



Balancing Acts

Managing the Tensions Inherent in Long-Term Youth-Led Projects

Suzanne Eyerman and Sarah Hug

The girls were really invested in the long-term projects; they liked working on it. It was hard that, for some of them, they didn't get finished. It was hard, but you work on growth mindset, and you work on helping them thinking about [the community impact project] as a prototype.

These words come from a staff member who works with a girls' engineering afterschool program run by Techbridge Girls, a U.S. nonprofit. This staff interview was part of a larger study of the organization's expansion to provide engineering education to more girls. Techbridge Girls seeks to inspire girls to discover their passion for science, technology, engineering, and mathematics (STEM), working to serve girls of color and girls in lower-income neighborhoods. Techbridge Girls has created and implemented STEM curricula in out-of-school settings for almost 20 years, funded by National Science Foundation (NSF) grants and corporate giving.

For many years, Techbridge Girls focused its weekly sessions on stand-alone lessons that asked participants to develop products that fulfilled specific criteria, such as “create the bounciest rubber ball,” “build the tallest paper tower,” or “design the largest bubbles.” These activities typically lasted one or two sessions.

Recently, the organization became eager to expose participants to more comprehensive, and therefore lengthier, design experiences while also wanting to

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keep the projects manageable for participants, program coordinators, and teachers. How could a larger design experience be implemented so that it would still fit into the two-hour weekly timeframe, the supply budget, and the program's staffing restrictions? That is, how would Techbridge Girls manage the tensions inherent in implementing long-term projects with adolescents?

This article explores how Techbridge Girls worked to stimulate long-term engagement and create opportunities for youth empowerment in semester-long community impact projects. It shows how staff and organization leaders used these long-term design projects to give participants opportunities for problem solving, critical thinking, and youth agency.

Project Work and Design Experiences

Long-term, open-ended projects are beneficial for youth (Grant, 2002; Hauer & Daniels, 2008), but engaging young people in such projects can be difficult. Long-term design experiences are engaging because they involve physical manipulation of materials and require cognitive work that can be explored iteratively, with time for regular reflection and redesign. Furthermore, long-term projects that require participants to work in groups or pairs can stimulate engagement by connecting participants with their peers (Dawes & Larson, 2011).

Opportunities for empowerment are tied into design experiences through the choices that occur along the way, which give participants the agency, or power, to make decisions. Choice can also be emphasized in a long-term design project as a way to make the curriculum more relevant when participants can see the connections between engineering and their real-world lives (Mosatche et al., 2013).

Research Context

Techbridge Girls, which has existed for almost 20 years, expanded geographically and tripled in size from 2014 to 2019 through a NSF development grant. For the expansion, the organization chose ethnically diverse cities and underresourced neighborhoods where residents are typically underserved in STEM programming.

The major goal of Techbridge Girls is to help

girls see STEM careers as a possibility. To accomplish this goal, the organization helps girls learn technical skills in STEM fields, gauge their interest in a variety of areas, and interact up close with professionals in STEM workplaces. Each middle school afterschool site is hosted by the participants' school and staffed by a Techbridge Girls program coordinator and a teacher from the school. Program coordinators usually have expertise in youth development, teaching, engineering, social work, social activism, or some combination of these areas. Techbridge Girls works to match staff members with teachers whose skills complement each other. For example, a staff member with social work expertise might be paired with a STEM teacher and a staff member with STEM knowledge with a literacy teacher.

Participants

Many of the middle school girls who were part of this analysis had become familiar with us as members of the research team during the six years of the larger study of which this analysis is a part. We worked with Techbridge Girls as social science researchers and as the education research team for the NSF expansion grant.

Familiarity with the participants, the staffs of the schools, the Techbridge Girls staff, and the regular routines of the afterschool program enabled us to understand and contextualize the girls' projects and explanations for this analysis.

Afterschool program staff were also part of this research study. One of us, Suzanne Eyerman, joined biweekly virtual staff meetings, which helped staff organize and synchronize their

work across sites and regions. Staff members served as invaluable insiders who provided member checks (Creswell, 2014)—that is, they verified whether they found our data analysis to be valid and accurate.

Methods

As participant-observers, we observed program sessions in which girls worked on their projects. We interviewed teachers and program leaders annually, with informal interviews occurring with each site visit. Each year we also interviewed curriculum developers and regional leaders and held focus groups with

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participants. Interview and focus group protocols emphasized the community impact projects that are the subject of this article. Though we collected data for all five years of the initiative from all sites, the analysis in this article relies on data from the 2016–2017 and 2017–2018 school years and on data from six sites.

Managing Tensions in Long-Term Projects

We chose the analytical tool of tensions, or contradictions (Engeström, 2001), to ground this case study of the implementation of community impact projects in the structured afterschool learning environments developed by Techbridge Girls. Contradictions “manifest themselves as problems, ruptures, breakdowns, clashes or as disturbances, which interrupt the flow of work” (Ekundayo et al., 2012, p. 2). Disruptive factors are considered valuable for empirical work, as they often are sites for change or renegotiation of practice (Engeström, 2001).

As we reviewed our data, we noticed substantial curricular negotiation at play in the sites we studied. In implementing the written curriculum, the adults involved had to see to what extent it would work in this time, in this place, with these girls. At first, the negotiation would take place in the mind of the person implementing the curriculum. But then negotiations had to happen between the Techbridge program coordinator and the teacher at a site, between the site-based program coordinators and their supervisor, and among the program coordinators. For the program expansion grant, the goal was to implement the same curriculum across sites. However, no one site implementation exactly replicated the written curriculum.

We began to focus on this and other areas of negotiation and tension, which were managed by the adults with formative feedback from the participants. As tensions emerged in the data, we interrogated the products of our analysis, such as memos and research briefs, to correlate data sources, data types, and data analysts (Patton, 1999). Our study of community impact projects found four tensions, together with the ways in which program stakeholders managed those tensions.

Tension Between Impact and Intent

Two middle school girls who are new to the program observe a pair of girls working with specialized equipment in a science lab. One girl, holding an umbrella out to her side, points to some modifications she and her partner made to create the prototype of a solution to a problem they identified—getting around safely in the dark, rainy late afternoons in the Pacific Northwest. “We walk home alone at night, and sometimes it is scary, especially in the winter. See, we added these LEDs here,” she points to the lights attached to the outside of the umbrella, “and we are going to add a switch. We just have to solder it.” While the visitors look on, the girl turns to her partner and grins, “I can’t wait to use this!”

As the teachers and program coordinators implemented the community impact project curriculum, they found that some of the curriculum functioned as intended, while other parts required reimagining. When Techbridge Girls set out to empower participants to create long-term engineering design projects that would impact their communities, staff members worked to work to align their conceptions of *community* and *impact* with the organization’s framework.

The curriculum described in this article is the second iteration. During the first year of community impact projects, each site partnered with an outside organization to serve as a

resource for the girls’ work. The concern was that the partner organizations identified the problems, so that the girls were guided toward solutions. The positive youth development perspective of Techbridge Girls required the community impact projects to be girl-directed. For the second iteration, then, the afterschool program sites did not partner with other organizations. Instead, they asked participants to define their target communities. Different sites, and even different groups of girls, operationalized *community* in different ways.

Defining *community* and *impact* in ways that are true to the intent of the program can be challenging. When adults define *community*, the outcome is often grand. When young people define it, the outcome may be smaller, but the definition is more likely to be

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meaningful to them (Calabrese Barton & Tan, 2009). What it means to have an impact on one's community depends in large part on how that community is defined. While adults may define *community* as something like "all the people who live in this ZIP code," young people may view *community* as "families who own ferrets," as was the case with the group who designed one community impact project. Giving participants ownership of their community impact projects decreased the scale of the projects because the girls tended to have small-scale definitions of *community*. Thus, Techbridge Girls chose to value girls' engagement and empowerment over impact on a larger segment of the outside community. Table 1 shows examples of problems girls identified to solve.

Valuing youth agency, however, does not mean that adult facilitators take a completely hands-off role. Program coordinators and teachers often intervened in ways that both respected participants' choices and helped them toward successful projects. For example, the participants who addressed recycling initially wanted to overhaul the recycling program for an entire section of the city. The adults encouraged them to create just two prototype recycling containers for blocks adjacent to their school. Later they could expand to provide more containers in their neighborhoods and eventually throughout the area. In another example, the water bottle group was originally two groups: One wanted to create a "smart" water bottle that provided hydration reminders; the other wanted to create a satchel, with a different digital component, that could also hold a water bottle. Their teacher helped the two groups to come together to work on one joint project.

Tension Between Authentic Experiences and Useful Tools

Program coordinators and teachers were eager to offer authentic experiences of the engineering design process to program participants. Even within the lengthier 12-week timeframe, however, the adults were challenged to situate girls as engineers who used real engineering tools and methods while simultaneously chunking the projects into weekly program sessions. To do so, they had to reconfigure some tools and methods, reimagining the ways engineers work to fit the program's allotted time, space, and resources.

An example is one program coordinator's decision to change a common engineering tool, the engineer's notebook. According to the curriculum, participants were supposed to write in notebooks at the end of each weekly program session to record and reflect on their progress. Reflection and planning are important parts of the design experience because they help students develop critical thinking necessary for problem solving (Bratman, 2000; Epstein, 2003; National Research Council, 2010). Facilitators thus wanted to include reflection as an integrated part of the design experience. However, they found that the girls wanted to continue working as long as possible rather than stopping near the end to take notes. One program coordinator addressed this challenge by reconfiguring the engineering notebooks into end-of-day sticky notes. A few minutes before the end of each session, each young engineer got two three-inch by three-inch blank sticky notes: one for what challenged her today and the other for her plan for next week. The girls could write only a sentence or

Table 1. Participant-Identified Problems and Design Solutions

| PROBLEM | SOLUTION |
|--|--|
| Responding appropriately to Islamophobia at school | App with information about Islam and being Muslim |
| Needing to recycle items while out on foot | Outdoor recycling container that automatically sorts materials such as paper from glass |
| Walking home on dark and rainy evenings | Umbrella with lights to increase the visibility of the carrier |
| Pets becoming bored alone at home | "Fabulous Home for Ferrets" enclosure with stimulating toys and activities |
| Staying hydrated and organized at school | Reusable water bottle with a digital clock and a cloth pocket for writing utensils and other small items |
| Children walking home without supervision | Bracelet with GPS to send children's location to their parents |

two on the small sheets, so their engineering work was less interrupted than it would have been by notebook entries. Furthermore, the program coordinator found that the girls did consult their notes the following week to help them return to their project work. The notes could be scanned into an electronic document or even glued into a physical notebook to create one repository for each girl's writings.

Tension Between Completed Projects and Meaningful Ideas

The Techbridge Girls staff member gathered the participants near the front of the room after their icebreaker activity. "Next Thursday is our Community Night. It is gonna be a fun thing. You will bring your family, there is going to be music, and we will have a raffle. When you think about presenting this prototype, you are going to need to communicate quickly to family and community members. Talk about your group's process. Why did you pick the community you chose? Why did you choose to address the problem you picked? Remember, each group will have a prototype and a poster describing it. Think about telling your audience, if you had more time, or if you had more money for materials, what would you have done?"

While girls were designing their projects, they were encouraged to keep in mind their constraints, including limited budgets and timeframes. Constraints are part of any real-world engineering project. However, adult facilitators also wanted the participants to create projects that fulfilled a need in their community. As the work progressed, the adults realized that the groups whose projects aimed to meet large community needs were unlikely to complete their projects by the end of the term.

This tension between authentic design experiences and finished projects required adults to adjust their expectations and then help participants do the same. They did so by reconfiguring what counted as "finished." A physical project, for example, might have some working components but not be fully functional. A website or app might have only a few complete pages. As the staff member quoted at the begin-

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ning of this article said, "You work on helping them thinking about it as a prototype."

For example, one group of girls, all of whom were Muslim, chose the goal of educating their community about Islam to combat Islamophobia; their project was an app. In describing the challenge, a participant said, "[Classmates] ask me about Ramadan and say, 'What, you don't eat for a whole month?' Of course not! I would die!" In the course of working on this project, group members discovered challenges in explaining Islam. Having been born in various countries including the U.S., they practiced their religion in different ways. As they talked and worked, they came to see that the cultural differences in the ways they practiced Islam had implications for the content they would put in their app.

The program coordinator and teacher had to decide whether to either curtail the deep discussions of Islam and Islamophobia so that the girls could finish their work on schedule or allow them to have full discussions, knowing that they would not complete the app. The adults decided to find a midway point, encouraging the group to create a prototype rather than aiming for a fully functional app. Guided by the program coordinator and teacher, the participants programmed about half of the app and created a storyboard that showed their full plan. Adopting this achievable goal enabled the girls to continue their meaningful conversations while enabling them to feel they had achieved a major goal and giving them a product to display at the site's culminating event.

Tension Between Attentiveness and Authentic Long-Term Work

Sometimes participants grew weary of working on their long-term projects. For example, a focus group respondent said:

Sometimes working on the same project [for] a really long time can get boring, and it can also get you off-task sometimes—sometimes, if you're working with your friends. Knowing my friends, I know I talk to them, but you also have to focus on your work to get it done. It's kind of a challenge.

Focusing for a long time on one goal can be hard. Afterschool programs have to consider

participants' need for novelty, as young people may lose interest and choose to spend their time elsewhere. Returning week after week to the same problem, with the same constraints and trade-offs, was difficult for some participants, particularly those with little previous experience with long-term projects.

One way Techbridge Girls helped participants sustain interest was to implement a final showcase event, which gave participants both a deadline and an opportunity to show their work to family and friends. Some sites had showcase events during the first year of the project. Based on this experience and on the need to sustain interest, program staff updated the curriculum for the second year so that every site would have a culminating event. In focus groups and observations, participants repeatedly talked about the importance of being able to show their projects to their families and friends, even if they had a prototype rather than a finished product. One reason was that they wanted a tangible thing for their hours of effort: An object gave significance and visibility to their work. Another reason was that having something to present enabled participants to explain their work to their families.

Managing Tensions: How and Why

Because of modifications the teachers and program coordinators made along the way, the implementation of the community impact project curriculum achieved its intended goals. The curriculum actively engaged participants in extended design experiences and created opportunities for empowerment, which can further stimulate long-term engagement. Program participants made decisions and created projects intended for their specific communities, however they defined those communities. Adults guided participants to scale their projects so that the girls could both accomplish something meaningful and gain experience with all aspects of the engineering design process.

The ways that program coordinators and teachers negotiated the four tensions revealed in our study have implications for design and implementation of long-term STEM projects in other afterschool programs.

Staff need flexibility to implement the program in line with program goals and values. In implementing

long-term project initiatives, different program values may come into conflict. For example, a commitment to foreground youth voice can conflict with a programmatic goal to instill engineering career skills. Staff need to be able to make pedagogical decisions that benefit their participants. Just as youth should have some autonomy, so on-the-ground educators need the flexibility to make difficult decisions when programs experience tension. Coaching staff and providing a clear understanding of program goals can empower facilitators to make autonomous decisions that support youth development.

Participants may need guidance to choose to emphasize process over product in long-term projects. By redefining the program goal to focus on prototyping and process over finished products, the staff resolved the tension between completed projects and in-depth discussion. Using prototypes, each small group could share its efforts with the larger community, and group members were accountable for discussing their projects in depth, whether or not they had a fully finished product. Scaffolding the culminating event to focus on problem identification, early stages of design, and reflection on process enabled everyone to participate. Learning about prototypes also provided relevant career knowledge, as prototyping is a common practice in engineering.

Staff need opportunities to communicate regularly with their peers and with curriculum developers. Biweekly meetings guided the work of managers and curriculum developers with program coordinators. Regular meetings with peers and leaders helped frontline staff choose how to modify their projects to best serve their participants, while maintaining the goals of the long-term project engagement. Dialogue with leaders, particularly with curriculum developers, can keep any implementation changes aligned with the goals and values of the program and can create feedback for further iterations of curriculum.

Staff and leaders need to keep a sense of community and active engagement central to the program. Because youth can vote with their feet, program staff must focus on keeping participants engaged, even when they encounter challenges. To

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make long-term projects possible, afterschool staff need to create and maintain bonds among participants through working and learning together. Other tactics are to implement long-term projects in the second half of the year, after norms and commitments have been established, and to anchor the year with a showcase of participants' projects.

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