The Power of Discovery: STEM^2 Initiative
2015 Final Report

University of California Irvine

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This Initiative was supported by funding from the Noyce Foundation, the Samueli Foundation, and the California Department of Education After School Division

ACKNOWLEDGEMENTS

We are grateful to our many collaborators and partners who contributed to the Power of Discovery STEM^2 Initiative. We are especially appreciative of the cooperation of the 132 afterschool program sites and five Regional Innovation Support Providers who were participants in Power of Discovery Initiative, as well as the Afterschool Education and Safety Programs who served as comparison sites. Our gratitude is extended as well to our Research Advisory Board members, Gil Noam, Sam Piha, and Lee Shumow, who provided their time and expertise to review our study design and findings. We also thank Ashley Wright, David Liu, and Connie Kang for their assistance with data collection and analysis. Finally, we thank the Noyce Foundation, Samueli Foundation, and the California Department of Education After School Division for their support of this effort.

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EXECUTIVE SUMMARY

The *Power of Discovery: STEM² Initiative* provided professional development (PD) and systemic support to publicly funded afterschool programs in California from 2012 to 2015. Findings from 2013-14 are available in an earlier report. The current report focuses primarily on the results of the 2015 evaluation conducted at 132 sites [75 Power of Discovery (PoD) sites and 57 non-Power of Discovery (non-PoD) sites]. The 2015 evaluation had three overarching goals: (1) to contrast STEM-related experiences at PoD and non-PoD sites, (2) to contrast more mature and less mature PoD sites, and (3) to formally test the logic model underlying the overall Power of Discovery Initiative.

These goals were assessed in relation to six specific aims. Key findings include:

SPECIFIC AIM 1—TO CONTRAST THE AFTERSCHOOL WORKFORCE AT PoD AND NON-PoD SITES

The staff at PoD and non-PoD sites were very similar. The staff were primarily young adults; and most were female. At both PoD and non-PoD sites, the most common education level of staff was "some college." Work experience also was similar. Approximately one-third of program staff were employed in their current position for less than one year, indicating high staff turnover at both the PoD and non-PoD sites.

SPECIFIC AIM 2—TO CONTRAST STEM PROFESSIONAL DEVELOPMENT AT PoD AND NON-PoD SITES

Significant differences were found in the STEM PD at the PoD and non-PoD sites. PoD staff met about once a week to discuss STEM topics whereas staff at non-PoD sites met, on average, about once a month to discuss STEM programming. The duration of the individual PD activities was longer at the PoD programs. Differences in topics and format of the PD also were found. PD at PoD sites focused on integrating STEM into existing curriculum and on project-based learning. Professional development at PoD sites also focused more often on STEM content areas and the Common Core State Standards, whereas PD at non-PoD sites focused more on Visual and Performing Arts and Social Science. Staff at PoD sites were more likely to report that the PD was implemented well.

SPECIFIC AIM 3— TO CONTRAST SPECIFIC STEM LEARNING ACTIVITIES AT PoD AND NON-PoD SITES

Staff submitted 3,140 reports of STEM activities. STEM activities were more frequent at the PoD sites. These STEM activities typically involved groups of 11 to 20 students and were 45 minutes to one hour in duration. Staff reported that students were very engaged in the STEM learning activities.

SPECIFIC AIM 4— TO CONTRAST MORE MATURE AND LESS MATURE PoD SITES

Across the 3-year Power of Discovery Initiative, some PoD sites participated for more than two years (designated as *Mature Sites*) and other PoD sites participated for less than two years (designated as *Less Mature Sites*). The duration of individual PD activities at the less mature sites was briefer (less than 30 minutes) compared to mature sites who reported PDs lasting more than one hour. Staff at mature sites reported more on-site coaching whereas less mature sites reported attending more in-person workshops. Staff at mature sites reported implementing STEM activities with larger groups of students in contrast to less mature sites. STEM activities at mature sites also tended to have longer durations. Staff at less mature sites reported that students were more engaged in the STEM activities and that activities went "very well", perhaps because the group sizes were smaller and the activities were briefer.

SPECIFIC AIM 5—TO TEST OF THE POWER OF DISCOVERY LOGIC MODEL

Data from 75 program sites (n = 2,030 students) in 2014-15 and 99 program sites (n = 1,548 students) in 2013-14 were used to test the Logic Model underlying the Power of Discovery Initiative. Significant support for the model was found in 2015 and then replicated with the data collected in 2013-14. In 2014-15, more frequent staff meetings about STEM topics predicted stronger staff beliefs about STEM, which predicted the quality of students' experiences at the programs. Program experiences then predicted students' work habits, reading efficacy, and reductions in misconduct. Similar relations were found in 2013-14, when staff beliefs about the value of STEM learning predicted higher program quality, and program quality then predicted gains in students' work habits, math efficacy, science interest, science career aspirations, and reductions in misconduct.

SPECIFIC AIM 6—TO USE OBSERVATIONS TO IDENTIFY EFFECTIVE STEM LEARNING PRACTICES

Two-day observations were conducted at eight PoD sites and eight non-PoD sites to focus more closely on effective STEM learning practices. These observations revealed program strengths in the areas of *Positive Relationships between Staff and Students; Positive Relationships among Students; Student Engagement;* and *Learning Materials*. *Higher Level Thinking* and *Skill Building/Mastery Orientation* were identified as areas for program improvement. In addition, detailed narrative observations identified two main areas of challenge for staff: (1) making explicit connections between STEM concepts introduced and the students' STEM learning activities and (2) guiding reflection processes that deepen student understanding of the STEM concepts addressed.

Findings from the Power of Discovery evaluation indicate that the Initiative was successful in providing opportunities for staff to engage in meaningful STEM PD and to meet frequently with colleagues about STEM programming at their sites. In formal tests of the PoD Logic Model conducted in both 2013-14 and 2015, STEM PD was related to staff beliefs and confidence in the STEM area, which predicted higher quality program experiences. Program quality program experiences then predicted relative gains in student-level academic and social outcomes.

SECTION I
INTRODUCTION

The 2015 evaluation of the *Power of Discovery: STEM*² Initiative builds on and extends the work conducted in the 2013-14 evaluation. The Logic Model that guided the Power of Discovery (PoD) Initiative is presented in Figure 1. The Logic Model is a sequential one in which inputs related to the Initiative (Staff Professional Development, Curricular Innovations, and On-Line Virtual Supports) are represented in the blue boxes on the left hand side of Figure. The supports were expected to yield improvements in (a) Staff Beliefs and (b) Program Offerings. These improvements, in turn, were expected to be mutually reinforcing, as illustrated by the bi-directional arrows in the Logic Model. The Staff Beliefs and Program Offerings were then expected to yield improvements in student STEM-related outcomes, the box on the far right of the figure.

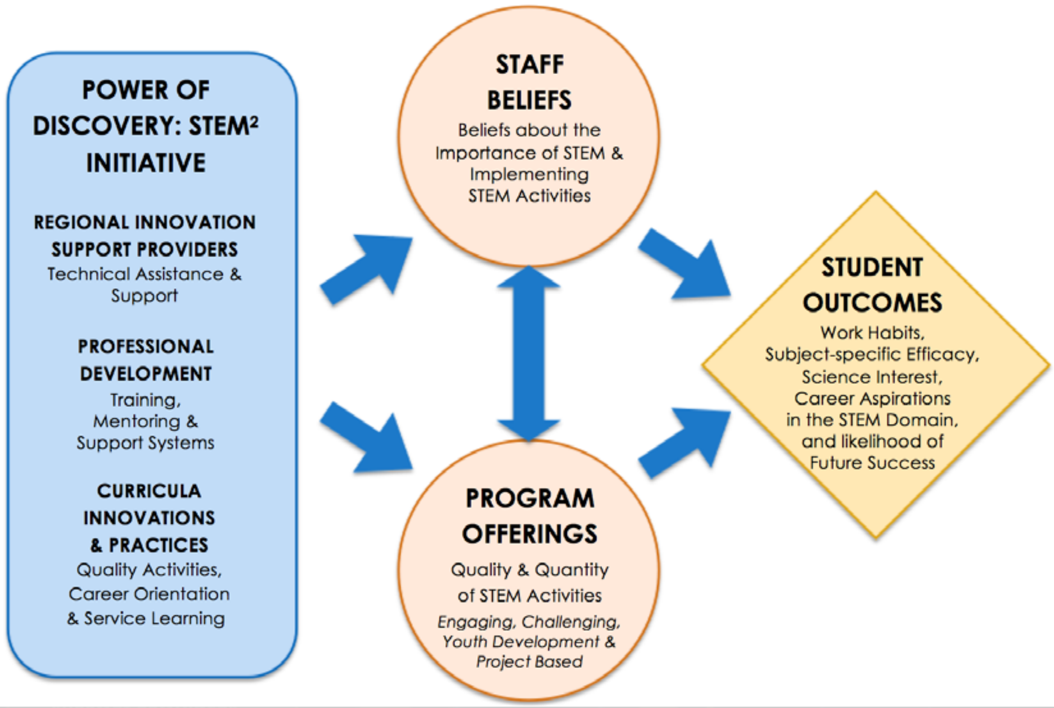

Figure 1. Logic Model of the *Power of Discovery: STEM*² Initiative

Appendix A1 provides placement of the PoD initiative within the broader afterschool landscape and a review of related research informing the current study. In 2013-14, the research team at the University of California, Irvine found evidence consistent with this logic model. In particular, over the course of the first full year of implementation, afterschool program staff reported increases in STEM training, increases in discussions of STEM topics with classroom teachers, and increased contact with parents about STEM activities. These STEM-related supports were associated with relative gains in staff beliefs about the value of STEM activities and feelings of efficacy in implementing STEM activities. These staff beliefs were then associated with the quality of program activities, including reports of student engagement in STEM learning. Finally, staff beliefs about the importance of STEM activities and reports of student engagement in the STEM activities were linked to gains in students' self-reports of math efficacy, work habits, science interest, science career aspirations, and a decline in student reports of misconduct. Taken together, these findings suggested that the Power of Discovery was effective during its first full year of implementation.

An important limitation of the 2013-14 evaluation was that analyses focused on variation within the PoD sites and did not include a comparison group of non-PoD sites. During 2014-15, the research team expanded the *Power of Discovery: STEM*[2] evaluation to include non-PoD sites that were not receiving professional development supports from a Regional Innovation Support Provider (RISP).

The 2014-15 evaluation had three broad goals:

- To contrast staff background and beliefs and program activities in Power of Discovery sites located in five afterschool regions served by Regional Innovation Support Providers (RISPs) versus non-PoD sites in these regions (or other nearby regions).
- To contrast staff background and beliefs, program activities, and student outcomes in Power of Discovery program sites who have participated in the Initiative for two or more years (designated *more mature sites*) versus less than two years (designated *less mature sites*).
- To formally test the Logic Model guiding the study using data collected in 2015. We then tested the Logic Model using data collected in 2013-14 to examine whether findings were replicated.

To that end, the 2015 evaluation had six specific aims:

SPECIFIC AIM 1—TO CONTRAST THE AFTERSCHOOL WORKFORCE AT POD AND NON-POD SITES

This aim contrasts the afterschool workforce staff at sites that participated in the Power of Discovery (PoD) initiative and other programs that received state funds from the Afterschool Education and Safety Program (ASES), but did not participate in the PoD professional development activities.

SPECIFIC AIM 2—To CONTRAST STEM PROFESSIONAL DEVELOPMENT AT PoD AND NON-PoD SITES

In Aim 2, the professional development (PD) opportunities provided at PoD and non-PoD sites are contrasted in terms of format, topics covered, trainers, and staff reports of how well the professional development was implemented.

SPECIFIC AIM 3—TO CONTRAST SPECIFIC STEM LEARNING ACTIVITIES AT THE PoD AND NON-PoD SITES.

In Aim 3, we compare activities offered at PoD and non-PoD sites in terms of the grade level and number of students in each activity, activity duration, specific STEM topics, and reports of quality for each activity.

SPECIFIC AIM 4—TO CONTRAST MORE MATURE AND LESS MATURE PoD SITES

This aim contrasts sites that participated in the Power of Discovery Initiative for two year or less years (designated as *less mature*) in comparison with sites that have been involved in the initiative for more than two years (designated as *more mature*). These sites were compared in terms of (1) staff characteristics, (2) professional development experiences, and (3) STEM activities implemented in 2015.

SPECIFIC AIM 5—TO TEST THE POWER OF DISCOVERY LOGIC MODEL

This aim uses structural equation modeling to formally test the proposed paths between professional development, staff beliefs, program activities, and student outcomes. These paths are tested first using data from the 2015 evaluation and then replicated using data from 2013-14.

SPECIFIC AIM 6—TO USE OBSERVATIONS TO IDENTIFY EFFECTIVE STEM LEARNING PRACTICES

In addition to the survey reports utilized to examine the first five aims, the UCI investigators conducted observations at 16 Southern California sites. These observations enabled the study team to identify ways that afterschool programs implemented afterschool learning activities, in particular activities with a focus on STEM learning, and to identify effective and ineffective STEM learning practices.

REPORT OVERVIEW

This report is organized in six sections. Following this introductory section (Section I), Section II places the Power of Discovery Initiative within a broader afterschool landscape and presents the background research that informed the current study. Section III presents the methods and measure used in the Power of Discovery study. Section IV presents the findings related to Study Aims 1 through 6. A summary of the study findings and conclusions and implications for practice are presented in Section V.

SECTION II
METHODS AND MEASURES

SELECTION OF STUDY SITES

A total of 75 PoD sites and 57 non-PoD sites were recruited to participate in the 2015 study. The PoD sites were obtained from lists of eligible programs provided by Regional Innovation Support Providers (RISPs) in five afterschool regions of California. Each RISP provided names and locations of program sites, the month and year when they joined the PoD initiative, and the sites' level of engagement in the Power of Discovery Initiative. Non-PoD sites from the same (or adjacent) afterschool regions as the PoD sites were approached and asked to participate in the study. Efforts were made to match PoD and non-PoD sites on various characteristics such as percent of students who were English Learners. Both PoD and non-PoD sites received from funding as part of the State's After School Education and Safety (ASES) program. All of the non-PoD programs were participants in the California Department of Education (CDE) Afterschool Outcome Measures Online Toolbox implementation.

MEASURES

The research team utilized a multi-method, multi-respondent approach to assess the PoD in 2015. Study measures included online surveys to staff and students, staff reports of specific STEM activities, site coordinator and staff reports of specific professional development opportunities, and on-site observations of afterschool learning activities.

Staff Surveys

Program staff at the PoD and non-PoD sites completed online surveys in which they reported their *age*, *race*, *educational background*, and *previous experience* implementing STEM-related activities of program staff (Noam & Sneider, et. al., 2010). Staff also reported their *professional development experiences* overall and in the STEM area (Vandell, et. al., 2008), their *beliefs about the value of STEM learning,* and their *confidenc*e in delivering STEM content (adapted from, Vandell, et. al., 2008). See Appendix B1 for the staff survey.

Student Surveys

Online surveys, administered to students at PoD and non-PoD sites in spring 2015, assessed student beliefs about STEM-related topics as well as broader youth outcomes. Attitudes and beliefs about STEM subjects were measured, including *interest and engagement in STEM learning* (Noam & Sneider, et. al., 2010) and *STEM career aspirations* (Tyler-Wood, Knezek, & Christensen, 2010). In addition, students' skill development (*science, math and reading efficacy* and *work habits*) and *positive behavior* were measured (Muris, 2001; Brown, Clasen & Eicher, 1986, Posner & Vandell, 1994). See Appendix B2 for a copy of the student survey.

STEM Activity Documentation Forms (ADFs)

Both PoD and non-PoD site staff completed Activity Documentation Forms (ADFs) to describe specific STEM learning activities as they occurred between March 1, 2015 and May 31, 2015. The forms allowed staff to record (a) the date and duration of the activity; (b) the number of students participating in the activity; (c) the name of the activity and the STEM content area addressed; and (d) four-point ratings of student engagement, level of challenge, and overall success of the activity. Staff were provided report forms, instructions, and prepaid and addressed envelopes for returning completed forms to UC Irvine. See Appendix B3 for the Activity Documentation Form.

Professional Development Documentation Forms (PDDFs)

Site directors at both PoD and non-PoD sites completed Professional Development Documentation Forms (PDDFs) between March 1, 2015 and May 31, 2015 that reported details about the specific professional development activities at their sites, including: (a) the duration of a particular activity; (b) the number of staff attending; (c) format of the PD activity, (d) the PD topic; (e) characteristics of the PD provider; and (f) a rating of how well the professional developments was implemented. See Appendix B4 for the Professional Development Documentation Form.

Observations of STEM Activities

Sixteen sites (8 PoD and 8 non-PoD) were observed for two days each, for a total of 32 observations. The observed PoD and non-PoD sites were similar in terms of ethnicity and Free Reduced Lunch (FRL) status of student population and geographic location. The Promising Practices Rating System (PPRS) (Vandell, et. al. 2014) was used as the observation instrument to assess the general quality of the programs and the quality of STEM activities observed. A total of 52 distinct activity observations were completed. See Appendix B for qualitative observation study measures.

SUMMARY OF SAMPLE SIZES

As shown in Table 1, staff surveys were collected from 303 staff at 132 sites. Student surveys were collected from 5,181 students at 141 program sites. STEM activity reports, describing a total of 3,140 activities, were obtained from 85 sites. A total of 221 professional development logs were obtained from 66 sites. Two-day observations were conducted at 16 sites.

Table 1. Study Sites and Data Collected, 2015

	Student Survey Sites	Student Surveys Completed	Staff Survey Sites	Staff Surveys Completed	Sites Completing STEM Activity Reports	# STEM Activities Reported	Sites Completing PDDFs	# PDDFs Activities Reported	Observ. Sites	Activity Observations completed
ACOE	14	445	11	32	9	335	6	18	0	0
SCOE	19	556	12	93	9	248	4	31	0	0
TECH	17	493	17	40	6	315	6	18	0	0
OC STEM	36	1,352	46	105	32	1,325	32	94	4	11
SDCOE	55	2,335	42	93	28	902	20	66	4	11
PoD	**80**	**2,261**	**75**	**176**	**52**	**1,452**	**39**	**143**	**8**	**22**
Non-PoD	**61**	**2,920**	**57**	**127**	**33**	**1,688**	**27**	**78**	**8**	**30**
Totals	**141**	**5,181**	**132**	**303**	**85**	**3,140**	**66**	**221**	**16**	**52**

SECTION III
FINDINGS

In this section, research findings are organized by the research questions associated with the project's six specific aims.

SPECIFIC AIM 1: ARE THERE DIFFERENCES IN THE AFTERSCHOOL WORKFORCE AT PoD AND NON-PoD SITES?

A total of 303 program staff completed surveys in which they reported their age, race, educational background, previous work experience, and current work experience. 176 staff were employed at 75 PoD sites and 127 staff were employed at 57 non-PoD sites. Chi-square tests were used to test whether the PoD and non-PoD staffs differed. Appendix C reports supplemental tables in relation with the quantitative findings presented in Aims 1 through 5. Detailed results from these analyses can be found in Table 1A in Appendix C.

The staff at both PoD and non-PoD sites were predominantly female, representing 63% of staff at PoD sites and 69% at non-PoD sites. The percentages of staff by gender did not differ significantly between PoD and non-PoD sites.

The staff at both PoD and non-PoD sites were relatively young, with more than 40% being less than 25 years of age and more than 70% being less than 35 years of age. The ages of the staff did not differ significantly at the PoD and non-PoD sites.

The staff was ethnically diverse at both the PoD and non-PoD programs (see Figure 1.1), although the non-PoD sites had a higher proportion of Hispanic staff than did the PoD sites. The PoD sites had relatively more staff who were Asian or were white.

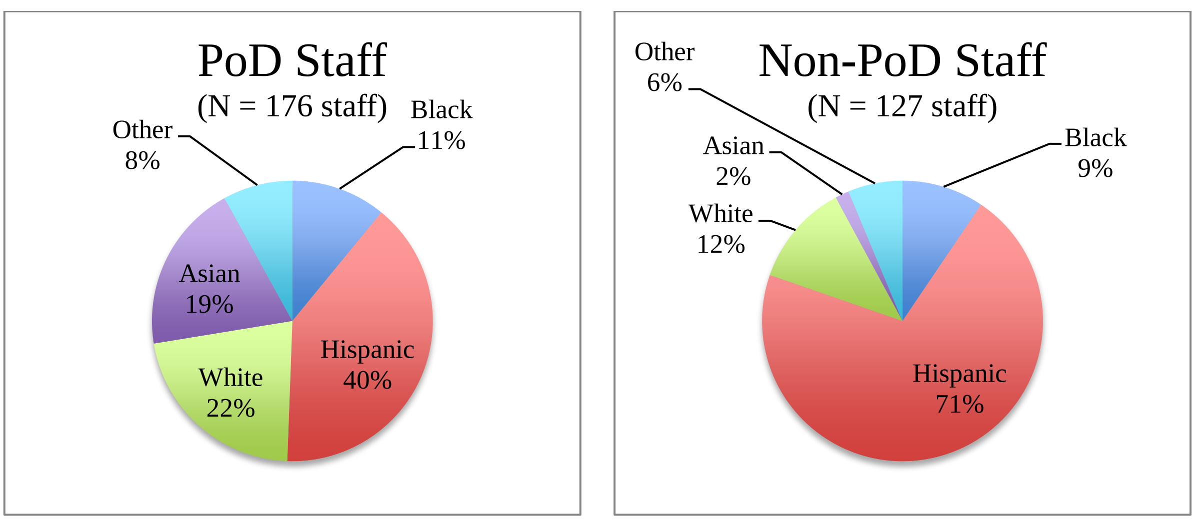

Figure 1.1. Race and Ethnicity of Program Staff by PoD and Non-PoD Sites

Staff educational background varied widely at both the PoD sites and non-PoD sites, ranging from high school diploma to graduate school. The most common level of education in both groups was "attended college." Twenty-eight percent of staff at both PoD and non-PoD sites reported having obtained a Bachelor's degree. Staff educational backgrounds did not differ significantly between PoD and non-PoD sites.

Of the 176 staff at PoD sites, 139 (79%) reported having previous work experience in school settings. Of the 127 staff at non-PoD sites, 96 (76%) reported previous work experience in school settings. Thus, the majority of staff at both PoD and non-PoD sites reported having had experience working in school settings other than their current position. The two work forces did not differ significantly in the roles they fulfilled at the schools. As shown in Figure 1.2, the most common experience was serving as a classroom aide or teaching assistant across (36%) at PoD sites and 42% at non-PoD sites.

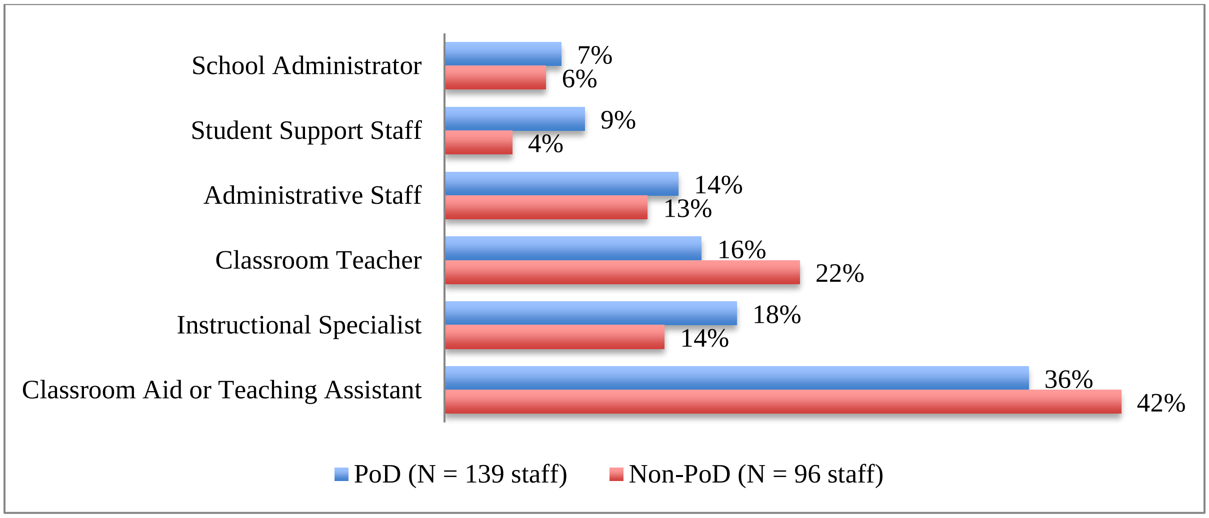

Figure 1.2. Professional Experience of Staff at PoD and Non-PoD Sites

Staff at both PoD and non-PoD sites reported how long they were employed at their current position. 33% of PoD staff and 28% of non-PoD staff reported having had worked in their position for less than one year, indicating high staff turnover in both groups. PoD and non-PoD sites did not differ significantly in their reports of how long they have worked in their current position.

PoD and non-PoD sites did not differ on many aspects of staff characteristics, suggesting that their staff have similar PD needs. Lengths of staff employment and previous education levels suggest high staff turnover and a need for STEM PD, respectively.

SPECIFIC AIM 2: DO PoD AND NON-PoD SITES DIFFER IN STEM PROFESSIONAL DEVELOPMENT?

To answer this question, PoD and non-PoD sites were compared in terms of PD format, topics, service providers, and quality ratings. PD was measured from two sources. First, program staff (N = 303) completed survey questions about how often they met with other staff to discuss program issues and/or STEM programming. Second, a subsample of this group (N = 73) agreed to complete more detailed reports of professional development using a new measure developed by the research team at the University of California, Irvine for this study. The Professional Development Documentation Forms (PDDFs) were intended to gather data for a more fine-grained examination of the professional developments offered to staff at sites participating in this study.

A. Staff Reports of Professional Development at PoD and Non-PoD Sites

The survey, completed by 303 staff, asked staff to respond to questions about how often they met with other program staff to discuss program issues and how often they met with staff to discuss STEM programming specifically. These questions were asked to capture the extent of opportunities that staff had to network and communicate program-based needs, goals, and plans amongst one another during the span of the PoD Initiative.

Staff Meetings

Staff at PoD sites reported meeting significantly more often with one another to discuss general program issues. As shown in Figure 2.1, staff at PoD sites were more likely to meet at least two to three times per month to discuss program issues whereas staff at non-PoD sites were more likely to meet once a month or less.

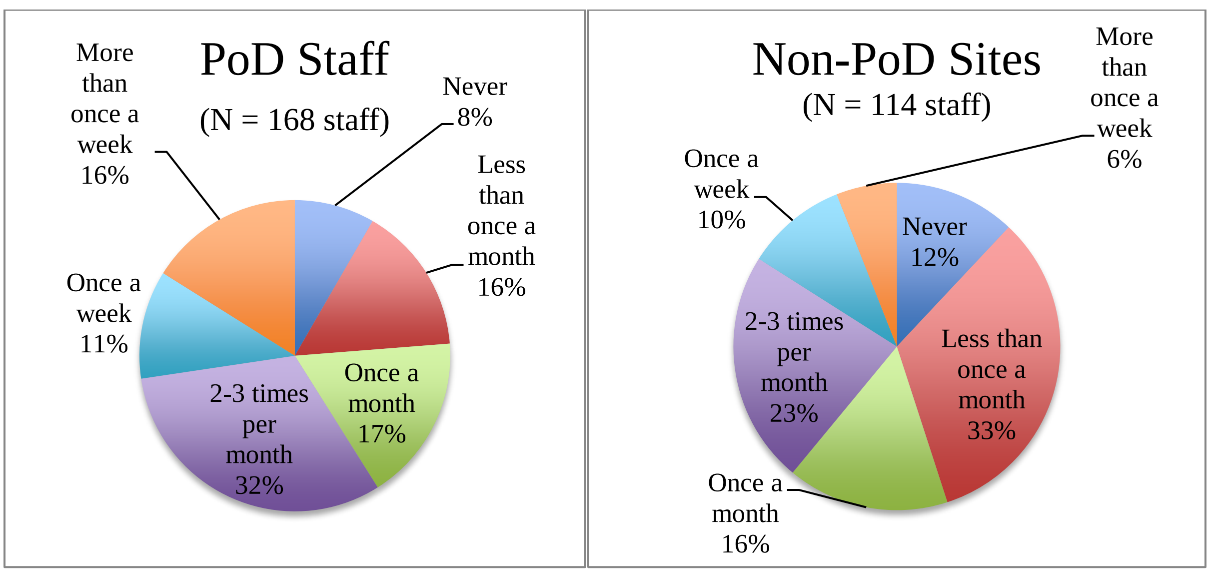

Figure 2.1. Frequency of Meetings to Discuss Program Issues: PoD and Non-PoD Sites

As shown in Figure 2.2, staff at PoD sites also were more likely to meet to discuss STEM programming. PoD were more likely to meet once a week to discuss STEM programming whereas staff at non-PoD sites were more likely to meet once a month. Approximately 18% of staff at non-PoD sites reported never meeting to discuss STEM programming.

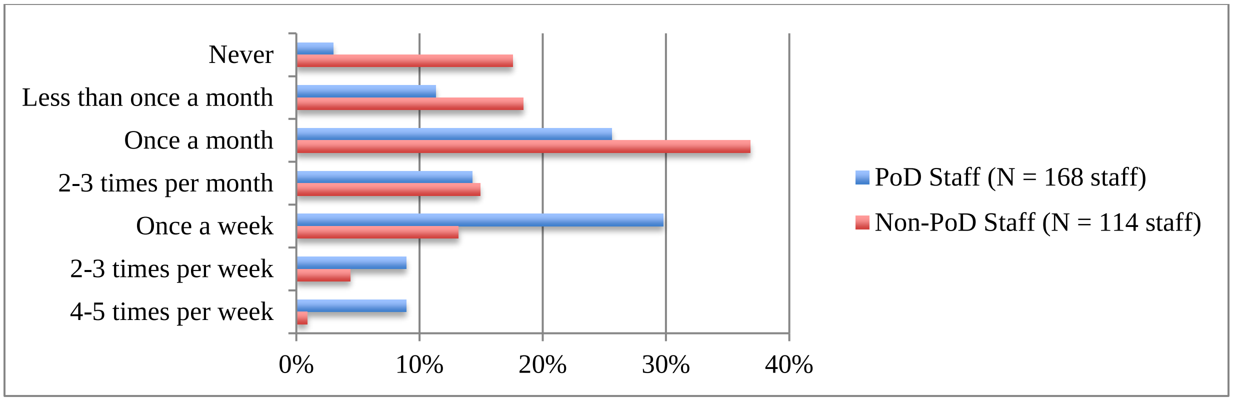

Figure 2.2. Frequency of Meetings to Discuss STEM Programming Reported by PoD and Non-PoD Staff

B. Staff Reports of Professional Development Experiences Using PDDFs—A Comparison of PoD and Non-PoD Staff Experiences

A subset of staff (N = 73) further described their PD experiences using the Professional Development Documentation Forms (PDDFs). A total of 221 reports were collected. According to these reports, the majority of PD activities occurred in groups of one to 10 staff, accounting for approximately 71 and 59% of PDs reported on for PoD and non-PoD sites, respectively. The majority of the PD activities were "In Person Trainings" — 55% and 54% at PoD and non-PoD sites, respectively. Onsite coaching and time to plan/debrief also occurred. The format of PDs attended did not significantly differ between PoD and non-PoD sites.

The specific PD topics did differ, however. Most notably, the percentage of PDs that focused on STEM content areas was significantly higher at PoD sites. Approximately 83% of PDs described by staff at PoD sites focused on STEM content areas whereas about 50% of professional development activities at comparison sites focused on STEM activities. In addition, as shown in Figure 2.3a, the percentage of PDs that focused on the Common Core State Standards (CCSS) was higher at the PoD sites. Approximately 29% of the PoD PDs focused on the CCSS, whereas approximately 12% of PDs reported on at non-PoD sites focused on the CCSS. The proportion of PDs that focused on Visual and Performing Arts was higher at the non-PoD sites.

Staff indicated the specific approaches to instruction targeted in their PD. PoD staff reported more PDs focused on "Integrating STEM into existing curriculum" than staff at non-PoD sites (47% vs. 27%). Of further note, PoD staff reported PD regarding "implementing project and/or inquiring based learning" as occurring twice as often than did staff at non-PoD sites.

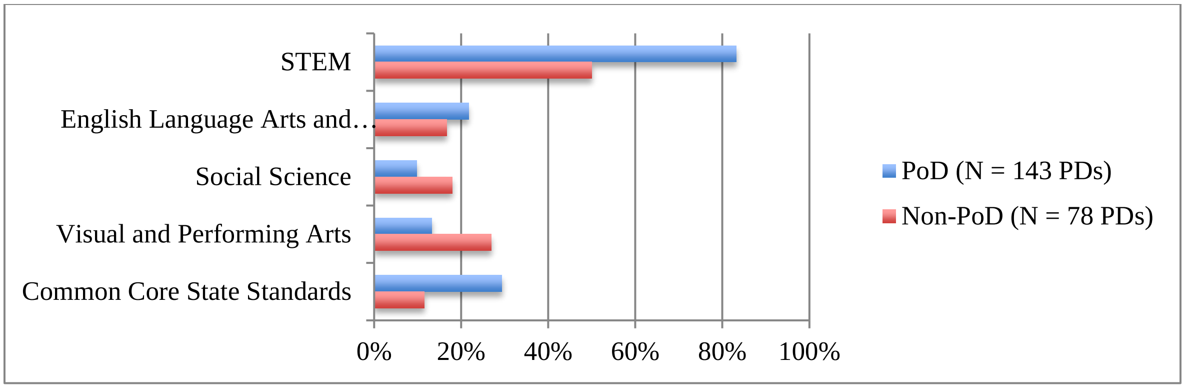

Figure 2.3a. Distribution of Academic Topics for Professional Developments at PoD and Non-PoD Sites

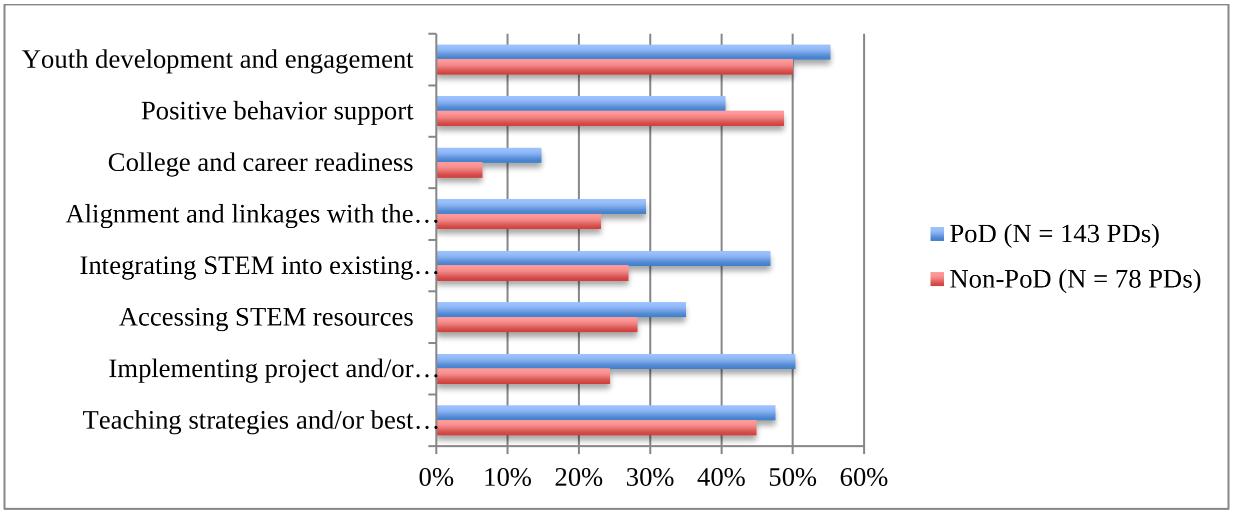

Figure 2.3b. Distribution of Strategies Focused on in Professional Developments at PoD and Non-PoD Sites

PD Providers

PD was provided by a number of internal and external providers. These providers differed at PoD and non-PoD sites. Approximately 19% of the PDs reported at PoD sites were provided by the County Offices of Education or by Regional Leads in their areas, whereas only 3% of the PD at non-PoD sites were offered by these sources. The PoD sites also were more likely to utilize trainings that were provided by internal staff and such trainings were therefore classified as "Internal Trainings" (e.g., these were trainings delivered by Site Coordinators or Program Directors)—consisting of 55% of the PoD trainings and 44% of the non-PoD trainings. Non-PoD programs were more likely to utilize community based and "other" sources for training.

Duration of Professional Developments

As shown in Figure 2.4, the duration of trainings was longer in the PoD programs.

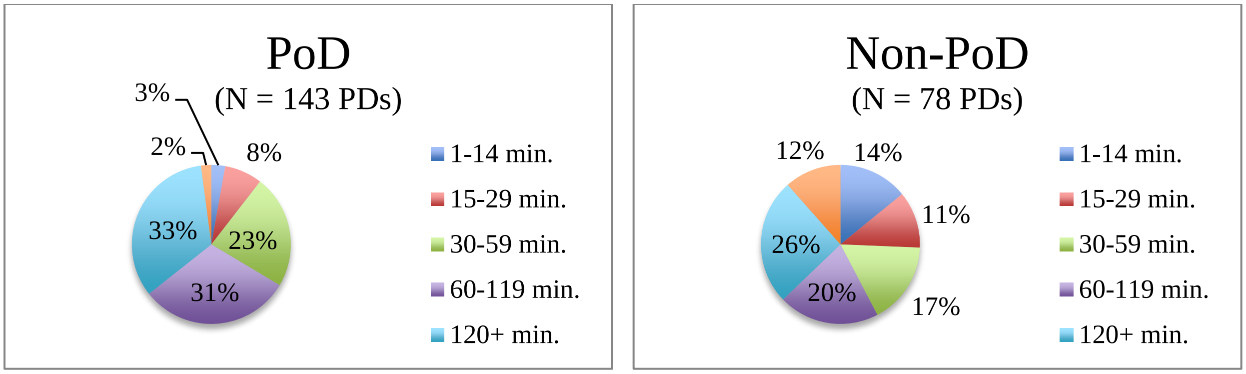

Figure 2.4. Duration of Professional Developments at PoD and Non-PoD Sites

Staff Reports of the PD Quality. Staff reported how well each PD was implemented by rating how much they agree with the statement, "The PD was implemented well." This item was assessed using a 4-point Likert scale ranging from 0 (*not at all true*) to 3 (*very true*). A two-sample t-test with equal variances was used to identify whether there was a significant difference in staff's reporting of how well PDs were implemented for PoD and non-PoD sites. Staff at PoD sites, on average, reported that PDs were implemented well significantly more than staff at non-PoD sites (with an average of 2.67 as compared with 2.45). Staff also reported significantly higher levels of engagement in the PD activities at the PoD sites versus non-PoD sites, with an average rating of 2.63 as compared with 2.48.

Power of Discovery sites received significantly more STEM-related PD in 2015 than did non-PoD sites. The detailed reports indicate that the PoD initiative increased the proportion, frequency, duration, and quality of STEM PD in the publicly funded afterschool programs.

SPECIFIC AIM 3: DO PoD and NON-PoD DIFFER IN STEM LEARNING ACTIVITIES?

To address Aim 3, the research team turned to Activity Documentation Forms (ADFs), developed specifically for this study. Participating staff were asked to complete daily activity documentation forms in which they recorded (1) date and duration of an activity; (2) number of students participating in the activity; (3) name of activity and STEM content area addressed; and (4) ratings of the level of student engagement, level of challenge, and overall assessment of success of the activity.

A total of 129 staff (79 from 52 PoD sites and 50 staff from 33 non-PoD sites) submitted a total of 3,140 Activity Documentation Forms. According to these daily logs, the most common group size was 20 students, with the numbers of students in the STEM activities ranging from 1 to 3 children to more than 100 children. The majority of activities reported by PoD staff involved students in the fourth (52%) and fifth (49%) grades, whereas staff at non-PoD sites most frequently reported activities involving students in the sixth grade (approximately 50%), a statistically significant difference. In general, the reported activities at PoD sites involved students in grades one through five whereas reported activities at non-PoD sites served students across more grade levels, including grades 6–8 and a few high school students.

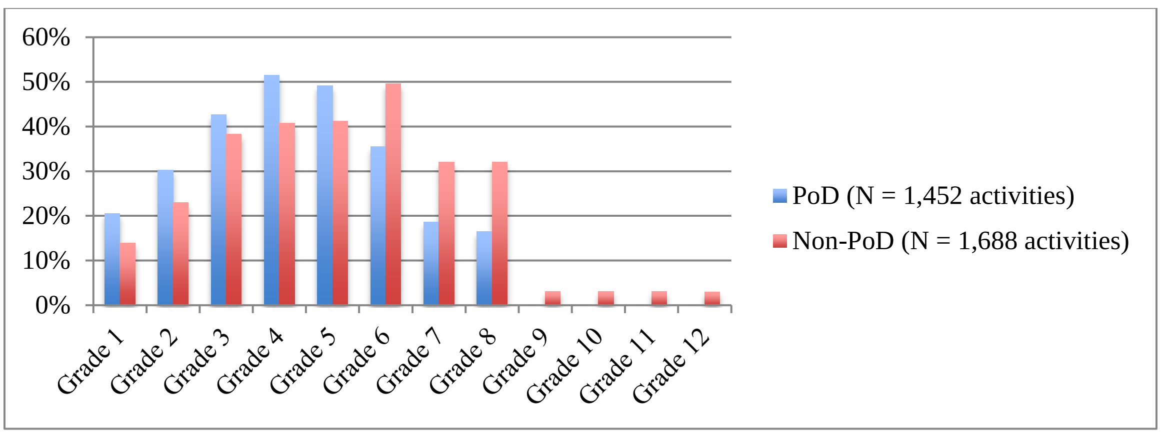

Figure 3.1. Grades of Students in Activities as Reported by PoD and Non-PoD Staff

Of the reported activities, 2,948 (of a total of 3,140 activities) had a specific STEM focus. The STEM focus areas, as reported by staff, were significantly different for PoD and non-PoD sites. As shown in Figure 3.2, staff at PoD sites reported leading activities that focused on science and engineering relatively more often, whereas staff at non-PoD sites reported leading activities that were more likely to focus on technology and math.

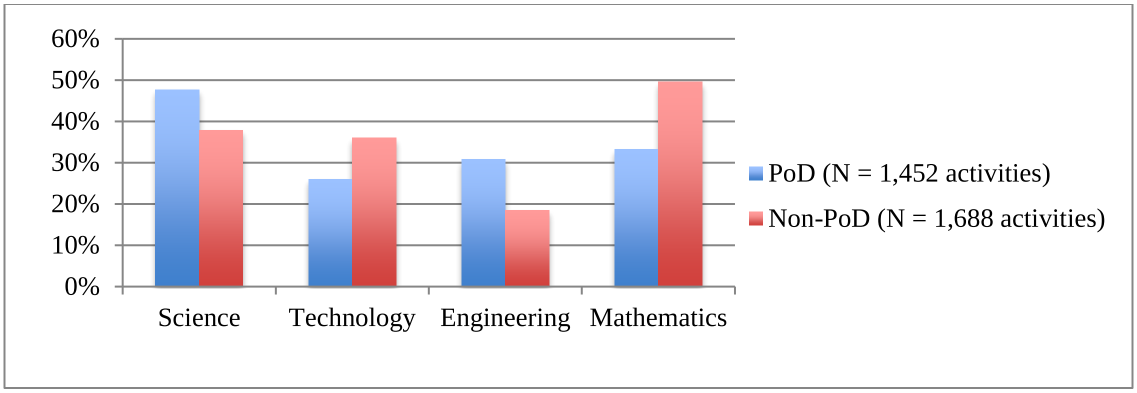

Figure 3.2. STEM Focus of Activities as Reported by PoD and Non-PoD Site Staff

Staff rated how engaged and challenged students appeared to be in the activity. Table 3A and Table 3B in Appendix C presents chi-square information and descriptive information, respectively, for these measures. Both PoD and non-PoD staff reported that students were very engaged (57-58%) or mostly engaged (33-35%) in the reported activities. Staff reports of low levels of student engagement were infrequent (less than 10%) at both PoD and non-PoD sites.

Staff reports of how challenged students differed significantly between PoD and non-PoD sites. Two-sample t-tests with equal variances showed that staffs at non-PoD sites reported that students were more challenged, on average, than reports from staffs at PoD sites. Staff at PoD and non-PoD sites did not differ in their overall assessment of how well the activity went.

The PoD sites reported a higher proportion of science and engineering activities whereas non-PoD sites reported higher proportions of math and technology activities.

SPECIFIC AIM 4: DO MORE MATURE AND LESS MATURE POD SITES DIFFER?

Because the PoD initiative was offered over a three period, it was possible to compare sites that have been involved in the initiative for two or less years (designated as less mature) with sites who had been involved in the initiative for more than two years (designated as more mature sites). Sites are compared in terms of (1) staff characteristics, (2) PD experiences, and (3) STEM activities implemented in 2015.

A. STAFF CHARACTERISTICS AT MORE MATURE AND LESS MATURE POD SITES

The staff survey completed by PoD staff (N = 176) asked staff to respond to questions about their demographic characteristics, educational background, previous work experience, and current position as well as experience in current position. 76 staff were employed at less mature PoD program sites and 87 staff were employed at more mature program PoD sites. Chi-square tests were used to determine whether there were differences in PoD staff characteristics by years of involvement in the initiative. This information is reported in Table 4A in Appendix C.

Demographic Characteristics

In many respects, staff at the more mature and less mature PoD sites were similar. There were no differences in staff educational background or previous work experience differences. The most commonly reported educational background in both groups was "attended college." Approximately a third of all staff reported that they had completed a four-year college degree. Also, there were no age differences between staffs at sites that have been involved in the initiative for two or less years versus those at sites that have been involved in the initiative for more than two years.

In other respects, some differences were found. More mature programs had a significantly higher proportion of male staff members, and staff ethnicities varied by sites based on the years of involvement in the PoD. As shown in Figure 4.1, there were significantly more Black staff members at less mature sites than more mature sites.

B. PROFESSIONAL DEVELOPMENT AT LESS MATURE AND MORE MATURE POD SITES

Types and Topic of PDs

The types of PD differed significantly between the less mature and more mature PoD sites. Table

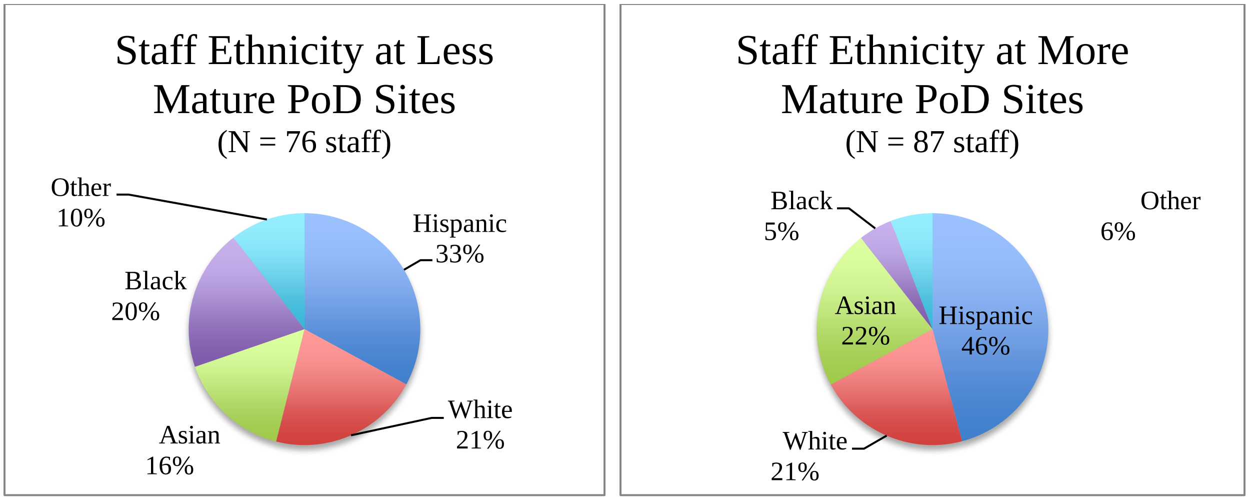

Figure 4.1. Race and Ethnicity of Staff at PoD Sites by Years of Involvement in the PoD

4B in Appendix C provides details of these analyses. Staffs were more likely to attend PDs that consisted of in-person trainings at less mature versus more mature sites—63% as compared with 44%. In contrast, onsite coaching occurred more at more mature sites—35% as compared with 14% at less mature sites. Lastly, peer-learning opportunities occurred at greater frequency at less mature sites—17% as compared with 3%.

One striking finding was the high proportion of staff at both the less mature and more mature sites who reported that they had received STEM PD—86% and 90%, respectively. Other aspects of PD differed significantly at the less mature and more mature sites. The frequency of PDs that focused on English Language Arts (ELA) and Literacy occurred at greater frequency at more mature sites—29% as compared with 10% at the less mature sites. PDs that focused on Visual and Performing Arts also were relatively more common at more mature sites—19% as compared with 7%. Lastly, PDs that focused on the Common Core State Standards (CCSS) was relatively more common at more mature PoD sites—35% as compared with 10%. Other topics, such as youth development and implementing inquiry based learning, were common at both less mature and more mature sites.

PD Providers and Duration

Providers of PD did not differ at less mature and more mature PoD sites, with site coordinators and/or program directors serving this role at all of the PoD sites. The duration of PD differed significantly between less mature and more mature sites. The proportion of PDs that lasted between one and 14 minutes was higher at less mature sites, whereas PDs that lasted between 60 and 119 minutes occurred at greater frequency at sites that had been involved in the more mature PoD sites—42% as compared with 19%.

Implementation and Engagement

Table 4.1 presents the differences in staff reports of how well PDs were implemented and how engaged staff appeared to be. Staff at less mature PoD sites reported, on average, that PDs were implemented well significantly more often than staff at more mature sites. Similarly, staff at less mature sites, on average, reported that staff appeared to be engaged more often than staff at more mature sites.

Table 4.1
Differences in staff's ratings of implementation of and staff engagement in PD by site years of involvement in the PoD initiative (N = 121 PDs)

	Less mature Sites (N = 59 PDs)			More mature Sites (N = 62 PDs)			
	n	Mean	SD	*n*	Mean	SD	p-value of difference
How well PD was implemented.	56	2.80	0.40	61	2.54	0.62	0.01**
How engaged staff were.	56	2.84	0.42	61	2.59	0.62	0.01*

Note. Asterisks indicate level of significance. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

C. STEM LEARNING AT LESS MATURE AND MORE MATURE PoD SITES

Seventy-nine staff from 52 PoD sites completed STEM Activity Documentation Forms (ADFs), which provided information about the content area of each reported activity, the number and grade levels of the students involved, the duration of the activity, how engaged and challenged students were during the activity, and how the each activity went overall. These reports provided detailed information about 1,391 specific activities. Chi-square tests were used to determine whether there were statistically significant differences in PoD staff characteristics by years of involvement in the initiative. This information is reported in Tables 4C and 4D in Appendix C.

Number of Students and Duration of Activities

The most common group size was 11-20 students at both the less mature and more mature PoD sites, followed by group sizes of 21-30 students. Other group sizes differed at less mature and more mature sites. Staff at less mature sites were more likely to report implementing STEM activities for groups of students between one and 10 whereas staff at more mature sites were more likely to report implementing STEM activities for larger groups of students (between 31-40 and 41-60 students).

The duration of STEM activity reports differed significantly by sites' years of involvement in the PoD initiative. Staff at less mature PoD sites were more likely to report leading STEM activities between 15 and 29 minutes, whereas staff at more mature PoD sites were more likely to report implementing STEM activities lasting between 30 and 59 minutes.

Grade Levels and STEM Area of Focus

Staff at more mature sites were more likely to report implementing STEM activities for students in grades one through three, whereas less mature programs were more likely to be serving students in grades five and six. The STEM content area reported by staff differed significantly by sites' years of involvement in the PoD initiative. Staff at less mature PoD sites were more likely to report leading STEM activities that focused on science whereas staff at more mature PoD sites reported more technology or engineering. Mathematics was equally common at the two types of programs.

Staff Reports of Activity Quality

Staff reported on the quality of the STEM activities by rating how engaged students were, how challenged they appeared to be, and how well the activity went overall. Table 4C and Table 4D in Appendix C presents chi-square information and descriptive information, respectively, for each of these area. Staff reports of student engagement in STEM activities implemented differed significantly by sites' years of involvement in the PoD initiative. As shown in Table 4D in Appendix C, staff reports of activity challenge did not differ significantly between less mature and more mature sites. Differences were found in other aspects of the activities. Staff at less mature PoD sites reported higher levels of student engagement in the STEM activities than did the staff at more mature PoD sites. And, staff-reports of overall quality of activities implemented also differed. As shown in Table 4D in Appendix C, staff at less mature sites reported, on average, that activities went "very well" more often than staff report from more mature sites.

Student Reports of Quality of Program Experiences

The student survey asked students to respond to questions about their relationships with staff (e.g., "*The teachers really try to help kids here*"), their relationships with peers (e.g., "*I like the other kids here"*), and their experiences during activities implemented (e.g., *"I like the activities here"*). Of the 5,181 students who completed the student survey, 2,261 students were at PoD sites.

Student reports of relationships with staff, relationships with peers, and experiences in program activities did not differ significantly between less mature and more mature PoD sites.

Some differences were found between less mature and more mature PoD sites. Staff at less mature sites received more in-person PD that tended to be shorter in duration. Staff at less mature PoD sites delivered STEM programming to smaller groups students. Staff at more mature sites received more coaching and longer PDs and implemented longer STEM activities with larger groups of students.

SPECIFIC AIM 5— IS THERE EVIDENCE TO SUPPORT THE LOGIC MODEL UNDERLYING THE POWER OF DISCOVERY INITIATIVE?

A primary goal of the research team was to test the Logic Model guiding the Power of Discovery Initiative. This model is presented in Figure 1 (page 3). The model was first tested using structural equation modeling (SEM) to examine data from the 2015 study. We then sought to replicate these findings using SEM to analyze data from the 2013-14 evaluation.

SITE-LEVEL MODELS

As shown in Figure 5.1, we hypothesized that (a) STEM professional development would be linked to staff beliefs and confidence in implementing STEM activities and (b) these staff beliefs would be linked to student reports of higher quality experiences at the afterschool programs. To test these relations, staff and student survey data were collected at 74 program sites in 2015

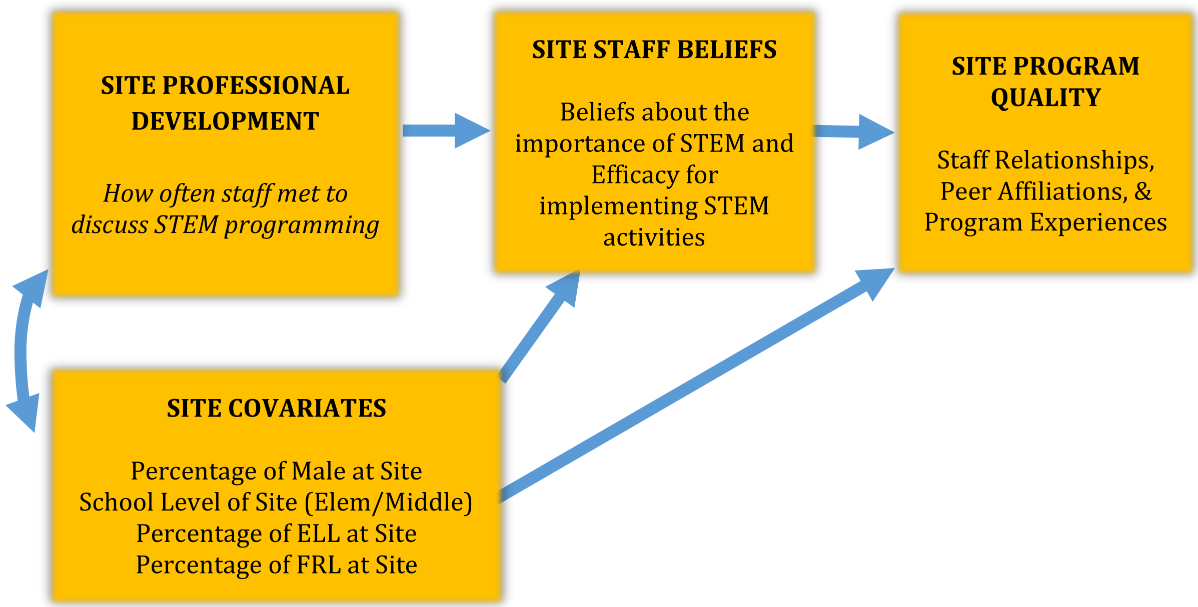

Figure 5.1. Site-Level Model: Site-level Reports of Professional Development Predicting Site-Level Staff Beliefs Predicting Site-Level Program Quality

Turning first to the site-level analyses of the 2015 program, the logic model provided a good fit for the data ($\chi^2 = 0.46[1]$, $p = 0.50$; RMSEA = 0.00; CFI = 1.00; CD = 0.26). Support for each of the proposed paths was found. In particular, as shown in Figure 5.2a, more frequent staff meetings to discuss STEM programming predicted stronger staff beliefs about the value of STEM learning and greater confidence in implementing STEM activities ($\beta = 0.33$, $p = 0.00$), which predicted student reports of the higher quality experiences at their afterschool program ($\beta = 0.25$, $p = 0.02$).

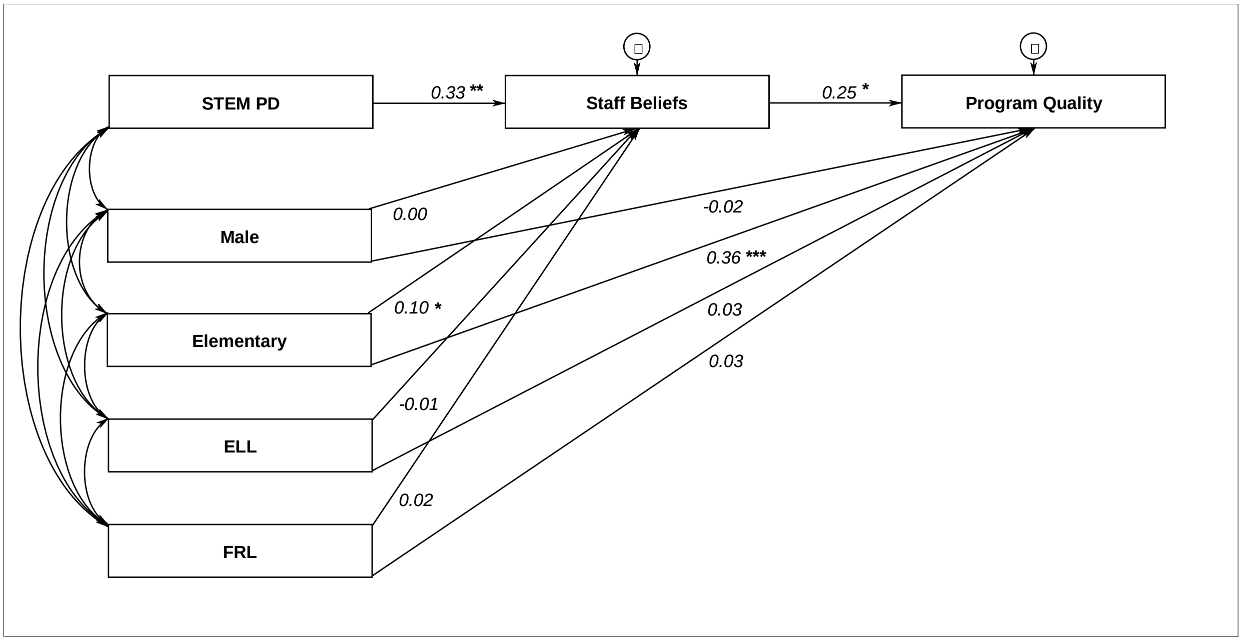

Figure 5.2a. Context-Level SEM Results Using 2015 Data

Our next step was to test the links between quality of program experiences and individual student outcomes. As shown in Figure 5.3, we hypothesized that quality of students' experiences at the afterschool programs would be linked to student outcomes. To test this part of the logic model, we examined data collected from 2,030 students in 2015, controlling for child and site characteristics.

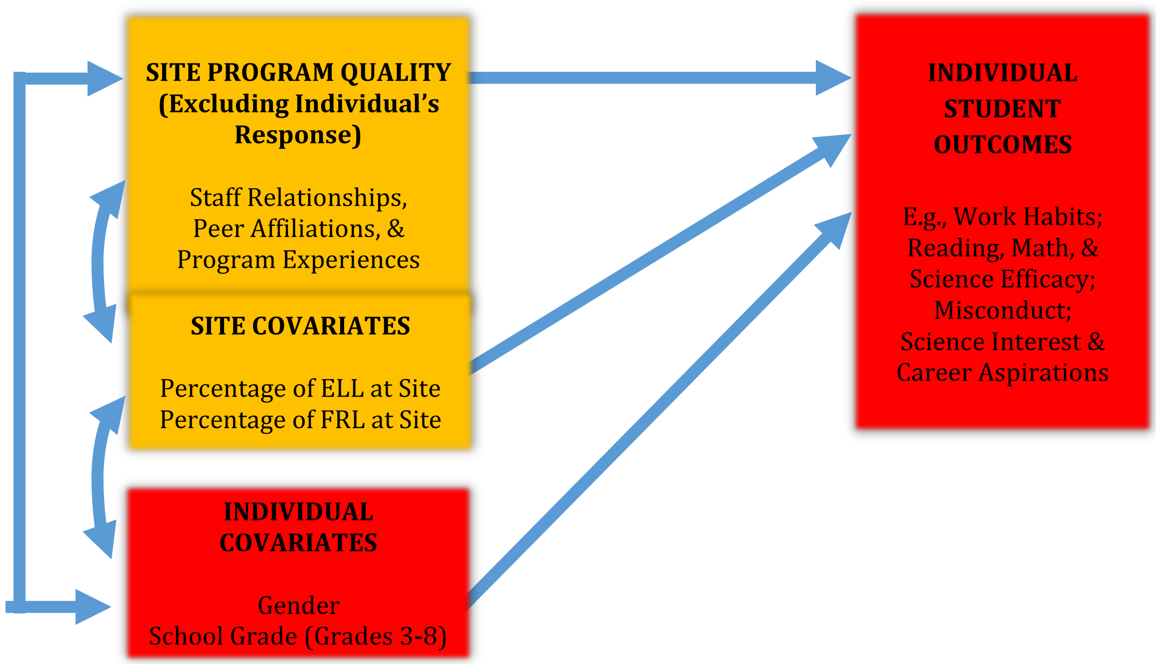

Figure 5.3. Individual-Level Model: Site Program Quality Predicting Individual Student Outcomes

The individual-level logic model provided a good fit to the data in 2015 ($\chi^2 = 0.00[0]$, $p = 0.00$; RMSEA = 0.00; CFI = 1.00; CD = 0.05). Relations between quality of program experiences and student outcomes are summarized in Table 5.1. We found that in 2015 afterschool program quality predicted student reports of higher work habits, reading efficacy, and less misconduct.

Now we turn to the test of the site-level logic model using the 2013-14 data. These analyses are based on 99 program sites. Here the overall fit of the model also was good, $\chi^2 = 0.30[1]$, $p = 0.59$; RMSEA = 0.00; CFI = 1.00; CD = 0.16). Figure 5.2b presents the SEM results of the site-level model tested using 2013-14 data. Consistent with 2015, staff beliefs about the value of STEM learning was related to student reports of quality of program experiences ($\beta = 0.36$, $p = 0.02$). The link between STEM professional development and staff beliefs, however, was not significant in 2013-14 ($\beta = 0.11$, $p = 0.47$).

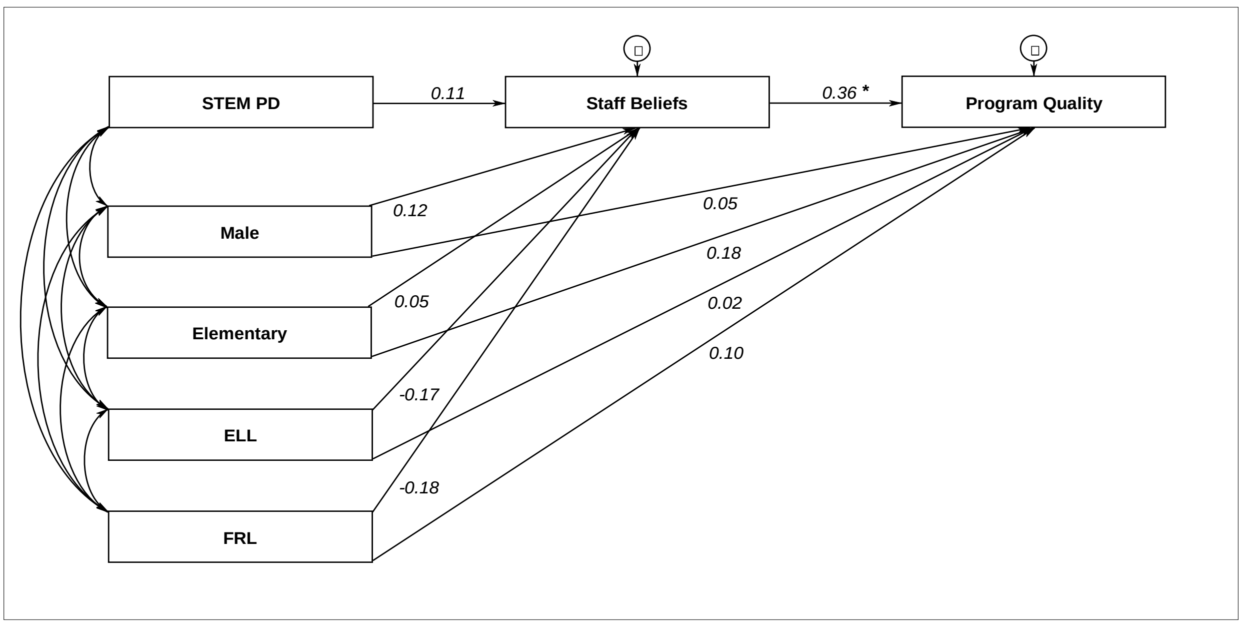

Figure 5.2b. Context-Level SEM Results Using 2013-14 Data

Finally, we tested the model fit between quality of program experiences and student outcomes, in this case also controlling for student performance at the beginning of the school year. Baseline scores of student outcomes were not collected in the 2014-15 evaluation and are therefore not included in the 2014-15 model. The individual-level logic model provided a good fit to the data in 2013-14 ($\chi^2 = 0.00[0]$, $p = 0.00$; RMSEA = 0.00; CFI = 1.00; CD = 0.25).

As shown in Table 5.1, higher quality program experiences in 2013-14 was linked to relative gains in work habits, math efficacy, science interest, science career aspirations and to relative decreases in reductions in misconduct.

Table 5.1
Associations between Afterschool Program Quality and Student Outcomes by Year

	Program Quality					
	2013-14			2014-15		
Student Outcomes	β	SE	*P*	β	SE	*P*
Work Habits	0.09*	0.04	0.03	0.11*	0.05	0.05
Reading Efficacy	0.04	0.03	0.15	0.06*	0.03	0.03
Math Efficacy	0.07**	0.03	0.01	0.02	0.03	0.60
Science Efficacy	-0.01	0.03	0.85	0.04	0.03	0.19
Social Skills	0.06	0.04	0.15	0.10	0.07	0.16
Misconduct	-0.07*	0.03	0.03	-0.09**	0.03	0.00
Science Interest	0.07*	0.04	0.05	0.05†	0.03	0.05
Science Career Aspirations	0.06*	0.04	0.05	-0.01	0.03	0.63
Future Aspirations	0.04	0.03	0.23	0.05	0.04	0.22

Note. † $p < .10$. * $p < .05$. ** $p < .01$.

Evidence to support the PoD logic model was obtained in 2015 and replicated in new analyses of the 2013-14 evaluation. These findings demonstrate consistent relations between staff beliefs about the value of STEM learning and the quality of students' experiences in the afterschool programs. Consistent relations also were found between quality of program experiences and student STEM-related outcomes as well as more general skills such as work habits and reduced misconduct. The positive associations between more frequent staff meetings about STEM topics and staff beliefs found in 2014-15 are promising.

AIM 6—WHAT DO PROGRAM OBSERVATIONS IDENTIFY AS AREAS OF RELATIVE STRENGTH AND WEAKNESS?

An observation study was conducted at 16 Southern California sites that were participants in the larger evaluation. Eight of the observation sites were participants in the PoD initiative (four OC STEM sites and four SDCOE sites) and eight non-PoD sites were located in Orange County, San Diego County, and four adjacent regions (San Bernardino, Riverside, Imperial Counties, and Los Angeles County). The PoD and non-PoD sites were similar in terms of (1) geographic location in southern California; (2) ages of students served; (3) student enrollment at the host schools; (4) program enrollment; (5) ethnicity of student school population; (6) percentage of English Learner (EL) students; and (7) percentage of Free and Reduced Lunch (FRL) eligible students at the host schools. Table 6.1 summarizes the demographic profiles of the PoD and non-PoD sites along these criteria.

Table 6.1. Demographics of Matched PoD and Non-PoD Observation Sites

a. PoD b. Non PoD	Region	Program Provider Type	Grade-span	School Enroll-ment	Program Enroll-ment	% African American	% Asian, Filipino, Pacific Islander	% Hispanic or Latino	% White	% Other*	% EL	% FRL
1a. PoD	9	District	6-8	1,306	90	3%	29%	13%	48%	6%	9%	23%
1b.Comparison	9	District	6-9	680	90	0%	1%	99%	0%	0%	47%	79%
2a. PoD	9	CBO	K-6	392	80	3%	2%	94%	2%	0%	63%	81%
2b. Comparison	9	District	K-6	416	N/A	1%	0%	97%	1%	0%	58%	81%
3a. PoD	9	City	K-5	663	130	3%	5%	76%	13%	3%	53%	77%
3b. Comparison	10	District	K-6	725	65	13%	3%	56%	25%	3%	11%	71%
4a. PoD	9	CBO	K-7	1,093	226	2%	3%	90%	3%	1%	57%	86%
4b. Comparison	11	CBO	K-12	1,786	60	1%	1%	98%	1%	0%	31%	84%
5a. PoD	9	CBO	K-6	462	100	1%	43%	50%	6%	0%	75%	84%
5b. Comparison	11	CBO	K-5	400	80	40%	0%	59%	1%	0%	33%	84%
6a. PoD	9	CBO	7-8	757	N/A	1%	57%	37%	5%	1%	33%	84%
6b. Comparison	11	CBO	7-8	752	100	1%	60%	38%	1%	1%	29%	78%
7a. PoD	9	District	K-6	637	100	1%	24%	22%	48%	6%	20%	33%
7b. Comparison	11	CBO	K-6	454	80	12%	39%	28%	19%	1%	15%	30%
8a. PoD	9	CBO	6-8	1,094	110	1%	60%	35%	3%	1%	37%	80%
8b. Comparison	11	CBO	6-8	1,057	150	8%	0%	92%	0%	0%	30%	79%

* Multiple/ None Reported/American Indian

Site Visits and Activity Observations

Two observations were conducted at each of the 16 study sites between March and June 2015, for a total of 32 observation visits. Two UC Irvine researchers were present for 30 of these visits when a total of 52 enrichment activities were observed. Two separated activities were observed at 20 site visits and a single activity observation occurred during 12 site visits. The duration of each observed activity ranged from 20 to 60 minutes. In 12 instances, more than one staff led a single observed activity (the range was 1 to 3 staff).

The majority of observed activities were led by staff who had completed a staff survey and STEM Activity Documentation forms as part of the larger Power of Discovery study. Out of the 35 activity leaders observed, 27 were active study participants. Five of the observed staff were outside support personnel and not part of a site's regular afterschool program staff.

Of the 52 observed activities, 40 had STEM-related content and learning goals. The following topics were observed: (1) Health and Nutrition; (2) Earth and Environmental Sciences; (3) Aerodynamics; (4) Chemistry; (5) Physics; (6) Engineering and Construction; (7) Robotics and Coding; (8) Computer Literacy and Keyboarding; (9) Math Games and Puzzles; (10) Scientific Inquiry Methods. Twelve of the observed enrichment activities were categorized as non-STEM activities falling under the following topic areas: Physical Education, Dance and Music, Visual Arts, and Leadership Club. The non-STEM activities did not have explicit STEM-related content or learning goals, although there may have been an implicit integrated STEM aspect within the activity (e.g., keeping score and strategizing a play, following rhythm patterns and counting beats, mixing colors and measuring lines, using technology to search images online, and print for an art project). The types of STEM and Non-STEM activities observed, the different activity names, and number of staff leading each observed activity are listed in Table 6.2 below.

The Promising Practice Rating System (PPRS) was used to rate the quality of the observed activities (Vandell et al., 2005). The PPRS assesses program processes that previous research has shown to be indicators of program quality and that are linked to child social and academic outcomes (Eccles & Gootman, 2002; Pierce, Hamm, & Vandell, 1999; Vandell, Shumow, & Posner, 2005). The PPRS has been found to have good inter-observer reliability (linear-weighted kappas = .63 to .94) and good validity (Mahoney, Parente, & Lord, 2007).

Seven aspects of program quality were rated: (1) Supportive relationships with adults; (2) Supportive relationships with peers; (3) Student engagement in activities; (4) Development of higher level thinking; (5) Skill building (mastery orientation); (6) Materials; (7) Structure. The PPRS uses a 4-point scale to measure exemplars of promising practices and program processes within each of the seven dimensions: (4=highly characteristic, 3=somewhat characteristic, 2=somewhat uncharacteristic, 1=highly uncharacteristic) [see Appendix B for the PPRS Observation Manual]. In addition, narratives were derived from detailed observational notes completed for each activity in addition to the PPRS ratings by each observer and are featured in the five sets of Case Studies presented in Appendix D.

Table 6.2. Activities Observed: Activity Type, Name and Frequency

Types of **STEM** Activities	Frequency of Activity Type	Activity Names [STEM content area]	Frequency of Activity
Health & Nutrition	5	DNA Model [Biology]	1
		Grams of Sugar [Nutrition]	2
		Lego Memory Challenge [Biology]	1
		Zombie Apocalypse [Biology]	1
Earth & Environmental Sciences	2	Eco Center [Earth and Animal Ecology]	1
Aerodynamics	4	Air Rockets and Air Resistance	2
		Parachutes	1
		Straw Rockets	1
Chemistry	5	Bubble Wand	1
		Density: Marshmallow Challenge	1
		Kinetic Sand	2
		Silly Putty	1
Physics	6	Crayon Physics [Computer-based game]	1
		Egg Drop	2
		Robo Wheels: Kinetic Potential	1
		Sound Activity: Water Whistle	1
		Zip-Line Challenge	1
Engineering & Construction	6	Car Building Challenge	1
		Spaghetti Tower	1
		Tallest and Strongest Tower	4
Robotics & Coding	4	Robotics	4
Computer Literacy & Keyboarding	4	Games on iPads	2
		Keyboarding Practice with Online Game	1
		Learning how to create a PowerPoint	1
Math Games and Puzzles	4	Math Flash Cards	1
		Math Memory Game	2
		Math Workbooks	1
Scientific Inquiry Methods	1	Forensic Science	1
	Totals:	**28** *different STEM activities*	**40**
Types of **Non-STEM** Activities			
P.E., Dance, and Music	8	Basketball Practice Drills	2
		Dance	2
		Drumming Practice	2
		Volleyball Practice	2
Visual Arts and Crafts	3	Identity Boards [Fashion Club]	1
		Visual Art Studio	2
Leadership Activity	1	Spirit Week Planning [Leadership Club]	1
	Totals:	**7** *different Non-STEM activities*	**12**

Calibration of Observers

A total of five observers were trained and certified to use the Promising Practice Rating System (PPRS). Each observer was provided with a PPRS manual, which they reviewed and discussed with a certified trainer. Observation trainees viewed video exemplars of the seven PPRS dimensions and discussed them with the trainer. Then, observation trainees individually viewed at least three pre-rated online videos of an afterschool activity. For each video, trainees were required to take detailed notes, rate each activity on the seven PPRS dimensions, and provide written justifications for each of their ratings. These ratings were compared to an established mean rating for each dimension for that activity. Trainees met with a trainer to review ratings and discuss their justifications. The goal was for each trainee to achieve 60% exact alignment with the mean rating for each PPRS dimension and 80% or more within one standard deviation from the mean. Next, all trainees carried out at least two practice observations at an afterschool site with a trainer. Immediately after completing the live observation ratings, trainees discussed their ratings and rationale with each other and the trainer. Once all observer ratings at the live observations were in alignment, the trainees were considered calibrated and ready to conduct activity observations at study sites.

Activity Observations

During each site visit, observers took detailed field notes about instructional practices and students' learning experiences, and rated program processes using the PPRS rubric (see Appendix B for sample of PoD Study PPRS Ratings Sheet). In addition to recording basic descriptive data about the site, the number of program staff leading the activity, the duration and type of activity observed, the observer pairs provided independent ratings of each activity observation and consensus ratings were obtained when needed. Two observers simultaneously observed and rated each activity on the PPRS dimensions, resulting in three sets of ratings on each dimension for each activity observation: i.e., a rating for each construct given by observer A, observer B, and a consensus rating (resulting from agreement between both observers when a difference in their rating occurred). Each consensus rating was coded based on three to four indicators for high and low ratings as outlined in the PPRS coding rubric.

C. Analysis of PPRS Ratings of Activity Observations

Activities observed at PoD and non-PoD sites are listed below in Table 6.3 and Table 6.4. Activities are listed by name of activity, grade level of students, and the PPRS mean score (from highest to lowest). Of the 52 activities observed, 40 were STEM related (22 at PoD; 18 at non-PoD sites). Twelve learning enrichment activities that were not directly STEM-related were observed only at non-PoD sites. Twenty-three of the 52 observed activities received a high mean score of 3.4 and above, 15 (8 PoD; 7 non-PoD) of these high quality activities were STEM-related addressing different areas of science, technology, engineering and mathematics. Another 19 sites (8 PoD; 10 non-PoD) received a mean score ranging from 2.86 to 3.29, and 10 activities (4 PoD; 6 non-PoD) scored low on the PPRS ratings scale with means of 1.71 to 2.71.

Table 6.3. Activities Observed at PoD sites, Grade Level, Number of Staff, and Mean Score

Activity Name	Grade Level	# of Staff	PPRS Mean
Car Building Challenge	Elementary	1	3.71
Air Rockets [Aerodynamics]	Elementary	2	3.71
Parachutes	Elementary	1	3.71
Air Resistance	Elementary	2	3.71
Robo Wheels: Kinetic Potential	Middle	2	3.57
DNA Model [Biology]	Elementary	1	3.57
Spaghetti Tower [Engineering]	Elementary	2	3.57
Tallest Tower [Engineering]	Intermediate	2	3.57
Lego Memory Challenge	Elementary	1	3.57
Silly Putty [Chemistry]	Elementary	1	3.43
Egg Drop	Intermediate	2	3.29
Forensic Science	Elementary	1	3.29
Zip-Line Challenge	Elementary	2	3.29
Sound Activity: Water Whistle	Middle	2	3.14
Tallest Tower [Engineering]	Elementary	2	3.14
Tower Challenge: Day 1	Warner Middle	1	3.00
Straw Rockets [Aerodynamics]	Elementary	1	2.86
Egg Drop	Intermediate	2	2.86
Zombie Apocalypse: the Brain [Biology]	Middle	2	2.00
Bubble Wand	Elementary	2	2.00
Tower Challenge: Day 2	Middle	1	2.00
Density: Marshmallow Challenge	Elementary	2	1.71
22 Activities	15 Elementary 7 Inter./Middle	1 to 2 Staff	3.12

Table 6.4 Activities Observed at Non-Pod Sites, Grade Level, Number of Staff, and Mean Score

Activity Name	Grade Level	# of Staff	PPRS Mean
Crayon Physics [Computer-based game]	Elementary	1	4
Robotics	Intermediate	1	4
Robotics	Intermediate	1	4
Keyboarding Practice w/ Online Game	Elementary	1	3.71
Dance, Latino and Hip Hop	Elementary	1	3.71
Dance, Hip Hop	Elementary	1	3.71
Drumming Practice	Intermediate	1	3.71
Math Workbooks	Elementary	1	3.57
Math Flash Cards	Elementary	1	3.57
Visual Art Studio	Middle	1	3.57
Robotics	Middle	1	3.57
Basketball Practice Drills [P.E.]	Intermediate	1	3.57
Visual Art Studio	Middle	1	3.43
Volleyball Practice	Intermediate	1	3.29
Volleyball Practice	Intermediate	1	3.29
Kinetic Sand	Elementary	2	3.29
Kinetic Sand	Elementary	2	3.29
Robotics	Middle	1	3.14
PowerPoint [Computer Literacy]	Elementary	1	3.14
Math Memory Game	Elementary	1	3
Identity Boards [Fashion Club]	Elementary	1	3
Drumming Practice	Intermediate	1	3
Spirit Week Planning [Leadership Club]	Elementary	1	2.86
Basketball Practice Drills [P.E.]	Intermediate	1	2.86
Games on iPads	Elementary	1	2.71
Eco Center [Earth & Animal Ecology]	Elementary	1	2.57
Grams of Sugar [Nutrition Science]	Elementary	3	2.57
Grams of Sugar [Nutrition Science]	Elementary	3	2.57
Math Memory Game	Elementary	1	2.29
Games on iPads	Elementary	1	2
30 activities	17 Elementary 11 Inter./Middle	1-3 staff	3.23

Across all activity observations, the PPRS dimensions with the highest overall mean scores were *Supportive Relationships with Adults* (3.44), *Supportive Relationships with Peers* (3.52), *Engagement* (3.54) and *Materials* (3.56). Given the strong emphasis on Youth Development in California's ASES and 21st CCLC programs it is not surprising to find positive relationships with adults and peers highly rated across all study sites (both PoD and non-PoD).

The lowest mean ratings were obtained for the areas of *Higher Level Thinking* (2.44) and *Skill Building (Mastery Orientation)* (2.79) across all study sites. For the dimension of Higher Level Thinking the PoD sites (where only STEM activities were observed) had a higher mean rating (M = 2.82, N =22) compared to the mean of STEM activities observed at non-PoD sites (M = 2.33, N = 30).

Table 6.5a and 6.5b shows the mean ratings for each PPRS construct for all 40 observed STEM activities at PoD and non-PoD sites, respectively.

Table 6.5a. Mean PPRS Ratings of **STEM Activities** Observed at **PoD** Sites

PPRS Construct	N	M	SD	Range
Supportive Relationships with Adults	22	3.36	0.79	2-4
Supportive Relationships with Peers	22	3.14	0.77	1-4
Engagement	22	3.55	0.80	2-4
Higher Level Thinking	22	2.82	0.73	1-4
Skill Building (Mastery Orientation)	22	2.68	0.65	1-4
Materials	22	3.5	0.86	1-4
Structure	22	2.82	1.05	1-4
Overall Program Quality (alpha = .89)	22	3.12	0.81	1-4

Table 6.5b. Mean PPRS Ratings of **STEM Activities** Observed at **Non-PoD** Sites

PPRS Construct	N	M	SD	Range
Supportive Relationships with Adults	18	3.33	0.68	1-4
Supportive Relationships with Peers	18	3.78	0.48	2-4
Engagement	18	3.56	0.57	2-4
Higher Level Thinking	18	2.33	0.83	1-4
Skill Building (Mastery Orientation)	18	2.67	1.01	1-4
Materials	18	3.56	0.50	3-4
Structure	18	2.94	0.87	1-4
Overall Program Quality (alpha = .83)	18	3.17	0.71	1-4

The observed activities receiving the highest ratings (3.5 and above) across all PPRS constructs were those that involved a mostly student driven hands-on project that challenged students to work collaboratively to create a model to test specific STEM concepts and principles and engage in group problem solving and reflection with supportive adult facilitation. These activities were well structured and organized around materials that were age appropriate and matched the activity learning goals, resulting in high levels of student engagement.

Across activities observed at PoD and non-PoD sites, the most consistently highly rated practices were within the domains of Positive Relationships with Adult Staff and Positive Relationships with Peers as well as high levels of Student Engagement. This may reflect the focused professional development efforts in Youth Development principles that have occurred over the past two decades within California's publically funded ASES and 21st CCLC afterschool programs with professional development, technical assistance and resources from intermediaries such as the California Youth Development Network (CAN), California School-Age Consortium (CalSAC), the Center for Collaborative Solutions (CSS) among others.

Materials and *Structure* also were generally good. Only three sites received lower than a 3 rating for *Materials* (33 sites received a 4 and 16 sites a 3 rating). For the most part, programs used age appropriate materials that were accessible and aligned with the learning goals of the activity and interesting to students.

Lower ratings were obtained for the dimensions of *Higher Level Thinking* and *Skill Development (Mastery Orientation)*, both areas identified by research as fundamental aspects of quality STEM learning in expanded learning contexts. Within the PPRS, these dimensions directly relate to the quality of STEM learning taking place. *Higher Level Thinking* considers the extent to which staff facilitated scientific inquiry practices, asking "why, how and what if" questions and held students to the expectation that they explain their reasoning behind their answers and choices they made in a project. Staff listened to students, took their input seriously and probed for deeper critical thinking. Opportunities for problem solving and reflection were part of hands on interactive project based activities that were rated highly in this dimension. Activities receiving high ratings in *Skill Development* [3 or 4 on the PPRS scale] were those in which students were challenged to create a project that required them to exercise their intellectual and creative capacities with the facilitation of staff that encouraged mastery through modeling, explanatory and coaching processes that served to scaffold student skill development.

Opportunities for students to engage in higher level thinking were not characteristic of more than half of the activities observed, with 29 activities receiving a rating of 2 or 1 in this dimension. Only six of the 52 observed activities received a 4 rating, and the remaining 17 sites received a 3 rating in *Higher Level Thinking*. Skill development opportunities were more frequently observed: 23 activities received a 3 rating and 11 activities a 4 rating. Still, one third of the activities were rated a 2 or 1 (n=18) in this important area for STEM learning.

In summary, the PPRS scores obtained across the 52 activity observations point to the need for further PD in inquiry based activity facilitation, and suggest that more challenging and sequentially structured curricula, that work towards building mastery, be incorporated by programs seeking to promote STEM-related knowledge and skill development in students.

SECTION IV.
SUMMARY OF FINDINGS AND IMPLICATIONS FOR PRACTICE

The 2015 evaluation of the Power of Discovery Initiative used a multi-method, multi-measure, multi-respondent approach to examine the relations between STEM professional development, staff beliefs and competencies, program activities and quality, and student outcomes. Six specific aims guided the 2015 evaluation, and the findings for each respective aim are summarized below followed by a discussion of implications of study findings for future practice.

SUMMARY OF FINDINGS

Aim 1—Afterschool Workforce Characteristics

The analyses of staff characteristics indicated that the program staff at the PoD and non-PoD sites were quite similar. Staffs in both sites were predominantly female and relatively young. They had similar prior work experience and did not differ in how long they had been working at their current position. Approximately one-third of the staff reported working in their current positions for less than a year, indicating that the sites experienced substantial staff turnover.

Aim 2—Professional Development (PD) Findings

Some notable differences were found in the STEM professional development provided at the PoD and non-PoD sites. Staff at PoD sites reported meeting with other staff to discuss STEM programming. They also reported more PD activities that focused on STEM content and the Common Core State Standards whereas PD at non-PoD sites was more likely to focus on Social Science and Visual and Performing Arts. PD at PoD sites was more likely to be offered by staff in the organization and by the Regional Leads.

Aim 3—Program Quality Findings

In analyses of the 3,140 activity documentation forms submitted by staff at PoD and non-PoD sites, we found that approximately half of the reported activities involved groups of 11 and 20 students. Staff at PoD sites most frequently led activities for students in elementary grades, whereas staff at non-PoD sites most frequently led activities for students in middle and high school grades. Of the reported activities, 2,948 focused on one or more of the STEM content areas. Staff at PoD sites more frequently led activities focusing on science or engineering, whereas staff at non-PoD sites more frequently led activities focusing on math or technology. Lastly, staff at non-PoD sites more often reported that the STEM activities were "too challenging" for their students than staff at PoD sites.

Aim 4 —Contrasts of More Mature and Less Mature PoD Sites

In this three-year initiative, some PoD sites had participated for more than two years (called more mature sites), whereas other sites had participated for two years or less (called less mature sites). Staff at more mature sites reported attending more PDs that involved onsite coaching and focus on the Common Core State Standards, Visual and Performing Arts, and English Language

Arts and Literacy compared to staff at less mature sites. Staff at more mature sites also reported attending PDs of longer durations (one hour or more). This PD was more likely to topics such as accessing STEM resources, alignment and linkages with the school day, and developing positive behavior support, as compared with reports of PDs attended by staff at less mature sites. Staff at less mature sites reported attending PDs that were between one and 14 minutes long (the shortest possible PD reported).

Aim 5—Linking Professional Development to Student Outcomes

Structural equation modeling was used to test the Logic Model guiding the Power of Discovery Initiative. Significant support was found for the overall Power of Discovery Logic Model. In an analysis of the 2015 program, we determined that the frequency of staff meetings to discuss STEM programming predicted staff beliefs about the importance of STEM learning and perceived efficacy for implementing STEM activities. Staff beliefs about STEM then significantly predicted student reports of program quality. Links were then identified between quality of program experiences and student outcomes. In particular, program quality predicted student reports of higher work habits, reading efficacy, and less misconduct.

We then asked if similar results were obtained in 2013-14. In 2013-14, the overall Power of Discovery Logic Model also was statistically significant, thus replicating the 2015 findings. And, similar to 2015, the site-level path from staff beliefs to program quality was significant as were the individual-student paths from program quality to student outcomes of work habits, math efficacy, science interest, science career aspirations, reduced misconduct. A strength of the 2013-14 model was that we also were able to control for baseline scores for student beliefs and behaviors.

Aim 6—Program Strengths and Areas for Improvement

The two-day observations of 16 sites revealed areas of program strengths and areas for improvement. Strengths were observed in relation to *Positive Relationships with Adult Staff* and *Positive Relationships with Peers.* High levels of *Engagement* also were found, indicating a general level of quality across observed program sites. Specific areas for improvement were in the dimensions most directly related to the quality of STEM learning taking place: *Higher Level Thinking* and *Skill Building/Mastery Orientation*. It should be noted that the PoD sites received higher ratings for *Higher Level Thinking* ($M = 2.8$) compared to the ratings of at non-PoD sites ($M = 2.3$).

IMPLICATIONS FOR PRACTICE

Several themes were found in the 2015 and 2013-14 evaluations. These themes are discussed below and are linked to other research-based recommendations for improving afterschool programs and supporting student outcomes, particularly in the STEM domains.

A first theme, consistent with other reports, is that the afterschool workforce differs from k-12 classroom teachers in important ways. In both 2013-14 and 2015, the PoD (and non-PoD) program staff were younger and had different educational backgrounds than classroom teachers. A substantial majority of the program staff charged with leading STEM activities had less than a four-year college degree. In contrast, classroom teachers must hold a four-year college degree at a minimum, and more than half have a master's degree (U.S. Department of Education, 2010).

Even though the afterschool staff have less academic background, they are expected to assume substantial responsibilities for leading STEM activities as well as other academic activities (Vandell & Lao, 2015), Given these expectations, there is a serious need for the afterschool field to provide high-quality pedagogical training to increase staff capacity to provide rich learning experiences to support students' interests and skills in the STEM area. This recommendation is in line with other research and policy recommendations to increase training, and development (Little, 2004). Professional development for afterschool staff in the STEM domain is critically needed (Bell et al., 2009; NRC, 2015). The PoD initiative represents a valuable effort towards remedying this.

A second theme, reflected in the 2013-14 and 2015 evaluations is the short job tenure of many afterschool line staff. Approximately one in three staff reported being at their respective sites for less than a year—a finding that serves as an indicator that sites participating in the study suffer from high staff turnover. High rates of turnover increase the challenge of professional development because programs need to provide training to support the needs of novice staff members as well as more experienced staff. Professional development needs to recognize and take into account differences in staff competencies and interests.

Programs, and the field in general, should also consider strategies to address staff retention. By offering financial incentives for staff to stay or return to their program sites may reduce staff turnover. Professional development, such as the sort by the *Power of Discovery* that enables staff to feel more confident and competent may also support staff retention over time, an area worthy of systematic examination.

Testing the Power of Discovery Logic Model using data collected from both the 2013-14 and 2015 academic years yielded noteworthy findings. The overall model linking staff professional development to staff beliefs, program quality, and student outcomes was found to be a good fit for the data. In both years, we found staff beliefs about STEM learning significantly predicted student reports of the quality of their program experiences, which then predicted students' work habits, reading efficacy, and less misconduct. In 2015, we also found a STEM professional development (in particular, regular staff meetings to discuss STEM programming) to be a significant factor in predicting staff beliefs and competencies in the STEM domain. These findings provide evidence to support cultivating these practices—perhaps by forming communities of practice and learning for OST staff. Professional development opportunities in the future can maintain a stronger focus on connecting OST staff with one another.

REFERENCES

Afterschool Alliance. (2013). *Defining Youth Outcomes for STEM Learning in Afterschool.* Retrieved from http://www.afterschoolalliance.org/ STEM_Outcomes_2013.pdf

Afterschool Alliance. (2014). *America After 3 PM: Top 10 States For Afterschool*. Retrieved from http://www.afterschoolalliance.org/documents/AA3PM-2014/AA3PM_TOP_10.pdf

Auger, A., Pierce, K. M. and Vandell, D. L. (April, 2013). Participation in Out-of-School Settings and Student Academic and Behavioral Outcomes. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Baker, J. Grant, s., & Morlock, L. (2008). The teacher–student relationship as a developmental context for children with internalizing or externalizing behavior problems. School Psychology Quarterly, 23(1), 3-15.

Ballard, M. (2014). Participation in out-of-school time science and later interest in STEM careers: An ISE research brief discussing Dabney et al., "Out-of-school time science activities and their association with career interest in STEM." Retrieved from http://relatingresearchtopractice.org/article/342

Beckett, M., Borman, G., Capizzano, J., Parsley, D., Ross, S., Schirm, A., & Taylor, J. (2009). *Structuring out-of-school time to improve academic achievement: A practice guide* (NCEE #2009-012). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Retrieved from http://ies.ed.gov/ncee/wwc/ publications/practiceguides.

Bevan, B., & Michalchik, V. (2013). Where It Gets Interesting: Competing Models of STEM Learning after School. *Afterschool Matters*, *17*, 1-8.

Bell, P., Lewenstein, B., Shouse, A.W., & Feder, M.A. (2009). Learning science in informal environments: People, places, and pursuits. Washington, DC: The National Academies Press.

Brown, B. B., Clasen, D. R., & Eicher, S. A. (1986). Perceptions of peer pressure, peer conformity, dispositions, and self-reported behavior among adolescents. *Developmental Psychology*, *22*, 521-530.

Bouffard, S., & Little, P. (2004). Promoting Quality through Professional Development: A Framework for Evaluation. Issues and Opportunities in Out-of-School Time Evaluation. Number 8. *Harvard University Harvard Family Research Project*.

California Academy of Sciences (2015). *Science Action Club Evaluation Findings Report.* Retrieved from http://publicprofit.net/Publications/AllPublications/.

Chun, K., & Harris, E. (2011). STEM Out-of-School Time Programs for Girls. Highlights from the Out-of-School Time Database. Research Update, No. 5. *Harvard Family Research Project*.

Costley, J. (1998). *Building a professional development system that works for the field of out-of-school time.* Wellesley, MA: National Institute on Out-of-School Time, Center for Research on Women, Wellesley College.

Dabney, K. P., Tai, R. H., Almarode, J. T., Miller-Friedmann, J. L., Sonnert, G., Sadler, P. M., & Hazari, Z. (2012). Out-of-school time science activities and their association with career interest in STEM. *International Journal of Science Education, Part B, 2*(1), 63-79.

Davis, J. (2015). *State of the State of Expanded Learning in California, 2014-2015.* California Afterschool Network. Retrieved from: http://www.afterschoolnetwork.org/post/newly-released-state-state-expanded-learning-ca-2014-2015.

Donner, J., & Wang, Y. (2013). Shifting Expectations: Bringing STEM to Scale through Expanded Learning Systems. *Afterschool Matters*, *17*, 50-57.

Durlak, J. A., & Weissberg, R. P. (2011). Afterschool programs that follow evidence-based practices to promote social and emotional development are effective. *Expanding and Opportunities,* 24.

Eccles, J. and Gootman, J.A. (Eds.) (2002). Community Programs to Promote Youth Development. Washington, DC: National Academies Press.

Eccles, J., Wigfield, A., Harold, R. D., & Blumenfeld, P. (1993). Age and gender differences in children's self- and task perceptions during elementary school. *Child Development, 64,* 830-847.

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology*, *53*(1), 109-132.

Groome, M., & Rodríguez, L. M. (2014). How to Build a Robot: Collaborating to Strengthen STEM Programming in a Citywide System. *Afterschool Matters*, *19*, 1-9.

Huang, D., & Dietel, R. (2011). *Making after-school programs better* (Policy Brief No. 11). Los Angeles, CA: University of California, Los Angeles, National Center for Research on Evaluation, Standards, and Student Testing.

Huerta Migus, L. (2015). *Broadening Access to STEM Learning through Out-of-SchoolLearning Environments*. Paper commissioned by the Committee on Successful Out-of-School STEM Learning, National Research Council. Retrieved from http://sites.nationalacademies.org/cs/groups/dbassesite/documents/webpage/dbasse_089995.pdf

Jacobs, J. E., Lanza, S., Osgood, D. W., Eccles, J. S., & Wigfield, A. (2002). Changes in children's self-competence and values: Gender and domain differences across grades one through twelve. *Child Development*, *73,* 509-527.

Krishnamurthi, A., Ballard, M., & Noam, G. G. (2014). Examining the Impact of Afterschool STEM Programs. *Afterschool Alliance*. Retrieved from: http://www.afterschoolalliance.org/STEMresearch.cfm

Krishnamurthi A., Ottinger R., Topol, T. (2013). STEM Learning Afterschool and Summer Programming: An essential Strategy for STEM Education Reform. Peterson, T. K. (Ed.) *Expanding Minds and Opportunities: Leveraging the power of afterschool and summer learning for student success.* Washington, DC: Collaborative Communications Group.

Lauver, S. C., & Little, P. (2005). Recruitment and retention strategies for out-of-school-time programs. *New Directions for Youth Development*, *2005*(105), 71-89.

Little, P. M. D. (2004). A recipe for quality out-of-school time programs. *The Evaluation Exchange, 10*(1), 18–19.

Lyon, G. H., Jafri, J., & St Louis, K. (2012). Beyond the Pipeline: STEM Pathways for Youth Development. *Afterschool Matters*, *16*, 48-57.

Lyon, G. (2013). State of STEM in Out-of-School Time in Chicago. Retrieved from http://www.projectexploration.org/wp-content/uploads/2015/02/stemost report_fnl_0606131.pdf

Mahoney, J. L., Parente, M. E., & Lord, H. (2007). After-school program engagement: Developmental consequences and links to program quality and content. *The Elementary School Journal, 107*, 385-404.

Muris, P. (2001). A brief questionnaire for measuring self-efficacy in youths. *Journal of Psychopathology and Behavioral Assessment, 23,* 145-149.

Nakamura, J., & Csikszentmihalyi, M. (2002). The concept of flow. *Handbook of Positive Psychology*, 89-105.

National Research Council. (2011*). Successful K-12 STEM Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics*. Committee on Highly Successful Science Programs for K-12 Science Education. Washington, DC: The National Academies Press.

National Research Council. (2015). *Identifying and Supporting Productive Programs in Out-of-School Settings.* Committee on Successful Out-of-School STEM Learning, Board on Science Education, Division of Behavioral and Social Science and Education. Washington, DC: The National Academies Press.

Noam, G. and Sneider, C. (et. al.), (2010). Common Goals, Common Assessments: Evaluation Guidelines for Youth Programs. Unpublished manuscript, Program in Education, Afterschool and Resilience (PEAR). Harvard University.

O'Connor, E. E., Dearing, E., & Collins, B. A. (2011). Teacher-child relationship and behavior problem trajectories in elementary school. American Educational Research Journal, 48(1), 120-162.

Partnership for Afterschool Education. (1999). *Developing the afterschool professional and the profession: Addressing quality and scale.* New York: Author.

Pierce, K. M., Hamm, J. V., & Vandell, D. L. (1999). Experiences in after-school programs and children's adjustment in first-grade class classrooms. *Child Development, 70*, 756-767.

Posner, J. K., & Vandell, D. L. (1994). Low-income children's after-school care: Are there beneficial effects of after-school programs? *Child Development, 65,* 440-456.

Rosenthal, R., & Vandell, D. L. (1996). Quality of care at school-aged child-care programs: Regulatable features, observed experiences, child perspectives, and parent perspectives. *Child Development, 67*, 2434–2445.

Smith, C. & Hoxie, A. M. (2010). *Evaluation Findings from the Frontiers in Urban Science Exploration (FUSE)*. Retrieved from http://www.iowaafterschoolalliance.org/documents/resources/33.pd.

Tai, R. H., Liu, C. Q., Maltese, A. V., & Fan, X. (2006). Planning early for careers in science. Science, 312, 1143–1144. doi:10.1126/science.1128690

Tyler-Wood, T., Knezek, G., & Christensen. R. (2010). Instruments for assessing interest in STEM content and careers**.** *Journal of Technology and Teacher Education, 18*(2), 341-363.

Vandell, D. L., Reisner, E. R., Brown, B. B., Dadisman, K., Pierce, K. M., Lee, D., & Pechman, E. M. (2005, March). *The Study of Promising After-School Programs: Examination of intermediate outcomes in year 2*. Report to the Charles Stewart Mott Foundation.

Vandell, D. L., Shumow, L., & Posner, J. (2005). After-school programs for low-income children: Differences in program quality. In J. L. Mahoney, R. W. Larson, & J. S. Eccles (Eds.), Organized activities as contexts of development: Extracurricular activities, after school and community programs (pp. 437-456). Mahwah, NJ: Erlbaum.

Vandell, D. L., Warschauer, M., O'Cadiz, P., & Hall, V. (2008). A *two year evaluation study of the Tiger Woods Learning Center*. Report to the Tiger Woods Foundation.

U.S. Department of Education, National Center for Education Statistics. (2010). *Teacher Attrition and Mobility: Results from the 2008–09 Teacher Follow-up Survey* (NCES 2010-353).

Walker, K. E., & Arbreton, A.J.A. (2004). After school pursuits: An examination of outcomes in the San Francisco Beacon Initiative. San Francisco: Public/Private Ventures. Available at www.ppv.org/ppv/publications/assets/168_publication.pdf.

Yin, R. K. (2003). Case study research: Design and methods (3rd ed.). Thousand Oaks, CA: Sage.