

An intimate look at
Black Girls CODE:
A case study of
culturally-relevant
coding programming
and its long-term
benefits



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"I was the only Black student in this one gaming class I took a few summers ago. It was the first time I actually learned coding in a real class, even though I basically taught myself how to do it the year before. I felt a little awkward. There were a lot of boys in my group...White and Asian. But one of the teachers really made me feel weird. It wasn't that he said anything, but it was how he made me feel. He kept focusing on me and I guess thought I didn't know anything about computers or gaming. He kept asking if I needed help even though I didn't ask for it. I actually knew a lot about what he was teaching, probably more than others so that was annoying. I ended up scoring the highest points in the class on my final project. When I think about that class and then think about Black Girls Code...it was like night and day." (12th grade Black Girls Code alumna)

In this student's mind, the message sent by her gaming teacher was clear; he assumed that because she was African-American, and perhaps female, that she knew less about computers and gaming than her counterparts, and needed his continued help and attention. This level of marginalization, doubt, and assumptions made, while not overt, reflects the experiences of many students of color and females whom are underrepresented in STEM fields (Hill, Corbett & St. Rose, 2010). The current study's outcomes provide additional insights into the experience of girls of color in STEM, and into a unique approach to addressing programs that integrate race and gender as a method for tackling the underrepresentation of certain groups.

Introduction & Literature

Countless studies point to the gender and racial disparities among female undergraduate and graduate students that pursue STEM fields, especially females in the African-American community (Griffith, 2010; National Science Foundation, 2013; DuBow, 2011). Viable explanations exist that address the gender and racial disparities at the undergraduate and graduate level. Firstly, there seems to be an assumption that female students are not given the same STEM exposure in K-12 education, and therefore, show less interest and lower achievement in STEM classes. On the contrary, females and males show the same levels of STEM interest and achievement in STEM-related classes (Xie & Shauman, 2005). The "pipeline" model has been referred to as a viable explanation for understanding this underrepresentation. According to Xie and Shauman (2005), women "leak" from the pipeline during the end of graduate school and near the beginning of their professional careers, much later than expected. Many

studies have attributed the leaky pipeline in college to the competitive, non-nurturing, “chilly climate” where female students are treated as outsiders (Bystydzienski & Bird, 2006; Colyar, 2008; Dingel, 2006; Kerr & Robinson-Kurpius, 2004). African-American female students experience something more compared to their White female counterparts.

While African-Americans in general enter college with a high level of STEM interest, they continue to have high rates of attrition in STEM education, lose interest, and take a different path, especially among African-American females (Smyth & McArdle, 2004). According to Leslie, McClure and Oaxaca (1998), self-concept is the main contributor to this attrition rate among African-American female students. Other negative factors include racial and gender discrimination, learning and educational environments that perpetuate negative racial stereotypes and trigger debilitating performance results such as stereotype threat (Steele, 1997), and minority students’ experience with isolation from White peers and faculty (Ehrhart & Sandler, 1987; Johnson, 2011). Brown (2008) argued that since there are very few women of color in STEM programs, women of color who continue in this domain have little to no interaction with their own racial group within their majors, which can feel isolating. Adding to this isolation, Johnson (2007) posited that women of color in STEM undergraduate programs are ignored more by faculty compared to their White counterparts, are subjected to racial stereotyping about their academic capabilities, and are excluded from participating in group or class projects (e.g., research, enrichment lab experiences) and informal study sessions by their White peers. The lack of minority student interaction with White faculty and peers has significant implications for the retention for minority students and has been linked to high attrition rates (Brazziel & Brazziel, 2001; Golde, 2005; Herzig, 2002; Taylor & Anthony, 2000).

The above explanations for the gender and racial disparities in college point to theories such as in-group interaction, racial-group composition of classrooms, discrimination, isolation, low self-esteem and low self-concept. However, it is worth exploring whether the experiences of undergraduate and graduate students are comparable to those of middle and high school students and if so, is there a way to curb some of these setbacks early through specialized programming before entering college. Renninger, Nieswandt and Hidi (2015) have argued that even at the high school level, girls are still underrepresented in STEM courses compared to their male counterparts. According to some studies, this underrepresentation at the high school level is a reflection of the fact that decisions to participate in STEM, particularly computer programming, are frequently made prior to high school, mainly during middle school (Hulleman & Harackiewicz, 2009; Tai, Liu, Maltese & Fan, 2006). Even if

girls do well in STEM classes early on, many girls do not pursue STEM subjects or majors due to lack of experience, confidence, and a perception that they do not fit in with the domain due to social and environmental factors (see Hill, Corbett, & St Rose, 2010).

The previously described factors are more common for “non-dominant” girls and youth, particularly from areas of lower socioeconomic status, since they may have limited access to in-and out-of-school opportunities and resources that have the potential to build their computational fluency (Goode, 2007; Margolis & Fisher, 2002; Margolis et al., 2008; Warschauer & Matuchniak, 2010; Watkins, 2012). However, girls of color represent a wide spectrum of socioeconomic classes and experiences that cannot be easily grouped as perhaps once before. For those who *do* have opportunities for participation in STEM activities, particularly programming, factors similar to “non-dominant” undergraduate and graduate students can arise that may hinder their confidence and sense of fitting into the domain.

These factors include STEM environments that breed negative stereotypes about girls’ and non-dominant students’ ability to succeed in performing in STEM environments dominated by White male students, which can lead to feelings of isolation when there are already few girls and students of color (Ben-Zeev, Paluy, Milless, Goldstein, Wallace, Marquez-Magana, Bibbins-Domingo & Estrada, 2017; Hill, Corbett, & St Rose, 2010; Margolis & Fisher, 2002; Johnson et al., 2011; Ko et al., 2014). According to Markus, Steele and Steele (2000), if educators do not create “identity safe” classrooms, or environments that build positive and accepting relationships, and create a sense of belonging for students, then negative stereotypes about one’s ability can interfere with learning. In addition, Ben-Zeev et al. (2017) found that educators should integrate the following psychosocial intervention, as a preventative measure, in an effort to create STEM learning environments that are free of negative stereotypes: a) provide a tutorial on stereotype threat (i.e., social contextual phenomenon that may lead to underperformance and early exit in the STEM domain), and b) encourage African-American and female students to use lived experiences for generating “be-prepared” coping strategies when a negative thought arises or a negative stereotype is mentioned by someone else.

Fitting in and not feeling like an outsider is a common theme among middle school students in general, and becomes particularly more important during this age when students begin to have more authority in class selection, and programs in which they will participate (e.g., afterschool, electives). Middle school students are also at a stage of identity development where fitting in may drive their decision making (Malcolm,

Hall, & Brown, 1976). The lack of opportunities, low STEM confidence, and an isolating STEM environment are all reasons why we might see a decline in the number of African-American girls that indicated an interest in STEM (Maltese & Tai, 2010; National Science Foundation, 2003). These common factors and declining numbers suggest that the racialized and gendered realities within STEM learning settings may make it difficult for many girls of color to develop a sense of belonging (e.g. Hall & Brown, 1976; Margolis & Fisher, 2002; Johnson et al, 2011; Ko et al, 2014). All said, this growing body of research suggests that designing STEM programming and curriculum that focuses on addressing issues such as prior experience, confidence, and sense of fit would increase the number of African-American girls who decide to pursue STEM activities.

We now describe the Black Girls Code (BGC), an out of school program designed to address issues of prior experience, confidence, and identity development in computer science and programming for African-American middle school girls. The BGC environment addresses these challenges faced by African-American girls by offering in-person activities led by racially diverse, male and female mentors, interactions with mostly African-American or Latina female peers in a technology focused setting, and field trips to local tech companies where programming and coding careers can become a reality. The mission of Black Girls CODE is to introduce programming and technology to a new generation of coders who, eventually, may become “builders of technological innovation and their own futures” (BGC Mission Statement, 2011).

Since its inception in 2011, and in direct response to the lack of African-American females in the tech industry, BGC sought to move beyond simply exposing girls of color to coding, but to increase their leadership and entrepreneurial proficiency overall. BGC has served over 8,000 girls of color in 13 cities nationwide and has one international chapter in Johannesburg, South Africa. In the past, BGC has implemented its goals primarily by engaging elementary and middle school girls of color in hands-on coding activities during either day- long weekend workshops or in multiple day summer programs. In early 2015, Black Girls Code decided to add in-school afterschool programs to its course offerings in order to reach students in their school environments. Code Club, originally launched as a pilot, was first implemented at Claremont Middle School in Oakland, California, for a period of three weeks, and again for ten weeks at the African American Art and Culture Complex (AAACC) in San Francisco, California.

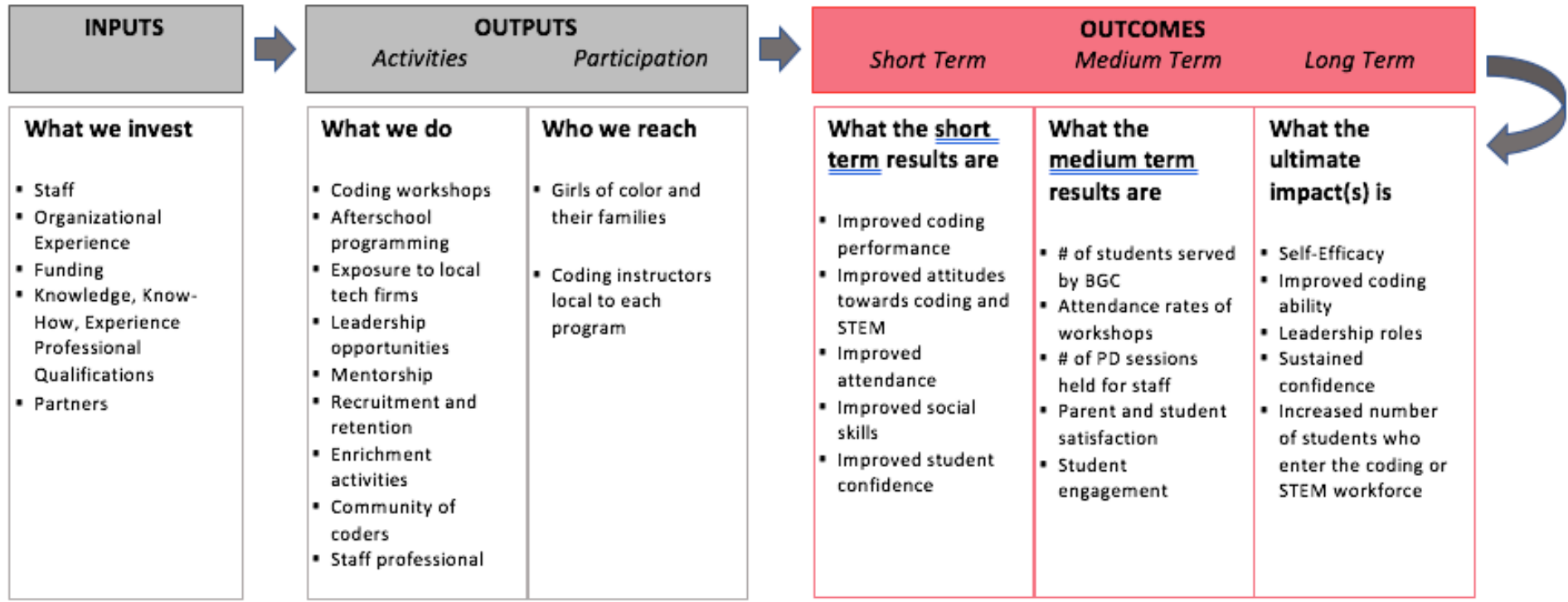
The main goals of BGC are to: (a) better prepare elementary and middle school girls for advanced STEM curricula in high school, which would then enable them to study computer science or other STEM subjects at the college or graduate level, and (b) to

open the doors for possible career paths in the tech industry, and (c) to foster leadership and entrepreneurial skills within its students. The hope is that, once exposed to computer programming, BGC participants would be more inclined to forge careers in the technology industry. Specifically, BGC seeks to encourage girls of color to not just be consumers of computer technology, but to *create* the technology that will be utilized for the generation and future generations of consumers.

In 2017, evaluators worked with the BGC founder to construct a logic model that defined the relationship between the program's activities and outcomes (Figure 1). The program is expected to: (a) enhance students' coding content knowledge, self-efficacy, and confidence for learning coding, and (b) demonstrate changes in student outcomes that would subsequently lead to sustained coding interest and future pursuits in the domain of computer technology. We recognized that the magnitude of these changes would vary by student. Hence, the BGC model acknowledges that students' prior knowledge, attitudes and experiences as well may mediate BGC's eventual impacts.

Black Girls CODE Program Model

SITUATION Black Girls CODE hopes to expose girls of color to computer programming and digital technology, and explore the images and perceptions of the field that may prevent girls of color from self-selecting such courses of study or STEM-related career pursuits.



ASSUMPTIONS Girls of color are underrepresented in the area of computer programming and digital technology.

EXTERNAL FACTORS Local and national funding priorities regarding coding and computer technology; funding priorities; sustainability and growth of partners and providers.

EVALUATION
Plan, Collect Data, Analyze, Interpret, Report

Evaluation Overview and Research Rationale

Over the past five years, REA has conducted four evaluations of BGC (including the current summarized study). Our previous findings are outlined in the table below (Table 1).

Through the years, program feedback and outcomes obtained through observations, surveys and interviews with students and parents have indicated a high level of satisfaction. Specifically, evidence previously collected from our evaluations has shown that: a) BGC students are being introduced and exposed to rigorous coding curricula; b) students have shown minimal gains in confidence, coding ability, learning changes and attitude changes towards coding and STEM in general; c) parents of student participants are satisfied with BGC programming; and d) students have shown greater interest in pursuing a career in the tech industry because of BGC. The program has shown that it may be beneficial to expand students' exposure to coding/STEM, but what influence does it have for students over the long term, especially for those who have participated in the most workshops and programs? Survey, observation, and interview data have been gathered through the years, but extensive, formal interviews and discussions with students and parents have not been undertaken.

To better understand the degree of sustained and longer-term impacts of BGC on students, REA and the BGC leadership recognized the value of interviewing students who have had the longest history with the program, including their parents. This study is a critical step toward examining not just the longer-term influence on middle and high school students' attitudes towards coding/STEM and interest in pursuing coding in the future, but how BGC's investment in student success helps shape areas of undergraduate study and career pursuits for those who frequently attend the programs that BGC has to offer.

The current study provides a closer look at BGC's impact, and a unique opportunity to understand BGC's long-term influence on student learning and attitudes, beyond anecdotal feedback from both students and their parents. Our purpose is to gather qualitative data on the program's impact from a smaller pool of BGC alums (e.g., "veterans"), and from years of BGC program offerings. In addition, our goal is to inform BGC leaders about the extent to which program objectives were met, and provide evidence-informed recommendations.

Current Research Questions

Our current evaluation addressed the following research questions:

- Does the BGC program affect the long-term coding learning and programming interest of students who participated between 2012-2017?
- What effect did students think BGC had on them years after the fact?
- Do certain external factors, such as participation in other similar coding or STEM programs and family support, play a role in the program's long-term impact?

Table 1. Previous REA Evaluation Activities and Findings for BGC (2012-2017)

Previous Evaluation Activities	Findings and Limitations
<p>Phase 1 – “Build a Workshop in a Day” (2012)</p> <ul style="list-style-type: none"> ▪ Observation of 5 workshops in one day ▪ Focus group with 7 student participants ▪ Interviews with 5 parents 	<p>+</p> <ul style="list-style-type: none"> ⇒ Girls had a positive experience and felt more confident as coders after the workshop ⇒ Parents valued the program for its content knowledge and further exposing their children to computer technology and coding ⇒ Girls displayed high levels of enthusiasm to learn more immediately after the day-long workshop ⇒ Observations yielded useful program implementation and process data <p>-</p> <ul style="list-style-type: none"> ⇒ No measure of longer term impact/outcomes ⇒ Could not measure one cohort of students ⇒ One day workshop leaves little room for longer-term change
<p>Phase 2 – Evaluation of two Code Club iterations: Afterschool Program & Summer Program (2015)</p> <ul style="list-style-type: none"> ▪ Pre-program and Post-program student surveys on STEM interest, self-efficacy, and future plans (31) ▪ Parent interviews (8) ▪ Post-lesson instructor reflection surveys (6 instructors, total of 16) ▪ Post-program interviews with instructors (2) 	<p>+</p> <ul style="list-style-type: none"> ⇒ Girls had a positive experience and felt more confident as coders ⇒ Significant changes in student’s attitudes about STEM professionals ⇒ Students attributed STEM to succeeding in life and a satisfying career ⇒ Parents valued the program for its content knowledge and further exposing their children to computer technology and coding ⇒ Girls displayed high levels of enthusiasm to learn more immediately after the program <p>-</p> <ul style="list-style-type: none"> ⇒ Girls came into the program with extremely high levels of tech interest and knowledge, leaving little room for change near the end of program ⇒ No post-program follow up with students
<p>Phase 3 – One-year follow-up of Code Club alums (2016)</p> <ul style="list-style-type: none"> ▪ Pre-program and one-year-post-program student surveys on STEM interest, self-efficacy, and future plans 	<p>+</p> <ul style="list-style-type: none"> ⇒ One year after participating in BGC, most respondents reported wanting to continue learning about coding after they finished the program ⇒ Participants also reported wanting to pursue coding as a potential career in the future. ⇒ BGC made them more interested in coding and computer science ⇒ Participants continued to work on coding/programming since starting BGC ⇒ Over half of respondents reported wanting to pursue a career in computer technology because of BGC <p>-</p> <ul style="list-style-type: none"> ⇒ Limited qualitative data on how BGC has influenced participants in one year ⇒ No long-term impact data from alums who participated in BGC workshops/programs/courses over a period of several years
<p>Current Study</p>	
<p style="text-align: center;">Phase 4 – Logic Model & Longitudinal follow up of BGC alums</p> <ul style="list-style-type: none"> ▪ Logic Model and site-visit presentation/exercise ▪ Case study analysis of 16 BGC alum (veterans) who have attended BGC for multiple years, and 15 parents (<i>requires parental consent</i>) 	

BGC Features and Activities

BGC brings together middle school girls with coding experts from university, business, and industry sectors in the San Francisco Bay Area in an effort to create high-quality learning activities and curriculum models for use in afterschool, summer, and weekend classes. The BGC project-based curriculum, developed collaboratively by program staff and course instructors, focuses on technological tools and languages for designing and developing web applications (apps) through hands-on programming activities. Participants gain experiences with the basics of programming, and familiarize themselves with integrated development software such as App Inventor, Scratch and Python.

Black Girls CODE offers the following types of programming:

- After school programs (e.g., Code Club)
- Summer programs lasting more than one week (e.g., Summer Camp, Code Club)
- Weekend workshops that last one day (e.g., "Build a Website in a Day")

BGC instructors are comprised of both volunteers and paid staff. Each BGC program starts with a kick-off meeting designed to motivate both students and parents with the following activities: a) inform them of the significance of their participation in BGC, and b) lead the girls in team-building exercises, which includes teaching the girls the BGC pledge (Figure 2). The workshops and courses consist of brief presentations followed by hands-on computer activities to provide students the opportunity to learn about app-building toolsets within the context of coding. Students are able to use MIT's App Inventor, Scratch, and Python to take their ideas and turn them into working applications. Students start out learning the basics of programming, and then move on to both concrete development skills and principles of coding. Many of the courses begin with the BGC pledge (see below), tutorials and lectures, followed by time to work on their apps or websites and apply what they learned to their projects. Students are given either a tablet or laptop to keep at the conclusion of each program depending on each student's

*Figure 2. Black Girls Code Pledge
(Adopted after the first iteration of
Code Club in an effort to help
define the group's purpose):*

"Who are we?

We are Black Girls CODE

What do we do?

We change the face of technology

Why are we here?

*To innovate, to collaborate, to
challenge ourselves*

How do we do it?

Through community and self-love

What is our purpose?

To build our own futures

Who are we?

BGC (x3)"

attendance record. Students participate in field trips to local tech companies such as Pinterest and Yammer, for greater exposure to real-life STEM professionals, careers, and companies.

At the end of each BGC iteration, and after instructors had made their way through the core curriculum, students learn to: (a) create interactive applications/websites, (b) use design thinking and logic to translate their ideas into working apps/websites (e.g., identifying the problem or challenges, helping girls develop brainstorming skills, collaboration, gathering pertinent information, generating ideas and a solution, then testing their solutions), (c) lightly apply math and science concepts they learned in school while programming, (d) use computer science concepts such as conditionals, loops, and variables, and (e) develop their problem solving and debugging skills to make things work effectively. Final projects are included in each course or workshop, where students are asked to present their final creations to parents, staff, and key stakeholders.

Methods

Design

To conduct this evaluation, REA employed a case study design. This study included individual interviews with students and parents, averaging one-hour each in length. With our previous quantitative work helping to establish the importance of BGC with program outcomes, we sought to employ qualitative methods to closely examine the underlying processes at work and the importance of the this program component from the students' perspectives. We used techniques from the Grounded Theory (Corbin & Strauss, 2008) and Guba's (1985) naturalistic approach (rather than rationalistic) which highlights the importance of authentic inquiry and discussions. Importantly, the goals of this design were to evaluation information that could yield evidence of the long-term impact of BGC on the highest-attending students. Table 1 in Appendix A lists the key objectives originally guiding our evaluation of the program, along with activities that sought to address each one.

Participants

In total, 31 individuals participated in this this study. Our primary sample consisted of 16 student alums, as well as 15 parents. REA and BGC program staff worked together to identify BGC alumna who had participated in the most workshops or courses offered by BGC, and that were closely connected to the program via contact with staff and

volunteer work with the program as a mentor. The ages of participants ranged from 15-18. Seven of the student participants reported being in high school at the time of the interview, six had graduated and were preparing to start college in the fall, three reported graduating but decided to take one year off before starting college.

Measures

The interview protocols included specific questions and prompts to ensure that relevant areas were addressed in the interview (e.g., general experiences at school, program experiences, etc.), but the interviewers followed the direction set by interviewees. The interview protocol began with very open-ended questions and interviewers expanded this line of inquiry with prompts to elicit both positive and negative feedback, and overall long-term impact. Interviewers also asked students more specific questions in relation to their involvement with the program. Interviewers asked students about their perceptions of the programs' effects on their cultural experiences and school experiences. Interviews with students' parents touched on the benefits of their daughters participating, reflections of their own upbringing, and the importance of programming like BGC (see Appendix for student and parent interview protocols).

Findings

This section discusses four emergent organizing themes from the qualitative interview analyses. The basic themes grouped by organizing themes are provided in Table 2. All quotations are taken from interviews with students and parents. Each section illustrates that in addition to the learning to code, gaming and developing apps, there are additional programmatic elements that enhance the experience of many African-American middle and high school girls.

Sense of Belonging and Improved Relationships

Students' interview results revealed that they experienced a sense of belonging in the BGC programs, met new friends, and developed new relationships. Four students commented that they felt "important," while two mentioned that the BGC instructors made them feel like they "mattered." There was a high endorsement of the general questions related to the benefits of BGC, with 83% of students agreeing that they benefitted in those ways. The results also showed that those involved in small-group

and pair exercises experienced specific benefits related to developing healthy relationship skills and communication styles (Table 2). For example, one 11th grade student explained how the program helped her to avoid unhealthy relationships, while a 12th grader reported developing improved relationships and referenced two girls in different cities that she had been in contact with for three years. Similarly, several students interviewed also reported that the

Table 2. Grouping of Themes from Interviews

Themes	Subthemes
"Mattering" & Belongingness (Rosenberg & McCullough, 1981)	Attention - the feeling that one commands the interest or notice of others
	Importance - the belief that others care about what we think, want, and have to say, or that we serve as their ego-extension—the feeling that others are proud of our successes, saddened by our failures
	Dependence - the realization that others depend or rely on us or our efforts
	Comfort
	Positive relationships established
Leadership & Confidence	Leadership and mentorship opportunities
	Public/group speaking
	Pride/confidence/maturity
	Positive self-concept
	Voicing opinions
Culturally Relevant Programming (Gay, 2012; & Lipman, 1995; Palmer, 1998)	Validation and affirmation
	Comprehension
	Multidimensional
	Liberating
	Transformative
	Empowering
Academic success and STEM career pathways	Identity Development
	STEM retention/retained interest and pursuit
	Academic performance
	Self-advocacy
	Educational goals
	Coding knowledge/skill gains from BGC
Interest in pursuing coding or other STEM field in the future because of BGC	

programming supported them in developing improved relationships. One mentioned, “It [the program] showed us how to talk to girls that we didn’t know, be confident, explain our projects, and be able to really talk about what we were working on in code-like language” (10th grade student). One recent high-school graduate student talked extensively about the ways in which BGC helped her self-confidence by making her feel important, while improving her coding abilities at the same time:

I was that quiet girl in the corner of the class that wouldn’t talk much, and felt awkward in my science classes. I took mainly AP science...biology, chemistry and physics. The Black Girls Code workshops kind of forced me out of my shell and all of a sudden I was in this tight group of girls. I was more talkative and just felt like the teachers cared. They [teachers and assistants] liked the things we liked, and made us laugh. They pushed me to communicate more. For our final projects we had to stand in front of the entire class and talk about the app we created. I did a good job, and I don’t think I could have done something like that if it hadn’t been for Black Girls Code. (High school graduate)

Parents reported that BGC supported their daughters in developing positive relationships, and that BGC’s learning environment made them feel like they finally fit in doing something that they weren’t used to doing. One mother of an 11th grade participant commented on the growth she has seen in her daughter with regard to her ability to make new relationships and maintain them. She also commented on how BGC’s learning environment taught her daughter more than coding, parallel to the previously mentioned research by Makrus et al. (2000) and Ben-Zeev et al. (2017) that fosters an “identity safe” learning environment:

A few months ago, my daughter said, “Mom, I’m expecting a call from [Maya], from Black Girls Code! Can you please get off the phone?” I listened to how she spoke to her, how they checked in, they talked about school. I was amazed. I hardly ever hear her speak to other kids about her school, her work, and games they created, computer stuff. It felt so mature. I just remember thinking, “Wow.”

Black Girls Code is teaching girls how to code, and they are doing it in a way that is challenging. It’s hard work! I saw what my daughter was doing and it wasn’t easy. But they aren’t just teaching coding, they are teaching my daughter that it is okay to be herself while learning something that she might think is out of her league, something that might shape where she wants to go. My daughter felt comfortable there. She wasn’t being judged, she wasn’t worrying about what

others thought, because they were all Black girls learning the same thing, together. She just felt good about it. We like to tell our children, "The sky is the limit." Well, the sky is not the limit if you are being discriminated against, or marginalized, or held back because of who you are. (Mother to 11th grade participant, New York)

Students identified additional communication skills they gained from BGC as helpful to building friendships and experiencing increased comfort at their own schools. Examples included overcoming shyness and becoming more outgoing, improved public speaking, respecting the opinions of others, and improved conversation skills. Student interview participants also reported that having female teachers and role models (some African-American, some not) eased their transition to similar tech programs either at their own school or at other after-school programs:



"It [the program] gives you mentors and role models who look like you, and you can look up to, and who can kind of prepare you for similar classes. After one of my workshops a teaching assistant gave me her phone number and email and

said I can reach out anytime, about classes, if I have a problem or questions about anything related to coding, or anything. I didn't contact her yet but just knowing she's there and available makes me feel good. I kind of knew a lot of people from the last Code Club and kind of got to know their friends and make new friends too." (12th grade student)

Parents viewed the programs' provision of African-American and female role models as important while reflecting on their own experience as a student:

...its powerful if these girls see women that look like them. Don't get me wrong, when I was in high school we didn't have programs like this. When I was in

college, I didn't see any Black IT professionals but that didn't stop me from pursuing technology. It has helped [daughter] though because it sends her the message that this is a possible path. With Black Girls Code, you see great leadership, you see articulate students who aren't afraid to dive into this. You can tell that it builds confidence and self-esteem. (Parent of 10th grade alum)

For students coming to Black Girls Code from different neighborhoods and cities (not their own), this opportunity to develop relationships with a wider circle of youth was particularly important for not only developing positive relationships with students and computer tech professionals but building a wider comradery. One participant, who did not feel that she was part of a “group” at school, reported that the BGC classes made her feel like she was a part of a team, which, in turn, made her school experience more bearable:

I felt like I was part of a group and part of a team. I don't really feel that tightness and closeness at school, except for a few friends. But at Black Girls Code I felt like I was part of a family or something. At school, I would look forward to going to the workshops because I would miss that. (11th grade alum)

Confidence and Leadership

Parent interviewees reported that BGC helped their daughters gain confidence and develop leadership skills. Students reported becoming more confident in voicing their opinions and getting involved in other school activities. For example, one student participant stated, ‘I started BGC before I did any other things in the school related to computers or gaming or coding and it gave me more confidence to go out and meet new people and do other activities at school’ (12th grade alum), and another said, ‘I feel that I get more involved with school stuff and clubs, where I wouldn't before. I'm part of this gaming club at school. I talk more too maybe because I'm just older but it [program] gave me a boost I guess’ (12th grade alum).

One parent identified BGC as a stepping stone to increasing school involvement, developing leadership qualities, participating in other youth development programs, and taking advantage of career/education:

After a few [BGC] workshops, [daughter] said, “I want to take this gaming class, I want to take a class during the summer.” Then she went on to join the Hack Club at her school and became one of the lead mentors for the younger students. (Parent of 11th grade alum)

Parent interviewees identified similar gains in overall confidence and demeanor among their daughters, 'There definitely has been a maturity in the way that she is approaching other activities and programs related to coding, like Hack-a-thons, and her school life' (Parent of 10th grade alum).

One student reported her experience giving a presentation about her project during a Hack-a-thon:

When we have the hack-a-thons we have to get on stage. I don't really like getting in front of a lot of people, because I get nervous and freeze, but I did it one time and it was pretty cool. I think it kind of helped me, and helped others, but I still feel a little afraid to talk to people. (10th grade alum)

Another student reflected on her Hack-a-thon experience:

I learned how to stand up in front of a crowd and speak and it makes me feel appreciated. It makes me feel like I am actually doing something that the other girls can learn from too. (9th grade alum)

Students also reported feeling proud and valued in the leadership roles that BGC provided, and a heightened level of self-efficacy. For example, one student participant stated, 'I felt kind of proud because you know I feel like I have a voice and they are listening to me. Scratch was hard to use at first but I got it quickly so I helped other students' (10th grade alum). Another student explained how helping others provided her with a more positive self-concept and influenced her desire to want to learn more about Python, an app developer:

It makes me feel good because I never really thought of myself as a mentor but I guess they must see my abilities and it just felt good to be a mentor to the ones that didn't get Python right away. After that workshop I remember wanting to learn as much as I could about Python so that I could help others in my summer workshop. (11th grade alum)

Parents noted the increase in leadership, confidence and self-efficacy, and in one case, connected it to the impact of the role modeling provided by the instructors and volunteers:

You see amazing leadership among Kimberly and her staff, you see talented volunteers, articulate students going off to colleges with high aspirations and

this newfound interest in pursuing coding, and these kids stay in touch. You can see that it builds confidence and capacity. (Parent of 12th grade alum)

Cultural Relevance

The role of culture emerged in many of the interviews with students and parents. Results indicated that 76% of students mentioned the importance of having a program specifically designed for African-American girls, while 91% of parents interviewed mentioned the importance of the girls feeling connected culturally. One 9th grade student explained, "The fact that it was just for Black girls is the main reason why I wanted to do it." Another student explained how at her school in Livermore, CA, she was one of few African-Americans, and the cultural connectedness she felt from attending BGC workshops in Oakland motivated her to seek out similar opportunities in her own community:

It was nice to be with other girls that looked like me this one summer. Where I live, there aren't a lot of Black people. I didn't feel like such an outcast when I was there. When I started school that year I went to stuff like "My Brother's Keeper" at the Lawrence Livermore Lab and other events for students of color. (12th grade alum)

Last year's evaluation, which included interviews with BGC instructors, pointed to the fact that the program hopes to include more of a cultural context to the program, including more dialogue about African-American history in STEM fields and what the demographic looks like today. While a direct and overt cultural programmatic component may be lacking, that did not stop students from seeking out more information about African-Americans in STEM. One student commented on how being in BGC encouraged her to want to learn more about the history of African-American women in coding and computer science, and learn more about the challenges and struggles women faced in similar fields:

I started wondering who the first Black female coder was [laughing]. I found out it was someone who either worked for NASA. Then I found out who the first Black woman was who got her Ph.D. in computer science. I forgot her name, but I was curious after being in the workshops and I wondered, "How many Black women coders are there and where do they work?" (11th grade alum)

Several students noted that being able to simply be in the presence of African-American girls in the context of computer programming was a particularly positive experience, and some even shared what they learned with their families. For example, one student (10th grade) commented on how during one Code Club class, an informal discussion began about how during a field trip to Pinterest that they didn't really see many people of color working there, but that they thought the place was "cool" and wanted to work there.

One student focused on the importance of girls coming together to combat feelings of inferiority:

Well, I believe it's really important for – in a world where girls are probably discriminated upon still despite there being many – how do you say – people are rallying against sexism and – but there are still many cases in which girls are discriminated upon. Even in everyday situations, such as in the gym class I was in, even my teacher, who was a woman, always told the boys to pick up the equipment. Just these little things, and I believe it's important for girls to get together and do something so that they don't feel that they are inferior in any way. (12th grade alum)

Another student commented on a group project she made with other girls, a Kevin Hart (comedian) app, and how she went home and proudly shared her app with her older brother and show him how it worked:



"I think my brother was shocked that I did it. He was asking me about it and I explained how it worked to him. Kevin Hart is also his favorite celebrity too." (11th grade alum)

According to one parent, BGC provides opportunities to embrace culture, identity, and be successful as students, thereby promoting coding competency:

The teachers and volunteers there are showing the kids that you can succeed and be a girl, and be African-American. The girls don't have to lose who they are in order to succeed in this field. They can be themselves. My daughter identifies herself as a coder. (Parent of 12th grade alum)

The concept of gender and racial bicultural competence is an important element of BGC because it explains how culturally relevant programming can complement and enhance academic success. Many researchers worry that culturally relevant programming might distract students from their academic pursuits. Conversely, Ko et al. (2014) argued that it is through the strengthening of cultural identity in learning environments that students experience enhanced identity and academic success overall. Both students and parents mentioned that the BGC culturally relevant programming helps girls to connect with their cultural identity contributed to heightened confidence and self-esteem, and will, in turn, improve academic success. One parent in particular commented:

[Daughter] was already a confident girl. Boy, is she. When I look at her I think, "Boy if I had an ounce of her confidence growing up." But because of Kimberly's program I think her confidence is on another level. The program isn't so in-your-face about connecting African-American culture and history to coding, but there's this unspoken acceptance for these girls that is, I think, empowering. They look around and see other Black students. They see Kimberly – who was a coder herself. [Daughter] is excelling in school and even wants to take a gaming class. She's shown this strong sense of focus. [Prompt: Is it because of the program?] Maybe. Maybe she's just getting more mature since she is in high school. She's been in Black Girls Code for a long time. It's not hurting her, I know that. It can only be helping her. (Parent of 11th grade alum)

Beyond changes at the individual level, it is important to consider potential systems level changes. As noted by one parent, who was included in one of our previous evaluations, promoting culture within K-12 school settings should be just as important as what you see in college. She reflected on her mother's time in college during the Civil Rights Movement in the 1960's:

I was in school at San Francisco State with the standard Black Student Union and it really helped me. I felt supported. My mother was in school during the "Black

is Beautiful,” and “I’m Black and I’m Proud” era. At that time, which was hard, all you heard was how beautiful and strong we were as a collective. Today, what do we hear? We see Trump, we see Black Lives Matter, we see more divide without the self-love that we they had during the 60’s. Today we just have divide without that “I’m Black and I’m Proud” in the background. But we need to separate that era and acknowledge that Black youth are important to us and we need to foster their identities and empower them too. By having a program that is built to teach them pride and success in fields that they may not see many people like them, is something we need to encourage. What if something like Black Girls Code existed at high schools and girls had this kind of support at their learning institution? (Parent of 12th grade alum)

As this one parent argued, school environment can in fact play a significant role in BGC students’ success, especially teachers’ attitudes, cultural sensitivity, and inclusiveness (Bell, 2004). While we do not have evidence of BGC students experiencing more overall school success because of the program, studies have shown that when underrepresented students encounter an intellectually safe and welcoming learning climate, free of negative stereotypes, that they are more prone to academic success (Steele & Aronson, 1995). Previous evaluations of BGC touched on potential partnerships with San Francisco Unified School District and Oakland Unified School District; hence, dialogues are taking place to address the additional level of supports needed for underrepresented students in STEM. While we are cautious in claiming that our results have led to systematic changes, there is room for further development. The current results show that BGC has worked to create a learning environment in which coding and computer programming can be taught in tandem valuing and validating gender and racial identity. One parent mentioned:

Black Girls Code gives the girls a sense of belonging. I know my daughter is very shy, if she doesn’t feel a connection through their culture, like other girls or other people of color or something that brings people together, then she might not be as engaged. Having that cultural piece where they feel welcome and they feel wanted and they feel like they can contribute

“It’s important for programs like this to exist I think it’s mainly because there’s not that many African Americans or women in general in the field of STEM and engineering and technology. I feel like doing this helps people, maybe like me, who I thought I was going to be a scientist and now I’m converting more into computer science, which is what it seems like my field might be in college.” (10th grade BGC alum)

that is a huge benefit for a lot of the girls. They are able to share and talk about things because they feel proud. (Parent of 10th grade alum)

This parent's comment supports previous research in the field about the positive effect of welcoming school environments on youth, and controlling learning spaces that are absent of negative intellectual stereotypes especially that target girls and African-Americans (Habib, 2012; Spencer, Steele & Quinn, 1998).

Student Success and STEM Pathways

Some student participants (N=6), and their parents (N=9) reported that their daughter's readiness for academic success had increased as an indirect result of BGC.

Approximately 85% of respondents indicated that they had become more successful at school as a result of participating in BGC (see Table 1 for subthemes related to "success"). During interviews, students identified a number of skills and attributes promoted in the BGC programs that led to their self-reported increase in academic success. For example, one student described increased success in learning self-advocacy by asking for help in one of her science classes. Another student reported that the positive *emotional* impact of the program may have helped her grades, while also steering her interest toward a career in computer technology: "It [program] made me feel good and I felt like it even helped how I was doing in school. I loved it and I know next year when I start [college] I want to take coding classes" (High school graduate). Parents also reported an improvement in grades and behavior for their daughters involved in BGC workshops over long-term, and, in some cases, provided very concrete examples:

[Daughter] actually wasn't doing as well when she started ninth grade. Just not focused and not motivated. It could have been because it was her first year in high school. I honestly think that after one summer of Black Girls Code classes she had this renewed focus and interest. She didn't just want to do more app development and gaming and what not, but she was doing better in school. (Parent of 10th grade alum)

One student explained how BGC helped her with time management, and, in turn, helped her improve school homework assignments. When asked what the most significant change experienced since participating in BGC, she commented:

I have to say my work my homework, my school work. At first I just wanted to work by myself and work on projects by myself, but Black Girls Code helps you get to know other girls who are interested in the same thing. It also just helps

you divide up the work and learn who's going to be the leader and who's the best time manager. Black Girls Code helped me with time management. I was able to use what I learned in school. (11th grade alum)

Other interviewees noted how important it was for them to connect their learning to things they liked. One student praised the BGC instructors and their attempt to make any new coding topic culturally relevant, and related that particular technique to her own success in school:

I remember when we were using Scratch, [Instructor] introduced the topic. She was from North Carolina I think. I worked on a Taylor Swift app and as I was working on it she let us all listen to music. They just let us have fun. The teachers let us put our own personal spin on things with everything we learned. It wasn't super strict, but I think that connecting assignments to things we liked was a good idea. In school, if I was learning something new that I wasn't really crazy about, I tried to relate it to something important to me to make it more interesting. (11th grade alum)

This comment and others highlights some of the techniques volunteers used in an effort to help students understand coding concepts better. According to several students, BGC instructors demonstrated some of the following strategies to support students in understanding difficult concepts: (a) confirming students' ideas about a concept; (b) probing students' prior knowledge in an effort to help students participate deeper discussions; (c) making knowledge easily accessible to students with one-on-one attention, answering any and all questions students may have, and referring students to App Inventor tutorials for further inquiry; (d) assuming the role of "coding expert" by either confirming or disconfirming students' ideas about coding; and (e) attempting to make app development relevant to students lives. One parent noted that her daughter had the highest grades that she had in several years, and attributed that success to the BGC programming.

I think that all [daughter] needed was to feel acceptance in classes that was hard, like coding. Since she was accepted, and fit in, she had this confidence and glow about her – like she can do anything. (Parent of 11th grade alum)

The long-term benefits of BGC participation were also shown through student participants' chosen career path. Of the 16 girls interviewed, 11 agreed that because of BGC they have chosen to stick with computer science, and nine specifically mentioned programming and coding as a potential career path. Four of the girls interviewed had graduated from high school at the time of the interview, and all of them had already made plans to pursue computer technology classes at their respective school. The following comments sum up these sentiments:

*It was definitely because of Black Girls Code that I want to be a programmer.
(high school graduate)*

*Black Girls Code showed me that I can code if I want to. I want to create games
and keep developing apps. (High school graduate)*

*I'm positive I want to do something in the area of computer tech or computer
science. (12th grade alum)*

One student commented on an unexpected benefit to long-term participation in BGC that helped her transition to college:

*One of my Hack-a-thon projects helped me win a \$500 scholarship for school.
That was helpful and I felt like I couldn't do something like that without Black
Girls Code. (High school graduate)*

While for the most part, student interviews consisted of overwhelming praise, some students offered concrete ways that BGC could improve the short and long-term benefits of such programming. Seven out of 16 of the students wanted more post-program communication and follow-up with the program and with BGC teachers and volunteers. Five students in particular mentioned wanting to participate in an online club or chat room with alums not just to stay in touch socially, but to share resources, news, and information amongst the group.

Conclusion

The results of this study were consistent with previous BGC formal feedback and satisfaction questionnaires collected over the past six years, and highlighted the positive effects of BGC programming on relationships, confidence, and student success nationwide. The inclusion of female and African-American educator voices introduced an added perspective. The importance of promoting cultural identity in the programming to foster cultural connectedness, protective factors (increased social competencies, self-esteem, personal mastery, and social support), and academic success among BGC students emerged as a major theme, consistent with previous research (Fleming & Ledogar, 2008; LaFromboise et al., 2006; Longboat, 2012; Moran et al., 1999; Mussell et al., 2004; Pridemore, 2004).

There are some limitations to this study and they are worth noting. First, although the parent perceptions of improved student success are important, these perceptions need to be validated with longitudinal data using more objective measures, such as

graduation rates and actual grades. Second, there were two sources of sample bias with respect to the student interviews. Students who volunteered to participate in interviews could view the program more favorably than those who did not. Moreover, BGC program staff helped to select this sample, undermining the representativeness of the interview sample. Finally, although participants were queried to provide both likes and dislikes of the programs, and asked for areas for potential improvement, they might have felt a demand to provide positive feedback.

Currently, the longitudinal impact of BGC on individual participants is unknown other than what is self-reported by some of its students. However, in upcoming years REA hopes to follow a cohort of grade 7 and 8 youth over a period of three years to evaluate the impact of the programs during the transition to high school and ultimately college. In the short-term, the results of this study demonstrate that gender and racially-specific (or culturally relevant), strengths-based school programming for African-American girls are perceived to provide a positive transformational experience for many participants. Parents indicated that BGC helped to build competency and a number of associated positive assets among Black youth participants, by providing them with the opportunity to develop a strong sense of cultural identity in a way that also encouraged academic success.

The results of this study show that culturally relevant programming, such as BGC, may contribute to enhanced educational outcomes. Specifically, this evaluation shows that the programming was perceived to: (1) enhance student success; (2) improve student relationships, and increase student sense of belonging; (3) increase student confidence and leadership skills; and (4) promote success through culturally relevant approaches and culturally-sensitive approaches. At the individual participant level, the results showed that the BGC helps promote a strong sense of identity and connectedness for Black girls, which could increase cultural connectedness.

Moving forward, helping a greater number of schools develop and implement such programs could ultimately improve the responsiveness of the education system to underrepresented groups attempting to pursue STEM. Some research studies have argued that students who attend STEM-focused schooling outperform their peers in similar institutions on standardized tests (Scott, 2012). At the systems level, it is possible that programs similar to BGC could create a more welcoming and inclusive environment for students within actual school districts. Research on the impact of STEM-focused afterschool programs for girls, with the duration of the program considered, is lacking however. The overall survey findings suggest that further

research is needed to better understand the impact of coding or STEM programs on the future success of middle school students.

Appendix

BGC Alum Student Interview Protocol

The present interview protocol is for the BGC alum retrospective impact study. One goal for the third phase of the study is to interview a small sample of alums about their experiences and perspectives concerning BGC, in an effort to develop cases.

Introduction

My name is _____ and I work for Rockman et al, a research and evaluation firm based in San Francisco. We are interested in learning about the role that BGC has played in your studies, and perhaps career aspirations, and ways the program has had an impact on you overall.

What you choose to share today will remain anonymous—no names are used in sharing/reporting of findings. We want you to be honest with us—we want to hear both positive and negative feedback. We will aim to limit our discussion to no more than one hour. Any questions before we begin?

We would like to record today's discussion so that we can focus more on listening than writing, and we want to be sure to capture all your input. Is it ok to record our conversation?

Background and Reasons for Participating in BGC

1. About when did you participate in BGC? How many workshops/classes and over a span of how many years?
2. Are you currently in school? If so, please describe your school.
 - a. Does your school offer coding or computer technology courses?
3. If you are not currently in school, please describe your reasons for not being enrolled.

4. Which BGC program(s) did you participate in?
5. What was your main reason for participating in the Black Girls Code program?
6. Had you participated in other coding or computer technology courses similar to BGC prior to participating? Please describe.
 - a. Any STEM programs prior?
7. Have you participated in other coding or computer technology courses since participating in BGC? Please describe.
 - a. How did these compare to BGC?
8. Why do you think it is important for programs like BGC to exist?
 - a. Would you recommend BGC or other coding or computer programming programs to your friends?

General impact (a way to get them thinking before getting into specifics)

9. Looking back over the years since you participated in BGC, what do you think was the most significant change you experienced? (OR what do you think was the most significant learning change you experienced? That's a little more specific)
10. In what ways has BGC influenced your:
 - a. Desire to pursue coding/computer programming/STEM as a future career goal?
 - b. Desire to take coding/computer programming/STEM classes?
 - c. Levels of confidence (Has your experience with BGC made an impact on your level of confidence in your ability to code? If so, please explain why)
 - d. Levels of comfort learning coding/STEM during your transition into higher grade levels
 - e. Perception of who coders are, or who computer programmers are?
11. What tools or resources that you got from BGC do you use today? If so, please describe.
12. In what ways has BGC influenced your interest in coding or computer programming in general? Add some examples: more workshops (internal or at school, external elsewhere), work groups with other students, internships, etc.

13. What can BGC do differently to make the coding experience for young girls even better?

Additional Impacts

14. Looking back at your experience in BGC, is there anything else you wish you had been covered during the workshops?

15. Have there been any unintended outcomes from participating in BGC (e.g., scholarship as a result of coding/STEM interest, etc.)?

16. Have there been any other benefits to your participation that you haven't yet discussed?

BGC Alum Parent Interview Protocol

The present interview protocol is for the BGC alum retrospective impact study. One goal for the third phase of the study is to interview a small sample of alums and their parents about their experiences and perspectives concerning BGC, in an effort to develop cases.

Introduction

My name is _____ and I work for Rockman et al, a research and evaluation firm based in San Francisco. We are interested in learning about the role that BGC has played for your daughter, and perhaps her career aspirations, and ways the program has had an impact on her overall.

What you choose to share today will remain anonymous—no names are used in sharing/reporting of findings. We want you to be honest with us—we want to hear both positive and negative feedback. We will aim to limit our discussion to no more than one hour. Any questions before we begin?

We would like to record today's discussion so that we can focus more on listening than writing, and we want to be sure to capture all your input. Is it ok to record our conversation?

Background and Reasons for Daughter Participating in BGC

1. About when did your daughter participate in BGC? How many workshops/classes and over a span of how many years?
2. Which BGC program(s) did she participate in?
3. What was your main reason for wanting your daughter to participate in the Black Girls Code program?
4. Had she participated in other coding or computer technology courses similar to BGC prior to participating? Please describe. Any STEM programs prior?
5. Has she participated in other coding or computer technology courses since participating in BGC? Please describe. How did these compare to BGC in your opinion?

6. Why do you think it is important for programs like BGC to exist?
7. Did programs such as these exist when you were younger?

General impact (a way to get them thinking before getting into specifics)

8. Looking back over the years since your daughter participated in BGC, what do you think was the most significant change she experienced? (OR what do you think was the most significant learning change she experienced?)
9. In what ways has BGC influenced your daughter's:
 - a. Desire to pursue coding/computer programming/STEM as a future career goal?
 - b. Desire to take coding/computer programming/STEM classes?
 - c. Levels of confidence (Did her experience with BGC have an impact on her level of confidence in her ability to code? If so, please explain why)
 - d. Levels of comfort learning coding/STEM during her transition into higher grade levels
 - e. Perception of who coders are, or who computer programmers are?
10. What tools or resources did you get from BGC that you use today? Please describe.
11. In what ways has BGC influenced your daughter's interest in coding or computer programming in general? Add some examples: more workshops (internal or at school, external elsewhere), work groups with other students, internships, etc.
12. What can BGC do differently to make the coding experience for young girls even better?

Additional Impacts

13. Looking back at your daughter's experience in BGC, is there anything else you wish had been covered during the workshops (that you are aware of)?
14. Have there been any unintended outcomes from your daughter participating in BGC that you have seen?
15. Have there been any other benefits to your daughter's participation in BGC that we haven't yet discussed?