The Connection between Afterschool Programs and In-School Success: The Science Mentoring Project

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Executive Summary

This study investigated the ways in which the Science Mentoring Project, an afterschool program with a youth development focus and mentoring component, helped fifth-grade participants develop key competencies in five areas: personal, social, cognitive, creative, and civic competencies. Development of these competencies, in turn, positively affected participants' school experiences. Using program observations, teacher interviews, student surveys, a student focus group, and mentor feedback forms, researchers studied *how*—not just *whether*—the project's youth development activities affected school performance. The study's evidence suggests that developing the key competencies affected three areas of participants' school experiences: engagement and motivation, including increased interest in possible science careers; constructive behaviors, including positive risk-taking; and academic skills and knowledge, including increased awareness of environmental issues and vocabulary. The role models provided by high school mentors also helped build a critical foundation for student success. The findings of this study suggest the importance of including a youth development focus in afterschool programs.

Evidence of the positive impact of afterschool programs on academic achievement has been accumulating over the last decade. Recent examples include the following:

- A longitudinal study showed that higher levels of participation in Los Angeles's BEST afterschool programs was associated with higher school attendance and higher achievement on math, reading, and language arts standardized tests (Huang, Gribbons, Kim, Lee, & Baker, 2000).
- McREL's meta-analysis of 56 studies that used comparison or control groups found that afterschool and summer programs had a small but statistically significant positive impact on reading and mathematics achievement (Lauer et al., 2004).
- Policy Study Associates' evaluation of The After School Corporation (TASC) afterschool programs found that participants showed significantly greater gains in math standardized tests, as well as better school attendance, than similar nonparticipating classmates (Policy Studies Associates, 2002).
- Mathematica's first-year study of the 21st Century Community Learning Centers, though it did not show improvement in academic achievement for students overall, showed positive results for several subgroups of students (Dynarski et al., 2002). Specifically, African-American and Latino participants showed statistically significant academic gains and a decrease in absences. African-American students also showed increased effort in class. Girls demonstrated significant gains in mathematics achievement and in class participation.

These and numerous other studies have not, however, examined exactly *how* afterschool programs affect student achievement. Further, there has been much debate about *what types* of afterschool programs can effect positive change in student outcomes, including academic outcomes (Roth, Brooks-Gunn, Murray, & Foster, 1998.) While afterschool educators generally agree that afterschool programs should not provide "more of the same" type of instruction that students receive in school, the field has not yet determined what types of programs have positive impact or what program characteristics are essential to produce academic outcomes.

In their review of research on community-based programs, Eccles and Gootman identified characteristics of afterschool programs that are critical to promoting positive outcomes for youth (National Research Council and Institute of Medicine, 2002). They found that program characteristics linked to promoting positive development and outcomes include opportunities for youth to:

- Experience supportive relationships and receive emotional and moral support
- Feel a sense of belonging
- Be exposed to positive morals, values, and social norms
- Be efficacious, do things that make a real difference, and play an active role in the program
- Develop academic and social skills, including learning how to form close peer relationships that support and reinforce healthy behaviors
- Acquire the skills necessary for school success and a successful transition to adulthood (National Research Council and Institute of Medicine, 2002)

Other researchers have found that afterschool programs that promote youth development can help foster nonacademic competencies that are critical to academic competence and therefore promote school success (Hall, Yohalem, Toman, & Wilson, 2003; Miller, 2003; Noam, Biancarosa, & Dechausay, 2002). For example, in a review of research and evaluation of afterschool programs, Beth Miller (2003) found that afterschool programs can play a key role in engaging youth in learning by providing opportunities to explore interests, gain competence in real-world skills, solve problems, assume leadership roles, develop a group identity with similarly engaged peers, connect to adult role models and mentors, and become involved in improving their communities. Miller argues that such opportunities allow youth to build "prerequisites" to learning, which support both academic achievement and long-term competence and success. In brief, she proposes a theory of change in which effective afterschool programs result in participant outcomes, including positive peer-group membership, relationships with caring adults and role models, practice of new skills, acquisition of new knowledge, and increased sense of academic self-confidence. These outcomes in turn lead to increased school engagement—better motivation, attendance rates, work habits, and cognitive skills—and increased school achievement (Miller, 2003).

> This study investigated an area of youth development and afterschool programming about which there is a dearth of understanding: It focused not just on *whether* but on *how* the program's development of youth competencies affected students' school success.

Lastly, research by the Search Institute on developmental assets—positive factors in young people, families, communities, schools, and other settings that promote healthy development—shows that these factors have as much or more impact on student achievement than other demographic factors such as racial or ethnic background or income status (Scales & Roehlkepartain, 2003).

The Academy for Educational Development (AED) conducted a study of the Science Mentoring Project, in which fifth-grade participants in a local afterschool program experienced hands-on science learning with the help of high school mentors, to investigate the ways in which the development of youth competencies can affect school success. This study investigated an area of youth development and afterschool programming about which there is a dearth of understanding: It focused not just on *whether* but on *how* the program's development of youth competencies affected students' school success. Understanding *how* competencies affect school achievement can not only allow researchers to develop better instruments and methodologies to measure such impact but also provide information to improve program design and delivery.

RESEARCH DESIGN

AED studied the Science Mentoring Project in 2004. In order to examine how development of youth competencies affects school success, we framed the following research questions:

- What specific youth competencies does the Science Mentoring Project address?
- How does Science Mentoring Project develop these competencies?
- In what ways do these youth competencies reveal themselves in academic settings and affect academic success?

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Research Context: The Science Mentoring Project

The Science Mentoring Project is a unique collaboration among Educational Equity Concepts (EEC), the New York City River Project, and the afterschool program at a public elementary school on Manhattan's Lower East Side. The project, which incorporates many youth development principles, combines EEC's After-school Science PLUS (AS+) curriculum with the River Project's field experience. Working with high school role models, fifth-graders in the school's afterschool program participate in hands-on urban ecology projects using the rich resources of the Hudson River.

Program Design

The daily afterschool program uses EEC's AS+ curriculum every week. AS+ is a hands-on, literacy-based science curriculum that emphasizes gender equity and career awareness. Activities focus on developing higher-order thinking skills such as decision making, problem solving, and creative thinking; on introducing students to diverse role models in science; and on helping students explore science careers. Each activity also includes a component called The Literacy Connection, which strengthens students' reading, writing, speaking, and listening skills. Ongoing evaluation has demonstrated the success of the AS+ curriculum, showing that students learned to experiment and think in new ways, using teamwork and cooperative learning skills as they participated in AS+ activities (AED, 2003). They also sharpened their literacy skills by documenting their AS+ experiences in science journals and writing original and creative stories.

These activities, which are implemented at the afterschool program throughout the year, served as the groundwork for students' participation in ongoing hands-on environmental science activities at the River Project, a marine biology field station at Pier 26 in Manhattan. From March 2004 to June 2004, students spent six two-hour sessions at the River Project working with scientists and with a diverse group of high school-aged mentors who were accomplished in science. Topics covered during the six sessions included water quality, oyster restoration, video microscopy, plankton ecology, and fish ecology and population. Students worked collaboratively in small groups to collect data and to record observations and reflections during each session. For example, students collected data on the water quality of the Hudson River Estuary. They also collected data for the River Project Oyster Restoration Project and performed a plankton tow to gather specimens, some of which were added to the River Project collections.

Using the data collected at the field station, pairs of students constructed a "report board" that included the raw data as well as graphs plotting change in water quality over time, oyster growth patterns, types of species in the Hudson River, and salinity of the samples in relation to tides in the estuary. The students presented their boards to their peers and mentors at the River Project; the boards were also posted at a school fair viewed by teachers, administrators, parents, and community members.

Through the hands-on afterschool activities, the site-based research activities, the emphasis on collaborative group work, and the mentoring component, the Science Mentoring Project aimed to develop specific youth competencies in several areas:

- Personal competencies including the ability to work with others
- Social competencies including respect for others and for diversity
- Cognitive competencies including critical and higher-order thinking
- Creative competencies including original thinking and the ability to express oneself orally and in writing
- Civic competencies including an orientation to community service and the ability to advocate for the interests of oneself, someone else, or the community

Participants

The River Project recruited 13 high school students from three New York City public high schools to serve as mentors. Two of the high schools had a science focus and one was a comprehensive high school. Most mentors had an interest in pursuing careers or post-secondary studies in science. A few mentors did not have science-related aspirations, but were interested in teaching and working with youth. Mentors participated in three days of training prior to working with the students. EEC staff conducted two days of training focused on the AS+ science curriculum and on equity issues such as encouraging equal participation by girls and boys and avoiding stereotypes. Hudson River Project staff conducted the third day of training, which focused on the specific activities and experiments used during the project. Each high school mentor worked with two fifth-graders.

Participation in the Science Mentoring Project was open to all fifth-graders in the afterschool program who expressed an interest; teachers were also asked to recommend students. Twenty fifth-graders—13 girls and 7 boys—were recruited in October 2003. Most of the students were Latino, three were Asian/Pacific Islander, and three were African American. All of the participants lived in low-income neighborhoods in New York City; they reflected the overall demographics of their Lower East Side school. About half the school's students in 2002–2003 were English language learners, approximately one-tenth were recent immigrants, and almost all (over 99 percent) were eligible for free lunch. Just over half the students, 55 percent, at this school met the standards in English language arts, and 62 percent met the standards in mathematics (New York City Department of Education, 2003).

Research Methods

We used several research methods to explore the relationship between the Science Mentoring Project and students' academic success. Through case studies, we took an in-depth look at the competencies six students developed in the program. These six students, two boys and four girls, were those who had the same teacher for both the school day and the afterschool program, were enrolled in school the entire year, completed the student surveys described below, and returned active consent forms signed by their parents. The fact that these students had the same classroom and afterschool teacher was beneficial in that it helped us identify competencies that transferred from the afterschool to the school setting, though this staff overlap was not part of the project design. To develop the case studies, we collected data at multiple points and sites of observation through detailed interviews with the classroom/afterschool teacher, written feedback from mentors, classroom and afterschool program observations, a focus group interview with participants, and a pre- and post-participation student survey. We also reviewed program documents and participating students' science journals. Each method is described below.

Teacher Interviews

We interviewed the classroom/afterschool teacher on two occasions to explore the impact of the Science Mentoring Project on students and on their behavior and success in the classroom. We conducted the first interview immediately following the end of the program and the second a few weeks later in order to explore issues that emerged in our analysis of the data. The teacher was a white female with several years of elementary-level teaching experience. She also had prior experience teaching in afterschool programs and other settings such as museums. She taught the school's afterschool program and had worked with the Science Mentoring Project for two years. In the interviews, we asked the teacher to describe participation, engagement, and school performance in the afterschool and school settings for participating students from her class in general and for the six case-study students in particular. As a measure of change, we asked her to rate the six case-study students on relevant competencies—personal, social, cognitive, creative, and civic—at the beginning of the project and again at the end. The teacher rated each student using the following five-point scale: not developed, emerging, capable, proficient, and advanced. We also asked her whether the competencies students developed in the Science Mentoring Project transferred to the classroom setting, and, if so, in what ways. Specifically, we asked the teacher to describe the project's impact on students' academic performance and in-school behavior.

Mentor Feedback Forms

AED asked each high school mentor to complete a feedback form for his or her mentees at the end of each Science Mentoring Project session. The forms asked mentors to provide feedback on the competencies the fifth-graders developed in the Science Mentoring Project and on changes in students' behaviors, attitudes, knowledge, and skills.

Observations

AED conducted non-participatory, direct observations at several points: six observations of the Science Mentoring Project site, two observations of the afterschool program, and two observations of the afterschool teacher's school classroom. The project observations provided evidence of case-study students' development of personal, social, cognitive, creative, and civic competencies. The project observations also documented the ways in which these competencies were developed in youth—through hands-on activities, use of high school mentors, and activities emphasizing science careers and scientists of racially and ethnically diverse backgrounds. The afterschool observations looked for students' connections between the AS+ curriculum and their experiences at the Hudson River. The classroom observations collected evidence on changes in the case-study students' academic success as defined by increased student interest and engagement, especially around science content; increased understanding of science content and research skills; and development of critical-thinking skills.

Student Focus Group

AED conducted a focus group with case-study students at the end of the program, asking students to reflect on the project's impact on their competencies and whether they believed their participation had affected their success in school.

The project observations provided evidence of case-study students' development of personal, social, cognitive, creative, and civic competencies.

Pre- and Post-Participation Survey

We asked all fifth-graders who participated in the Science Mentoring Project to complete a survey at the beginning of the school year and at the last Science Mentoring Project session. Both surveys asked students about their knowledge of science—environmental issues, ecology, and biology—and included attitudinal questions about science studies and careers in science. In the post-participation survey, students were also asked to comment on the program's impact and on their experience with their mentor. Nine students completed both surveys.

Document Review

As part of our research, we reviewed relevant program documents and materials including the Science Mentoring Project proposal, the AS+ activity guide, session agendas, training materials, and all session handouts. In addition, we reviewed the participating school's annual report card and students' science journals.

Data Analysis

Four AED researchers collected the data for this study using the quantitative and qualitative sources described above. While there was overlap in the roles of the researchers, each researcher was primarily

New York Hall of Science

responsible for collecting one type of data. For example, one researcher was responsible for conducting observations of all the sessions, another for collecting and analyzing the survey data, and a third for conducting the focus group interview. The number of sources, varying qualitative and quantitative formats of the data, and multiple researchers presented some challenges to analyzing the data in a way that would allow us to triangulate findings and to benefit from the perspectives of the various researchers. To address these challenges, we used a multi-step process. First, each researcher typed up his or her field notes from observations, interviews, and the focus group. These notes were shared among the researchers. Results from the pre- and post-participation student survey, the quantitative questions from the mentor feedback forms, and the teacher ratings of student competencies were summarized through frequencies, means, and cross tabulations; these results were then also shared.

To explore patterns among case-study students, data from all sources were organized by, and compiled for, each case-study student. For example, a folder was created for each case-study student to hold data from the pre- and post-participation surveys, the mentor feedback forms, the teacher rating of the student's competencies, and the student journal. After completing data collection, each researcher reviewed field notes and descriptive quantitative data. When reviewing the data, researchers looked for evidence related to the research questions, as well as for emerging themes.

The researchers then met to discuss the data and themes. The purpose of the meeting was for researchers to share data, especially since each researcher collected different types of data; to discuss and develop emerging themes; to identify sources of evidence for the themes; and to discuss possible theories emerging from the data. The discussion started by one researcher listing the major themes arising from the data that researcher was primarily responsible for collecting. The team discussed these themes and then systematically added themes emerging from other data sources. In this iterative process, we discussed the results, interpretations, and corroborations among different data sources. We then went through the themes one at a time to note examples of evidence from the data. For example, under the theme of mentors as role models, we noted evidence from the surveys, focus group, and interviews with the teacher that supported the finding that mentors provided positive role models for students.

After going through each data source, researchers reviewed all the themes to see if any were missing and where they overlapped. We then discussed possible theories about why and how participation in the project had improved students' performance in school, grouping these explanations into categories.

HOW DEVELOPING YOUTH COMPETENCIES AFFECTS SCHOOL PERFORMANCE

By triangulating results from multiple sources, we found that the Science Mentoring Project's site-based, hands-on research activities and mentoring component helped participants develop competencies that research suggests are related to academic success. The data also suggest that participation had an impact on students' school experiences in several areas including confidence in their abilities, increased involvement and engagement in school, and increased responsibility for learning. The high school mentors also had a positive impact on students, serving as positive role models and enhancing students' motivation in school.

Developing Youth Competencies

Our evidence suggests that the Science Mentoring Project did indeed facilitate development of the five kinds of youth competencies listed above as its goals: personal, social, cognitive, creative, and civic competencies.

Personal Competencies

The Science Mentoring Project activities fostered cooperation and group work among participants. For example, activities required students to collaborate to conduct tests and create graphs of water-quality levels and to play games aimed at teaching students the interdependence of the ecological system and the importance of each person in a community. One game, called the "food-chain game," involved students selecting a picture of a sea animal and then forming a big circle. The object of the game was to connect creatures at different levels of the food chain by means of a rope. After everyone was connected, the rope formed one big interconnecting web. The students representing creatures directly dependent on oysters were asked to drop the rope. Doing so caused the entire web to fall apart, showing the importance of every animal in the sea in maintaining the ecosystem.

The Science Mentoring Project's site-based, hands-on research activities and mentoring component helped participants develop competencies that research suggests are related to academic success.

Program observations and mentor feedback forms provided evidence that these activities helped students develop personal competencies. For example, when asked on the feedback form what changes he had seen in the participant with whom he worked, one mentor reported that he noticed a change in his mentee's ability to work with other students. The mentor reported that, at the beginning of the project, the student tended to do "most of the work by himself" during the group activities and did not interact much with the female students in his small group. At the project's end, the mentor noted that the student had "learned to let others help out with the activities. He also learned to work with [the female students in his group]." The mentor saw this ability to work with the female students as an accomplishment, given the mentee's previous lack of interaction with girls. Other mentors also commented in their feedback forms on how well their mentees worked with other students: "He looked out for his partner by making sure she had all the information," for example, or, "She helped her peers by explaining what they didn't understand."

Development of students' ability to work with each other was also evident in quantitative data from the weekly mentor feedback forms. Mentors were asked at the end of each session to rate how well their mentees worked with other students, using a response scale of not at all, not very well, somewhat, and very well. At the first project meeting, mentors rated 12 out of 19 (63 percent) of mentees as working "very well" with other students. Later in the project, 8 out of 10 (80 percent) of mentees earned a "very well" rating.[1] Additionally, the classroom/afterschool teacher confirmed in an interview that students increased their competence in working together over the course of the project.

Social Competencies

The Science Mentoring Project activities also fostered social competencies by emphasizing respect for others and for diversity. Group activities emphasized mutual respect, speaking in turn, and listening to what others had to say. In addition, the mentors and project leaders encouraged students to appreciate each other's opinions, observations, and impressions.

Development of these competencies was observed by mentors, who rated students weekly in this area, as well as by the classroom/afterschool teacher. When asked for examples of how students showed respect for others, mentors wrote:

> She always allows other students to do the hands-on activities also.
>
> She is really courteous. She gives everyone a chance to work hands-on.
>
> Once I asked her to give others a chance to do the experiments—she let others do it and was helpful.

One student started talking about becoming a veterinarian, and another talked about wanting to be a psychiatrist—careers the teacher had never heard students consider before the project.

In an interview, the classroom/afterschool teacher stated that the program promoted social competence by recruiting mentors and guest speakers in scientific fields who were similar to students in terms of their racial and ethnic background, gender, and socioeconomic status. As a result, the teacher reported, students "saw themselves" in these role models and began considering careers in the sciences.

In addition, once students saw that scientists "come in all shapes and sizes," as the teacher put it, some began talking about taking up scientific careers. For example, one student started talking about becoming a veterinarian, and another talked about wanting to be a psychiatrist—careers the teacher had never heard students consider before the project.

Further, when asked to rate case-study students on their development over the year in social competencies, the teacher reported that all of the students increased in this area. By the end of the year, she rated all six as either "proficient" or "advanced" in social competency.

Cognitive Competencies

A variety of measures gave evidence that students in the Science Mentoring Project had opportunities to develop critical higher-order thinking skills as well as to add to their knowledge about environmental sciences. For example, researchers observed students discussing in depth the reasons oysters were disappearing from the Hudson River. Through a brainstorming activity, students determined that the oysters were disappearing because of pollution and overharvesting. Students were also encouraged to use critical-thinking skills by making predictions and drawing conclusions about data they collected. For example, during one of the last sessions, students created a graph of the air and water temperature data they had collected over the previous weeks. They then analyzed the relationship between the two, discovering that air and water temperatures were not directly proportional to each other.

Evidence from the student focus group and surveys also indicated that students learned a great deal about environmental sciences. For example, when asked in the focus group what they learned from the Science Mentoring Project, students responded:

> I learned how to use the water kit. I compared the Ph levels and then did the graphs.
>
> I learned to get the water's temperature. I learned all the equipment you need to do it.
>
> I learned that oysters have their own language.
>
> I learned how to observe and how to compare how things look.

Students' self-reported knowledge about environmental issues also increased during the project. Of the nine students who took both the pre- and post-participation surveys, four (44 percent) reported knowing "a great deal" or "a good amount" (other choices were "I've never heard of it," "nothing," "a little," and "some") about environmental issues such as pollution and water quality before the project; the number increased to seven (78 percent) who gave those answers at the end of the project. Mentors also reported that most students showed high levels of understanding of the concepts and knowledge taught in the activities. For example, in two different weekly feedback forms, mentors reported 10 out 15 (67 percent) and 10 out of 11 (91 percent) of students understood "very well" the concepts and knowledge taught in each session.

Creative Competencies

Student participants in the Science Mentoring Project were consistently prompted to think, make connections and observations, and ask questions—thus fostering students' creativity and communication skills. Students gained in oral communication skills by discussing topics with their peers and by making a presentation to the group on the results of their water-quality tests at the end of the project. Writing skills were fostered by encouraging students to record observations, activities, and data in their journals. Here are two sample journal entries:

> My most memorable moment was today because I never thought that today would ever come. My mentor was kind, cool and nice. My mentor was the best. I'll never forget her.
>
> My favorite moment was when we went downstairs to check the air and water temperature. It was fun. We had a good time.

Students were also encouraged to explore the water station and river environment using all of their senses. For one activity, students constructed a chart of what they observed by seeing, hearing, touching, and smelling. One student's response is below:

Smell	**Touch**
Salt	Water
Water	Cold air
See	**Hear**
Dirty water	Water falling
Dead fish	

In addition, students were encouraged to write creatively about their experiences at the river. In one activity, students were given a half hour to draw, write a poem, or write prose about their experience. The teacher also gave evidence of opportunities to develop written and oral communication skills. She reported in an interview that students even used what they learned in the project to write a speech to convince other classes in the school that recycling was important.

Civic Competencies

Observations showed that the project raised students' environmental awareness and that students began to understand the importance of caring and advocating for the environment. For example, in one session that emphasized valuing and protecting the community and the environment, students discussed environmental cleanups; the meaning of "reuse, recycle, and reduce"; and endangered fish. Students showed their increased awareness of environmental issues in their journal reflections, for example, "The river keepers protect the river by making sure people and factories do not dump sewage and junk in the river."

"The Science Mentoring Project helped students understand pollution and made it real to them. They started the battery recycling project at school as a result."

Participation in the project not only raised students' awareness of environmental concerns, but also spurred their sense of responsibility for the environment, according to their teacher. In rating the six case-study students' ability to advocate for the interests of themselves, someone else, or the community, the teacher reported at the beginning of the project that two students were at the "emerging" level and four were at the "capable" level. By the end of the project, she rated one student as "capable," while the other five moved into the "proficient" category. To illustrate students' development in this area, the teacher explained in an interview, "The Science Mentoring Project helped students understand pollution and made it real to them. They started the battery recycling project at school as a result." One of the students corroborated this statement in a focus group:

> I understand better now why we should recycle, like our recycle project in school. I know how batteries affect the water and I learned how we should care for the water more.

In summary, evidence from multiple sources indicates that the Science Mentoring Project did foster students' personal, social, cognitive, creative, and civic competencies. In the next section, we describe the ways these competencies revealed themselves in students' school performance.

Impact on School Performance

Data collected for this study revealed that students' participation in the Science Mentoring Project had an impact on students that went beyond gaining knowledge about the content areas covered. According to the students' classroom teacher and their self-reports, their participation also positively affected students' engagement in school, their positive behaviors, and their academic skills.

Impact on Engagement

According to the afterschool/classroom teacher, the Science Mentoring Project helped students become more engaged with school because the activities helped students take responsibility for their learning:

> The activities at the Science Mentoring Project improved students' involvement and engagement in class. The students started getting more serious and focused in their school work. At the Science Mentoring Project, they worked hard and they felt good about it. They saw the tie between what they were doing at the river and what they did at school. As a result, they worked harder in school.

Assuming responsibility for carrying out tasks, completing experiments, and documenting results transformed students into active learners.

The Science Mentoring Project gave students responsibility for their work and for the equipment they needed to accomplish that work. For example, students were responsible for taking careful notes on all the water-quality tests and for charting the results. Because their results were posted at the field station for the staff to use to monitor water quality, the students' work had meaning and purpose. Students were also responsible for handling the equipment they used in experiments and for cleaning and storing it properly. According to the teacher, the real-life, hands-on nature of the activities was powerful because it "gave the students a sense that they were doing something important—[the activities] had a purpose." Having a sense of purpose and meaningful participation are two factors that have been identified as cultivating resilience in school (Bernard, 1991; Topf, Frazier-Maiwald, & Krovetz, 2004). Further, assuming responsibility for carrying out tasks, completing experiments, and documenting results transformed students into active learners.

Observations showed that students were most excited and engaged when their learning was active; one researcher noted that students were "extremely enthusiastic and asked a lot of questions" during the activities. Student responses in focus groups corroborated this finding. When asked to describe their favorite activity in the Science Mentoring Project, students pointed overwhelmingly to hands-on activities such as doing experiments and observing marine life firsthand.

> I like doing the experiments. In school, we just learn about these things, we don't experiment. In the Science Mentoring Project we checked the water temperature.
>
> It was cool to test the water and the temperature. Touching the oysters was my favorite part.
>
> Going out to the dock and pulling the net for the planktons that was my favorite part.
>
> My favorite part was catching the fish and the shrimp.

Further, in response to the post-participation survey question, "What did you like best about the Science Mentoring Project?" 14 out of 17 respondents reported liking best the hands-on activities and experiments.

According to the teacher, the enthusiasm generated through hands-on and engaging activities carried over into the classroom, motivating students to learn and helping them to assume ownership of and take responsibility for their learning. One example she gave in an interview was that students began to ask more questions in class.

To illustrate this "carryover" effect into the classroom, the teacher described one student, Jorge,[2] who was very disengaged from school at the beginning of the project. He never did his homework, even though his parents were involved in his education and attempted to follow up on homework at home. According to the teacher, "Jorge didn't own the work" and therefore was not interested in completing it. At the Science Mentoring Project, the teacher saw a different student. Jorge was engaged in the activities and found the work of the project to be fun. He worked hard in the Science Mentoring Project and "felt good about his work," according to the teacher. After a few

weeks, the teacher reported that Jorge started to see the tie between the Science Mentoring Project and his school work: "He saw that he could do the work at the Science Mentoring Project and be successful, so he began to do his work in school too." Of all the case-study students, Jorge also showed the most growth in the key competencies emphasized in this project. According to the teacher's pre- and post-project ratings, Jorge jumped one level in three areas (respect for others, respect for diversity, and original thinking) and two levels in four other areas (ability to work with other students; critical thinking and higher-order skills; ability to express oneself through verbal and written communication; and ability to advocate for the interests of oneself, someone else, or the community).

Students' increased interest in science was also indicated by their responses to the post-participation survey. All of the survey respondents either agreed or strongly agreed that "going to the Science Mentoring Project made me better at science." In addition, eight out of nine (89 percent) agreed or strongly agreed that participating in the project made them more interested in science; seven out of nine (79 percent) agreed that their participation had changed the way they felt about science.

The student surveys also indicated that the project had an impact on students' motivation towards coursework and careers in science. Several students changed their responses to questions about their interest in taking science courses from "I'm not sure" on the pre-participation survey to "very" or "somewhat" interested on the post-participation survey. Additionally, of the nine students who took both surveys, the percentage of students who agreed or strongly agreed that a career in science would be "dull and boring" decreased from four (44 percent) to two (25 percent).

"He saw that he could do the work at the Science Mentoring Project and be successful, so he began to do his work in school too."

Impact on Positive Behaviors

The teacher and mentors reported seeing changes in students' behavior, motivation, and level of participation, indicating increased levels of confidence and of positive risk taking. For example, the teacher reported greater participation in activities by the girls over the course of the project. At the beginning of the project, the girls tended to hang back during experiments, letting the boys do all the hands-on work. Encouraged by project staff and the mentors, the girls began to take a much more active role, asserting themselves in group projects and contributing more to discussions. On their feedback forms, mentors noted increased participation for both girls and boys:

> She hesitated at first to participate but towards the end she was really eager to work hands-on. She gained confidence trying new things, like touching animals and going out on the floating dock.
>
> My mentee was able to break out of his shell, and became less shy. In the last weeks he participated more and talked a lot more.
>
> She started asking more questions and became more involved in the activities. She was more willing to speak.

For one student, Emily, the most apparent change in behavior had to do with her interactions with others. In an interview, the teacher described Emily's typical classroom behavior before the project as "either not participating in class or constantly calling out. She's very into being 'cool' and often rebels against authority." The teacher noticed that during the project Emily started participating in more appropriate ways and began giving other students a chance to participate. The teacher also reported that Emily described the mentors as being "cool" and "smart": "This is an issue that Emily is dealing with, and it was important that she saw that the mentors could be cool *and* smart." The teacher's ratings of Emily in the competency areas of respect for others, respect for diversity, and ability to work with other students also showed marked improvement, moving two levels from an "emerging" or "capable" level at the beginning of the project to "proficient" or "advanced" at the end.

Science Mentoring Project activities helped bolster students' confidence in their ability to ask questions and to experience learning in new and different ways.

Both the teacher and the mentors observed that Science Mentoring Project activities helped bolster students' confidence in their ability to ask questions and to experience learning in new and different ways. The teacher reported that students' increased confidence affected how they behaved in school:

> I saw students coming out of themselves. For example, Federico—who never says anything in class—all of the sudden started talking and giving his opinion [at the Science Mentoring Project]. He was never asked his opinion before, and the Science Mentoring Project gave him a safe environment to express himself. This helped build his confidence in school.

In another example, the teacher said that Martha was initially very hesitant to participate in Science Mentoring Project activities, especially those that involved either handling fish and other animals or taking risks such as walking out on a platform over the water to collect water samples. With encouragement from her mentor and from other students, Martha began to participate more in such activities. The teacher saw this increased confidence carry over into the classroom in several ways. For example, Martha became comfortable handling the classroom guinea pigs—something she was previously afraid to do—and showed more confidence in classroom discussions:

> Before, Martha would never raise her hand in class. Then, she started raising her hand but would preface a comment or question with, "I don't know if this is the right answer" or "I know this is a dumb question." The response from the adults and mentors at the Science Mentoring Project was, "There are no dumb questions." Martha doesn't start her questions out that way any more. I think by hearing from other adults (besides me) and young people that there are no dumb questions, she started to believe it.

This finding is particularly notable in light of research indicating the importance of a learning environment that encourages expression of ideas, risk taking, and questioning (National Research Council, 2005).

Evidence from the student surveys also showed a shift in Martha's perspective about science. For example, Martha indicated on the pre-participation survey that she was "not sure" if she was interested in taking science courses in high school or having a science-related job or career. On the post-participation survey, she reported that she was "very interested" in both. She reported on her pre-participation survey that she knew only "a little" about environmental issues; on the post-participation survey, she changed her answer to "a good amount." She also strongly agreed on the post-participation survey that her mentor encouraged her to learn things and that going to the project made her better at doing science.

Impact on Academic Skills

When asked in a focus group if project activities had helped with school work, a few students made the connection that what they had learned in the project increased their scientific knowledge:

> When we go to middle school, we will be doing chemistry. I'll be using chemicals and I won't be afraid because I've already worked with chemicals. If you are learning about the environment, we already know how to care for the water, and to not pollute.

The teacher also indicated that she had seen an increase in the students' vocabulary: "Students used words they learned at the Science Mentoring Project in class." A student corroborated this observation in the focus group: "If you are learning about the ocean, you can use the language you've learned at the Science Mentoring Project, like brackish water, salt water, fresh water."

The teacher commented in an interview that she believed the project had a powerful impact on students because it gave them a chance to succeed in an academic area. She noted that many of her students have failed in school, not meeting the standards on the city and state English language arts and mathematics tests and repeating grades as a result of their poor performance. At the Science Mentoring Project, students successfully completed activities and assignments including experiments and had the opportunity to share their results through a presentation.

The teacher also concluded that the Science Mentoring Project helped students learn skills that would help them become better students:

> The project exposed students to adult and high school students modeling different ways of thinking and solving problems. This helped the students increase their metacognitive skills, their understanding of finding a learning strategy that works for them.

This comment was supported by her ratings of the case-study students' competencies in critical thinking skills and ability to express themselves in written and oral communication. At the beginning of the project, the teacher rated two students as "emerging" and four as "capable" in higher-order thinking skills. At the end of the project, the teacher rated all six students as "proficient" in this area. In the area of communication skills, the teacher rated three students as "emerging," two as "capable," and one as "proficient" at the beginning of the project. At the end, she rated five students as "proficient" and one as "advanced." Martha, the student mentioned earlier whose confidence grew during the course of the project, jumped two levels in both critical thinking and communication skills from "emerging" at the beginning of the project to "proficient" by the end. The teacher noted in an interview that, "The project gave her a place to practice—speaking, volunteering answers, and writing about her experience. The project gave her a reason and context for the writing, which is important."

'The project exposed students to adult and high school students modeling different ways of thinking and solving problems. This helped the students increase their metacognitive skills, their understanding of finding a learning strategy that works for them."

Impact of the Mentors

A key catalyst of the impact of the Science Mentoring Project was the mentor-mentee relationship. Students were clearly impressed by their mentors. For example, a review of the students' journals revealed that a good part of the student writing revolved around the mentor-mentee relationship.

> My favorite memory is when I first met my mentor.

> I will remember the most is my mentor because he helped me out a lot and he taught me a lot of stuff. He taught me about the different type of fish and crab.

> My mentor was funny. We had a good time. I wish we could meet again. I wish him a lucky year.

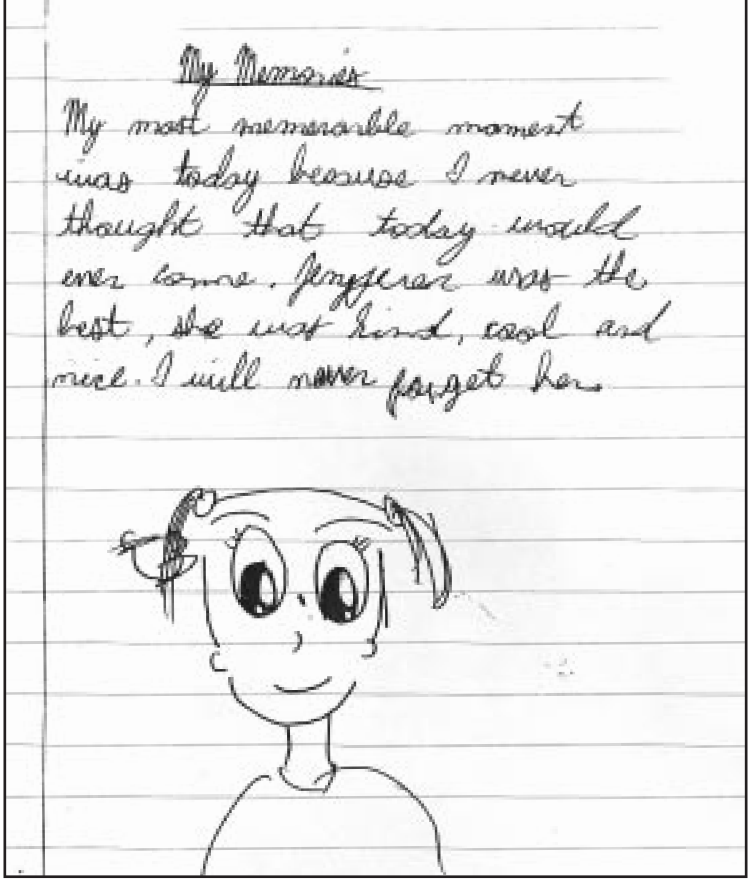

Figure 1

> "The students saw the high school mentors as role models. The students liked that the mentors looked like them. The mentors were 'cool' but also did the work. The mentors showed the students that you can be cool and still do well in school."

Students expressed similar sentiments during the focus group:

> My mentor was my favorite part. I was nervous at first, but she was a lot of fun. She helped me fill out the logs.
>
> I got to know my mentor. She helped me a lot. What I will remember the most is my mentor. She was fun. I think about her.
>
> At the Science Mentoring Project, I was excited because I got along with my mentor. She helped me.

The observation of the final session of the Science Mentoring Project also showed the prominence of the mentor-mentee relationship. The observer's field notes stated:

> The students and the mentors were given about half an hour to draw, write a poem or some prose about their experiences at the river. It was very moving to hear students describe their feelings about the project. The focal points of the drawings were the relationships that the students had developed with their mentors. Most of the students drew pictures of themselves with the mentors performing experiments in the river.

One example of a student's tribute to her mentor is shown in Figure 1.

The teacher attributed many of the positive effects of the project to the mentors: "The mentors made a personal connection with students, which made the project more engaging and fun to students." The teacher noted that much of the project's impact on students' confidence and attitudes was due to this bond between the students and their mentors and to the positive role model the mentors provided.

> The students saw the high school mentors as role models. The students liked that the mentors looked like them. The mentors were "cool" but also did the work. The mentors showed the students that you can be cool and still do well in school.... The students became more comfortable with their mentors and more confident about talking, having discussions and raising their hands to ask questions. The high school mentors modeled different ways of learning, which helped the students' confidence.

The teacher's comments were corroborated by the student surveys, in which 15 out of 17 (88 percent) of respondents agreed or strongly agreed that they looked up to their mentors; 16 out of 17 (94 percent) agreed or strongly agreed that their mentor encouraged them to learn; and all 17 agreed or strongly agreed that they enjoyed spending time with their mentor. These findings are further testimony to the powerful impact of a caring older person in young people's lives, as revealed in the literature reviewed at the beginning of this article.

IMPLICATIONS FOR RESEARCH AND PRACTICE

This study, through multiple qualitative and quantitative methods, investigated the ways in which the Science Mentoring Project's youth development focus

New York Hall of Science

and mentoring component helped participants develop key competencies that positively affected their school experiences. Specifically, evidence from this study suggests that the competencies participants developed in the project had an impact on three areas of their school experiences. First, the project helped increase students' engagement in school and motivation toward both school and careers. Jorge, for example, discovered that academic "work" could be fun and therefore began to complete more of his assignments and homework. Second, the project, by helping participants increase their self-confidence, brought about positive changes in their classroom behaviors. Emily, formerly an unengaged and rebellious student, discovered in the Science Mentoring Project that smart people could also be cool; she transformed into an engaged student whose classroom interactions were more appropriate than before the project. Similarly, Martha's hesitation to participate in class discussions and hands-on activities dissipated. Third, the project had an impact on students' skills and knowledge, including increased awareness of environmental issues and vocabulary. The higher-order critical thinking skills participants developed through the project's hands-on scientific exploration will be crucial for those students' academic success.

Areas for Further Study

Further study on the effect of youth development programs on school success is warranted. Our research suggests several avenues such research might take. For example, the changes in students' attitudes and behaviors through the Science Mentoring Project are especially impressive given the project's short duration. The question arises whether longer or more intense programs will yield greater impact or whether the effect of youth development programs on students' school experiences reaches a "ceiling" at some point. Longitudinal studies are also needed to investigate the long-term impact of youth development programs on school success.

Another question our study raises is related to the importance of basing youth development programs on a specific content area. Grounding the activities and mentoring component in a science curriculum gave the Science Mentoring Project an authentic purpose for addressing cognitive and civic competencies, including issues of diversity. A study comparing outcomes from youth development programs with and without a content-area focus would be revealing.

> The changes in students' attitudes and behaviors through the Science Mentoring Project are especially impressive given the project's short duration.

Our findings lead us to encourage researchers to combine quantitative and qualitative techniques, as we did in this study. Additional quantitative techniques—academic self-concept scales and other standardized measures, as well as traditional indicators of achievement such as test scores and attendance—might be brought to bear in order to measure the impact of youth development programs on academic competencies. Such quantitative data provide rigorous evidence of program outcomes that are persuasive to funders and policymakers as well as to practitioners. However, while measuring student outcomes using rigorous quantitative techniques is critical, understanding the mechanisms that produce the outcomes is equally important. Qualitative data that explore the nuances of participants' and leaders' experiences can help open the "black box" of youth development programs to illuminate how, why, and in what circumstances such programs produce particular outcomes.

Programmatic Implications

In general, our findings speak to the importance of including a youth development focus in afterschool programs. In particular, this study showed how powerfully a mentoring component and hands-on, real-world activities can affect students' school engagement, behaviors, and skills. Our findings indicates that programs do not need to be extensive in duration in order to have impact in these areas.

The findings point to the mentors as a key factor in the project's success. Informal interviews with EEC staff revealed that training for mentors in equity issues was crucial to helping the mentors to encourage equal participation by girls and boys and to avoid stereotyping and biased behavior. This training helped mentors identify when such instances occurred and gave them strategies to address these situations with students.

The Science Mentoring Project's impact on students' engagement, motivation, and positive risk taking are important because these attributes help build a critical foundation for student success. Our findings fit into Miller's (2003) theory about how afterschool programs can build "prerequisites" to learning that support students' school performance. The five key youth competencies identified in this study are areas that are often not developed in typical day-school curricula. Afterschool programs such as the Science Mentoring Project provide an ideal setting to promote and facilitate positive youth development while, at the same time, offering fun activities that expose youth to areas of knowledge and possible career opportunities they may not otherwise experience.

ABOUT THE AUTHORS

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NOTES

[1] More students were present at the first meeting than at the last.

[2] Pseudonyms are used to protect the anonymity of the students.