

Afterschool Matters

Number 18 • Fall 2013

**Teaching the *What* as Well as the *How*:
Content-Rich OST Professional Development**
Benjamin Cooper

**Participation as Relational Process: Unpacking
Involvement in Social Action and Community
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**What Afterschool STEM Does
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WELCOME

With this issue of *Afterschool Matters*, we are thrilled to recognize the 25th anniversary of the National AfterSchool Association (NAA). Barb Roth, chair of the NAA Board of Directors, notes in the Summer 2013 issue of *AfterSchool Today* that, 25 years ago, people working in the out-of-school (OST) time profession believed in (a) learning through play, (b) development through fun and physical activity, (c) healthy snacks as a support to learning, and (d) academic development through helping children and youth to discover and develop their passions. And now the research has finally caught up!

Enormous strides in the OST field have been propelled by NAA's work in these 25 years. The National Institute on Out-of-School Time (NIOST) has partnered with NAA throughout that time. In the early 1990s, we determined that programs had few ways to gauge their success in providing high-quality programming. In our role as a national technical assistance provider to the emerging field, NIOST developed a self-assessment tool that later became the basis for the standards used in national accreditation. The first NAA accreditation was issued in 1999. Acute attention to the *quality* of children's OST experiences as well as their logistical structure is one of the major accomplishments of the field over the last two decades.

We are also thrilled that this issue of *Afterschool Matters* leads off with our first article contributed by a fellow of the Afterschool Matters Practitioner Research Fellowship, Level II, Benjamin Cooper. The first level of the fellowship brings practitioners into a learning community where they explore issues in the field and complete an action research project in their own programs. Level II fellows are selected from the Level I fellowships in several cities around the country to spend another year refining their work into an article for possible inclusion in this journal.

In addition to Ben's work, this issue brings you an article about stimulating youth participation in social action and community service, along with several pieces on content and learning outcomes in science, technology, engineering, and math (STEM). We are grateful for the continued support of the Noyce Foundation, which has helped us to focus on STEM in the last few issues.

Robert Halpern concludes in his book *Making Play Work* (2003) that "in the larger fabric of children's lives, the after-school hours have always had an evocative, even slightly magical quality" (p. 164). Program quality, practitioner research, a new focus on STEM—these and other topics covered in *Afterschool Matters* attest to the amazing power of afterschool. We salute NAA for its 25 years of inspiring the development of magical experiences for children and youth.



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Afterschool Matters is a national, peer-reviewed journal dedicated to promoting professionalism, scholarship, and consciousness in the field of afterschool education. Published by the Robert Bowne Foundation and the National Institute on Out-of-School Time, the journal serves those involved in developing and running programs for youth during the out-of-school hours, in addition to those engaged in research and shaping policy. For information on *Afterschool Matters* and the Afterschool Matters Initiative, contact

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teaching the *what* as well as the *how*

Content-Rich OST Professional Development

by Benjamin Cooper

Across the nation, adults gather in classrooms. As sign-in sheets circulate the room, school teachers, out-of-school time (OST) staff, and youth workers of all stripes cram into child-sized chairs, coffee cups in hand. They ready themselves to think and talk about their work, to learn something new and useful. From CPR to conflict resolution, from curriculum standards to mentoring, professional development is a fact of life for educators at all levels and in all contexts.

Although a significant amount of research has evaluated the efficacy of professional development, most focuses on school rather than OST settings. A recent literature review notes, “The irony is that, while school teachers are increasingly called upon to become more proficient in subject matter, we expect OST staff to improve student outcomes . . . without adequate subject matter training” (Hill, 2012, p. 6). Indeed, the irony is furthered by the fact that so little research has focused

on content-specific OST training. As OST programs are increasingly pressured to connect their activities to school day learning, identifying and implementing best practices in OST professional development has become increasingly important. Many practitioners and researchers have answered that call, but their work is likely to focus on evaluating the pedagogy of professional development rather than its content.

This article examines the literature on best practices in content-specific professional development and then aligns this work with the practices of a citywide afterschool chess program run by After School Activities Partnerships (ASAP) in Philadelphia. This analysis shows that implementing content-specific professional development based on best practices can lead to long-lasting and content-rich OST programming.

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Studying Best Practices in Professional Development

OST practitioners need external perspectives and fresh ideas in order to evaluate and improve their own programming. Without such research, ineffective and unimaginative activities will persist, and true gems will remain undiscovered. High-quality professional development directly affects the group most responsible for creating those programmatic gems: front-line staff. Since the skill and longevity of a program's workforce are central markers of its quality, professional development that can build skills and encourage staff retention is critical (Metz, Burkhauser, & Bowie, 2009). As the Harvard Family Research Project (2004) notes, "*Staff development can affect youth outcomes*" (p. 4, emphasis original).

A Focus on Methods and Efficacy

Much of the research on professional development mentions that content is important but then moves to other topics without explanation. Rather, the research tends to focus either on cataloging types of professional development—that is, the methods by which the undiscussed content is delivered—or on evaluating the efficacy of training, as determined by student outcomes. The mode of training gets the attention, while content is, intentionally or not, a secondary concern. The work of the Harvard Family Research Project demonstrates this tendency. Its 2004 article lists eight types of professional development and discusses evaluation methods, but it mentions content just three times, and then in little detail.

Researchers who do include content in the constellation of factors influencing OST quality may still neglect to pursue the topic fully. For example, Huang and Cho (2010) conducted two studies, the first of which parsed best practices from 53 high-quality OST programs, while the second, the extension study, examined professional development in four programs in more depth. Although "exemplary practices in organization, structure, and especially in content delivery" (Huang & Cho, 2010, p. 10) were part of the first study, the article emphasizes the second study's findings on staff retention rather than focusing on content.

Research on Content-Specific Professional Development

In the words of Gil Noam (2004), content encompasses "the essential features of afterschool programming: goals, curricula, and activities" (p. 8). Much of the research on content-specific programming and professional development has been conducted on initiatives related to science, technology, engineering, and math (STEM), whose skills dovetail nicely with those taught by chess. This relationship holds true for professional development as well.

In one major survey, Garet, Porter, Desimone, Birman, and Yoon (2001) tested the effect of various professional development practices on the learning, knowledge, and practices of a large sample of math and science teachers. The researchers identified six criteria for effective professional development. In keeping with other studies, the criteria are wide ranging; however, the first criterion is "focus on content knowledge." The authors found no correlation between student achievement and

professional development on general pedagogy. Rather, the professional development that positively affected student outcomes emphasized "specific content and how students learn that content" (Garet et al., 2001, pp. 924–925). The researchers found that the type of professional development—the *how*—mattered much less than the *what*: "the core features (i.e., content, active learning, and coherence)" (Garet et al., 2001, p. 936). They conclude that their findings "give renewed emphasis to the profound importance of subject-matter focus in designing high-quality professional development" (Garet et al., 2001, p. 936).

Structuring Content-Specific Professional Development

The online *Guide to Professional Development for Out-of-School Science Activity Leaders* created by the National Partnerships for After School Science (N-PASS, 2009) is a research-backed treasure trove of content-specific professional development practices. The guide aims to help OST staff lead high-quality science activities even if they have little background in science. It coalesces best practices into a set of recommendations for training staff

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in science content—the *what* of STEM learning—so that they can implement ready-made curricula and activities (N-PASS, 2009).

N-PASS has three recommendations for teaching content: explicit modeling of science activities, discussing science content and processes, and reflection on pedagogical practices (N-PASS, 2009). N-PASS notes that explicit modeling “is much more convincing and effective than merely telling participants what to do” (p. 16) because the hands-on experience allows staff to see how an activity can work for their students (N-PASS, 2009). Practicing the activity enables the future leader to grapple with the content personally, rather than in the abstract. Under the guidance of a skilled instructor, such practice gives staff direct feedback on the structure and presentation of an activity.

Guided modeling leads to the second NPASS recommendation: discussion. Conversations with a knowledgeable instructor can give participants who may feel less confident in their science background a better sense of what is expected (N-PASS, 2009). Participants thus learn content knowledge through both direct experience and specific feedback.

N-PASS’s final recommendation, reflection, builds from the first two, as it advises professional developers to introduce pedagogical practices within the context of science activities, in order to demonstrate how they are applied (N-PASS, 2009). Only once the practitioners understand the content and the lesson does the instructor reveal the pedagogical underpinnings. This final level of understanding emphasizes why activities are presented in certain ways—the rationale for specific instructional practices—in order to encourage youth development (N-PASS, 2009).

Reflection often requires time and intentional practice. N-PASS (2009) therefore recommends that “there needs to be adequate time given for reflection” (p. 16) in the course of professional development programs. Reflection on the techniques being learned should be guided by the instructor. After they have put their new skills to use in their work with youth, participants should have the opportunity to discuss common implementation issues. “This type of reflective exercise is essential to help participants adopt these pedagogical strategies into their own practice” (N-PASS, 2009, p. 16).

N-PASS’s research-based recommendations on teaching STEM content provides a useful framework for the examination of ASAP’s chess club leader trainings.

Professional Development in ASAP’s Chess Initiative

ASAP is a Philadelphia-based nonprofit organization founded in 2002 to increase the number of afterschool enrichment activities available to the city’s youth and to create and maintain a free public database of all OST programming citywide. ASAP’s own programming focuses on four main initiatives: chess, debate, Scrabble, and drama. These enrichment clubs meet at least once a week for at least an hour, for at least a semester. Many clubs operate more frequently and for much longer. They are fueled by volunteers recruited by ASAP and by staff of existing OST organizations.

Volunteers are recruited by ASAP’s small administrative staff, who also perform required background checks. Volunteers receive training in at least two separate sessions: The first covers general youth-work skills, and the second teaches skills specific to the club type, such as chess. We then place volunteers in existing afterschool programs that match their schedule and logistical requirements.

ASAP recruits other club leaders from the staff of existing afterschool programs in schools, libraries, recreation centers, and other sites. Our pitch? If the site can identify staff interested in leading an ASAP club, we will train those individuals in activity instruction, provide supplies and instructional materials, and follow up with ongoing support, including free events such as tournaments and family fun days. Since these individuals already have clearance to work with youth and have been trained by their employers in general youth-work skills, they jump right into the program-specific training. This approach has yielded many strong partnerships that have remained active over many years.

The Philadelphia Youth Chess Challenge is ASAP’s largest initiative, with 230 clubs serving more than 3,000 youth throughout the city. Our two-person chess staff organizes 18 tournaments and events each year, as well as a 15-week chess league for public and charter school teams, a five-session academy for female players, and a mentorship program that partners high school chess players with younger clubs. To serve the adults who lead those 230 clubs, ASAP holds about 30 training sessions each year. Most are facilitated by ASAP’s lead chess instructor, Stephen Shutt, a longtime classroom teacher and chess coach who has led several national championship chess teams.

Characteristics of Chess Club Leaders

ASAP’s professional development is shaped by the needs of our chess club leaders. Those leaders, in turn, are

shaped by the nature of employment in the OST field—namely, that “there is no standard route to becoming a provider” (Harvard Family Research Project, 2004, p. 2). Leaders are an eclectic group from many walks of life—teachers, librarians, recreation center staff, concerned citizens, OST program staff, and student volunteers. Similarly, the 230 chess clubs meet at many different venues: public, charter, parochial, and private schools; libraries; recreation centers; churches; and community centers. In spring 2011, ASAP conducted a large-scale survey of its chess club leaders. The results, shown in Tables 1 and 2, demonstrate the variety among club leaders and host sites.

These adults share a dedication to the city’s youth, but their familiarity with teaching, classroom management—and, most importantly, the game of chess—varies. Determining what club leaders need is no small task. Their varied experiences and roles mean that there is no one thing that they all need in equal amounts. Any given training session might be attended by an expert chess player who has never before worked with youth and a 10-year teacher who can command a classroom but barely knows how the pieces move.

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What, then, stitches together ASAP’s diverse club leaders? The game of chess. ASAP’s focus on content appeals to leaders who themselves love chess or who believe strongly in the game’s value for the students with whom they work. People become chess club leaders because they value the game—the *what*—and teaching it to youth. One of the consequences of that focus and the enthusiasm it engenders is the longevity of ASAP chess clubs. The annual return rate for chess clubs has hovered around 75 percent; the other 25 percent may dissolve or enter hiatus for a time. The average chess club has been in existence for five years. Some clubs keep the same leader throughout their lifespan; others have multiple leaders over time. To keep those numbers at such a high level, ASAP

has made it a priority to identify replacements when club leaders are unable to continue. Our 2011 survey indicated that 68 percent of club leaders had 0–3 years of experience in that role; the rest had 4–10 years. Club leaders’ affinity for chess is at the heart of ASAP’s content-specific professional development.

Workshop-Based Professional Development

Given ASAP’s limited funding, its volunteer-based model, and the diversity among club leaders, we rely on workshops to deliver most of our professional development. This choice is not without limitations. Workshops have been criticized for offering insufficient “time, activities, and content . . . for increasing teachers’ knowledge and fostering meaningful changes in their classroom practice” (Garet et al., 2001, p. 920). These limitations are particularly evident in single-session workshops that lack follow through. Indeed, ASAP has worked hard to build a workshop-based model that addressed those pitfalls.

Early in its existence, ASAP used one-off workshop sessions. Over time, the organization began to expand and revise its pre-service and in-service trainings based on research-backed best practices. All ASAP-recruited volunteers are required to attend a general volunteer orientation, during which they learn about ASAP, volunteering with OST programs, working with youth, and the legal obligations of youth workers. The volunteers are joined by OST site staff for a second pre-service training that focuses on the type of club they will lead. In the Youth Chess Challenge, this session is called the New Chess Club Leader Training. At its conclusion, new club

Table 1. Chess Club Leaders

LEADER TYPE	PERCENTAGES
School teacher or staff	51%
Afterschool program staff	25%
Volunteer	15%
Recreation center staff	9%

Table 2. Chess Club Host Sites

SITE TYPE	PERCENTAGES
School	60%
Community center	26.5%
Recreation center	9%
Library	2.5%
Church	2%

leaders are given their chess supplies. Attendees are invited to a series of two optional follow-up trainings that teach additional chess content. Open question-and-answer sessions and other advanced topics are also offered.

Workshops were chosen as the main avenue for ASAP's professional development for several reasons. First, workshops are the most cost-effective way for a small-budget outfit to provide high-quality professional development to a group of educators. Second, an in-person workshop creates an opportunity for club leaders and ASAP staff to meet face to face, building a sense of community and belonging. The diversity among ASAP club leaders and host sites makes this connection to ASAP especially important.

However, relying on workshops has forced us to face the challenges listed by Garet and colleagues (2001). For starters, those myriad club leaders have a wide variety of scheduling needs. Although we hold training sessions both in the morning and in the evening, there are always conflicts. In addition, we limit each session to two hours. If it's any shorter, it's not worth bringing attendees together. If it's any longer, participants begin to fade, causing the training to lose its efficacy.

Sustaining turnout is also a challenge. While the required general orientation and New Chess Club Leader Training sessions are consistently well attended, some club leaders require incentives to attend the follow-up trainings. Trainer Shutt says of the optional sessions, "There is a cost factor, which is that you're tired; you've spent all day at school. How much do I really need to go? I know I'll enjoy it, but I've got papers to grade" (personal communication, April 12, 2011). The numbers bear this out: Over the course of two school years, 2009–10 and 2010–11, 70 percent of the club leaders trained by ASAP attended only required trainings.

To lower this high percentage, ASAP has enacted several strategies. First, additional instructional materials are distributed only at follow-up sessions to provide a concrete incentive for attending. We also altered the schedule of follow-up sessions to create a training *series*, at the successful conclusion of which club leaders who attend all sessions receive certificates. Such a series provides time and practice for reflection, as recommended by N-PASS (2009). Club leaders implement training recommendations in their program and then to return

to the group to share their experience and learn from one another. When club leaders decline to attend additional trainings, our ability to guide their reflection and continued learning is limited to phone, e-mail, and site visits. These leaders lose the opportunity to learn from the experiences of the other members of their cohort.

Despite the pitfalls of limited-duration professional development, a workshop series is the best method we have available to deliver content-specific professional development.

Teaching the What

Our 2011 survey of chess club leaders gave us powerful confirmation that club leaders preferred content-specific professional development that focused on the *what* of chess, rather than on classroom management, youth development, or other general topics.

Near the beginning of each training, the instructor tells the attendees that a club that consists merely of a group of youth playing chess will quickly stagnate. To keep a club vibrant and attractive to youth, the club leader must offer new chess skills and engaging activities. Indeed, the survey showed that club leaders wanted just those things, for their students and for themselves. In a question that asked leaders to choose six professional development topics from a list of 18, the only options selected by more than 35 percent of respondents were the opening, the middle game, the endgame, tactics, and checkmate patterns. Only 19 percent selected classroom management. The message from club leaders reinforced the insight of Garet and colleagues (2001): The content of a program drives youth engagement; other issues, such as classroom management, are positively affected by compelling content. OST staff members can do more with their background knowledge in youth development when they pair it with content-specific expertise.

Creating Cohorts

Because of their interactive nature, ASAP trainings are limited to a maximum of 12 participants. As recommended by N-PASS (2009), we customize each training to the needs of the specific group in attendance. As Shutt puts it, workshops "won't be the same from one week to the next because the group is different. So much of what I do is based off the feedback from the group" (personal

Our 2011 survey of chess club leaders gave us powerful confirmation that club leaders preferred content-specific professional development that focused on the *what* of chess, rather than on classroom management, youth development, or other general topics.

communication, April 4, 2011). Before and at the beginning of each training, we seek to understand each participant's situation: where the club will be located, what age group it will work with, what chess skills the students may possess, and what chess skills the club leader possesses. This information is used to shape the content of the training, from the subjects chosen to specific asides for one club leader or another.

The challenge of this individualization is the work that it takes to form and maintain. During 10 years of professional development, we have discovered that, once a cohort is created, effort should be made to keep it together at subsequent follow-up trainings. Since each training is customized to the group, the content delivered varies slightly from training to training. It takes effort to track what has been covered with each cohort—effort that goes to waste if the cohort cannot be sustained over time. This continuity is the reason we provide incentives to club leaders for attending follow-up trainings.

Modeling Strategies and Discussing Content

N-PASS recommends that workshops provide explicit modeling of content-specific activities and discussion of the content in those activities. We have found that such interactive and exploratory modeling is indeed an effective way of teaching both content and content-specific teaching techniques. The new-leader training centers on chessboards and relies on demonstration. There is no lecture without an accompanying example at the chessboard. The instructor works through each chess piece, demonstrating techniques for teaching the piece's movement and abilities. After all six pieces have been covered, the instructor moves into an examination of checkmate, the ultimate goal of a chess game. The instructor then puts all the pieces on the board to commence an introduction to the opening of a chess game.

Throughout, the training is highly interactive. ASAP's executive director says of the chess instructor, "Steve is great at drawing club leaders out, even if they're guarded about their own ability" (personal communication, December 30, 2010). The training converts the variety of chess skill levels among club leaders from a challenge into an asset. When demonstrating a skill, the instructor will pass the board around and have at-

The training converts the variety of chess skill levels among club leaders from a challenge into an asset. When demonstrating a skill, the instructor will pass the board around and have attendees try the activity, putting participants into the role of their students.

tendees try the activity, putting participants into the role of their students. As Shutt puts it, "I suppose some of the things that work the best are when you have some adults that are good models for teaching, and you've got some others that are skilled enough on their own to see what you're doing with the others" (personal communication, April 12, 2011). This technique takes advantage of the range of skill levels usually represented at each training, giving participants the chance to experience the lesson themselves while also allowing them to see the teaching methodology in action on others.

Adding Materials to Accompany Workshops

ASAP has found that giving training participants outlines of the workshop agenda and copies of the exercises greatly enhances content retention. One volunteer club leader expressed the concern this tactic addresses: "The interactive nature of the trainings is good, but Steve goes very fast. . . . I wanted to pay attention to what he was doing, but I also wanted to outline it so I could go home and practice what he showed" (personal communication, April 9, 2011). A training outline, lesson plans, activity suggestions, and chess exercises relevant to the new-leader training are included in the manual each club leader receives. This written material can remind club leaders of lessons learned during the training. They need not feel they have to write everything down, so they can focus on the training content in the moment. The instructor

integrates the manual directly into trainings, referring to lesson plans and exercises during sessions and connecting the in-person lesson to written content that participants can review and use later. Distributing such a manual is consistent with best practices identified by Huang and Cho (2010).

Reflecting on Pedagogy

N-PASS (2009) emphasizes that professional development participants need to be able to reflect on content-specific pedagogical practices both while the instructor is presenting them in training and on an ongoing basis as participants apply their newly learned skills to their work with youth. We have found that, although it is easy to integrate explicit instruction in and discussion of pedagogy into training sessions, it is more difficult in the OST sphere to sustain participant reflection over time.

During trainings, we take great care to explain the pedagogical rationale behind specific activities and our recommended lesson plan. ASAP strives to encourage chess players to use divergent thinking to understand and improve their game. To that end, trainings teach inductive reasoning exercises that coax players to tease out rules and strategies. For example, it is common to teach the movement and power of a chess piece by explaining and demonstrating the movement and by assigning that piece a static point value. We discourage such an approach; rather, we introduce a piece by having a student move it without any knowledge of the rules that govern it. We teach the club leader to simultaneously move the same piece of the opposing color and, through a series of turns and questions, lead the student to understand the piece's movement and abilities. When teaching the strength of a piece, the leader demonstrates how a piece's power often depends on its position on the board. The student is left with a range, rather than a static number, to represent the power of any given piece.

During training, the instructor introduces each exercise, teaching technique, or subject matter in the context of student learning, providing a rationale for the method being presented. Participants have the opportunity to ask questions about the method, to consider how it can be implemented, and to pose “what ifs” that explore potential problems with the activities. Techniques like these cement the content in a youth development framework and give participants time to organize what they've learned so they can successfully lead the activities and teach the material themselves.

Promoting ongoing reflection is more challenging. At the optional follow-up trainings, participants are encouraged to share their implementation experiences with the group, and the instructor uses their successes and failures to shape the lesson. Additionally, ASAP's open question-and-answer sessions have provided a valuable forum for club leaders to bring their reflections to ASAP staff and fellow leaders. Rather than being instructor-led, these sessions are discussion-based, with club leaders sharing suggestions and learning from their peers. We also encourage club leaders to share their successes and failures through personal communication with the chess staff—whether over the phone, through e-mail, or in person. At chess events, we seek to connect club leaders with one another directly.

We can only encourage such reflection, however. Some club leaders will always choose not to share their thoughts with ASAP staff or other club leaders. We continue to seek new methods through which club leaders can actively reflect on their chess club strategies, especially those they find to be practical, efficient, and worthwhile.

Implications for the OST Field

In their review of professional development practices, Huang and Cho (2010) conclude that “a qualified, motivated staff with a low turnover rate” is critical to creating quality afterschool programming (p. 10). As OST programs consider content-specific programming, the sustainability and quality of their workforce should play a prominent role in their thinking, as should student outcomes.

The range of curricula available in OST is a strength of the field and an opportunity for individual programs. Some activities can occur daily, others weekly; some might last for six weeks while others continue all year. Such flexibility opens the door

for content-specific programming. ASAP chess clubs, for example, are active an average of 1.5 hours per week. By limiting the frequency and length of specific offerings, OST programs can keep the focus fixed on content.

Once a content-specific activity has been created, both staff and students must be allowed to opt in to the activity. Almost all of ASAP's chess club leaders, whether they are volunteers or, especially, teachers or OST staff members, have chosen to take on the responsibility of leading a chess club. Leaders who appreciate the game for themselves or who see the effect it can have on their students make more willing facilitators than people who are randomly assigned the responsibility. By, as Huang and Cho (2010) say, “aligning staff skills with tasks” (p. 11), OST programs increase staff morale and lower turnover.

When staff lead content-specific programming of their choosing, they should be given responsibility for and some degree of autonomy over that activity. Huang and Cho (2010) found that “staff autonomy to create and implement personal goals” (p. 14) was a consistent feature of high-quality OST programs. Such autonomy challenges and engages staff, increasing satisfaction and retention while, ultimately, improving student outcomes. For all the professional development that ASAP offers chess club leaders, we enforce very few rules or restric-

Leaders who appreciate the game for themselves or who see the effect it can have on their students make more willing facilitators than people who are randomly assigned the responsibility.

tions about the structure or governance of chess clubs. With as much support as they want, leaders build their clubs according to their needs and those of their students and their programs. We believe that this autonomy is a key factor in the longevity of chess clubs.

For those researching the OST field, ASAP's model and the feedback of its club leaders, when placed alongside available research on content, should point to intriguing avenues for future exploration. The picture may currently be incomplete, but the relationships among content, professional development, OST program quality, and student outcomes warrant further research.

In our 2011 survey, 88 percent of ASAP chess club leaders rated the increase in their chess knowledge and ability to teach chess skills as either 4 or 5 on a scale of 1 to 5. These individuals learned the content and transmitted it to their students, who—through chess—engaged with an enriching activity after school; learned valuable critical thinking skills; and applied these skills to academic achievement, state and national chess competitions, and their college applications and aspirations. OST programs are not the same as school classrooms; they can engage with content using methods unique to their own settings. In the words of Gil Noam, “The ways to learn practiced in afterschool programs should feel distinct to children. Afterschool learning should be experience-rich” (2004, p. 16). Content-specific professional development can make it so. When staff members are equipped to create content-specific activities and are given autonomy to implement them, OST programs create an “experience-rich” environment that pushes youth to achieve and that engenders enthusiasm and longevity among staff.

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participation as relational process

Unpacking Involvement in Social Action and Community Service

by Jeffrey N. Jones, Joshua H. Bench, Bethany L. Warnaar, and John T. Stroup

Educators, policymakers, and other concerned adults share an interest in promoting lifelong patterns of community service in youth. Youth community service in out-of-school time (OST) has been associated with a host of positive outcomes (see Anderson-Butcher, Newsome, & Ferrari, 2003; Durlak & Weissberg, 2007; National Research Council [NRC] & Institute of Medicine [IOM], 2002).

These outcomes include academic success and civic engagement (Schmidt, Shumow, & Kackar, 2007) and increased initiative and personal responsibility (Larson, 2000; Wood, Larson, & Brown, 2009). Practitioners and researchers alike highlight the importance of youth participation in afterschool service activities. In some ways, participation is the prerequisite of community service. Without participation, no amount of engagement is possible. Authentic engagement has affective, cognitive, and behavioral aspects (Fredricks, Blumenfeld, & Paris, 2004; Rose-Krasnor, 2009). Lerner (2005) stated that youth development must be

considered within a larger meta-process of interpersonal relationships. Since adolescents are highly interested in peer group involvement, the presence of peers in afterschool programs promotes engagement (Denault

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& Poulin, 2009; Huebner, & Mancini, 2003; Simpkins, Eccles, & Becnel, 2008). Researchers are also examining supportive adult-youth interactions (see Anderson-Butcher et al., 2003; Durlak & Weissberg, 2007; Fredriksen & Rhodes, 2004; Hilfinger Messias, Fore, McLoughlin, & Parra-Medina, 2005). By co-planning and implementing social action projects with youth, adults can encourage the development of strategic thinking; by mentoring youth, they can support cognitive reasoning and agency (Larson & Hansen, 2005). Jones & Deutsch (2011) observed that meaningful connections with adult mentors and with peers can lead to increased participation in activities that promote prosocial development.

In addition to relationships, context is critical. Using an expanded concept of participation, researchers and afterschool youth workers can explore the reciprocal interaction of participants' values with the values privileged in cultural and programmatic systems (Barber, Stone, Hunt, & Eccles, 2005). Our understanding of participation should not presuppose that influence flows one way, from group to individual; participation involves a dynamic interchange between participants and the group. Hirsch, Deutsch, and DuBois (2011) suggest that participation and engagement are, in part, a function of the program environment. Youth may be motivated to participate in settings that have quality programs, activities, youth-staff relationships, and program culture.

In order to unpack the relational and context-specific aspects of youth participation, this paper focuses on youth involved in PeaceJam, an innovative service program. Consistent with contemporary thought in developmental psychology, we view behavior as being driven by needs fulfillment. Deci & Ryan (1985) identified three fundamental psychological needs: autonomy, belongingness, and competence. Self-determination theory holds that environments that support these needs can foster intrinsic motivation and self-regulation (Reeve, Deci, & Ryan, 2004). This social-cognitive view of motivation and behavior includes both the context of the learning community and the primacy of quality relationships (Sidorkin & Bingham, 2004). Using self-determination theory as a conceptual framework, our study explores how PeaceJam program elements meet the needs of participants and promote their authentic engagement in community service.

Our understanding of participation should not presuppose that influence flows one way, from group to individual; participation involves a dynamic interchange between participants and the group.

Research Methods

Our research objective was to study the effects of a social action program on positive youth outcomes. With Blumer (1969) and Denzin (1989), we assumed that relationships, program content, and experiences influence the ways in which participants make meaning of PeaceJam programming. Our study addressed the following framing questions:

- How do youth perceive the PeaceJam environment in relation to autonomy, belongingness, and competence?
- How do perceptions vary among participants?
- How do youth connect the afterschool learning context with increased participation?
- What are the perceived benefits of involvement in PeaceJam?

PeaceJam is a community-based social action program created 17 years ago to engage gang members in inner-city Denver in prosocial activities. Since that time, more than one million youth have participated worldwide. "PeaceJammers" study the lives of Nobel Peace laureates, identify a pressing community issue, and plan and implement a social action project. Local programs gather in the fall to connect and organize efforts in a regional PeaceJam Slam. They also come together in the springtime at the PeaceJam Youth Conference, where they present their projects and work on issues of social justice with a Nobel Peace laureate. In the words of the founders, PeaceJam is "[b]ringing young people together with Nobel Peace laureates to tackle the toughest issues facing our planet" (Suvanjiëff & Engle, 2008, p. 6). The PeaceJam Ambassadors program, which is geared to high school students, is the focus of the current study. (See www.PeaceJam.org for an overview of programs for other age groups.)

We employed mixed methods in this study, combining results from quantitative surveys with program observations and participant interviews. This approach enabled us to study constructs of interest from several perspectives and to describe the development of participation in context—how respondents understood the origins, progression, and outcomes of program involvement.

Surveys were administered over three years at the two main organizing events in the Great Lakes PeaceJam region, which serves Michigan, Illinois, Indiana, and

Ohio. Not all PeaceJammers attend the regional events, but most who attended the Great Lakes events completed the survey, with a 97 percent response rate. A few PeaceJammers completed more than one survey because they attended more than one conference.

In addition, researchers assumed the role of participant-observer in three local programs, taking detailed field notes to capture a thick description of events and social interactions. At each of two program sites, 15 adolescents, ages 14–18, were recruited for interviews through an announcement at a program meeting.

The survey sample of 781 youth was 67% female, with 43% reporting an ethnicity other than Caucasian. The sample included more juniors (33%) and seniors (32%) than freshmen (15%) and sophomores (20%). Respondents averaged 1.6 years of involvement in PeaceJam. Similarly, of the 30 interviewees, 73% were female, and 38% reported an ethnicity other than Caucasian.

To examine the multidimensional nature of engagement, we used factor analysis, a statistical procedure that examines how related survey questions “hang together” to indicate a common construct. We found three dependable factors (or latent constructs) in the survey: self-determination, academic goals and purpose, and community involvement. These factors are correlated with one another and reflect the larger construct of social engagement (Jones, Applegate, & Spybrook, 2013). This paper focuses on the first factor, examining individuals’ psychosocial experience in context of the PeaceJam learning environment. We investigated differences across subgroups of PeaceJammers on indicators of program and service involvement and of self-determination using one-way analysis of variance (ANOVA) to see if group differences were statistically significant or simply due to chance.

Youth Perceptions of PeaceJam Involvement

Our survey results reveal youths’ reported levels of participation in PeaceJam, highlight differences across subgroups, and help us explore perceptions of the program environment using the tenets of self-determination theory. Analysis of interview responses focuses on how PeaceJammers connected these perceptions with social action and behavioral change. The interviews also reveal participants’ perceptions of the benefits of program and service involvement.

Involvement in PeaceJam

We asked PeaceJammers to rate, on a five-point scale, both their involvement in PeaceJam and their participation in service projects through PeaceJam. The average rating for the statement “I am highly involved in Peace-

Jam” was 3.62. Statistically significant differences among subgroups include the fact that freshmen and sophomores reported higher levels of involvement than did juniors and seniors. However, respondents who had been involved in PeaceJam for three or four years scored higher on program engagement than did those with one or two years of participation. Gender was not a significant predictor of PeaceJam involvement. Ethnicity was a significant predictor for only one category with a small sample.

Similarly, the statement “I am highly involved in service through PeaceJam” had a mean rating of 3.47. The same patterns held across subgroups, except that there were no differences in terms of grade level.

Perceptions of Autonomy, Belongingness, and Competence

Self-determination theory, a leading model of social-cognitive motivation, provides a framework for considering how features of the learning environment interact with the core psychological needs of autonomy, belongingness, and competence. When these needs are met in social settings, individuals can act on a sense of determination and engage deeply in social communities and learning experiences. Figure 1 displays our concept of self-determination in the context of the current study.

On our survey, PeaceJammers reported high levels on the constructs associated with the three psychological needs of autonomy, belongingness, and competence. Using exploratory factor analysis, we found five items on the survey relating to self-determination and meaning, such as “I feel like I have a voice in the activities of my PeaceJam group,” “PeaceJam makes me feel connected to something larger,” and “Working on social action projects makes me feel successful.” The overall mean for this factor was 4.34 on a five-point scale. The variables that had the greatest effect on self-determination were youths’ level of participation in PeaceJam and in community service: Youth who reported higher levels of program and service involvement also reported higher levels of self-determination. Interview responses, organized below by the three core psychological needs, aid in understanding the survey trends.

Autonomy

A sense of autonomy is fundamental to self-determination. It is also fundamental to participation in voluntary activities like PeaceJam on the part of adolescents who have competing calls for their time and attention. Because of our interest in agency and in engaged community service, we asked PeaceJammers about their perceived choices and whether they felt they had a say in their

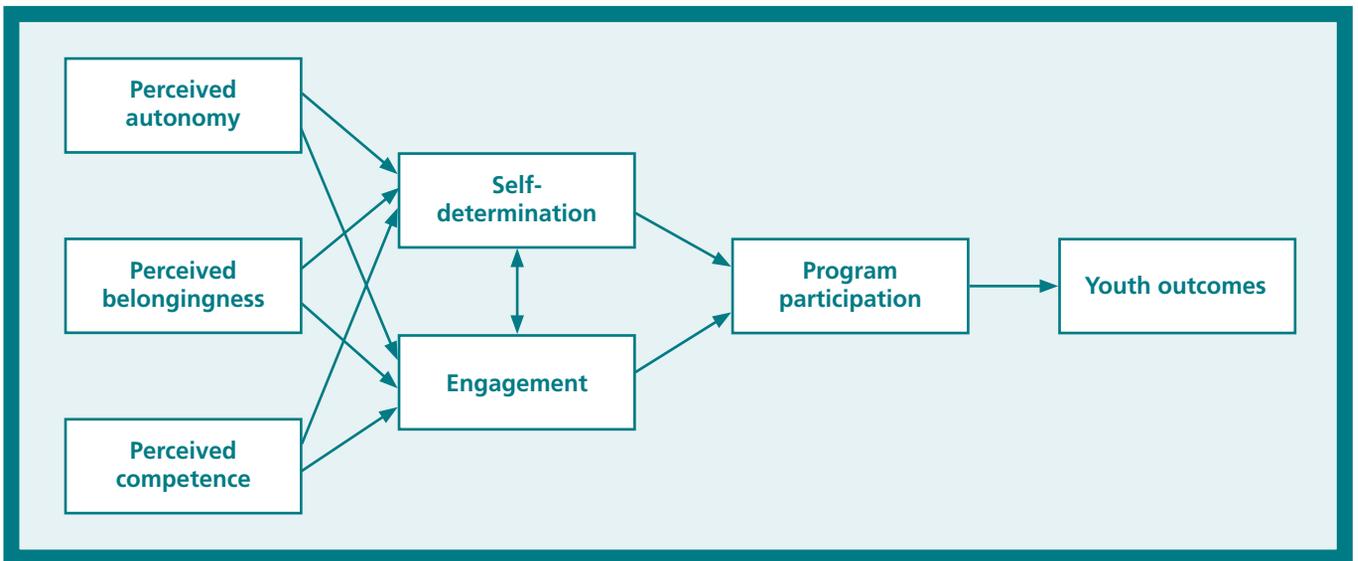


Figure 1. Self-Determination, Participation, and Youth Outcomes

group’s activities. When asked if she felt she had a voice in her group, one 16-year-old said:

Yeah, you kind of have to make your voice though. ... Like, you could sit back if you wanted to and accept that you don’t have much of a say, but if you actually want something changed and you don’t agree with it, then speak up.

Several PeaceJammers described the need to feel comfortable in the group before actively participating:

Since I’m kind of new, I’m not sure what all we do.... So I have that filling-in, like getting-roots-placed feeling. Once I get those roots, I can start sprouting out ideas and new ways to help.

These comments show the interrelation of individual decisions and the larger social context. Being part of the group suggests involvement, but participants have the flexibility to grow into active participation. PeaceJammers further noted that personal efforts contribute to larger group goals. The notion of “power in numbers” (Kirshner, 2009) is reflected in the observation of a female respondent, age 17: “I think we all have our own contributions and we all can work collectively to make it better.”

Larson (2000) studied how youth initiative can thrive in structured voluntary activity like that offered by PeaceJam. PeaceJammers regularly placed their own autonomy and agency in the context of the role of their advisor. For example, when asked if she had a voice in the group, one participant responded, “Oh yeah, I’ve come to my advisor with ideas and she feeds off of them. So yeah, I do feel like I have a voice.” Autonomy appears to be both intra-

personal, in that one must initiate it, and interpersonal, in that it is related to adult advisors and group norms.

PeaceJammers who reported the highest levels on the self-determination factor perceived that taking on roles and responsibilities in service projects helped develop their active involvement. The adoption of roles is important in building a connection to youth-serving settings (Deutsch, 2005) and can lead to a sense of responsibility (Wood et al., 2009).

Belongingness

The second element of self-determination has been variously referred to as belongingness, connectedness, or relatedness. Responses to survey questions on connectedness were mostly positive but not homogenous, indicating that youth do not experience PeaceJam uniformly. Some PeaceJammers said that similar goals bind the groups together through a common purpose. One boy, 17, noted, “Everyone is working towards pretty much the same problems we are, so that’s kind of a binding force.”

Others said that connection is earned through social actions and service projects. Finn (1989) suggested that a reciprocal interaction exists between active participation and identification with an organization. When asked if he felt connected to his PeaceJam group, a 17-year-old responded:

Yeah, I’ve met a lot of people since I started joining and making more friends through it. You have a connection with them because you’re always doing the same projects and you can relate to what they’re doing.

Research has described the positive influence of peer groups in community service (Barber et al., 2005). Social identity can be a powerful motivator of behavior (Stets

& Burke, 2000; Tyler & Blader, 2001). Having friends in PeaceJam was an important part of connection for the PeaceJammers with whom we spoke. Some attributed a sense of belonging to a bond with the group, for example:

I know everybody here, and I count on seeing them once a week. I can always count on the atmosphere of the group being the same, because we have a little community here.

Belongingness is the intrapersonal experience of social and relational activity. PeaceJammers reported that this connection was formed by sharing a common purpose—a purpose that is strengthened by service, a common history, and social interaction with friends. This sense of belonging may relate to continued and increased participation.

Competence

The feeling of success is another powerful psychosocial experience that can promote increased engagement and positive outcomes. PeaceJammers discussed the feeling of competence that stemmed from seeing the results of their individual and group efforts. When asked, “Does working with PeaceJam make you feel successful?” one young person, age 13, responded, “Yeah, just because it makes you see, like, all the trash on the grounds, and two hours later most of it’s gone—and you’re just, like, ‘Whoa, we all did this together.’” Similarly, when asked about his best experience in PeaceJam, a 17-year-old said:

The dinner at the homeless shelter, just because of how successful it was.... It was a really good feeling, knowing that you’ve done something good through cooking and giving the people that don’t always have the best meals a very good meal.

Several PeaceJammers described the experience of competence as a kind of feedback loop: The feeling of success leads to a positive experience of the program, which in turn leads to increased and continued participation. As one participant put it:

Being with PeaceJam makes me feel like I want to do more. Not just for myself, but for everyone else—academically and athletically. It makes me feel like I want to do more and succeed.

The experience of competence is further related to a host of psychosocial perceptions that include pride and enjoyment. When asked if work-

ing in PeaceJam made him feel successful, one 17-year-old said, “It gives me a sense of pride.” A 15-year-old saw two advantages of participation: “I guess the biggest part of it is you’re helping a lot of people, but it’s also really fun, so it has benefits all around.”

Autonomy, belongingness, and competence were all salient to PeaceJammers’ experiences. Participants readily identified the ways in which features of the program environment fostered these psychosocial constructs and motivated increased involvement in PeaceJam and in community service.

Participation and Youth Outcomes

To determine how youth perceived the benefits or outcomes of involvement in PeaceJam and in community service, we asked interviewees, “What do you get that your friends who don’t do PeaceJam miss out on?” PeaceJammers said that they benefited from an expanded perspective on community and global issues, a sense of meaning and of agency attained through “actually doing something,” and a connection to something larger, beyond the self. For some, PeaceJam activity was congruent with the caring individuals they perceived themselves to be or hoped to become.

The most frequent response to the question about what PeaceJammers get that non-PeaceJam friends miss was that PeaceJammers expanded their perspective on global and community issues. More than one-third of interviewees noted this perceived outcome of program participation, for example:

I get to know more things about this community. Because before I joined PeaceJam, I didn’t know that there was a shelter for homeless people....I get to know about my community more.

People who don’t do any volunteering...don’t really have a full view of what the world is actually like and how we can make a big difference.

One-quarter of the sample shared that involvement promoted a sense of meaning, describing it variously as the satisfaction of helping others or as increased self-awareness and personal development:

I feel like I have a feeling of satisfaction that I’m helping out....I think the way that this organization is run, it’s very helpful because you’re directly related to people in your community and you have an impact right at home.

Several PeaceJammers described the experience of competence as a kind of feedback loop: The feeling of success leads to a positive experience of the program, which in turn leads to increased and continued participation.

One-fifth of interviewees noted an enhanced sense of their own agency—of “actually doing something”—as an important program outcome. In answer to the question about what she got out of PeaceJam, one 16-year-old responded:

Just the participation—the knowledge—and feeling like you’re doing something bigger than yourself and you’re actually contributing to things....Mostly teenagers basically don’t have any say, and people overlook them a lot. But in PeaceJam you’re the main people, and teenagers are, like, controlling it.

Another fifth of the sample reported that feeling connected to something larger was a main outcome of participation. PeaceJammers reported a connection to the group, but also to something larger. One teen, 17, summed it up:

It’s, like, a really strong sense of community between us, and it’s the idea of serving a community and being part of something bigger than yourself that really helps out. It’s like when people mesh together really well for a common cause.... That’s what keeps us coming back, I think.

This sense of connection, then, must be considered not only as a process that promotes social identity and increases involvement, but also as an outcome of participation. Additionally, PeaceJammers reported that involvement was congruent with their individual interests or values and that PeaceJam created the opportunity to transform these values into action. A 17-year-old shared, “My interest is helping people...and it got me to think about what I could do to help.” Another PeaceJammer reported, “We don’t have to align our interests with it, but PeaceJam naturally lines up with us.”

Lastly, several of those interviewed evoked care and responsibility as perceived outcomes of participation. A 16-year-old said: “I feel like it’s our job to care about other people....It would be terrible if someone was forced to live on the bottom rungs of life, just because no one around them cared.”

Positive Outcomes Through the Process of Engagement

In this exploratory study, we were interested in PeaceJammers’ perceptions of their participation and engagement in their afterschool learning environment. Analysis of our quantitative and qualitative data explored the connections

between psychosocial experience and participants’ sustained engagement in PeaceJam and in service to the community. In speaking of the process of participation, youth reported high levels of autonomy, belongingness, and competence. They related these supportive attributes to their participation and engagement. They spoke of a reciprocal relationship between their participation and their identification with the PeaceJam community. They described opportunities for connecting interests with action and for developing new patterns of civic behavior. They also described the outcomes that resulted from high levels of program and community engagement, particularly an expanded perspective on the community and a sense of meaning and agency.

Our findings suggest that youth experience and engagement, viewed through a relational lens, may be a function of program activity, the role of the advisor, and the influence of peers. All of these factors affect participants’ meaning-making processes and, ultimately, their behavioral decisions. Consistent with the person-context paradigm (Lerner, 2005), our findings show that participation

is a complicated interaction among features of learning environments, individual needs and characteristics, and the participants’ psychosocial experience of the setting.

Early in this inquiry, it became clear that PeaceJam means a lot of different things to the diverse youth who engage in it. More research is necessary to promote understanding of developmental processes in large and complex youth

service organizations. Moving forward, we are interested in identifying and describing additional patterns of youth engagement. Participation varies among individuals in PeaceJam, but it also varies depending on the kind of program activity in which participants engage, for example, working with the local PeaceJam group, experiencing the PeaceJam curriculum, taking part in community service projects, or attending regional conferences. Indeed, many PeaceJammers described the Youth Conference as the high point of the program. However, individuals’ participation in other group activities varied because those contexts provided uneven opportunities for individual autonomy, belongingness, and competence. The relational environment in these contexts may affect how individuals participate.

Implications for Research and Practice

Our findings describe several possible pathways to the positive outcomes and perceived benefits of behavioral

Our findings suggest that youth experience and engagement, viewed through a relational lens, may be a function of program activity, the role of the advisor, and the influence of peers.

engagement and youth participation in afterschool service. Learning environments that provide high levels of support for autonomy, belongingness, and competence promote self-regulation and motivation to pursue intrinsically rewarding goals (Reeve et al., 2004). Larson (2000) described how settings like PeaceJam that offer voluntary but structured activity may promote the development of initiative or agency in youth participants. As many of the youth in this study expressed, the experience of making a difference is a core component of the process of participation. Furthermore, as youth provide direction and invest their identities in their collective work, they may also develop a sense of personal and collective efficacy (Kirshner, 2006). Taken together, these ideas suggest that researchers and practitioners should consider both organization-level and individual-level characteristics in assessing how informal learning environments affect the lived experience of youth. Applied research on OST engagement has focused specifically on the *outcomes* of participation. However, this study highlights the need for a greater understanding of the *processes* through which youth commit to authentic engagement. This understanding will advance the field's ability to structure programs both to support increased engagement and to promote positive results for youth.

The findings of this research also have clear implications for practice in school and community settings. They speak to the need to engage in intentional practices that are organized around, and sensitive to, the diverse needs that are present in youth-serving settings. In particular, practitioners should be prepared to structure interpersonal interactions to promote participants' identification with group goals and values, as well as their sense of autonomy and competence. Findings also draw attention to the benefits of a relational pedagogy—one that is informed by daily interactions and that provides a network of support for youth (Jones & Deutsch, 2011; Sidorkin & Bingham, 2004). To enter into such a relational pedagogy, youth workers need the support of a professional community of practice (see Fusco, 2012) and of professional learning environments that engage in relational and evidence-based practices.

Together, schools and service organizations must invest in developmentally appropriate structures and processes to maximize youth and community outcomes. Indeed, out-of-school programs have the potential to help meet the developmental needs of adolescents (Riggs & Greenberg, 2004). Researchers are considering the effects of program quality (Siaca, 2010) and of the quality of youth experience (Shernoff & Vandell, 2008) on youth involvement. These findings suggest that practitioners should focus on

aligning the core components of programs: activities, relationships, and culture (Hirsch et al., 2011).

Participation and Youth Development

Authentic engagement is an ideal toward which every youth worker strives in daily interactions with youth; it is also a concern for afterschool programs as they design and implement activities. Engagement has been consistently linked with positive outcomes for youth (Anderson-Butcher et al., 2003). Researchers have suggested that positive afterschool experiences may provide benefits in other domains such as peer groups and school settings (Durlak & Weissberg, 2007; NRC & IOM, 2002). Programs that facilitate social action may promote the development of shared purpose through collaborative efforts towards a common goal (Kirshner, 2006). Inspired by these experiences to critically analyze their own values and goals, youth may develop a sense of purpose and self-determination (Youniss, McLellan, & Yates, 1997). To move current understandings of the influence of youth-serving settings forward, "participation" must be considered as a multidimensional and contextual process that can lead to youth engagement in community service.

Acknowledgements

This research was supported by a grant from the Faculty Research and Creative Activities Award from Western Michigan University. The authors would like to thank the directors, staff, volunteer mentors, club advisors, and participants of PeaceJam, and the larger PeaceJam community, for feedback and support throughout this research.

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the quest for quality in afterschool science

The Development and Application of a New Tool

by Anahit Evoyan Papazian, Gil Gabriel Noam, Ashima Mathur Shah, and Caitlin Rufo-McCormick

Studies have found that, though many students have generally positive attitudes toward science, technology, engineering, and math (STEM), their attitudes toward school science are “mixed” (Sjøberg & Schreiner, 2006). Students’ initial interest in science often dwindles because of the way science is taught in school (Krajcik, Czerniak, & Berger, 2003).

By contrast, out-of-school time (OST) programs are intermediary spaces that connect opportunities across a range of contexts (Noam, Biancarosa, & Dechausay, 2003). STEM experiences in OST can cultivate and multiply students’ initial interest in science, helping students to stay motivated and engaged to learn STEM in school. Afterschool and summer settings are being identified as environments for engaging youth in STEM and building their interest in pursuing future STEM careers (Coalition for Science After School, 2004).

Growing evidence shows that participation in OST activities positively supports youth development in general (Hall, Yohalem, Tolman, & Wilson, 2003; Vandel,

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Reisner, & Pierce, 2007) and STEM learning in particular (Tamir, 1991). However, simply participating in a self-identified STEM program is not sufficient. Youth will benefit more if they participate in *quality* afterschool programs (Mahoney, Levine, & Hinga, 2010). In fact, participation in a low-quality program can negatively affect youth development (National Institute on Out-of-School Time, 2009). Therefore, a common understanding of quality indicators in STEM OST is vital not only for researchers and evaluators but also for afterschool program leaders and staff.

An important way of knowing whether programs are of high or low quality is to observe them systematically and reliably. Such observation is practically impossible without good definitions of what constitutes quality. Observation tools employing such definitions and related indicators are being developed and applied both in schools (Bill and Melinda Gates Foundation, 2012) and in OST programs (Gitomer, 2012). Reputable observation tools for assessing STEM instruction in school settings include the Reformed Teaching Observation Protocol (Piburn et al., 2000) and the Classroom Observation Protocol (Weiss, Pasley, Smith, Banilower, & Heck, 2003). The OST field has several observation tools, as described by Yohalem and Wilson-Ahlstrom (2009), for assessing program quality generally. However, “instruments designed specifically for observing informal settings in science are only now being designed and researched” (Gitomer, 2012, p. 2).

In order to address this gap, researchers at the Program in Education, Afterschool, and Resiliency (PEAR) created the Dimensions of Success (DoS) assessment tool to help OST programs and researchers monitor and measure quality. The DoS tool allows observers to collect systematic data along 12 quality indicators to pinpoint the strengths and weaknesses of afterschool science learning experiences. These data can then be used to guide technical assistance and professional development and to help programs choose and modify curricula to meet students’ needs (Noam & Shah, in press). The previous work on afterschool quality assessment, especially the research done by Yohalem and colleagues (2009), along with the existing national frameworks of STEM assessment, guided the development of the DoS tool.

DoS is taking the lead in establishing definitions of and indicators for STEM program quality. This paper describes the development of the DoS tool, outlines its structure and the professional development that enables its use, and presents a case study of its application in an urban OST program offering STEM activities. Use of DoS is facilitating program improvement in OST programs and networks across the country.

Development of the DoS Observation Tool

In 2006, the research team at PEAR was invited to evaluate the effectiveness of the Summer METS (math, engineering, technology, and science) Initiative, which was established by the Kauffman Foundation to expand opportunities for student participation in science and technology-related summer activities and to better assist underserved youth in metropolitan Kansas City. In 2007, in addition to surveying 450 Summer METS students and 64 teachers, observers recorded notes using the first pilot version of the

DoS tool (Noam, Schwartz, Bevan, & Larson, 2007). Based on these observation data, the tool was further developed in 2008, when 10 programs in Kansas City began using DoS to observe one another in a peer-to-peer evaluation network (Dahlgren, Larson, & Noam, 2008). Though the programs were all STEM-focused, they were diverse in many ways. For example, they used different curricula and served different student populations; they worked in a variety of configurations, whether school-based or community-based, free-standing or part of a bigger network. Therefore, researchers’ biggest challenge was to standardize DoS to be applied in a wide variety of programs while still

using the same rubrics so that the results could be compared across sites (Dahlgren et al., 2008).

After incorporating feedback from the Summer METS project, developers worked to expand the usability of the DoS tool and to pilot it in a wider sample of afterschool programs, starting with the Informal Learning of Science Afterschool (ILSA) project. As part of ILSA’s in-depth case studies, trained observers used DoS in eight afterschool sites in California and Massachusetts, conducting 115 observations from January 2008 to August 2010. To triangulate DoS with previously validated observation tools, researchers also collected data on these programs using the

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Promising Practices Rating Scale (PPRS, Wisconsin Center for Education Research & Policy Studies Associates, 2005) and the Classroom Observation Protocol (Weiss et al., 2003). PPRS is a general afterschool observation tool, while the Classroom Observation Protocol, originally designed for use in schools, provided a science-specific framework. This process led to further revisions of the DoS tool.

Alignment with Nationally Recognized Frameworks

Two recent documents were fundamental in shaping quality indicators for OST STEM learning and accelerated the need for a quality assessment tool specific to this field. In 2008, the National Science Foundation (NSF) developed *Framework for Evaluating Impacts of Informal Science Education Projects* (Friedman, 2008), which outlined the main areas in which OST STEM programs should be evaluated. Additionally, the National Research Council (NRC, 2009) introduced six strands that describe goals and practices for informal science learning. The NRC strands, like the NSF domains, offer a framework for designing quality STEM experiences in OST and for identifying possible outcomes. Specifically, the NRC framework highlights the importance of students' excitement and interest; their ability to use models and build explanations, explore and test questions, reflect, and use scientific language and tools; and their ability to identify as people who can learn, use, and contribute to science (NRC, 2009).

The NSF framework (Friedman, 2008) defines five impact categories for assessment:

- Awareness, knowledge, or understanding of STEM concepts, processes, or careers
- Engagement or interest in STEM concepts, processes, or careers
- Attitude toward STEM-related topics or capabilities
- Behaviors related to STEM concepts, processes, or careers
- Skills based on STEM concepts, processes, or careers

The researchers' goal was to align DoS with the NSF framework and the NRC strands. At the time, three of the four DoS domains were Engagement or Interest, Content Knowledge & Competence and Reasoning, and Career Knowledge/Acquisition & Attitude/Behavior. All three domains are closely related to both the NSF framework and the NRC strands. As a result of numerous observations, the researchers felt the need for an additional domain to describe the curricula, materials, and space offered by afterschool programs, so they created a fourth domain, Programmatic Features. Over time, as researchers observed more STEM programs, dimensions within these domains were modified.

Validation

In order to make DoS available to a wide spectrum of OST programs, the development team needed to validate the tool by studying and reporting its psychometric properties. To accomplish this goal, PEAR teamed up with Educational Testing Services (ETS) in 2010 under NSF's Research and Evaluation on Education in Science and Engineering program. A team of observers was trained to use DoS in more than 300 STEM programs across seven states.

Teams of two trained observers, who had established initial inter-rater reliability with each other and with the pool of observers, observed STEM activities using DoS. These data were then analyzed to build a validity argument for the tool. Specifically, developers looked at the distribution of scores for each dimension, the rater reliability of observers, and the average scores for each dimension. They also looked for significant differences in scores from different kinds of programs—school-based, community-based, museum-sponsored, and so on. These details established the validity of the DoS tool; they are available in the NSF final technical report (Shah, Wylie, Gitomer, & Noam, 2013).

The Final DoS Tool

As illustrated in Figure 1, the current version of DoS has 12 dimensions in four domains: Features of the Learning Environment, Activity Engagement, STEM Knowledge and Practices, and Youth Development in STEM. Together, the twelve dimensions capture key components of what makes a quality STEM activity in OST.

The current DoS domains continue to be aligned with NSF categories and NRC strands, though they are arranged in different "bins." For example, the NSF category Engagement and Interest is now covered by several DoS dimensions including Participation, Engagement with STEM, and Relevance. The NSF category Skills and Awareness, Knowledge, and Understanding is reflected in such DoS dimensions as STEM Content Learning, Inquiry, and Reflection. Similarly, the DoS dimension Inquiry aligns with the NRC strand "Manipulate, test, explore, predict, question, observe, and make sense of the natural and physical world." The DoS dimensions Relevance, Engagement with STEM, Relationships, and Youth Voice contribute toward NRC strand 1, "excitement, interest, and motivation." The 12 DoS dimensions work together to cover the range of outcomes in both the NRC and NSF frameworks.

The DoS protocol consists of a short description of each dimension, a more elaborate description, commentary for training, and a four-point rubric. The description defines the dimension; the elaboration provides more details, presents

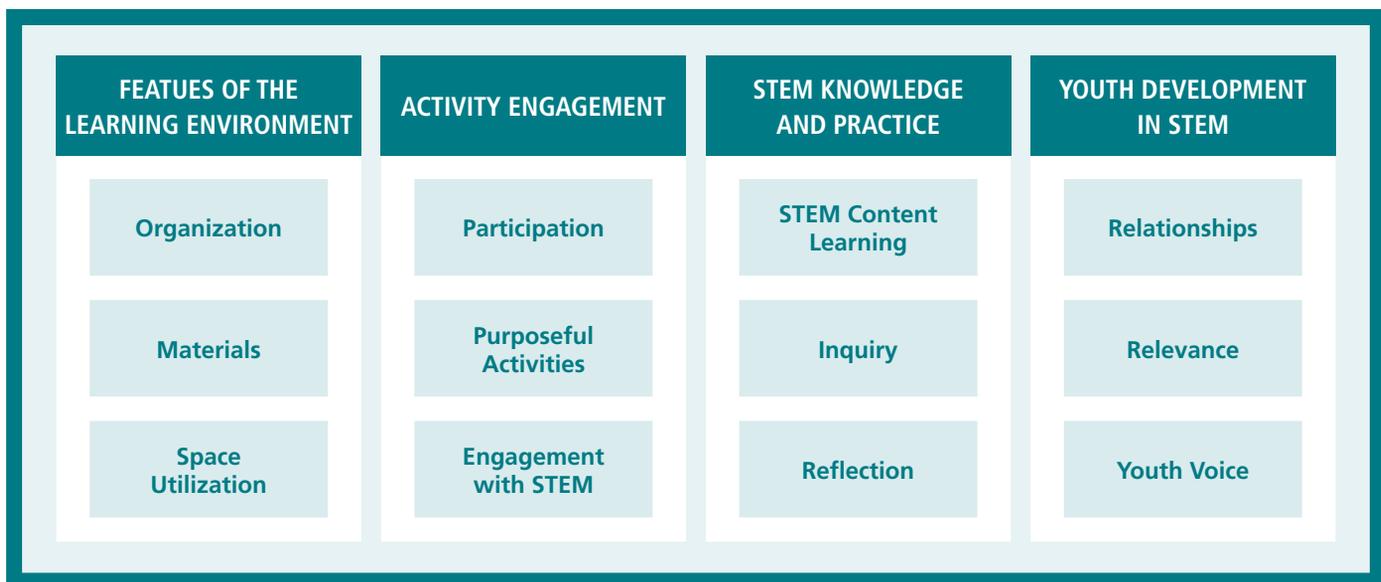


Figure 1. The Final DoS Domains and Dimensions

examples from the field, and provides tips on scenarios that commonly occur while observing STEM activities in OST. The commentary for training highlights key issues for trainees as they learn how to use the tool. The summary of the rubric provides examples of numerical ratings on a scale of 1 to 4, where 1 indicates little evidence and 4 indicates strong evidence of quality in that dimension. Each level is defined carefully in the rubric so that observers can distinguish the levels during their observation of an activity. The rubric for one dimension, Inquiry, is summarized in Figure 2.

DoS Training

To one observer, “inquiry” may mean “experiments,” while to another it may mean “rich discussions.” Simply reading rubrics and watching science activities is not enough to make someone a proficient DoS observer. The text in the rubric helps to guide observers, but they need training to learn the meaning of each of the 12 dimensions and how to identify each of the four levels.

DoS training familiarizes participants with the DoS tool and prepares them to conduct observations in the field. It also calibrates observers’ ratings so that the results are reliable and valid. The basic training consists of four steps:

- Eight hours of content training, online or in person
- Four to six practice observations in local afterschool STEM programs, in pairs
- A one-hour online calibration session with PEAR
- Certification for two years, with technical assistance and coaching as needed

The training materials include case studies of real

afterschool science programming, exercises asking observers to critique evidence from real DoS observations in the field, and observation simulations using videos of science activities of various levels of quality.

After completing all the parts of DoS training, new observers are certified for two years. One training fee covers all four steps, including continued coaching and technical assistance for two years to support the successful use of DoS in the field. Certified DoS observers can use the tool at no additional cost as frequently as needed to meet their program goals.

Why Use DoS

DoS can be used in flexible ways based on the needs of a program. Some reasons to use DoS include:

HOW TO BE CERTIFIED AS A DOS TRAINER

Researchers or practitioners can become certified DoS observers by completing the certification process outlined in this article. Contact PEAR to schedule a training. Training sessions are held year-round; the schedule can be adjusted to accommodate the needs of the organization. In-person trainings are great for large state networks or organizations looking to train their whole team, while online webinars accommodate participants from different locations.

EVIDENCE ABSENT	INCONSISTENT EVIDENCE	REASONABLE EVIDENCE	COMPELLING EVIDENCE
There is minimal evidence that students are engaging in STEM practices during activities.	There is weak evidence that students are engaging in STEM practices during activities.	There is clear evidence that students are engaging in some STEM practices during the activities.	There is consistent evidence that students are engaging in a range of STEM practices during the activities.
1	2	3	4
Students observe experiments demonstrations, or are given data, but do not participate in inquiry practices on their own.	Students follow cookbook experiments where they are given step-by-step directions, or may be given data or facts instead of collecting them. Some aspects of the activity will support students engaging in STEM practices, but it is quite scripted or unnatural.	Students engage in STEM practices; however, there may be uneven use of these practices by students or the level of support during inquiry may not be appropriate for the group of students.	Students have multiple opportunities to ask questions; to think like scientists, mathematicians, and engineers; and to engage in STEM practices that allow them to investigate questions as they are appropriately guided by the facilitator.

Figure 2. Summary of the DoS Rubric: Inquiry Dimension

- To help individual programs track their progress over time
- To encourage self-reflection among program staff, who can use DoS as a common language to discuss the quality of their activities and to pinpoint areas for improvement
- To aggregate information across individual sites for large youth-serving organizations such as Ys or for city or state afterschool networks
- To integrate DoS observations into an experimental evaluation design using pre- and post-participation assessments whose findings can be connected to the quality of the inputs observed using DoS

DoS can be used to help identify the areas where professional development or coaching may be needed. It provides a common language that staff members can use as they reflect on the quality of their science activities. Observers engage in consensus discussions in which they compare their field notes and ratings to make sure they have covered all aspects of the activities they observe and that they leave no room for misinterpretation. They then use the results of that discussion to frame the feedback given to staff members to help them improve their activities. DoS scores, along with the ensuing discussion and feedback, can help programs improve their curricular activities and pedagogical approaches.

Because DoS training involves several steps, OST programs will benefit most if they send staff members or leaders who are committed to the organization and are

likely to stay for at least a year. Despite the high turnover in afterschool settings, DoS can become an integral part of a program's planning, monitoring, and evaluation process. Its dimensions and quality indicators can be passed on to new staff members as a common framework for discussion when, for example, staff participate in curriculum design or undergo observation to help them improve their facilitation of activities. We are currently working on a train-the-trainer model so that program, curriculum, and training directors can begin to train their own staff and therefore make DoS an integral part of their program.

A Case from the Field

To illustrate how DoS can be applied in the field and to provide practical details on DoS training, we next describe a case study of DoS observations conducted from summer 2009 to spring 2010 at East End House, a community center in Cambridge, Massachusetts. At the time of the study, East End House served 100 youth, ages 11–14, the majority of whom were eligible for free or reduced-price lunch. Approximately 60 percent of the participants were male and 40 percent female. The racial and ethnic composition of the student population was 35 percent African American, 25 percent Caucasian, 20 percent Hispanic, 10 percent Asian, and 10 percent other.

DoS was applied in this program both as a quality observation tool to pinpoint strengths and weaknesses and as a professional development tool to help the staff plan and

revise their activities. PEAR trained the afterschool staff to use DoS, conducted observations of STEM activities, and provided feedback and recommendations that staff incorporated into their STEM curricula. In total, 19 one-hour observations were conducted, eight before the afterschool staff received DoS training and 11 after the DoS training.

The one-day training included information about existing quality frameworks in OST science, including the NSF framework and the NRC strands; approaches to quality in OST STEM instruction; and the development of DoS. More importantly, participants practiced applying the tool by watching videos of STEM activities, rating them, and reaching consensus on the ratings in small groups. Later, their ratings were calibrated with those of PEAR observers to establish inter-rater reliability with the tool's developers. Inter-rater reliability was also established during practice field observations by comparing the ratings of pairs of newly trained observers. This process ensures that DoS is being used consistently and accurately, regardless of who the observer is.

After the East End House staff received training in DoS, PEAR and East End House staff began conducting observations together. PEAR observers were paired with the East End House middle school program director and the curriculum director. Each pair observed one activity at a time and then discussed their ratings to reach consensus. The feedback was communicated to the facilitator of the observed activity. At the beginning of each curricular unit, the two directors worked with front-line staff to develop new curricula, incorporating the findings from the DoS observations. PEAR also used observation data to recommend ways that East End House could improve its programming.

The observed curricula were developed by the afterschool staff. Some examples of curriculum units included Numbers Behind Sports, Body Movement, Music by Me, and Green Thumbs Club. On average, the units were offered three times a week for four weeks. Typically one facilitator taught each unit, while groups of students rotated, so that all students got through all of the available curricular units during the academic term. During our study, four facilitators were teaching the units; there was no facilitator turnover. All facilitators had or were working toward bachelor's degrees. Only one had a science background.

Figure 3 compares the findings of the eight pre-training observations with those of the 11 post-training obser-

ations, using the dimensions that comprised the DoS domains at the time of the East End House case study. (See Figure 2 for the current domains and dimensions.) Post-training quality ratings for each of the 11 dimensions¹ increased relative to pre-training observations. The mean difference between pre-training and post-training scores was significant for nine dimensions: Planning and Preparation, Materials, Space, Engagement, Interest, Exploration, Investigation, Broadening Perspective, and Relevance. The only dimensions that did not show significant gains were Content Learning and Structure.

This case study suggests a correlation between use of the DoS tool and quality improvement. The study was not designed to confirm a causal relationship between the DoS training and an increase in quality of STEM programming. It used DoS as a *formative* instrument to help East End House improve its training and programming. A *summative* study, by contrast, would separate the external evaluators from the observers; the evaluators would analyze the observers' data. Moreover, an experimental design with treatment and control groups would be the only way to establish a causal

relationship between DoS and STEM quality. Thus, this case study cannot pinpoint exactly what influenced the quality improvement. However, it does suggest that the focused training and feedback DoS provides were associated with positive trends in quality.

Staff interviews confirmed the importance of DoS to the STEM programming at East End House. DoS

training enabled afterschool staff members to look at the program from an outsider's perspective and to strive to achieve quality. They also became familiar with national frameworks of STEM quality assessment and with the dimensions of STEM quality in OST. In follow-up interviews, front-line staff reported feeling more confident in their STEM teaching and in their understanding of what quality STEM activities look like. Staff members stated not only that the DoS training was important but also that actual use of the tool, with time for reflection and planning, greatly enhanced their ability to develop and implement quality STEM activities. One activity facilitator said:

When we started doing science in our afterschool program, before being trained on DoS, we didn't do inquiry; we didn't know how to teach content. We did a lot of projects without a lot of depth. But now, we build lessons around student voice that engage kids in really understanding science, making meaning of their world, and using critical thinking skills.

In follow-up interviews, front-line staff reported feeling more confident in their STEM teaching and in their understanding of what quality STEM activities look like.

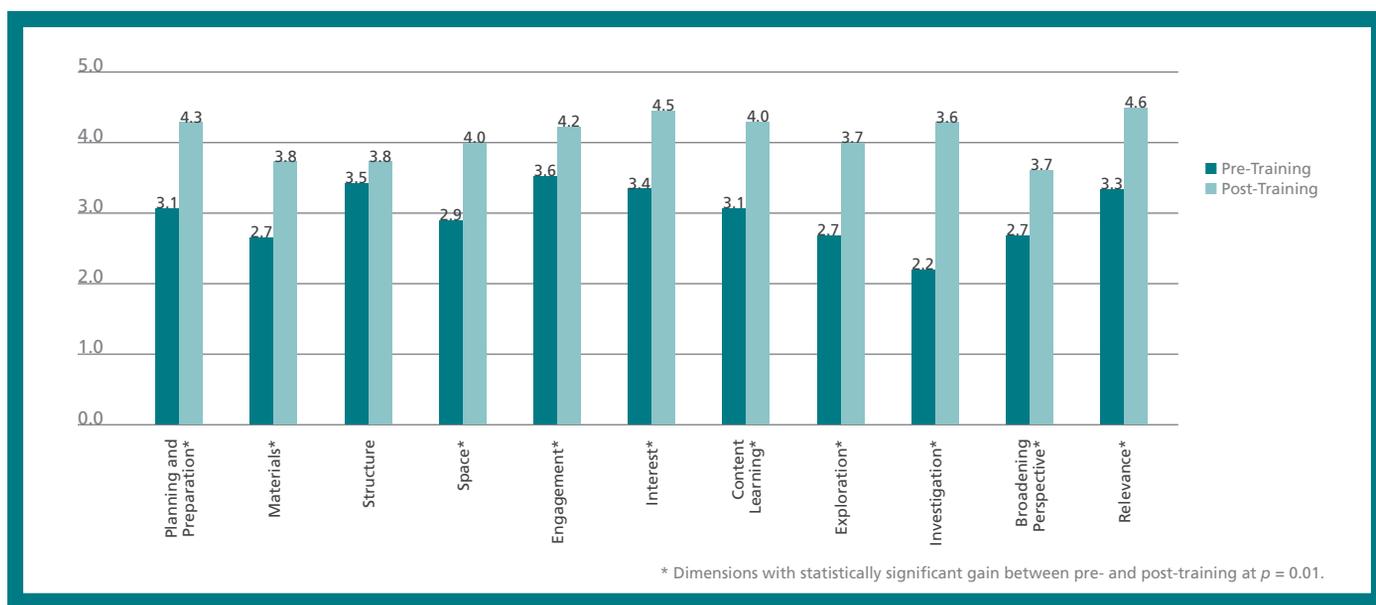


Figure 3. Comparison of DoS Dimension Average Scores, Pre- and Post-Training

The staff also reported that they were able to use their newly acquired skills to engage students in better science experiences. This improvement is exemplified in the words of another facilitator, who said, “One of the things we’re best at now is helping kids to make their own meaning and draw their own conclusions. Now they get to do the thinking.”

Strengthening the Investment in Afterschool STEM Quality

Our findings extend the creative work of a number of program assessment and quality observation tools by helping to define quality STEM education and enabling practitioners to observe STEM activities systematically. The DoS platform of observation and data-driven professional development can support programs to build practices that foster student interest and engagement in STEM.

Findings from the case study of East End House can be generalized to a wide spectrum of afterschool science programs. Although each program is unique, the DoS tool is designed to help afterschool staff identify the strengths and weaknesses in their STEM instruction so that, through consensus discussions, they can work to improve the program.

As a next step, the Mott Foundation, in collaboration with the Noyce Foundation, has created a technical assistance team to support nine state afterschool STEM networks. In each state, we will train teams to use DoS and certify them when they have reached acceptable levels of reliability. This large-scale project has several components, including training professionals to use DoS and comparing DoS observation data with students’ expressions of science interest and facilitators’ self-reports on their science

programming. We are also planning to give DoS training to afterschool providers across California. In the meantime, the DoS tool has been adopted successfully in many afterschool networks. We have built the infrastructure to serve many regions and organizations across the country.

We have collected valuable data describing quality across a range of sites and have seen improvement when OST staff systematically observe their STEM activities. Through continued analysis of the data, we are able to improve our training process and prepare observers to achieve the most accurate ratings possible. The practical feedback provided by certified observers can immediately be used to improve OST STEM programming.

Public and private funders are investing millions of dollars to get students interested and engaged in science outside of school. Use of DoS helps the OST field to demonstrate that the quality of our STEM instruction is strong and that it can lead to the student outcomes that funders, researchers, and practitioners alike are working to achieve.

Acknowledgements

The authors would like to express their gratitude to the Kaufmann Foundation and the National Science Foundation, which generously supported the development and validation of the DoS tool (NSF award numbers 540306 and 1008591). We would also like to thank Dr. Dylan Robertson and Michael Delia. East End House would like to thank the Biogen Idec Foundation and the Massachusetts Department of Elementary and Secondary Education’s 21st Century Community Learning Centers program for their generous support.

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Notes

¹ Data from the Belonging/Relationship dimension were removed from analysis. During development, the protocol for this dimension was changed several times. This dimension therefore was not deemed consistent enough for the purpose of this paper.



youth as community science experts in green energy technology

by Angela Calabrese Barton, Daniel Birmingham, Takumi Sato, Edna Tan, and Scott Calabrese Barton

“We know what we are doing. We know how to make a difference. We know how to save energy and how to convince other people of better ways to do things with electricity. That is one way that we are experts.”

These words come from Janis, a 13-year-old African American and incoming ninth grader who has participated in Green Energy Technology in the City (GET City) for nearly four years, first as a student-participant and later as a youth leader. Janis went on to say:

What I would like do in the future... is become an engineer specializing in computer and electrical engineering or reverse engineering. I would like to invent or create something that will save energy and be very useful to people, that will cost less. I would love to create an energy-efficient refrigerator that will use less and maybe tell you how and what items that are still in the refrigerator. I am aware of energy-efficient refrigerators that are currently in the market, and I am very interested in learning about how such refrigerators are actually designed and made.

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Consistent with these ideals, Janis refers to herself as a *community science expert*, or someone who can “make a difference” because of what she knows about science and about her community. These aspirations are new for Janis, who, in fifth grade when we first met her, openly expressed a dislike of science, was unfamiliar with engineering, and aspired to be a singer. Janis describes GET City as the place where she learned what an engineer is and where she realized she could use her love of art to do science and engineering. It was also where she learned that being smart in science was not only for “geeks.”

Janis’ story is, unfortunately, the exception and not the norm. In the U.S., African Americans make up only 5 percent of the engineering workforce, mostly as technicians rather than managers or leaders (National Action Council for Minorities in Engineering, 2011). This statistic has changed little in the past two decades despite efforts to reform science and mathematics in our nation’s schools. In particular, interest and motivation in science, technology, engineering, and math (STEM) drops precipitously in the middle grades, when youth make critical course choices that can have lifelong consequences (Vedder-Weiss & Fortus, 2012).

In this paper, we examine what it means to become a community science expert (CSE) like Janis and why this goal is important for youth in afterschool environments. Using GET City as a case study, we describe how this afterschool program nurtures youth as CSEs. We draw on data gathered in 2007–2010 including student and teacher interviews; field notes on student participation; student artifacts; and pre- and post-participation measures of technology knowledge and skills, STEM practices, career aspirations, and community engagement. The guiding questions for the case study included “What does it mean to become a CSE?” and “Why should developing CSEs be an important outcome of afterschool programming?”

Becoming a Community Science Expert

Success in school science has been narrowly defined by achievement scores. However, as noted by others (for example, National Research Council [NRC], 2009), this narrow framing overlooks other crucial indicators of learning and development, such as changes in identity and in forms of participation. Learning science is a long-term process of becoming a legitimate participant; it involves learning the discourses and practices of science (Lave & Wenger, 1991; Rosebery & Warren, 2008). Especially for students for whom science represents ways of knowing, talking, or doing that are different from those they usually experience, figuring out how to negotiate the multiple discourses and

knowledge of the science learning community can be challenging (Moje, et al., 2004; Rosebery, Ogonowski, DiSchino, & Warren, 2010).

A growing body of research demonstrates how informal science settings, both programmed and freely formatted, have been successful in reaching youth from underrepresented backgrounds (NRC, 2009). This work shows how informal science learning not only supports knowledge gains but also increases the desire to participate in science (Dierking, 2007; Falk, Storksdieck, & Dierking, 2007; Harvard Family Research Project, 2011). Informal science environments recognize and value a broad set of learning outcomes that are more consistent with how people learn in everyday life than are traditional school outcomes (NRC, 2009). Outcomes more recognized as important forms of learning and achievement in informal settings than in traditional settings include development of science identity—for example, “I am an oceanographer who loves to dance with the dolphins”—and novel forms of participation that merge cultural and scientific practices (Calabrese Barton & Tan, 2010; Nasir & Hand, 2008). The dolphin-dancing oceanographer, for example, might become the choreographer of an artistic and scientific documentary.

Drawing on this research base, we posit that one important outcome of community-based informal science programming is providing opportunities for youth to become CSEs. Becoming a CSE involves developing deep knowledge of science and applying that knowledge by taking action in meaningful ways in the local community. We define CSEs as youth who are knowledgeable in science, are deeply connected to place, and use their expertise and connections to engage community members and take action on local issues (Calabrese Barton & Tan, 2010). As Lee and Roth (2003) argue, “science is not a singular normative framework for rationality, but merely one of many resources that people draw on in everyday collective decision-making processes” (p. 2). CSEs combine scientific knowledge with community experience to inform action.

Community science expertise challenges traditional notions of scientific expertise because it values experiential knowledge, family concerns, and community history alongside scientific knowledge. Youth are positioned as experts—as individuals who are capable of leading and making a difference by using science in their communities. Authority is shared; community science expertise requires multiple perspectives and engagement with many people. From this perspective, scientific expertise can be leveraged to redistribute the power structure in a community.

The idea of being CSEs was initially developed by youth in GET City. They began to refer to themselves as people

who, as Janis says, “make a difference” because of the science they know and the work they do with that knowledge in their community. When asked to describe, for a presentation to a sustainability scholar, what CSEs are and do, GET City youth created a slide that described CSEs as “committed... ready to learn... willing to take on big problems that will help your community... willing to make a difference.” This concept of community science expertise highlights the need to learn relevant science, identify community issues, and take educated action to improve the community.

GET City supports youth in becoming CSEs by providing a platform where they can engage in scientific discourse while having the freedom to affect their community in ways that matter to them. Supporting youth in developing as CSEs positively affects their interests and aspirations in science and engineering. The next sections describe how GET City has helped youth to become CSEs. We first explain the structure of GET City and give an example of how it supports youth in developing identities as CSEs. Then we discuss implications for other programs interested in giving youth opportunities to gain knowledge and interest in science and to use that knowledge to take action in their local communities.

Green Energy Technology in the City

Supported by the National Science Foundation, GET City serves 20–30 youth annually at the Boys and Girls Club in Great Lakes City, MI (a pseudonym). The authors of this paper designed the program and work as facilitators in it. The youth are local to the area; many come from low-income and minority backgrounds. Child poverty in Great Lakes City has increased more than 40 percent since 2000 (Michigan League for Human Services, 2009). More than a quarter of Great Lakes City children live below the poverty line, with the rate jumping to over 40 percent for African-American youth.

GET City is built on the premise that meaningful learning happens when youth engage in authentic investigations of local problems and have scaffolded opportunities to educate others about their findings. This year-round program helps youth to develop into science and engineering *experts* and *citizens* by supporting them to take on green energy issues and to communicate findings to their community. Supporting youths’ development as CSEs are the three organizing components of GET City:

- Building STEM expertise
- Building STEM citizenship
- Educating others

The first component is *building STEM expertise*. GET City engages youth in authentic investigations of issues that have local relevance and global importance, fostering deep engagement with energy and environmental issues. Youth engage in authentic scientific practices: asking research questions; developing, testing, and revising scientific models; collecting and analyzing data; and reporting and defending findings. GET City investigations usually emerge from youth questions that are generated in collaborative discussions with adult staff about energy concerns in the city and state. For example, the youth investigated whether their city should build a hybrid power plant because their parents received letters from the local power company regarding potential rate hikes. GET City investigations are supported by field trips to related partner projects such as power plants, wind farms, solar arrays, and LEED-certified buildings.

The second component is *building STEM citizenship*. As part of their investigations, youth develop multimedia products to educate particular audiences on energy issues, addressing the question, “What’s important for others to know about my investigation?” These products include digital public service announcements, podcasts, raps, and others. Developing these products encourages youth to discern the scientific messages that are most salient to other people. The process helps youth move from being STEM experts to being STEM citizens as well.

The third component is *educating others*. Youth use their knowledge and products to educate target audiences and enable them to adopt green practices. The GET City Education Network provides an audience for youths’ scientifically rigorous ideas. In this network, youth work with GET City staff, local teachers, and community leaders to develop their multimedia products into educational activities that align with school and community needs. GET City youth typically host three community forums each year to teach their findings to peers, families, and community members, reaching 50–150 people per event. Youth also teach lessons in their school, where they educate peers about their findings in youth-centered ways.

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The GET City website, where youth blog and post multimedia products, provides additional authentic audiences.

GET City's three components support youth in developing expertise and using it in powerful ways in their community. Case study and external evaluation data (Laorenza, Whitney, & Feger, 2010) indicate that GET City youth not only made a difference in their school and community, but also significantly increased their interest and career aspirations in science and engineering along with their knowledge and skills. Even more interesting, they also placed more value on science and information technology for solving community problems (Laorenza et al., 2010). These outcomes support the idea that developing youth as CSEs is important.

So what does becoming a CSE look like in action? What strategies and planning practices are used in the three components of GET City to support youth in developing as CSEs?

Community Science Experts in Action

To address these questions, we studied a GET City investigation of the statewide initiative Change a Light, Change Michigan. We used this policy in our investigation because it enabled youth to engage with current local energy-related dialogue and to take action based on their understanding of the science and of community needs. The investigation is thus typical of GET City experiences.

Authentic Investigations

During the 2009–2010 school year, GET City youth investigated the newly introduced initiative Change a Light, Change Michigan, which encouraged residents to switch from incandescent light bulbs to compact fluorescent lights (CFLs). The investigation began with the questions, “What is this initiative asking residents of our state to do, and why? Why should we care?” Like many science-related public policy initiatives, this one focused on action goals and behavioral changes but did little to help people understand the science behind the changes. Our goal in introducing this unit to GET City youth, therefore, was to help them get smarter about the science underlying Change a Light, Change Michigan. The youth delved into several months of scientific investigation, including

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experiments designed to produce electricity from different sources, exploration of energy supply and consumption in their city, and study of the relationship between energy conservation and carbon emissions. The investigation was built around the idea that people and organizations have

carbon footprints: Daily activities such as driving a car and turning on lights produce carbon dioxide. An additional premise was that people have some control over the size of their carbon footprints.

In the first part of the investigation, youth gathered data to determine their own carbon footprints and that of the community club that hosts GET City. Using online calculators, GET City youth surveyed their own and their families' energy practices to determine their carbon footprints. They compared footprints with one another and with youth around the globe. They asked their parents and other family members

how they kept track of their energy usage, if at all. They interviewed grandparents and great-aunts and uncles to learn how appliance usage had changed over two generations. They determined the power needs of representative electrical items in homes and businesses and learned about the relationship between personal actions and energy usage. Embedded in these investigations were core concepts such as the law of conservation of energy and the fact that electrical energy is measured in kilowatt-hours. Students also audited the community club's energy practices: what appliances were used, how often, and for what purposes; whether appliances were left on when not in use. They then wrote a letter to the club president, recommending changes to conserve energy and reduce the club's carbon footprint.

In order to understand that energy consumption contributes to carbon emissions, youth have to understand how electricity is produced and delivered. For example, flicking on the light switch indirectly produces carbon through the harvesting and burning of coal. In the second part of the investigation, students built hand cranks using magnets, copper wire, and micro-amp bulbs to produce electricity using human power. They visited the local coal-fired power plant. They used these ideas to write and produce musical raps about the production of electricity.

In the third part of the unit, the youth delved more deeply into the public initiative Change a Light, Change Michigan. They came up with questions, such as, “Why



Figure 1. GET City Participant Analyzing Data

would changing the style of light bulb make a difference?” To satisfy their curiosity, the youth conducted several experiments, using digital probes to compare the power requirements and the heat and light outputs of CFLs and incandescent light bulbs. They then organized their data using spreadsheets (Figure 1). For example, they rode a bicycle connected to an electrical generator to power incandescent bulbs and CFLs so they could physically feel the increased effort needed to power the incandescent bulbs. They measured the heat emissions of the two types of bulbs after 1 minute, 5 minutes, and 10 minutes of usage. Embedded in these investigations were the core ideas of energy efficiency and energy transformation. Incandescent bulbs require more electricity because they convert electrical energy into both light and heat energy, whereas CFLs more efficiently convert electrical energy primarily into light energy. These experiences built the youths’ expertise in energy-related science.

During this portion of the investigation, the local school district announced major budget cuts that would largely affect afterschool programming and special activities at the youths’ school. Three GET City youth—we’ll call them Etta, Chloe, and Chantelle—were particularly upset by these cuts. They decided to use their knowledge of Change a Light, Change Michigan to take action. They believed that, if they could figure out how much money the school could save by

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Using Science and Community Knowledge to Take Action

With video recorder, surveys, and cameras in hand, Etta, Chloe, and Chantelle set out to perform an energy audit of their school. They counted the incandescent bulbs in the school building and documented their locations. They recorded the kilowatt-hour expenditure and the need for light in each location. Based on school routines, they conjectured how often and for how long each light would need to be on. Putting their data into spreadsheets, they calculated current energy expenditures and

then performed the same calculation assuming that all bulbs were CFLs. Using the difference, they calculated how much money and how many pounds of carbon emissions would be saved if the school switched to CFLs. They also interviewed teachers and students on their energy practices in school.

Prior GET City investigations had shown these youth how to translate their findings into digital productions that were scientifically rigorous and relevant to their community. Using their own time as well as time in GET City, the three girls turned their findings into a four-minute public service announcement, “The Light Bulb Audit,” targeted to school leaders and peers.

“The Light Bulb Audit” is serious yet humorous, scientifically complex yet accessible to the intended audience. It starts with a series of images backed by John Mayer’s song, “Waiting on the World to Change.” The first image shows youth playing and dancing in their school. The next images are of an incandescent light bulb and then a CFL accompanied by the text, “MAKE A CHANGE.” The video then transitions to the three girls explaining their decision to conduct a light bulb audit and asking viewers if they think their school is green. Although their audit covered most school spaces, the girls focused their video on the bathrooms located in each classroom. The video shows its producers inspecting school bathrooms to count CFLs and incandescent bulbs, interspersing these shots with in-

formation about the number of watts used by each. The girls discover that all but one bathroom use incandescent bulbs, helping to set up their storyline about why their school must make a change.

The next segment of the video uses music, text, and vivid images to detail how and why energy efficiency reduces carbon emissions and is better for their environment. In the background is Michael Jackson's "Earth Song," whose lyrics question, "What have we done? Look what we've done." The video juxtaposes images of coal mines and coal harvesting with text declaring, "This coal mine used to be filled with trees and grass." As the music fades, Chloe asks viewers, "Have you ever seen those smoke stacks?" Next, we see a picture of the local power plant. Three stacks billow smoke of an ominous burnt-orange hue as the music asks, "What about flowering fields?" The mine image reappears, but now the text reads, "This land and our atmosphere may NEVER be the same."

The last segment of the video presents the girls' calculations of the money and carbon that would be saved if their school changed bulbs. The video closes with scrolling text reviewing how incandescent bulbs use more energy, while Michael Jackson's song says, "I'm asking you to make a change." The girls used their knowledge of energy-related science, of their school, and of IT applications to deliver an educational message to members of their community. The video, an instant hit among their GET City peers, spurred the group onto action.

Getting the Message Out There: Making Real Change

As a group, GET City youth decided that they needed to share their findings with their school. Using "The Light Bulb Audit" as the centerpiece, they prepared a 30-minute workshop for the school's student congress, focusing on why the school should switch the bathroom lights to CFLs. The youth prepared a presentation highlighting the energy consumption and emissions of incandescent bulbs and CFLs. They created a rap about the science of incandescent bulbs, carbon emissions, and climate change. In addition, they prepared a pledge committing to change the bulbs that they hoped all school leaders—student congress and adult leaders alike—would sign. The GET City presentation helped student representatives to deepen their scientific understanding of the environmental slogan Change a Light, Change Michigan, while pledging to make a difference in their school.

On hearing about the investigation and resulting school workshop, the local power company donated 1,000 CFLs for GET City youth to distribute to their schools,

neighbors, and families. A group of 16 GET City youth took their workshop on the road to their churches and other community centers until all of the bulbs were distributed. The network of people who saw the "The Light Bulb Audit" expanded when it was shown on local television stations in Great Lakes City and Detroit. Its creators also submitted it to the Show Green! Student Film Challenge, a statewide competition organized by a Michigan nonprofit. The video won first prize for the under-12 category and was shown at Ann Arbor's historic theater to a packed audience.

Like all GET City youth, Etta, Chloe, and Chantelle worked as CSEs: In hopes of making a difference, they took action on an issue they saw facing their community. Table 1 highlights how the three organizing components of GET City were enacted in the Change a Light, Change Michigan investigation to support students' growth as CSEs. The goals, planning, and action were originated by the youth, either alone or in collaboration with adult leaders.

Implications

The GET City model can work in other informal learning contexts, even ones that may not have the same level of resources or support. Four core design principles are vital to supporting youth in developing as CSEs:

1. Ensuring community relevance
2. Valuing youth expertise
3. Distributed expertise and decision making involving local experts
4. Empowering youth to take action

The first principle, community relevance, supports youth engagement and inspires young people to learn more through scientific investigations. In the Change a Light example, the scientific investigations were based in the participants' school, community, and families. The investigation required a deep understanding of energy-related science. Situating the investigation in the community contextualized the science participants were learning and helped them form questions about what else they needed to know.

The principle of valuing youth expertise leads to authentic investigations. As the designers of the program, we realized that GET City youth brought rich and complex understandings of their community to their development as CSEs. Although we planned for youth to build deep understanding of energy-related science, their engagement would not have been the same if expertise had not been shared among members of the group. The youths' public service announcements were geared toward a local audience of peers, community members, and teachers. The youth used their knowledge of this audience, of

GET CITY COMPONENT	GOALS	PLANNING	ACTION EXAMPLES
Building STEM expertise	<ul style="list-style-type: none"> • Identify science-related concerns in the community • Identify science learning goals • Identify potential investigations • Identify community stakeholders and their potential role in supporting development of youth expertise 	<ul style="list-style-type: none"> • Map out major activities of the unit • Develop lessons for authentic investigations and gather necessary materials • Make connections with local experts and resources • Select field trip sites and plan visits 	<ul style="list-style-type: none"> • Light bulb audit • Experimenting with hand-cranked generators • Light bulb experiment comparing energy demands of incandescent and CFL bulbs • Visiting the local power plant
Building STEM citizenship	<ul style="list-style-type: none"> • Identify the message youth wish to communicate • Identify technology skills needed 	<ul style="list-style-type: none"> • Develop lessons or tutorials for producing digital artifacts, such as videos, raps, websites • Allow time for supported use of technology 	<ul style="list-style-type: none"> • Light bulb audit video • Coal rap
Educating others	<ul style="list-style-type: none"> • Identify the audience and its concerns 	<ul style="list-style-type: none"> • Solicit youth input on the audience to whom they want to communicate the results of their scientific investigations • Support youth in planning appropriate format, events, and venues • Coordinate with selected audiences to create spaces for youth to share their work 	<ul style="list-style-type: none"> • Workshop for the school student congress • Workshops at local churches and community centers

Table 1. Supporting the Development of Community Science Expertise

what its members cared about and what they responded to, when designing messages to share their findings.

Distributed expertise and decision making involves local experts in supporting meaningful STEM learning. Learning in informal environments is often described as a process of apprenticeship (Lave & Wenger, 1991), in which novices learn knowledge and practice alongside experts. GET City relies on four kinds of partners: host community organizations, community energy organizations, schools, and businesses. Providing opportunities for youth to work with partner experts situates the science knowledge and practices youth are developing. This process opens spaces for youth to collaborate with local experts in design-based work for learning and educating others (Kolodner, 2006), while supporting youth in

crossing borders as they bring science to their communities. Science practices in which novices and experts work side by side support youth in developing core science practices and provide opportunities for them to practice leadership in science as they educate others, from siblings to teachers.

The fourth core component is to give youth opportunities to do something with what they know. Although adults support youth throughout the learning process, how they act on what they have learned is ultimately up to them. Youth have the power to take ownership. As one participant noted, “You listen, then start letting your community hear you [and] get your point across to the world. You are saving the world and its power. Think about it. I’m an 11-year-old sixth-grade girl, saving the world and its people.”

Why Community Science Expertise Matters

Learning science is imperative for informed citizenship. It opens possibilities for improving one's community. It also opens doors to future STEM careers. The GET City model of youth engagement in science shows how urban youth can engage in complex practices at the intersections of culture, place, and science, in the process of becoming engaged CSEs.

Statistics say that urban, low-income, and minority students are unlikely to access quality science education or move into science and engineering trajectories. GET City's CSE model offers an avenue for pushing back against these trends. It gives youth opportunities to engage in authentic, scientifically rigorous, and culturally relevant investigations and to educate others, on their own terms, about their findings. GET City youths' work as CSEs makes a difference both in their communities and in their own orientation toward science as a part of their current and future lives.

Acknowledgements

This material is based on work supported by the National Science Foundation under Grant No. 0737642. Any opinions, findings, and conclusions or recommendations expressed in this material are our own and do not necessarily reflect the views of the National Science Foundation. We would like to thank the staff at the Innovative Technology Experiences for Students and Teachers (ITEST) resource center who reviewed earlier versions of this paper for the ITEST summit on innovative models for engaging youth in STEM.

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learning from science

Case Studies of Science Offerings in Afterschool Programs

by Patrik Lundh, Ann House, Barbara Means, and Christopher J. Harris

Afterschool programs have increasingly gained attention as settings that can help enrich students' science learning (Halpern, 2004). Even though science is widely included in afterschool activities, sites often lack adequate materials and staff know-how to implement quality science. Moreover, not much guidance is available on how afterschool sites can offer quality science within the practical constraints of their work (Chi, Freeman, & Lee, 2008; Noam et al., 2010).

To address this need, this article examines afterschool science in light of the National Research Council's comprehensive synthesis report on promoting science learning in informal environments (NRC, 2009). We present the results of our analysis of qualitative case studies of nine state-funded afterschool sites in California, discussing the strengths of these programs against the background of three key site-based constraints—time available for science, staff's science backgrounds, and instructional materials—as well as the importance

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of partnerships with outside organizations to support sites in overcoming these obstacles.

Goals for Afterschool Science

Over the last two decades, experts have called for a shift in science education away from a focus primarily on knowledge acquisition and toward a focus on learning science by engaging in the *practices* of science (AAAS Project 2061, 1993; NRC, 1996, 2007, 2012). These practices include asking questions, developing and using models, conducting investigations, interpreting data, constructing explanations, engaging in scientific arguments, and communicating information and findings. This “science-as-practice” perspective (Duschl, 2008; Harris & Salinas, 2009; Lehrer & Schauble, 2006) has recently been applied to science learning in out-of-school settings, with added attention to cultivating students’ science interests and science identities (NRC, 2009). Research in a variety of out-of-school settings that emphasize science as practice have shown promising outcomes in such areas as learning of science concepts (Bell, Blair, Crawford, & Lederman, 2003; Etkina, Matilsky, & Lawrence, 2003), collaboration and communication (Ritchie & Rigano, 1996), curiosity and interest in science (Barab & Hay, 2001; Bouillion & Gomez, 2001; Stake & Mares, 2005), science identity (Fadigan & Hammrich, 2004), and pursuit of science careers (After-school Alliance, 2011; Chi, Snow, Lee, & Lyon, 2011).

The NRC (2009) report proposes six strands of science learning that illustrate how informal learning environments can support meaningful participation in science:

1. Developing interest in science
2. Understanding science knowledge
3. Engaging in scientific reasoning
4. Reflecting on science
5. Engaging in scientific practices
6. Identifying with the scientific enterprise

Our case studies explore the extent to which afterschool science offerings are addressing the NRC strands and consider the factors that help or hinder their progress.

Case Studies of Afterschool Science

We conducted case studies at nine afterschool sites in different regions in California. In constructing our cases, we examined the goals and scope of science offerings and compared them with the NRC’s (2009) six strands.

Selecting Cases

The case studies were part of a larger study in which we surveyed 406 sites in a state-funded network of afterschool programs throughout California. The purpose of the survey was to collect data on sites’ partnership networks and how partner support influenced the depth and frequency of science offerings. We conducted case studies of nine sites from our survey sample to generate hypotheses about how various factors—in particular time, staff capacity, instructional materials, and support from other organizations—relate to one another and affect science offerings. We selected critical cases (Flyvbjerg, 2006) that would showcase science offerings under the most

promising conditions, allowing the generation of explanatory patterns (Greene & David, 1984) of the critical factors associated with strong science offerings.

To find sites with frequent and broad science offerings, we followed a three-step process. First, we selected a sample of sites based on whether they had two or more sources of support, offered science at least once a week, and reported

features that indicated high-quality science learning, such as inquiry-related activities. Our first-round selection resulted in 122 candidate sites. Second, we reviewed each of these 122 surveys holistically and in detail, looking at the broad picture of what sites reported about science activities, frequency of science offerings, instructional materials, and kinds of support for science, as well as open-ended descriptions of sites’ science activities. We then conducted screening phone calls with 20 of the most promising sites. The results of these calls, along with geographical diversity, informed the final selection of nine sites.

Data Sources and Collection

Instruments—which included semi-structured interview protocols and structured observation debrief forms—and data collection were informed by a set of key categories intended to create rich descriptions of each case, to guide a detailed examination of individual cases, and to provide a framework for cross-case comparisons. These categories included site locations; program activities; number of staff members, their background and history in the program, and staff turnover; number of participating children and their ages, background, and demographic characteristics; history and purpose of science offerings;

Over the last two decades, experts have called for a shift in science education away from a focus primarily on knowledge acquisition and toward a focus on learning science by engaging in the practices of science.

instructional materials; staff background in, knowledge of, and interest in science; and external support for science education. We visited three of the sites twice, once in spring 2011 and again in fall 2011. Because data from the second site visits mostly confirmed data from the initial visits, we visited only one more site twice; the other five were visited once. During the visits, which took one or two days apiece, we interviewed science facilitators, site leaders or coordinators, and representatives of support organizations. We also observed science activities, taking detailed notes and writing up insights on a structured observation form.

Analysis

We began the analysis by examining the key categories described above in order to compare across cases. Comparisons highlighted substantive differences among sites. These differences served as the starting points for explanations of the relationships among science offerings and materials, unique and common circumstances, and supports. We profiled each case based on key factors and relationships between categories, highlighting the differing conditions under which science programs occurred. We then looked across cases to discern explanatory patterns in programming and support as well as to highlight notable program or support features using a grounded theory approach (Glaser, 1992).

Next we compared the science activities we observed to NRC's (2009) six strands of informal science learning. To generate a description of a site's science offerings that could be compared with the NRC strands, we considered several factors: the goals of science activities as reported by facilitators and site coordinators, the structures of the activities we observed and the engagement of children in the activities, and site staff reports of typical science activities. Each site was assigned a high, medium, or low score for each of the six NRC strands. A high score meant that at least one of the explicit science goals aligned with the strand and that the activities provided strong learning opportunities relating to that strand. A medium score meant that some aspects of science activities were aligned with the strand, but that these aspects were not made explicit to the children or the activities reflected the strand only moderately. A low score meant that few aspects of the activities were aligned with

the strand and that these aspects were not highlighted. If the activity did not refer to or include any aspect of the strand, it received no score.

For example, an activity involving mixing borax, glue, and water to make "goo" would be scored high for strand 5, engaging in scientific practices, if children were encouraged to experiment with different proportions of ingredients, make predictions, and take observation notes about what these recipes created. It would be scored medium if the children merely made their own goo, following the same prescribed steps, and participated in a reflective group discussion after the activity. It would be scored low if the children just observed the teacher or followed directions without understanding the scientific purpose of the scripted acts, with the emphasis instead falling on the fun of playing with the goo.

Effects of Constraints and Support on Case Study Science Programs

Our findings revealed significant capacity constraints at these sites. The types and depth of science offerings were consistently explained by three site-based factors: time, staff capacity, and instructional materials. The support of other organizations, particularly with staff capacity and instructional materials, played a significant role.

Below, we describe science activities observed at two of the nine case study sites. We then discuss our findings across all nine cases, considering the three key factors and external support in light of the NRC framework for science in informal settings. Finally, we discuss the implications of our findings for how afterschool programs can use their strengths to address the NRC strands within their practical constraints.

The case of Lockhart, one of two sites with the strongest science offerings, demonstrates how limited staff capacity can be improved through professional development from a partner organization.

Two Case Studies

The Alhambra¹ site exemplified science activities and staff capacity constraints common among the nine sites. The case of Lockhart, one of two sites with the strongest science offerings, demonstrated how limited staff capacity can be improved through professional development from a partner organization.

Science at Alhambra

Alhambra is an elementary school serving grades 1–6 in a low-income neighborhood in a small urban area on Califor-

nia's north coast. The school operated the afterschool program, which, at the time of this study, offered science every Thursday for about one hour. In addition, undergraduates from the nearby university's community outreach program facilitated science activities for 45 minutes every Friday.

One of the activities we observed involved making rockets. When the two undergraduate volunteer facilitators told the children that the rockets would shoot up in the air, the children applauded. One facilitator explained that the children were to color and cut out rocket parts that were pre-drawn on paper. Participants were then to glue the rocket parts onto an empty film canister. The facilitator said, "After decorating and things like that, you will do some science stuff." The children began coloring and cutting out the pieces of paper. They were highly engaged in their coloring, chatting together as they worked. During the activity, about a quarter of the children left as their parents picked them up.

When most of the children had finished coloring and cutting, the facilitators demonstrated how to wrap the paper parts around the canister. This task was difficult for most children, so they ended up waiting for a facilitator to wrap and tape the parts onto their canisters. They sat and waited passively or chatted with other students.

When all the children had finished their rockets—which were quite attractive in various colors and patterns—they went outside. In the yard, the children lined up by a picnic table to have one of the facilitators pour a cola drink into the canister. Then they went to the other side of the table, where the other facilitator helped them add a mint tablet, quickly plug the canister, and place the rocket right side up on the table. The first few rockets fizzled. One jumped a few inches into the air. Some children started asking why the rockets did not "explode," and some suggested adding more mints or more cola. But no discussion ensued, and the remaining parents were arriving to get their children. After all the children had launched their rockets, the activity ended.

Science at Lockhart

Lockhart is an elementary school in a predominantly Hispanic urban community in the Los Angeles metropolitan area. The afterschool site, which served 120 children, was operated by an afterschool organization with dozens of sites in the area. Science was offered to children in grades 3–5 two to four times a week, in addition to other activities including arts and crafts, gardening, dance, basketball, drill team, reading, chess, and keyboarding.

In one activity we observed at Lockhart, the facilitator began by asking the fourth- and fifth-grade children,

"Can anybody give me an idea about how an airplane flies?" After the children shared their thoughts, the facilitator read from an activity sheet to inform them about the goals of the activity. Pulling polystyrene plates and a sheet of instructions from a large bag, he led the children through the process of making a plane.

The steps involved measuring, drawing, and cutting pieces of the plates. For each step, the facilitator waited for all the children to finish. When the planes were finished, the facilitator told the children to line up in the back of the room and throw their airplanes one at a time. "Did it glide?" he asked. When they responded "No," he told them to add a paper clip to the nose of their planes. One boy asked why a paper clip would help. The facilitator responded, "I don't know. We will discuss and see."

After the children tested their planes with paper clips, the facilitator led a discussion of what they observed. He related children's observations of their planes' flight to how a real plane flies. He asked questions such as, "Why do you think it flies in the air?" He explained how the wind carries the wings of a plane. He asked children what pulls a plane down and so shifted the discussion to gravity, asking them, for example, about the difference between how a crumpled piece of paper falls compared with a flat sheet of paper.

For the last 10 minutes of the session, the facilitator had the children explore and test their airplanes. The children continued to modify their planes; some competed to see how far their planes could fly. They exchanged ideas and techniques on the modifications they made to their planes. One girl excitedly told the facilitator, "Look! I took off the tail wing; it went so fast." One boy told the facilitator that he took off the bottom of the wing, saying: "It goes way better." One boy cried enthusiastically, "Dude! Did you see mine glide?" His friend asked what change he had made to the plane, and the two boys shared their ideas with a girl nearby. The activity ended with this exploration.

Comparing the Two Cases

The science activities at Alhambra and Lockhart shared some features. Both were partially scripted activities using simple materials. In both, the children followed step-by-step instructions to assemble vehicles that they later attempted to launch. In both, the amount of time allotted for science was about an hour. None of the facilitators had science backgrounds.

The two activities differed significantly, however, in the way they were facilitated. At Alhambra, even though a facilitator began the session by saying that participants would "do some science stuff," the children had no ap-

parent reason to think that their rocket-building efforts amounted to anything scientific. The Alhambra children were engaged, but primarily when they were coloring and cutting their rocket pieces, an effort that in essence amounts to an arts activity. The scripted nature of the activity also did not leave much room for the children to explore or ask questions. At the end, when the mints were added to the cola to propel the rockets, the children began to express curiosity about why some rockets lifted and others did not. They made suggestions about how to change the outcome, but there was no time to explore the children's questions, and the facilitators did not attempt to discuss the phenomenon.

By contrast, the Lockhart facilitator framed the activity from the very beginning with a question about what makes airplanes fly. Although children spent significant time following prescribed procedures, once they had their planes built, the facilitator encouraged them to test the effect of adding the paper clip to the plane and to think about what happened. Then the children had time to play and explore with their planes without specific instructions. They collaborated and eagerly shared their discoveries with one another and with the facilitator. In the discussion, the facilitator did not lecture the children but asked open-ended questions. Rather than answering children's questions, he acknowledged that he did not know and said they might find answers during their experiments. He acknowledged the children's questions and suggestions. He also shaped the conversation by asking questions and by drawing his own comparisons with how other objects fall and how real planes behave.

A notable factor that distinguished the two sites was their access to support for science education. Alhambra had a partnership with a university whose undergraduates facilitated activities, both in the regular program and in the environmental science activities provided by the university's community outreach organization. None of the undergraduates studied science, however, or had science backgrounds. The students did their own online research to find activities. Lockhart similarly worked with undergraduate students with no science background. However, Lockhart's sponsoring afterschool organization provided access to extensive science training for facilitators—the most extensive of all our case study sites. In this training, facilitators engaged in hands-on activities themselves to develop an understanding of science inquiry. They also received training on the two afterschool science curricula used at the site. An additional training session specifically on science inquiry was provided by one of Lockhart's partners, a local science museum.

Site-Based Factors Shaping Afterschool Science Activities

Findings from all nine case studies show considerable variation in the way sites dealt with the three main constraints of time, staff capacity, and instructional materials. The support of partner organizations was one of the main factors in sites' ability to transcend their constraints in order to provide high-quality afterschool science experiences.

Time

Time was the most obvious limit, imposed both on individual activities and on opportunities to connect and build on activities across days and weeks. Most of the case study sites offered science at least once a week; the frequency ranged from a couple of times a month to every day, although daily programs were offered only periodically. In all nine programs, science was one of several activities offered. In all but one site, no more than an hour at a time was dedicated to science. Because science was usually scheduled as the last activity of the day, after homework or other activities, parents often picked up their children in the middle of science activities. Between time spent setting up, getting organized, and cleaning up at the end, children would spend about half an hour on actual science activities. This limited time made it difficult to conduct in-depth investigations or discuss children's observations. Facilitators intentionally selected activities that they felt would engage children who might be tired after a long day and that could be implemented in a short time and with minimal setup.

Staff Capacity

Only two of the nine sites, including Lockhart, provided science-focused professional development. Of the 26 facilitators and 10 site coordinators interviewed, only one was formally studying science in college and only one had a teaching credential. Facilitators often had experience or training in youth development; most sites provided professional development on youth work in general but not specifically on science. Facilitators' limited science backgrounds were reflected in the way they enacted activities. For example, they mostly stayed on script, following directions in the instructional materials. Discussions were limited in time and scope; facilitators asked fact-based questions and responded to students' questions rather than facilitating open-ended and exploratory discussions. Furthermore, the learning experiences they generated were mostly procedural, with the entire group working in unison through prescribed steps. In the few cases where facilitators had received some training in science

content and inquiry practices—and had acquired some confidence in implementing inquiry-based activities—their science activities were more open ended, allowing children to explore on their own and engage in reflective discussions. The comparison between the rocket activity at Alhambra and the plane activity at Lockhart exemplifies this critical difference.

Instructional Materials

Across all sites, facilitators reported that they selected, or influenced the selection of, activities based on what they thought children would enjoy and would be able to engage with at the end of a long day. Facilitators also reported taking into account what they themselves would enjoy, were already familiar with, or felt comfortable implementing. All nine sites had scarce resources, so facilitators often used whatever they had on hand, frequently mixing and matching materials. Staff at all sites searched for science activities on the Internet to some degree.

Support Through External Partnerships

All of the sites received varying degrees of support for science learning from the organizations operating the program, which included afterschool organizations, school districts, and individual schools. Other partners included a university, a museum, a government agency, and a nonprofit organization. The most common kinds of support were instructional materials, professional development, sending facilitators to lead science activities, and, in the case of educational institutions, providing undergraduate or high school students to work in the science program. We grouped sites into three categories based on the level of support they received for science activities. In the first category, “most support,” we placed sites with consistent science-specific support from one or more organizations. Two sites fell into this category, including Lockhart.

Four sites, including Alhambra, had “some support” for science, meaning that the operating entity or other partner organizations provided general resources, such as professional development and materials focused on youth development. These organizations also emphasized making

science a part of regular programming but did not provide consistent science-specific support. The three sites in the last category had no external support for science and little support for other programming.

In the few cases where facilitators had received some training in science content and inquiry practices—and had acquired some confidence in implementing inquiry-based activities—their science activities were more open ended, allowing children to explore on their own and engage in reflective discussions.

Scope and Depth of Science

The science offerings at the nine sites, though often well facilitated and engaging from a youth development perspective, varied considerably in the degree to which they realized the NRC framework.

All nine sites focused on making science fun and interesting to children, a goal that corresponds to NRC framework strand 1: “Experience excitement, interest, and motivation to learn about phenomena in the natural and physical world.” This aspect was perhaps most emphasized in statements by site staff about the goals and purposes of their science offerings. One site

coordinator, for example, said that she aimed “to make sure the children feel positive about science and have fun while learning.”

All sites also tried to address science concepts and ideas in their activities, an effort that corresponds to strand 2: “Come to generate, understand, remember, and use concepts, explanations, arguments, models, and facts related to science.” However, facilitators’ limited knowledge of science meant that they often did not address content in any depth beyond the information provided in kits, worksheets, or other materials.

At four of the nine case study sites, we observed activities where children had opportunities to explore and perhaps wonder about science phenomena—for example, digging with their hands inside pumpkins, creating models of erosion, and observing chemical reactions or models of what happens during earthquakes. But children’s opportunities to ask questions about such phenomena and to engage in more open-ended testing and exploration to support sense-making, as expressed in NRC strand 3, were few. This finding again may be explained by facilitators’ limited knowledge of the phenomena.

At one site—one of the two with the most external support—we saw very limited evidence in one activity of strand 4: “Reflecting on science as a way of knowing; on processes, concepts, and institutions of science; and on their own process of learning about phenomena.” Among

the instructions the facilitator had posted on the wall was the text, “I can use the scientific method to compare different materials and to examine insulating properties.” However, the facilitator did not actually lead the children in this kind of reflective discussion.

In six of the nine sites, we observed children engaging in science inquiry corresponding to strand 5: “Participate in scientific activities and learning practices with others, using scientific language and tools.” The two sites with the most external support stood out in this regard; at these sites, children had opportunities to conduct (but not design) experiments, collect and interpret data, collaborate, make predictions and state hypotheses, and present their observations. Activities at other sites also involved some steps of scientific inquiry, but in these cases the steps were prescribed and not driven by the children themselves.

Opportunities for children to identify with science practice, as in strand 6, were limited to the two sites with the most partner support. The site coordinators from these two sites mentioned goals of helping children connect to science and see themselves as persons doing science. One facilitator also said that site staff “want to give [children] a vision of there being other things out there, to open their eyes, and dream and perhaps become a scientist.” In an activity at one site, the facilitator gave

the children explicit roles as “chief scientists.” However, we did not see widespread evidence at any of the sites of explicit, sequenced, or sustained practices that might help children relate to science as a practice, take on roles relevant to different aspects of science, or envision themselves as scientists.

When we compared sites’ level of implementation of the NRC informal science strands to the level of support they received from external partners (Figure 1), we found that the two sites with the most support implemented five or more of the six strands in at least some of the observed science activities. The four sites with some support scored in the middle in terms of the NRC strands: Their science activities covered fewer of the NRC strands than those at the best-supported sites, but they engaged children in fun ways. Activities at these sites gave children opportunities to find science interesting, to encounter some scientific phenomena, and to learn limited science ideas and vocabulary.

The three sites with no support for science activities implemented the NRC strands least fully. At two of these sites, in comparison with other sites, science activities were characterized by more behavior problems, more superficial exposure to science ideas and practices, and more failure to engage children in questioning and wondering. In the third site with no support, children

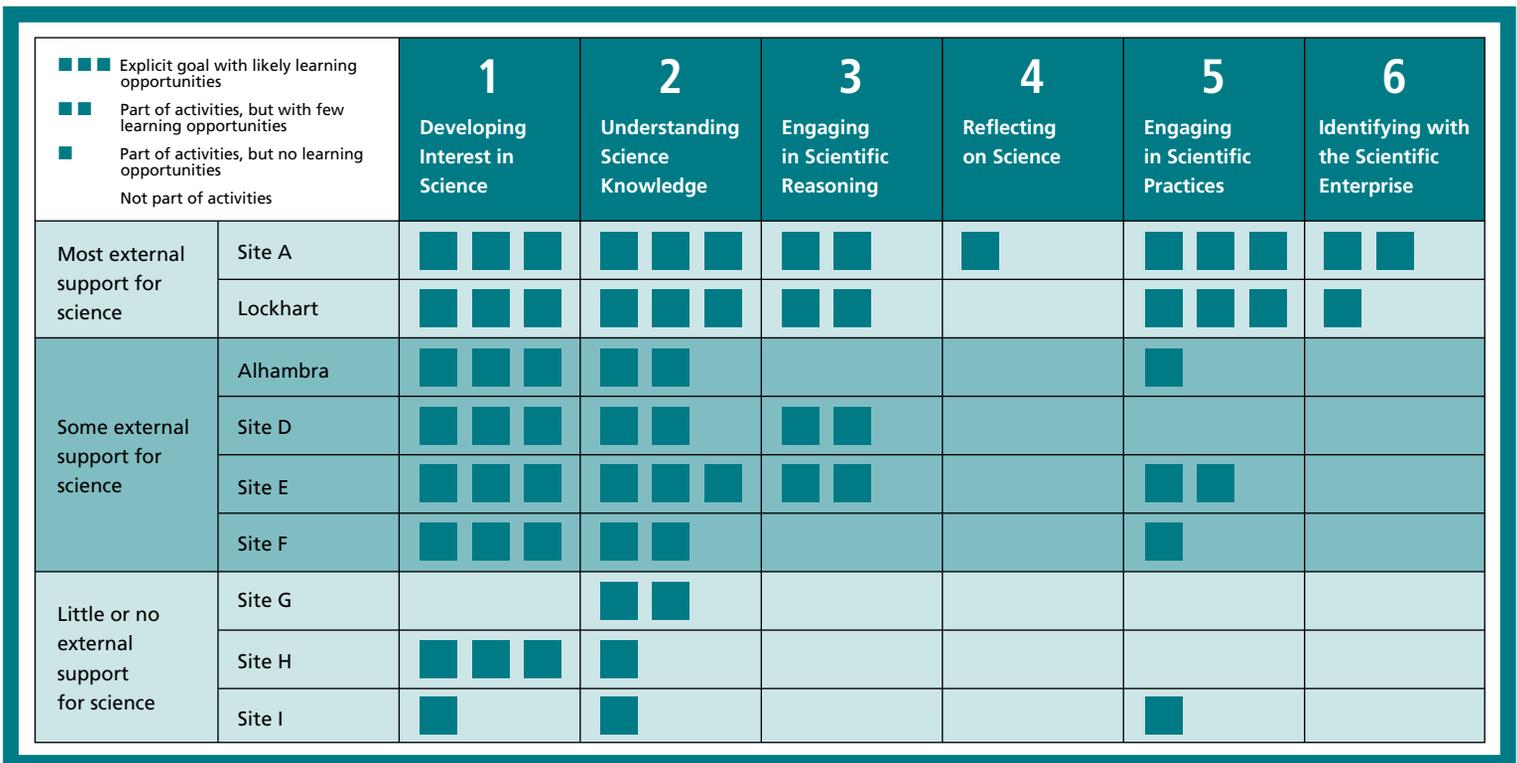


Figure 1. Comparison of Sites’ External Support for Science and Their Scores for NRC Strands

had some exposure to science phenomena, but, as in the other two sites in this category, they had no opportunities to discuss, ask questions, or delve into the science behind the activity in any depth.

Implications for Afterschool Science

Creating engaging experiences that build on children's interests and that incorporate science learning is a tall order. The task becomes even more difficult when afterschool science sessions happen infrequently, for about an hour at a time at the end of long school days, and when they are led by facilitators who have little background—or sometimes even interest—in science.

Although achieving the ambitious goals in the NRC framework within these constraints is challenging, our case studies offer evidence that, with the right support, youth development professionals can create powerful science experiences for children. At various moments in our site observations, we saw science activities that engaged children in exploring phenomena, collecting and analyzing data, asking questions, and discussing scientific concepts. These observations provide “existence proofs” that afterschool settings can deliver effective science learning experiences. This finding is especially important in light of the reduced time being spent on science during the elementary school day (see, for example, Dorph, Shields, Tiffany-Morales, Hartry, & McCaffrey, 2011; Marx & Harris, 2006). However, our cases also show that the challenges programs face in providing science experiences prevent sites from pulling these experiences together into sustained and complete science learning. Having partnerships with other organizations is one way for programs to build their capacity for offering science. Of the three main constraints on afterschool science programming, only time is not often affected by external supports. By contrast, quality instructional materials and science-focused professional development are areas in which external partners can intervene to help programs strengthen their science offerings.

Acknowledgement

This material is based on work supported by the National Science Foundation under Grant No.0917536.

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Note

¹ Alhambra and Lockhart are pseudonyms for the sites.



what afterschool STEM does best

How Stakeholders Describe Youth Learning Outcomes

by Anita Krishnamurthi, Bronwyn Bevan, Jen Rinehart, and Vicky Ragan Coulon

Afterschool programs are increasingly recognized as venues for effectively engaging children and youth in science, technology, engineering, and mathematics (STEM). Since the last set of national science standards was published in 1996, the number of afterschool programs and participants—and of dollars invested in STEM learning in these settings—has expanded substantially. The afterschool field has enthusiastically embraced STEM education. According to a 2011 Afterschool Alliance survey, a majority of providers now believe that it is important for them to offer STEM programming.

As more stakeholders get involved in the effort to engage youth in STEM outside of school, afterschool providers are being asked to document a wide range of outcomes, from generating interest in STEM to improving standardized test scores in math and science and to increasing the

number of students who pursue STEM majors in college. Although stakeholders agree that afterschool STEM education can be powerful, there is less agreement on the critical question of which aspects of STEM education the afterschool field is best positioned to support (e.g., Sefton-Green, 2012). This issue has significant policy implications as lawmakers work on legislation that affects STEM education and decide on funding for efforts to improve it.

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The Next Generation Science Standards (Achieve, 2013) call for STEM education to move beyond facts and procedures by introducing broad *concepts*, such as scale or systems, and by engaging students in STEM *practices* such as developing evidence-based explanations. Because this expanded perspective will require active and contextualized modes of learning, the afterschool field has a clear and compelling opportunity to position itself as a key partner in a STEM learning “ecosystem” comprising schools, afterschool programs, and other community settings and partners.

In this context, greater clarity about appropriate afterschool STEM learning goals and outcomes is essential to demonstrating how afterschool programs can best facilitate STEM education. Hence, in spring 2012, the Afterschool Alliance undertook a study to ask afterschool stakeholders what aspects of STEM learning the field is best positioned to support. The aim of the Afterschool STEM Outcomes Study was to identify consensus views on appropriate and feasible outcomes and indicators for afterschool STEM programs. The study provides a realistic vision of the field’s potential for supporting student learning, a vision that can inform policy decisions and evaluation design.

Listening to the Field

The growth in afterschool STEM has been accompanied by expansion of the field of informal science education (ISE), where a significant body of work has accumulated to define youth outcomes and guide assessment. Most notably, *Learning Science in Informal Environments*, a report of the National Research Council (NRC, 2009), articulates the multi-faceted dimensions of science education, which involves not only scientific concepts and skills but also scientific practices, ways of knowing, fields of activity, and the development of interest and identities.

Other work has articulated ways to discern evidence of science learning (Friedman, 2008), for example, through changes in interest, skills, and patterns of behavior. In addition, work in the learning sciences has revealed how science literacy develops across settings and over time (Bransford et al., 2006; Ito et al., 2012). Policy studies have posited the importance of integrating the full array of institutional settings—schools,

afterschool programs, and other cultural and community settings—to support STEM learning (Carnegie Corporation of New York & Institute for Advanced Study, 2009; President’s Council of Advisors on Science and Technology, 2011).

However, as many of these reports note, assessing the full impact of ISE projects is complex. Afterschool programs face a particular challenge. They differ from other commonly discussed ISE settings, such as museums, mass media, and gaming environments, because they:

- Sit at the junction of formal and informal learning settings
- Are driven by strong youth development goals
- Are commonly led, and their activities facilitated, by non-STEM experts
- Are more likely than other non-school educational settings to work with young people from populations historically underrepresented in STEM fields (Afterschool Alliance, 2009)

Not only are afterschool programs different from other ISE settings, they are also diverse among themselves, varying in such particulars as:

- Student ages, prior STEM experience, and interests
- Staff members’ formal training and STEM background
- Time dedicated to STEM, ranging from daily to a few times a year
- Local resources and partnerships with, for example, universities, museums, or parks
- Level of resources allocated to science programming
- Type of STEM programming, from isolated hands-on activities to multi-year mentorships

As afterschool becomes more widely accepted as a partner in STEM education—and therefore subject to increased scrutiny—the field must clearly articulate how afterschool programs contribute to children’s STEM learning.

This diversity is an important asset. Key to a robust learning ecology is a wide array of opportunities for learners to develop and pursue new interests. However, the diversity complicates efforts to describe concisely the contributions of the field as a whole. As afterschool becomes more widely accepted as a partner in STEM education—and therefore subject to increased scrutiny—the field must clearly articulate how afterschool programs contribute to children’s STEM learning.

The Afterschool STEM Outcomes Study, *Defining Youth Outcomes for STEM Learning in Afterschool* (Afterschool Alliance, 2013), used a process called the Delphi method. In this process, a carefully selected group of

experts answer questionnaires in multiple rounds. After each round, a facilitator summarizes responses; the experts are then encouraged to revise their answers in light of the replies of other panelists. During this process, the range of the responses is expected to decrease as the group converges toward consensus. The process ends at a pre-defined stop point: completing a certain number of rounds, achieving consensus, or getting stable results. Participants remain anonymous throughout the process.

The Delphi method was chosen for the Afterschool STEM Outcomes Study to achieve convergence of opinions among two groups of experts:

- A panel of 55 afterschool providers: experienced afterschool leaders responsible for selecting, designing, or leading programming; providing professional development; and delivering program outcomes
- A panel of 25 afterschool STEM supporters: funders; national education policy leaders; and state education department representatives responsible for providing funding, making policy decisions, and establishing outcomes for afterschool programs

Three rounds of online surveys were conducted with each of these two groups in order to work toward consensus on:

- The main outcomes for which the field as a whole could be responsible
- The indicators of progress toward these outcomes
- Specific sub-indicators that afterschool programs could document to demonstrate their contributions toward achieving these outcomes

Afterschool STEM Outcomes Study Results

The Afterschool STEM Outcomes Study yielded consensus about three major outcomes for children and youth in diverse afterschool STEM programs: developing young people's interest in STEM, building their capacity to engage productively in STEM learning activities, and helping them come to value STEM. These broad developmental outcomes and indicators of learning resonate with prior literature on afterschool STEM programs (Afterschool Alliance, 2011), child and human development (e.g., Hidi & Renninger, 2006; Holland, Lachicotte, Skinner, & Cain, 1998; Lave & Wenger, 1991), youth development (e.g., Barber, Stone, Hunt, & Eccles, 2005; Eccles, 2005), and science learning (e.g., NRC, 2007, 2009). For each of the three outcomes, participants identified a set of indicators and sub-indicators, as shown in Table 1. Participants also indicated which outcomes they felt the field was best positioned to address.

The results of the Afterschool STEM Outcomes Study provide a framework for thinking about how individual programs can demonstrate their support for STEM learning. For example, many afterschool leaders believe that their programs support children's ability to work in teams, but not all are aware that teamwork is intrinsic to STEM practices and professions. The Afterschool STEM Outcomes framework helps afterschool leaders connect STEM learning outcomes to the program goals they value.

Although the expert panelists achieved consensus on the outcomes and indicators shown in Table 1, several interesting distinctions in their responses have implications for policy and practice.

STEM Activities vs. STEM Values

In defining the outcomes that afterschool STEM programming is best positioned to affect, the expert consensus ranked the following three indicators highest: active participation in STEM learning opportunities; curiosity about STEM topics, concepts, or practices; and ability to productively engage in STEM processes of investigation. Panelists also agreed that afterschool programs are less likely to be able to affect the other three indicators: awareness of STEM professions, ability to exercise STEM-relevant life and career skills, and understanding of the value of STEM in society. This finding suggests that the afterschool field is more confident about affecting indicators related to the active *doing* of STEM and less confident about affecting indicators that relate to the practices and value of STEM in society.

Shorter-Term vs. Longer-Term Sub-Indicators

In ranking sub-indicators, panelists indicated the most confidence that the field's work supports young people's interests, inquiries, and engagement with STEM activities. These sub-indicators of progress toward STEM learning can be seen and documented in immediate ways. The experts felt comparatively less confident about achieving impacts described by some of the longer-term sub-indicators of learning such as demonstration of STEM knowledge, understanding of STEM methods of investigation, and pursuit of further in-school or out-of-school STEM learning. The comparative lack of confidence about longer-term sub-indicators may reflect the uncertainty of participant attendance and other inherent structural features of the afterschool setting. These structural features must be considered in policy decisions and evaluation design.

Table 1. Framework for Developmental Outcomes and Learning Indicators for Afterschool STEM

OUTCOME Through STEM afterschool programs, children and youth...	INDICATOR You know or can see that children and youth demonstrate...	SUB-INDICATORS If you had appropriate tools, you could document the following types of evidence...
A. Develop an interest in STEM and STEM learning activities “I like to do this.”	Active participation in STEM learning opportunities	Active engagement and focus in STEM learning activities <i>Examples of evidence: persisting in a task or program; sharing knowledge and ideas; expressing enthusiasm, joy, etc.</i> Pursuit of other out-of-school time STEM learning opportunities <i>Examples of evidence: enrolling in programs; attending programs regularly; reporting performing STEM-related activities at home</i> Pursuit of school STEM learning opportunities <i>Examples of evidence: participating more actively in school STEM activities; enrolling in courses; selecting special programs or schools; improving academic achievement</i>
	Curiosity about STEM topics, concepts, or practices	Active inquiries into STEM topics, concepts, or practices <i>Examples of evidence: exploring ideas verbally or physically; questioning, hypothesizing, testing</i> Active information-seeking about mechanical or natural phenomena or objects <i>Examples of evidence: conducting Internet searches for more information; getting books or journals about STEM; watching TV programs on science</i>
B. Develop a capacity to productively engage in STEM learning activities “I can do this.”	Ability to productively engage in STEM processes of investigation	Demonstration of STEM knowledge <i>Examples of evidence: demonstrating increase in knowledge in specific content areas; making connections with everyday world; using scientific terminology</i> Demonstration of STEM skills <i>Examples of evidence: formulating questions; testing, exploring, predicting, observing, collecting and analyzing data</i> Demonstration of an understanding of STEM methods of investigation <i>Examples of evidence: demonstrating understanding of the nature of science; using evidence-based reasoning and argumentation; demonstrating engineering design practices</i>
	Ability to exercise STEM-relevant life and career skills	Demonstration of mastery of technologies and tools that can assist in STEM investigations <i>Examples of evidence: developing capacity to use measurement and other scientific instruments; running computer programs for data analysis; developing effective methods to communicate findings</i> Demonstration of ability to work in teams to conduct STEM investigations <i>Examples of evidence: communicating effectively with team members; collaborating effectively with team members; demonstrating leadership on the team</i> Demonstration of applied problem-solving abilities to conduct STEM investigations <i>Examples of evidence: engaging in critical thinking; questioning, sequencing, reasoning</i>

OUTCOME Through STEM afterschool programs, children and youth...	INDICATOR You know or can see that children and youth demonstrate...	SUB-INDICATORS If you had appropriate tools, you could document the following types of evidence...
<p>C.</p> <p>Come to value the goals of STEM and STEM learning activities</p> <p>“This is important to me.”</p>	<p>Understanding of the value of STEM in society</p>	<p>Demonstration of an understanding of the relevance of STEM to everyday life, including personal life <i>Examples of evidence: referencing examples of STEM in everyday life, everyday problems</i></p> <p>Demonstration of knowledge of important civic, global, and local problems that can be addressed by STEM <i>Examples of evidence: contributing to projects that address a community need; developing awareness of how STEM is implicated in larger societal issues</i></p> <p>Demonstration of awareness of opportunities to contribute to society through STEM <i>Examples of evidence: engaging in a service-learning project</i></p>
	<p>Awareness of STEM professions</p>	<p>Development of an understanding of the variety of STEM careers related to different fields of study <i>Examples of evidence: gaining knowledge about relevant professions; gaining knowledge of where such jobs and careers exist</i></p> <p>Demonstration of knowledge of how to pursue STEM careers <i>Examples of evidence: acquiring knowledge of what courses are needed to prepare for or pursue STEM degrees; declaring STEM interests or majors</i></p> <p>Demonstration of awareness that STEM is accessible to all <i>Examples of evidence: expressing a desire to meet role models; declaring STEM interests and majors; desiring to become a role model to pave the way for others</i></p>

Availability of Assessment Tools

When asked about the availability of assessment tools to document the learning outcomes and indicators, the afterschool STEM supporters—state and national education leaders and funders—were much more optimistic about the availability of such tools than were the afterschool providers. This difference, though it did not meet the criterion for statistical significance, suggests that the two expert groups may have different standards for assessment. Another possibility is that providers are unaware of existing tools or feel that these tools are not usable or not accessible.

In-School vs. Out-of-School STEM Learning

Panelists were least confident that the afterschool field could demonstrate effects regarding the sub-indicator “pursuit of school STEM learning opportunities.” This result is extremely important in light of the fact that many large-scale studies have used school achievement measures to assess the contributions of afterschool programs to children’s

learning. The relatively low ranking of this sub-indicator may reflect the panelists’ feeling that achievement test scores are affected by too many factors that are out of the control of afterschool practitioners and supporters.

Implications and Areas for Further Research

The outcomes, indicators, and sub-indicators identified by participants in the Afterschool STEM Outcomes Study as representative of the field’s contributions to STEM learning constitute a good step toward articulating the impact of afterschool STEM programs. The field’s continuing challenge is to develop tools and methods that can document outcomes without significantly interfering with the afterschool experience, as, for example, pen and paper tests might do, and without incurring significant cost, as, for example, conducting ethnographic research might do. Besides documenting outcomes, the field is also challenged to show how program activities contribute to those

RELATING THE AFTERSCHOOL STEM OUTCOMES FRAMEWORK TO A MIDDLE SCHOOL STEM PROGRAM

The example of Exploratorium XTech helps to demonstrate how the Afterschool STEM Outcomes framework relates youth leadership, a capacity highly valued in many afterschool and youth programs, to STEM learning.

Exploratorium XTech is a three-year program that works with middle school youth during summer camps and on Saturdays during the school year. XTech students design and construct table-top versions of exhibits or activities on the museum floor. In the process, they engage with phenomena; develop proficiencies with machine and digital tools; and exercise scientific practices including design, experimentation, problem-solving, observing, and analyzing.

As they grow older, XTech students can become XTech facilitators, assisting staff in XTech and in community afterschool programs to lead design-and-build activities with younger students. Exercising leadership in XTech involves developing mastery of STEM concepts, tools, and practices in order first to support incoming students and eventually to take on formal teaching roles with elementary-aged students. In the process, students develop their interests and become local experts on particular tools, such as band saws or video documentation, or on concepts, such as mechanics or optics. Led by their interests, they deepen their engagement and mastery, as evidenced by the increasing complexity of the mini-exhibits they produce over time. Developing participants' capacities to engage in STEM is not the end goal but the means for full program participation and leadership development.

In a focus group, a number of participants shared their reflections on how it felt to teach younger students. One commented:

I kind of think the whole thing was fun because, in the beginning, we were . . . trying to tell ourselves, "Okay, this is what we can teach," and we would teach. What always came up is, "Okay, but we have to explain this to kids who are way younger than us." That's what made it more interesting, was taking all of these concepts we knew and turning it into a way to explain it to third through fifth graders. (Vossoughi, 2012, p. 8)

Although youth leadership is not included in the Afterschool STEM Outcomes framework, the framework clarifies the ways in which STEM activities provide a context in which leadership can develop.

OUTCOME	INDICATOR	SUB-INDICATORS	XTECH ACTIVITIES
Developing interest	Active participation in STEM learning opportunities	Active engagement and focus in STEM learning activities	Mastering ideas and techniques in order to teach others
Developing capacities	Ability to productively engage in STEM processes of investigation	Demonstration of STEM knowledge; demonstration of STEM skills	Designing and constructing increasingly sophisticated STEM mini-exhibits

outcomes. The nature of children's experience in afterschool programs remains largely unexamined.

The expert panelists agreed that afterschool programs contribute to students' school success, but they expressed lower levels of confidence, relative to other effects, in the field's ability to affect school outcomes such as test scores and course taking. This finding is perhaps unsurprising, given the peripheral relationship of school outcomes to afterschool interventions, but it is notable because programs have often been evaluated on exactly (and sometimes only) these dimensions. Better communication and coordination between school and afterschool, together with a clearer understanding of what each can contribute as a component in an ecosystem of learning, would help to correlate learning between the two.

The study results point to some key areas that could benefit from additional research. For one, the panelists' relative confidence in the field's ability to document immediate as opposed to longer-term effects, along with their lack of confidence about demonstrating impact on school STEM learning, suggest the need for new research and evaluation methodologies and instruments. The field needs ways to investigate STEM learning across settings, showing how immediate STEM learning outcomes in afterschool settings relate to longer-term learning in school or other community settings. New tools may enable the field to articulate and evaluate the value and contributions of afterschool programs.

Another area for additional research is suggested by disparities between how panelists ranked particular learning indicators as opposed to the outcomes the indicators support—for example, indicating that programs do support teamwork but do not support the development of STEM skills. This finding suggests a need for dialogue and professional development that unpack core ideas in STEM learning outcomes. This need is especially relevant and important in relation to the concepts and cross-cutting practices highlighted in the Next Generation Science Standards, which will require an integrated view of teaching and learning. Dialogue about learning outcomes can help afterschool providers understand the many dispositions and practices involved in STEM fields and how programs can support their development.

Finally, variations in perspective between afterschool supporters and afterschool providers—though these did not reach the level of statistical significance—invite further investigation to detect and resolve any real and meaningful differences that emerge between the two groups. For example, supporters felt more confident than providers that programs could support development of students' STEM

knowledge. What is the basis of this difference, and how does the disparity in perspectives affect how programs are designed and evaluated? Following up on this issue should yield information to help the field move forward to achieve its full potential. It may also provide guidance to funders seeking areas for high-impact afterschool investments.

The Place of Afterschool in the STEM Ecosystem

An increasingly robust research base points to the need to build an ecosystem of learning that spans school and out-of-school learning (Bevan & Michalchik, 2013; Ito et al., 2013). Concurrently, the ability of the afterschool field to support STEM learning is advancing at a rapid pace. This convergence brings a unique opportunity to cement the role of afterschool programming as an integral component of a re-imagined effort to improve STEM education.

A clear understanding of the outcomes to which afterschool STEM programs can contribute is essential to making this case. The consensus produced by the Afterschool STEM Outcomes Study provides on-the-ground perspectives—from those who lead, design, and fund afterschool STEM programs—about the outcomes the field is best positioned to advance. Policymakers and funders should consider these consensus views in framing the place of afterschool as an important part of the STEM education ecosystem. Furthermore, practitioners and researchers can use these outcomes and their corresponding indicators to design evaluations that document the role of afterschool programs in the STEM learning ecology.

The diversity of afterschool STEM programs is simultaneously a strength and an argument against developing one unifying measure for use across settings. However, using a common language like that provided by the Afterschool STEM Outcomes Study could facilitate a synthesis of results from like programs while enabling description of the range of possible outcomes across diverse programs. This common framework can enable the field to better describe how afterschool programs help children develop interest in, build capacity for, and come to value STEM and STEM learning activities.

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Afterschool Matters

Call for Papers

Afterschool Matters, a national, peer-reviewed journal dedicated to promoting professionalism, scholarship, and consciousness in the field of afterschool education, is seeking material. Published by the National Institute on Out-of-School Time with support from the Robert Bowne Foundation, the journal serves those involved in developing and running programs for youth during the out-of-school time hours, in addition to those engaged in research and in shaping youth development policy.

Afterschool Matters seeks scholarly work, from a variety of disciplines, which can be applied to or is based on the afterschool arena. The journal also welcomes submissions that explore practical ideas for working with young people during the out-of-school hours. Articles should connect to current theory and practice in the field by relating to previously published research; a range of academic perspectives will be considered. We also welcome personal or inspirational narratives and essays for our section “Voices from the Field.”

Any topic related to the theory and practice of out-of-school time programming will be considered. We are particularly interested in manuscripts that offer practice recommendations and implementation strategies related to the featured research. We invite you to discuss possible topics in advance with us. Suggested topics include:

- Physical activity and healthy eating
- STEM (science, technology, engineering, and math) program delivery or STEM staff professional development
- Expanded or extended learning time and the OST hours
- School-community partnerships that support OST programming
- 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
- Special needs youth in OST
- Immigrant and refugee youth in OST
- Youth-centered participatory action research projects
- Gender-focused research and policy initiatives related to OST

Submission Guidelines

- Submissions should be submitted electronically in Microsoft Word or Rich Text format.
- Submissions should not exceed 5,000 words.
- Include a separate cover sheet with the manuscript title, authors' names, addresses, phone numbers, and e-mail addresses.
- The names of the authors should not appear on the text, as submissions are reviewed anonymously by peers.
- Follow the *Publication Manual of the American Psychological Association, 6th Edition* (July 2009), for reference style guidelines. Present important information in the text and do not use extensive footnotes.

Inquiries about possible articles or topics are welcome.

To inquire or to submit articles, contact:

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