UMASS DONAHUE INSTITUTE • RESEARCH & EVALUATION GROUP

Massachusetts Mathematics, Science, Technology & Engineering Grant Fund (Pipeline Fund)

2005 Pipeline Fund Regional PreK-16 Networks Year End Report

Presented to the Massachusetts Board of Higher Education

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Introduction

The Pipeline Fund was established through a $2.5 million[1] Legislative appropriation under the Acts of 2003 Economic Stimulus Trust Fund. The Massachusetts Board of Higher Education (BHE) was directed to administer the Pipeline Fund with a focus on the following three goals:

(1) to increase the number of Massachusetts students who participate in programs that support careers in fields related to mathematics, science, technology, and engineering;

(2) to increase the number of qualified mathematics, technology, engineering and science teachers in the Commonwealth; and,

(3) to improve the mathematics, technology, engineering and science educational offerings available in public and private schools.

To achieve these goals, the BHE awarded a series of planning grants in Spring 2004 which established seven Regional PreK-16 Networks across the state linking institutions of higher education (both public and private), employers, PreK-12 institutions, and non-profit groups within each geographic area. The seven regions largely overlay those of the Regional Competitiveness Councils (RCC)[2] with two exceptions: the RCC's Greater Boston region was divided into two Networks (Greater Boston East and Greater Boston West), and the Southeast and Cape/Islands regions were combined into one Network. As a result, the Pipeline Fund Regional PreK-16 Networks consist of: Berkshire, Boston East, Boston West, Central, Northeast, Pioneer Valley, and Southeast.

Through the planning grants, each Network determined an individual set of regional priorities related to the three goals of the Pipeline Fund. After the Networks had completed their planning processes, the BHE initiated a second round of grants in Summer 2004 directed at funding specific projects that might serve as models for achieving the three Pipeline Fund goals. The funded projects covered a range of student- and teacher-centered activities which incorporated both content- and skill-based leaning.

To provide technical assistance to the funded projects to the Pipeline Fund goals, and to conduct the statewide evaluation of the Pipeline Fund projects, the BHE contracted with the University of Massachusetts Donahue Institute (UMDI). The results of our statewide evaluation and analysis are contained in the following report.

[1] Of this $2.5 million, $1.34 million was allocated to projects through the system of Regional PreK-16 Networks and $960,000 was allocated directly to projects at independent organizations.

[2] The Regional Competitiveness Councils were established in February 2003 by the Governor of Massachusetts through Executive Order No. 446. See the following document for more details: http://www.lawlib.state.ma.us/ExecOrders. The RCC's website is: http://rcc.massmeansbusiness.com/.

Executive Summary

For the 2004-2005 program year, the Massachusetts Board of Higher Education spent over $1 million to fund 17 projects through seven Regional PreK-16 Networks. These projects represented both the initiation of new, original activities as well as innovative expansions to already existing ones.

Statewide, 2,728 students and 216 teachers from 148 schools in 91 school districts participated in Pipeline Fund Projects. Among the projects that collected gender and racial information on their participants 46% of the students and 63% of the teachers were female. Twenty-eight percent (28%) of the students and nine percent (9%) of the teachers were minority. In most cases, the school districts that were involved with the Regional Networks' projects were "higher needs" than the average for the region in general. That is, the school districts involved in the projects had higher percentages of students who were low-income, minority, English language learners, or for whom English was a second language than was the average for the region as a whole.

For this report projects were generally categorized into three groups: ones with only students as participants, ones with both students and teachers as participants, and ones with only teachers as participants. However, the level of diversity among the projects went much further than this. Projects involved students and teachers from all grade levels. Project activities were varied in their duration (from a few hours to a full year in length), in their focus (some were focused in increasing interest in STEM while others were focused on conveying particular STEM content-knowledge), and in the STEM-oriented predisposition of their participants (some students were chosen to participate in projects because they were already interested in STEM areas, other projects involved students who specifically were not strongly interested in STEM areas).

In addition to the high degree of variety among the projects, there was considerable variation in the projects' evaluation methods. While several general types of instruments such as focus groups, pre- and post-project tests of content knowledge, pre- and post-project surveys of interest, reflective writing, and evaluator observations were used by multiple projects the exact format of these tools as well as their implementation varied considerably. To facilitate analysis of each project's evaluation, the instruments used were categorized into three groups: (1) formative methodologies (instruments that assessed the project's implementation and management processes), (2) short-term summative methodologies (instruments that assessed the goals each project set out to meet within its time span), and (3) long-term summative methodologies (instruments that assessed lasting effects beyond a project's time span, especially the linkage of each project's internal goals to the three goals of the Pipeline Fund).

While the diversity among projects and their evaluations presented limits to the amount of generalized analysis that could be done, several specific examples of effective evaluation within projects could be found and their results placed within the larger context of the three goals of the Pipeline Fund. Among projects which involved only students, almost all projects reported increases in either student knowledge and/or interest. In addition, among projects which involved only teachers, almost all projects reported increases in knowledge and/or teaching skills. However, in both cases the exact nature and degree of the changes depended on each project's duration and intensity, as well as the level of sophistication of the evaluation instruments used to document the changes.

A more detailed analysis of each project and its evaluation results suggests several ways in which the implementation and evaluation of future projects might be refined. Changes to data collection and evaluation processes will better enable analysts to make targeted statements of impact.

Network Evaluation Expectations and Technical Assistance

When the Pipeline Fund Regional PreK-16 Networks applied for Phase II funding during the summer of 2004, the Call for Proposals outlined that "Each proposal must include a set of evaluation methods and criteria to measure project's effectiveness." Once the proposals were submitted, reviewers were asked to assess each one's "evaluation and dissemination plan" on the following scale: strong response, satisfactory response, needs improvement, and unsatisfactory. Specific evaluation items that reviewers were to assess included:

- Do the goals of each project seek to meet STEM goals?
- Are the goals for the plan measurable?
- Is there a set evaluation plan whereby the projects will be measured to determine whether or not stated goals are met?[3]

Once projects were reviewed for Phase II funding, the BHE returned the proposals to their respective Regional Networks along with an outline of which projects within the proposals would be funded and what the funding level for each project would be. Each Regional Network was to review the BHE's outline and funding limits and submit a revised budget as well as a revised budget narrative that outlined what changes were made to the original proposal.

In December 2004, the BHE contracted with the Donahue Institute's Research and Evaluation division to provide evaluation technical assistance for the seven Regional Networks. From January to March 2005, the Donahue Institute Pipeline Fund Team conducted meetings with each Regional Network (including, minimally, the Pipeline Fund Coordinator, the project evaluator, and a designated representative of the lead institution) that adhered to the following agenda:

I. Introductions and questions
II. Review plans for funded projects
    A. Any changes?
    B. Have timeline targets been met to date?
    C. What is the timeline going forward?
III. General evaluation guidelines
    A. Emphasis on short-term (e.g., internal to project duration) outcomes
    B. Incorporation of academic, skill, and affective measures
    C. Balance of formative, process, and summative evaluations
IV. Review of Network evaluation plan
    A. Any changes from proposal?
    B. Nature of formative or process evaluation?
    C. Nature of summative evaluation?
        1. Academic
        2. Skill
        3. Affective
        4. Other
V. Wrap up

[3] From the Phase II PreK-16 Network Planning Project evaluation form.

Furthermore, at each of these meetings the Donahue Institute Pipeline Fund Team engaged representatives of the Regional Networks in a discussion of how to balance and mesh evaluation of short-term outcomes (e.g., outcomes that are achievable within the duration of the project) with that of long-term outcomes (e.g., the three goals of the Pipeline Fund) for each of their projects.

Following these initial visits between representatives of each Regional Network and the Donahue Institute's Pipeline Fund Team, the Networks were required to submit a Mid-Year Report to the BHE that described progress to date as well as any changes that had been, or would be, made to the project, including its evaluation plan.

From April to September 2005 (the month in which all projects were to be completed) the Donahue Institute's Pipeline Fund Team kept in contact with the project coordinators and lead-institution-representatives of each Network through a variety of channels and concerning both evaluation technical assistance as well as other points of the Donahue Institute's contract with the BHE.

Upon completion of their projects, each Network submitted a detailed End-of-Year Report to the BHE that included descriptive information about the Network as a whole, its project(s), each project's participants, and the results of the evaluation of each project.

Statewide Descriptive Project Data

Project Information

For the 2004-2005 program year, the Massachusetts Board of Higher Education spent $1.34 million[4] to fund 17 projects through seven Regional PreK-16 Networks. These projects represented both the initiation of new, original activities as well as innovative expansions to already existing ones. Of the 17 projects, three were new, original activities: Making the Connection (Central Regional Network), STEM Fellows (Northeast Regional Network), and Project Invention (Southeast Regional Network). Twelve projects were new applications of existing activities, or expansions of those activities to new groups of participants. The remaining two were projects that did not involve primary participants: Engineering Pathways Mapping Project (Pioneer Valley Regional Network) and MassBioEd Lab Awards (Southeast Regional Network). The following contains a brief description of all funded projects:

Berkshire Regional Network

"Got Math?": A project that taught math skills to fourth grade students through hands-on activities that were linked to real life applications through a unifying theme. Three sets of students from three elementary schools worked after-school in small groups with a mentor for eight weeks and, after completing the project, took a field trip to a related business to see math "in action."

Boston East Regional Network

Boston Summer Advanced Mathematics: A six-week, summer, pre-calculus project designed to prepare students for taking calculus during their senior year of high-school. The course took place at Northeastern University where students attended classes for about 2 hours, four mornings each week and were required to finish daily assignments. In addition, students were introduced to "The Bottom Line," a college counseling program.

Discovery Lab/MassPEP: An academic-year, after-school project where elementary and middle school students from Roxbury and Mattapan could learn about engineering through computer modules. Students attended the project twice per week and were required to write a journal entry and pass a quiz with 100% accuracy for each module before proceeding on to the next one.

Waterfront Learning Project: A project that introduced Boston elementary school teachers to the Boston waterfront for hands-on, field studies. Teachers attended a full-day introductory session that covered the connection of project content to the schools' science curriculum as well as direct field training. Teachers also attended a three-hour follow-up session where they could work on lesson plans and other things associated with implementing an actual field studies trip for their students.

[4] Of the $1.34 million, $70,000 was allocated to the Regional Networks through Phase I Planning Grants and $1.27 million was allocated via Phase II Project Grants.

Boston West Regional Network

Future Scientists of America and Robotics Clubs: An after-school science and engineering project for middle and high school girls that utilized materials from the Future Scientists and Engineers of America organization. Teachers were given eight hours of training that covered lesson plan development, STEM career choices, engineering design processes, and experimental activities. These teachers then led students in a project that the students could bring to a competition.

SolidWorks: A project that utilized Computer Assisted Design. Teachers attended a full-day workshop that covered understanding of 3D modeling and integration of 3D modeling with math and science curricula. Teachers then led workshops for high school students using the software to teach basic principles of 3D modeling.

Central Regional Network

Making the Connection: A 40-hour teacher preparation project that focused on improving teachers' understanding of data analysis. Teachers, in turn, then led students in classroom-based application of data analysis through experiments and design activities.

Northeast Regional Network

STEM Fellows: A team of middle and high school teachers was recruited from each participating district. The teachers each developed, in consultation with a mentor, a personal professional development plan that incorporated taking one of the several professional development offerings organized by the Network. In addition, the participating district teams produced capstone plans focused on long-term improvement of STEM education in their district that incorporated analysis of their district's STEM needs, analysis of their district's demographic and academic information, and analysis of their district's potential resources.

Pioneer Valley Regional Network

Academic Year Seminars for Teachers: Also referred to as Science and Engineering Saturday Seminars. A set of five, independent sessions each facilitated by the UMass Amherst College of Engineering and the STEM Education Institute and each covering a mix of engineering content, curriculum integration, and pedagogy.

Engineering Pathways Mapping Project: A project that organized available career and educational options into a set of coherent engineering pathways. Two community colleges were given funds to catalog existing activities and to resolve transfer issues between high schools, community colleges, and four-year colleges. Pamphlets were produced for distribution to parents, guidance counselors, teachers, and students to inform their understanding of opportunities.

Engineering/Technology Career Fairs: Three career fairs were held to introduce middle and high school students to various engineering, technology, and other STEM careers. One fair focused on recruitment of minority students into engineering.

Saturday Explorations in Science and Engineering: A project at Western New England College for middle and high school students from Springfield. The project consisted of six sessions with a mix of presentations, hands-on activities, lab work, and visits to labs. Each Saturday was devoted to a different STEM area.

Summer Content and Pedagogy Institutes: A project that consisted of three summer courses offered through Smith and Westfield State colleges. All were offered for college credit and/or 67.5 professional development points. One course covered math issues while two covered engineering issues.

Summer Enrichment Activities: Two, one-week projects, one at Greenfield Community College and one at Springfield College that engaged middle school students in activities to increase their awareness of STEM careers.

Southeast Regional Network

Advanced Studies and Leadership Program: A four-week, residential, summer project hosted by the Massachusetts Maritime Academy for 8th and 9th grade students. Students took classes in STEM related areas that emphasized hands-on activities and real-world applications.

MassBioEd Lab Awards: A project that gave financial assistance to three approved (by MassBioEd[5]) but wait-listed proposals for science laboratory remodeling and refitting in Taunton, Plymouth North and Plymouth South high schools.

Project Invention: A project based on the "Invention Convention" model where secondary school teams research topic areas; find a need to fulfill, a problem to solve, or a plan to develop; develop and test an appropriate invention; and present the invention at a convention dedicated to the project participants.

Participant Information

Project funding covered many areas, including the direct cost of teacher and/or student educational activities; both project and Network administrative costs; costs associated with conducting local, objective project evaluation; and costs associated with outreach and technology. Each Regional Network supported a part-time manager whose duties involved oversight of the funded project(s), coordination of all other Network activities (e.g., board meetings, regional outreach, communication with members), maintenance of Network technology (e.g., website, electronic mailing lists, electronic bulletin boards), and communication with both the BHE and UMDI. Table 1 shows the distribution of projects and Phase II project funds across the seven Regional Networks.

Table 1: Number of Projects and Funding by Network for Pipeline Fund Phase II Funding

Network	Number of Projects	Amount of Funding
Berkshire	1	$65,539
Boston East	3	$126,353
Boston West	2	$120,048
Central	1	$225,119
Northeast	1	$238,961
Pioneer Valley	6	$261,966
Southeast	3	$236,172
Statewide Total	**17**	**$1,274,158**

As mentioned above, Pipeline Fund projects involved both teachers and students. Statewide, seven projects had only students as their primary participants, four projects had only teachers as their primary participants, and four projects had both students and teachers as their primary participants. Two projects did not have primary

[5] See MassBioEd's website for more information: http://www.massbio.org/massbioed/index.php.

participants: the Engineering Pathways Mapping Project and the MassBioEd Lab Awards. Table 2 shows the type and grade level for the fifteen projects with primary participants.

Table 2: Type of Primary Participants by Project

Network	Project	Type of Participants	Grade Level of Participants
Berkshire	"Got Math?"	Students and Teachers	Elementary School
Boston East	Boston Summer Advanced Math	Students	High School
Boston East	Discovery Lab/MassPEP	Students	Middle and High School
Boston East	Waterfront Learning Project	Teachers	Elementary School
Boston West	Future Scientist and Engineering/Robotics Clubs	Students	Middle and High School
Boston West	SolidWorks	Students and Teachers	Middle and High School
Central	Making the Connection	Students and Teachers	Middle School
Northeast	STEM Fellows	Teachers	Middle and High School
Pioneer Valley	Academic Year Seminars for Teachers	Teachers	Middle and High School
Pioneer Valley	Engineering/Technology Career Fairs	Students	Middle and High School
Pioneer Valley	Saturday Explorations in Science and Engineering	Students	Middle and High School
Pioneer Valley	Summer Content and Pedagogy Institutes	Teachers	Middle and High School
Pioneer Valley	Summer Enrichment Activities	Students	Middle School
Southeast	Advanced Studies and Leadership Program	Students	Middle School
Southeast	Project Invention	Students and Teachers	Middle School

Table 3 shows the number of students and teachers by Regional Network. Statewide, 2,728 students and 216 teachers were involved as primary participants in Pipeline Fund projects. The majority of student participants were served by projects in two Networks: Central and Pioneer Valley. Participating teachers in the Central Regional Network led applied learning activities for two to three of their classes, with an average of forty students participating. The Engineering/Technology Career Fairs sponsored by the Pioneer Valley Regional Network contributed to its large number of student participants.

Table 3: Number of Primary Participants by Network

Network	Students	Teachers
Berkshire	60	3
Boston East	37	29
Boston West	262	16
Central	1,182	28
Northeast	--	36
Pioneer Valley	988	86
Southeast	199	18
Statewide Total	**2,728**	**216**

In this initial year of funding, it was not required that the Regional Networks collect specific demographic information from their participants. However, some projects did collect racial and gender distributions on their own and submitted these data as a part of their final reports. Gender distributions were collected for 1,591 students and 101 teachers. Of these, 730 (or 46%) of the students and 64 (or 63%) of the teachers were female. Racial distributions were collected for 1,371 students and 64 teachers. Of these, 385 (or 28%) of the students and 6 (or 9%) of the teachers were minorities.

Statewide, 148 known public, non-charter schools from 91 school districts were involved with Pipeline Fund projects.[6] School specific data from two of the Networks (Boston East and Southeast) were incomplete so only those schools that were readily identifiable were counted. Table 4 shows the distribution of participating districts and schools across the seven Regional Networks:

Table 4: Number of Participating School Districts and Schools by Network

Network	Number of School Districts	Number of Schools
Berkshire	3	3
Boston East*	1	3
Boston West	11	13
Central	4	8
Northeast	8	21
Pioneer Valley**	42	78
Southeast*	22	22
Statewide Total	**91**	**148**

*Known: other districts and/or schools participated, but their data were not available.

**Public, non-charter only. One charter school and 6 private or alternative schools also participated, but their data were not available.

Demographic data for public school districts are available through the Massachusetts Department of Education website.[7] Tables 5 through 8 show selected student demographic percentages statewide, for each Network, and for the sub-set of districts participating in Pipeline Fund projects within each Network. In most cases, the Regional Networks involved districts in their projects that were "higher needs" than the average for their region. In five of the seven Networks the percentage of low-income students in districts participating in Pipeline Fund projects was higher than that of the region as a whole. In four of the seven Networks the percentages of minority, 1st Language is not English, and Limited English Proficient students in districts participating in Pipeline Fund projects were higher than that of the region as a whole.

Table 5: Students Who are Low-Income

Network	All Districts Within the Network	Districts that Participated in Projects
Berkshire	28%	32%
Boston East	36%	74%
Boston West	9%	12%
Central	27%	33%
Northeast	28%	16%
Pioneer Valley	40%	41%
Southeast	25%	15%

Note: Statewide average for all districts is 28%.

[6] Seven additional collaborative, early college, special education, private and charter schools also participated, but their data were not available.

[7] http://profiles.doe.mass.edu/

Table 6: Students Who are Minority		
Network	**All Districts Within the Network**	**Districts that Participated in Projects**
Berkshire	11%	11%
Boston East	42%	86%
Boston West	14%	17%
Central	22%	32%
Northeast	26%	16%
Pioneer Valley	32%	35%
Southeast	16%	7%

Note: Statewide average for all districts is 26%.

Table 7: Students for Whom Their First Language is not English		
Network	**All Districts Within the Network**	**Districts that Participated in Projects**
Berkshire	3%	2%
Boston East	23%	37%
Boston West	8%	13%
Central	13%	20%
Northeast	19%	9%
Pioneer Valley	13%	18%
Southeast	8%	2%

Note: Statewide average for all districts is 14%.

Table 8: Students With Limited English Proficiency		
Network	**All Districts Within the Network**	**Districts that Participated in Projects**
Berkshire	2%	2%
Boston East	8%	17%
Boston West	3%	4%
Central	5%	8%
Northeast	6%	4%
Pioneer Valley	7%	8%
Southeast	2%	1%

Note: Statewide average for all districts is 5%.

Project Characteristics

Educational Characteristics

The following characteristics were self-identified by each project in the year-end reports submitted to the Board of Higher Education.

Projects with Students as Primary Participants

Table 9: Educational Characteristics of Projects with Students as Primary Participants

Project	Advanced Studies and Leadership Program	Boston Summer Advanced Math	Discovery Lab/ MassPEP	Engineering/ Technology Career Fairs	Future Scientist and Engineering/ Robotics Clubs	Saturday Explorations in Science and Engineering	Summer Enrichment Activities
Network	**Southeast**	**Boston East**	**Boston East**	**Pioneer Valley**	**Boston West**	**Pioneer Valley**	**Pioneer Valley**
Primary Participants	Students	Students	Students	Students	Students	Students	Students
Number of Primary Participants	122 Students	18 Students	19 Students	928 Students	160 Students	30 Students	30 students
Start Date	7/05	Summer 05	9/04	1/05	10//04	1/05	7/05
End Date	7/05	Summer 05	6/05	3/05	5/05	2/05	7/05
Total Hours	More than 80	19 to 30		3 to 6	41 to 80	19 to 30	19 to 30
Credits Offered	No		No	No	No	No	No
School Level	Middle School	High School	Elementary and Middle School	Middle and High School	Middle School	Middle and High School	Middle School
Content-based Learning	Yes	Yes			Yes		
Hands-on Learning	Yes		Yes	Yes	Yes	Yes	Yes
Individual Inquiry Projects	Yes		Yes				
Group Inquiry Projects	Yes				Yes		
Self-Directed Learning	Yes	Yes					
Observation							
Reflection Exercises	Yes						
Visits to Industry Sites							
Industry Mentoring					Yes		
Career Awareness	Yes			Yes	Yes		
Career Advising	Yes	Yes		Yes			
Use of Technology	Yes				Yes		Yes
Other							
Comments							

Projects with both Students and Teachers as Primary Participants

Table 10: Educational Characteristics of Projects with both Students and Teachers as Primary Participants				
Project	**Got Math?**	**Making the Connection**	**Project Invention**	**SolidWorks**
Network	**Berkshire**	**Central**	**Southeast**	**Boston West**
Primary Participants	Students and Teachers	Students and Teachers	Students and Teachers	Students and Teachers
Number of Primary Participants	60 Students and 3 Teachers	1,182 Students and 28 Teachers	77 Students and 18 Teachers	102 Students and 16 Teachers
Start Date	N/A	10/04	11/04	10/04
End Date	N/A	06/05	5/05	5/05
Total Hours	41 to 80	41 to 80	41 to 80	41 to 80
Credits Offered	No	Yes	No	No
School Level	Elementary School	Middle School	Middle and High School	High School
Content-based Learning		Yes	Yes	Yes
Hands-on Learning	Yes	Yes	Yes	Yes
Individual Inquiry Projects		Yes	Yes	
Group Inquiry Projects		Yes	Yes	
Self-Directed Learning		Yes	Yes	Yes
Observation			Yes	
Reflection Exercises		Yes	Yes	Yes
Visits to Industry Sites	Yes		Yes	
Industry Mentoring		Yes	Yes	
Career Awareness	Yes	Yes	Yes	Yes
Career Advising				
Use of Technology		Yes	Yes	Yes
Other	Math application and problem solving			
Comments				

Projects with Teachers as Primary Participants

Table 11: Educational Characteristics of Projects with Teachers as Primary Participants				
Project	**Academic Year Seminars for Teachers**	**STEM Fellows**	**Summer Content and Pedagogy Institutes**	**Waterfront Learning Project**
Network	**Pioneer Valley**	**Northeast**	**Pioneer Valley**	**Boston East**
Primary Participants	Teachers	Teachers	Teachers	Teachers
Number of Primary Participants	46 teachers	36 Teachers	40 Teachers	29 Teachers
Start Date	9/04	11/04	7/05	Spring 05
End Date	6/05	10/05	7/05	Spring 05
Total Hours	More than 80	41 to 80	41 to 80	3 to 6
Credits Offered	No	Yes	Yes	
School Level	Middle and High School	Middle and High School	Elementary, Middle and High School	
Content-based Learning	Yes	Yes	Yes	Yes
Hands-on Learning		Yes	Yes	Yes
Individual Inquiry Projects		Yes		
Group Inquiry Projects		Yes		
Self-Directed Learning		Yes		
Observation		Yes		
Reflection Exercises		Yes		
Visits to Industry Sites				
Industry Mentoring				
Career Awareness		Yes		
Career Advising				
Use of Technology		Yes		Yes
Other				Field Work
Comments		60 PDPs were awarded for project completion.		

Evaluation Characteristics

The following characteristics represent a summary of tools that were used by projects in their evaluations. The Request for Proposals (RFP) to which the Regional Networks responded did not call for a specific set of evaluation methodologies to be used or an overarching framework within which they were to be organized. Rather, the Regional Networks were asked to describe a plan for demonstrating the effectiveness of their projects. The tools described in these plans have been organized into formative, short-term summative, and long-term summative evaluation methodologies as a means of framing their analysis. An effective evaluation is generally thought to contain tools that address all three areas.

I. Formative – methodologies and results that assess the project's implementation and management process,
II. Short-term summative – methodologies and results that assess the goals each project set out to meet within its time span, and
III. Long-term summative – methodologies and results that assess lasting effects beyond a project's time span, especially the linkage of each project's internal goals to the three goals of the Pipeline Fund.

Projects with Students as Primary Participants

Table 12: Evaluation Characteristics of Projects with Students as Primary Participants

Project	Advanced Studies and Leadership Program	Boston Summer Advanced Math	Discovery Lab/ MassPEP	Engineering/ Technology Career Fairs	Future Scientist and Engineering/ Robotics Clubs	Summer Enrichment Activities
Network	**Southeast**	**Boston East**	**Boston East**	**Pioneer Valley**	**Boston West**	**Pioneer Valley**
Formative Evaluation Methodologies						
Curriculum Materials						
Enrollment Records						
Focus Groups						
Interviews						
Post-Project Survey/Test		Yes		Yes	Yes	
Staff Observations		Yes	Yes			
Short-term Summative Evaluation Methodologies						
Curriculum Materials	Yes		Yes			
Enrollment Records	Yes					
Evaluator Observations						
Focus Groups						
Interviews						
Participant Self-Assessment						
Post-Project Survey/Test Only		Yes		Yes		
Pre- and Post-Project Survey/Test	Yes				Yes	Yes
Pre-Project Survey/Test Only						
Reflective Writing						
Rubric-based Assessment						
Staff Assessment		Yes	Yes			
Long-term Summative Evaluation Methodologies						
Participant Tracking		Yes				

Projects with both Students and Teachers as Primary Participants

Table 13: Evaluation Characteristics of Projects with both Students and Teachers as Primary Participants				
Evaluation Method	**"Got Math?"**	**Making the Connection**	**Project Invention**	**SolidWorks**
Network	**Berkshire**	**Central**	**Southeast**	**Boston West**
Formative Evaluation				
Curriculum Materials	Yes			
Enrollment Records			Yes	
Focus Groups			Yes	
Interviews	Yes	Yes		
Post-Project Survey/Test		Yes	Yes	Yes
Staff Observations				
Short-term Summative Evaluation				
Curriculum Materials				
Enrollment Records				
Evaluator Observations	Yes		Yes	
Focus Groups		Yes		
Interviews		Yes		
Participant Self-Assessment		Yes		
Post-Project Survey/Test Only				
Pre- and Post-Project Survey/Test	Yes	Yes	Yes	Yes
Pre-Project Survey/Test Only				
Reflective Writing		Yes	Yes	
Rubric-based Assessment		Yes		
Staff Assessment				
Long-term Summative Evaluation				
Participant Tracking				

Projects with Teachers as Primary Participants

Table 14: Evaluation Characteristics of Projects with Teachers as Primary Participants				
Evaluation Method	**Academic Year Seminars for Teachers**	**STEM Fellows**	**Summer Content and Pedagogy Institutes**	**Waterfront Learning Project**
Network	**Pioneer Valley**	**Northeast**	**Pioneer Valley**	**Boston East**
Formative Evaluation				
Curriculum Materials				
Enrollment Records				
Focus Groups		Yes		Yes
Interviews				
Post-Project Survey/Test	Yes	Yes	Yes	
Staff Observations				
Short-term Summative Evaluation				
Curriculum Materials				
Enrollment Records		Yes		
Evaluator Observations				
Focus Groups		Yes		Yes
Interviews				
Participant Self-Assessment				
Post-Project Survey/Test Only				
Pre- and Post-Project Survey/Test		Yes	Yes	Yes
Pre-Project Survey/Test Only				
Reflective Writing				
Rubric-based Assessment		Yes		
Staff Assessment				
Long-term Summative Evaluation				
Participant Tracking		Yes		

Analysis Framework

This first year's cohort of projects was very diverse both in their activities and in their evaluations. Throughout this report projects are divided into three large categories: (1) projects with only students as primary participants, (2) projects with only teachers as primary participants, and (3) projects with both students and teachers as primary participants. It should be noted, however, that the range of differences inherent in this cohort of projects goes beyond this grouping by type of participants. In addition to different participant groupings, these projects covered a wide spectrum of intensity and duration. In one case a project consisted of seminars for teachers that lasted a few hours each (teachers were not required to attend all of the seminars, only those – or the one – in which they were interested). In another case, a project required teachers, over the course of twelve months, to complete not only a full forty-hour STEM-related class for professional development credits, but to engage in outside research and preparation for an independent activity that totaled at least another eighty hours of time, and to attend regular meetings throughout the year.

A second way in which projects varied was in their specific educational foci. Some projects were content-oriented while some projects were interest-oriented. Among the content-oriented projects, some were focused on specific STEM areas (e.g., math or engineering) while others addressed either every STEM area or STEM areas in general. Among the interest-oriented projects some were focused on short-term goals such as increasing students' interest in a school subject they were taking. Other interest-oriented projects were focused on long-term goals such as increasing middle school students' interest in STEM career fields.

Thirdly, projects differed in their educational approaches. Some projects involved simple, direct content presentation in a seminar format. Other projects involved "real-world" application of skills gained through hands-on experience. In addition, the grade level of the teachers and students varied, ranging from elementary to high school.

Another area in which student projects varied was in the STEM-oriented predisposition of their participants. In some cases projects drew only on those students who already had an interest in, or showed above average skills in, science, technology, engineering or mathematics. In other cases the project participants were drawn from general student populations, or even targeted students who showed difficulties in STEM areas or in school in general.

The diversity in evaluations of the projects was just as extensive as the diversity in the projects themselves. While several general types of instruments such as focus groups, pre- and post-project tests of content knowledge, pre- and post-project surveys of interest, reflective writing, and evaluator observations were used by multiple projects the exact format of those tools as well as their implementation varied considerably. In some cases the variation in format or implementation was directly related to one of the project differences discussed above. For example, while multiple projects implemented content pre- and post-project tests, the amount of time and degree of learning that took place between each of those tests varied according to the duration and intensity of the project as a whole. An example of difference in format includes one case where response options to an interest survey were presented as emotional icons (e.g., a smiley face) because it was anticipated that a number of the students participating in the project would still be English language learners. In another project, students were asked questions about their interest in specific kinds of STEM activities that had taken place during the project.

Effective Evaluation Methods

The high level of diversity among projects and their evaluations places limits on the amount of generalized analysis that can be presented in this report. However, examples of where different evaluation methods were effectively utilized are presented below within the context of the three goals of the Pipeline Fund.

Pipeline Fund Goal I: To increase the number of Massachusetts students who participate in programs that support careers in fields related to mathematics, science, technology, and engineering.

The projects associated with the Pipeline Fund in 2005 provided access to specialty STEM projects for over 2,700 students. Table 15 shows the distribution of STEM areas covered by the eleven projects in which students participated.

Table 15: Distribution of STEM Areas Among Pipeline Fund Projects Which Involved Students

Project (Network)	Number of Students	Science	Technology	Engineering	Math
Advanced Studies and Leadership Program (Southeast)	122	X	X	X	X
Boston Summer Advanced Math (Boston East)	18				X
Discovery Lab/MassPEP (Boston East)	19	X	X	X	X
Engineering/Technology Career Fairs (Pioneer Valley)	928		X	X	
Future Scientists and Engineering/Robotics Clubs (Boston West)	160	X	X	X	X
"Got Math?" (Berkshire)	60				X
Making the Connection (Central)	1,182	X	X	X	X
Project Invention (Southeast)	77	X	X	X	X
Saturday Explorations in Science and Engineering (Pioneer Valley)	30	X	X	X	X
SolidWorks (Boston West)	102	X	X	X	X
Summer Enrichment Activities (Pioneer Valley)	30	X	X	X	X

As mentioned above, these projects varied greatly. Some projects involved one-day career fairs focused on increasing students' interest in STEM careers. Other projects involved multi-week hands-on learning projects focused on helping students see the interrelations of the STEM subjects they are learning in school and to learn about those subjects in a different manner. Projects that had been in existence longer (e.g., projects for which the Pipeline Fund supported expansions to new populations), or that invested in professionally-developed evaluation instruments, tended to have evaluation processes that were more effective. That is, the instruments used by these projects, and the analysis of their results, were done at a higher level of sophistication than other projects. Generally, almost all projects reported increases in either student knowledge or interest. The exact nature and degree of that change, however, depended on each project's duration and intensity, as well as the level of sophistication of the evaluation instruments used to document the changes. Qualitative evaluation results (e.g.,

reflective writing, open-ended comments on a post-project survey, focus groups) were also generally supportive of the funded projects and often served as effective sources of ideas for expanding or further improving them.

In documenting the value of this year's Pipeline Fund-sponsored, student-oriented projects the following ones exhibited effective methodologies and results:

Formative Evaluation

Project Invention (Southeast Regional Network) implemented an effective set of pre- and post-project surveys that documented both students' and teachers' perceptions of the value of the project and the ways it could be improved. End-of-project focus groups were also effective in soliciting anecdotal information about the value of the project, what initial impressions of such a project were among the students, and in what way those impressions changed.

Short-term Summative Evaluation

The Advanced Studies and Leadership Program (Southeast Regional Network) implemented an effective pre- and post-project survey to document changes in students' content knowledge and their awareness of different career options in various STEM areas. The survey also attempted to document changes in students' knowledge of how the information students learned was connected to real-life, but was less effective in this area.

Making the Connection (Central Regional Network) implemented an effective assessment of student activities within the project that was able to document how the kind of teaching/learning strategies that were central to the project affected "underserved" students somewhat differently than students who were not "underserved."

Project Invention (Southeast Regional Network) implemented a strong pre- and post-project survey that tracked increases in students' knowledge and interest of STEM areas from both the students' as well as the teachers' perspectives. Analysis of questions concerning general skills and interests (e.g., teamwork and going to college) was done at a level of calculating statistical significance and of differentiating the scores for male and female students.

SolidWorks (Boston West Regional Network) implemented an effective set of pre- and post-project tests that documented knowledge and skills gains specific to the project's subject area (three-dimensional geometry).

Long-term Summative Evaluation

Boston Summer Advanced Math's (Boston East Regional Network) plans to track participants included documenting the degree of success participants have in their senior year calculus course and other STEM classes, documenting in which colleges participants enroll, and tracking participants during college to see if they eventually choose STEM-oriented majors. As of yet there are no results to report for these tracking methods so their effectiveness is undetermined.

Pipeline Fund Goal II: To increase the number of qualified mathematics, technology, engineering and science teachers in the Commonwealth.

The projects associated with the Pipeline Fund in 2005 provided access to STEM projects for over 200 teachers. Table 16 shows the distribution of STEM areas covered by the eight projects in which teachers participated.

Table 16: Distribution of STEM Areas Among Pipeline Fund Projects Which Involved Teachers

Project (Network)	Number of Teachers	Science	Technology	Engineering	Math
Academic Year Seminars for Teachers (Pioneer Valley)	46	X	X	X	X
"Got Math?" (Berkshire)	3				X
Making the Connection (Central)	28	X	X	X	X
Project Invention (Southeast)	18	X	X	X	X
SolidWorks (Boston West)	16	X	X	X	X
STEM Fellows (Northeast)	36	X	X		X
Summer Content and Pedagogy Institutes (Pioneer Valley)	40		X	X	X
Waterfront Learning Project (Boston East)	29	X	X	X	

As with the student-oriented projects, teacher-oriented projects varied greatly. In one case a project consisted of seminars for teachers that lasted only a few hours each and where teachers were not required to attend all of the seminars, only those – or the one – in which they were interested. In another case, a project required teachers, over the course of twelve months, to complete not only a full forty-hour STEM-related class for professional development credits, but to engage in outside research and preparation for an independent activity that totaled at least another eighty hours of time, and to attend regular meetings throughout the year. Generally, almost all projects reported increases in knowledge or teaching skills. As with the student-oriented projects, the exact nature and degree of that change, however, depended on each project's duration and intensity, as well as the level of sophistication of the evaluation instruments used to document the changes. Qualitative evaluation results (e.g., reflective writing, open-ended comments on a post-project survey, focus groups) were also generally supportive of the funded projects and often served as effective sources of ideas for expanding or further improving them.

In documenting the value of this year's Pipeline Fund-sponsored, teacher-oriented projects the following ones exhibited effective methodologies and results:

Formative Evaluation

Making the Connection (Central Regional Network) implemented an effective series of interviews that yielded feedback not only from the teacher-participants, but also from administrative personnel in the teachers' home school districts. The feedback from the district administrators included commentary on potential further implementation of the project's activities.

Project Invention (Southeast Regional Network) implemented an effective set of pre- and post-project surveys that documented both students' and teachers' perceptions of the value of the project and the ways it could be improved. End-of-project focus groups were also effective in soliciting anecdotal information about the value of the project, what initial impressions of such a project were among the students, and in what way those impressions changed.

STEM Fellows (Northeast Regional Network) implemented effective focus groups with both its teacher-participants and with key project partners/stakeholders. The focused groups were structured to gain commentary on several issues including communication, relationships, project expectations, as well as general strengths and weaknesses.

Short-term Summative Evaluation

Making the Connection (Central Regional Network) implemented effective, open-ended, problem-based, rubric-assessed pre- and post-project tests to document gains in teacher-participants' knowledge. The tests assessed teachers' degree of understanding of project concepts through application-based, open-ended scenarios that were evaluated via a structured scoring-rubric. Making the Connection also effectively implemented written reflections by teachers to document teachers' in-the-field application of project content and focus groups to document anecdotal information concerning teachers' knowledge application.

SolidWorks (Boston West Regional Network) implemented an effective set of pre- and post-project tests that documented knowledge and skills gains specific to the project's subject area (three-dimensional geometry).

STEM Fellows (Northeast Regional Network) implemented effective pre- and post-project surveys to document changes in teachers' attitudes toward STEM teaching and learning as well as teachers' knowledge about strategies and skills for direct STEM classroom teaching. STEM fellows also implemented an effective, rubric-based assessment of the teachers' capstone plans (e.g., final reports) that covered areas such as breadth of knowledge of STEM facts and issues displayed in the plan, and reasonableness of proposed goals and actions.

Long-term Summative

STEM Fellows' (Northeast Regional Network) plans to track participants included structured follow-up to document how participants are progressing with the implementation of their capstone plans and how their plans are, or are not, fulfilling the goals of the Pipeline Fund.

Pipeline Fund Goal III: To improve the mathematics, technology, engineering and science educational offerings available in public and private schools.

The seventeen Pipeline Fund projects served almost 150 schools from over 90 districts throughout Massachusetts. As discussed above, in the cases of both student- and teacher-centered projects, the degree to which a project was effective in producing positive change in its participants depended on a variety of factors. While the majority of projects showed positive results in their short-term, summative evaluations, none, as of yet, are able to show the kind of long-term, summative evaluation results that will indicate whether they are serving as effective means for improving STEM offerings throughout our educational system.

Two of the projects (one student-oriented and one teacher-oriented) laid out plans in their evaluation reports for tracking participants over the course of the next few years to see how effective the participants are in achieving a number of long-term goals. This tracking will focus not just on whether the gains in knowledge made by the participants hold for the long term, but whether the participants are able to take further STEM steps. In the case of the student participants this means not only do the students maintain the content knowledge gained during their project, but do they go on to do well in subsequent STEM classes in school and do they choose STEM majors once they are admitted to college. In the case of the teachers, tracking is focused on to what degree the teachers are able to implement STEM improvement plans they developed as one activity during the project. This tracking has a two-fold effect of not just documenting the progress of the teacher-participants, but of documenting what helps or hinders them through their attempts to improve STEM education in their districts.

Going Forward

As of the writing of this report, the Massachusetts Board of Higher Education has already begun planning for how it will implement and manage programming for subsequent Pipeline Fund projects. Under consideration are ideas for focusing/refining the diversity of projects as well as streamlining and expanding project and participant data collection. Also being considered are ways to guide and focus projects' evaluation processes, including standardizing aspects of the evaluation tools and requirements. These changes to data collection and evaluation processes will better enable analysts to make targeted statements of impact based on more consolidated sets of outcomes and standard measures of progress.

For the BHE, an important component to these considerations continues to be the discussion of how project reporting and evaluation for Pipeline Fund projects might be done parallel to other similar programs so as to complement the projects funded by those other programs and to build a wider understanding of STEM project information.

Regional Network Evaluation Methodologies and Results

What follows is an overview of the evaluation methodologies and results reported by each project. Projects are presented in three groups based on the primary participant categories from Table 2 (page 6): students only, both students and teachers, and teachers only. The two projects that did not have primary participants (the Engineering Pathways Mapping Project and the MassBioEd Lab Awards) were not required to submit evaluations and, consequently, and not reviewed here. Within the discussion of each project, evaluation methodologies and results are grouped into three categories:

As mentioned earlier, the Request for Proposals (RFP) to which the Regional Networks responded did not call for a specific set of evaluation methodologies to be used or an overarching framework within which they were to be organized. Rather, the Regional Networks were asked to describe a plan for demonstrating the effectiveness of their projects. The tools described in these plans have been organized into formative, short-term summative, and long-term summative evaluation methodologies as a means of framing their analysis. An effective evaluation is generally thought to contain tools that address all three areas.

IV. Formative – methodologies and results that assess the project's implementation and management process,
V. Short-term summative – methodologies and results that assess the goals each project set out to meet within its time span, and
VI. Long-term summative – methodologies and results that assess lasting effects beyond a project's time span, especially the linkage of each project's internal goals to the three goals of the Pipeline Fund.

Projects with only Students as Primary Participants

Advanced Studies and Leadership Program (Southeast Regional Network)

Short-term Summative Evaluation

Methodologies

Enrollment and attendance records: These were used to document whether the project reached its goal of enrolling 100 high achieving students and the number of those students who completed the project.

Curriculum materials: These were used to document whether the project reached its goal of developing STEM courses.

Pre- and Post-Project Surveys: These were used to document (1) changes in student knowledge about STEM careers; (2) changes in student knowledge about science, engineering, and other content presented during the project; (3) changes in student knowledge about application to real life of computer, math, and technology skills presented during the project; and, (4) changes in student interest in Science, Technology, Engineering and Math. The pre-survey utilized a four-point Agree-Disagree scale (22 questions) and a set of career interest areas that were to be ordered from one to ten. The post-survey included all of the pre- survey questions plus three additional Agree-Disagree questions and four open-ended questions.

Results

Enrollment and attendance records: 122 students were enrolled in the project and 118 completed the project.

Curriculum materials: Five "modules" were developed for the project including (1) Imagination and Innovation with Power Engineering, (2) Navigation and Seamanship, (3) Mapping the Environment Around Us, (4) Ice, Sand and Water: Geology, Physiography and Coastal Processes of Cape Cod, and (5) Marine Environmental Problems on Cape Cod.

Pre- and Post-Project Surveys: 113 pre- and post-project surveys were completed properly. There were statistically significant increases in the level of agreement with 13 of the 16 survey statements.

There was an increase in the level of agreement with one of the 16 survey statements, but the change was not statistically significant. This statement was:

I know how the Math I have learned in school can be applied to solve real life problems.

There were decreases in the level of agreement with two of the 16 survey statements, but the changes were not statistically significant. These statements included:

I know how the Computer and Technology skills I have can be applied to solve real life problems.

When I finish school I would like to work at a job in Science, Engineering or Technology.

When asked on the post-project survey "I have more interest in Science, Math, Engineering and Technology because of ASLP" 88% of the respondents chose "agree" or "strongly agree."

Boston Summer Advanced Math (Boston East Regional Network)

Formative Evaluation

Methodologies

Observations from two teaching assistants attached to the project: These were used to document the nature of the learning environment and student attitudes.

Post-project surveys: These were used to document student attitudes.

Results

Observations from two teaching assistants attached to the project: Assistants described the teacher as making teaching seem easy and as someone who could "captivate" students with various topics within pre-calculus. Assistants had the impression that students were motivated. Student motivation was also supported by comments from the students that most saw the usefulness of math in everyday life and that most applied to the project explicitly to improve their math skills.

Post-project surveys: The only complaints were regarding early class time (7:30 am starting time) and lack of food during class time. Some participants suggested that a mentor or tutor outside of class time would have been helpful.

Short-term Summative Evaluation

Methodologies

Post-project surveys: These were used to document students' interest in math and attending college.

Final Assessment Recommendations: These were used to document whether students had succeeded in the course and mastered the course's material.

Results

Post-project surveys: Ninety-five percent (95%) of students saw the usefulness of math in everyday life. One-hundred percent (100%) of students planned to attend college immediately after high school graduation. Seventy-nine percent (79%) had already taken the SAT or ACT.

Final Assessment Recommendations: Twenty-two of the 25 participating students received recommendations to take calculus in their senior year of high school.

Long-term Summative Evaluation

Methodologies

Follow-up Tracking of Participants: This will be used to document participants' success in calculus during their senior year in high school, their choice of colleges, their choice of college major, and their persistence in college.

Results

Too early to report any results.

Discovery Lab/MassPEP (Boston East Regional Network)

Formative Evaluation

Methodologies

Comments from Lead Site Coordinators at each project site: These were used to document project implementation.

Results

Comments from Lead Site Coordinators at each project site: Comments from the lead site coordinators were generally positive. The strongest critique concerned the project's open enrollment policy and the frequency of sessions.

Short-term Summative Evaluation

Methodologies

Tracking of Subject Modules: This was used to document content learned by project participants.

Observations by Lead Site Coordinators: These provided additional documentation of learning gains from modules.

Results

Tracking of Subject Modules: Nineteen (19) students total worked on engineering modules (21 modules were available). Seven students (37%) completed at least half of the engineering modules.

Seven (7) students total worked on architecture modules (21 modules available). Two students finished at half of the architecture modules.

Observations by Lead Site Coordinators: Observations made by lead project coordinators focused on general educational issues.

Engineering/Technology Career Fairs (Pioneer Valley Regional Network)

Formative Evaluation

Methodologies

Post-Project Surveys: These were used to document participants' (students', teachers', and employers') levels of satisfaction with the project and what suggestions for improvement participants' had.

Results

Post-Project Surveys: Different surveys were used at each career fair. Consequently, the results for each career fair are presented separately.

Survey results from the Holyoke Community College (HCC) fair were generally positive. Suggestions for improvement were focused primarily on logistical issues.

Survey results from the University of Massachusetts, Amherst (UMass) fair were also generally positive.

Survey results from the Springfield Technical Community College (STCC) fair were more critical than those for the HCC and UMass career fairs. Teachers/chaperones made several comments concerning logistical issues.

Short-term Summative Evaluation

Methodologies

Participant Information Section on Post-Project Surveys: These were used to document number, gender, and racial background of participants.

Participation Career Interest(s) Section on Post-Project Surveys: These were used to document student interest(s) in STEM Careers.

Results

Participant Information Section on Post-Project Surveys: Based on completed surveys, an estimated total of 720 students and 46 chaperones participated in the three fairs. Gender and minority status were only reported on the Holyoke Community College and Springfield Technical Community College surveys: out of the 512 students for which gender and race/ethnicity were reported, 63% were male, 37% were female, and 28% were of minority background.

Participation Career Interest(s) Section on Post-Project Surveys: Interest-oriented questions were phrased differently on the survey for each career fair. Consequently the results for each one are presented separately:

Seventy-one percent (71%) of University of Massachusetts, Amherst fair student-participants reported that they were considering a career in engineering.

Sixty percent (60%) of Holyoke Community College fair student-participants reported they would like a career in engineering.

Fifty-eight percent (58%) of Springfield Technical Community College fair student-participants reported they would consider a career in engineering.

Future Scientist and Engineering/Robotics Clubs (Boston West Regional Network)

Formative Evaluation

Methodologies

Post-Project Surveys: These were used to document students' perceptions of the value of participating in the clubs and students' suggestions for improvement of future clubs.

Results

Post-Project Surveys: Fifty-three percent (53%) of the 75 students whose post-survey comments were analyzed commented on some aspect of the hands-on nature of the clubs as what they liked most about participating.

Short-term Summative Evaluation

Methodologies

Pre- and Post-Project Surveys: These were used to document students' perceptions of the fun of math, science, and engineering; students' interest in engineering and pursuing engineering careers; and, students' understanding of what engineers do. The pre- and post-project surveys were identical except for two questions that were added to the post-project survey. Because it was anticipated that English was a second language for a number of the students participating in the project emotion icons were used as response choices instead of words (e.g., a smiley face instead of the work "like"). Because of timing in the grant administration, no surveys were administered to students who participated in Fall 2004. Surveys were administered to the Spring 2005 cohort, some of whom may have also participated in the fall session. Thirty-eight (38) students completed both the pre- and post-project surveys.

Results

Pre- and Post-Project Surveys: On four of 12 measures student response rates remained unchanged from the pre-survey to the post-survey. On eight of 12 measures students response rates decreased.

There was no statistically significant change between pre- and post-survey scores regarding students' understanding of what engineers do. On both pre- and post-surveys more that 75% of the students completing both surveys correctly responded to at least 8 of the 10 items that were targeted at assessing knowledge of the professional characteristics of engineers.

Summer Enrichment Activities (Pioneer Valley Regional Network)

Short-term Summative Evaluation

Methodologies

Pre- and Post-Project Surveys: These were used to document how likely students were to choose a career in the sciences and whether they liked or disliked various science areas.

Results

Pre- and Post-Project Surveys: Results were reported only for one (Greenfield Community College) of the two sessions that fell under this project. Twenty-one students responded to the surveys and their likelihood of choosing a career in the sciences generally increased. The number of students who reported that they liked various subjects generally increased. However, the number of students who reported that they disliked various subjects also generally increased.

Projects with both Students and Teachers as Primary Participants

"Got Math?" (Berkshire Regional Network)

Formative Evaluation

Methodologies

Interviews with School Administrators and Project Teachers: These were used to collect information on quality of project implementation.

Compare Curriculum from each Variation of the Project to the Massachusetts Curriculum Frameworks: This was used to assess the degree of conformity between project variations and the Curriculum Frameworks.

Results

Interviews with School Administrators and Project Teachers: Feedback from teachers was generally good, although some concerns about organizational issues were made.

Compare Curriculum from each Variation of the Project to the Massachusetts Curriculum Frameworks: All three variations of the project aligned with the Massachusetts Curriculum Frameworks.

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Short-term Summative Evaluation

Methodologies

Pre- and Post-Project Surveys: There were used to document changes in participants' interest and motivation to achieve in math.

Evaluator Observations: These were used to document whether there was an increase in collaboration between schools, between school districts, and between schools and other educational organizations.

Results

Pre- and Post-Project Surveys: Surveys were completed at two of the three elementary schools. Each of the two schools that did complete surveys (Brayton and Undermountain) used different tools. Results are therefore reported by school and not for the project as a whole.

Undermountain Results:

In every category, the majority of students had no change in scores.

Brayton Results:

Students improved in almost every area.

Evaluator Observations: Four new links with other educational institutions (three colleges and one high school) were documented. Per the evaluator, there has been a clear increase in the collaboration between

school districts, regional colleges, and Berkshire County businesses via current programming and there has been a modest increase in the collaboration between schools, especially among school representatives.

Making the Connection (Central Regional Network)

Formative Evaluation

Methodologies

Project Exit Questionnaire: This was used to gather information on project implementation from the teachers' perspectives.

Interviews with Participating Teachers and District Administrators: These were used to gather information on project implementation from the teachers' perspectives.

Results

Project Exit Questionnaire: Teachers reported a high level of satisfaction with the professional development. About three-fourths of the teachers strongly agreed with the following statements:

I was presented relevant information that addressed the goals set out in the syllabus (20 out of 28).

The facilitators delivered the material in an organized manner and the information was presented clearly (19 out of 28).

Interviews with Participating Teachers and District Administrators: Teachers found that the course increased their content knowledge and their repertoire of pedagogical strategies. Teachers were also positive about the opportunity to collaborate with their colleagues. District administrators were enthusiastic about their teachers' involvement with the project, and offered specific plans to follow-up next year.

Short-term Summative Evaluation

Methodologies

Open-ended, Problem-based Pre- and Post-Project Tests: These were used to document gains in teachers' content knowledge and subject area skills. The test was scored using a ten category five-point scoring rubric that assessed understanding of important ideas such as study design, measures of center, variability, group size, randomness, proportional reasoning, representations, and generalization.

Teachers' Written Reflections: These were used to collect qualitative information regarding gains in teachers' content knowledge and subject area skills.

Teachers' Assessments of Their Students' Projects: These were used to collect information on how successfully teachers' gains in content knowledge and subject area skills were transferred to their students.

Focus Groups and Interviews: These were used to collect further qualitative information.

Results

Open-ended, Problem-based Pre- and Post-Project Tests: There were statistically significant gains in several data analysis content areas. In the two areas in which slight declines occurred, those declines were statistically the same as no change at all.

Teachers' Written Reflections: About three-fourths of the teachers wrote in their reflections that they had learned how to use graphing calculators. About half of the teachers wrote specifically about how they became familiar with different representations during the course. About one-third of the teachers wrote about the difference between discrete and continuous data.

Teachers' Assessments of Their Students' Projects: Even though there was information from only nine percent (9%) of the participating students (106), each district was represented. Forty-nine percent (49%) of the under-served students (minority and/or free and reduced lunch students) showed increased science grades on their science project as compared to their semester grade in science. Fifteen percent (15%) of the non-underserved students increased their grades.

Focus Groups and Interviews: Teachers commented on a number of areas, including that the course content helped them work with students, that district administrators were enthusiastic about the results of the project, and that students were very engaged with the project.

Project Invention (Southeast Regional Network)

Formative Evaluation

Methodologies

Attendance Records: These were used to document the number of students and student demographics.

Focus Groups: The internal evaluator conducted focus groups at the final Invention Convention with four groups of students (74 students total) and three groups of teachers (14 teachers total).

Discussions with Advisory Board Members: The internal evaluator had one-on-one discussions with two Advisory Board members.

Post-Project Surveys: Surveys were given to both students and teachers that used both quantitative, agree-disagree scaled questions and qualitative open-ended questions. Seventy-three (73 students) completed the post-project survey. Fourteen teachers completed a post-project survey.

Results

Attendance Records: Demographic data was collected on 70 students who presented at the Invention Convention. Of these 37 were male (53%) and 33 (47%) were female. Of the 15 teachers who participated in group discussions at the convention, four (4) were male (27%) and 11 (73%) were female. Most of the 70 students were Caucasian and seven (7) or 10% were from minority backgrounds (one checked Hispanic and six checked "other"). Eleven schools from nine school districts participated in the project including one charter school and one alternative special education school. The schools included Atlantis Charter School

(Fall River), Chatham Middle School, Dighton Middle School, Paul J. Primavera Education Center (Bellingham), Pembroke Community Middle School, Plymouth Community Intermediate School, Plymouth South Middle School, Plymouth High School, Westport Middle School, Whitman Middle School and Williams Middle School (Bridgewater).

Focus Groups: "Hot topic" areas were not identified and suggested as ideas for inventions. Instead the Project Director asked each team to present several ideas to her and then she selected one invention for the team.

Discussions with Advisory Board Members: "Hot topic" areas were not identified and suggested as ideas for inventions. Instead the Project Director asked each team to present several ideas to her and then she selected one invention for the team.

Post-Project Surveys: Both teachers and students generally expressed satisfaction with the project. About 45% of both teachers are students thought that students had gained more interest in math, science and technology as a result of the project. Over 70% of students and teachers reported that the project was worth the time and effort it took.

Short-term Summative Evaluation

Methodologies

Observational Site Visits: The internal evaluator observed one Advisory Board Meeting, one school team working on their invention, one meeting of teachers who were leading teams, one combined meeting of teachers and the Advisory Board, and the final Invention Convention

Pre- and Post-Project Surveys: Surveys were given to both students and teachers that used both quantitative, agree-disagree scaled questions and qualitative open-ended questions. Sixty-nine students completed both the pre-and post-project survey. Eighty-nine students completed the pre-project survey, 73 students completed the post-project survey, and 69 students completed both. Fourteen teachers completed a post-project survey.

Student Reflection Papers: Some teams wrote reflection papers that provided examples of what students learned, and what students found to be difficult or rewarding, what the students liked or disliked.

Results

Focus Groups: In response to discussion group questions, teachers indicated that "students learned how to work as a team" and "learned cooperative learning skills."

Pre- and Post-Project Surveys: The most frequent student responses to the open-ended question "What new skills did you develop doing this project?" were teamwork (51%), science and engineering process (22%), and computer skills (18%). There was a small but not statistically significant increase in the number of students who selected STEM careers in the question "What occupation(s) or career(s) do you think you would like to pursue as an adult?

Student Reflection Papers: Entries in students' reflection papers explained in more detail the kinds of specific knowledge students named in the open-ended questions from the post-project survey.

SolidWorks (Boston West Regional Network)

Formative Evaluation

Methodologies

Teachers' Post-Seminar Surveys: These were used to document teachers' opinions of seminars' most valuable components and teachers' suggestions for improvement.

Students' Post-Workshop Surveys: These were used to document students' opinions on what was best about the workshop and their suggestions for improvement.

Results

Teachers' Post-Seminar Survey: Teachers reported several aspects of learning, instruction as the most valuable parts of the seminar.

Students' Post-Workshop Survey: Students reported aspects of learning and types of accomplishment as the best things about the workshop.

Short-term Summative Evaluation

Methodologies

Teachers' Pre- and Post-Seminar Surveys: These were used to document changes in teachers' confidence levels in their knowledge of seminar content and changes in teachers' confidence levels in their ability to teach seminar content.

Students' Pre- and Post-Workshop Surveys: These were used to document changes in students' confidence levels in their knowledge of workshop content and students' interest in careers in math, science, engineering, and design.

Results

Teachers' Pre- and Post-Seminar Surveys: There were statistically significant increases between the pre- and post-surveys in teachers' self-reported confidence in their own knowledge of some topics, including: how to use SolidWorks software, applied 2D geometry, and applied 3D geometry. Average responses regarding teachers' confidence in their ability to teach students increased between the pre- and post-surveys for all areas except applied algebra, although none of the increases were statistically significant. There were no statistically significant differences between teachers' pre- and post-survey responses regarding their interest in teaching applied geometry and interest in teaching 3D modeling software applications. There was an increase in teachers' awareness of the importance of math competency in the areas of nursing and the liberal arts.

Students' Pre- and Post-Workshop Surveys: There were statistically significant increases between pre- and post-surveys in students' self-reported confidence in their knowledge of all topics covered in the

workshop, including: 3D geometry, how to use mechanical design software, and how to model geometry in 3D space. Average responses regarding students' interest in careers in math, science, engineering, and design increased between pre- and post-surveys. The increase in interest in a math career was statistically significant. There was an increase in students' awareness of the relevance of math and science to nurses, sales people, and musicians (100% replied yes to engineering on the pre-survey).

Projects with only Teachers as Primary Participants

Academic Year Seminars for Teachers (Pioneer Valley Regional Network)

Formative Evaluation

Methodologies

End of Seminar Surveys: These were used to document teachers' opinions on the usefulness of each seminar and what they would improve.

Results

End of Seminar Surveys: The majority of teachers gave the project positive ratings in a number of measures. Among what teachers described as the most important things they learned were valuable interactive, inexpensive and simple activities to use in the classroom; and, additional content knowledge, useful information, and helpful resources. Teachers' suggestions for improvement varied by seminar but included: allowing more time, creating smaller groups, dealing with each activity discretely, having a quicker pace.

STEM Fellows (Northeast Regional Network)

Formative Evaluation

Methodologies

Focus Group with Project Participants: This was used to document the following: (a) collaboration with team members, (b) relationship with project organizers, (c) opinion of project by their schools and districts, (d) expectations for project and capstone plan, (e) effect of professional development experiences on STEM learning and teaching, and (f) project strengths.

Focus Group with Project Partners/Stakeholders: This was used to document the following: (a) member involvement; (b) network strengths in 3 areas – partnerships, professional development opportunities, and communication; and (c) suggestions for improvement in same 3 areas.

Post-Project Survey Questions: These were used to document participants' opinions of project.

Results

Focus Group with Project Participants: Participants commented on the collaboration experience, communication with organizers, their home districts, and their gains in content knowledge as positive aspects of the project.

Focus Group with Project Partners/Stakeholders: The Network's Steering Committee served as the pool of project partners/stakeholders. Comments made by them during a focus group at one of their meetings included that the partnerships were strong and extensive, that there were a wide variety of high quality professional development opportunities available, and that more industry partners should be recruited.

Post-Project Survey Questions: Written comments in open-ended questions reinforced those recorded during earlier focus group.

Short-term Summative Evaluation

Methodologies

Pre- and Post-Project Surveys: These were used to document the following: (a) participants' attitude toward issues around STEM teaching and learning, and (b) participants' knowledge about strategies and tactics for improving classroom instruction in STEM content areas.

Expert, Rubric-based Evaluation of Participants' Capstone Plans: This was used to document whether (a) the plan demonstrated comprehensive knowledge about STEM teaching and learning issues, (b) the plan demonstrated advanced knowledge about the strategies and tactics used for teaching STEM subjects and improving STEM enrollment, (c) the plan demonstrated the teams' understanding of their district's current STEM achievement and enrollment data (especially of female and minority students), and (d) the plan described a viable strategy for stimulating student interest and engagement in STEM subject areas, for improving classroom discussion, and for improving STEM achievement and enrollment (especially of female and minority students).

Participant Progress Tracking: This was used to document the number of participants who completed the 40 hours of professional development and were awarded professional development points.

Focus Group with Project Partners/Stakeholders: This was used to document partners'/stakeholders' opinions of the project.

Results

Pre- and Post-Project Surveys: There were 38 respondents to the pre-survey and 32 respondents to the post-survey. The number of Fellows who spoke to their students about STEM careers and who research STEM career opportunities increased. The number of Fellows who collaborate with other teachers to prioritize curriculum and to model lesson plans increased.

In the participant self-evaluation on the post-project survey 90% of Fellows expressed that their capstone plan identified obstacles that needed to be overcome in their home districts and that it created a vision statement for the district to generate support. Less than 50% of Fellows expressed that their capstone plan created target goals for the number and percentage of graduating female and minority students who indicate on their SAT I application that they plan to major in a STEM subject area.

Expert, Rubric-based Evaluation of Participants' Capstone Plans: Rating of participants' capstone plans according to the rubric were largely positive with the sections involving analysis of current STEM-related conditions, formulation of a vision, analysis of obstacles and opportunities, and identification of useful resources rated "moderately to very successful." Rating of participants' short-term goals was generally "very likely" while rating of participants' long-term goals were generally "likely."

Participant Progress Tracking: Thirty-six (36) of the starting thirty-eight (38) participants completed forty (40) hours of professional development.

Focus Group with Project Partners/Stakeholders: Partners/stakeholders commented that the quality and variety of professional development opportunities for Fellows' was very strong and that the project focused on the crucial area of teachers' development. Stakeholders were very positive about the partnerships that had developed among institutions from different professional sectors.

Long-Term Summative Evaluation

Methodologies

Follow Up on Final Project Implementation: This is designed to document how participants' are progressing with the implementation of their final project plans and how those plans are or are not fulfilling the goals of the Pipeline Fund.

Results

Too early to report any results.

Summer Content and Pedagogy Institutes (Pioneer Valley Regional Network)

Formative Internal Evaluation

Methodologies

Post-Project Surveys: These were used to document the quality and usefulness of the project.

Results

Post-Project Surveys: These were administered only at the Smith College Summer Institute for Educators held July 11-15, 2005. Eighty-five percent (85%) of participants described the workshop as "very useful" and 15% as "useful" on post-workshop evaluations. Eighty percent (80%) of participants gave the workshop a rating of "excellent" and 20% and "very good" on post-workshop evaluations.

Short-term Summative Evaluation

Methodologies

Pre- and Post-Project Tests: These were used to document changes in content knowledge.

Results

Pre- and Post-Project Tests: This was administered only for UMass Civil and Environmental Engineering in Our World offered at/through the Smith College Summer Institute for Educators and held July 11-16, 2005. As a whole, the cohort of participants showed gains in all of the content areas covered.

Waterfront Learning Project (Boston East Regional Network)

Formative Evaluation

Methodologies

Focus Groups: These were used to document teacher opinions on project implementation.

Results

Focus Groups: Teachers were generally positive about the training and expressed appreciation for how well the materials integrated with literacy and math curricula. Teachers thought that Boston Waterfront Learning would make science more real for their students.

Short-term Summative Evaluation

Methodologies

Pre- and Post-Project Surveys: These were used to document changes in participants' perspective about the educational benefit of waterfront trips, participants' knowledge about resources for a waterfront visit, and participants' confidence in conducting such a trip.

Focus Groups: These were used to follow up on project participants to see if changes expressed in the survey instrument still held true and to document whether participating teachers had begun to implement what they had learned.

Results

Pre- and Post-Project Surveys: There was an increase in the percentage of teachers who thought field study work in science and math was very or completely useful. There was also an increase in the percentage of teachers who thought it was very or completely important to study Boston Harbor in the field. The percentage of teachers who thought they were very or completely confident about conducting and organizing a field visit increased from 20% to 86%.

Focus Groups: Comments made by project participants at a project-follow-up focus group included that several had set a date and secured permission for a waterfront field trip, that they could name a variety of resources and materials for use/planning and that they claimed to have greater confidence in trip planning/implementation.