Challenges in Designing and Conducting Research on Afterschool Programs

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The field of afterschool programming is growing rapidly, and is concerned about the quality of its programming and staff. Afterschool programs are being encouraged to become more academic in nature, and to incorporate science learning activities that can both inspire student interest and build their knowledge of science concepts and processes (Yaeger & Falk, 2008). There is widespread concern, however, that afterschool program staff members often have neither access to ideas and materials from informal science programs nor an understanding of how to make science more engaging than the typical in-school science lessons (Penuel & McGhee, 2008). While the National Science Foundation (NSF) has funded a number of projects that have developed high-quality materials for use in youth and community programs through its Informal Science Education (ISE) and Innovative Technology Experiences for Students and Teachers (ITEST) grants, it is unclear how well connected these projects are to publicly funded afterschool programs.

With funding from the National Science Foundation, SRI International has been investigating (1) the nature of afterschool science offerings in publicly funded afterschool programs for elementary school students within California and (2) the sources of support for science programming and afterschool staff development. California was selected as the setting for this research because voter approval of Proposition 49 in 2002 directed the state to invest $550 million each year in afterschool programming for grades K-9 through the After School Education and Safety (ASES) program. Full funding of the program, in the form of renewable three-year grants to school districts and their community partners, commenced in 2006-07.

Currently in the second year of our five-year Afterschool Science Network (ASN) study, the SRI team has some early findings, but more than that, a much deeper understanding of the challenges entailed in trying to apply systematic, rigorous research methods within an afterschool system organized principally at the community level, rather than at the regional or state level. This paper focuses on research challenges and how we are addressing them, while weaving in a description of some of our early learnings about the nature of California's publicly funded afterschool providers and their capacity to provide children with high-quality science learning experiences.

At a later stage in the work, we will apply social network methods to investigate an important barrier to wider participation in STEM — access to support for providing high-quality learning activities. We will study the network structure of different types of afterschool providers, youth- and community-based programs, to describe how the network shapes access to materials and support for afterschool science.

We also will employ experts in informal science education in a structured review of the instructional resources being used in afterschool programs to judge their usability and appropriateness for voluntary youth activity, and the soundness of their content. We will contrast the spread of high- and low-depth materials and programs through the afterschool network, paying particular attention to mechanisms within the network for vetting the quality of materials and sharing information about their usability and effectiveness.

Research Questions

The Afterschool Science Network project was designed to address three main research questions, as described below.

Question 1: What is the nature of afterschool science offerings in ASES elementary sites?

Prior to the ASN project, no comprehensive description of the frequency and nature of afterschool science activities in ASES sites existed. Our research sought to collect data from a representative sample of afterschool sites to address issues such as:

To what extent is science offered by ASES elementary sites?

What features characterize these afterschool opportunities to learn science?

What science instructional resources are used by ASES sites and what are the sources of these resources?

Question 2: What is the nature of the network connecting ASES elementary sites to organizations that can support afterschool science programming?

Our underlying hypothesis is that providing strong afterschool science programs requires organizational capacity on the part of afterschool programs that can be developed through linkages with organizations that can provide high-quality science learning resources and support for afterschool staff. We use the term "intermediary organizations" to refer both to organizations that develop science activities and curriculum materials that are adopted or adapted by afterschool programs and organizations that provide services such as offering the afterschool science activity themselves, advising programs on the design and implementation of afterschool science, and training afterschool staff in how to implement either specific afterschool science activities or afterschool science in general. We are applying social network analysis to address questions such as:

How well connected are ASES grantees to intermediary organizations that support science learning?

How are these intermediary organizations connected to NSF grantee institutions and other organizations?

What organizational characteristics are associated with different kinds of network involvement?

Question 3: What is the relationship between an ASES grantee's network ties and the quality of its science offerings?

Finally, the project will address the hypothesis that the frequency and quality of afterschool science offerings is associated with certain types of network ties to organizations that can provide needed resources. A hypothesis taken from studies of innovation diffusion in other fields is that a network that links (1) a service providing organization; (2) organizations and people with specialized knowledge (in our case, organizations with NSF-funded informal science curriculum projects); and (3) organizations and people offering general services to provider organizations (e.g., general afterschool capacity-building organizations) is necessary to achieve broad impact.

Data Sources

The main data sources for the ASN project are

- Survey of ASN elementary sites to obtain information on topics such as
  - Frequency and type of afterschool science activities at the site
  - Specific instructional materials and resources used for these activities (by name)
  - Types of supporting services and resources for afterschool science activities received from outside individuals and organizations
  - Names of outside individuals and organizations providing these services and resources
- Survey of intermediary organizations providing services and resources to afterschool programs to investigate
  - Types and extent of services provided to ASES sites
  - Relationships with other intermediary organizations
- Analysis of the quality of instructional materials used at ASES sites using expert judgments with respect to the extent to which the materials
  - Engage children through drama and relevance to their lives
  - Are usable by facilitators and children
  - Promote scientific thinking, reasoning, and practice
  - Provide opportunities to make progress toward science learning goals
- Site visits to selected sites to capture the ways in which science activities are enacted

Samples

Program Sample

Though ASES grants are available to both middle and elementary schools, 85% of the programs are affiliated with schools that serve elementary students through the 5th or 6th grades.[1]

[1] The State of California administers a separate afterschool program for older students through the 21st Century High School and After School Safety and Enrichment for Teens (ASSETs) program.

To constrain the diversity of science learning resources we had to obtain and evaluate, we decided to limit our sample to these programs.

ASES grants are awarded to California schools serving low-income students. The afterschool services themselves may be offered either at the school site or at the site of a not-for-profit organization, such as a Boys and Girls Club. Each program, however, is associated with a specific school. A stratified random sample of 600 grantees was drawn from the 3,438 ASES elementary school programs. Our sampling used urbanicity (urban/rural) as a stratification variable on the assumption that rural sites would be less likely to have close proximity to major science institutions engaged in informal science. Since only schools with 50% or more of their students eligible for free or reduced-price lunch can receive ASES funding, a strictly random sample of ASES sites would be heavily tilted toward urban areas,

Initially, we collapsed the 12 locale designation assigned by the National Center for Education Statistics (NCES) into four categories—city, suburb, town, and rural. A precision analysis revealed that with a sample size of 600 grantees, we would obtain acceptably precise estimates for just two strata. For this reason, we will report data for just two larger locale categories "urban" (city and suburb) and "rural" (town and remote rural). SRI oversampled rural grantees to ensure that we could produce study findings for rural and urban programs separately as well as for state elementary programs overall.

We determined strata sizes by equalizing anticipated standard errors for each group—the goal being to obtain equally precise estimates of urban and rural afterschool programs. As a result, we sampled a total of 349 urban schools and 251 rural schools. Within each group, we sampled proportionally by substrata (the urban sample schools comprise 202 city and 147 suburban schools; the 251 rural schools comprise 112 town, and 139 remote rural schools). During the process of obtaining a contact person for each sampled site, we learned that 10 schools in the sampled ASES grantee database had closed or had their afterschool program moved to a different school within the district. Ten substitute sites, within the same districts as the initially sampled sites, were substituted for these cases. In addition, some of the sites or their districts declined to participate. In these cases, another site from the same geographic category (city, suburb, town, or rural) was sampled at random from sites in districts that had approved study participation. In total, 102 sites in the final sample were resampled for one of these reasons.

The ASES program survey sample is equivalent to the population of ASES elementary programs in terms of proportion of students eligible for free or reduced-price lunch, average Academic Performance Index (API) scores, average parental education, proportion of their school's teachers who are credentialed, and proportion of students in their school identified as gifted/talented. The sample is more rural than ASES elementary programs as a whole (as a result of the oversampling) and somewhat more white. The application of sampling weights will allow us to provide estimates that are representative of the state's population of ASES elementary programs. Exhibit 1 demonstrates that the final weighted survey sample is a good match to the population of ASES elementary grantees in terms of all of these variables.

The ASES elementary school population itself differs from the population of California elementary schools as a whole in a number of ways. Because only schools with more than half of their students eligible for free or reduced-price lunch are eligible for ASES, ASES elementary schools tend to have more non-white students, lower API scores, more students eligible for free/reduced-price lunch, and fewer students identified as gifted/talented compared to California elementary schools as a whole, as shown in Exhibit 1.

Intermediary Survey Sample

The intermediary survey instrument will gather information from individuals and organizations that support the science offerings of ASES afterschool programs. Items on the program survey ask site coordinators to identify organizations and individuals assisting them with informal science strategies and materials. We are using responses to this question to identify the sample for the intermediary survey. Our intermediary sample will include any organizations nominated by more than one program as having provided them with resources. In addition, we have identified roughly two dozen science institutions in California (or that serve institutions in California) that have received $1 million or more in NSF grants for program development in informal science or technical education during the last 10 years. These institutions include the California Science Center, the Exploratorium and the TECH Museum of San Jose. These "Tier I" informal science institutions are included in the intermediary survey sample regardless of their number of program nominations.

Science Materials Sample

The program site survey asked ASES site coordinators to name the specific science learning materials they use with children and the source from which these materials were obtained. Cited resources ranged from a curriculum expressly designed for afterschool science settings (*Kidz Science*) to individual science activities located on the Internet. The research team is in the process of identifying the science materials named most frequently by ASES site coordinators. Copies of these resources will be obtained for review and rating by a set of external science education and informal science experts.

Encountering and Addressing Challenges to Implementing the Research Design

Any complex research project encounters challenges and complications as it moves from the design phase into implementation. This was particularly true in the present case, as we tried to apply systematic approaches that we are accustomed to using in formal education settings to the more community-based, and therefore more variable, world of afterschool programming. Below we describe some of the challenges faced in the first 18 months of our work that we believe have relevance for any attempts to apply systematic research methods at scale to afterschool settings.

Identifying the program population and sample

Researchers accustomed to working in formal education settings expect a level of hierarchical organization and documentation that is not available in the afterschool arena. In trying to specify the population of ASES programs and to identify appropriate individuals to complete the program survey, we found that the staff and structure of the ASES system itself is

not described or listed in any single location. The system has multiple layers between the California Department of Education and the service providers working directly with children. In between there are 11 persons who serve as "Regional Leads" across the state, providing support to the districts (and sometimes programs) in their area. These 11 regions are comprised of from one (Los Angeles) to up to 10 counties. Within each county there are multiple school districts, and within districts often multiple afterschool programs. Individuals within the ASES system typically communicate one level up or down. In most cases, the afterschool staff rosters are kept by district or community-based organization program leaders and rosters of program leaders are kept by regional leads. Regional leads do not maintain a listing of site coordinators. There is no statewide listing of all ASES site coordinators.

To deal with this problem, we created two databases of publicly funded afterschool programs in California. The first includes information about all state-funded ASES programs and integrates information provided by the California Afterschool Network with demographic, staffing, and achievement data gathered from public databases maintained by the National Center for Education Statistics and California Department of Education (CDE). This population database was used to stratify the population and create the program survey sample.

The second database contains our program survey sample. Having selected the school sample, we then had to contact Regional Leads to identify appropriate district staff for each site and then contact district staff to get names and contact information for site coordinators. As a tool for project management and logistics, the program sample database includes for each site: contact information for afterschool staff, requirements for conducting research in the site's district, and fields for tracking each step in the site's involvement in the study. When integrated with a GIS program such as Google Earth, the program sample database also allows a geospatial representation of the ASN sample, enabling visual inspection of the extent to which sample sites represent the state's varied geography.

Obtaining required permissions

Since we proposed to survey leaders of afterschool programs and not to collect data from either children or school teachers, we had not anticipated having to go through formal district review processes to get permission to field our program survey. As we began contacting districts to get names of their afterschool program leaders, however, we learned that many districts require such approval because the afterschool program is offered on their premises. The 600 sites in our sample came from roughly 300 different districts. Each district has its own policy with respect to both the process for obtaining research permissions and the content of the application package.

We began by searching district web sites to obtain posted information on requirements for obtaining permission. Through this process and follow-up phone calls we were able to classify districts into those with a formal application process, those that would accept and approve requests by email or phone call, and those without requirements for which we provided a notification letter. Early on, we completed the quite comprehensive package required by the Los

Angeles Unified School District. We found that this package contained nearly all of the information that any of the districts required. One district required an in-person presentation of our data collection plan to its research review panel.

Obtaining an adequate program survey response rate

In evaluations for federal or state agencies of the formal education programs they fund, responding to evaluator requests for information is often an implicit or explicit requirement for continued funding. Such was not the case for our study of afterschool programs. Site coordinators were informed that survey participation was completely voluntary, and our research funder (NSF) was not their program funder or in any way connected to their formal chain of command. Attempts by another research center to survey site coordinators for a state-funded ASES evaluation had succeeded in obtaining responses from only about a quarter of program sites, a response rate which we knew would be inadequate for making inferences about the nature of science activities in elementary ASES programs.

The ASN survey was fielded from November 2010 through February 2011 and was made available in both hard copy and electronic form. Respondents were offered a gift certificate as a token of appreciation for the estimated 30-40 minutes they would spend completing the survey.

We used a multi-pronged strategy for encouraging site coordinators to respond. We worked with the 11 ASES Regional Leads to announce the upcoming survey to district leads and site coordinators, and sent announcement postcards to site coordinators. As the survey was launched, we provided Regional Leads with weekly information on the response rate for their regions (not individual names of responders and nonresponders, however), and every few weeks we sent reminder postcards to site coordinators who had not yet responded.

Response rates were tracked by region and tailored promotions were used to increase response rates in regions that were lagging. These promotions included activities such as reminder announcements in the region's ASES newsletter, researcher participation in district or county-level meetings of afterschool providers, and phone calls to district staff requesting their assistance. In addition, SRI staff called and emailed site coordinators who had not responded or who had submitted partial surveys online to encourage them to complete the survey.

As a result of all these efforts, we obtained a final response rate of 71 percent overall. Exhibit 2 shows the individual response rate for each ASES region. No region had a response rate lower than 50 percent.

Adapting social network analysis techniques for an ill-specified population

SRI has successfully used social network analysis in prior studies in formal education settings and found that the structure of the ties among school staff is associated with the spread of a reform through the school (Penuel, Frank, & Krause, 2006). We had anticipated applying a similar approach to afterschool science programs after identifying the set of intermediary organizations supporting afterschool science in California. Early on, however, conversations with site coordinators made us aware of the great diversity of not only organizations but also

individuals supporting afterschool science in different ways and that the connections between afterschool sites and their sources of science materials and support are loosely coupled. Rather than getting materials or support from major science material/support providers or from the major general-purpose support providers in the state that have links to these Tier I science organizations, as we had anticipated, ASES sites are typically connected to local organizations that may or may not connect with organizations operating on a regional or statewide level. For example, an afterschool site may get materials from an in-school science teacher, who obtained them from a County Office of Education, who in turn originally located the materials from a key institution such as the Exploratorium. The fact that many materials are freely available over the Internet, and that the organization providing the materials does not necessarily know who is using them, further complicates efforts to document interorganizational connections.

Defining quality of science learning opportunities in informal settings

Two of the goals for this research—describing the quality of afterschool science learning opportunities and examining the relationship between a site's network of connections to intermediary organizations and the quality of its science offerings—require analytic judgments about the value of the science activities in ASES sites. The study is developing dimensions and rubrics for evaluating the instructional materials being used in afterschool settings and for evaluating features of program enactment based on data collected through site coordinator surveys and on-site interviews and observations. All of these require a conceptualization of the nature of quality in an afterschool setting, and inevitably encounter the tension between providing activities that support learning relevant to in-school science education and those that are highly engaging or easy to implement.

The afterschool science education field itself has not reached a consensus on this issue. Some focus on engagement as the sine qua non for informal learning and warn of the risk of making afterschool activities so much like school that they turn students off (National Research Council, 2009). Others argue that a basic purpose of programs like ASES is to better equip low-income students to perform well in formal education settings (Beckett et al., 2009; Kali, Linn, & Roseman, 2008). The California After School Resource Center, for example, funded by the state as a clearinghouse for reviewing and disseminating instructional materials for afterschool settings, emphasizes the extent to which science materials reflect the state's specific science curriculum standards for the grade levels for which they're recommended.

In developing the quality criteria for science learning for our study, we sought a middle road. Primary guidance was derived from the two National Research Council volumes, *Learning Science in Informal Environments* and *Science Goes to School*, and from the AAAS Project 2061. We are not emphasizing the degree of alignment to specific California curriculum standards, but two of the ratings we will ask our expert judges to make involve the extent to which science learning materials represent "big ideas" in science and authentic science practices as set forth in these consensus volumes. At the same time, we will ask for judgments about the suitability of the materials for implementation in an afterschool setting and about the extent to which they are likely to engage students. By treating quality as a multi-dimensional construct,

we will give our audiences the opportunity to focus on those dimensions that they believe are most crucial in afterschool science.

Preliminary Findings

The only data collection that is complete at this time is the site coordinator survey, and that data set is presently being cleaned and structured for analysis. With appropriate caveats with respect to the preliminary nature of the data, we can offer some tentative findings based on initial runs of descriptive statistics.

Most ASES elementary sites in our sample—just over two-thirds—offer science learning activities. Those sites reporting that they offer science learning activities:

- Typically judge their staff to be knowledgeable about how to structure activities for afterschool settings but not about science or the design of science activities
- Emphasize hands-on activities
- Rarely receive visits from scientists or go on science field trips
- In many cases obtain instructional materials from Internet sites
- Usually (in about two-thirds of cases) receive some kind of support for science learning activities from one or more external organizations or individuals
- Sometimes (roughly half of respondents) provide supports related to science offerings to other afterschool programs

Future analyses will examine relationships among these variables as well as the influence of ties to California's Tier I science organizations.

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Exhibit 1. Comparison of Afterschool Network Study sample to ASES and California public schools elementary populations

	Weighted Sample (Estimate)					ASES Elementary Population					CA Elementary Population				
Variable	N	Mean	SD	Min	Max	N	Mean	SD	Min	Max	N	Mean	SD	Min	Max
API Score 2009	571	757.3	55.9	553	936	2998	755.1	56.6	372	942	6041	788.1	88.6	310	998
Level of Parental Education**	574	2.29	0.51	1.03	4.13	2998	2.29	0.48	1.00	5.00	6136	2.76	0.77	1.00	5.00
Distance in Miles to Major City	567	34.9	41.1	0.90	272.2	2995	34.1	40.5	0.06	272.2	6107	36.9	40.0	0.06	272.2
Variable	N	%	SD	Min	Max	N	%	SD	Min	Max	N	%	SD	Min	Max
% Non-White Students	580	75.1	22.6	0	100	3030	74.2	22.9	0	100	6233	55.7	30.5	0	100
% Free/ Reduced Lunch Students	580	78.1	17.2	1	100	3030	77.2	18.5	0	100	6233	55.7	31.2	0	100
% Gifted/Talented Students	580	6.98	7.14	0	48	2982	6.47	7.06	0	100	6233	7.2	8.29	0	100
% Teachers with Full Credentials	578	97.7	5.31	59	100	2979	97.8	6.14	0	100	6233	97.2	9.15	0	100
% Schools in Program Improvement	549	48.1	n/a	n/a	n/a	2839	49.9	n/a	n/a	n/a	4231	42.5	n/a	n/a	n/a

**The level of parental education is the average of all parent educational level responses for a school where the following scale is used: 1 = Not high school graduate; 2 = High school graduate; 3 = Some college; 4 = College graduate; 5 = Graduate school.

Exhibit 2. Program survey response rates, by region