of technology, the curriculum was implemented with greater fidelity; facilitators were able to pose questions that kept the girls engaged and were able to guide the girls through the conceptually challenging activities. At those sites, the interviews and observations data suggested that the girls were engaged and were excited about the classroom activities they were doing, which could have contributed to their understanding and furthering their interest in pursuing IT careers.

Another way group leaders impacted girls’ attitudes about and interest in IT careers was through their own belief and expectations of the girls’ potential to learn technology. At some sites, group leaders believed the girls were not developmentally ready to learn technology, did not recognize the girls’ potential to learn technology, and expressed the view that language skills made the curriculum difficult for some girls. For example, one coordinator said that reading level in particular and developmental level in general can keep girls from being able to understand the curriculum. Additionally, some staff members felt it was challenging to communicate the concepts to girls whose first language was not English. They felt to some extent that language was an insurmountable barrier, because although they adjusted the language and adapted the classroom activities, every year they would have a girl whose literacy level was lower than in previous years. Staff members emphasized that they did not want to dumb down the program but rather thought that for some girls it was best to find something else for them to do rather than have them participate in the program. One
Discussion

This study contributes to the literature on the effective use of STEM professionals in after-school programs to help girls overcome obstacles in entering the STEM workforce. In order to close the gender gap in the STEM workforce, many organizations (i.e., Expanding Your Horizon; Techbridge) have proposed more effective integration of STEM professionals in programs to prepare and engage young girls early in technology. However, not every girl exposed to technology will choose to pursue it as a career. It is, nonetheless, important to offer girls the opportunities to learn and understand technology so that when they make their decision about a career, technology will be among their choice set.

This study builds on the field’s understanding of the importance of integrating professionals as role models to encourage girls to consider STEM careers. The data from this study suggest girls’ expectations for success in IT careers increased and girls also seemed to place greater value on work with technology. They also had more positive attitudes about women in IT careers. Integrating professionals with the strong support of the youth development coordinator holds promise for increasing girls’ perceptions about themselves in IT careers as well as their attitudes about women in those careers. While our findings on the change in attitudes and interest are modest, they provide empirical evidence of the influence that IT professionals can have in developing girls’ attitudes and interest in IT careers.

Challenges staff faced, including finding IT professionals, making IT visits effective, and the lack of focus on an IT career as a possibility, could have attributed to the little change in interest among the girls.

The interviews with the girls showed that over time there was progress in their understanding that IT careers are accessible to them and that technology can be useful in many of the careers in which they had prior interest. Participants in the Build IT programs mentioned that family, friends, and Girls Inc. influenced their career choices. Although girls may not hear much about IT or STEM careers from family or friends, we found in implementing the Build IT program at Girls Inc. affiliates that youth development programs can influence girls to consider IT careers. Over the course of the program, both the survey and interview data showed participants’ views of IT careers as solitary and boring changed to collaborative, fun, and intellectually challenging. These changes among participants and their own experiences using information technologies seemed to foster girls’ interest in pursuing IT careers. The survey data showed that participants increasingly had more positive, though modest, changes in IT career attitudes. This is unlike the comparison group, which showed weaker positive changes in IT career attitudes. The interviews and observations showed that participants considered IT careers while in the program; however these careers were not always the girls’ first choice, and yet many of the girls felt that they could have a career in IT if they wanted one. These positive changes among participants were partly associated with their interactions with professionals and the youth development facilitator.

Two key findings emerged from our interviews and observations of the Build IT program. First, interactive interactions with IT professionals did impact middle school girls’ expectations of success and attitudes toward IT careers, and these interactions did increase the value girls placed on IT careers. Second, the support the youth development facilitator provided the girls during the implementation of the curriculum—especially activities before, during, and after a visit with a professional—influenced the girls’ attitudes about IT careers. The role of the facilitator had not been considered in existing guidelines for integrating professionals as role models to encourage girls to consider IT careers.

Implications for Practice

There are three primary implications for practice that are informative for future implementation of after-school programs in ways that support a learning environment to increase girls’ interest in IT and IT careers.

IT professional interactions with girls should be interactive and connected to what girls are learning.

Professionals should demonstrate what they do and not simply talk about what they do. They should give the girls an opportunity to engage in a learning experience with them. The professionals’ work should be tied to the activities and curriculum the girls are engaged in at that time of the visit or trip. In that way, there is immediate real-life exposure to the technology and concepts that the girls are learning and to how this technology is applied in a work setting.

From our experience implementing the program, we have identified several best practices for IT professionals to follow to improve the quality of their interactions with the girls. During a visit or fieldtrip, interaction is extremely important. Engaging girls after a long day at school requires activities that tap into their interests and get them active. IT professionals should follow four main practices when interacting with girls about their careers. First, the IT professional should start with an icebreaker to start interacting with the girls and get them to open up. Second, professionals should
keep their presentations short and personal. Girls want to hear about the professionals’ personal experiences and how their interests connect to their career. Other topics that professionals may want to address include how IT work helps people and society, what educational choices the professionals made, and how the professionals balance work life with family life. The presentation should last a maximum of 10 minutes. Third, professionals should spend the majority of the time engaged with the girls in a hands-on activity. The hands-on activities should be the bulk of the time and reflect the professional’s career. Finally, it is important to save time for questions and reflections as well as input from the girls on what they liked and what could be improved for next time.

Youth development facilitators’ (YDF) active engagement with the IT professionals, and positive IT attitudes in general can encourage girls in these fields. During the visit, the YDF can ask questions or encourage discussion that makes connections between the Build IT curriculum and the IT professionals presentation. After these visits, YDF might ask the girls what they liked and disliked about each job they learned about and what path they would need to follow to have careers like those of the IT professionals they visited with. This reinforcement by youth facilitators can bridge between the IT professionals’ activities and the curriculum in a way that solidifies the girls’ understanding of the potential of pursuing IT careers.

Furthermore, it’s important that YDFs are comfortable with the curriculum and have a positive attitude towards IT and girls’ abilities to engage with technology. Professional development sessions are an important time for YDFs to gain experience with the technologies and curriculum, and to discuss their concerns or lack of comfort with IT. Through training and discussion, YDFs can develop confidence with IT and comfort with the curriculum in order to encourage girls in their IT learning.

For IT professionals’ visits to be an effective component of youth development programs, the staff and facilitators need to connect to their local resources of IT professionals and build relationships with them. The development and implementation of Build IT suggests five practices on relationship-building that youth development staff can adapt to engage girls with IT professionals in ways that will likely have positive impacts on the girls’ expectations of success in IT and IT careers and will most likely increase the girls’ regard of IT careers.

First, youth development managers should focus on networking with IT professionals for at least the first year of their program, getting the connections established and setting up the ongoing relationship potential. Build IT provides tips on how to find these individuals. Second, youth development facilitators (YDF) need training and support so that they can provide guidance and assistance to IT professionals on how to interact with girls as well as on the types of hands-on activities the professionals can do with the girls to relate to what the girls are learning. In addition to guidance, YDFs act as co-facilitators during the interaction with the girls, making connections for the girls to the curriculum through questions and examples that the IT professionals may not know. Third, YDFs and managers should treat the relationship with IT professionals as a commitment and support the professionals as they would any ongoing volunteer relationship for their organization. Fourth, once YDFs and managers are working with an IT professional, they should seek through their contact and the human resources department of her organization to make other connections within the organization so the relationship can be maintained beyond an individual contact. Finally, youth development managers should train all staff on how to interact with IT professionals and foster these relationships.

With these three elements in place—(1) relationships between youth development and IT professionals, (2) interactive, well-facilitated IT professional interactions with girls, and (3) youth development facilitators excited about girls exploring IT careers—programs with an emphasis on IT professional visits and field trips can influence girls to pursue IT careers or at least add them to their list of possible careers.

Conclusion

In summary, this article describes how a youth development program effectively incorporated IT professionals to encourage girls to think about the possibility of an IT career. We found using IT professionals as role models combined with the strong support of the program’s youth development staff and the facilitator can have a positive influence on the girls’ expectations of success and interest in IT careers, and their attitudes about women in those careers. The strongest finding is that it’s the combination of IT professionals’ involvement and youth development staff’s enthusiasm and support that encourages girls’ interest in IT careers. Adding IT professionals to a technology program for girls alone will not encourage girls to explore these careers. The youth development staff’s active engagement with and support of the professional, and their excitement about IT and women in IT careers in general seems to have a positive influence on girls’ interest in IT and IT careers.

1 A video of the trip organized by CAITE is available at
http://www.umass.edu/newsoffice/newsreleases/articles/77447.php

2 A video by PBS of Build IT in action and girls’ thoughts on IT careers is available at
References


Authors Note

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<thead>
<tr>
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