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A. Significance

A.1. Severity of the Problem: Women of color (e.g. African American, Native American, Latina0, who will comprise the majority of our nation's total population by 2050 (U.S. Census Bureau, 2014), continue to be underrepresented in science, technology, engineering and math (STEM) in general and technology, one of the most lucrative and fastest growing of STEM fields (White House Council on Women and Girls, 2015), in particular. The US Bureau of Labor (2015) demonstrated that Native American women constitute less than 1%, Latina 1%, and African American women 3% of computing occupations. On the macrolevel, the failure to provide girls and women of color the necessary resources and opportunities to enter and persist in technology will result in the national struggle to fill the increasing number of STEM jobs (Nixon, Meikle, Borman, 2013). On a microlevel, girls of color will continue to lack access to quality STEM learning opportunities and will not gain the skills necessary for 21st century success, namely computational thinking skills such as abstraction, automation, and analysis (Lee, Martin, Apone, 2014). Arizona is not immune to this phenomenon. A recent Change the Equation (2015) report indicates that while Arizona is ranked fourth in the nation for STEM job growth and fifth in terms of STEM employment advantage, Latina and African American students, in general, and girls, in particular, lag in science and math achievement. Furthermore, the report indicates that these students have the greatest likelihood of having teachers who do not feel they have access to resources to teach math or science and parents who report their children do not have access to any STEM programs. *COMPUGIRLS Remixed* proposes a **development grant** that addresses **Absolute Priority 4** (**Influencing the Development of Non-Cognitive Factors**) and **Absolute Priority 5 (Serving Rural Communities)** by expanding our empirically-based program, COMPUGIRLS, in partnership with a consortium of 11 of Arizona's highest needs rural and urban schools. *COMPUGIRLS Remixed* is intended to impact non-cognitive outcomes, engaging 100 girls in the pilot study and 640 girls in a full impact and implementation study. Arizona Board of Regents on behalf of Arizona State University's Center for Gender Equity in Science and Technology (CGEST) is a novice applicant and qualifies for the **Competitive Preference Priority.** CGEST hosts the nearly ten-year-old COMPUGIRLS program that has received considerable support from the National Science Foundation (#1139426, #1136079, #0833773, #1427399), schools, and local foundations to implement, scale, and research COMPUGIRLS. COMPUGIRLS responds to the underrepresentation of women of color in STEM by providing a culturally responsive computing program for adolescent (ages 13-18) girls from high needs districts. Presenting a series of courses that offers a culturally responsive computing experience provides participating girls access and opportunity to acquire the technical and "power" skills--namely, how to present an argument, build a coalition, design solutions to a problem, and further one's community (Scott, in press)-- necessary for them to enter and persist in STEM. Research clearly shows that many girls of color begin their postsecondary careers in STEM but do not persist (Chen, 2013). For instance, 37.1% of Latina college freshman declare a STEM major (National Science Foundation, 2015), yet only 9.4% graduate with a bachelor's degree in a STEM discipline (National Center for Education Statistics, 2015). Since lack of interest is not a reason for self-selecting out of these disciplines (Girl Scouts, 2012). Ashcraft, Eger and Friend (2012), among other research (Mayfield & Garrison-Wade 2015), found that offering a culturally responsive curriculum can offset the lack of belongingness (Hausmann, Schofield, Woods, 2007), access to regularly available and supported teachers (Mosatche, Matloff-Nieves, Kekelis, Lawner, 2013), and support systems all of which depresses girls' interests, motivations, and valued placed in STEM (Scott, Sheridan &

Clark, 2015). While there has been heightened awareness on identifying these features and more girl-centered out-of-school programs have emerged, particularly for girls of color, the vast majority of strategies focus only on technical skills potentially leading to “technical ghettos” (Anderson, 2016) and many assume a deficit approach ignoring the assets girls’ ecosystems possess and can construct. There is limited research on how interventions can impact non-cognitive outcomes and computational thinking of girls’ of color who disproportionately populate high-needs urban and rural areas (Orfield & Lee, 2005) and come from low-income families who often lack opportunities to learn how to support their children (Williams & Sanchez, 2011). Little is known how to scale the burgeoning number of attempts with fidelity. *COMPUGIRLS Remixed* will **build on our existing strategies** by revising and enhancing the COMPUGIRLS’ experience to examine the impact on urban and rural participants’ noncognitive outcomes, plans for pursuing STEM coursework, and computational thinking skills. The potential broader impact of our project on research includes: (1) evidence from a research based culturally responsive computing in-school learning experience for girls from under-resourced schools; (2) evidence on how expanding a program to (a) increased support and participation from families and (b) access to industry professionals and opportunities to apply their computational thinking through experiential learning, will influence girls’ STEM-specific self-efficacy, self-regulatory disposition in college and career settings; (3) evidence of the impact of teacher self-efficacy; (4) evidence of parental engagement and its effect on girls’ STEM self-efficacy; (5) rigorous evaluation model that provides data to inform replicability of in-school projects. Our program is innovative and unique in its focus on engaging high school girls of color from both urban and rural Arizona schools in a curriculum that encompasses and cultivates schools, parent, and industries as partners in girls’ STEM learning. Additionally, COMPUGIRLS

Remixed rests on **strong theory** of self-efficacy and related factors and culturally responsive computing.

A.2. Development or Demonstration of Promising New Strategies: Launched in 2007, COMPUGIRLS has been recognized at federal (e.g. White House) and local levels for providing more underrepresented girls access to STEM opportunities. Primarily implemented as an out-of-school experience, various models (e.g. in libraries, community centers, after-school clubs) with different durations (one to fifteen weeks) have been attempted. Researchers such as Eccles (1983; 2011) have indicated that several non-cognitive factors are essential to academic and career success. These factors include efficacy expectations, persistence in pursuing choices (e.g. self-regulatory behaviors) (Malka, Covington, 2005), and future time perspective (Lang, Carstensen, 2002). As Appendix J.1 indicates, our past data suggest that participating girls experience an increase of academic self after participating. They also enjoy sharpening their computational thinking skills as long as it benefits their communities. With several COMPUGIRLS from earlier cohorts approaching adulthood, we have some qualitative data narrating the significance of the program's supportive environment, influence on parent support, and value of industry mentors (Vilchis, Scott, & Besaw, 2014). These characteristics oppose the hostile environments, unsupportive peers, and lack of opportunities research suggests causes women of color to leave or cease pursuing STEM majors and careers (Ong, Wright, Espinosa, & Orfield, 2011). While promising, we do not have data revealing the impact of our program on other salient non-cognitive factors or how a sustainable in-school model can positively impact participating girls. We posit that delivering the traditional COMPUGIRLS to the control group and revised curriculum with a treatment group concurrently will allow us the opportunity and the data to assess the effectiveness of the model revisions. Appendix J.2 outlines the differences between the current and proposed program. COMPUGIRLS Remixed will be piloted, implemented, and evaluated at a total of 3 urban and 8 rural high schools in Arizona all of whom are categorized as or maintain Title 1 programs. Beginning with a pilot study of 100 girls, Table 1 indicates that our partner schools serve up to 100% of low-income, 24% African American, 100% Native American, and/or 98% Latino students. Appendix J.3 shows how the partner schools represent a vast geographic area.

Table 1:Partner Schools

School	Rural or Urban	% Latino	%African American	%Native American	% Low-Income	# of girls
Ajo High School	rural	67%	0%	16%	58%	60
Bisbee High School	rural	98%	0%	0%	80%	60
Chinle High School	rural	0%	0%	100%	100%	80
Globe High School	rural	28%	0%	31%	41%	80
McClintock High School	urban	48%	10%	5%	61%	80
Miami High School	rural	44%	0%	3%	52%	40
Morenci High School	rural	69%	0%	0%	33%	40
Nogales High School	rural	98%	0%	0%	100%	80
Phoenix Collegiate Academy	urban	92%	6%	0%	94%	60
South Pointe High School	urban	66%	24%	5%	100%	120
Valley High School	rural	0%	0%	100%	99%	40

*Based on Arizona Department of Education Enrollment figures for 2014-2015 school year

Considering Bronfrenbrenner's (1979, 1994) ecological model for human development and the impact of multiple systems on child development, COMPUGIRLS Remixed will implement **four elements** affecting the 100 girls' from pilot study and the 320 treatment group girls' (n=420) school, family and industry communities: **(Element #1) Culturally responsive computing curriculum (CRC) Integration in school:** Culturally responsive computing (CRC) refers to a pedagogical practice that makes tacit connections among computational thinking, an individual's intersectional identities, and the three pillars of culturally responsive teaching (asset building, reflection, and connectedness) (Eglash, Gilbert, Taylor, Geier, 2013; Scott, Sheridan, & Clark, 2015). By emphasizing girls' intersectional identities (Collins, 2000; Crenshaw, 1991) and cultural background as assets on which to build (Gay, 2013); developing and facilitating reflective small and large-group activities encouraging participants to analyze and oppose race-gender-social class biases (Ladson-Billings, 2014; Paris, 2012); and co-constructing a supportive coalition of social actors (mentors, peers, parents), this project will apply theory to practice. Central to CRC is computational thinking and its emphasis on society, science, and technology as drivers towards innovation (Wing, 2006, 2008). Integrating computational thinking with culturally responsive computing results in participants researching a social/community issue and using various technologies as a manipulative tool to describe, analyze, and offer solutions to the self-selected research issue. Although this approach is not often applied or researched, it has potential to better engage underrepresented groups given combination of culture with this type of thinking (Grover & Pea, 2013). Research has illustrated that culturally responsive schooling increases Indigenous youth's academic performance and behaviors (Agbo, 2004; Apthorp, D'Amato & Richardson) but the effects of CRC are less known. The Curriculum Development Team will collaborate with partner schools and past COMPUGIRL instructors, called mentor teachers, to lead the redesign of the out-of-school curriculum to an in-school culturally responsive course elective. All three of the COMPUGIRLS courses depicted in Appendix J.4 will be “remixed” and offered over 120 hours in school. Drawing on past successful methods of recruitment, we will collaborate with principals to conduct a demonstration to all rising ninth-grade girls to showcase past projects, girls’ accounts of the COMPUGIRLS’ experience, and hands-on activities with hardware (e.g. laptops) and software (iMovie, SCRATCH, Virtual World) that will appear in courses. Since research indicates the significance of mentors to discuss barriers they overcame in STEM (McCullough, 2011), redesigning our curriculum will include matching girls on a one-to-one ratio with a STEM woman from the New York Academy of Science’s1000 Girls, 1000 Futures. After the Curriculum Development Team collaborates with this and other industry partners to develop and digitize an orientation package for 1000 Girls, 1000 Futures’ mentors, the organization will use it as a recruitment and educative tool for potential mentors. This partnership will allow access to female mentors regardless of geographic location, an especially critical component when addressing the needs of girls in remote rural settings (Songer, Lee, & Kam, 2002; Avery, 2013). **(Element #2) Process and Implementation of culturally responsive computing professional development:** Teachers, particularly those in high needs urban and rural areas, often lack access to opportunities and resources to implement best practices, such as culturally responsive computing (Peterson, Bornemann, Lydon, & West, 2015). Using a hybrid approach that combines both an on-line platform Nexus Lab committed to revise (see Appendix G for letter of support) and a three-day in-person training held at ASU, we will work with partner schools to identify teachers to teach the elective as part of their load using a 1:10 teacher:student ratio; train these individuals on the theoretical tenets grounding culturally responsive computing, COMPUGIRLS’ history, how to reinforce culturally responsive teacher practices and computational thinking, and meeting the unique needs of each school's geographic setting, particularly rural (Favela & Torres, 2014). Instruction in these areas is particularly important for Indigenous Communities wherein taking into account the unique, contextualized Tribal elements and knowledge systems of Indigenous peoples and nations correlates with students' sense of self (Brayboy & Maughan, 2009). Training will also include strategies for using online platforms such as Yellow Dig to encourage participants to interact with other program participants across sites to strengthen their peer coalitions. Expansion of teacher professional development will also include development and management of professional learning communities across campuses and the addition of professional development check-points. Past practice indicates that teachers enjoy weekly check-ins to discuss issues, share achievements and provide collegial support. Managed by the Curriculum Development Team, teachers will experience 60 hours of training followed by a total of 38 hours of continuous virtual support. **(Element #3) Parental CRC Infrastructure:** Rozek, Hyde, Svoboda, Hulleman, & Harackiewicz (2012, 2015) work demonstrates that the more parents, particularly mothers, value STEM, the more their adolescent children will value these disciplines. Yet, Dasgupta and Stout's (2014), among others (Gunderson, Ramirez, Levine, & Beilock, 2012) point out that parents often hold gender stereotypes about math and science producing obstacles for their daughters. Particularly for Latina girls that research says are primary sources of support (Simpkins, Price & Garcia, 2015), and parents from low-income rural and urban areas who lack access to resources that can unpack their own biases and provide activities to become STEM advocates for their daughters, it is critical to engage parents as STEM advocates. These groups represent a significant segment of Arizona's youth as 26 percent of all children, 30 percent of Latino children, and 46 percent of American Indian children live under the poverty level. Furthermore, approximately 18 percent of Arizona's nearly 345,000 children who speak a language other than English at home reported that they speak English less than "very well." In the culturally responsive computing framework, parents are assets that must be strategically included in intervention efforts for underrepresented groups (Scott, Sheridan, & Clark, 2014). The full impact of their support is narrowly understood. Led by the nationally recognized American Dream Academy (ADA), parents/guardians of all 100 girls participating in pilot and those randomly assigned to treatment group (n=320) will attend a series of weekly workshops over the course of 16 weeks for a total of 32-hours. Two-hour Saturday sessions ADA will implement a revised parent curriculum that will align with *COMPUGIRLS' Remixed* objectives. Identifying and training community leaders from communities surrounding partner schools as ADA facilitators to implement the curriculum will be replicated as ADA has found this to be effective for recruitment of parent. Revisions to parent curriculum will include guiding parents on how to set academic goals towards STEM majors, develop academic success behaviors for underrepresented girls in STEM by combatting gender bias in the home (Ing, 2014), become familiar with the financial aid process for underresourced girls to persist in STEM, how to discuss high school course and career options that will poise girls to enter and persist in STEM, as well build a college portfolio. The second eight-week session will focus on preparing parents to support their daughters' participation in the Summer Residency Experience. It is critical that families across Arizona have a good understanding of the K-12 and post-secondary education system to ensure that they can help prepare their child for academic success. Unfortunately, both the K-12 and post-secondary education systems are fraught with complexities and nuances that are difficult for many parents to understand without relatable information shared by a trusted messenger (Dounay, 2008). In addition, students who are the first in their families to consider college often do not receive timely college planning information, might not take the necessary courses, and may struggle with cultural conflicts between their new college-oriented world and the worlds of their friends, families, and communities (Hardiman & Jackson, 1997). ADA's Spring 16-hour parent meetings to help girls and families learn the required steps to prepare, apply, enroll, afford and successfully transition to ASU, in general, and a STEM discipline in particular. ADA has agreed to revise their existing curriculum for the COMPUGIRLS Remixed project. ADA has also agreed to utilize their existing retention and recruitment strategies to ensure continued parent engagement throughout the duration of the project. Including a call center with 1-2 bilingual individuals has proven to be successful to maintain a low attrition rate of 2%. **(Element #4) Experiential Learning Experience:** Numerous studies conducted with underrepresented minorities, first generation college students, and girls of color, support the positive impact of experiential learning in the form of out of classroom activities, living-learning communities, pre-college summer programs, internships, and research assignments (Weinberg, Basile, Albright, 2011). Using data from the 2004–2007 National Study of Living Learning Programs (NSLLP), research indicates positive effects on the girls' interest and motivation towards STEM after living and learning in a STEM residential program. Longer term studies have found positive effects of informal learning on self-efficacy and participation in science-related activities or courses (Marcowitz, 2004; Redmond, 2000) as well as interest in science-related careers. For underrepresented groups, data indicate that students are well-prepared, have a strong sense of belonging, and are retained in their STEM discipline better than other students when engaged in experiential STEM learning experiences (Tomasko, Ridgway, Waller, Olesik, 2016). COMPUGIRLS Remixed weaves these outcomes into the collaborative design and implementation of an enriching Summer Residential Experience in order to provide participants with increased experiential opportunities to positively affect their interests, self-efficacy, self-regulatory, self-concept and computational thinking skills. COMPUGIRLS Remixed will leverage new and existing industry and academic partnerships and provide a 3-week summer residential programs each year to two cohorts of 50-80 girls. Engaging in industry experiences to simulate how their computational thinking, emergent products and self-concepts may be applied, enhanced, and molded in college and a STEM career. Hosted at Arizona State University, this 336-hour on-campus residency with trained Resident Assistants will provide 24-hour supervision and activities that reflect culturally responsive computing. Critical to this experience are industry partners listed in Table 3b committed to providing guest speakers, field trip opportunities during this residency experience, and mentorship to guide girls in reflecting on how their self-concept can be used to accentuate their marketable talents, and develop workforce-ready skills; experiential activities to understand the wide application of computational thinking and culturally responsive computing into fields in and outside of STEM; guest speakers from partner industries to further discuss alignment of individual goals with career aspiration by building on sense of self-concept, self-efficacy, and social consciousness; and a research based group project in which teams of 6-7 girls will apply STEM skills and principles to develop a project plan and prototype that will support the operational needs of the industry. A final day of the residency will include a closing program which will include a mini college resource fair and a poster presentation wherein participants will illustrate their experience, research, project plan, and prototype to an audience consisting of families, school personnel from partner sites, mentors from 1000 Girls, 1000 Futures, teachers from home schools, and industry partners. While we will collaborate with industry, our advisory board, and school partners on crafting summer curriculum discussed in Section B.3, a sample schedule appears in Appendix J5. Table 2 provides the logic model for this project.

Table 2: Logic Model

	Inputs	COMPUGIRLS Remix Elements	Activities	Short-Term Outcomes	Long-Term Outcomes
School	• Culturally irrelevant "interventions"/programs • After-school programs that are not sustainable	CRC Integration in school INPUT • Culturally responsive computing curriculum (e.g. asset building, reflection, connectedness + computational thinking) • Curriculum development team • District support for the course • On-line mentoring	• Use feedback from focus groups, qualitative data to re-design and expand existing CompuGirls program • Implement CompuGirls Remixed as in-school model • Use design based research model to collect ongoing feedback from participants, teachers, school leaders and parents to support continued improvement throughout project	• Future Intent to Use Technology • Self-Concept around Computing • Self-regulation • Increased computational thinking • Increased value of and expectations for success in STEM fields • Articulated plans to pursue STEM coursework in high school and college	• Strong Ecosystem poising girls towards college-enrollment and persistence in STEM
School	• Teachers lack access to culturally responsive computing curriculum • Teachers lack understanding of culturally responsive computing • Teachers lack continuous training to implement culturally responsive computing curriculum	Process and Implementation of CRC professional development INPUT • Curriculum development team • Focus group of past mentor teachers • Coaching/Training of CRC PD • Design Based Research process • On-line professional learning community platform • District support of PD	• Use design based research model to collect ongoing feedback to support continued improvement throughout project • Use feedback from focus groups, qualitative data to revise and expand CompuGirls teacher professional development • Provide ongoing in-person and online training in culturally responsive computing to reinforce culturally responsive best practices, STEM content, and meeting the unique needs students • Engage teachers in professional learning communities that foster climate of mutual support and sharing of culturally responsive STEM resources	• Increased use of pedagogical practices and resources to implement a in-school culturally responsive computing • Teacher understanding of culturally responsive computing practices • Increased support system to operationalize CRC	
Family	• Parents who lack knowledge on how to support daughters to enter STEM • Parents lack access to resources to support daughters to enter STEM • Gender-bias in home around STEM	Parental CRC Infrastructure INPUT • Curriculum writer • Parent STEM-gendered curriculum • District support for parental development • Facilitators implementing parent curriculum	• Work with ADA to align existing parent training to CompuGirls Remixed program (i.e., emphasis on STEM, combating gender bias in the home,parent orientation for Summer Residential Experience) • Provide 8-week parent training using American Dream Academy revised curriculum • Recruit and train facilitators to deliver ADA curriculum • Host ADA information session • Schools provide space to hold parent training classes • Schools assist in marketing classes to parents • Activate ADA call center to assist with recruitment and retention of parents	• Understanding the importance of STEM for their daughters • Reducing gender bias at home • Awareness of steps they can take to support their daughters as they pursue STEM study in college • Expectations for their daughters' success in STEM • Practices to develop academic success behaviors • Knowledge of resources to support their daughters' college attendance	
Industry	• Limited access to experiential learning opportunities • Low access to role models to discuss structural barriers and how to overcome them	Experiential Learning Reinforcement INPUT • Student support in experiential learning • Summer residency curriculum • Industry support	• Recruit and train lead teachers and camp counselors in culturally responsive program and camp curriculum • Implement Summer Residential Experience at ASU • Engage industry partners to provide speakers, workshop facilitators, field trip opportunities, and mentors • Orientation/coaching for industries	• Increased experiential opportunities • Increased girls' expectations that they can be successful in STEM fields • Increased value of and expectations for success in STEM fields	

A.3. Absolute Priority: COMPUGIRLS Remixed addresses **Absolute Priority 4** by focusing on how factors operating within a system of social actors (e.g. teachers, parents, mentors) that, with appropriate support, can collectively and positively influence academic performance and outcomes (Davis, D. & Veenstra, C, 2014; Ing, 2014; Traphagen, K., & Traill, S., 2014). Understanding that this program may not be everything girls need to declare or persist in a STEM degree, the noncognitive factors include self-regulation, expectations for success in STEM fields (self-concept), their perceptions of the value of STEM, their plans to pursue STEM in courses and career, and their computational thinking skills. In recognition of the importance of the development of non-cognitive factors, we propose to expand our empirically-drive

COMPUGIRLS program in rural and urban school contexts to influence the development of non-cognitive factors associated with fostering a strong STEM self-concept for underrepresented girls. To meet **Absolute Priority 5**, the majority of girls participating in COMPUGIRLS Remixed come from rural schools (65%).

B. Quality of the Project Design and Management Plan

B.1. Goals, Objectives, and Outcomes: The overall goal of *COMPUGIRLS Remixed* is to positively impact underrepresented girls' noncognitive ourcomes, plans for STEM coursework, and increase computational thinking skills. There are three objectives shaping our strategies: **Objective #1:** Revise an out-of-school culturally responsive computing curriculum as an in-school model; **outcome**: More girls from high needs areas will have access to a prolonged intervention with a strong theoretical foundation. **Objective #2:** Expand our curriculum to provide participants with increased opportunities to positively affect their interests, self-efficacy, self-regulatory, self-concept and computational thinking skills; **outcome:** More girls from participating high needs area possess non-cognitive and computational thinking skills poising them to pursue future STEM coursework and careers; **Objective #3:** Integrate more experiences within our curriculum that demonstrate cultural relevance of learning from varied social actors; **outcome**: More girls from high need areas will have access to a strong support system that will influence self-perception in short and long-term outcomes.

B.2. Management Plan, Timeline, and Milestones: Roles and Responsibilities: The COMPUGIRLS Remixed Management Team will implement various systems and process to ensure continuous and incremental improvement in the operations of this collaborative work. Feedback and expert advice will be collected annually from **Advisory Board** (see Appendix J. 6 for Board members) and other collaborators (see Appendix J. 7 and will be used to inform decision making throughout the project. **COMPUGIRLS Remixed Management Team (CRMT),** along with leads from Summer Residency Experience and Curriculum Development teams, will meet weekly to discuss needs related to recruitment, onboarding of partner sites, hiring of mentor teachers for pilot and teachers for full implementation, budgetary updates, industry relations, and to monitor implementation plan. The CRMT will also maintain open and frequent lines of communication with all partner schools, in particular, to ensure appropriate supports are in place and ADA facilitators leading parent courses. work to deliver program content and to proactively address needs.

Table 3a: COMPUGIRLS Remixed Management Team		
Name	**Title**	**Expertise & Responsibilities**
Center for Gender Equity in Science and Technology Staff		
Dr. Kimberly Scott	**Director/PI**	Expertise: Ten years serving as principal investigator of federal funded COMPUGIRLS' grants; researcher in digital equity, girls of color, and education; COMPUGIRLS founder. Responsibilities: Leads project management team; mentors postdoctoral scholar in analyzing feedback from mentor teachers and participants; ensures adherence to project timeline, budget, and objectives; dissemination of results
Jennifer Velez	**COMPUGIRLS Program Coordinator**	Expertise: Along with her four years of experience managing outreach programs, she is enrolled in preparation coursework to become a Certified Associate of Project Management. Responsibilities: General oversight and project management; manages execution of MOUs, liaison to school administrators, assists with teacher and participant recruitment; responsible for communication to project teams, partners, and school administrators; manages program website; support schools and mentor teachers in implementing COMPUGIRLS Remixed program; oversee implementation of COMPUGIRLS control model, including teacher training.
Dr. Gabriel Escontrias	**Center Manager**	Expertise: Over 15 years of professional experience in higher and postsecondary education, focusing on educational access and equity for rural and urban communities. Responsibilities: Oversees all budgetary and human resources components of project including budget management, hiring, stipends, and all other financial paperwork and reporting.
Curriculum Development Team		
Sharon Torres	**Summer Residential Experience Coordinator**	Expertise: Nine years of program coordination in higher education with focus on student engagement. Responsibilities: Serves as coordinator for the COMPUGIRLS Summer Residential Experience; development and implementation of summer experience; works closely with management intern to schedule industry experiences; hires summer experience staff;

		arranges participant transportation; responsible for communicating details of summer experience to parents; secures industry partners to support activities
To be hired	**Postdoctoral Scholar**	Expertise: Experience working in an interdisciplinary social science environment; demonstrated familiarity with current work in critical feminist studies, critical digital media, and/or critical pedagogy. Responsibilities: Oversees curriculum development and teacher training team; gathers feedback from focus groups, surveys, and interviews to guide decision making throughout project; develops activities and lesson to expand curriculum for in-school model; supports and collaborates with Summer Residential and ADA teams to create cohesive and consistent programming; formulates and oversees implementation of professional development plan; dissemination of results
To be hired	**Assistant Research Professional**	Expertise: Experience designing and facilitating teacher professional development and curriculum design. Responsibilities: In collaboration with postdoctoral scholar, develops expansion curriculum and teacher professional development; co-leads teacher training sessions with curriculum team; assists with recruitment and selection of mentor teachers; serves as liaison to mentor teachers; responsible for timely and meaningful communication to mentor teachers; facilitates professional learning community meetings; manages online training site; disseminates results
***Additional project staff include a graduate research assistant (TBD) and management intern(TBD).		
American Institutes for Research Staff		
[redacted]	**External Evaluators American Institutes for Research**	[redacted]

Table 3b: Key Partners
Key partners enable the various aspects of COMPUGIRLS Remixed from development to implementation by serving as host institutions, study participants, monetary and in-kind contributors, and more. In the process, key partners become part of the ecosystem that is able to nurture participant girls' self-concept and consequently, their entry and persistence in STEM.
Schools: Three (3) urban and eight (8) rural high schools in Arizona with high percentages of African American, Latino, and Native American students will serve as the consortium of schools that will implement the *COMPUGIRLS Remixed* curriculum during pilot and full implementation and impact study. Pilot Study Schools: Phoenix Collegiate Academy; South Pointe High School; Ajo High School; Bisbee High School

Full Implementation & Impact Study Schools: Phoenix Collegiate Academy; South Pointe High School; Ajo High School; McClintock High School; Globe High School; Bisbee High School; Morenci High School; Miami High School; Chinle High School; Valley High School; Nogales High School
Industry: Industry partners from various fields will engage in the experiential learning component of COMPUGIRLS Remixed's Summer Residential Experience which at minimum includes providing mentorship, hosting field trips, delivering presentations, and advising the teams of girls on their research-based culminating project. Some industry partners have also committed to monetary and in-kind support. COMPUGIRLS Remixed partner committed to the length of the three year implementation plus pilot, providing consistency in delivery as well as variety in industry experience. Partners include: ·1,000 Girls, 1,000 Futures will provide access to one-on-one mentorship from women currently working in a STEM field. ·2 Sigma Lab at Ira A. Fulton Schools of Engineering at ASU will provide access to knowledge and resources within an environment that fosters diversity in computer science research and practice.·AZ SciTech Festival will support an intensive research project during the summer residency program ·Base11 will provide access to the fabrication laboratory at South Mountain Community College. ·Change the Equation has committed to leveraging their vast network to supplement our list of industry networks. ·Intel will host thought leadership institutes on their Chandler, AZ campus. ·Nexus Lab will support the revision of the teacher-mentor training curriculum. ·State Farm will provide female and male employees to support project based activities during the summer residency experience..
Family: Through the nationally recognized American Dream Academy, parents/guardians of participant girls will receive attend workshops that will develop their ability to support their daughters' educational trajectory in STEM and overall academic success. Guided by a curriculum writer, the American Dream Academy will adapt the traditional parent curriculum with emphasis on identifying, pursuing, and persisting in STEM opportunities as a family process. Parts of the curriculum will also align with the summer residency program in the form of parent orientation, family-friendly activities like field trips and general assembly programs, and parent workshops.

This project will employ three phases. As presented in Table 4, over the course of four years, we will focus on the three communities discussed above.

Table 4: Timeline and Milestones

Milestone	**Deadline**	**Lead**	**Logic Model**
Ongoing			
Ongoing feedback loop to inform decision making and continuous improvement of curriculum, teacher training, SRE, ADA, project operations	ongoing	CPC	School
Site visits, including recruitment events, info sessions, and celebrations	ongoing	CPC	School
Data collection (teacher surveys, student surveys, parent surveys, computational thinking assessment, fidelity of implementation measures) and data analysis	Ongoing	AIR	All
Establish MOUs	annually	CPC	School
Teachers engage in regular professional learning community meetings	Weekly during school year	ARP	School
Phase 1: Planning and Curriculum Re-Design January - July 2017			
Organize FG1 meetings:2 virtual and 1at Intel Thought Leadership Convening to collect feedback on existing CG curriculum and training	1/2017	PS	School
Use feedback from FG1 to develop expanded CG curriculum and teacher training	3/2017	ARP	School
Identify teachers for *COMPUGIRLS Remixed* Pilot	4/2017	Partner LEAs;	School

		CPC	
Create professional development materials for in-person training	4/2017	PS	School
Work with Nexus Lab to update Blackboard training course for teachers	4/2017	ARP	School
Develop fidelity of implementation rubric to guide measure development	5/2017	AIR	All
Meeting with FG1 and AB to review CG Remixed curriculum and training materials	5/2017	PS	School
Use feedback from FG1 and AB to refine curriculum and training	6/ 2017	ARP	School
Pilot teachers complete revised online and in-person training	7/2017	ARP	School
Revision of ADA curriculum complete	7/2017	ADAD	Parent
Hire and train Pilot ADA facilitators	7/2017	ADAD	Parent
Review, revise, and develop survey measures as needed	7/2017	AIR	All
Phase 2: Pilot Test August 2017-August 2018			
Recruit girls for pilot study, obtain parental consent, and conduct random assignment	5/2017	AIR	School
Launch COMPUGIRLS Remixed pilot at partner sites	8/2017	CPC	School
Launch ADA - host parent information meeting, activate call center	9/ 2017	ADAF	Parent
Host 2 virtual meetings and 1 in-person meeting with FG2 and industry partners to collect input about development of SRE	1/2018	SREC	Industry
Use input from FG 2 to develop SRE Curriculum	2/2018	SREC	Industry
SRE parent orientation as part of ADA	4/ 2018	SREC	Industry
Identify mentor teachers for COMPUGIRLS Remixed Full Implementation - treatment and control	4/2018	Partner LEAs; CPC	School
Hire and train SRE pilot staff	5/2018	SREC	Industry
Pilot ADA parents graduate	5/2018	ADAF	Parent
Identify participants for full implementation; assign to treatment or control	6/ 2018	AIR	School
Remixed teachers, school admin, and AB provide feedback on elective course, teacher training, and ADA portions of pilot	6/2018	PS	School, parent
Use feedback to refine Remixed pilot curriculum, teacher training and ADA	6/2018	ARP	School, parent
Launch SRE pilot	6/2018	SREC	Industry
Treatment and control group teachers complete online and in-person training	7/2018	CPC	School
Hire and train ADA facilitators for Full Implementation	7/2018	ADAD	Parent
Phase 3: Full Implementation & Independent Evaluation August 2018-December 2020			
Recruit Cohort 1 & 2 girls for implementation, obtain parental consent, and conduct random assignment	5/2018, 2019	AIR	School
SRE Debriefing	8/2018, 2019	SREC	Industry
Launch Full Implementation for Cohort 1 & 2	8/2018, 2019	CPC	School
Launch ADA - host parent information meeting, activate call center for Cohort 1 & 2	9/2018, 2019	ADAF	Parent
SRE parent orientation as part of ADA for Cohort 1 & 2	4/2019, 2020	SREC	Industry
Hire and train SRE staff for Cohort 1 & 2	5/ 2019, 2020	SREC	Industry

ADA Graduation for Cohort 1 & 2	5/2019, 2020	ADAF	Parent
Launch SRE full implementation	6/2019, 2020	SREC	Industry
Remixed teachers, school admin, and AB provide feedback on Remixed	6/2019, 2020	PS	School, parent
Meet with Advisory Board to discuss plans for dissemination and replication	11/2020	PI	School, parent, industry

B.3. Feedback and Continuous Improvement: Too often, efforts targeting high-needs communities do not include participation of individuals who will be impacted most (Irvine, 2003). Our strategies oppose this trope by creating interdependent teams, focus groups, and lines of communication that provide feedback for continuous improvement. Drawing on Penuel's (2011) Design-Based Implementation Research Experiment the Curriculum Development Team, past COMPUGIRL mentor teachers, industry partners, advisory board, principals from partner sites, and ADA curriculum writer will meet virtually and then in-person at Intel's Chandler campus to (1) analyze practical problems of the girl and teacher training curricula as well as parent curriculum; (2) develop solutions to problems using COMPUGIRLS Remixed principle elements; (3) iteratively cycle test, and refine suggested solutions; and (4) reflect to produce enhanced curricula for in-school curriculum, teacher training, and summer residency experience. Appendix J.8 details this process and responsible groups that will be used throughout the three phases. In collaboration with American Institutes for Research (AIR), our external evaluator, we will engage in ongoing assessment of our project through continuous feedback. AIR will share results from the pilot study--including measures of implementation fidelity and survey responses from all participants--and will share results with us during team meetings. COMPUGIRLS has developed partnerships with various local and national organizations throughout the years who will support COMPUGIRLS Remixed through in-kind and financial contributions and other support. Table 3b presents all commitments that will poise this project for success (also see Appendix J.7). After the pilot study, we will have 12 industry partners so that each industry will work with one Summer Residency group of girls during the Full Implementation Phase.

B.4. Mechanisms to broadly disseminate information: The Center for Gender Equity in Science and Technology advocacy and research arms will work collaboratively with AIR to share results in academic articles, poster sessions, digital stories, and at conferences. The Advisory Board will also meet in Fall of 2020 to review and inform the dissemination plan. In addition, three times a year (Fall, Spring, Summer), participating girls will organize a closing ceremony that will be open to the communities and actors integral to this project (school industry, and family) and present their final projects. We will also leverage the local and national attention COMPUGIRLS has received from being featured on national and local media outlets. In terms of replication, the project team will (1) nurture a robust online learning community of educators to where teachers can contribute resources, engage in peer mentoring, and share stories and (2) develop a COMPUGIRLS Roadmap that outlines best practices for implementing our model based on key learnings from feedback and evaluation results.

C. Quality of Project Evaluation

American Institutes for Research (AIR) will conduct an independent evaluation of the COMPUGIRLS Remixed program. Evaluation activities will include an impact study to assess the program's effectiveness at increasing student outcomes in the logic model as well as an evaluation to study the program's fidelity of implementation in participating schools and its association with student outcomes.

C.1. Pilot Study. A pilot study of all components of the COMPUGIRLS Remix program will take place during the 2017-18 school year (Years 1 and 2 of the project) with 100 students across four schools. AIR will pilot all data collection protocols that will be used as part of the impact study and implementation fidelity study (described below). AIR will share data collected using the implementation fidelity instruments with CGEST staff in order to help them identify aspects of the program that are not being implemented with fidelity so that they can work with participating teachers to determine appropriate modifications as needed. AIR will also conduct analyses of all impact study measures in order to determine that data collection can occur efficiently during the impact study and verify that the psychometric properties of all measures are within appropriate ranges.

C.2. Impact Study. To investigate whether COMPUGIRLS Remixed results in the intended short-term outcomes for students identified in the logic model, the **key impact study question** is: <u>What is the impact of COMPUGIRLS Remixed on girls' noncognitive outcomes, plans for pursuing STEM coursework, and computational thinking skills?</u>

The impact study will use a student-level block randomized design and will meet What Works Clearinghouse (WWC) Evidence Standards without reservations. Participating schools are located throughout the state and serve students representing diverse backgrounds. In the spring of 2018 (Cohort 1) and 2019 (Cohort 2), 640 female students in eighth-grade who will be entering participating high schools (320 for Cohort 1 and 320 for Cohort 2) and who express an interest in participating in a COMPUGIRLS program will be recruited to participate in the study. Should more students indicate interest than can be accommodated by the study, we will randomly select students for participation. After obtaining parental consent, students will be randomly assigned within blocks (the high school they will be entering) to either the treatment group or the control group. By randomly assigning students within each school, the treatment and control groups are expected to be equivalent in all ways, observable or not, and to differ only in terms of their exposure to the COMPUGIRLS Remixed program. Based on conversations with participating schools, we anticipate an average of 29 students per school per year will be interested in participating in the study (see Table 1. Partner Schools). After randomization, we will use administrative data obtained from schools to assess baseline equivalence of students in the treatment and control groups on prior academic achievement and demographic characteristics. Students in the treatment group will take the year-long, in-school course taught by a teacher in the school who participates in COMPUGIRLS Remixed professional development and attend the summer residency program; their parents will be invited to participate in the parent program. Students in the control group will participate in an out-of-school computing program taught by a community member hired by the project team. Although the impact study focuses on student outcomes, we will conduct additional analyses to explore changes in teacher and parent outcomes, specifically: Do teachers report an increase in their use of resources for and understanding of CRC and their perceptions of the support they have to implement the COMPUGIRLS Remix curriculum? Do treatment group parents report increased expectations for their daughters' success in STEM, use of practices to develop academic success behaviors, and knowledge of resources to support their daughters' college attendance?

C.2.1. Data Collection and Measures for Impact Study. The following data collection procedures will be carried out separately for Cohort 1 and Cohort 2.

Student Measures. To obtain data on student background characteristics, including prior achievement test scores and demographic characteristics, AIR will establish data-sharing agreements with all participating schools. Measures of student noncognitive outcomes and computational thinking will be collected at the end of the summer residency program for girls in the treatment group and at the end of the school year for girls in the control group. The study will examine impacts on four noncognitive outcomes: (1) The **Self-Regulation Questionnaire** (Brown, Miller, & Lawendowski, 1999; α = .91) measures students' ability to develop, implement, and flexibly maintain planned behavior in the face of changing circumstances in order to achieve one's goals; (2) The **Self-Concept of STEM Ability** scale will be adapted from a scale that asks students to evaluate their ability (Zarrett & Malanchuk, 2005, α = .87); (3) Students' **perceptions of the value of STEM** will be measured by adapting survey items that have been widely used to measure students' perceptions of various academic activities (Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2001; α = .73); and (4) Because the project's timeframe will not allow us to follow students through high school and into college, we will assess their **future plans to pursue STEM coursework and career** by developing measures to assess their plans to pursue study in STEM fields in high school and college and major in a STEM field in college, and desire to work in a STEM field as an adult. The measure will build on those used previously to demonstrate the association between adolescents' college plans and later attendance (Eccles, Vida, & Barber, 2004). To assess participants' **computational thinking skills** at the end of the program, AIR will work with CGEST staff to identify components of the Principled Assessment of Computational Thinking (PACT) for use in the impact study. PACT was developed using Evidence Centered Design (Mislevy & Riconscente, 2006) and will be released for public use in fall 2016 (Bienkowski, Snow, Rutstein, & Grover, 2015).

Teacher Measures. Prior to participating in teacher professional development for the revised COMPUGIRLS Remix curriculum, participating teachers will complete a survey that includes questions about their background and experience, the frequency with which they employ pedagogical practices that are part of the CRC curriculum, their understanding of CRC practices, and their expectations for their students' achievement in STEM fields (to be adapted from

Jacobs, 1991). Teachers will complete a survey that includes the same questions at the end of the school year.

Parent Measures. At the beginning and end of the ADA parent program, parents will complete a survey that includes questions about their **expectations for their daughters' success in STEM** fields (Jacobs, 1991), their **practices to develop academic success behaviors** (Ing, 2014), and their **knowledge of resources to support their daughters' college attendance**.

C.2.2. Statistical Power and Data Analysis Plan

To estimate the impact of the intervention on student outcomes, we will use fixed-effects linear regression models, with block fixed effects, for each outcome. Based on the following assumptions, the study is powered to achieve a minimum detectable effect size (MDES) of .21: significance level alpha = 0.05 (two-tailed test); statistical power beta = 0.80; 58 students per school recruited to participate in the study (i.e., two cohorts of 29 students each, which is based on the partner schools' information provided previously); 50 percent of students in the treatment group (i.e., balanced design); and 25 percent of the outcome variance explained by student-level covariates and block fixed effects (R^2), which we have selected for these noncognitive outcomes as it is more conservative than what is typically used in power analyses for academic outcomes (Bloom, Richburg-Hayes, & Black, 2007).

For analyses of the student outcome measures, we will estimate the following fixed-effects linear regression model for student *i* in random assignment block *j*:

(1) $$Y_i = \beta_0 + \beta_1 T_i + \boldsymbol{X}_i' \boldsymbol{\beta}_x + \boldsymbol{B}_j' \boldsymbol{\gamma}_j + e_i,$$

Where Y_i is an outcome measure value for student *i*; T_i is a dichotomous indicator for treatment status for student *i* (coded 1 for students assigned to the treatment group and 0 for students assigned to the control group); X_i is a vector of pre-treatment covariates (grand-mean centered);

B_j is a vector of *J-1* dichotomous indicators for the *J-1* randomization blocks in the study; β_0 is the pooled within-block mean for control students, adjusted for student background characteristics; β_1 is the pooled within-block mean difference between treatment and control students, adjusted for student background characteristics; β_x is a vector of relationships between a given student background characteristic, *x*, and the outcome; γ_j is a vector of *J-1* block fixed effects, which capture differences across schools and cohorts; and e_i is the residual term for student *i*. *The parameter of primary interest in this model is* β_1*, which is the precision-weighted average treatment effect.*

C.3. Implementation Study. The implementation study will document the extent to which COMPUGIRLS Remixed is implemented with fidelity in participating schools and will include exploratory analyses to examine how implementation fidelity is associated with improved outcomes for students. The precise **key implementation study questions** will be guided by an implementation matrix that CGEST and AIR develop during the first year of the study and will address (1) the number of the professional development activities teachers attended, (2) the number of key CRC curriculum activities teachers used with students during the school year, (3) the number of sessions parents' attended, and (4) the number of the summer residence session activities in which girls participated.

The design for the implementation study will be based on the standards established by the National Evaluation of i3 (NEi3) and will utilize technical assistance tools designed for this purpose. In the first year of the grant, AIR will work closely with CGEST staff to develop quantitative measures of achieved relative treatment strength (Hulleman & Cordray, 2009) that can be collected from treatment and comparison groups, and included in exploratory analyses to examine whether and how implementation moderates the impact of the program. The steps we will follow to develop these measures are as follows: identify the key components of the program, operationalize each component into measureable indicators, identify a measurement plan for each component, calculate scoring ranges and cut-offs for levels of implementation, and determine score ranges and thresholds at the unit and sample levels (Abt Associates Inc., 2015). Measures will be designed to assess the extent to which students in the treatment and control groups are exposed to instructional practices and experiences characteristic of the CRC curriculum.

C.3 Resources for the Evaluation. The evaluation team will draw on AIR's experience serving as the external evaluator of 14 i3 grants (eight development grants and six validation grants). The evaluation will be led by [redacted], researcher at AIR, will oversee the fidelity of implementation study. Additional proposed project staffing includes data analysts with experience conducting multi-level analysis of impact study data and survey methodologists. As part of being an evaluator of i3 grants, AIR has worked with the National Evaluation of i3 (NEi3) Analysis and Reporting team to provide data both on impact and fidelity of implementation that is required by the i3 program. This ongoing experience across i3 grants (both development and validation grants) allows AIR to work effectively with the NEi3 to provide required information within specific reporting formats. As a well-established research and evaluation firm that has conducted hundreds of evaluations, AIR maintains the infrastructure and broad capabilities needed to conduct i3 evaluations. This infrastructure includes computing equipment to collect, process, and securely store data; qualitative and quantitative analytic software; and telecommunication equipment to communicate with collaborators and study participants.