Afterschool Matters

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(see article on page 1)

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WELCOME

As a new administration sets out its priorities for the next four years, it's time to take stock of the role of out-of-school time (OST) programming in the larger ecosystem of healthy child and youth development. What value does OST add in fulfilling our local, state, and national goals?

No matter what priorities might be imposed from outside the field, those of us who live and breathe OST know that our contribution goes far beyond better grades and test scores. In *Lives of Promise: What Becomes of High School Valedictorians* (Jossey-Bass, 1995), author Karen Arnold concludes that "academic achievement alone is insufficient to guarantee high career aspirations and a smooth transition between school and work."

OST programs have long addressed children and youth holistically, influencing as many facets of their development as we can reach—strengthening academic achievement, yes, but also fostering physical, emotional, and social growth. To set young participants up for lifelong success, we offer high-quality programs with plenty of variety in both substance and process. The markers of OST quality are well established:

- Opportunities for reflection, such as closing campfires or community check-ins
- Leadership development through, for example, peer presentations, book club buddies, or youth-in-philanthropy programs
- Learning enrichment through special-interest clubs, tutoring, and project-based learning
- Relationships with caring adults who ask questions, make life connections, serve as mentors, and welcome and affirm all participants

These experiences are critical to help young people thrive both now and throughout their lives.

As we set out in directions guided by the Every Student Succeeds Act of 2015 and our new administration and its Department of Education, let's remember the good work we have done and the vital contributions we have made to positive youth development.

More importantly, let's talk about that good work wherever and whenever we can. Of course the venues include professional circles—journals like this one, academic OST programs, conferences, professional learning communities like the Afterschool Matters Fellowship that produced two of the articles in this issue (those by Frosini and by Hodgkins).

But let's also talk about the value of OST programming in community meetings, in places of worship, around the dinner table, and on the playground with our kids' or grandkids' friends' caregivers. Let's remind ourselves and everyone we know that— well, that afterschool *matters*.

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What If?

Building Creative Cultures for STEM Making and Learning

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Active, learner-driven, collaborative activities—a hallmark of youth development—are key to the success of afterschool programming in supporting young people's learning and well-being. How can the field leverage this strength as it seeks to expand STEM programs for young people? (See box "Defining STEM" on the next page.)

This question is especially important for programs serving youth who attend underresourced schools, where opportunities to engage in STEM are less frequent and less likely to be hands-on or inquiry-based (National Research Council, 2012b). Afterschool programs can play a vital role in leveling the playing field by giving young people opportunities, like those common in high-performing schools, to learn STEM by doing STEM (Bevan & Michalchik, 2013). Through *doing* (rather than memorizing) STEM, students can come to understand it as a creative process of inquiry. They can develop positive STEM learning identities that can guide them in future academic and career choices.

Making (see box "Kinds of Making" on page 3) is an approach to STEM education that may be especially well suited to afterschool. Inherently playful, learner-driven, creative, and fun, Making leverages key dimensions of youth development. Research (Peppler, Halverson, & Kafai, 2016; Vossoughi & Bevan, 2014) has found that Making:

- Exercises students' creative and improvisational problem-solving abilities

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DEFINING STEM

STEM is an acronym whose life began as a set of five words with three commas: "science, technology, engineering, and mathematics." Coined by the National Science Foundation, the term is still often used it in this way.

Over the past decade or more, many have come to think of STEM not as four things but as one: an integrated approach to answering questions or developing ideas that incorporates science, technology, engineering, and mathematics. Some have integrated the arts to produce STEAM. Although school has traditionally separated the disciplines, in the real world, questions are inherently interdisciplinary. Research is often led by teams with different training—in computer sciences, physics, and mathematics, for example—who work together to address a common question.

Making is inherently interdisciplinary. To make something—whether it is a cake or a table-top robot—Makers must use design (engineering), measurement (mathematics), and proportion (mathematics and engineering). Often they are also guided by aesthetic considerations (arts and engineering). STEM-rich Making activities also can involve scientific phenomena, such as electricity or sound, or computer sciences, such as coding. For example, designing and sewing a purse is a Making activity. Designing and sewing a purse using conductive thread and Lilypad mini-processors, a task that can involve wiring, circuitry, and coding, is STEM-rich Making.

This article uses the term "STEM" because the Making activities in our study, which always involved engineering and usually involved science, frequently also involved mathematical practices and sometimes technologies.

- Builds students' agency, persistence, and self-efficacy
- Helps students to deepen and complexify ("level up") their STEM understanding through iterative processes of design, testing, redesign, and refinement

Making doesn't *look* like STEM; it therefore may appeal to young people who aren't automatically drawn to STEM activities. Making has been described as having low floors, high ceilings, and wide walls (Resnick & Silverman, 2005). Because there is no one "right way" to develop a Making activity, learners start with what they know and are interested in; then they advance their thinking by trying out and developing their ideas.

Making's iterative processes—design, build, test, redesign, retest—are fundamental to STEM practices (Quinn & Bell, 2013). Indeed, design failures can be powerful moments for learning, as they are for real scientists and engineers, if students are supported to notice what caused the failure, redesign based on evidence, and retest (Vossoughi, Escudé, Kong, & Hooper, 2013).

"Fail fast, fail often" is the motto of Silicon Valley, the birthplace of the Maker Movement. Making is commonly heralded as an opportunity to "celebrate failure." However, many have noted that assumptions of privilege underlie this celebration of failure (Buechley, 2013; Martinez & Stager, 2013; Vossoughi, Hooper, & Escudé, 2016). It's easy to fail when one can afford to fail. Youth from economically and racially marginalized communities attend schools in which missteps of any kind are likely not to be tolerated. They may not be in a position to celebrate and learn from failure as readily as youth from communities of privilege (Ryoo, Bulalacao, Kekelis, McLeod, & Henriquez, 2015). Educators need to address and model the ways in which failure is a part of the creative process. Young people must experience moments in which things fail as moments in which to learn how things work, not as moments in which they themselves have failed. Explicit attention to this process can build young people's confidence and identity as STEM learners.

This article shares the results of a research-practice partnership involving four afterschool programs serving youth from marginalized communities. Over three years, the project identified key characteristics of inclusive and equity-oriented Maker activities and facilitation. It also defined the kinds of professional development afterschool educators need to support the creative intellectual risk taking that makes Making a powerful context for STEM learning. The results of the study can support the expansion of inclusive Making programs that are equitable for all youth.

Making and STEM Practices

Research shows that to learn STEM, young people must "do STEM," that is, engage in STEM practices. In 2012, the National Research Council (NRC, 2012b) issued a report that detailed eight practices of scientific and engineering inquiry. It found that engaging in these practices provides the best context for learning STEM concepts and skills. Researchers have parsed these practices into three clusters of activity (McNeill, Katsh-Singer, & Pelletier, 2015):

- **Investigating practices**: asking questions; planning and carrying out investigations; using mathematical and computational thinking

KINDS OF MAKING

Three broad types of Making programs are distinguished by their purpose. Some programs focus on entrepreneurship, others on workforce development, and yet others on broadly educative goals (Vossoughi & Bevan, 2014).

Within educative Making, there are again three types:

In *assembly*-style Making, learners follow step-by-step instructions to produce identical or nearly identical objects.

In *creative construction,* learners are given a challenge to address or a model to replicate, but they make choices about the look, scale, and sometimes behavior of the object. The result is many different versions of the same type of object.

In *open-ended inquiry,* learners develop their own ideas and figure out how to make the objects they have envisioned. The result is a wide range of objects, designed to address unique purposes and goals.

This last form of educative making is sometimes called "Tinkering" because of its emphasis on creative, improvisational problem solving. Students may, for instance, develop projects such as a ping-pong table whose net lights up in reaction to a ball coated in conductive paint, a self-zipping jacket that opens and closes based on external temperatures, or shoes for visually impaired wearers that alert them when an object is within 10 feet of their toes. This kind of Making provides a profound example of interest-driven, student-centered learning.

But all kinds of educative Making can give students a concrete purpose for engaging with STEM. Students learn about electricity and batteries not to pass a test but to successfully build a Bluetooth-enabled radio housed in an antique radio shell. Young Makers can not only develop a wide range of STEM skills, such as measurement, scaling, design, and data analysis, but also grapple with STEM concepts such as forces, balance, circuits, and cause and effect—all while engaging deeply in practices of scientific and engineering inquiry.

- **Sensemaking practices**: developing and using models; analyzing and interpreting data; constructing explanations
- **Critiquing practices**: engaging in argument from evidence; obtaining, evaluating, and communicating information

This vision of STEM learning emphasizes the firsthand *phenomena* of science, instead of text-based or abstract *representations* of science. For an example, see the box "STEM Practices in a Making Activity" on the next page. Learning STEM and coming to want to learn STEM, according to current research, requires engaging with real stuff in the real world. Such engagement can motivate interest and a need to know about more abstract concepts.

The NRC vision of STEM learning also emphasizes the role of evidence and the critique of evidence in scientific meaning making (2012b). Unless students have experiences collecting data, testing hypotheses, and considering competing evidence-based explanations, they may miss the most critical dimension of real-world science and engineering: its evidence-based nature.

However, the report finds that few students gain such experience in the classroom, and even fewer in schools that are underresourced (NRC, 2012b). Afterschool can thus play an important role in leveling the playing field by giving students opportunities to engage in STEM practices.

Making provides direct, immediate, and concrete evidence of students' understanding. If students' understanding about how to wire a battery and motor is incorrect, their NatureBots will not locomote. In response, they need to closely examine their design choices, recognize where their understanding or technical skills went awry, and adjust accordingly. In addition, Making can be implemented in ways that require students to systematically collect and record data. Makers can be asked to explain their thinking in journals or during share-outs in circle time.

Investigating STEM-Rich Making in a Research-Practice Partnership

This article outlines key findings of a study of STEM-rich afterschool Making programs offered by the four organizations participating in a project called the California Tinkering Afterschool Network. Two of the organizations, the Fresno Community Science Workshop and the Watsonville Environmental Science Workshop, organized their entire programs around Making. These programs took place in designated workshops replete with a wide variety of materials, tools, and models of past Maker projects. These sites operated as community drop-in centers, welcoming family members of all ages. In both places, many of the paid staff had themselves been drop-in participants when they were

STEM PRACTICES IN A MAKING ACTIVITY: PAPER CIRCUITS

Paper Circuits is a Making activity that extends students' understanding of how to construct an electrical circuit. Students use a variety of paper, paints, and other art supplies to create a greeting card. With copper tape and a battery, they integrate LED lights, so that when the card is opened, a circuit is closed and the LEDs light up.

This activity uses all three kinds of STEM practices identified by McNeill and colleagues (2015).

Investigative practices. Students first develop an idea about the kind of card they would like to create. Then they plan and sketch out their designs, building on the conceptual models they have developed about how circuits work. The open-and-close mechanism of the paper card requires them to extend their circuitry models to function across different planes. They need to figure out how opening a card can complete a circuit without letting copper tapes touch so they short the circuit.

Sensemaking practices. Students' initial designs frequently do not work. They need to rethink their models of circuits and troubleshoot to solve the problem. The card itself provides immediate feedback, or evidence, about the accuracy of their conceptual models and design solutions. If it lights up intermittently, weakly, or not at all, students have to determine if they need to add a second battery, devise a new switch, or rethink their design. The aesthetic and personal components of their creative vision serve as constraints to the design and engineering processes.

Critiquing practices. In Making, the object itself—whether and how it works—provides a powerful critique of the students' thinking and conceptual models. Additionally, students can share their processes of designing and building, even in cases where they cannot get the circuit to work. They can articulate why or how it works—or doesn't—and share with one another their solutions and questions.

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younger. Both programs served primarily low-income, bilingual Latino families.

A third program, Techbridge in Oakland, was a weekly afterschool program for girls, hosted at schools and taught by a team consisting of a classroom teacher and a Techbridge coordinator. The program supported girls' engagement in science, technology, and engineering activities and in career exploration with professional role models. Maker activities were integrated into Techbridge's robust hands-on engineering program.

The fourth organization, the Discovery Cube in Santa Ana, provided professional development to Southern California educators who wanted to integrate Making into afterschool programs housed mostly in schools serving low-income communities. The workshops were offered in collaboration with the San Bernadino Community College District.

These four organizations, along with the Exploratorium, partnering with the San Francisco Boys & Girls Clubs, worked together for three years to design and implement new Making programs and to study how to introduce Making into programs serving low-income students.

Study findings are organized into three main areas:
- How Making advanced the organizations' goals
- Key features of the Making programs
- Staff development to support productive Making programs

Advancing Afterschool Organizational Goals Through Making

Afterschool programs often see both social-emotional and academic learning as crucial to students' development and well-being. They seek to create supportive social communities in which participants can exercise choice and peer leadership. Our research has found that Making programs both contribute to and leverage such supportive communities to provide a powerful context for social-emotional and academic learning.

Encouraging Risk Taking

Making can help students to take and persist in intellectual and creative risks by allowing them to develop their ideas with the support of program staff. This process can be both challenging and rewarding.

For example, a group of Techbridge girls wanted to design and build a "progressive" alarm clock that would become increasingly loud and annoying each time the snooze button was pushed. Their design incorporated a small, low-cost microprocessor called an Arduino that they could program to raise the alarm clock's volume. The wiring and soldering in this project were complicated, and the young women had to try several different soldering techniques. In the end, they could not get the clock to work in time for the Maker Faire at which they had planned to demonstrate it. However, they remained committed to their

vision and were proud of their process. At the Faire, they showcased the different soldering versions and recounted to passersby what they were trying to do, what happened, and what they planned for next steps.

Engaging Students in STEM Practices

Making engages students in authentic STEM practices, such as designing, building, testing, and refining objects based on feedback. For example, at the Fresno Community Science Workshop, students made an annual summer field trip to a nearby lake. A group of girls wanted to build a boat for the field trip. They worked together to design a six-foot catamaran that could keep two people afloat. They constructed it using PVC pipes and copious amounts of duct tape, testing different ways to wrap the duct tape (in tiles, in layers, or in a weave) to see which was the strongest and most waterproof. They also had to test how to brace the catamaran. In the end, they brought the boat to the lake and took turns taking their peers for a ride.

Developing 21st Century Skills

Making supports the development of 21st century skills, such as problem solving and critical thinking, that have been shown to advance deep learning (National Research Council, 2012a). For example, a Techbridge student wanted to hack a pair of earbuds to use the Bluetooth function to power a speaker sewn into her backpack. Engineering, testing, and trouble-shooting the system took weeks. The young woman engaged in ongoing problem solving by experimenting with the earbuds, taking them apart, and learning how the Bluetooth controls functioned. Using the earbuds' Bluetooth buttons to call her friend through her cell phone, she observed whether sound was passing through the speaker. This experiment enabled her to figure out the inner workings of the system so she could use it in her backpack project.

> Creating a "what-if" culture communicates that there are questions worth asking, concepts worth discovering— and that the process of coming to understand is a valued activity.

Expanding Young People's Vision for the Future

The programs we studied regularly framed Making as a way to improve the world through science and engineering. Making can thus expand participants' understanding of possible futures by showing how they can use STEM to contribute to their communities. For example, Techbridge staff challenged participants to develop projects for a social purpose that they could showcase at Maker Faire. The results included shoes for the visually impaired that would vibrate when approaching objects, as well as backpacks and alarm clocks that could assist teenagers with their everyday needs. Mentors working in STEM fields visited the program to help with these Maker Faire projects, offering perspectives on how STEM is used and valued in academic and work contexts.

Characteristics of Productive Making Programs

Developing a culture of exploration and creative risk taking is a critical feature of productive afterschool Making programs. Programs that are organized around asking "what if?" set the stage for creative inquiry; they can also help students persist in troubleshooting as they run into challenges. Creating a "what-if" culture communicates that there are questions worth asking, concepts worth discovering— and that the process of coming to understand is a valued activity. It also suggests that there is not a known endpoint, and that participants will learn how to do things as they engage in the process of doing them. The features of productive and equitable Making programs are outlined below.

Environments Organized to Foster Collaborative Learning

Productive Making programs make ideas, questions, and strategies visible. The tools are accessible and the horizons open, allowing everyone to see everyone else's work. Adults model processes of questioning, testing, and making. Regular reflective conversations support a community ethos of investigation. Both the physical and the social environment support collaboration.

In Watsonville Environmental Science Workshop, the organization of physical space—such as gluing stations, machine tools, and flat surfaces for building—encouraged students to engage with one another while integrating common tools and techniques into their distinct projects. For example, when an Exploratorium researcher who was building a car went to use the gluing station, she started a conversation with a girl who was using the gluing station to build a doll house. This conversation led the two to collaborate on a car for a doll.

In all of the sites we studied, facilitators roamed throughout the physical space, engaging in conversation and providing technical assistance. Like the researcher who was constructing a car, they modeled productive Making by building alongside the students. In interviews, facilitators

stressed key pedagogical moves—such as asking questions and being careful not to take over projects—that could support learners. They emphasized the importance of maintaining a focus on process over perfect final products.

Process-Oriented Facilitation
Process-oriented teaching encourages careful listening and questioning; it helps learners engage in evidence-based reflection through iterative design-redesign activities. For example, at an afterschool program in Southern California, students were struggling with wiring batteries. The facilitator, building on models from Discovery Cube professional development, wrote on the board, "Failure is not the end of the process; it's just a *step* in the process." She encouraged students to share their varied approaches to wiring batteries, stressing that there was no single way to succeed.

Such process-oriented facilitation was evident across all four sites. The emphasis on process was reinforced by the fact that projects sometimes took several days or weeks to complete. Process-oriented teaching and learning means that youth work on their own ideas at their own pace, a characteristic that may be more common in afterschool than in school settings.

Multiple Entry Points and Pathways
Maker activities that are designed with multiple entry points and pathways allow students to choose their own directions based on their prior experiences and interests. For example, at the Watsonville Environmental Science Workshop, students developed individualized Rube Goldberg chain reaction machines, which they would later take to school as class projects. Each machine performed several different actions in order to move a rubber ball from the start of the machine to the end. One student started her machine by building a pinball plunger; another designed a pulley that would bring the ball to the top of a track; yet a third started his machine with a ramp.

At Techbridge, girls visited local thrift stores to choose inexpensive items that they could "hack" and repurpose. They created a Harry Potter book that screamed when turned to a page where evil character Voldemort appears, music boxes, lamps made of photographic slides, and a piggy bank whose bellybutton lit up when a coin was added. In all cases, they started with a creative idea. Then they took their thrift-store items apart; combined multiple items; and coded and integrated small microprocessors wired to lights, speakers, or sensors. Comparing these results to those of the previous year, program leaders said that students were far less likely to be frustrated when things didn't work and were more

positive about the experience generally when they were allowed to select their own projects.

Connections Across Settings
The afterschool Making programs we studied linked Making activities to engineering practices and professionals and provided tools with which young people could create school projects. These practices helped the youth connect their experiences across school, home, and afterschool contexts. For example, students at the Watsonville Environmental Science Workshop regularly used the workshop to repair their bikes. Often they worked side by side with adult family members who were using workshop tools for authentic family projects, such as building a dog house or a wooden tortilla press. Students also used the workshop to complete classroom projects, such as a middle school assignment to build a trebuchet or a Rube Goldberg machine. The workshop provided tools, social networks, and space that could help young people use their design and building skills to complete their school assignments.

Staff Development to Support Productive STEM-Rich Making
All four participating organizations prioritized the professional learning of program facilitators. In particular, organizational leaders were attuned to building facilitators' capacity to provide equity-oriented Making activities. The group defined "equity-oriented" Making activities as ones in which all young people were invited and supported to participate fully. Often this meant helping students to recognize their own prior experiences and skills, positioning them as capable and knowledgeable in Making, and supporting them to persist through difficulties. Among the programs we studied, staff development to support this kind of facilitation was characterized by specific kinds of activities.

Learning to Create a Culture of Risk Taking
In equity-oriented staff development, participants experience ways to create a culture of inquiry and creative risk taking through a set of routines designed to develop trust and collaboration among students.

For example, educators from both Fresno Community Science Workshop and Watsonville Environmental Science Workshop took part in a workshop that included role-playing activities where they could experience firsthand what it would mean to be a new student unfamiliar with Making or, in one group, a facilitator unfamiliar with the kinds of support students need to get started. Using *teatro* techniques developed by Boal (2006), small groups devel-

oped short skits in which they explored the problem and improvised solutions. After their initial skits surfaced the problems and conflicts, the whole group discussed how the actions of skit participants could have better supported the new learner. They then revised and replayed their skits, demonstrating key moves that could better support a productive culture of inquiry and risk taking. Workshop participants also articulated what they valued in their work and what they valued for students, thereby building a deeper understanding of why it was important to them to support learning through Making.

Experiencing Firsthand the Iterative Nature of Making

Staff of all programs attended workshops where they engaged in the very Making activities that their students would later do. In such workshops, participants reflected on how leaders had supported them to persist in the design-redesign process in a way that deepened their learning. For example, workshop leaders asked "what if?" rather than telling participants what to do. They provided tools or materials when participants needed them and not before. Throughout, leaders supported group reflection and meaning making.

For example, at Discovery Cube teacher workshops, the leader modeled ways to support learner inquiry without providing solutions too quickly. When a participant asked for help in making her circuit board work, the leader pointed her to the different models the group had already examined. He then engaged her in dialogue as she identified the positive and negative parts of her circuit. She tested her connections, rearranged wires following one of the models, and came to recognize, through this iterative process, that she had created an open circuit. On her third attempt, she successfully got the bulb to light up.

Exploring How to Position Students as Leaders

Staff development throughout the network focused on enabling facilitators to encourage students to serve as mentors, coaches, and leaders for other students. While engaging in the hands-on Making activities they would soon teach to their students, educators were encouraged to collaborate as peer leaders in the same ways they were expected to facilitate youth collaboration in their afterschool programs. For example, at Techbridge, program facilitators

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were paired so that returning educators collaborated with new educators. During activities, program facilitators were encouraged to look at one another's projects and offer support or advice. These processes were repeated in the afterschool program, where educators regularly encouraged girls to turn to more expert peers for guidance as they built their projects and paired new Techbridge students with returning students who could show them, for example, how to solder wires together safely. Peer mentoring also occurred informally. For example, when a group of girls encountered problems in programming Lilypad, a small computer used for sewing e-textiles, they had already grown so used to peer coaching that they asked girls who had used this device the previous year rather than the adult facilitator.

Discussing Marginalization

Explicit discussions about how students might experience marginalization or deficit views in school and in society made facilitators more conscious of how to avoid reproducing these views in the afterschool program. For example, in Techbridge professional development workshops, educators discussed career access and unequal pay between men and women. They discussed the best ways to talk about such issues so that girls wouldn't be discouraged from pursuing competitive careers and salaries. Participants also addressed how people perceive intelligence and when individuals feel "smart." They discussed ways that youth could feel that their intelligence is not valued—especially when they are faced with external measures of intelligence such as standardized testing—and how to avoid replicating these experiences in afterschool.

Where We Go From Here

A 2014 review of the literature found a growing number of studies celebrating the potential power and excitement of the Maker movement in education (Vossoughi & Bevan, 2014). Most of these studies address implementation of activities, such as e-textiles or engineering; some explore the nature of Maker communities of practice. Only in the last year or so has research begun to emerge that addresses core issues of teaching and learning or the ways in which Making can be positioned to empower

learners from economically and racially marginalized communities (Vossoughi et al., 2016).

The results of our study contribute to the literature by demonstrating the ways in which Making can support valued STEM learning outcomes. It also addresses a gap in professional development, which often focuses exclusively on how to implement activities. Though educators must have firsthand experience doing the Making activities they will later facilitate with students, our study suggests that this experience is only the beginning. To support equitable Making programs, educators need to learn together how to create a culture that leverages the potential of Making to engage students in the full scope of STEM practices. A "what-if" culture recognizes and builds on what students know and can do. It supports process and iterative design, helping students to persist through difficulties and imagine new solutions. It intentionally fosters reflection and meaning making.

Developing such a culture is not easy. It may require not only expert facilitation but also implementation support. For example, enlisting high school students to serve as co-facilitators can lower student-teacher ratios to allow the responsive facilitation that our research shows is critical to productive and equitable learning through Making. The challenges are compounded by high staff turnover rates in afterschool; many of the educators in the four featured organizations have since moved on. Partnerships with community Makers or science education institutions with Maker expertise may be crucial to long-term success.

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Why Are OST Workers Dedicated—or Not?

Factors That Influence Commitment to OST Care Work

Meghan C. C. Blattner and Anderson J. Franklin

Increasingly youth development advocates, educators, and communities recognize the importance of out-of-school time (OST) activities for academic achievement and youth well-being (Alexander, Entwisle, & Olson, 2007; Gordon, Bridglall, & Meroe, 2005; Hall, Yohalem, Tolman, & Wilson, 2003). Scholars suggest that youth-adult relationships may be key for program efficacy (Celano & Neuman, 2008; Cole, 2011; Gordon et al., 2005). Strengthening the OST workforce is thus a critical goal to enhance children's learning and development.

Commonly identified challenges with the OST workforce include retention and lack of education and experience (Asher, 2012; Khashu & Dougherty, 2007; The After-School Corporation [TASC], 2009). Asher (2012) raises some of the challenges with this part-time workforce and starts to explore job satisfaction and career development issues. OST workers serve as potential educational change agents and make significant contributions to children's development, but they often see their jobs as transient rather than as part of a career path (Razavi, 2007; Richardson, 2012). Their positive contributions and job satisfaction are rarely studied, in part because of the nature of the OST workforce and workplace (Asher, 2012). OST care workers not only

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earn a low hourly wage, but also mainly work part time before or after school (Bradshaw, 2015; National Afterschool Association, 2006; Richardson, 2012; TASC, 2009).

Mentoring and professional development have been identified as important strategies for supporting OST workers (Bradshaw, 2015; Cole, 2011; Cooper, 2013). TASC (2009) articulates the value of strong professional development for both organizations and workers. The expectation is that supporting these workers might simultaneously improve program *content* by enhancing the quality of instruction and activities, while enriching program *process* by fostering a stronger social-emotional climate and better youth-adult relationships. However, there is no universal certification or license for OST positions (Cole, 2011; Gabrieli, 2011; Stonehill et al., 2011).

This study situates OST work in the workforce sector the career development literature calls "care workers" (Blustein, 2006; Richardson, 2012). Working within that framework, we surveyed OST line staff and site directors to attempt to quantify factors that led them to be more or less dedicated to their care work. Our findings have implications for staff recruitment, training, and retention and for the institutional and policy development of OST programs.

> Today, as OST programming has expanded beyond simple childcare into targeted educational and social-emotional interventions aimed at improving long-term youth development outcomes, it has evolved into what psychology of work scholars call "market care work" (Folbre, 2006).

OST Labor as Market Care Work

To understand the influences on OST workers' dedication, we started by considering OST work as a form of care work. Richardson (2012) identifies four social contexts through which people construct their lives: (1) market work, or work for money outside the home; (2) personal care work, which involves caring for oneself, one's dependents, and one's community; (3) personal relationships, or lifelong relationships with family and friends; and (4) market work relationships, which include connections with mentors, supervisors, colleagues, and students. Tutoring and mentoring youth after school was historically considered personal care work because it usually happened informally at home. Today, as OST programming has expanded beyond simple childcare into targeted educational and social-emotional interventions aimed at improving long-term youth development outcomes, it has evolved into what

psychology of work scholars call "market care work" (Folbre, 2006).

For OST care workers, Richardson's (2012) contexts overlap and intersect. OST care work is relational and social; workers are tasked with multiple and diverse caring roles, which can include, for example, coaching, mentoring, teaching, tutoring, and even feeding the children in their program. OST care workers often come from the communities in which they work and have personal relationships with the families of the youth enrolled in their programs (TASC, 2009). Blustein's relational theory of working (2011), which emphasizes relationships in work interactions, is particularly applicable to OST care workers. Though all work contains relational components (Blustein, 2011), the relational attributes of OST work are particularly salient because of the intersection of school, family, and community contexts.

OST care workers often feel dedicated to their jobs because they value programs' social justice orientation, aligning with such goals as, for example, narrowing the achievement gap and promoting positive outcomes for underserved youth (Nelson Chair Roundtable, 2014). External influences, such as sociopolitical development and life circumstances, also influence OST workers' career beliefs and expectations and their attitudes toward their work (Diemer et al., 2010; Duffy & Dik, 2009). OST staff who work in programs in their own communities may have personal and work experience with the same local institutions that affect program youth; for example, they may have attended the same schools. These experiences will help to shape their ideas about their work and about the youth they serve. Understanding how the relational and cultural contexts of OST care workers influence their work is therefore necessary to a holistic concept of the OST workforce.

Context

To begin to understand what keeps OST care workers engaged in their challenging roles, we surveyed direct-service workers in OST programs delivered by a nationwide community-based organization in a large Northeastern city. At the time of survey administration in spring 2013, this organization ran 31 afterschool sites in the city, 22 of them in public schools. Programs typically served elementary-

aged students; activities included homework help, physical activity, and specialized programs like Girl Scouts and STEM activities from community partners.

Each location had a site director and anywhere from one to eight group leaders, depending on the number of youth at that site. Group leaders typically managed a specific group of children and delivered all activities except those provided by community groups. Site directors supervised group leaders. They would frequently rotate among groups to provide assistance, coach group leaders, support lesson plan development, and coordinate with outside partners. Almost all group leaders were part time, as were most site directors.

Methods

In order to understand what leads to dedication among OST care workers, we had to measure the degree to which survey respondents were in fact dedicated to their work. We selected three dependent variables to measure dedication:

- Job satisfaction
- Career commitment
- Work as meaning

The primary assumption is that higher levels of dedication, as evidenced by these three variables, would lead workers to stay in the OST field and to pursue professional development and career advancement.

To understand the life experiences that could influence OST care workers' dedication, we selected three independent variables:

- Mentoring: respondents' experience of having been mentored
- Collectivist or individualist orientation: cultural orientation toward community or toward individuality
- Work volition: perceived degree of career-related choice

We presumed that workers' experience of being mentored would positively influence their dedication to market care work. A collectivist orientation would be likely to lead toward involvement in community programs; greater work volition would likely lead workers to perceive more opportunity in their work and thus be more dedicated.

Participants and Procedures

The sample consisted of 47 adults employed as either site directors or group leaders in the afterschool programs. We contacted the 31 site directors to ask them to get the permission of group leaders to share their email

Table 1. Respondent Demographics

Characteristic	N	%
Male	11	23%
Female	36	77%
White	21	45%
Nonwhite	26	55%
Site director	24	51%
Group leader	23	49%
High school diploma	14	30%
Associate's degree	6	13%
Bachelor's degree	25	53%
Master's degree	2	4%

Table 2. Respondent Age and Tenure

Characteristic	Average
Age	26.7 years
Time in current position	2.2 years
Time in this organization	4.1 years
Time in OST or childcare field	6.4 years

addresses. Through this process, we got contact information for 88 employees, whom we emailed an invitation to participate in the online survey. A grant enabled us to give each participant a $2 gift certificate, an amount based on their hourly wage for the 10-minute survey.

As shown in Table 1, 48 participants completed the online questionnaire, which had been approved by our institutional review board. Of these participants, 51 percent were site directors and 49 percent were group leaders; 77 percent identified as female and 45 percent as white. Because of the small numbers of respondents in some racial categories, we combined respondents who identified as African American, Asian, Latino, multiracial, and "other" into a single category, *nonwhite*. Table 2 shows that, on average, the participants were 27 years old and had been employed by the organization in some capacity for four years. Two older workers with many years of experience skewed the average, though this average is still younger than the average age of 35 reported by the National Afterschool Association (2006).

Measures

We used previously validated brief survey instruments to measure the three dependent variables and three inde-

pendent variables related to OST care workers' job dedication. All measures had strong internal consistencies, indicating strong reliability, except for the measure of individualist or collectivist orientation, which had a weak internal consistency.

Job Satisfaction
A five-item measure (Judge, Locke, Durham, & Kluger, 1998) evaluated participants' perception of their job satisfaction. We asked respondents to think of their OST work with their current organization, indicating their agreement with each question on a 7-point scale from *strongly disagree* to *strongly agree*. Sample items included "I feel fairly well satisfied with my present job," "Most days I am enthusiastic about my work," and "I find real enjoyment in my work."

Career Commitment
The Career Commitment Measure (Carson & Bedeian, 1994) contains 12 items that examine individuals' commitment to their career. We asked respondents to consider their OST work in rating their agreement with the 12 statements on a 5-point scale. Items included, for example, "I have created a plan for my development in this line of work/career field" and "My line of work/career field is an important part of who I am."

Work as Meaning
The Work as Meaning Inventory (Steger, Dik, & Duffy, 2012) is a 10-item measure composed of three subscales: positive meaning, meaning making through work, and greater good motivations. Again, we asked respondents to think specifically about work at their current organization as they rated items on a 7-point scale. Example items included, "I have found a meaningful career" and "I know my work makes a positive difference in the world."

Mentor Experience
To measure experiences of being mentored, we used the 11-item mentor subscale of the Relational Health Indices (Liang et al., 2002). The 5-point scale ranges from *never* to *always* in response to such items as "I can be genuinely myself with my mentor." Respondents were free to select any mentor relationship from any period in their life to rate these items.

Individualist or Collectivist Cultural Orientation
Triandis' (1995) 13-item measure of culture assesses whether individuals are more collectivist or individualist in their cultural orientation. Respondents were asked to rate, on a scale of 1 to 9, *true,* how likely they were to do what each item describes. An example of a collectivist item is "Ask close relatives for a loan." An example of an individualist item is "Live far from your parents."

Work Volition
We used the Work Volition Scale (Duffy, Diemer, Perry, Laurenzi, & Torrey, 2012) to assess respondents' perceptions of their capacity to make occupational choices despite constraints or challenging life circumstances. Respondents selected the extent to which they agreed with each item on a 7-point scale. The 14-item scale contains three subscales: volition, financial constraints, and structural constraints. An example of a volition item is "I've been able to choose the jobs I wanted." A financial constraints item is "Due to my financial situation, I need to take any job I can find." A structural constraints item is "I feel that outside forces have really limited my work and career options."

Results
Table 3 presents the correlations among the primary measures, dividing cultural orientation into its binary components of collectivism and individualism for a total of seven measures. The dark shading indicates a strong correlation. Lighter shading indicates a relationship that is statistically significant but not as strong. Note that the three measures of dedication—job satisfaction, career commitment, and work as meaning—are highly correlated with each other. These three measures therefore offer a good indicator of who is and is not dedicated to their work.

Moreover, some of the independent variables significantly correlated with the dependent variables in the expected direction. Work volition had the strongest association with all three indicators of dedication: job satisfaction, career commitment, and work as meaning. Positive experiences of being mentored showed significant correlation with two indicators: commitment and meaning. Although collectivist orientation was not significantly correlated with any measures, individualism was negatively related to job satisfaction—that is, respondents with an individualist orientation were less likely to express satisfaction with their jobs.

We conducted statistical analyses to see whether respondents' race (white or nonwhite) or role (site director or group leader) predicted differences among the seven measures. We found no statistically significant differences; we therefore did not control for race or staff role in the regression analyses described below. The other demographic variables were not normally distributed: The sample was largely female, and outliers skewed vari-

Table 3. Relationships Among Variables Related to Job Dedication

		Dependent Variables			Independent Variables			
		Job satisfaction	Career commitment	Work as meaning	Mentor experience	Collectivism	Individualism	Work volition
Dependent Variables	Job satisfaction		██ (dark)	██ (dark)			░ (light)	██ (dark)
	Career commitment			██ (dark)	░ (light)			██ (dark)
	Work as meaning				██ (dark)			██ (dark)
Independent Variables	Mentor experience							░ (light)
	Collectivism							
	Individualism							
	Work volition							

Note: Shading indicates a statistically significant relationship. Dark shading signifies a very strong relationship (correlation of 0.40 or greater). Light shading signifies a strong relationship (correlations between 0.30 and 0.40).

ables for age and length of career. These characteristics also were therefore not included in the analyses.

Using ordinary least squares regressions, we found that, as hypothesized, work volition did indeed predict both job satisfaction and career commitment. We used hierarchical linear regression analysis to look for additional influence on job satisfaction and career commitment from experiences of being mentored, but we found no significant effects.

We then conducted multiple regression analyses to examine how the three subscales of work volition—financial constraints, structural constraints, and volition—predicted job satisfaction and career commitment. The financial constraints subscale was the only statistically significant predictor of job satisfaction. That is, respondents who experienced fewer financial constraints and had greater work volition tended to have higher job satisfaction scores. For career commitment, structural constraints and volition were related at a level that did not reach statistical significance but could constitute a trend: Respondents with fewer structural constraints and higher volition tended to be more committed to their OST careers.

For the third dependent variable, work as meaning, we used hierarchical linear regression analyses to look for predictors among the independent variables. Mentor experience and work volition, taken together, predicted work as meaning: People who had more positive experiences of being mentored coupled with higher work volition were more likely to find their OST care work meaningful. The results of our regression analysis are illustrated in Figure 1. Because the measures of collectivist and individualist cultural orientation had low internal consistency and weak correlations with the indicators of dedication, we could not conduct regression analyses of these relationships.

Figure 1. Life Experiences Leading to Job Dedication Measures: Regression Analysis Results
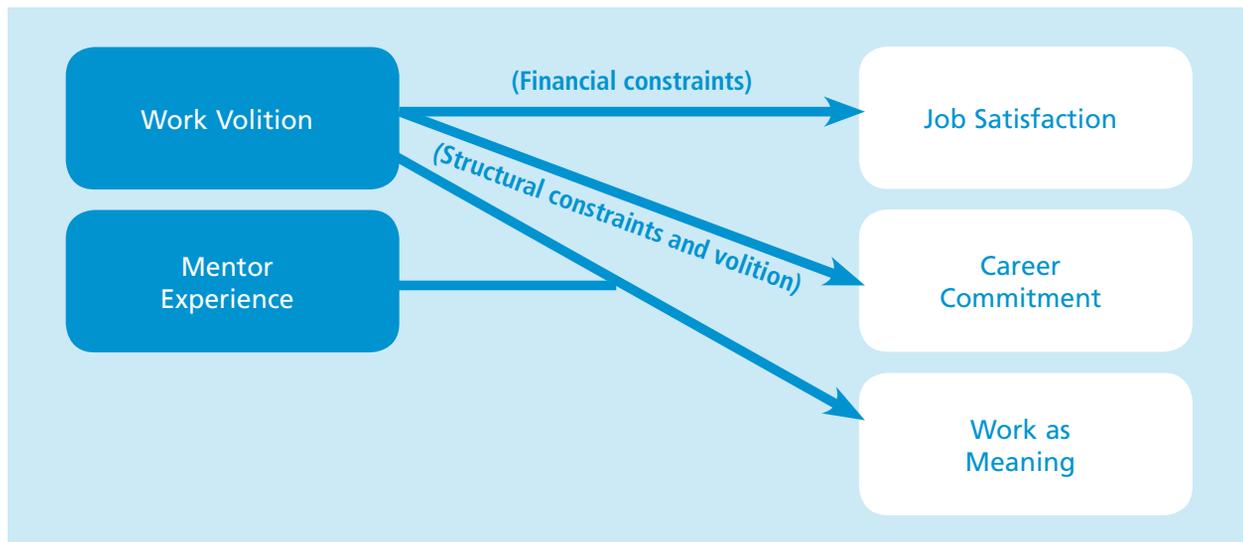
Discussion: Contextual Factors That Influence Dedication

OST care work is relational, community-based work. Its psychosocial mission aims to improve social-emotional and behavioral outcomes for youth. Understanding the factors that create dedicated and passionate OST care workers can enable the field not only to improve the work experience and retention of OST care workers but also, as a consequence, to better serve participating youth. We therefore examined how the contextual experiences of OST care workers— their mentor relationships, cultural orientation, and volitional constraints—affected their dedication to OST work, as evidenced by their job satisfaction, career commitment, and perception of the meaningfulness of their work.

Positive experiences of being mentored predicted greater dedication to OST care work, specifically influencing career commitment and work as meaning. Taken together, being mentored and higher work volition strongly predicted the perception of work as meaningful. The strong effect of being mentored might be expected in light of the relational nature of OST work. For one thing, OST care workers who have been mentored earlier in their development might easily recognize the value of their own work as mentors to youth. Secondly, evidence suggests that being

> The strong effect of being mentored might be expected in light of the relational nature of OST work. For one thing, OST care workers who have been mentored earlier in their development might easily recognize the value of their own work as mentors to youth.

mentored by someone in a specific line of work supports pursuit of that line of work (Whitely, Dougherty, & Dreher, 1991). Though we asked respondents to describe any mentoring relationship in their lives, some of those are likely to have been OST mentorships. Finally, mentoring that includes meaning-making dialogue may help mentees to be more adept at making meaning out of their life experiences, including their OST work.

Although collectivist cultural orientation was not associated with dedication to OST work, individualism negatively correlated with job satisfaction. Workers primarily focused on their own success, not surprisingly, found less satisfaction in OST work, which is characterized by low pay and little recognition. Workers with self-oriented, conventional career aspirations for success and prestige may be especially deterred by the marginalized nature and uncertain career direction of market care work.

OST care workers in our study who had higher levels of work volition also had higher levels of job satisfaction, career commitment, and work meaningfulness. Work volition measures whether people believe they can navigate or persist through constraints on their occupational choices. Individuals who feel less constrained by finances and organizational systems perceive themselves as having chosen to work in the OST field. They thus

find their work more meaningful and are more satisfied with and committed to their positions.

However, work volition is complicated. It can reflect resilience in the face of financial hardship and prejudice. For example, OST staffers may be committed to work in the underserved neighborhood in which they grew up even though they could find higher-paying jobs elsewhere. By contrast, work volition can also reflect privilege. Some OST workers with higher work volition, for example, may have family resources to fall back on. They can pursue lofty social justice goals in their work because low wages represent less of a financial obstacle than for workers with fewer resources. Whether or not they enjoy such privilege, OST staffers can experience work volition for additional reasons. Some may see long-term career possibilities in the care work sector (TASC, 2009), rather than perceiving their current position as transitional or as a stepping-stone. Some might strongly identify with OST social justice goals such as narrowing racial disparities in academic achievement.

OST programs and their youth would undoubtedly benefit if all OST care workers had high work volition: Such workers would be dedicated despite low pay and lack of recognition. However, hiring only workers with high work volition would be impractical in light of the field's challenges with staff recruitment and retention. In fact, diverse levels of work volition are likely to continue for programmatic reasons. Research indicates that matching nonwhite youth with nonwhite mentors yields better mentoring outcomes (DuBois, Holloway, Valentine, & Cooper, 2002; Santos & Reigadas, 2000). Meanwhile, evidence also shows that nonwhite workers face more financial and structural constraints than white workers (Aud et al., 2013). OST organizations are therefore likely to continue to employ workers who have low work volition because they face significant financial and structural constraints. The best option may be to continue to hire care workers who can relate to children and then develop organizational strategies to enrich those workers' work volition and work meaningfulness. Such strategies might include providing staff mentoring and career guidance.

> OST organizations are therefore likely to continue to employ workers who have low work volition because they face significant financial and structural constraints. The best option may be to continue to hire care workers who can relate to children and then develop organizational strategies to enrich those workers' work volition and work meaningfulness.

Limitations and Future Directions

This study contributes to an empirical understanding of factors that influence the dedication of OST care workers. Though the study's sample was small, this modest sample was sufficient to produce meaningful findings. However, our sample represents OST care workers from just one urban organization, with its particular mission and context. The response rate we achieved out of the total possible sample was strong, at 50 percent, but more research is necessary to reach a more diverse population, for example, from other cities and other kinds of organizations.

Future studies may also expand on the questions to be investigated. For example, one important avenue for future research is the relationship between dedication among OST care workers and positive youth outcomes. One retrospective study, by Khashu and Dougherty (2007), did find that staff in higher-quality afterschool programs had greater enjoyment and commitment to working in OST than those in lower-quality programs. In addition to surveying OST care workers, future studies should expand to survey the youth with whom they work. Because relational elements are so vital in OST programming, youths' and staff members' perceptions of their interactions can provide insights into how these relationships contribute to OST program efficacy. Such future research may generate additional implications for the OST workforce and for policy development.

Implications for the Field

Our results suggest practical avenues OST leaders can take to improve the working experience of front-line OST staff. OST administrators would likely benefit from consultation about how to improve staff members' work volition, by, for example, offering career opportunities with related training and education. Professional development related to career advancement could help OST workers to find meaningful and practical ways to both commit to and contribute to the organization's mission (Cole, 2011; Cooper, 2013; TASC, 2009). OST workers could thus learn how to pursue future leadership positions, either with their current employer or in another OST organization.

Funders and state- and citywide intermediary organizations could support community-based organizations in providing clear career trajectories with steps toward upward mobility within the field. Boston College's Nelson Chair Roundtable, which brings together a network of national and international community-based organizations, is an example of how collaborative networks can develop career ladder strategies and build individuals' leadership capacity (Lynch School of Education, 2016). Another way OST organizations and coalitions could improve work volition is to find ways to help staff complete college credits and earn degrees.

Another step that may be more immediately practical within OST organizations is to foster staff mentoring. Our study found that, in the highly relational environment of OST programs, mentoring can facilitate work volition, which in turn facilitates career dedication. This support is particularly important in the face of the financial and structural constraints that work against the work volition of so many OST workers. A staff mentoring program can simultaneously offer vital relationship-based support for entry-level personnel while providing leadership opportunities for more experienced OST care workers. Such mentoring can be structured specifically to help workers navigate the constraints that work against their ability to find volition and meaning in their work. For example, experienced mentors can explain how they learned to navigate work-life balance while juggling part-time jobs. By fostering volition and perceived work meaningfulness, mentoring programs can help prevent staff burnout and boost retention.

Much more research remains to be done in this understudied work sector. Better understanding of the spectrum of OST workers in their diverse contexts can help to advance OST market care work as a viable occupational choice—one whose rewards go beyond salary and status to encompass such intangibles as relationships, commitment, and a sense of purpose.

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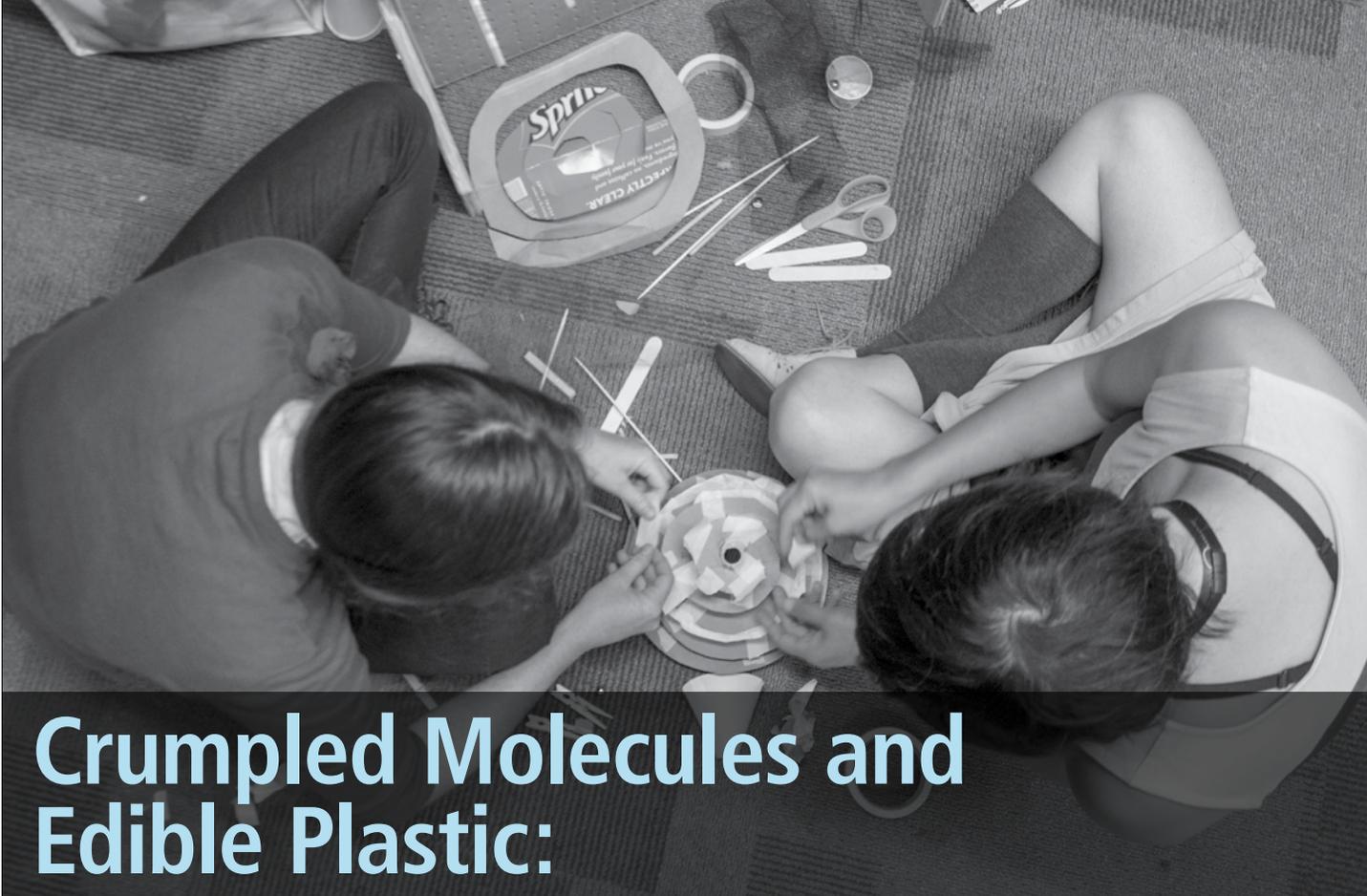
Crumpled Molecules and Edible Plastic:

Science Learning Activiation in Out-of-School Time

Rena Dorph, Christian D. Schunn, and Kevin Crowley

"Informal environments beyond the school day promote flexibility that lets children engage in science in the same way they play sports or create art. Playing with bubbles, blocks, robots, and plants not only helps students when it comes time to learn physics, chemistry, and biology— but it also sparks an interest in science that translates to future classroom and career" (Coalition for Science After School, 2012).

The Coalition for Science After School highlights the dual nature of outcomes for science learning during out-of-school time (OST): Learning experiences should not only be positive in the moment, but also position youth for future success. Several frameworks speak to the first set of immediate outcomes—what youth learn, think, and feel as the result of informal learning experiences (Afterschool Alliance, 2013; Friedman, 2008; Hussar, Schwartz, Boiselle, & Noam, 2008; National Research Council [NRC], 2009, 2011).

Much less research has been conducted on longer-term outcomes—how OST experiences affect engagement over time, prepare youth for future learning, or even influence career trajectories. There are hints: By eighth grade, for example, career expectation is a better predictor of future success than math achievement (Cannady, Greenwald, & Harris, 2014; Tai, Lui, Maltese,

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& Fan, 2006), a finding that suggests OST programs might do well to focus on science interest and career awareness. In general, however, the field urgently needs research and practice frameworks that speak directly to the ways OST programming produces longer-term learning, engagement, and career outcomes (NRC, 2015).

Responding to this need, we have been developing a new framework and set of assessments built on the idea of *science learning activation*. This paper draws on in-depth interviews with and observations of adults and youth to explore this new concept. Researchers, evaluators, and program developers can use this description to judge whether the concept of science learning activation aligns with their goals and can help them understand, develop, and assess their work.

Science Learning Activation

The goal of the Activation Lab (www.activationlab.org) is to develop practical theories that explain both the immediate results of specific learning experiences and the longer-term effects of early engagement in science. Building on recent advances in science education, sociocultural studies, and cognitive and social psychology, we define *science learning activation* as the dispositions, practices, and knowledge that enable learners to be successful in science learning and that are, in turn, influenced by success. Science learning activation is a developmental feedback loop (Figure 1): Activated science learners have

the resources to be successful when they engage with science. This success makes them more activated, which makes them more likely to engage with science and be successful, which leads to more activation, and so on. This feedback loop is the heart of why activation is important. Learning experiences that increase science learning activation can encourage youth to follow pathways to science. Conversely, poor experiences can reduce activation, undermining future success and thus making young people less likely to pursue STEM literacy or STEM careers.

Our work suggests that activated science learners score higher than non-activated learners on the four dimensions in the Activation box in Figure 1: fascination, valuing science, competency beliefs, and scientific sensemaking. All four provide useful personal resources that individuals carry from one science learning experience to the next and that influence their chances of success in any given experience.

What is "success" in a science learning experience? Success certainly includes engagement during the experience and achievement of the intended science learning outcomes. However, successful learning experiences should also prepare youth for more learning, affecting their choices to participate in science activities in the future. Successful experiences encourage youth to perceive themselves as successful when they do science; this perception supports their confidence and agency.

The concept of science learning activation and our definition of success in science learning are based on five

Figure 1. The Science Learning Activation Framework
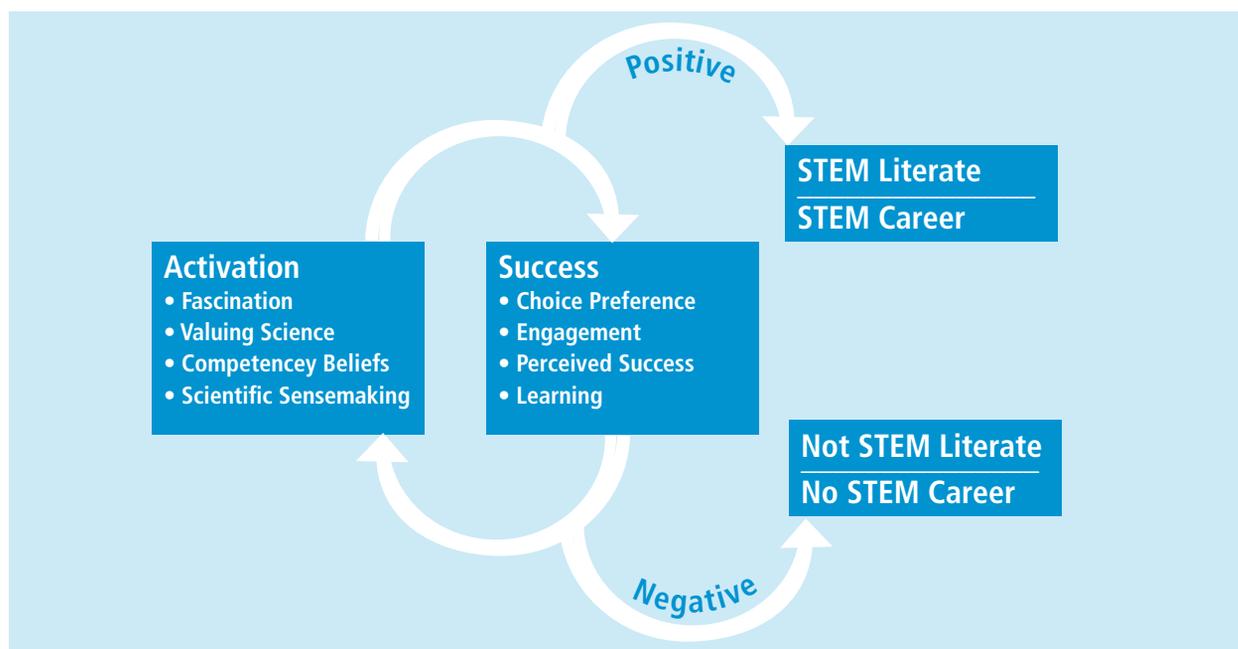
years (and counting) of literature review, research studies, and measurement development. The Activation Lab has:

1. Developed and extensively validated, across years of empirical work, survey measures of the four dimensions of science learning activation so they could be included in research and program evaluations. Technical reports are currently available at www.activationlab.org/tools; downloadable, customized measurement systems for field use will soon be available.

2. Analyzed longitudinal datasets to understand pathways toward diverse STEM careers (Cannady et al., 2014).

3. Engaged in a retrospective study of the life histories of approximately 70 scientists and engineers (Crowley, Barron, Knutson, & Martin, 2015; Knutson & Crowley, 2015).

4. Conducted two waves of in-depth case studies with 24 Bay Area youth whom we followed through selected science learning experiences in grades 5–8. Each case includes video observation, interview, artifact analysis, and survey data.

5. Conducted large-scale quantitative studies with thousands of youth exploring changes in activation and the relationship between activation and success (Bathgate, Crowell, Schunn, Cannady, & Dorph, 2015; Dorph, 2016; Dorph, Cannady, & Schunn, 2016; Dorph, Schunn, Crowley, & Shields, 2012, 2013).

Our work so far supports the positive feedback model: The four dimensions of activation all have positive effects on one or more of the aspects of success—choice, engagement, perceived success, and learning—which in turn predict increases in the dimensions of activation. Thus, science learning activation appears to provide developmental momentum that can support persistent success in science learning.

The Dimensions of Science Learning Activation

To describe the four dimensions of science learning activation, we draw on two sources of qualitative data: in-depth case studies with 10–14-year-olds (number 4 above) and retrospective life-history interviews of adults who work in science (number 3). Descriptions of the four dimensions of activation below mix reviews of the literature, sample items from the survey scales that measure that dimension, and examples from our data to show how activation is grounded both in theory and in the lived experience of science learners.

Dimension 1: Fascination

Fascination is emotional and cognitive attachment to science. It can serve as intrinsic motivation. This dimension includes aspects of:

- Curiosity (Litman & Spielberger, 2003)
- Interest or intrinsic value in science (Baram-Tsabari & Yarden, 2005; Hulleman & Harackiewicz, 2009; Osborne, Simon, & Collins, 2003)
- Mastery goals (Ames, 1992)
- Positive emotions related to science and scientific inquiry (Silvia, 2008)

All these constructs are associated with choosing to engage with science and with success in science learning (Hidi & Ainley, 2008; Hidi & Renninger, 2006). It makes sense that these aspects of fascination would occur together in the same individuals; for example, people who are interested in science are likely also to have mastery goals for science. In fact, our research has confirmed that all of these aspects of fascination cohere, psychometrically, into a single factor. Figure 2 provides sample items from our activation assessment that measure how fascinated youth are with science.

What does fascination sound like when you talk to a learner about science? Here is one example from a 12-year-old boy:

There's some things that's interesting about molecules, like, if you get different types of molecules and you put them together, you can actually make a new thing to use. In the past they found a type of molecule that … when you crumple it, it's able to uncrumple and then become smooth, and it's unburnable, so when it hits an object or hits fire, it's not able to burn.

> The four dimensions of activation all have positive effects on one or more of the aspects of success—choice, engagement, perceived success, and learning—which in turn predict increases in the dimensions of activation. Thus, science learning activation appears to provide developmental momentum that can support persistent success in science learning.

Figure 2. Sample Survey Items in the Fascination Scale

	YES!	yes	no	NO!
a. After a really interesting science activity is over, I look for more information about it.	○	○	○	○
b. I need to know how objects work.	○	○	○	○
c. I want to read everything I can find about science.	○	○	○	○
d. I want to know everything about science.	○	○	○	○
e. I want to know how to do everything that scientists do.	○	○	○	○

Asked where he learned about these molecules, the boy described a "science show about, like, aliens. It showed … something that hit the earth…." He went on to describe the experiments scientists conducted on this material, trying to tear and crumple it. "And then they put it in … a fireplace, and then they lit it on fire, and then it wouldn't burn."

We have often found that young people who score high on the fascination scale, like this boy, convey their passion for science by giving detailed accounts of phenomena that have struck them. They sometimes tell stories of scientific discoveries, as this boy did. Sometimes they talk about their own experiences pursuing their scientific interests.

Our interviews with adults about their paths towards science careers also suggest that phenomena and facts can be a focus for early fascination. A 41-year-old female neuroscientist told the interviewer how fascination spurred her pursuit of science:

I just know that it's fascinating, and I didn't know how everybody didn't want to be a biologist, because how do you not want to know how your heart pumps? How do you not want to know how your brain works? … The seeds of that, and how that's unfolded in all these different ways … have gotten me even closer to trying to understand my place in the world.

Dimension 2: Valuing Science

The second dimension of science learning activation is the degree to which learners *value* various aspects of science, including scientific knowledge, scientific reasoning, and the role science plays in families and communities (Brickhouse, Lowery, & Schultz, 2000; Costa, 1995; Dogan & Abd-El-Khalick, 2008; Hill & Tyson, 2009). Young people may express both the everyday value and the career value of science. They can understand the interactions of self with science and value those interactions within their social context (DeBacker & Nelson, 2000; Eccles & Wigfield, 2002; Osborne et al., 2003; Pintrich, 2003). Learners who value science are more likely than those who do not to pursue science as a possible career. Whether or not they find science fascinating, those who value science and the role it plays in their lives and in society are more likely to engage in learning about science, both in and out of school (Eccles, 2005; Lyons, 2006). Sample items on the *valuing science* scale of our activation assessment are shown in Figure 3.

A 12-year-old girl we interviewed described the value of scientific invention: "In the past, science helped to make, like, the microwave and TV…. If you want to make a motor, you are able to know, like, science works." This girl also expressed the value of a scientific process that allows for mistakes:

Some people make mistakes on science, which is good, because if you make a mistake, you can still think about it. Some people, when they make mistakes on science, they're able to— There are some kids in science who tried to make plastic, but they made a mistake, and they made edible plastic. That's why sometimes it's really good to … make mistakes, because you might create a new thing.

Figure 3. Sample Survey Items in the Valuing Science Scale

	YES!	yes	no	NO!
a. I think scientists are the most important people in the world.	○	○	○	○
b. I think science is more important than anything else.	○	○	○	○
c. Science makes the world a better place to live.	○	○	○	○
d. Knowing science is important for being a good citizen.	○	○	○	○
e. I think science ideas are valuable.	○	○	○	○

Another example of valuing science comes from a 25-year-old crop scientist. Before high school, she had thought she would go into politics. A pivotal moment occurred on a church mission trip during her senior year of high school, when she saw very poor people create cooperatives to grow corn.

> I saw a real opportunity to solve problems on an individualistic level…. It was a very eye-opening experience in my life…. I was kind of like, "You know what? Politics can't solve a lot of these issues." I started looking at other things. It kind of made me open my eyes.

As a young person, this scientist had seen that science provided a way to solve a problem she cared about.

Dimension 3: Competency Beliefs

The dimension *competency beliefs* refers to the extent to which learners believe that they are good at science tasks. A core construct in social cognitive theory, competency beliefs are defined as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986, p. 391). Competency or self-efficacy beliefs are an important predictor of many types of achievement behavior, including choice of task, engagement, effort, and persistence (Pintrich, 1999, 2002; Schunk, Pintrich, & Meece, 2008). The sample items shown in Figure 4 illustrate how competency beliefs can manifest in individuals.

Prior research makes a clear distinction between people's actual competence and their subjective perceptions. For example, college students' reasoning ability has been shown to play a more significant role than self-efficacy in science achievement (Lau & Roeser, 2002; Lawson, Banks, & Logvin, 2007), but learners with high self-efficacy beliefs were more likely to be behaviorally and cognitively engaged in learning (Linnenbrink & Pintrich, 2003). Durik, Vida, and Eccles (2006) found that individuals' subject-specific competency beliefs predicted their career aspirations. Thus, competency beliefs affect both short-term and long-term choices.

Figure 4. Sample Survey Items in the Competency Beliefs Scale

I think I am very good at:	YES!	yes	no	NO!
a. Figuring out how to fix a science activity that didn't work.	○	○	○	○
b. Coming up with questions about science.	○	○	○	○
c. Doing experiments.	○	○	○	○

Observation of an 11-year-old boy in a science camp offers an example of a young person with high competency beliefs. First, he took charge of the activity, which involved timing the movements of mosquito fish. He confidently engaged in the task, demonstrating that he believed he knew what he was doing. When asked by the facilitator whether he needed help, the boy replied, "No, I can do it myself."

An interview with a physicist who works as a museum educator offers another straightforward example of how belief in one's own science competence provides momentum on a science learning and career pathway.

> I think at college … the fact that I started off in an Intro to Physics class with 70 people, and there were only two of us that graduated with a degree.… I feel like I made it all the way through to the end because I was good at it.

Dimension 4: Scientific Sensemaking

The final dimension, *scientific sensemaking,* refers to the degree to which individuals learn in ways generally aligned with the practices of science. The behaviors associated with sensemaking include asking investigable questions, seeking mechanistic explanations for natural and physical phenomena, engaging in evidence-based argumentation, interpreting common data representations, designing relevant investigations, and understanding the changing nature of science (Apedoe & Ford, 2010; Lehrer, Schauble, & Petrosino, 2001). Some of these behaviors are captured in the sample survey items in Figure 5. Research shows that these sensemaking practices are associated with choosing, engaging with, and learning from science activities (Chi, Leeuw, Chiu, & LaVancher, 1994; Lorch et al., 2010; Songer, Kelcey, & Gotwals, 2009; Zimmerman, 2007).

A 12-year-old provides an example of scientific sensemaking as he recognizes the importance of evidence, seeks coherent explanations for natural and physical phenomenon, and uses models to understand how things work.

> People in my school keep on saying there's aliens and stuff like that. There's no evidence about it.… You need to think more when you're doing science.… If you do science— if you make something with science and you know the answer but you don't know really how it works … and you get confused, you can really think about it more. In a while, you'll be able to know how it works, and when you know how it works you can know how to be able to make a new model.

Similarly, a 42-year-old molecular biochemist describes her drive to engage in scientific sensemaking during her elementary school years, moving beyond mere enjoyment into a quest for making sense of how the natural world works.

> At least once a week or so, we had a day in nature where we'd collect bugs or things, and I loved that. I didn't love it in the way that you just enjoy the outdoors, but I loved it because I wanted to find out more and more and more things and how they worked. I remember I wasn't grossed out by the bugs, but I wanted to actually, like, open them up and see things.

What's New About Science Learning Activation for OST Programming

Not only is science learning activation well grounded in prior research, but many of its components are familiar drivers of science learning in OST. Three features of our framework make it novel and useful to OST science programs.

> Not only is science learning activation well grounded in prior research, but many of its components are familiar drivers of science learning in OST. Three features of our framework make it novel and useful to OST science programs.

First, it defines activation *specifically in relation to science*. It pushes past both general theories, which apply to learning in any content area, and ratings of student outcomes from specific classes or OST programs, which may be too specific to guide later learning. Activation is a middle-level approach that applies what research says about general approaches to describe how youth build momentum specifically toward science; it could therefore be uniquely useful for OST programs that focus on science learning.

Second, the science learning activation framework *merges findings from research both on cognition and on motivation or affect*. Cognitive research has described what is required to build difficult skills and knowledge (Anderson, 2009) but has largely ignored what builds identity or career interest (Bybee & McCrea, 2011). Research on motivation and affect has described what

Figure 5. Sample Survey Items in the Scientific Sensemaking Scale

The next set of questions are about dolphins. Some types of dolphins may become extinct in only a few years if something is not done to help them. Scientists are studying how different kinds of dolphins live, to learn what they need to survive.
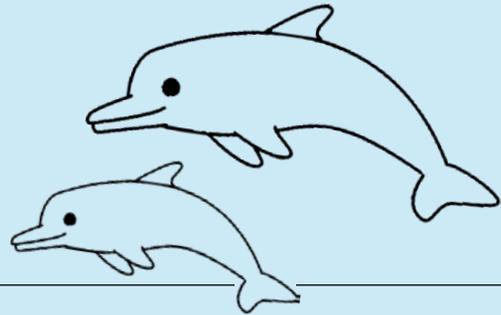
Elijah wonders if the temperature of the water makes a difference in how much dolphins play.

Which question is the best to ask to investigate this?

○ Do dolphins play in warm water?
○ Which other animals live in the same part of the ocean as dolphins?
○ Do dolphins live in warm or cold water?
○ Do dolphins play more when the water is warm or cold?

What would make one scientific explanation better than another for why dolphins play?

○ It is new and different.   ○ It is closer to what people think now.
○ It is in more books.   ○ It is based on more and better evidence.

A group of students are observing dolphins in a cove.

Maria and Celia both think:

- Dolphins are affected most by the amount of noise.
- Many dolphins left the bay when there was a lot of noise.

Maria says: Dolphins cannot hear each other when there is a lot of noise, so they leave.
Celia says: Dolphins leave because it is noisy, so when there is a lot of noise they leave.

Whose reasoning for why the dolphins leave the cove is more scientific?

○ Celia because she repeats the important idea.
○ Maria because she explains how the noise causes a problem.
○ Celia because she uses data collected from a study.
○ Maria because I would also leave if my environment was noisy.

guides learner choices (Bandura, 1989; Gollwitzer & Bargh, 1996; Vallerand, Fortier, & Guay, 1997) or learner persistence (e.g., Eccles & Wigfield, 2002; Harackiewicz, Durik, Barron, Linnenbrink-Garcia, & Taver, 2008). Though both disciplines have examined specific aspects of science learning activation, no research has outlined the full set of dispositions, practices, and knowledge that lead to positive long-term outcomes.

Third, the science learning activation framework recognizes that there is no single pathway to science, so that *the design of science learning interventions must be responsive to a broad range of learners.* The term "science" itself refers to diverse learning content and environments. Science dispositions, practices, and knowledge are developed in diverse contexts that span many learner years and involve many formats—not only textbooks, lectures, and classroom experiments, but also fiction and nonfiction books, afterschool and summer programs, museum and science center visits, television programs, and the internet (NRC, 2009, 2011). The quantity and format of school science instruction varies widely (Banilower et al., 2013), as does access to and participation in OST science learning (NRC, 2009). The youth in any given science learning environment—especially in OST—are likely to come from a great variety of prior science experiences; when they leave, they face a great variety of future experiences. This heterogeneity challenges the notion of a science learning pathway, in which successive learning experiences build on one another.

To understand how these features play out concretely in program design, consider two 11-year-old children, Laura and Greg. Laura told us she had little interest in science. However, as we observed, she got engaged in building an airplane and radio control tower out of thin wooden blocks and in creating a wind turbine. Later, she explained that these activities interested her because she drew on experiences of learning with her father, who was a pilot. The blades on the turbine were exactly like propellers on an airplane. The activities were compelling to her because of her prior experience, so her low level of fascination with science did not keep her from engaging— and learning STEM practices along the way.

By contrast, Greg indicated that he did not find these same activities relevant to his life. But that did not matter;

he was highly engaged and learned a lot because, he explained, he likes science when he gets to use his hands, though he doesn't like reading about science in books. Greg was attracted by the chance to design and build a functional wind turbine. Fully engaged in the activity, he learned how wind can be converted into energy.

OST programs serve youth who, like Laura and Greg, start with varied activation points; understanding what motivates them will enable programs to support their learning. Program designers should consider who their learners are and what learning experiences will serve them. One size doesn't fit all. Young people who are high in fascination may be likely to learn about a particular area of science if that area already interests them. Youth who are high in valuing science may be motivated to engage in an activity if they see its direct applicability to helping people or solving a societal problem. Young people who are high in competency belief are likely to be drawn to areas in which they already feel adept; they may require encouragement or scaffolding to work with others whom they do not perceive to be as competent. Youth who are high in scientific sense-making may be turned off when asked to memorize facts or to do a hands-on activity that does not offer opportunities for scientific thinking.

Activation Lab staff use the activation survey to conduct evaluations of several OST programs that have found the activation framework to be aligned with outcomes they care about.

Expanding Use of the Framework and Its Tools

Empirical work designed to show when and how learning experiences support the development of science learning activation must ask several important questions. How and when do science learning experiences support an individual child to develop activation? For whom and under what conditions do different combinations of activation dimensions enable which aspects of success? Further study of these questions will enable exploration of:

- Design principles that produce interventions targeted toward developing specific dimensions of science learning activation
- Diagnostic information about where an individual young person begins at the outset of an OST science program
- Measures of the effects of interventions on the four dimensions of science learning activation and the four factors of success

Another potentially transformative role for the science learning activation framework is in program eval-

uation and improvement. The first steps toward widespread use are underway. Activation Lab staff use the activation survey to conduct evaluations of several OST programs that have found the activation framework to be aligned with outcomes they care about. These programs are interested in measuring outcomes in the individual activation and success dimensions, driven by the desire to position their participants for success in future science learning.

Further, Activation Lab researchers have designed and piloted ActApp, a system that facilitates use of the instruments to measure activation and success dimensions. These instruments include both the survey scales described above and the qualitative interview and observation protocols. ActApp offers easy access to these tools to enable program designers and educators, in all kinds of STEM learning settings at all levels, to make continuous program improvements, help young participants succeed, and conduct summative evaluations of program impact. Administered on- or offline, ActApp is well suited for OST providers and evaluators because it can be scored without specialized skills or knowledge and interpreted without statistical expertise. During the pilot process, several organizations used ActApp to survey hundreds of youth in OST STEM programs. The pilot suggests that ActApp can work for researchers and evaluators who seek well-established measurement tools and for program providers who seek psychometrically sound assessments and high-quality evaluation resources (Dorph, Cannady, & Hartry, 2015).

Our goal in developing the science learning activation framework and measures has been to identify a meaningful outcome that can be measured reliably and that might be expected to increase over time in response to strong science learning experiences in and out of school. Our work so far has connected activation with the literature on learning, motivation, interest, and engagement in science; produced empirically grounded, psychometrically tested, and field-ready assessments; and studied the relationship between activation and success. Further studies, both underway and planned, explore how activation changes as the result of short-, middle-, and long-term exposure to science learning experiences.

OST programs are an important venue for developing science learning activation; they offer flexibility and opportunities youth may not encounter elsewhere. Because activation positions youth for success and persistent engagement in science learning, researchers and program providers may want to consider science learning activation as a fitting program outcome.

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An "I" in Teen?

Perceived Agency in a Youth Development Program

Chelsea Frosini

As I reviewed participant feedback from the out-of-school time (OST) youth development program I managed at the New-York Historical Society Museum and Library (N-YHS), I was excited to recognize a pattern.

Many of the teen participants wrote responses like "I am proud of what my team was able to accomplish" and "I enjoyed being able to plan an event on our own and actually see it happen." These participants were reflecting a high level of ownership of their accomplishments in the program. They seemed to have experienced the youth development outcome known as *agency;* that is, they were "acting or exerting influence and power" (Mitra, 2004, p. 662). More specifically, Mitra (2004) says that *agency* "connotes a sense of confidence, a sense of self-worth, and the belief that one can do something, whether contributing to society writ large or to a specific situation" (p. 662).

The N-YHS OST program already had assessments to collect the kinds of outcomes research has shown to result from participation in youth development programs: academic success, initiative, personal responsibility, and the like (Jones, Bench, Warnaar, & Stroup, 2013). What we didn't have was a system for measuring whether the program improved participants' sense of agency. I had no evidence either to show that participants developed agency or to uncover any effects of an increase in their perception of themselves as active agents.

As a fellow in the National Afterschool Matters Practitioner Research Fellowship, I was in a position to investigate program participants' expressed sense of agency in relation to research in developmental psychology and youth development. My inquiry was significantly shaped by Dawes and Larson's (2011) study of engagement, which suggests that, in order to

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fully benefit from program participation and achieve intended outcomes, youth need to be psychologically engaged. They need to be motivated enough that their attention is absorbed in the tasks and challenges of program activities (Dawes & Larson, 2011). In addition to measuring program participants' perceived agency, I wanted to investigate whether that perception of agency was correlated with engagement and with achievement of intended outcomes.

Using instruments I designed myself, I found that participants in the N-YHS program who reported a moderate to high degree of perceived agency also reported improved academic, personal, and social skills over the course of their program—more than their peers who perceived lower levels of agency. Participants who experienced agency also expressed their engagement with the program. In this paper, I describe the program, provide context from the literature for the significance of agency, outline the methods I used to measure participants' sense of agency, and describe how perceived agency correlated with intended program outcomes and with youth engagement. Finally, I share lessons learned that OST practitioners can use.

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The Student Historian Program at the New-York Historical Society

The OST program in which I conducted my participant research is an internship for students in grades 10–12 offered by the education division of the N-YHS, an American history museum and library in New York City. The program serves the city as a whole, not individual schools; participants represent the city's socioeconomic, racial, and cultural diversity. Students learn about the program from their history teachers or through recruitment visits to their school. To apply, they submit a written application and a teacher recommendation. Title I schools are targeted for recruitment because at least 60 percent of participants must qualify for free or reduced-price lunch. These students receive an hourly stipend.

The two-tiered Student Historian program provides participants with vocational and academic training while fostering leadership skills and increasing students'

understanding of American art and history. In both tiers, participants work on an assigned project during their 75 hours in the program. Though the youth get basic prompts from program facilitators, it is up to them to develop the vision and content for the project. By design, the projects, which involve both individual and group tasks, provide opportunities for youth to act as agents.

Participants in the first-tier group are known as Student Historians. Their project is to use the collection of N-YHS to develop resources local students and teachers can use to prepare for the state-mandated Regents Exam in U.S. History and Government. The Student Historians develop and host a U.S. History Regents Review Night at the museum in late May, leading gallery tours and activities; they also publish their materials on the N-YHS website. The project is assigned, and the OST program provides training to set the teens up for success, but the Student Historians decide how to conceptualize, organize, and actualize the project. As one Student Historian put it in her end-of-year assessment, "The supervisors do a lot of work to steer us in the right direction and help us get resources for our research upon request, but our tours and the NY Regents review manual are done completely by the students."

The Teen Leaders in the second-tier program have an even bigger responsibility: curating N-YHS's summer satellite exhibit on Governors Island in New York Harbor. The topic of the satellite exhibit is assigned by N-YHS senior staff, and the program supports Teen Leaders with content instruction and with curatorial training and supervision, but the Teen Leaders are responsible for identifying themes, choosing content, and developing the narratives for the exhibit. During the seven months of the program, Teen Leaders leverage the research skills they learned as Student Historians to explore their theme in depth. The group assigns specific roles to members, who participate in various check-ins and peer reviews as they research, write, and make curatorial selections. They work alongside N-YHS staff designers, archivists, and curators to make the final decisions for the exhibit. One Teen Leader described the process in her end-of-year assessment: "Starting from nothing, we were able to

create a vision for our exhibit, select artifacts, write up and organize label text, and brainstorm activities for when the exhibit opens.… We have accomplished a lot as a group."

Agency and Youth Development

Selected research from the literatures in youth development, developmental psychology, and anthropology helped to inform my inquiry into agency, engagement, and outcomes in the Student Historian program.

Some youth development researchers refer to agency, belonging, and competence as the "ABCs" of youth development (for example, Carver, 1997). Larson and Angus (2011) argue that adolescence is a particularly fruitful period during which to study the development of agency because teenagers develop new potential for higher-order thinking, such as reasoning about the dynamics of complex systems and exercising executive control of their own thought processes. However, "these new high-order cognitive potentials, are just that: potentials. Their realization depends on adolescents having the requisite experiences" (Kuhn, 2009, quoted in Larson & Angus, 2011, p. 65).

Teens are developing the cognitive capacity for agency, but they have few opportunities to realize this potential in our society. An anthropological study conducted by Schlegel and Barry in 1991 revealed that American teens are given little responsibility to society or authority over certain domains of social life; they therefore "seldom act as autonomous groups in constructive, socially meaningful ways" (p. 202). Teens are not likely to be given full responsibility for tasks from beginning to end, from planning through implementation to evaluation (Larson, 2000)—even though they are developing higher-order executive abilities, including the ability both to think from means to ends and to organize actions over time to achieve a goal (Larson & Angus, 2011). Schlegel and Barry (1991) found that American and European adolescents have less responsibility than adolescents in most other societies; they also have fewer occasions to engage in consequential action that requires planning.

Schlegel and Barry use the term *autonomy*, rather than *agency*, to describe adolescents' experience of owner-

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ship. Ryan, Deci, and Grolnick (1995) explain the connection between the two terms: "To be autonomous means to act agentically and to experience a sense of choice and willingness in one's actions" (p. 623). Agency thus can be understood as the ability to undertake actions from which autonomy can be experienced.

The relationships among agency, autonomy, and engagement are illuminated by self-determination theory. As described by Dawes and Lawson (2011), this theory maintains that environments that support autonomy, belongingness, and competence can foster intrinsic motivation and self-regulation. Increased motivation and engagement occur when a person identifies with, internalizes, and integrates the activity's goals into the self (Dawes & Larson, 2011). Thus, if a program environment is structured to support autonomy by facilitating agency, it can also foster engagement. Dawes and Larson (2011) outline three "personal goals" that enable youth to integrate an activity's goals:

- Learning for the future
- Developing competence
- Pursuing a purpose (p. 259)

These three goals emerged in the data I collected from N-YHS program participants.

Methods

When I conducted this research, I was the director of the Student Historian OST program. The methodology thus falls into the category of participant research. Below I outline some of the benefits and pitfalls of participant research, describe the tools I used to gather data from program participants, and outline my analysis methods.

Participant Research

Conducting research as a program participant—in my case, as program manager—offers benefits as well as potential conflicts. I acted as a participant-observer to gather my data, fully participating in the program I was studying (Becker, 1958, p. 652). This position comes with implicit bias and subjectivity: The "observer is part of the context being observed, and [the observer] both modifies and is influenced by this context" (Schwartz & Schwartz, 1955, p. 344). I know that my observation

could influence the students and activities I was observing, but I expected that influence to be minimal because I was already the program facilitator.

My goal was not to do a rigorous study but to understand my program better by conducting internal research. My experience with the program's existing assessment methods allowed for collection of new participant data to occur naturally; I could integrate both old and new measurements easily into established activities. DeWalt and DeWalt (2011) note that participant observation can enable a beneficial fluidity; it "encourages the continual reassessment of initial research questions and hypotheses, and facilitates the development of new hypotheses and questions as new insights occur" (p. 15). Though this method lacks the objectivity provided by an outside researcher, the conclusions I reached were valuable for internal program improvement.

Tools

The three tools I used or developed to study agency and its effects tapped into systems already in place in the N-YHS program.

Pre- and Post-Program Self-Assessments

I used previously developed pre- and post-participation self-assessments to assess student outcomes. Larson and Angus (2011) support the use of self-assessment to measure youth development outcomes, noting that the development of agency requires youth to be intentional producers of their own growth. Developed with the help of an outside consultant alongside a major revision to the Student Historian program in 2010, this self-assessment had been in use at N-YHS for five years. The results were used for program improvement and for reports to funders.

The assessments ask participants to rate themselves on 11 academic, professional, and personal skills the program seeks to develop: public speaking, leadership, time management, group work, independent work, written communication, punctuality, and others. Participants rate their mastery of each skill on a scale ranging from "beginning" to "exemplary"; they then provide written explanations for each choice. For example, a student who assesses her ability to work with primary sources as "developing" at the start of the program might rate her ability as "accomplished" or "exemplary" at the end of the program, explaining that she is now "able to find the main idea in a primary source and analyze its conclusions."

Mid-Program Survey

To measure agency, I administered a survey to the 42 participants in both tiers of the 2014–2015 Student Historian program. Thirty students, 19 in the first-tier Student Historian program and 11 in the second-tier Teen Leader program, completed the survey, for a response rate of 71 percent. The survey, which I created for this project, asked participants to rate, on a scale of 1 to 5, statements about aspects of agency such as voice, responsibility, the impact of their work, and their sense of being part of a team. As on the self-assessments, participants were asked to explain each rating. I determined the degree of perceived agency based on students' numerical ratings; their explanations illustrated their ratings and helped me select participants to interview. The questions and samples of their explanations are shown in Table 1.

To understand in depth how teens experienced agency and engagement in the Student Historian program, I interviewed five participants, two from the first-tier program and three from the second tier. They represented different ages, genders, and schools. I also chose participants with varying levels of apparent engagement and of achievement: one who frequently took charge of group discussions, one who preferred to work behind the scenes, one whose survey indicated a low level of agency, one whose survey indicated a high level of agency, and one who struggled to complete her work in the program.

I chose an unstructured interview approach to allow the participants to tell me about their project. I started by asking just two questions: "How do you describe your internship to your friends? Teachers? Another museum professional?" and "Describe your last Student Historian or Teen Leader meeting." From there, I let the respondents direct the conversation and asked follow-up questions based on their responses. The average length of the interviews was about 20 minutes.

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Table 1. Rubric for Coding Responses to Agency Survey

Survey Question	Description and Sample Student Explanation		
(Rated on a scale of 1 to 5)	**Low Agency**	**Medium Agency**	**High Agency**
How much of a voice do you feel you have at N-YHS?	1 = No voice 2 = Voice at (few) times *"I have little or no voice."*	3 = Voice half of the time *"I can provide input but I am not sure it would make a difference."*	4 = Voice most of the time 5 = Voice at all times *"I have the opportunity to influence every aspect of the exhibit we are curating."*
How much responsibility do you feel you have at N-YHS?	1 = No responsibility 2 = Low level of responsibility *"I have little responsibility at N-YHS."*	3 = Average level of responsibility *"I have an average level of responsibility, with some things I need to complete."*	4 = Above average level of responsibility 5 = Significantly above average level of responsibility *"I have the opportunity to have a group discussion with peers at each meeting to discuss … curating an upcoming exhibition."*
How much do you feel your work as an intern has an impact on the functions of N-YHS?	1 = No impact 2 = Low impact *"I feel like the work I'm doing is personally important but not significant to N-YHS."*	3 = Moderate impact *"I believe that our work forwards the mission of N-YHS, but I'm not sure how much it does outside of the education department."*	4 = Significant impact 5 = Extraordinary impact *"The quality of the exhibition is directly dependent on the work that we put in."*
How much do you feel you are part of the team at N-YHS?	1 = Never 2 = At (few) times *"We are student interns and aren't really included in the work at N-YHS."*	3 = About half the time *"I'm not sure that our work is related to the work of others at the museum."*	4 = Most of the time 5 = Always *"I have a special part to play at N-YHS."*

Analysis

Every student who completed an agency survey also completed a pre- and post-program self-assessment. Neither instrument was anonymous. The fact that I could identify (and knew personally) the survey respondents would be a limitation in more rigorous research. However, it did give me the ability to match each participant's agency survey with his or her outcomes assessment. I noted how each participant said that he or she had grown (or not) in the 11 skills on the self-assessment. I then connected that development to the level of agency indicated in the participant's survey.

To analyze the interviews, I isolated the parts where participants described making choices and having ownership of their projects in order to understand what agency looked and felt like to them. I used the same rubric I had used to code the surveys to look for patterns in the ways interviewees communicated that they had experienced agency and to see what program features or other factors influenced their perception of agency. I also looked for expressions of the three goals Dawes and Larson (2011) identified that can indicate engagement: learning for the future, developing competence, and pursuing a purpose.

Findings

This informal research yielded three interesting observations:

1. Many students in both tiers of the Student Historian program reported a high level of perceived agency.
2. Perceived agency as reported on the surveys was correlated with self-reported positive outcomes on the pre- and post-program assessment.
3. Students who expressed a moderate or high level of agency in their program experience also frequently expressed at least two of Dawes and Larson's (2011) three indicators of engagement.

Perceived Agency

More than halfway through the program, participants reported a high level of perceived agency on the survey.

- **Voice.** Asked whether they had a voice in their program, 87 percent of participants said that they did, most or all of the time. No participant chose "a few times" or "never."
- **Responsibility.** A majority of participants, 57 percent, said they had an above average level of responsibility at

N-YHS, with 17 percent responding that they had a significantly above average level of responsibility.
- **Impact.** Only 4 percent of participants felt they had a low level of impact on N-YHS; none said they had no impact. The remainder, 96 percent, said that they had a moderate to extraordinary amount of impact.
- **Teamwork.** Asked whether they felt like part of the team at N-YHS, 57 percent of respondents said that they were part of the team most or all of the time. No participants said that they were never part of the team.

These responses show that most participants experienced a high level of agency in the program.

Correlation Between Perceived Agency and Positive Outcomes

When I linked participants' development during the program, as reflected in their pre- and post-program self-assessments, to their responses on the surveys, I found a correlation between perceived agency and positive outcomes. Participants who ranked high or moderately high on the agency survey also were more likely to indicate growth from the beginning of the program to the end. High-agency participants typically indicated that they felt they had grown in 75 to 100 percent of the 11 youth development outcomes on the self-assessment.

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One Student Historian, an 11th grade public school student, indicated a moderately high level of agency on her survey: She said that she had voice in the program most of the time, felt an above average level of responsibility, and always felt a part of the team. Her self-assessments showed an increase in every one of the 11 skills, often moving from a rating of "developing" or "accomplished" to "exemplary." She cited examples of her work in the Student Historian program to explain her growth in each area. For example, to explain how her public speaking skills went from "developing" to "exemplary," she used as an example her ability to give museum tours.

Another Student Historian, a 10th grader, communicated a high level of agency in her survey, stating that she was always allowed to voice her opinions, that she had a lot of responsibility, and that she accomplished all of her work in a group. She also indicated improvement in all 11 outcomes on her self-assessment. To support her assess-

ment of her leadership skills, for example, she explained, "When no one steps up to take charge, now I will."

By contrast, the respondents whose surveys indicated lower levels of perceived agency also tended to show less development between the pre- and post-program self-assessments. For example, a Student Historian noted that she had a voice in the program half of the time, had a low level of responsibility, and felt a part of the team at N-YHS only a few times. This response indicates a low-moderate level of agency. Her self-assessments noted improvement in only three of the 11 outcomes—a much lower rate than that of participants whose surveys reflected higher levels of perceived agency.

Agency and Engagement

The student interviews provided evidence that program participants were frequently experiencing Dawes and Larson's (2011) three indicators of engagement: learning for the future, developing competence, and pursuing a purpose. Respondents who expressed a sense of agency in their interviews described at least two of these three indicators.

One 11th-grade Student Historian said that she felt like a part of the community at the museum because she got to do what she really liked: working on a team, writing, creating, and helping others with their exams. This response indicates a high level of agency, as the student felt like part of a team and could do something she liked. It also indicates engagement: She felt a sense of *purpose* in that she was helping others.

A 12th-grade Teen Leader expressed a high level of perceived agency and indicated that she was engaged with work that gave her a sense of *purpose*:

> I took a painting and did heavy research on it. From then on, I made it my own. I told a story about it, I interpreted it on my own, and gave back and let everyone know what I learned.

This Teen Leader also shared another indicator of engagement, *learning for the future*, when she said, "I think I'd now describe myself as an up-and-coming curator."

All the participants I interviewed who indicated a high level of perceived agency also exhibited a high level of acquired *competence* as they described their internship projects. They spoke at length about history topics with which they had developed experience, saying that their projects had taught them new processes and skills. One Student Historian, for example, said, "As an intern, I have developed tours for families, written materials for the education department, and helped curate an exhibit."

Building Agency and Engagement

In my surveys and interviews, respondents indicated that they experienced a high degree of agency in the N-YHS program. Participants with a high level of perceived agency on the survey also tended to perceive improvement in the 11 youth development outcomes on the self-assessments. Furthermore, interviewees with high levels of perceived agency tended to cite at least two of Dawes and Larson's (2011) three indicators of engagement. This finding is not surprising in light of the established connections among agency, autonomy, and engagement (Dawes & Larson, 2011).

My research was designed to inform program improvement and further my own professional development. However, my findings suggest practices other OST programs can adopt in order to cultivate agency. Though these practices stem from my work with a history museum, they can foster general youth development goals and are not specific to history-based or even humanities-based program content. They can be useful to any OST program that has agency as a program goal or wants to foster youth agency as a catalyst to realize other program objectives—at no additional financial cost.

Develop Agency to Achieve Intended Outcomes

My research in the N-YHS program revealed a correlation between perceived agency and the positive outcomes the program intended to achieve, such as public speaking and time management skills. OST practitioners might want to identify intended youth outcomes to which participant experiences of agency

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might contribute, such as self-efficacy, leadership skills, and ability to work in groups. Practitioners can then implement changes to facilitation styles and curriculum in order to foster agency.

Encourage Agency to Promote Engagement

Programs that want to foster both agency and engagement could look to the three personal goals that accompany engagement: learning for the future, developing competence, and pursuing a purpose (Dawes & Larson, 2011). These three indicators give program developers a clear menu of directions for curriculum, program design, and program structure. For example, the Student Historian program built in opportunities for staff from various museum departments to talk with students about their profession and their academic and professional trajectories. Another way the program encouraged agency was by making sure student clearly understood the purpose of their projects. For example, first-tier Student Historians got background information on the state history exam, such as current passing rates. Teen Leaders understood that the reason they attended a research methods training was to enable them to access resources they needed to curate their exhibit.

Use Youth Self-Assessments

The pre- and post-program outcomes measures I used in this study were self-assessment tools that required the teens to rate their own abilities. Larson and Angus (2011) found that self-assessments can allow youth to be intentional producers of their own development. Giving young people responsibility for setting their own goals and assessing how well they have met them encourages agency. Such self-assessments can also provide qualitative and quantitative data for continuous improvement and program accountability. The self-assessments used at N-YHS not only helped participants take responsibility for their own development but also provided data for funder reports and for ongoing program improvement.

Student Voice and Program Improvement

My research reinforced the importance of letting teens speak for themselves—giving them a say in fostering not only their own development but also the development of the program. Enabling youth voice both encourages agency and gives practitioners tools for program improvement. When program leaders reflect on possible improvements, and before making additions or revisions, they should listen to the youth as they speak about their experience and what engages them. At N-YHS, we started to present proposals for educational programming, including the Student Historian program, to the students. Collecting their feedback helped participants to feel a part of the N-YHS team and provided valuable insights to inform program development.

"Soft-Touch Adult Support"

My inquiry leads to many more questions, but I believe one is most urgent: How do OST educators facilitate youth agency while still "steering the ship"? One study describes the role of educators as "leading from behind" (Grossman, Campbell, & Raley, 2007, p. 40). Larson and Angus (2011) theorize that youth are most likely to learn skills for strategic thinking when they experience agency but also receive "soft-touch adult support that helps them keep on track, stretch, and exercise agency in expanded domains" (p. 292).

What does "leading from behind" or "soft-touch adult support" look like, especially from the perspective of youth participants? Student Historians and Teen Leaders provided some insights in their responses to my survey and interviews. On the agency survey, 90 percent of participants said that the balance of responsibility between youth and the adult supervisor was "good" or "exemplary." Describing her work to me during an interview, one teen described "soft-touch adult support":

> [The manager of visual arts programs at N-YHS] would help us a lot with the art-making part of our project, and it would be viewed as collaboration. It was part of his job to put together [an art] program for the museum, and he was helping us with our job, which was to do the same thing…. [We] were contributing to the same projects.

This participant appreciated the sense that she was working alongside an adult professional who also served as activity facilitator.

This response underscores an important point about youth agency: Cultivating agency in youth programs requires capable facilitation. Adult leadership that fosters agency is considerably more difficult than traditional models where adults tell youth what to do. Soft-touch adult support requires caring and highly trained facilitators who can help youth tap their own strengths. Only then can youth develop the agency that can lead to engagement and to positive youth development outcomes.

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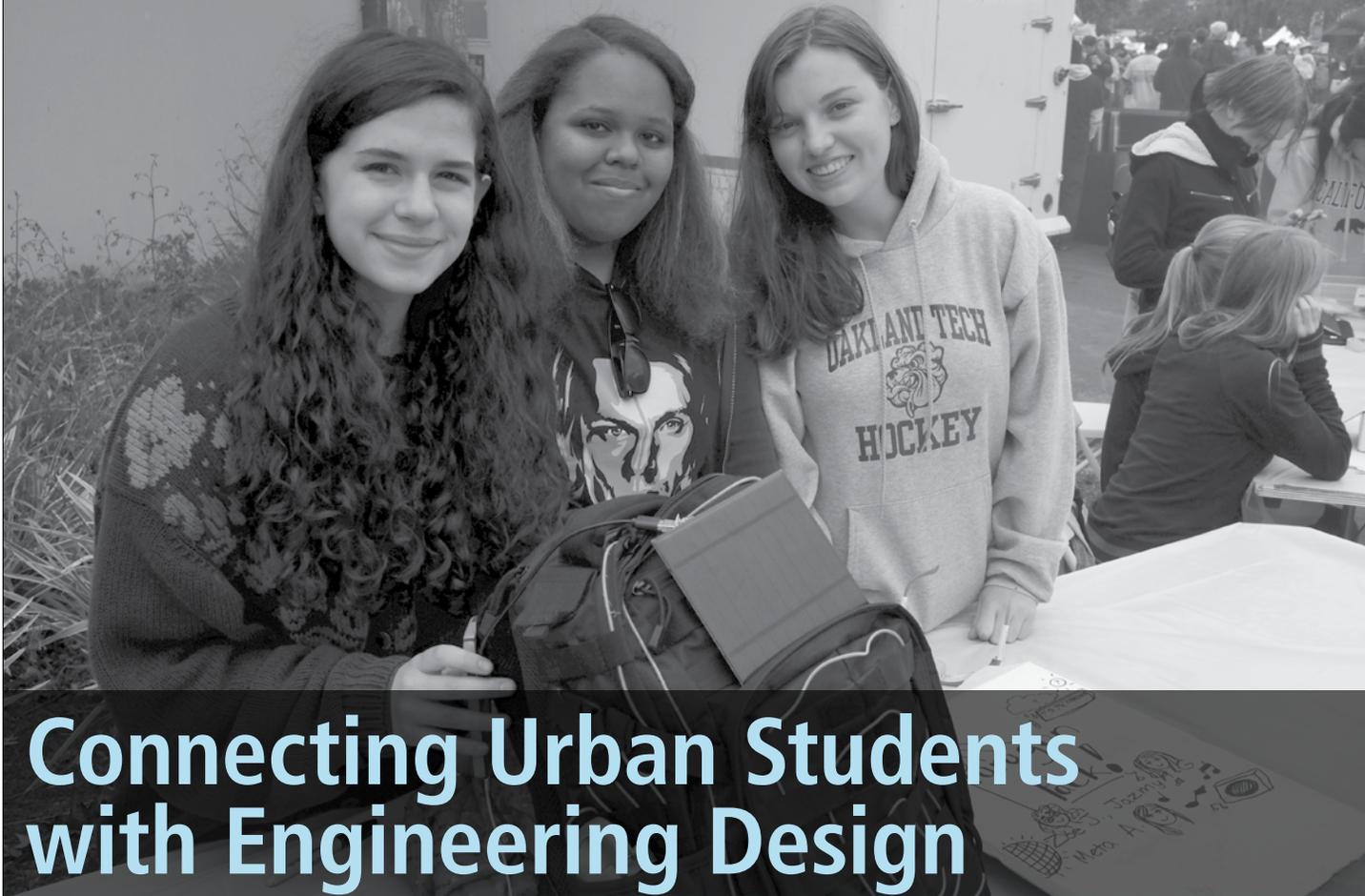
Connecting Urban Students with Engineering Design

Community-Focused, Student-Driven Projects

Carolyn Parker, Catherine Kruchten, and Audrey Moshfeghian

"Test it, and you gotta figure out what's the problem, like, if I build the rain barrel, … and I test it out with the filter, … and then see if … the polluted water comes down and see if it can works, turn it to clean water. And if we see it does not … I gotta figure out, "What's the main problem?" So I gotta think that, it's the filter's problem, or just the water's problem…. So I gotta check the filter. And then you take it out and then see what's wrong with it, and then figure out and then can improve it."

Tamitha, a fifth grader, explains engineering concepts after participating in the out-of-school time (OST) part of STEM Achievement in Baltimore Elementary Schools (SABES) for two years. Other participants offered similar ideas. Our study of this OST program, focused on science, technology, engineering, and mathematics (STEM), suggests that community-focused student-driven projects can help low-income urban elementary students develop an understanding of the engineering design process (EDP). OST STEM programs have been found to engage students and enhance interest in the

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STEM fields (Dynarski et al., 2004; James-Burdumy, Dynarski, Deke, Mansfield, & Pistorino, 2005). STEM-focused OST programs often support student-centered learning more than does in-school education, which is often driven by national or state standards and assessment requirements (Dierking, Falk, Rennie, Anderson, & Ellenbogen, 2003; Rennie, 2007).

Student-Driven Projects

Rennie (2007) notes that OST environments provide learning opportunities in which the curriculum is student-centered, attendance and involvement are voluntary, and program activities are not evaluative or competitive. The informal setting "is learner-led and intrinsically motivated, rather than teacher-led and extrinsically motivated" (Rennie, 2007, p. 127). The student-centered, voluntary, none-valuative nature of OST settings can make them better able than schools to bring the product and processes of STEM learning to students and to integrate STEM into their lives.

This integration is particularly important in low-income urban settings, where many students perceive STEM as disconnected from their own experiences (Basu & Barton, 2007). Brickhouse (1994) attributed the disconnect to a narrowly defined scientific way of knowing that separates science from students' personal experience. Seiler (2001) characterized the disconnect this way: "We were battling our own and others' perceptions that science is a collection of facts laid out in a book and not a collection of topics connected to everyday lived experiences" (p. 1007). To resolve this disconnect, Roth and Lee (2004) suggest that educators "organize learning environments that allow students to become knowledgeable by participating in and contributing to the life of their community, which has the potential to lead to life-long participation and learning" (p. 264). In particular, Basu and Barton (2007) found that when low-income urban "students encountered science classrooms in which they could choose and engage in activities connected to their visions of the future . . . they developed a strong, long-term commitment to pursuing science" (p. 487).

> When they start early with engineering practices and design process thinking, students develop important skills—such as communication, collaboration, inquiry, problem solving, and flexibility—that form the foundation for their educational and professional lives.

Engineering Design

Historically, engineering has not been a prominent component of K–12 education. The Next Generation Science Standards (NGSS Lead States, 2013) are seeking to change this reality by introducing an integrated approach to STEM learning. In the new framework, engineering and design constitute one of the four disciplinary core ideas, along with Earth and space science, life science, and physical science. The practice of engineering, with explicit connections to professional engineering practice, is likewise emphasized. The crosscutting concepts in NGSS enable students to integrate the sciences and engineering, reinforcing the close relationships between the disciplines and providing context for problem-based learning. The goal is to develop an integrated understanding of science and engineering over time (NGSS Lead States, 2013).

The NGSS promotion of engineering design as a critical element of K–12 education is in keeping with the recent trend of promoting design process skills in college engineering programs (Doppelt, Mehalik, Schunn, Silk, & Krysinski, 2008). When they start early with engineering practices and design process thinking, students develop important skills—such as communication, collaboration, inquiry, problem solving, and flexibility—that form the foundation for their educational and professional lives (Doppelt et al., 2008; NGSS Lead States, 2013).

STEM Achievement in Baltimore Elementary Schools

In 2012, Johns Hopkins University and Baltimore City School District formalized the SABES project. SABES is a community partnership initiative that includes both in-school and afterschool STEM education for grades 3–5. It was designed to broaden participation and achievement in STEM education by bringing science and engineering to the lives of low-income urban elementary school children. With the support of community-based organizations that provide afterschool programming, SABES serves families and children in three Baltimore City neighborhoods.

SABES engages directly with students in three ways:

1. During the school day, students are taught with a curriculum aligned to the NGSS (2013) that challenges them to draw their own conclusions about science concepts through hands-on investigations.
2. Community-based organizations help facilitate local STEM events that bring together teachers, students, families, other community members, and university-based partners to learn collaboratively about STEM topics, engage in hands-on activities, and celebrate student projects.
3. Community afterschool providers help SABES staff offer the OST program, which is organized around community-focused, student-driven projects, explored through problem-based learning and the EDP.

Problem-based learning takes place when "students encounter carefully selected, but ill-structured problems before they experience any instruction in the particular focus area" (Bridges & Hallinger, 1997, pp. 5–6). The essence of ill-structured problems is their open-endedness; problem-based learning does not direct students toward a determined path. Using ill-structured problems in STEM education gives students the autonomy to define a problem they want to address and to develop the process they will use to work toward a solution. The literature often confuses *problem-based* learning with *project-based* learning, *inquiry-based* learning, or *expeditionary* learning. The feature that distinguishes problem-based learning in SABES is the centrality of the ill-structured problem identified by students and explored through the EDP.

The SABES OST program meets for four hours each week, led by facilitators who are either teachers in the host school or individuals hired by the partner community-based program. Twice a semester, facilitators receive professional development designed to support implementation of student-driven projects.

The student-driven projects emphasize the relevance of STEM in the children's neighborhoods. Accompanied by their facilitators, students from each site complete a community walk-through. As a group, they identify a problem or dilemma in their community. Once the group has chosen a problem, the facilitators help the students view that problem through the lens of problem-based learning. In alignment with the problem-based learning approach (Bridges & Hallinger, 1997), students are responsible for everything from defining the problem to researching appropriate content and developing a solution. This process connects students with the engineering process by giving them complete ownership of their project through its entire lifespan. By choosing projects that are directly relevant to their lives and developing real-world solutions, the students experience first-hand that STEM, far from being merely a decontextualized school subject, can be used to improve their community.

Once the students identify their problem-based project, the facilitators guide their exploration of the project using the five-step EDP for elementary-age children outlined by Engineering Is Elementary (2016):

1. **Ask.** What is the problem? How have others approached it? What are your constraints?
2. **Imagine.** What are some solutions? Brainstorm ideas. Choose the best one.
3. **Plan.** Draw a diagram. Make lists of materials you will need.
4. **Create.** Follow your plan and create something. Test it out!
5. **Improve.** What works? What doesn't? What could work better? Modify your design to make it better. Test it out! (Engineering Is Elementary, 2016)

STEM mentors from the Johns Hopkins Whiting School of Engineering volunteer to work with students to develop their projects. The volunteers include university faculty, postdoctoral fellows, and students from several departments, including computer science, mechanical engineering, civil engineering, materials science and engineering, and geography and environmental engineering. The Johns Hopkins mentors, along with site facilitators, support the use of the EDP as the students develop their problem-based projects. Working with the

> Examples of student-driven projects undertaken in SABES programs during the 2014–2015 school year include exploring vacuum technology to clean up a littered playground; developing inexpensive, sustainable shelters for Baltimore's homeless population; and exploring ways to decrease the amount of lead in Baltimore's drinking water.

university mentors also exposes students to engineers in a variety of fields.

Examples of student-driven projects undertaken in SABES programs during the 2014–2015 school year include exploring vacuum technology to clean up a littered playground; developing inexpensive, sustainable shelters for Baltimore's homeless population; and exploring ways to decrease the amount of lead in Baltimore's drinking water. By creating projects that have personal significance, students develop a rich experiential understanding of the EDP. Creating projects that align with the values of their communities bridges students' academic lives and their environment beyond the school walls. Research suggests that basing STEM projects in students' communities is crucial in meeting the needs of low-income students and in developing their long-term engagement with STEM (Basu & Barton, 2007; Bouillion & Gomez, 2001; Roth & Lee, 2004).

Building Understanding of the Engineering Design Process

To understand how the SABES approach influences students' understanding of the EDP, we adopted a validated instrument developed by Hsu, Cardella, and Purzer (2012). The instrument uses an illustration of a student's design process for a specific assignment—an egg drop contest—to structure one-on-one interviews that probe the student's understanding of the EDP. We chose the instrument because it is an age-appropriate, validated instrument that shows promise in capturing a student's knowledge of the EDP.

Using the protocol established by Hsu, Cardella, and Purzer (2012), interviewers used the instrument to frame individual interviews with 12 students who had participated in the SABES OST program for two years. All 12 came from a site that had been assessed by SABES staff as having a well-implemented program. The SABES research and evaluation team completes regular visits at each site during which we document facilitator and student attendance, note the general instructional climate, observe the engagement of the facilitators and students, and assess instruction. This site was determined to have the best-run OST program of the three sites because students attended regularly, the climate was positive, and almost all students were engaged in the day's activities during the site visits.

Ten girls and two boys were interviewed. Nine of the girls identified as African American, one girl identified as Asian, and both boys identified as African American. All 12 students were in fifth grade. Each interview was video recorded, transcribed, and analyzed by two independent coders. The two coders worked together to develop consensus on the assertions developed for each interview. The coding process allowed us to identify themes and draw conclusions about the students' understanding of the EDP.

The analysis of the interviews and the themes that emerged revealed that the SABES OST program supported students in developing an understanding of the EDP. The interviewed students recognized the EDP and could describe it in detail. Moreover, the students described the importance of community-focused, student-driven projects in supporting their understanding and application of the EDP. Our assertions support and extend findings from earlier studies focused on the importance of integrating students' communities in STEM learning (Basu & Barton, 2007; Bouillion & Gomez, 2001; Roth & Lee, 2004).

Highlighting the Importance of Iteration in the Engineering Design Process

When we interviewed the 12 students, four of them recognized the EDP and described it in detail without any prompting. Six others recognized that the instrument depicted the EDP, but, unprompted, gave much more limited explanations. When these six students were prompted about how the EDP diagram in the instrument was related to their experiences in the SABES OST program, they explained the EDP in detail without additional prompting. All 12 students remembered the "imagine" and "plan" components of the EDP, and no student forgot more than one EDP component.

What we found most intriguing was that 11 of the 12 students were able to articulate the "improve" phase in great detail. Students were quite articulate about the notion that the EDP is a cycle that may need to be repeated, especially to improve on the project; that is, they understood the iterative nature of the EDP. Kaiya shared her understanding of the improve phase:

> And improve … if you test your model and … if it falls or the head falls off or the tape wasn't strong enough, you could remove the tape and put new tape on or change the position.

> We are experienced educators who have taught STEM both in school and in OST. We were pleasantly surprised, yet intrigued, by the students' emphasis on how the iteration step improves the design of a product.

Nevette shared the importance of improving a design: "When you test it and it don't work, you gotta improve it to make it better."

We are experienced educators who have taught STEM both in school and in OST. We were pleasantly surprised, yet intrigued, by the students' emphasis on how the iteration step improves the design of a product. In the age of No Child Left Behind (NCLB) and now Every Student Succeeds, STEM education is often pushed aside, particularly in the elementary grades. In a survey of 164 elementary teachers, more than half indicated that they had cut time from science instruction since NCLB became law (Griffith & Scharmann, 2008). The main reason they gave was the need to increase time for mathematics and reading instruction. This perception is not surprising: Reading and mathematics are the most commonly assessed subjects, and educators' careers can be determined by their students' assessment results. However, the focus on reading and math to the exclusion of science may be shortsighted: Some evidence suggests that science learning can promote student achievement in math and reading (Milner, Sondergeld, Demir, Johnson, & Czerniak, 2012).

Although they may understand the benefit of making science relevant, teachers cite lack of time, resources, and professional development as impediments to teaching science (Milner et al., 2012). Marx and Harris (2006) state that contemporary elementary students are missing out on what many adult scientists experienced when they themselves were in elementary and middle school: science instruction and experiences that sparked their interest, curiosity, and imagination. Teachers are often forced to move through STEM content quickly, perpetually chased by the high-stakes assessment at the end of the year. Students are not given time to explore processes or revise their answers. There is an overemphasis on finding the "right" answer.

SABES aims to address these issues by leveraging the flexibility of the OST environment, which allows time to explore science and engineering content. SABES also provides support and professional development to allow facilitators to meet the challenge of leading problem-based learning through student-driven projects. Our student interviews suggest that this approach was working: Almost all of the students understood that revision was an important step of the EDP and that one answer, developed after a brief struggle with the material, was not necessarily the most appropriate or "right" answer.

Bridging STEM Learning with Students' Community

In their study of a community-based education partnership, Bouillion and Gomez (2001) found that solving real-world, community-based problems enhanced student learning. Students were more interested in science and expanded their understanding of the nature of science (Bouillion & Gomez, 2001).

Our work with community-focused, student-driven projects extends this work from the domain of science to the domain of engineering design. The students we interviewed were able to contextualize the importance of using the EDP in their projects to help their communities. For example, Raushaun said that the steps of the EDP "will make you more to be an engineer and more to make the structure better to help the people." The students who grounded the EDP in contexts to which they could relate in personal and meaningful ways showed greater understanding of the EDP and of engineering in general. Furthermore, the students we worked with were able to articulate how engineering applied to their lives beyond the confines of school. Alisha related her work in the OST to her community:

> [The site facilitator] took us on a community walk. We try to solve—we could try to list out all the things that we had problems during the community … brainstorm many ideas and then choose one best idea. So then we list a whole bunch of problems and then we discuss, and then each group select one topic. And then they gonna do some research … about that and see … how many affect the environment and how we can make this better.

Our work contributes to the body of literature on the value of community-focused, student-driven projects. Moreover, our work highlights the need to provide context for STEM content, allowing students to develop understanding of how engineering and design processes are valuable outside the classroom.

> The students who grounded the EDP in contexts to which they could relate in personal and meaningful ways showed greater understanding of the EDP and of engineering in general. Furthermore, the students we worked with were able to articulate how engineering applied to their lives beyond the confines of school.

This need to allow students to connect with their projects has several implications for STEM teaching and learning. Educators must not only be well versed in the STEM content that supports student projects but also be able to show students how their projects have value beyond their performance in school. Facilitators need to spend time explicitly on the "big picture" of the EDP in order to mitigate students' tendencies to look for the "right" answer or get caught up in the details of executing individual steps. The need to improve designs and to repeat the EDP cycle should be emphasized. Educators need to help students see the societal value not only of their specific projects but also of engineering generally and of the use of a design process to solve problems.

Implications for Practice

Encouraged by how students articulated the importance of the student-driven projects in their developing understanding of engineering and the EDP, we interviewed the two facilitators of the OST site attended by the 12 interviewees. Both facilitators were teachers at the host school, one in fourth grade and one in fifth. Our interview questions focused on what improvements could be made in the implementation of the OST STEM program and in the support of the student-driven projects.

These facilitator interviews led to several modifications to the SABES OST program. For example, because the community walk-throughs are such an important component of the student-driven projects, we have given the students guiding questions to focus their observations, providing a bit more structure to maintain their attention.

Another improvement was to reach out to more community members and businesses who could support deeper community connections, strengthening the students' projects. Consequently, student-driven projects now include awareness campaigns designed to engage community partners. Students create flyers, attend events, visit local businesses and organizations, and speak to the public about the problem they are addressing and their proposed solutions.

One of the facilitators' biggest concerns was the need for professional development regarding community-focused, student-driven projects. Rather than providing answers to students, SABES OST facilitators have learned to guide students by asking questions and coaching independent exploration—the approach advocated in the NGSS. The facilitators we interviewed said that they required time to become comfortable in this role and that they needed professional development to become comfortable redirecting questions back to the students and asking them to explain their answers.

Finally, we used the interview feedback of students and facilitators to revise the process for the next cycle of projects. OST STEM programs that want to implement community-focused, problem-based student-driven projects might consider implementing these steps.

1. **Arrange community walk-throughs.** Take students on a walk through the school's neighborhood, asking them to take note of particulars. Use a handout with specific questions to focus students on community issues for which STEM can be used to create a solution. Have STEM mentors—for example, university students or mentors from area STEM-focused businesses—help the students develop and refine the questions.

2. **Identify potential neighborhood partners.** Recruit local businesses, schools, and other organizations that can provide resources to help students better understand community issues. Focus on organizations that will provide different perspectives on the same community issue.

3. **Narrow down issues.** Discuss with students the issues they identified, examining how these problems affect the neighborhood. Help students narrow the list to the most problematic. Discuss which students are qualified to tackle these issues.

4. **Formulate solutions.** Help students conceptualize three possible STEM solutions to the issue or issues they have chosen. STEM mentors, if available, can help the students narrow down the choices by discussing which solution is the most feasible and affordable. Students may split into groups and try different solutions, if they want, as long as the process is coherent.

5. **Create a preliminary supply list.** Disclose the operating budget to students and give them responsibility of creating an initial supply list. Supervise them closely to avoid going over budget.

6. **Perform background research.** While supplies are being ordered, have students conduct research on the topic. Research can include interviewing community members or reading about the topic in print or internet sources.

7. **Create a campaign.** During the research phase, have students design a small-scale community awareness campaign. For example, they could create a brochure featuring the community problem and how the students intend to solve it.

8. **Arrange field trips and invite guest speakers.** Identify local organizations and projects that students can visit or invite guest speakers to discuss the topic. Outside input can shed light on the issue or the proposed solution.

9. **Model and test.** Have facilitators and STEM mentors work with the students to create a preliminary model of a proposed solution. Then have students test their first model.
10. **Improve.** Once students test their first model, lead them to modify and improve the model.
11. **Launch.** Sponsor a recognition event at which students can present their projects to their families and community members. Support the students to prepare a presentation of their project. This event helps student develop public presentation skills.
12. **Initiate next steps**. Finally, encourage students to continually refine and improve their model.

Finally, every student should have a project notebook in which to document the group's models, tests, findings, and improvements.

Applying what we learned by observing one site and interviewing 12 students and two site facilitators, we have scaled SABES to nine elementary schools. Other OST programs may be able to build on our work to provide elementary students with community-based, student-driven programming that helps them learn the engineering design process.

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"Systems Trump Programs"

A Case for Agency Support in Afterschool

Alexandria Hodgkins

At a training by one of New York City's main afterschool funders, the presenter introduced common scenarios in the field. My group's scenario read something like this:

> Liz just started as director of an afterschool program. She is excited to start a new arts program and wants to hire teaching artists. When she asks her human resource manager to explain the hiring process, he tells her to ask her supervisor. Her supervisor tells Liz to e-mail a coworker. Liz sends the e-mail but never hears back. Liz asks her supervisor for the program budget but is told she is not allowed to see it. She asks how much she is allowed to spend on instructors. No one seems to be sure. After a few months of this, Liz is getting discouraged and losing her ambition. What should Liz do?

People in my group said the situation resonated with them. As they gave suggestions on how Liz could move forward, I was stuck on more basic questions: "Why is this acceptable? Why isn't Liz's agency accountable for supporting its afterschool program?" In the large-group discussion, a program manager from the funder sponsoring the training said she sees situations like Liz's all the time. That raised another basic question: "If our funders know this is a problem in the field, why aren't they doing anything to prevent it?"

When I started my inquiry for the National Institute on Out-of-School Time's Afterschool Matters Practitioner Research Fellowship, I wanted to investigate afterschool programs that had been rated "excellent" by funders. I wanted to understand what excellent programs look like and how they get that way. I had a hidden assumption: that success rests solely—or maybe just mostly—on the shoulders of the person on the ground running the show: the program director.

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However, as the year of inquiry wore on, an unforeseen theme kept popping up. It became more and more clear to me that, if you want to run an excellent program, you need support from your agency or organization, which in turn needs support from program funders. In other words, "systems trump programs" (Fixsen, Naoom, Blase, Friedman, & Wallace, 2005).

This essay explores what I learned during that year. My aim is to help program directors who have found themselves in Liz's shoes: They want to run high-quality programs, but they make little headway because they have little support from their agencies. Besides offering program directors some ideas on how to cope with this situation, I also want to implore agencies to take ownership of their programs and to beg funders to hold agencies—and themselves—accountable.

What Makes a Program "Excellent"

The first thing that tipped me off to the importance of agency support was a list of programs rated "excellent" by the New York City Department of Youth and Community Development (DYCD). In 2014, out of 703 out-of-school sites, 28 were identified as excellent. The tipoff was that those 28 excellent sites were sponsored by only 17 agencies. A light went off in my head: This can't be a coincidence. These agencies must have good systems and be helping their programs to succeed. I started to realize that the program director isn't the only one who lays the groundwork for success; the agency is important as well.

To arrive at these ratings, DYCD grades sites based on their administrative records, rate of participation, and two site visits by DYCD program managers every year. The visits, which usually last at least two hours, include a combination of observations and interviews. The observers rate sites in six main categories: facility and environment, effective staffing, relationships, structures and partnerships, quality of implementation, and program content. The observers visit program sites but not the agency's headquarters—that is, they assess the program only at the point of service where children and staff interact. The agency itself never seems to be evaluated.

My plan for examining what makes a program excellent included surveys of sites, both those rated excellent and

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some that were not. However, I received surveys from only two of the programs rated excellent—not enough to go on. In this essay, therefore, I report only on my interview with a DYCD program manager and my visit to a highly rated site, during which I interviewed four staff members including the program director.

When I interviewed program staff, the things they said would make a program excellent had little to do with the six categories on which DYCD rates programs. My respondents kept bringing up criteria such as "buy-in" and holistic programming. For example, when asked what makes programs excellent, longtime DYCD program manager Karen Hill said:

> The first and most important thing is that everybody must buy into the program. And what I mean by "buy in" is, they must be committed. Everybody wants to be a part of it…. Number two: The program must have support from either their main agency or their top person. It must be very supportive of the program.

Karen's words reinforced what I was learning about agency support, but the criteria she outlined were not reflected in the rating tools.

Why Agency Support Is Crucial

The idea that afterschool sites need agency support to run successful, high-quality programs is supported by the Forum for Youth Investment study "Continuous Quality Improve-ment in After School Settings" (Smith et al., 2012):

> Reviewers noted that an explicit focus on how point-of-service settings are nested within higher levels of organizational and policy context is a critical conceptual frame for advancing intervention science because interventions must take account of how "systems trump programs." (p. 7)

Figure 1 illustrates the idea that programming at the point of service is embedded within the agency context. Both the program and the agency are, in turn, embedded within the policy context, which includes, for example, funder requirements and political realities. On the right are a few of the many additional forces that affect the program, such as its school and neighborhood and the agency's network.

Figure 1. Program Context

Ratings that measure programs only at the point of service do not account for the broader contexts in which programs function. A program will have a hard time achieving success if its agency lacks effective systems. The ones who need to address this issue are the agencies themselves. In addition, funders need to hold agencies just as accountable as they now hold direct program staff.

What Excellent Programming and Agency Support Look Like

A visit to one of the sites DYCD had rated as excellent helped confirm my sense of the importance of agency support. The Greater Ridgewood Youth Council (GRYC) has provided services to youth and families in the Ridgewood area of Queens since 1980. When I walked into the building, an old Masonic Temple turned community-based organization headquarters, I immediately noticed all the colors. Children's art hung all over the walls. A pre-K group walked past with blue and yellow fish they had made in arts and crafts class. In the background, I heard the busy noises of children playing.

The director of program operations, who managed a variety of GRYC programs, was warm and friendly. As we walked to her office, she introduced me to the crossing guard, the secretary, and all her co-workers. As she told me about GRYC and its work, I was struck not only by how kind she was, but also by how calm and relaxed she seemed. She spent two and a half hours with me without giving a single sign that she had to leave or move on. When she took me to one of GRYC's school-based afterschool programs, I got the same feeling from the site director: He didn't seem to have a care in the world.

The staff and kids mirrored the leaders I'd met—they seemed calm and happy. When bringing out the snack, a group leader had to say, "If you hear my voice, clap once" only one time, and all the kids went silent. The facility didn't seem exceptional, and the homework time was pretty standard. What set this site apart was the adults' relationships with the kids and the positive atmosphere. This was a program where everyone knew everyone's name, and a clear community existed. The instructors led hands-on activities that seemed to engage and interest the kids. When I asked the site director what he thought every excellent site director should bring to work every day, he said, "a smile." This program seemed to have something that is being lost in many afterschool programs: good old-fashioned fun.

When I looked for reasons for GRYC's excellence, a few things stood out. For one, both the program operations director and her boss, the president of GRYC, had degrees in education and were former classroom teachers. They also described close ties with the community. Both senior leaders seemed to be hands-on, supportive bosses. They visited every site every few weeks and knew staff and children on a first-name basis. The program operations director and site director both regularly reviewed instructors' weekly lesson plans. Simply put, GRYC was very involved in the daily operations of the sites. The result was well-run sites with excellent programming.

When I asked leaders if they set specific goals, purchased expensive curriculum, or had a rigorous staff training program run by highly skilled consultants, they simply said "no." The president told me what he thought made for great programming: "It's about passion. I tell my staff all the time, 'We can teach you anything, but we can't teach you passion.'" GRYC seemed to be sticking to basics—qualified staff, strong relationships, and, most of all, a passion for children. The approach seemed to be working.

The Doom Loop and the Flywheel Effect

GRYC was avoiding what Jim Collins, in his business book *Good to Great* (2001), calls the "Doom Loop." Instead, it embraced the "Flywheel Effect." Flywheel Effect organizations like GRYC make change "gradually, consistently—building tangible evidence that their plans [make] sense and … deliver results" (Collins, 2001).

GRYC didn't rely on magic bullets. The agency was building on strong leadership and offered support to its programs. The president had put together a team whose members stayed for the long term. He "got the right people on the bus." Collins (2001) points out that great leaders "don't motivate people—their people are self-motivated." That's the "passion" the president told me he was looking for. Once he put together his team of passionate educators, together they stuck with what worked; they didn't buy into gimmicks but stayed with the basics.

In contrast to GRYC, programs that struggle to find clear direction from their agencies may fall victim to what Collins (2001) calls the Doom Loop: constant change without enough time and discipline to see it through. "They start down one path only to change direction. After years of lurching back and forth, [they] discover they've failed to build up any sustained momentum" (Collins, 2001).

The Doom Loop sounds familiar to many program directors. Many sites and agencies struggle to keep up with constant changes in demands—especially from funders but also from other stakeholders, such as the host school or parents. Every year brings new expectations: How many hours of literacy must we do? How much physical recreation do students need each week? And now we have to incorporate a robust STEM (science, technology, engineering, and math) program.

Agencies that have a strong sense of their identity and mission often can deal with new mandates. They say, for example, "OK, there is a new mandate for STEM. What are we already doing that could be considered STEM, and how can we bolster it?" Creatively finding ways to align what they are already doing to the new standards supports the Flywheel Effect of sustainable change.

Other agencies that don't have such a strong sense of self may panic when faced with new mandates. Often they buy new curriculum from the companies that sell "proven" materials—but without getting proper buy in from program leaders and staff. They go for the quick fix, causing a constant Doom Loop. Meanwhile, the whole problem could have been fixed by dialogue. Agencies blame funders for always changing things on them. Meanwhile, funders wonder why agencies don't see that the mandates are flexible enough to work with their existing program strengths. The entire process often leaves the program director and staff out of the conversation entirely. Not being consulted leaves staff feeling disaffected, increasing the Doom Loop through lack of buy-in.

Constant change and lack of adaptability creates a systemic Doom Loop effect both in individual programs and agencies and throughout the field. "Systems trump programs" (Fixsen et al., 2005) when top-down policies affect programs at the point of service. Years of constant changes to program mandates have created what feels like a Doom Loop in the entire system.

> When I looked for reasons for GRYC's excellence, a few things stood out. For one, both the program operations director and her boss, the president of GRYC, had degrees in education and were former classroom teachers. They also described close ties with the community. Both senior leaders seemed to be hands-on, supportive bosses. They visited every site every few weeks and knew staff and children on a first-name basis.

Recommendations

How can we convert from Doom Loop behavior to become Flywheel Effect organizations? I have some ideas for program directors, for agencies, and for the field, especially funders.

For Program Directors

For program directors, the Doom Loop may sound all too familiar. If so, your agency may not be supporting your program as it should. Though it can be hard to maneuver through broken systems, I have some ideas to help you keep your sanity and make your program successful.

Give yourself a break. If you are anything like me, you may feel that the success of your program rests solely

on your shoulders and that you are responsible for all mistakes or failures. Stop that! Give yourself some credit, and stop blaming yourself.

Take stock. Figure out what is within your control—what you can fix or improve on, such as program routines and culture. Do what you can in those areas. For things that are outside your control, see the next steps.

Manage up. Addressing issues you can't control, like fiscal and human resource systems, means asking your boss or other higher-ups for help. It can be tricky when your pleas fall on deaf ears, so be sure to document your efforts. If things go wrong, at least you have a record of your attempts to fix the situation.

Call for backup. If you can find an ally either in your agency's senior management or at your funder, you can bring that person the issues that need to be corrected. This tactic has to be executed delicately. Never "throw people under the bus"; speak in generalities and from a place of caring. Your only objective should be to run a great program, not to win a power struggle.

For Agencies

Agencies are under a lot of pressure to perform according to their contracts while always keeping community interests at heart. Agency leaders might consider these steps to support their programs in serving the greater good.

Get clear about the standards. If your funders give a new mandate, ask questions: What does this have to look like? Can we phase it in over time? Is anything we are already doing aligned to this mandate? I have spoken with funders who seemed frustrated that agencies make knee-jerk changes instead of looking at how to align existing programs with new requirements.

Get clear about your identity. If you know who you are and what your programs are all about, you will not bend so easily to every new fad coming down the pipeline. Agencies should invest time and resources in understanding their strengths and the needs of the community they serve. This understanding forms a solid foundation for the work. Figure out what you are willing to change and what is intrinsic to your identity and mission. Get really clear on what is important to you.

For the Field

Program directors and agencies can do only so much. Most efforts to promote the Flywheel Effect and avoid the Doom Loop will have to come from the top.

Hold the agency accountable too. The most important thing funders can do is create systems of accountability. They must give agencies clear guidelines on the role they should play in supporting programs. They should evaluate not only whether program staff are doing their job at the point of service but also whether agencies are doing their job behind the scenes to make sure programs are successful.

Be clear on what your standards mean. Sometimes the new mandates that come out each year reach agencies in cryptic emails that read almost as threats. No wonder agencies freak out and run to curriculum suppliers for help! Help agencies do what you really want them to accomplish by breaking down what the standards mean. Discuss what compliant programs can look like and how programs will be judged. Make sure agencies know they can meet the standards by creatively augmenting what they are already doing. Above all, keep the lines of communication open.

Our students deserve the best programs we can give them. Sometimes it is our job—whether we are program directors, agency leaders, or funders—to fight the good fight on their behalf. The more the education system as a whole struggles, it seems, the more the afterschool field feels the shock. We have to be our own advocates, working to break the Doom Loop to get our agencies—and our field—established in the Flywheel Effect.

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Afterschool Matters

Call for Papers

Afterschool Matters is a peer-reviewed journal dedicated to promoting professionalism, scholarship, and consciousness in afterschool education. Published by the National Institute on Out-of-School Time with legacy support from the Robert Bowne Foundation, *Afterschool Matters* serves practitioners who work with youth in out-of-school time (OST) programs, as well as researchers and policymakers in youth development.

We are seeking articles for future issues of the journal, beginning with Spring 2018. Scholarly or practice-based work on all aspects of OST programming for children and youth, from a variety of disciplines and academic perspectives, will be considered. We welcome submissions that explore practical ideas for working with young people in OST programs. Personal or inspirational narratives and essays are appropriate for our section "Voices from the Field."

All articles, whether scholarly or practice-based, should connect theory to practice and should be broadly applicable across the field. Articles must be relevant and accessible to both practitioners and academic researchers.

We invite you to discuss possible topics in advance with us. A broad variety of topics will be considered, including the following:

- Innovative program approaches
- OST programs and civic engagement, social and emotional development, arts development, or academic improvement
- Research or best-practice syntheses
- OST program environments and spaces
- Key aspects of program leadership and administration
- OST system-building, such as cross-city and statewide initiatives
- Expanded or extended learning time and the OST hours
- School-community partnerships that support OST programming
- Physical activity and healthy eating
- STEM (science, technology, engineering, and math) program delivery or STEM staff professional development
- Special needs youth, immigrant and refugee youth, or other vulnerable populations in OST
- Youth-centered participatory action research projects
- Gender-focused research and policy initiatives related to OST

Submission Guidelines

- For consideration for the Spring 2018 issue, submit your article no later than June 10, 2017, to ASMsubmission@wellesley.edu.
- Submissions should not exceed 5,000 words.
- Submit your article electronically in Microsoft Word or rich text format. Use 12-point Times New Roman font, double-spaced, with one-inch margins on all sides. Leave the right-hand margin ragged (unjustified), and number pages starting with the first page of text (not the title page, which should be a separate document).
- Include a separate cover sheet with the manuscript title, authors' names and affiliations, and the lead author's phone number and e-mail address.
- The names of the authors should not appear in the text, as submissions are reviewed anonymously by peers.
- Follow the *Publication Manual of the American Psychological Association, 6th Edition* (2009), for reference style guidelines. Present important information in the text and do not use extensive footnotes.

We welcome inquiries about possible article topics. To discuss your ideas, please contact:

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