

# ***STEM TECH ALLIANCE: FINAL REPORT***

Funded by the Massachusetts  
Department of Higher Education  
STEM Pipeline Fund

Final Evaluation Report  
March 2009 - June 2010

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June 2010

***E***VALUATION ***A***nalysis ***S***olutions, Inc.

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STEM Tech Alliance  
Final Evaluation Report

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# EXECUTIVE SUMMARY

This evaluation report covers the period from March 2009 through June 2010 of the StemTech Alliance project. The report documents the activities of both the Project's Pilot (Spring 2009) and Implementation (2009/2010 academic year). It begins with findings related to the pilot activities and outputs and then presents information on perceived impact of the project on classroom teachers students who participated in the STEM Tech Ambassador visit.

In sum, the evaluation found that the STEM Tech Alliance project met its goals:

- Successfully implemented planned activities
- Recruited the desired target number of classrooms
- Trained STEM Ambassadors prior to their visits
- Supported STEM Ambassadors in presenting key messages
- Yielded positive evaluations from STEM Ambassadors, teachers, and students

Important teacher outcomes include:

- 90% rated the quality of the visits as high or very high
- 88% rated the materials as high or very high
- 97% would recommend the visits to others

Important STEM Ambassador outcomes include:

- 100% judged the quality of materials as high or very high
- 94% rated the quality of the training as high or very high

Important student outcomes include:

- Statistically significant gains in understanding that math is important
- Statistically significant gains in understanding the types of STEM careers available to them
- Statistically significant gains in understanding the steps needed to pursue STEM careers

The full report with details follows.

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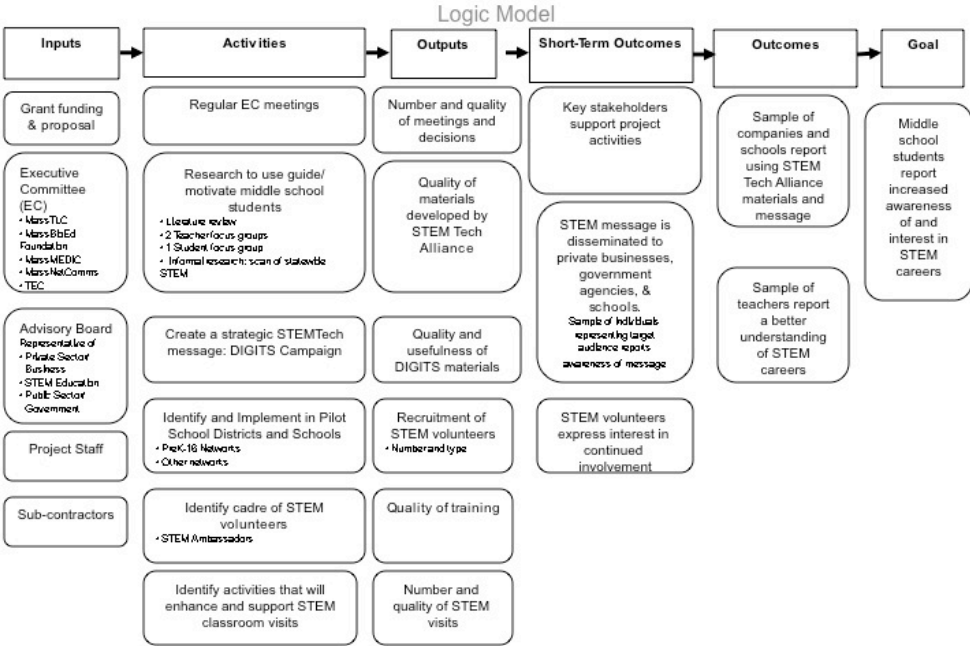
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# PROJECT DESCRIPTION OVERVIEW

The STEM Tech Alliance project, funded by the Massachusetts Department of Higher Education’s STEM Pipeline Fund and with the support and leadership of the Massachusetts Technology Leadership Council, is designed to increase middle school students’ interest in and understanding of science, technology, engineering, and mathematics (STEM) careers.

The project’s theory of change, illustrated in the project “logic model” below is that the project inputs, such as the grant funding, executive committee advice and project staff expertise, would enable the STEM Tech Alliance to engage in specific activities including the development of a campaign to increase STEM awareness among sixth graders. In turn, these activities would lead to specific outputs such as the DIGITS campaign materials and short-term outcomes. Ultimately, the project is designed to achieve the goal of increasing middle school students’ awareness and interest in STEM careers.<sup>1</sup>

**Graphic 1. Project Logic Model**



The logic model guided the development of the evaluation questions, analyses and reporting framework, which are presented in the next section.

## **EVALUATION DESIGN**

### **INTRODUCTION**

The STEM Tech Alliance contracted with Dr. Diane Schilder at Evaluation Analysis Solutions, Inc. (EAS) to conduct an external evaluation of the STEM Tech Alliance project. In order to provide formative data—feedback about project activities—to guide decision-making for future activities, the evaluator collected data and reported preliminary findings to the project leaders. The evaluator also collected summative data—to document the impact of the project on participating students. This report presents data collected between March 2009 and June 2010.

The independent evaluator engaged in wide-ranging activities to collect the data discussed in this report. Different types of data were collected in order to:

- Document baseline conditions
- Describe project activities, strategies, and site contexts
- Provide formative feedback to the project
- Report final impacts of project activities

### **QUESTIONS, DATA COLLECTION, AND ANALYSIS**

The logic model presented earlier guided the refinement of evaluation questions and methods.

The evaluation questions that guided the data collection and analysis, linked with the logic model, are as follows:

- 1) Did the project complete planned activities? Did the project produce desired outputs?
- 2) How did teachers, Ambassadors, independent observers, and students view project activities? What conditions supported implementation? What barriers were experienced?
- 3) Did the project result in desired outcomes? What conditions are related to desired outcomes?

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The evaluator engaged in the following specific activities to guide the evaluation. (Each evaluation activity is only listed in one place, even though there is some overlap in categories.)

Project Chair and Director

- › Refinement of logic model
- › Observation of and participation in selected project team meetings and conference calls
- › Facilitation of formative evaluation feedback meetings
- › Informal conversations with project leaders
- › Reviews of documents produced by project leaders

STEM Ambassadors

- › Informal conversations during training\*
- › Training of Pilot STEM Ambassadors via conference call\*
- › Surveys of STEM Ambassadors
- › Direct observation of STEM Ambassador visits\*

Target teachers

- › Surveys
- › Observations using structured protocols\*
- › Informal interviews with teachers\*

Students

- › Observations\*
- › Surveys (baseline and follow-up)

\* Data collection activity occurred in pilot year only.

**Table 1. Data Collection Activities**

<b>Evaluation Activity</b>	<b>Description</b>	<b>Number</b>
<b>Observations</b>	Project chair and director meetings/conference calls	5
	STEM Ambassadors, teachers and students in classrooms*	19
<b>Surveys</b>	Teacher surveys	66
	STEM Ambassador surveys	69
	Baseline and post student surveys	532
<b>Document review</b>	Project communications DIGITS materials STEM Ambassador materials	

\* A total of 10 classroom observations were conducted. A total of 19 observational forms were completed; 2 observations were conducted by the evaluator.

The evaluator used varied qualitative and quantitative methods to examine and describe project activities and associated impacts on teachers and their students. Our quantitative methods consisted of inferential statistical methods using paired-samples t-tests of means to examine sample differences and pre-post gains. Our qualitative methods were guided by Miles & Huberman's framework of creating an initial coding schema, refining the codes after preliminary analysis, and exploring emerging themes and trends. Qualitative data were coded based on a schema that examined the relationship between actors (such as project director and teachers), activities (such as the STEM Ambassador training, recruitment of schools throughout the state, etc.), outputs (such as number of visits and number of students), and outcomes (changes in participating teachers and their students). The evaluator performed descriptive statistical analyses to determine frequencies and averages and performed dependent samples t-tests and Chi Square to determine changes in students' pre-survey and post-visit survey responses to questions regarding attitudes and knowledge.

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## FINDINGS

The findings are organized into 3 sections. We begin with a description of activities and their implementation, and suggestions for future changes. We follow by summarizing the perceptions of the project as reported by participating teachers and Ambassadors and then present findings regarding the project's impact on students.

### ACTIVITIES

#### DESCRIPTION OF PLANNED ACTIVITIES

The project created an ambitious plan of activities to be carried out from the spring 2009 through the spring 2010. Specifically, the project planned to:

- Complete a pilot test
- Recruit implementation schools
- Recruit teachers to participate in the implementation
- Recruit volunteers to serve as STEM Ambassadors
- Distribute guide to STEM Ambassadors
- Conduct training of STEM Ambassadors
- Provide support to STEM Ambassadors through regular communication and through coordination of communication with schools and teachers
- Collect and use formative data to revise activities
- Assess impact of the project on teachers and students

#### SUCCESSFUL COMPLETION OF OBJECTIVES

##### Recruitment of Sites and Teachers

Between the spring 2009 and spring 2010, the project successfully completed planned project activities and met output targets. For the pilot test year only, the project successfully recruited 10 schools representing the 10 Congressional Districts throughout the Commonwealth. For the full implementation year, the project successfully recruited a total of 119 schools throughout the Commonwealth. The project reported that the higher than expected take up rate in the first year of implementation required additional resources to meet this demand. As a result the project reported the inability to offer visits to schools in three regions in the state: the city of Boston, Pioneer Valley and the

Berkshires. Schools were selected to ensure representation across geographic and socio-economic contexts.

The schools and districts that were recruited represent a mix of urban, suburban, and rural settings. Moreover, schools served children with a range of socio-economic backgrounds with some schools serving high percentages of children living in poverty and others serving children from high-income families. The STEM Ambassadors reported that they visited schools that reached more than 10,000 students.

### **Recruitment of Ambassadors**

STEMTech Alliance engaged in steps to recruit STEM Ambassadors. A total of 69 out of 154 STEM Ambassadors—or 45 percent—participated in the evaluation. These Ambassadors represent each STEM sector represented by STEM Tech Alliance:

Biotechnology	16
Medical Device	4
Engineering	28
Energy	7
Software and Internet	55
Telecommunications	36
Other	8
<b>TOTAL</b>	<b>154</b>

Following the pilot year, the New England Clean Energy Council joined the project and recruited 7 volunteers who visited classrooms in the 2009/2010 academic year.

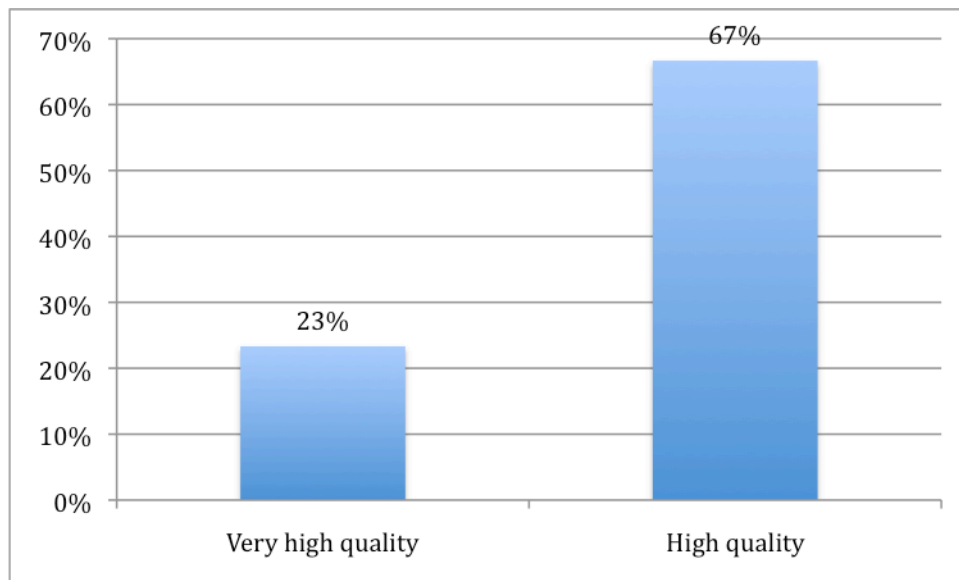
### **Steps to Enhance Fidelity of Implementation**

To increase the likelihood that the visits would be implemented with fidelity, project leaders developed a detailed guide for STEM Ambassadors that was pilot tested in the spring 2009. Each STEM Ambassador received the guide that highlighted key messages and campaign materials. Each STEM Ambassador was required to participate in training via conference call. A number of telephone conference call training sessions were provided to ensure that each Ambassador had the chance to participate in one training session. During the training key messages were explored and volunteers were given information about successful best practices for middle school visits. Moreover, volunteers had opportunities to ask questions.

## PARTICIPATING TEACHER REPORTS FAVORABLE

Teachers viewed STEM Ambassador visits as quite favorable. Graphic 2 below shows that 90% of teachers who responded to the evaluation indicated that the DIGITS presentation was either high quality or very high quality. Respondents were asked to rate the quality of the presentations on a 4-point scale with options “very high quality,” “high quality,” “low quality” and “very low quality.”

**Graphic 2. Teacher Perceptions of Quality of DIGITS (Sample = 60 teachers)**



Teachers provided comments that:

*Students were engaged by the activity and presenter.* [Teacher from Boston Metro Area Urban Rim District]

*The STEM Ambassador was thoughtful, engaging and clearly very excited about her work in civil engineering. She offered a professional, enriching opportunity for my students.* [Teacher from Metro West Suburban District]

*It really made the students think about how much math and science they experience each day. It helps make the STEM positions a realistic goal.* [Teacher from South Shore Suburban District]

*[The Ambassador] spoke three languages. He talked about honeybees. The kids could relate. The kids loved the stickers.* [Teacher from Central Urban School District]

*Students were engaged-completing activities and asking questions of STEM Ambassador.* [Teacher from North Shore Suburban School District]

Most teachers either reported that the DIGITS materials were high quality or very high quality (See Graphic 3 below.) Sixty percent of teachers participating in the evaluation reported that the materials were high quality and 28 percent reported that the materials were very high quality. Teachers elaborated on their ratings:

*The stickers were very cool especially the way the pictures were incorporated into the letters.*

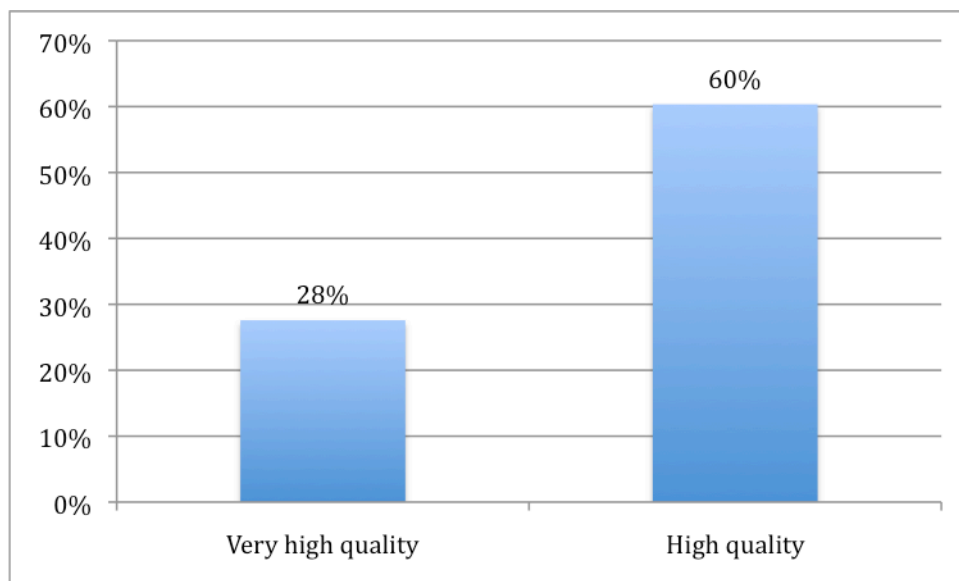
*The students LOVED the stickers. They were highly engaged in the activity involving the stickers.*

*Students absolutely loved the stickers. I have MANY students who moved their stickers to their notebooks and binders.*

*Students were very excited about the stickers-many fixed them onto their notebooks-they are constantly seeing the different STEM fields.*

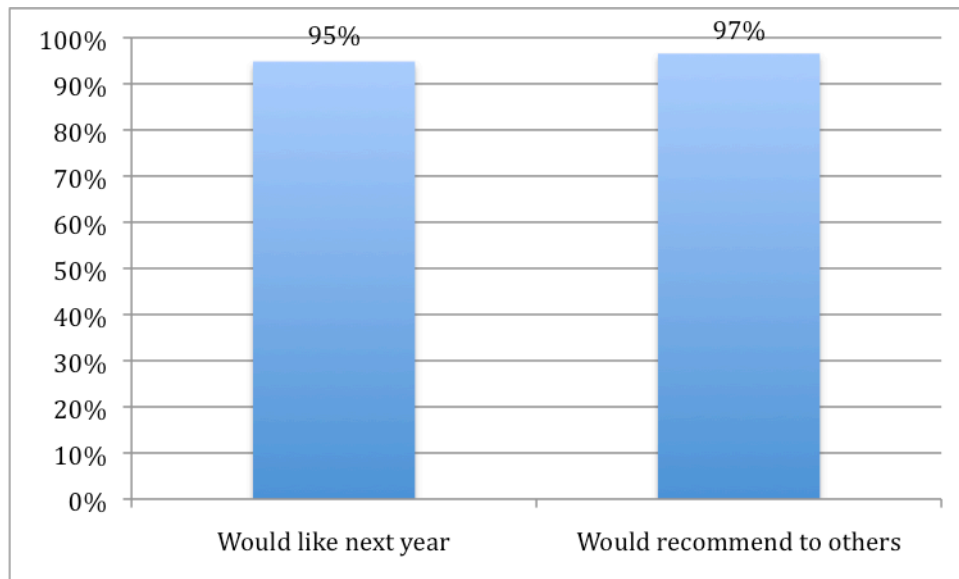
*Hands on materials keep the students involved and active.*

**Graphic 3. Teacher Perceptions of DIGITS Materials**



The majority of teachers reported that they would recommend visits in the future and would like to have another visit if offered. (See Graphic 4.) A small percentage of teachers reported that their schedule is too full for a future visit. However, the vast majority reported that they believed their students would benefit from additional visits and 97% reported that they would recommend visits to others.

**Graphic 4. Teachers Recommend Future Visits**



Most teachers reported that the visit benefitted their students in terms of increasing students' interest in mathematics and science. Example teacher comments are presented below.

*I would welcome a STEM Ambassador for another visit for a follow up visit. I think the presentation was well done and interesting. I, also, think guest speakers are a very worthwhile part of the curriculum. This presentation gave a wonderful example of what can be achieved through studying math, science, and technology.* [Teacher from South Shore Urban District]

*It is great for students to connect math and science to the world and possible careers. Students were very interested and asked a lot of good questions.* [Teacher from North Shore Suburban District]

*I would love to have another ambassador come in because I feel that it is important for these kids, especially in this district, to see why math and science are truly important in "the real world."* [Teacher from Boston Metro Urban District]

*The more exposure kids have to engineering, math and science, the more likely they are to go into the field. Plus, I don't have the most recent information. It is good to get another perspective.* [Teacher from Central Urban School District]

*I would like to continue to network with STEM Ambassador next year. Exposure to jobs that use science vocabulary words, emphasize the importance of discussion/teamwork, demonstrate creativity is important for our students. All they see everyday is an academic environment. [Teacher from North Shore Suburban District]*

## **STEM AMBASSADOR REPORTS VERY POSITIVE**

STEM Ambassadors who visited classrooms participated in the evaluation. A total of 70 Ambassadors completed post-visit surveys. Of the 70, 100% of these Ambassadors reported that the quality of DIGITS materials was high quality with 49% reporting that the materials were very high quality and 51% reporting that the materials were high quality. These Ambassadors also reported that the quality of the training was high—with over 94% reporting that the training was high quality. Nearly all of the Ambassadors reported that they felt prepared for their site visits.

Of the STEM Ambassadors reporting, 95% that they believed their presentations were high quality or very high quality. Twenty-six percent reported that they believed their presentation was very high quality with 69% reporting that the presentation was high quality. The specific comments from Ambassadors show the range of styles and approaches that were employed:

*Both the sticker and the cards exercise were well received. They provided breaks in the process where the students could participate. In telling my personal story, any mention of points that the students could relate to were well received (like where I worked or what leisure activities I pursued). When I spoke about computer games, a few students approached me after to talk about it.*

*I think it's a great idea and the teacher was so excited for me to come in and show the kids how what they're learning can translate into real world situations.*

*Students felt the importance of science and Math. Even one student claimed that he wants to be a computer engineer after I delivered the presentation when he was escorting me out of the school and wants to be in touch with me.*

*The students seemed to be very engaged, asked lots of questions and were very interested in STEM careers. One student asked for a field trip to my place of work.*

*It rocked and the kids loved it.*

Some Ambassadors reported that they felt more comfortable after their first visit. For example, one Ambassador stated, “I think it went well. Once I delivered by first presentation, I was able to modify it for subsequent classes.” Another Ambassador stated, “I thought I did pretty well, considering it was my first time presenting to a group of 6th graders. I do think I got everybody involved and got the message across.”

## **IMPACTS**

### **STUDENTS REPORT BENEFITS OF VISITS**

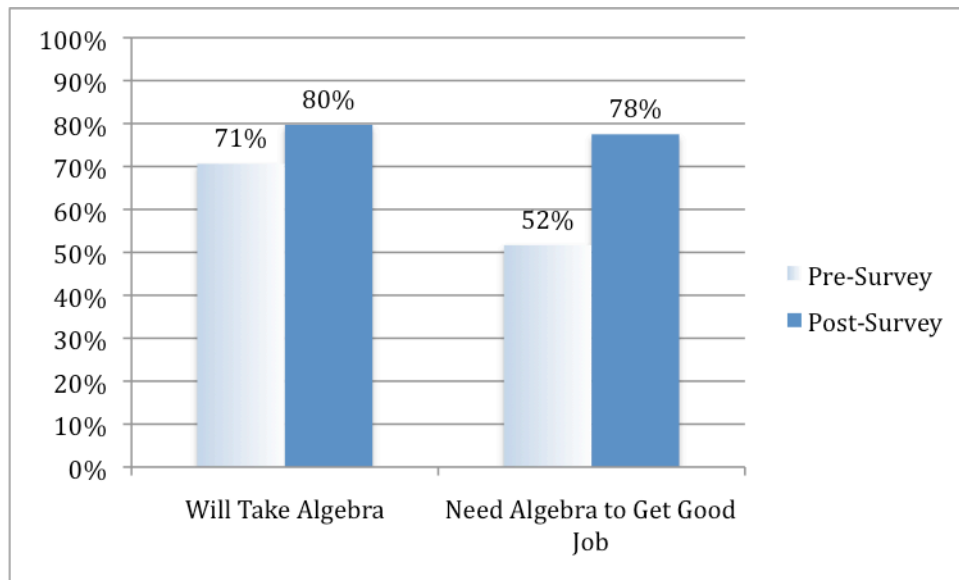
Students participating in the STEM Ambassador visits were asked to complete a pre-visit survey and a post-visit survey. A total of 572 students completed surveys prior to the visit and after the Ambassador visit. A sample of matched pre and post surveys were analyzed and the results of analyses on student survey data are summarized below.

Students reported improvements in attitudes and knowledge of STEM careers after the Ambassador visits. Our analysis of differences between the pre and post surveys reveals increases in the percentage of students who reported either agreed or strongly agreed with the statements that that mathematics and science can be fun. Moreover, t-test analysis of average attitude scores reveals statistically significant improvements in attitudes regarding mathematics after the STEM Ambassador visit ( $p < .05$ ).

Students' attitudes also increased slightly when asked to report their attitudes regarding how "interesting" STEM careers are. Students participating in the pilot test and the full implementation year reported increased interest in science and mathematics on the post survey. For example, on the pre-survey 81 percent of students reported that they believed mathematics was interesting and 85 percent reported that they believed science and technology was interesting.

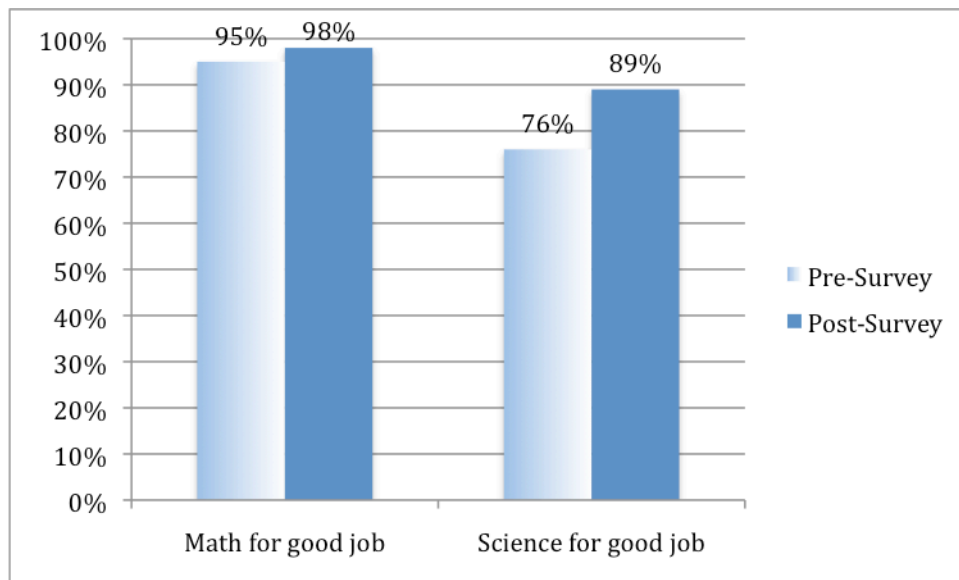
Students' knowledge increased as well. Students demonstrated statistically significant gains in understanding the types of STEM careers available to them and that mathematics is needed to pursue STEM careers. Graphic 5 illustrates that students were more knowledgeable about the importance of Algebra for getting a good job ( $p < .01$ ) and were more likely to report they would take algebra in the future ( $p < .05$ ).

**Graphic 5. Students' Attitudes and Knowledge about Algebra**



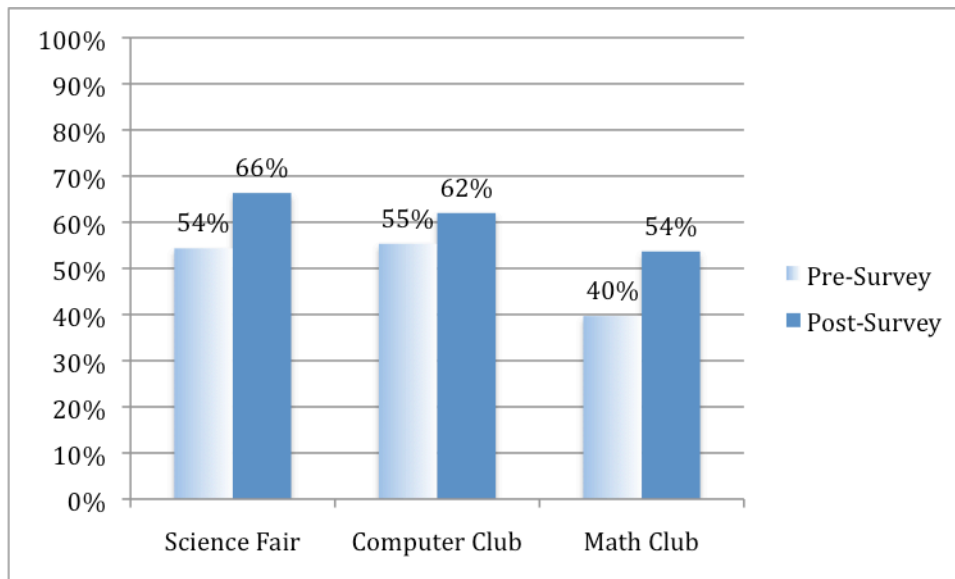
Students' attitudes toward science, technology, engineering, and mathematics also changed after the Ambassador visits. Students reported an increased understanding of the importance of mathematics, science, and technology in getting a good job (see Graphic 6).

**Graphic 6. Percent of Students' Who Believe STEM Important to Get a Good Job**



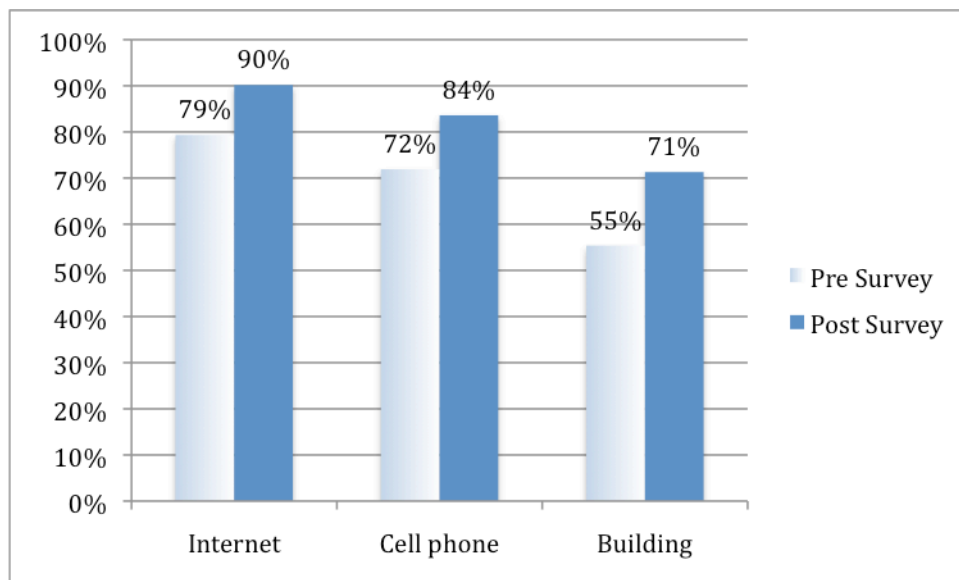
Students were also more likely to report that they would join clubs after the Ambassador visits. The percentage of students who reported that they would participate in future science fairs, computer clubs and mathematics clubs increased after the Ambassador visit. For example, prior to the visit under 40% of students in the pilot and full implementation year reported that they would join a mathematics club and after the visit this figure increased to over half of the students (see Graphic 7).

**Graphic 7. Percent of Students' Who Will Join Clubs**



Students were more likely to view science, technology and mathematics jobs favorably and to correctly identify careers that require knowledge of STEM. For example, Graphic 8 illustrates the percentage of students who believed STEM skills are used for the jobs involving the Internet, cell phones, or building before and after the visit. Higher percentages of students viewed words such as Internet, cell phones, as related to STEM after the Ambassador visit. See Graphic 8 below.

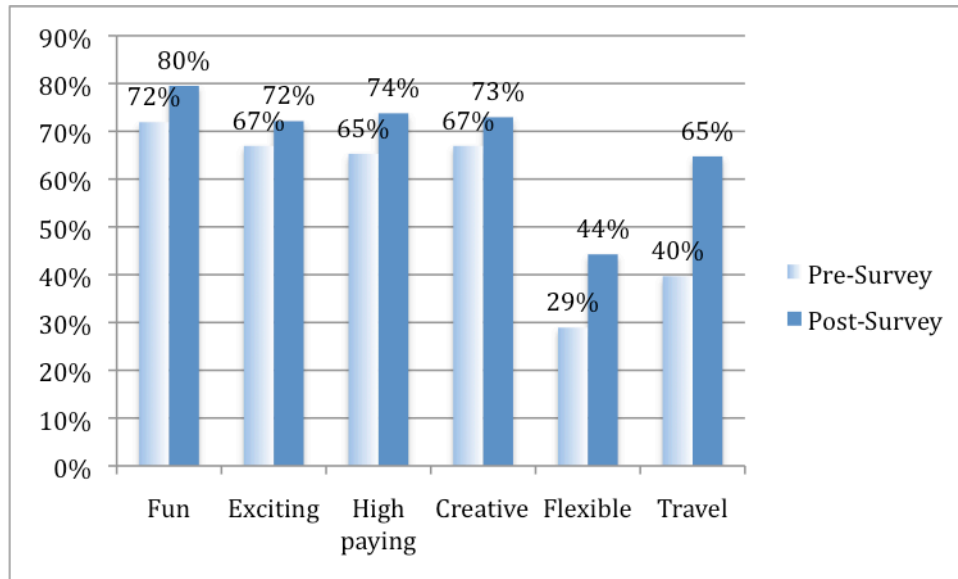
**Graphic 8. Percentage of Students Viewing Jobs As Involving...**



Qualitative analysis of open-ended questions reveals that students' awareness of careers that involve mathematics, science, and technology expanded after the STEM Ambassador visits. For example, when asked on the pre-survey to list jobs that involve mathematics numerous students listed the following occupations: teacher, cashier, and banker. Following the visit, examples of students' responses include: mechanical engineer, Comcast worker, and computer analyst. When asked to list jobs that involve science, examples of responses on the pre-survey include: scientist, teacher, and astronaut. Post-visit science jobs listed by students include: pediatrician, meteorologist, and video game developer. Example pre-survey technology jobs listed by students include: teacher, manager, and secretary. Finally, example post-survey technology jobs listed include: satellite designer, website creator, and computer programmer.

In addition, after the STEM Ambassador visit, students were more likely to view STEM jobs as fun, exciting, high paying, creative, flexible, and involving travel. See Graphic 9 below.

**Graphic 9. Percentage of Students Viewing STEM Jobs As . . .**



Students viewed the visits favorably. The overall rating was high and their comments revealed that they gained knowledge from the visit and that their attitudes toward STEM careers improved. On a 4-point scale with 4 being the highest and 1 being the lowest, the average score was 3.5.

Students reported that they learned from the STEM ambassador visits. Illustrative comments follow:

*I learned a bunch of cool jobs related to math, science, and technology.*

*I could have a life of science.*

*[I learned] . . . what job I can do after learning math and science and about different technologies there are for helping people.*

*[I learned] . . . what I will do in the future.*

*[I] learned that math and science can be fun and you will need it in the future.*

Most of the comments about the quality of the visits were positive. During the pilot year, some students had one key suggestion that was addressed during the implementation year. During the pilot year a few students indicated that they felt the Ambassador was not sensitive to working-class families. To address this issue, the STEM Tech Alliance leaders incorporated additional information in the training materials to ensure Ambassadors are aware that they need to address students from a range of backgrounds. No similar comments were reported in the full implementation year.

However, the majority of students provided favorable comments about the quality of the visits. Illustrative comments follow:

*It was interesting; now I want to become an engineer.*

*It was really interesting. I learned new interesting facts.*

*It taught me that always math is in your life.*

*I got to understand through activities.*

*You can be anything you want in math, science, and technology.*

*I loved hearing things that includes science and math.*

*DIGITS is important in helping you pick a career.*

## CONCLUSION AND RECOMMENDATIONS

### CONCLUSION

During the pilot test and full implementation year, the STEM Tech Alliance met or exceeded the project goals and benchmarks. In sum, the project:

- Successfully implemented all planned activities
- Met the target number of visits for the pilot test and for the full year of implementation
- Supported STEM Ambassadors, thereby enhancing fidelity of implementation
- Received positive reports from Ambassadors, teachers and students
- Improved student outcomes in terms of attitudes toward mathematics and knowledge about the importance of STEM ( $p < .05$ )