

**Mathematics and  
Science Partnerships:  
Summary of  
Performance Period  
2008 Annual Reports**

**Analytic and Technical  
Support for  
Mathematics and  
Science Partnerships**

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## Executive Summary

Our nation's students are underachieving in mathematics and science compared to students in other industrialized nations. International tests of science and mathematics such as TIMSS and PISA (Schmidt, 1999; Gonzales et al., 2004; Lemke et al., 2004; Van de Werfhorst & Mijs, 2010) expose a need for improved education in mathematics and science. Research suggests that increased teacher content knowledge and teaching skills lead to improved student achievement (Cochran-Smith and Zeichner, 2005; Goldhaber and Brewer, 2000; Hanushek and Rivkin, 2010; Hill, Rowan, and Ball, 2005; Nye, Konstantopoulos, and Hedges, 2004; Timperley et al., 2007; Wenglinsky, 2002). Thus, education improvement efforts around the country are increasingly focused on the teacher as the most powerful agent of change for improving student learning.

As the limitations of short-term professional development opportunities for teachers have been recognized, there has been widespread interest in sustained university partnerships with local school districts to offer rich professional learning opportunities for teachers and administrators. The U.S. Department of Education's Mathematics and Science Partnership (MSP) Program funds 626 collaborative partnerships between high-need school districts and mathematics, science, and engineering departments at institutions of higher education (IHEs) for the purpose of providing intensive content-rich professional development to teachers and other educators, thus improving classroom instruction and ultimately student achievement in mathematics and science.

Implemented under the *No Child Left Behind Act of 2001, Title II, Part B*, MSP is a formula grant program to the states, with the size of individual state awards based on student population and poverty rates. The states then award the funding on a competitive basis to local partnerships. Federal support for MSP increased substantially from the program's inception in FY 2002—from \$12.5 million to \$100 million in FY 2003, when MSP became a state-administered formula grant program. Funding has since increased further, and in FY 2008, states awarded \$179 million in funds to 626 local partnerships.

### *Performance Period 2008 Mathematics and Science Partnerships*

This report presents an overview of the MSP program in Performance Period 2008 (PP08), including the characteristics of MSP projects and participants; the professional development content, models, and activities of the projects; and the MSP projects' evaluation designs and outcomes.

### **Characteristics of MSP Projects and Participants**

In Performance Period 2008 (PP08), the Mathematics and Science Partnership Program reached more teachers and students than ever before. Together, over 6,300 local educational agencies (LEAs), organizations, and institutions—involving over 3,900 IHE faculty members—partnered to form 626 projects across the country. Projects served more than 57,000 educators<sup>1</sup> nationwide, with each educator receiving an average of 97 hours of professional development<sup>2</sup>, thus enhancing the quality of classroom instruction for over 2.8 million students.

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<sup>1</sup> Professional development was provided to a variety of teachers, coaches, paraprofessionals, and administrators across grades K through 12.

<sup>2</sup> The median hours of professional development offered across projects was 86 hours.

### ***Amount of Funds***

In PP08, federal MSP resources totaling \$179 million were distributed to the 50 states, the District of Columbia, and Puerto Rico through formula grants.<sup>3</sup> State grants ranged from \$890,414 to over \$21.9 million, with an average of \$3.4 million and a median of \$2.0 million (see Appendix D). In turn, the states funded a total of 626 local MSP projects, with local grants ranging from \$16,496 to \$8.2 million, with a median project grant of \$200,000, and mean of \$318,752. As shown in Exhibit ES.1, more than four-fifths of projects (81 percent) received \$500,000 or less in state funding. In addition to federal funds, local projects reported receiving supplemental funding from other federal and non-federal sources.

<b>Exhibit ES.1 Project Budgets from State MSP Grants, Performance Period 2008</b>	
<b>Project Budgets</b>	<b>Percent of Projects (N=574)</b>
\$100,000 or less	13%
\$100,001 to \$200,000	38
\$200,001 to \$500,000	30
\$500,001 to \$1,000,000	17
\$1,000,001 or more	2

*Source: Annual Performance Report item IA.6  
The non-response rate<sup>4</sup> was 0 percent in PP08.*

### ***Participant Selection***

In selecting schools and teachers to participate in the MSP program, MSP projects were encouraged to assess the professional development needs of individual schools and teachers. Most MSP projects (84 percent) in PP08 targeted individual teachers in their professional development interventions. The remaining 16 percent of projects indicated that their professional development models were designed to improve mathematics and/or science instruction throughout a school, or a set of schools.

### ***Characteristics of Project Participants***

Over 3,900 faculty members from institutions of higher education (IHEs) were involved with MSP projects in PP08, with average of 6 IHE faculty members per project. Projects are required to establish direct interactions between participants and IHE faculty members in mathematics, the sciences, or engineering. Additionally, over two-thirds of the projects (69 percent) reported working with faculty members from education departments.

Over 57,000 elementary, middle, and high school teachers, coaches, paraprofessionals, and administrators participated in MSP projects in PP08. The number of these participants served by individual MSP projects ranged widely from 4 to 3,944, with typical projects serving slightly over 40 participants. These participants, in turn, taught over 2.8 million students.<sup>5</sup>

<sup>3</sup> The American Virgin Islands, Guam, the Northern Mariana Islands, and Samoa pool their MSP funds as part of their consolidated budget.

<sup>4</sup> Throughout this report, all non-response rates are calculated out of the total number of projects that that should have answered the APR question.

<sup>5</sup> Students may be included twice in this count, once as mathematics students and once as science students.

Seventy-five percent of MSP participants were regular classroom teachers of core mathematics and/or science content. In order of prevalence, the remaining 25 percent of participants included school administrators, special education teachers, ELL teachers, gifted and talented teachers, math coaches, science coaches, and paraprofessionals.

### ***School Levels***

MSP projects are free to select the grades or school levels in which they provide professional development. In PP08, the vast majority of projects (79 percent) targeted multiple school levels (i.e., some combination of elementary, middle, and/or high school); 44 percent served participants from all three school levels. Among the participants of MSP activities, 53 percent were employed at the elementary school level, 28 percent were at the middle school level, and the remaining 19 percent were at the high school level.

## **Professional Development Content, Models, and Activities**

### ***Professional Development Content***

In PP08, nearly one-third of MSP projects (32 percent) provided professional development in both mathematics and science; 37 percent provided professional development in mathematics only; and 31 percent of projects provided professional development in science only.

Across school levels, scientific inquiry was the most frequently addressed science topic (92 to 95 percent of projects that addressed science), and chemistry was the least frequently addressed science topic (47 to 53 percent). In mathematics, problem solving was among the most frequently addressed content areas (81 to 86 percent of projects that addressed mathematics), and calculus was the least frequently addressed topic (3 to 20 percent of projects that addressed mathematics).

### ***Professional Development Models***

As shown in Exhibit ES.2, the majority of projects (56 percent) conducted summer institutes<sup>6</sup> with school-year follow-up activities. These projects reported offering a median of 96 hours of professional development. Just 3 percent of projects provided summer institutes only, with no follow-up. The remaining 41 percent of projects provided professional development activities that primarily took place during the academic year. These projects reported offering a median of 80 hours of professional development.

<b>Exhibit ES.2 Average Professional Development Hours, by Professional Development Model Type, Performance Period 2008</b>		
<b>Professional Development Model</b>	<b>Percent of Projects (N=626)</b>	<b>Total Median Hours</b>
Summer institute with follow-up	56%	96
Summer institute only	3	80
Focus on school year activities	41	80
<i>Source: Annual Performance Report item V.A.1, V.B(i).1, V.B(ii).1</i>		
<i>The non-response rate for each model was as follows:</i>		
<i>Summer institutes only: 0 percent; Summer institutes with follow-up: 15 percent; and Focus on school year activities: 1 percent</i>		

<sup>6</sup> Summer institutes provide intensive learning experiences for a minimum of two weeks during the summer. Projects that included summer workshops that were less than 2 weeks were classified as projects with a focus on school year activities.

### ***Professional Development Activities***

The professional development activities offered by MSP projects focus on increasing teachers' content knowledge in mathematics and/or the sciences and on enhancing their pedagogical skills. The most commonly reported primary focus for school-year activities was on-site professional development (71 percent of projects), followed by study groups (15 percent), content coursework at colleges or universities (10 percent), and on-line coursework/distance learning networks (1 percent).

## **MSP Evaluation Designs and Outcomes**

### ***Evaluation Designs***

In PP08, MSP projects reported on the primary design they used to assess program outcomes. Three percent reported using an experimental design in which teachers, classrooms, or schools were randomly assigned to a treatment or control group. Another 49 percent of projects reported using a quasi-experimental design with a matched or non-matched comparison group. The remaining projects used less rigorous evaluation designs, such as: single group design with pre- and post-tests (25 percent); qualitative or descriptive methods only (12 percent), mixed quantitative and qualitative methods (8 percent), or an "other" design type (3 percent).

### ***Teacher Content Knowledge Outcomes***

As shown in Exhibit ES.3, approximately two-thirds of teachers (67 percent) who were assessed in mathematics and nearly three-fourths of teachers (73 percent) who were assessed in science showed statistically significant gains in their content knowledge. Furthermore, approximately half of these gains were found on standardized tests (57 percent of teachers in mathematics and 40 percent in science), that often are not directly aligned to the material being taught.

<b>Exhibit ES.3 Percent of Teachers with Significant Gains In Content Knowledge, Among Teachers with Pre-Post Content Assessments, Performance Period 2008</b>			
<b>Content Area</b>	<b>Total Number of Teachers Served</b>	<b>Number of Teachers with Content Assessments</b>	<b>Percent of Assessed Teachers with Significant Gains</b>
Mathematics	36,546	15,567	67%
Science	31,762	15,041	73

*Source: Annual Performance Report items VIII.A. 1, 2, 4, 5  
Individual teachers who received professional development in both mathematics and science may be double counted.*

In PP08, the most frequently reported assessments of teacher content knowledge in mathematics were nationally normed/standardized tests (57 percent of projects). Projects that did not use nationally normed or standardized content assessments often developed their own assessments for their MSP projects. Forty-three percent used locally developed tests to assess teacher gains in mathematics content knowledge. In science, the most frequently used instruments were locally developed tests (53 percent of projects), followed by standardized instruments (40 percent).

### ***Student Achievement Outcomes***

As shown in Exhibit ES.4, among the 43 percent of students with assessment data in mathematics, over one half (58 percent) scored at the proficient level or above. Similarly, among the 26 percent of students with assessment data in science, 58 percent scored at the proficient level or above. These

levels represent substantial increases from the previous years in the proportion of students with assessment data scoring at the proficient level or above both in mathematics and in science.

<b>Exhibit ES.4 Percent of Students Scoring at Basic or Above, Among Students Taught by MSP Teachers And Assessed In Each Content Area, Performance Period 2008</b>			
<b>Content Area</b>	<b>Total Number of Students Taught by MSP Teachers</b>	<b>Number of Students with Assessment Data</b>	<b>Percent of Assessed Students at <i>Proficient</i> Level or Above</b>
Mathematics	1,442,254	623,950	58%
Science	1,252,853	325,586	58
<i>Source: Annual Performance Report items VIII.B. 1, 2, 3, 4, 5, 6, 7, 8</i>			

In PP08, almost all MSP projects that measured student achievement in mathematics used state assessments (95 percent); however, in science, only approximately half of projects (53 percent) that measured student achievement in science used state assessments. Projects also commonly reported utilizing locally developed tests (29 percent) and/or other types of tests (31 percent) to assess student achievement in science.

### ***Conclusions***

Unlike many teachers participating in more typical professional development programs, teachers who participate in the MSP program receive intensive and sustained content-rich professional development from college and university faculty partners from science, mathematics, engineering, and education departments, as well as from other professionals, that integrates mathematics and science content with effective pedagogical strategies. Many of these teachers have the additional advantage of receiving ongoing support in the form of mentoring and coaching from faculty and master teachers as they begin to implement their new knowledge and practice in their classrooms.

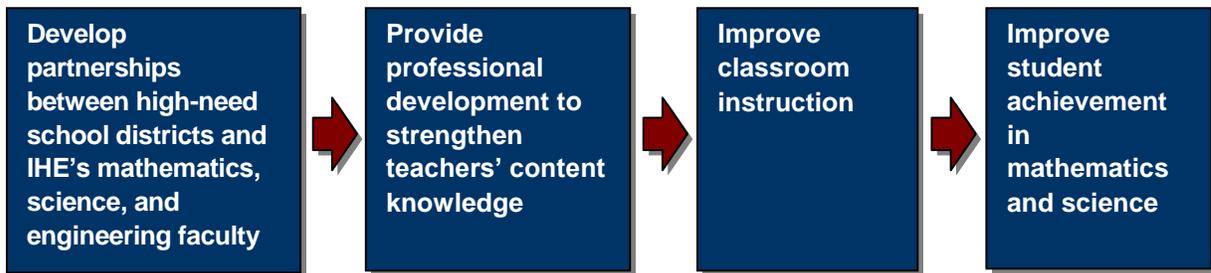
MSP program indicators show that of the 57,000 educators served by MSP projects in PP08, over two-thirds of these educators exhibited significant gains in their content knowledge (67 percent in mathematics and 73 percent in science). These educators, in turn, are enhancing the mathematics and science education of their students—over 2.8 million in PP08.

# Chapter 1: Introduction

American students' underperformance relative to students in other industrialized nations on international tests of science and mathematics such as TIMSS and PISA (Schmidt, 1999; Gonzales et al., 2004; Lemke et al., 2004; Van de Werfhorst and Mijs, 2010) exposes a need for improved education in mathematics and science. Research suggests that increased teacher content knowledge and teaching skills lead to improved student achievement (Cochran-Smith and Zeichner, 2005; Goldhaber and Brewer, 2000; Hanushek and Rivkin, 2010; Hill, Rowan, and Ball, 2005; Nye, Konstantopoulos, and Hedges, 2004; Timperley et al., 2007; Wenglinsky, 2002). Thus, education improvement efforts around the country are increasingly focused on the teacher as the most powerful agent of change for improving student learning.

As the limitations of short-term professional development opportunities for teachers have been recognized, there has been widespread interest in sustained university partnerships with local school districts to offer rich professional learning opportunities for teachers and administrators. The U.S. Department of Education's Mathematics and Science Partnership (MSP) Program funds 626 collaborative partnerships between high-need school districts and mathematics, science, and engineering departments at institutions of higher education (IHEs) for the purpose of providing intensive content-rich professional development to teachers and thus improving classroom instruction and ultimately student achievement in mathematics and science (see Exhibit 1).

## Exhibit 1 Conceptual Model of Mathematics and Science Partnerships Program

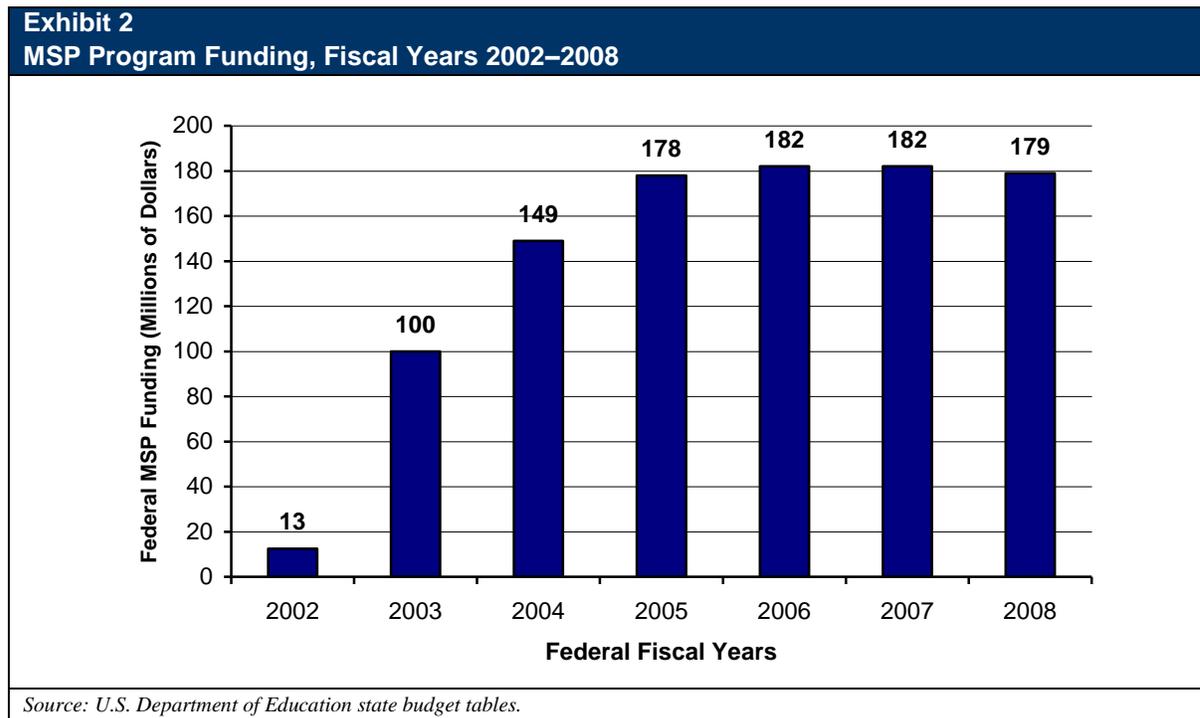


### *The Mathematics and Science Partnership Program*

Implemented under the *No Child Left Behind Act of 2001, Title II, Part B*, the MSP program is strategically designed to improve the content knowledge of teachers and the academic performance of students in mathematics and science. The MSP program is a formula grant program to the states, with the size of individual state awards based on student population and poverty rates. The states then award the funding on a competitive basis to local partnerships between high-need schools or school districts<sup>7</sup> and science, technology, engineering, and mathematics departments in institutions of higher education.

<sup>7</sup> The definition of “high-need” is not explicitly defined in the statute for the Mathematics and Science Partnership Program. Each state educational agency is responsible for conducting a needs assessment to determine the highest priority for these professional development funds and for defining high-need for its grant competition.

Federal support for MSP increased substantially from the program's inception in FY 2002 (\$12.5 million) to FY 2003 (\$100 million), when MSP became a state-administered formula grant program (Exhibit 2). Funding has since increased further, and in FY 2008, states awarded \$179 million in funds to 626 local partnerships (projects) that collectively provided professional development services to an estimated total of over 57,000 teachers. Moreover, many projects trained teacher leaders, who then provided additional training to other teachers in their schools and districts.<sup>8</sup>



The administration of the MSP program involves an annual cycle of activities conducted at the federal, state, and local agency levels (Exhibit 3). The Department of Education is charged with distributing MSP program funds to state education agencies as formula grants based upon the number of children in the state 5 through 17 years old and living in families with incomes below the poverty line.

Since FY 2003, all 50 states, the District of Columbia, and Puerto Rico have received MSP formula grants.<sup>9</sup> In turn, the states are required to run a competitive grant process to identify MSP projects and provide technical assistance to funded projects.

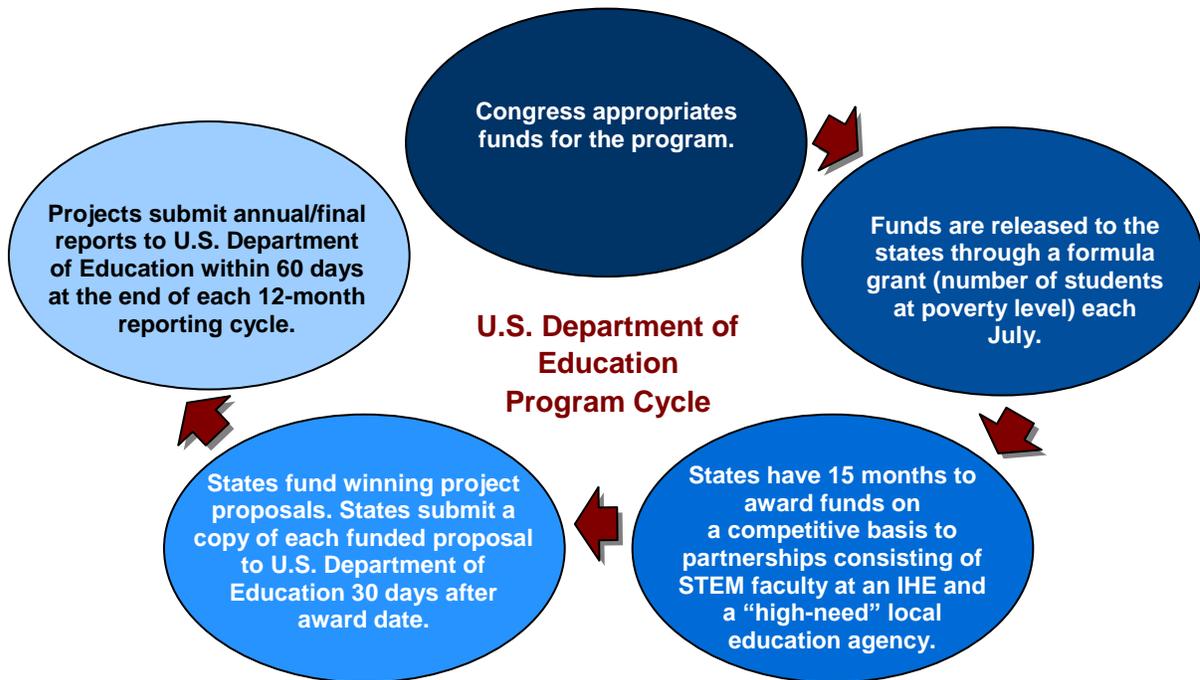
State education agencies are provided with funds for each fiscal year in July and they have 15 months (through September 30 of the following year) to award those funds to projects through competitions (Exhibit 3). MSP grants may be funded for up to three years, and the law requires all funded MSP projects to report annually to the U.S. Department of Education. Projects provide descriptive

<sup>8</sup> Only teachers who received direct professional development through the MSP program are included in these numbers. Additional teachers who received training from teacher leaders trained through the MSP program are not included.

<sup>9</sup> The American Virgin Islands, Guam, Mariana Islands, and Samoa pool their MSP funds as part of their consolidated budget.

information and report progress toward their goals in a standard on-line Annual Performance Report (APR), which State Coordinators review for completeness and accuracy and submit to the U.S. Department of Education. Beginning in FY 2004, the MSP program has required that projects submit within 60 days after each 12-month performance period.<sup>10</sup> Thus, for most projects, APRs for each annual performance period must be submitted no later than November 30.

**Exhibit 3  
MSP Grant and Funding Cycle**



APRs include responses to both open-ended and close-ended questions. Projects are required to report the following types of information in their APRs through both open-ended and closed-ended items:

- Roles and responsibilities of MSP partners,
- Characteristics of MSP participants,
- Professional development models and content,
- Program evaluation design, and
- Evaluation findings and evidence of outcomes.

<sup>10</sup> Projects with duration of 12 months or less must submit a report within 60 days after the end of their award. Projects with 13–18-month awards have only one report due to the U.S. Department of Education 60 days after the end of their project activities. Projects with a duration of 19 months or more must submit a report to the U.S. Department of Education 60 days after each 12-month period.

## *Study Design and Research Questions*

This report presents a summary of the data for the MSP program for Performance Period 2008 (PP08).<sup>11</sup> The findings presented in this report are primarily based on annual performance report (APR) data submitted by all MSP projects by February 28, 2010.<sup>12</sup> Additionally, to understand the evolution of the MSP program over time, data from previous years were also examined. The report includes findings on selected APR items from previous periods beginning in PP04 when the first APRs were submitted.<sup>13</sup> Since there is substantial turnover in the set of projects included in the analyses for each year, the findings should not be thought of as longitudinal. Thus, we cannot necessarily expect to see growth over time, as new projects are continually added to the program and other projects are ending.

The analyses are guided by the four research questions presented in Exhibit 4. These research questions are addressed through the use of simple descriptive statistics, such as means and percentages from closed-ended questions from the APR, as well as examples from the open-ended APR items. Additionally, to help illustrate the types of professional development activities offered and the challenges and successes faced by projects, the open-ended items from a sample of MSP projects from PP08<sup>14</sup> were examined, and examples from these projects are provided throughout the report.

<b>Exhibit 4</b>	
<b>Research Questions that Guide Analyses</b>	
RQ1	How are MSP projects implemented?
RQ2	Do MSP projects report using rigorous designs, such as experimental or quasi-experimental designs, for their evaluations?
RQ3	Do teachers that participate in the MSP program increase their scores on assessments of content knowledge?
RQ4	Do students in classrooms of teachers that participate in the MSP program score at the proficient level or above in state assessments of mathematics or science?

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<sup>11</sup> Performance Period 2008 (PP08) refers to the period between October 1, 2008 and September 30, 2009. PP08 projects are those for which the majority of months of activities described in the Annual Performance Report take place in the 2008 fiscal year, between October 1, 2008 and September 30, 2009.

<sup>12</sup> These primarily included PP08 reports, but they also included some PP07 reports for which teacher and/or student data were not available in time to submit during the previous year.

<sup>13</sup> The format of the APR was significantly changed for the PP06 and PP07 reporting periods; therefore some findings presented in this report only go as far back as PP06 or PP07.

<sup>14</sup> The sample of PP08 projects reviewed was based on recommendations from MSP State Coordinators about projects in their state that present well articulated professional development models, findings, and lessons learned in their APRs.

## ***Report Organization***

The remainder of this report is organized into five additional chapters and four appendices, as follows:

- Chapter 2: Characteristics of MSP Projects and Participants
- Chapter 3: Professional Development Content, Models, and Activities
- Chapter 4: MSP Evaluation Designs and Outcomes
- Chapter 5: Highlights from Select MSP Projects
- Chapter 6: Summary and Conclusions

- Appendix A: Challenges Reported by Projects in Implementation and Evaluation
- Appendix B: Criteria for Classifying Designs of MSP Evaluations
- Appendix C: Review of Projects with Rigorous Designs
- Appendix D: 2008 State MSP Appropriations

Chapters 2 and 3 respond to the first research question, describing how MSP projects were implemented. Chapter 4 responds to Research Questions 2, 3, and 4, describing the designs and outcomes projects reported. Chapter 5 presents highlights from MSP projects that are representative of partnerships across the across the country. Finally, Chapter 6 provides a summary of the findings and makes concluding comments.

Appendix A documents some of the implementation and evaluation challenges reported by projects. Appendix B provides criteria for classifying rigorous evaluation designs, and Appendix C provides a review of the final evaluation designs of projects that reported using experimental or quasi-experimental designs, using these criteria. Finally, Appendix D includes a table with the 2008 MSP state appropriations.

## Chapter 2: Characteristics of MSP Projects and Participants

This chapter describes the sources and amounts of funding used by MSP projects, the types and number of partners involved in MSP projects, the number of teachers and students served by MSP projects, the characteristics of those teachers, and the methods of participant selection.

### *Sources and Amounts of Funding*

The MSP program is a formula grant program to the states, with the size of individual state awards based on student population and poverty rates. No state received less than one half of one percent of the total appropriation. With these funds, each state is responsible for administering a competitive grant competition, in which grants are made to partnerships to improve teacher knowledge in mathematics and science. In PP08, federal MSP resources totaling \$179 million were distributed through formula grants to all 50 states, the District of Columbia, and Puerto Rico.<sup>15</sup> MSP appropriations to individual states ranged from \$890,414 to \$21.9 million (see Appendix D).

Individual MSP project budgets ranged from \$16,496 to \$8.2 million with an average funding level of \$318,752 and a median of \$200,000. As shown in Exhibit 5, over three-fourths of projects (77 to 81 percent) received \$500,000 or less in state funding between PP04 and PP08. Between PP07 and PP08, the proportion of projects receiving between \$100,001 and \$200,000 decreased slightly (from 43 to 38 percent), while projects receiving \$100,000 or less increased (from 9 to 13 percent), reversing a trend that had been seen since 2004.

<b>Exhibit 5</b>					
<b>MSP Project Budgets from State MSP Grants, Performance Periods 2004–2008</b>					
<b>Project Budgets</b>	<b>PP04 Percent of Projects (N=238)</b>	<b>PP05 Percent of Projects (N=341)</b>	<b>PP06 Percent of Projects (N=488)</b>	<b>PP07 Percent of Projects (N=574)</b>	<b>PP08 Percent of Projects (N=626)</b>
\$100,000 or less	22%	20%	17%	9%	13%
\$100,001 to \$200,000	23	29	37	43	38
\$200,001 to \$500,000	32	32	26	26	30
\$500,001 to \$1,000,000	17	14	15	18	17
\$1,000,001 or more	6	5	5	4	2

*Source: Annual Performance Report item IA.6*  
*The non-response rate<sup>16</sup> was 7 percent in PP04, 9 percent in PP05, 1 percent in PP06, <1 percent in PP07, and 0 percent in PP08.*

Some MSP projects supplemented their federal MSP funds with funds from other federal and non-federal sources. In PP08, 21 percent of projects reported receiving funds from other sources. These additional funds ranged from \$2,250 to \$3.95 million.

<sup>15</sup> The American Virgin Islands, Guam, the Northern Mariana Islands, and Samoa pool their MSP funds as part of their consolidated budget.

<sup>16</sup> Throughout this report, all non-response rates are calculated out of the total number of projects that that should have answered the APR question.

MSP projects classified their stage of implementation, with “new” defined as conducting start-up tasks such as planning activities, formalizing partnerships, and implementing the professional development model for the first time; “developing” defined as revising, enhancing, or continuing to develop their professional development model; and “fully developed” defined as all components of a project’s planned model were fully operational. Exhibit 6 shows that in PP08, more projects reported being fully developed or developing than new (45 percent, 40 percent, and 15 percent of projects respectively). This represents a slight shift from the previous year’s MSP projects from new to developing.

<b>Exhibit 6</b>			
<b>Projects’ Stage of Implementation, Performance Periods 2006–2008</b>			
<b>Stage of Implementation</b>	<b>PP06 Percent of Projects (N=366)</b>	<b>PP07 Percent of Projects (N=573)</b>	<b>PP08 Percent of Projects (N=626)</b>
Stage 1: New	28%	23%	15%
Stage 2: Developing	30	35	40
Stage 3: Fully developed	42	42	45

*Source: Annual Performance Report item VII.C*  
*The non-response rate was 0 percent in PP06, <1 percent in PP07, and 0 percent in PP08.*

### ***Partnerships***

The MSP program requires that all local partnerships include: 1) a science, mathematics, or engineering department of an institution of higher education (IHE) and 2) a high-need school district. However, MSP projects may elect to incorporate other types of partners such as education departments from IHEs; additional local education agencies including public charter schools, public or private elementary or secondary schools and school consortia; and businesses and non-profit or for-profit organizations that have a proven capacity to effectively improve the knowledge of mathematics and science teachers. MSP projects reporting in PP08 had an average of 10 partner organizations, with the number of partners ranging from 1 to 80.

Each MSP grant has a designated fiscal agent that serves as the lead organization for the project. The fiscal agent is primarily responsible for distributing MSP funds, but often organizes and manages the project’s activities as well. The lead organization is typically either a local school district or an IHE, as seen in Exhibit 7. In PP04, school districts and IHEs held this responsibility in approximately equal percentages of projects (41 percent and 44 percent, respectively). However, between PP05 and PP08, at least half of all projects (between 50 and 56 percent) had local school districts serve as fiscal agents, while approximately one-third of projects (between 29 and 37 percent) had IHEs fulfill this role. The remaining projects indicated neither local school districts nor IHEs served as the lead organization. In PP08, other designated fiscal agents for the projects included regional organizations (6 percent) and non-profit organizations (5 percent).

<b>Exhibit 7</b>					
<b>Types of Lead Organizations, Performance Periods 2004–2008</b>					
<b>Type of Lead Organization</b>	<b>PP04 Percent of Projects (N=257)</b>	<b>PP05 Percent of Projects (N=375)</b>	<b>PP06 Percent of Projects (N=487)</b>	<b>PP07 Percent of Projects (N=575)</b>	<b>PP08 Percent of Projects (N=626)</b>
Local school district	41%	54%	53%	56%	50%
Institution of higher education (IHE)	44	29	31	31	37
Non-profits, regional educational agencies, or other organizations	15	17	16	13	13

*Source: Annual Performance Report item I.B.3*  
*The non-response rate was 0 percent in PP04, 0 percent in PP05, 1 percent in PP06, 0 percent in PP07, and 0 percent in PP08.*

Over 3,900 IHE faculty members, working in a variety of disciplines, were involved with MSP projects during PP08. MSP projects are required to establish direct interactions between participants who participate in professional development and IHE faculty members in mathematics, the sciences, or engineering. As shown in Exhibit 8, at least 60 percent of all projects included faculty from mathematics (65 percent) and science (60 percent) departments, and 11 percent of projects included faculty from engineering departments. Additionally, more than two-thirds of the projects (69 percent) reported working with faculty members from education departments, and 19 percent of projects included faculty from “other” departments such as technology, business, agriculture, and computational science, as well as faculty that specialize in working with Geographic Information Systems (GIS).

<b>Exhibit 8</b>			
<b>Disciplinary Affiliation of IHE Faculty Participating in MSP, Performance Period 2008</b>			
<b>Discipline</b>	<b>Percent of Projects (N=625)</b>	<b>Average Number per Project</b>	<b>Total Number Participating in MSP (Sum=3,906)</b>
Science	60%	4	1,327
Mathematics	65	3	1,089
Education	69	2	1,068
Engineering	11	2	155
Other	19	2	267

*Source: Annual Performance Report items IV.A.1- 5*  
*Percents total more than 100 percent because respondents could check more than one category.*  
*The non-response rate was <1 percent.*

In addition to the participants learning content and teaching methods from IHE faculty members, the faculty members also reported learning and changing their own teaching due to their interactions with participants. One project from Louisiana noted that their IHE made a special effort to understand teachers’ strengths and weaknesses and tailored their teaching accordingly.

*“Teachers expressed concern about the level at which the content was presented...Rather than watering down the content, the instructor took the time to meet with each group of teachers to further discuss and explain the content presented. In subsequent presentations, the instructor took extra care to ensure that the participants’ content knowledge was ramped up during the presentation, so that they were not lost when the time came to present the content at a much deeper level. As a result, the teachers stretched their content knowledge and developed a*

I think that this opportunity has helped me to put myself in the students’ place while learning. I had several “a ha” moments when I truly felt like I understood something for the first time  
-- GET SMART Participant

*conceptual understanding of the content presented. As one of the teachers stated, “I think that this opportunity has helped me to put myself in the students’ place while learning. I had several ‘a ha’ moments when I truly felt like I understood something for the first time.” (Graham, 2009).*

Two projects noted that their faculty incorporated these valuable lessons gleaned from teachers’ learning styles in broader settings such as their education courses at large.

*A project from California reported that the project’s collaborative approach in investigating teaching and student learning through Lesson Study improved the university faculty’s awareness of what is critical for teacher education coursework and has influenced their work as credential advisors and instructors of the methods course for the single subject credential (Brown, 2009).*

*A faculty member from CCSTEM in Arizona noted, “Since I teach several Mathematics for Elementary Teachers courses at the college level, I am able to have a direct impact on future elementary teachers. Through the CCSTEM project, I see first hand some of the misconceptions about mathematics that current elementary teachers have. This insight has allowed me to emphasize certain topics in a different way so that my own Mathematics for Elementary Teachers students can avoid the same misconceptions” (Bristol, 2009).*

One project even discussed an impact the partnership had on the university and on bridging the divide between their education and arts and science faculty in order to train teachers more effectively:

*“...[T]he historical context of science education might best have been characterized as a divide between the College of Education faculty and College of Arts and Sciences faculty with regard to science education courses. In particular, science education majors would be prepared for content in the College of Arts and Sciences while they would be prepared for pedagogical aspects of science education within the College of Education. This apparent division among colleges has been negotiated through the collaborative development of 6 new science courses that acknowledge the specialized content needed for teaching—content that is different for pre-service and practicing teachers than for students majoring in the subject area. These courses have been developed collaboratively by science educators and science faculty; some will be taught by science education faculty and others will be taught by science faculty. The first of these courses was taught very successfully this summer by a physics professor (sometimes team teaching with a high school science teacher.” (Langrall, 2009).*

## *Number of Teachers and Students Served by MSP*

The central focus of the MSP program is to provide professional development to teachers in order to increase their mathematics and/or science content knowledge and their pedagogical skills. The underlying logic is that with deeper knowledge of the subject matter and understanding of effective instructional strategies, teachers will be better able to impact their students' achievement in mathematics and science. To accomplish this goal, MSP projects work with a variety of teachers, across grades K through 12. Additionally, the program aims to increase the support structures in place for these teachers by training teacher leaders, coaches, and paraprofessionals, and by promoting the instructional leadership of administrators.

Individual projects in PP08 served fewer participants on average than in PP07 but roughly the same numbers as in PP06 (Exhibit 9). MSP projects reported that more than 57,000 elementary, middle, and high school teachers, coaches, paraprofessionals, and administrators participants in PP08.<sup>17</sup> The median number of participants served per MSP project decreased from 54 to 43, nearly the level seen in PP06 (see Exhibit 9).<sup>18</sup> The number of participants reported by individual projects varied widely, ranging from a minimum of 4 participants to a maximum of 3,944. Nearly all projects (90 percent) worked with 200 participants or fewer. Over half of the projects (57 percent) reported serving 50 or fewer participants in PP08; over one-fifth (22 percent) reported serving between 50 and 100 participants; and the remaining projects (21 percent) reported serving more than 100 participants.

<b>Exhibit 9</b>			
<b>Distribution and Statistics Regarding Total Number of Participants Served by MSP Projects, Performance Periods 2006–2008</b>			
<b>Number of Participants Served</b>	<b>PP06<sup>a</sup> (N=484)</b>	<b>PP07 (N=551)</b>	<b>PP08 (N=595)</b>
Total number served by MSP projects	55,896	59,969	57,639
Median number served per project	42	54	43
Minimum number served per project	5	2	4
Maximum number served per project	2,075	1,540	3,944
	<b>Percent of Projects</b>		
25 or fewer	24%	18%	21
26-50	33	30	36
51-100	19	26	22
101-200	10	13	11
201 or more	14	13	10
<i>Source: Annual Performance Report items IV.C, IV.G.1</i>			
<i>The non-response rate was 2 percent in PP06, 4 percent in PP07, and 5 percent in PP08.</i>			
<i><sup>a</sup> The PP06 figures on number of teachers served are slightly different from those presented in the Mathematics and Science Partnerships: Summary of the Fiscal Year 2006 Annual Reports, due to a change in the method of calculating that variable.</i>			

<sup>17</sup> Thirty-one projects did not report the number of participants served.

<sup>18</sup> The median of 43 means that half of reporting MSP projects served 43 or fewer participants, and half served more than 43 participants. The median is a more meaningful measure of the number of participants served by typical projects since the mean number of participants was heavily skewed by a few projects that reported serving more than 1,000 participants.

In total, MSP projects reported reaching over 2.8 million students in PP08. Exhibit 10 shows the total number of students at each school level who were taught by MSP participants, as well as the median,<sup>19</sup> minimum, and maximum number of students reached by MSP participants.

<b>Exhibit 10</b>			
<b>Total Number of Students Taught by Participants in MSP Projects, Performance Period 2008</b>			
<b>Number of Students Taught</b>	<b>Elementary School (N=466)</b>	<b>Middle School (N=505)</b>	<b>High School (N=363)</b>
Total number taught by MSP participants	909,628	1,157,458	775,908
Median number taught per project	741	1,084	1,000
Minimum number taught per project	6	7	7
Maximum number taught per project	105,000	32,804	46,575
<i>Source: Annual Performance Report item IV.H</i>			
<i>The non-response rate was 4 percent.</i>			
<i>Projects could serve one or multiple school levels.</i>			

### ***Methods of Selecting Participants***

MSP projects design their interventions to target specific groups of participants within the K–12 education system. These groups include individual teachers from one or more schools or districts or whole schools in which most or all participating teachers are in one school or a group of schools. MSP projects are encouraged to identify and select schools and teachers for participation according to the level of need for professional development services in mathematics and science.

As shown in Exhibit 11, most MSP projects (84 percent) in PP08 targeted individual teachers in their professional development interventions. The remaining 16 percent of projects indicated that their professional development models were designed to improve mathematics and/or science instruction throughout a school, or a set of schools. Among projects that targeted schools, almost all reported serving public schools (98 percent), with only a few serving private schools (2 percent).

<b>Exhibit 11</b>	
<b>Primary Target for Intervention, Performance Period 2008</b>	
<b>Primary Target</b>	<b>Percent of Projects (N=624)</b>
Individual teacher	84%
Schools (one school, schools within a district, or schools across district lines)	16
<i>Source: Annual Performance Report item IV.B.2</i>	
<i>The non-response rate was &lt;1 percent.</i>	

Exhibit 12 shows how projects classified whether their goal was to train individual teachers, or to train teacher leaders who in turn would train other teachers. Slightly over two-thirds of projects (69 percent) indicated that the main goal of their MSP project was to improve individual teachers' content knowledge, while just 3 percent had the main goal of training teacher leaders. Teacher leaders are expected to train other teachers throughout their schools or districts. Twenty-two percent of projects

<sup>19</sup> These data, similar to the data on number of teachers, have been skewed by the presence of several unusually large projects. Therefore, the median is used to illustrate the number of students reached by a typical MSP project.

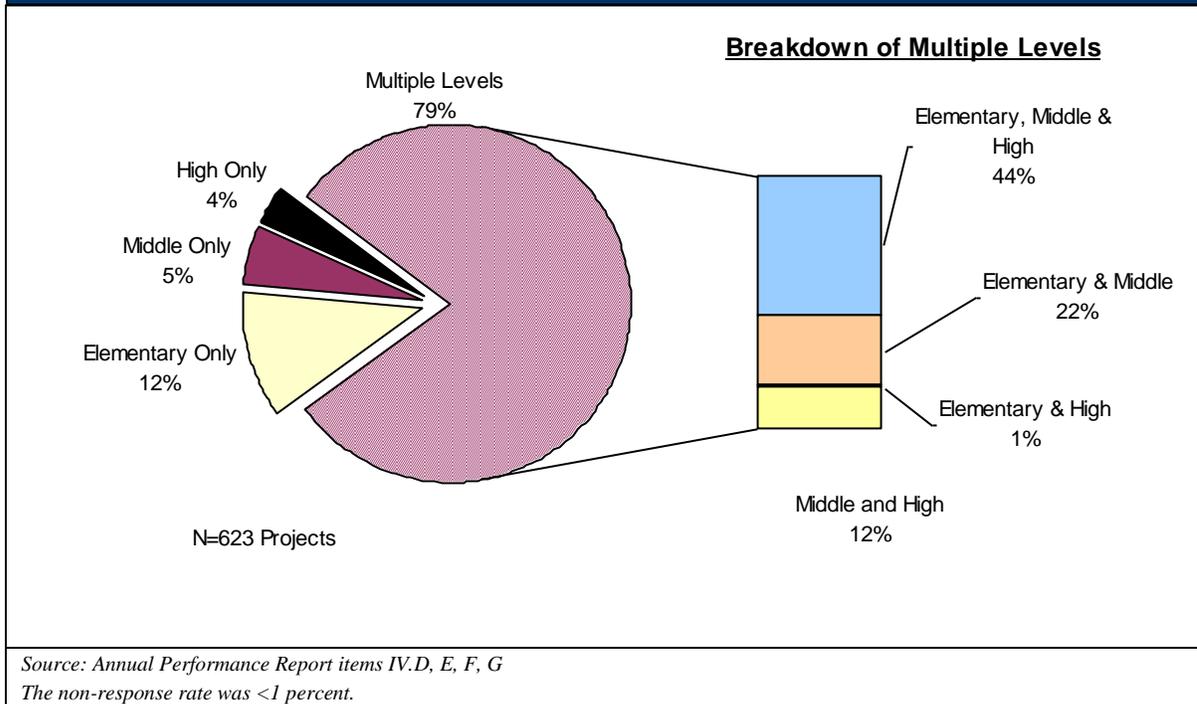
reported that both goals were equally important, indicating that most projects who train teacher leaders also train individual teachers.

<b>Exhibit 12</b>	
<b>Main Goal of MSP Project, Performance Period 2008</b>	
<b>Main Goal</b>	<b>Percent of Projects (N=592)</b>
Improving teachers' content knowledge	69%
Training teacher leaders	3
Both	22
Other	6
<i>Source: Annual Performance Report item IV.B.1</i>	
<i>The non-response rate was 5 percent.</i>	

### ***School Levels and Types of Participants Served***

MSP projects are structured to address the professional development needs of educators at varying levels of the K–12 system. Projects may work with a group of participants drawn from a single school level (elementary, middle, or high school), participants from a combination of these school levels, or participants from the entire K–12 spectrum. Overall, in PP08, 79 percent of projects worked with participants from multiple school levels, while 21 percent of projects targeted a single school level.

As shown in Exhibit 13, 12 percent of all MSP projects in PP08 targeted the elementary school level only, 5 percent targeted the middle school level only, and 4 percent targeted the high school level only. The remaining 79 percent of projects targeted multiple school levels. Forty-four percent of projects targeted participants at all school levels; 22 percent targeted elementary and middle school participants; 12 percent targeted middle and high school; and 1 percent targeted elementary and high school. Although the majority of projects served multiple school levels, the majority of participants who participated in MSP projects (79 percent) were from elementary or middle schools.

**Exhibit 13****School Levels of Participants Served, Performance Period 2008**

The MSP projects serve a variety of educators at all three school levels, including classroom teachers, administrators, and other school staff. Exhibit 14 examines the different types of educators participating in MSP projects and shows the percentages of total participants in each category across the MSP program as a whole.

The most commonly reported MSP participants, across all school levels, are “regular core content” teachers, defined as elementary school teachers who have regular classroom assignments, and middle and high school teachers with mathematics, science, or technology assignments. Other types of MSP participants include:

- *Special education teachers*—teachers who teach or offer support to children with special learning needs;
- *School administrators*—including both principals and assistant principals;
- *Mathematics and science coaches*—including specialists who provide direct one-on-one coaching to students, and specialists who work with teachers to model instruction, conduct classroom observations, and provide personalized feedback and support;
- *Teachers of English language learners (ELL)*—teachers who offer support to students whose primary language is a language other than English;
- *Gifted and talented /Advanced Placement(AP)/International Baccalaureate (IB) teachers*—teachers who specialize in working with gifted students who need additional challenge; and
- *Paraprofessionals*—staff, often referred to as *aides*, who are not licensed to teach, but who perform many educational duties, both individually with students and organizationally in the classroom.

Exhibit 14 shows the total proportion of each participant type served by school level. For example, special education teachers made up 5 percent of all elementary school level MSP participants.

MSP participants were distributed across school levels of in PP08 as follows: 53 percent at the elementary level, 28 percent at the middle school level, and 19 percent at the high school level. At each school level, over 80 percent of teachers were regular core content teachers. The next two largest groups of MSP participants across school levels were special education teachers (between 5 and 6 percent) and school administrators (between 5 and 6 percent).

<b>Exhibit 14</b>			
<b>Percent of Teachers and Other School Staff Among All MSP Participants Served, by School Level, Performance Period 2008</b>			
<b>Participant Type</b>	<b>Percent of Teachers and Other School Staff Served</b>		
	<b>Elementary School (K-5)</b>	<b>Middle School (6-8)</b>	<b>High School (9-12)</b>
	<b>PP08 (N=27,724)</b>	<b>PP08 (N=14,320)</b>	<b>PP08 (N=9,654)</b>
Regular core content	84%	82%	84%
Special education teachers	5	6	4
School administrators	5	6	6
Math coaches	1	1	1
Science coaches	<1	1	1
ELL	3	2	1
Gifted and talented / AP-IB	1	2	3
Paraprofessionals	<1	<1	<1

*Source: Annual Performance Report items IV.D, E, F, G*  
*The non-response rate was 0 percent in PP08.*

## Chapter 3: Professional Development Content, Models, and Activities

This chapter describes the content covered by the professional development activities offered in MSP projects as well as the types of activities that were part of the professional development offerings. First, it describes the specific mathematics and science content of the MSP professional development. Then it describes the models of professional development offered (i.e., whether the professional development was primarily offered through summer institutes with follow-up or whether it focused on school year activities) as well as the specific learning activities within those professional models.

### *Professional Development Content of MSP Projects*

In their annual reports, projects indicated whether they provided mathematics and/or science content in their MSP professional development, and then identified the major topics within each discipline and the grade level of the teachers to whom each topic was taught. As shown in Exhibit 15, in PP08, 37 percent of projects focused on mathematics only, 31 percent focused on science only, and 32 percent focused on both mathematics and science. The distribution of content focus across projects shows a slight shift from math to science over time.

<b>Exhibit 15</b>			
<b>Content Focus of Professional Development, Performance Periods 2006–2008</b>			
<b>Content Focus</b>	<b>PP06 Percent of Projects (N=482)</b>	<b>PP07 Percent of Projects (N=550)</b>	<b>PP08 Percent of Projects (N=619)</b>
Mathematics only	44%	37%	37%
Science only	26	30	31
Mathematics and science	30	33	32

*Source: Annual Performance Report items VI.A.1, VI.B.1*  
*The non-response rate was 2 percent in PP06, 4 percent in PP07, and 1 percent in PP08.*

MSP projects that provided professional development in both mathematics and science chose whether or not to integrate content delivery across the two subjects. Projects that used a separate approach addressed mathematics and science in courses that were taught contemporaneously or consecutively, while projects that used an integrated approach offered joint professional development opportunities on mathematics and science topics.

### **Mathematics Content**

Professional development in mathematics was provided in topic areas relevant to the grade level of the participating teachers. Across MSP projects, these areas included: number and operations, algebra, geometry, measurement, probability and statistics, problem solving, reasoning and proof, calculus, and technology. As shown in Exhibit 16, many projects provided professional development in multiple content areas. In mathematics, problem solving was the most frequently addressed content areas across all school levels (81 to 86 percent of projects), and calculus was the least frequently addressed topic (3 to 20 percent).

At the elementary school level, approximately four-fifths of projects that involved math professional development addressed problem solving or number and operations. Additionally, 60 percent or more

of projects addressed measurement, algebra, or geometry; over half of projects addressed technology or reasoning and proof; and nearly half of projects addressed probability and statistics.

At the middle school level, over 70 percent of projects that involved math professional development addressed problem solving, algebra, or number and operations. In addition, over 60 percent of projects addressed geometry, technology, or measurement; and over half of projects addressed reasoning and proof or probability and statistics.

At the high school level, over 70 percent of projects that involved math professional development addressed problem solving, algebra, or technology. Additionally, over 60 percent of projects addressed geometry or reasoning and proof; and over half of projects addressed number and operations, measurement, or probability and statistics. Finally, 20 percent of projects addressed calculus or other topics.

<b>Exhibit 16</b>			
<b>Content Areas and Processes of Mathematics Professional Development Provided to Teachers, by School Level, Performance Period 2008</b>			
<b>Mathematics Content and Processes</b>	<b>Elementary School Teachers Percent of Projects (N=318)</b>	<b>Middle School Teachers Percent of Projects (N=339)</b>	<b>High School Teachers Percent of Projects (N=246)</b>
Problem solving	81%	86%	86%
Number and operations	79	71	56
Algebra	65	77	78
Geometry	60	65	63
Measurement	69	63	52
Probability and statistics	46	54	52
Reasoning and proof	52	56	61
Calculus	3	6	20
Technology	55	65	72
Other	17	19	20

*Source: Annual Performance Report item VI.A.2*  
*The total number of projects that provided professional development in mathematics content areas or processes in PP08 was 426. The non-response rate was 0 percent in PP08.*  
*Percents total more than 100 percent because respondents could check more than one category. Projects could serve one or multiple school levels.*

## Science Content

As in mathematics, professional development in science was provided in topic areas relevant to the grade level of the participating teachers. Projects also focused on multiple disciplines. Across MSP projects, these areas included: scientific inquiry, physical science, physics, chemistry, life science/biology, earth science, and technology. As shown in Exhibit 17, scientific inquiry was the most commonly addressed topic among projects that addressed science across school levels (92 to 95 percent of projects). Chemistry was the least frequently addressed topic for elementary and middle schools (47 to 53 percent of projects), and earth science was the least frequently addressed topic for high schools (49 percent of projects). Most projects (67 to 72 percent) across school levels provided professional development in technology.

At the elementary school level, 95 percent of projects that involved science professional development addressed scientific inquiry. Additionally, over two-thirds of projects addressed physical science or technology, and slightly over 60 percent of projects addressed earth science or life science/biology. Fewer than half of projects (47 percent) serving elementary school teachers provided professional development in chemistry.

At the middle school level, 95 percent of projects that involved science professional development addressed scientific inquiry. In addition, over 70 percent of projects addressed physical science/physics or technology, and more than 60 percent of projects addressed life science/biology or earth science. Just over half of projects (53 percent) serving middle school teachers provided professional development in chemistry.

At the high school level, 92 percent of projects that involved science professional development addressed scientific inquiry, 70 percent of projects addressed physical science/physics or technology, over 50 percent of projects addressed life science/biology or chemistry. Nearly half of projects (49 percent) serving high school teachers provided professional development in earth science.

<b>Exhibit 17</b>			
<b>Content Areas and Processes of Science Professional Development Provided to Teachers, by School Level, Performance Period 2008</b>			
<b>Science Content Areas and Processes</b>	<b><u>Elementary School Teachers</u> Percent of Projects (N=298)</b>	<b><u>Middle School Teachers</u> Percent of Projects (N=307)</b>	<b><u>High School Teachers</u> Percent of Projects (N=199)</b>
Scientific inquiry	95%	95%	92%
Physical science/Physics	71	75	70
Chemistry	47	53	52
Life science/Biology	61	64	56
Earth science	62	61	49
Technology	67	72	70
Other	28	29	24

*Source: Annual Performance Report item VI.B.2*  
*The total number of projects that provided professional development in science content areas or processes in PP08 was 391. The non-response rate was 0 percent.*  
*Percents total more than 100 percent because respondents could check more than one category. Projects could serve one or multiple school levels.*

### ***Professional Development Models***

MSP partnerships often focus their professional development activities around a summer institute, a model of professional development that provides multiple, intensive learning experiences over a minimum of a two-week period. These learning experiences include deep exploration of mathematics and science content. Teachers then apply content they have learned to their teaching during the school year and receive follow-up support, such as additional content development sessions with faculty, coaching on classroom practices, and classroom observations. Although improving teacher content knowledge directly through a summer institute with in-school follow-up is the most common model of MSP professional development, some projects focus their efforts on the school year activities.

## Projects with Summer Institutes

Over half of MSP projects (59 percent) conducted a summer institute. According to the statute governing the MSP program, projects that use MSP funds to establish summer institutes are required to conduct the workshop for a period of not less than two weeks.

Projects that offer summer institutes are required to provide at least three or four days of follow-up activities during the academic year. Nearly all of the projects that offered summer institutes also conducted follow-up activities, with the aim of enhancing or extending the knowledge gained by participants over the summer. As shown in Exhibit 18, in PP08, 56 percent of projects conducted summer institutes with school year follow-up activities, while only 3 percent reported that they conducted summer institutes without any school year follow-up activities. Two descriptions of projects that provided summer institutes with follow-up are provided below.

*An MSP project in Arizona provided 16 elementary schoolteachers with a two-week summer institute, with four follow-up sessions during the academic year, then a second one-week summer institute. The first summer institute focused on standards-based content and inquiry-based instruction in number sense, geometry and measurements. The second summer institute concentrated on algebra integration that continued the development of pedagogical content knowledge through the use and application of Curriculum Topic Study and content literacy. Follow-up training included two formative instructional observations, and centered on the application of previous content knowledge to the areas of data analysis, discrete mathematics and probability (Bristol, 2009).*

*A Louisiana MSP project offered a three-week summer institute with five follow-up Saturday sessions to 25 ninth grade level teachers focusing on standards-based lessons to deliver the content and skills contained in the Benchmarks of the Louisiana Algebra and Physical Science Frameworks. Training sessions included the two content strands: Algebra I and the Chemistry of Physical Science. The lessons were embedded with literacy strategies and technology. Participants were given the opportunity to increase their content knowledge while developing their abilities to teach inquiry skills (Holcomb, 2009).*

<b>Exhibit 18</b>	
<b>Types of Professional Development Models, Performance Period 2008</b>	
<b>Professional Development Model</b>	<b>Percent of Projects (N=626)</b>
Summer institute only	3%
Summer institute with follow-up activities	56
Focus on school year activities	41
<i>Source: Annual Performance Report item V.B The non-response rate was 0 percent.</i>	

## Projects Focusing on School Year Activities

The remaining 41 percent of MSP projects in PP08 provided other types of professional development activities, which primarily took place during the academic year. While some professional development may have taken place over the summer, these activities did not fit into the definition of “summer institute,” which requires a minimum of two weeks of professional development. Instead, they were likely to include shorter workshops or conferences interspersed throughout the summer

months as well as during the school year. Examples of other types of school year professional development activities offered by projects in this category include evening courses for credit, regular Saturday workshops, and semester-long internship sabbaticals for in-service teachers. Two examples of projects that focused on school year activities, in addition to shorter summer sessions, are provided below.

*One Arkansas MSP project provided a 5-day residential intensive workshop at the University of Arkansas as an opportunity for high school earth and physical science-licensed teachers to gain physics content knowledge, develop their teaching strategies, and integrate technology into their teaching. The workshop included evening educational and mentoring activities by university faculty. The program also included a weekend follow-up session where participants shared their experiences implementing workshop activities and technology in their classrooms. Each participant developed or revised a lesson based on the 5-day workshop and conducted an evaluation of the lesson (Stewart, 2009).*

*In Kentucky, an MSP project held a 5-day summer workshop, eight monthly cadre meetings and mentor-mentee training. The monthly cadre meetings consisted of developing teachers' concept understanding of the targeted topics, pedagogical content knowledge, and appropriate assessment strategies, and analyzing student work to revise the instructional units. The targeted science curriculum topics were Force and Motion in year 1 and Properties of Matter in year 2. The 5-day summer workshop concentrated on working the pertinent grade band instructional units, revising the units based on feedback, and enhancing content and pedagogical content knowledge. The mentor-mentee training engaged participating teachers in training all other same-grade level teachers in their district on the instructional unit for implementation (Zeidler-Watters, 2009).*

## **Hours of Professional Development Provided**

Exhibit 19 shows the median number of hours of professional development<sup>20</sup> provided by model type. Overall, projects that conducted summer institutes with follow-up activities provided a median of 96 hours. Of the projects that conducted summer institutes with follow-up activities, a median of 60 hours was for the summer institute portion, and a median of 32 hours was for the follow-up activities portion. Both projects that conducted summer institutes only and projects that focused on school year activities each provided a median of 80 hours of professional development. This represents an increase from 74 hours in 2007 in the average number of hours of professional development offered for projects that focus on school year activities.

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<sup>20</sup> Projects that provided a very high or very low level of professional development skewed the average (mean), so we present the median.

<b>Exhibit 19</b>	
<b>Total Median Hours of Professional Development, By Model Type, Performance Period 2008</b>	
<b>Professional Development Model</b>	<b>Median Number of Hours</b>
Summer institute only	80
Summer institute with follow-up activities:	96
<i>Summer institute portion</i>	60
<i>Follow-up activities portion</i>	32
Focus on school year activities	80

*Source: Annual Performance Report item V.A.1, V.B(i).1, V.B(ii).1*  
*The non-response rate for each model was as follows:*  
*Summer institutes only: 0 percent; Summer institutes with follow-up: 15 percent; and Focus on school year activities: 1 percent.*

### ***Professional Development Activities***

In addition to intensive summer institutes, MSP projects offered a wide range of other professional development activities to participating teachers in PP08. Such activities were offered as follow-up to summer institutes, to supplement material and concepts learned in those institutes, or in lieu of summer institutes. In this section, we first present the prevalence of these additional activities, and then we describe each type of professional development activity and provide examples from specific projects. The examples provided help to provide a sense of the broad variety of activities in which projects are engaged.

Exhibit 20 lists the primary activities that projects listed in addition to, or in lieu of, summer institutes. Overall, the most common form of school year professional development reported by MSP projects in PP08 was on-site activities, taking place at or near the teachers' schools. This category includes activities such as recurring workshops, coaching, and mentoring, and was reported by 71 percent of projects that offered school year activities. The next most common form of academic year professional development reported was study groups, such as professional learning communities or lesson studies (15 percent). Other reported activities include coursework at universities (10 percent) and on-line course work/distance learning networks (3 percent). Finally, 1 percent of projects reported that they offered professional development activities that did not fall into one of the previously mentioned categories.

<b>Exhibit 20</b>	
<b>Primary Form of Professional Development Activities Provided by Projects, Other Than Summer Institutes, Performance Period 2008</b>	
<b>Primary Focus of Professional Development Activities</b>	<b>Percent of Projects (N=560)</b>
On-site activities during academic year	71%
Study groups	15
Course work at university	10
On-line course work / distance learning networks	3
Other activities	1

*Source: Annual Performance Report items V.B.(ii), V.B.(iii)*  
*The non-response rate for each model was as follows:*  
*Projects with summer institutes with follow-up activities: 8 percent; Projects that focus on school year activities: 7 percent.*

The following sections describe each of the professional development activities in more detail and provide specific examples of how individual projects reported implementing these activities.

## **On-site Activities during Academic Year**

As noted above, over two-thirds of all MSP projects (71 percent) reported that they engaged in on-site activities during the academic year as the primary focus of their professional development. Examples of these on-site activities include STEM content courses in mathematics and science for teachers, exploration of STEM education content standards, curriculum mapping, lesson and curriculum development, classroom modeling and demonstration, classroom observation with feedback, and inquiry activities.

Depending on the project and the activity, these sessions were conducted either with groups of teachers within or across grade levels, or one-on-one between individual teachers and mentors or coaches. Examples of the types of mentors or coaches reported by various projects include fellow teachers, district staff members, IHE faculty, STEM graduate students, and professional providers of professional development. Mentors and coaches can provide direct one-on-one coaching to students or work with teachers to model instruction, plan lessons, conduct classroom observations, and provide personalized feedback and support. Following are two examples of projects that employed coaching.

*An MSP project in New York adopted a Board Instructional Coach model to increase academic achievement in math and science by enhancing the subject matter, content knowledge, and teaching skills of classroom teachers. The instructional coaches are developing and delivering professional development to teachers based on their individual needs rather than adopting a one-size-fits-all approach. The project director noted that this strategy has helped teachers build strong relationships with the coaches and also has facilitated an environment where teachers feel comfortable asking questions (Smith, 2009).*

*A Delaware MSP project held a 2-day professional development training each summer for administrators and teachers, with 5 school release days and 4 after-school dinner meetings. During these professional development sessions, math specialists from the University of Delaware partnered with district teacher coaches to facilitate the sessions. The teacher participants consisted of a mix of regular and special education teachers. The activities included: 1) mathematics content training with an emphasis on visual models and graphic organizers, 2) conversations about student work and lesson planning, and 3) discussions of pedagogical practices. These activities were closely aligned to the mathematics curriculum that most state teachers are currently using (Maxwell, 2009).*

## **Study Groups**

Fifteen percent of the projects reported that their primary form of professional development during the academic year was study groups. Teacher study groups provide opportunities for ongoing collaboration with colleagues. Through these study groups, teachers meet periodically as professional learning communities (PLCs). For example, some projects reported that teachers in these groups shared lesson plans with each other and reflected on both their content knowledge and classroom practice. Lesson Study is an example of a study group model used by some MSP projects. It is a process in which teachers jointly plan, observe, analyze, and refine actual classroom lessons. In study groups teachers might work with peers teaching the same grade to better understand STEM education content standards for the grade they teach. In other models, teachers can participate in vertical teaming where they work with colleagues at consecutive grade levels to better understand the learning

progression embodied in the standards and/or the curriculum. Below are examples of two projects that used PLCs to encourage collaboration among staff.

*In Georgia, an MSP project utilized PLCs as their professional development model. A math and a science PLC met monthly at two high schools and three middle schools to collaborate on lesson plan preparation, develop a continuum of skill building from one grade level to the next, build teacher content knowledge acquisition, conduct peer observations of teaching, and improve teaching process through discussion and analysis of research-based teaching methods. Each quarter math and science PLCs met as a group to collaborate on interdisciplinary curricula (Riddleberger, 2009).*

*A Maine MSP project established PLCs for collaborative inquiry and to ensure learning for all students. PLC topics have included common assessments, differentiation, how the program aligns with our report card cross-grade discussion, student Maine Educational Assessment results and student answers. PLCs engaged in activities such as study groups, examination of student work, exploration of best practices and development of common assessments aligned to Maine's Learning Results/Parameters (Marcotte, 2009).*

### **Content Course Work at a College or University**

With the goal of enhancing teachers' content knowledge, 10 percent of projects reported STEM courses provided by a local college or university as their major form of professional development, other than summer institutes. The courses were often intensive and condensed into a period of two to three full-time weeks in the summer, or were held in the evenings or on weekends during the school year. In some cases, teachers earned undergraduate or graduate credit in STEM fields, and completing the courses helped teachers meet requirements for certification or highly qualified status.<sup>21</sup> Below are descriptions from two projects that provided teachers the opportunity to attend university courses and earn graduate credits.

*In Massachusetts, one MSP project offered a total of five courses on four weekends and six days over two weeks in the summer during the first grant year. A total of 52 middle school teachers attended the courses with 20 teachers attending two courses. The courses placed strong emphasis on mathematics content, each consisting of 45 hours of in-class instruction and 20 hours of school implementation in which content knowledge was applied to classroom practice; teachers received three graduate credits from Lesley University. (Collins, 2009).*

*An Illinois MSP project increased the number of highly qualified teachers by offering a sequence of graduate-level courses culminating in a master's degree in one of two tracks: Master of Science in Mathematics (mathematics education) or Master of Science in Curriculum and Instruction (science education). These tracks provided teachers who held a middle school endorsement with the content required for state endorsement in either middle school mathematics or science. Coursework was provided by faculty at Illinois State University and included intensive courses and practical experiences that were designed to improve content and pedagogical knowledge in mathematics and science. The program included three core courses that integrate research, learning and instructional strategies with*

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<sup>21</sup> A "highly qualified" teacher must 1) hold a bachelor's degree; 2) have a full state certification or license; and 3) have demonstrated subject matter competence in each of the subject area(s) taught.

*the domains of mathematics and science. Teachers had the opportunity to conduct an action research study and report the results in a written paper and research presentation (Langrall, 2009).*

## **On-Line Coursework/Distance Learning Networks**

In order to provide convenient access to content materials to teachers who needed it, some MSP projects offered on-line courses or course modules that teachers could access on demand during the summer or school year and distance learning networks that help projects reach out to geographically isolated teachers. Three percent of projects reported this as their primary form of professional development, in addition to summer institutes.

An advantage of on-line programs is that they allow expanded access to professional development for teachers in rural areas and those who need the scheduling flexibility. Like other STEM content activities offered by MSP projects, on-line courses usually focus on mathematics or science content but might also address issues related to teaching and learning, curriculum development, assessment, or other topics. A project's on-line course might also utilize software applications that support on-line communities such as Blackboard or WebCT, to encourage collaboration and communication among participants and facilitators.

Whereas the main function of on-line coursework activities is content delivery, distance learning networks focus on increasing collaboration and support among participants and MSP facilitators. Teachers who would otherwise have had to travel long distances to meet with their counterparts or with university faculty were able to form communities and/or mentoring relationships through the use of email, message boards, phone contact, videoconferencing, and other communication technologies. Examples of professional development offered by distance learning networks include mentoring and coaching, lesson plan exchanges, on-line study group discussions, and blogging. Following are two examples of MSPs that used online learning.

*A Connecticut MSP project established on-line content learning as part of its professional development activities. To enhance physical science content understanding, two-content-specific SciPacks from the National Science Teachers Association's Learning Center, "Force and Motion" and "Energy," were offered. Assistance from a physics professor was available upon request (Carver, 2009).*

*One MSP project in New York provided various models of professional development including on-line work. Participants engaged in hybrid coursework that included three face-to-face sessions but primarily took place on-line asynchronously. The activities were created to build on teachers' understanding of STEM and how to develop STEM projects in the classroom based on STEM curricula (Nieves, 2009).*

## **Other Activities**

One percent of MSP projects reported a variety of other professional development activities to accommodate the varied needs and circumstances of participating schools and teachers as their primary form of professional development provided in addition to summer institutes.

Some commonly cited "other activities" included various types of field experiences, which ranged from daylong field trips to laboratory workshops to long-term internships or field work. Some

reported examples of sites for these field experiences include museums, factories, observatories, national parks, mountains, lakes, and laboratories. While some of these activities were limited to daylong visits, other projects reported that teachers took part in more in-depth experiential learning. Below are examples from three MSP projects that used field experiences to supplement teachers' learning.

*An MSP project in Oklahoma held field investigations in the Wichita Mountains and at Beavers Bend State Park. Seventy 6<sup>th</sup>–12<sup>th</sup> grade math and science teachers learned how to identify, collect, preserve, and quantify both insect and flower species using technology such as digital formats with movie cameras, computers, and movie making software. They developed skills for collection and manipulation of data using TI-84 calculators. Teachers designed graphs depicting their own research. Follow-up discussions about professionalism of teaching math and science and the implementation of research into the classroom took place after the field experiences (Calaway, 2009).*

*One MSP project in Illinois held professional development consisting of lecture/discussion, laboratory activities, and field activities. Professional development was presented by scientists and education specialists on the university faculty and a professional scientist in water resources. Teachers engaged in a field study of Geneva Lake and glaciated and unglaciated landscapes in the area. They also participated in astronomical studies at Yerkes Observatory and had the opportunity to use digital imaging equipment (Gardner, 2009).*

*In New Hampshire, one MSP project offered a university course on data, probability, and statistics based on the National Council of Teachers of Mathematics Navigation Series and New Hampshire State Frameworks in math and science. Participants were also paired in groups of grade K–2 and 3–5 teachers for a day at the Amoskeag Fishways, where they experienced the process of collecting, managing, interpreting, and analyzing data in the classroom using a life science framework. Experienced senior program naturalists helped teachers discover how to facilitate a project with their students in which they collected relevant life science data with students, and how to help their students organize and display such data. They attended Saturday meetings at University of New Hampshire at Manchester to discuss successes and problems implementing the mathematical concepts learned over the summer. Each teacher was given a membership in the New Hampshire Teachers of Mathematics and the National Council of Teachers of Mathematics (Kieronski, 2009).*

## Chapter 4: MSP Evaluation Designs and Outcomes

This chapter first presents findings related to the MSP projects' evaluation designs in Performance Period 2008 (PP08). The chapter then describes teacher and student assessments and outcomes, which are used to assess the effectiveness of the MSP interventions.

### *Evaluation Designs*

Every MSP project is required to design and implement an evaluation and accountability plan that allows for a rigorous assessment of its effectiveness. The plan must include measurable objectives to: 1) increase the number of mathematics and science teachers who participate in content-based professional development activities; and 2) increase student academic achievement.

MSP projects reported using a variety of types of evaluators, and some projects reported using multiple types (Exhibit 21). In PP08, 71 percent of projects hired an external evaluator. External evaluators are specialized staff from outside of the partnership who are trained to conduct evaluations and who can help the projects to implement the most rigorous design feasible, given the constraints of the available resources. Forty-six percent of projects used MSP partnership organization staff (for example, staff from the partnership IHE), 19 percent participated in a statewide evaluation of MSP projects, and 2 percent of projects reported using another type of evaluator. Examples of other types of evaluators reported include doctoral students, county education offices, and regional collaboratives.

<b>Exhibit 21 Types of Project Evaluators, Performance Period 2008</b>	
<b>Type of Evaluator</b>	<b>Percent of Projects (N=622)</b>
External evaluator	71%
MSP partnership organization staff	46
Statewide evaluation	19
Other	2

*Source: Annual Performance Report item VII.A  
The non-response rate was 3 percent.  
Percents total more than 100 percent because respondents could check more than one category.*

Several projects cited the early involvement of an evaluator who could offer ongoing formative evaluation as well as clarity regarding expectations, and close collaboration between the evaluator, teachers, faculty, and grant facilitators as important factors contributing to a successful evaluation. Below are two quotes from projects.

*“The use of an external evaluator who attends many of the sessions and provides formative assessment as well as the usual summative reports has proven very valuable. Our external evaluator has real knowledge of the content as well as pedagogy and evaluation techniques. Her contributions are very important” (Sparks, 2009).*

*“The evaluator communicated with the participants and the instructors on an ongoing basis and the instructors used the information for formative feedback as well as changing their instructional plan” (Lawrence, 2009).*

Exhibit 22 presents the types of evaluation designs that projects reported using in PP08. Over half of projects (52 percent) reported using an experimental or quasi-experimental design. Three percent of projects reported that they implemented an experimental design (up from 2 percent in PP07), which is the most rigorous research design for testing the impact of an intervention, wherein schools, teachers, or students are randomly assigned to treatment or control groups. Nearly half of the projects (49 percent) reported using a quasi-experimental, or comparison group, design to compare the effects of the MSP program on participating teachers and/or their students to non-participating teachers and/or students. This is up 7 percentage points from PP07. Specifically, 27 percent of projects used a matched comparison group design, which attempts to show causality by demonstrating equivalence between groups at baseline or adjusting for any initial differences between groups, and 22 percent of projects reported using a non-matched comparison group.

The remaining 48 percent of projects reported using a less rigorous design type. One-quarter of projects (25 percent) reported using pre-tests and post-tests to assess the gains of the teachers served by MSP. Twelve percent of projects reported using qualitative methods only, and 8 percent of projects reported using a mix of quantitative and qualitative methods.

<b>Exhibit 22</b>		
<b>Types of Evaluation Designs Used by Projects, Performance Periods 2007–2008</b>		
<b>Evaluation Design</b>	<b>Percent of Projects</b>	
	<b>PP07 (N=574)</b>	<b>PP08 (N=625)</b>
Experimental (random assignment)	2%	3%
Quasi-experimental	42	49
<i>Matched comparison groups</i>	25	27
<i>Non-matched comparison groups</i>	17	22
One-group	20	25
Qualitative / descriptive	14	12
Mixed methods	11	8
Other	11	3

*Source: Annual Performance Report item VII.B*  
*The non-response rate was <1 percent.*

### ***Measures Used in Evaluations***

MSP projects used a variety of instruments to assess teacher knowledge, student achievement, and/or the extent to which teachers applied the lessons from the MSP professional development to their classroom instruction. Below, we discuss the measures that projects used to assess their teachers’ content knowledge, student achievement, and teachers’ classroom practice.

### **Measures of Teacher Knowledge**

All projects were required to administer pre- and post-tests during the year(s) in which their teachers received intensive professional development. Exhibit 23 presents the types of assessments used to measure teachers’ content knowledge in mathematics and in science, and the types of assessments used to assess teachers’ classroom practices.

The percentages of projects that reported using each assessment type followed similar patterns for mathematics and science. Standardized tests were the most frequently reported type of assessment utilized to assess teachers' content knowledge both in mathematics (57 percent) and science (40 percent). Locally developed assessments that were not tested for validity and reliability were the next most frequently reported type of assessment for both mathematics (27 percent) and science (37 percent), followed by locally developed assessments with evidence of validity and reliability (16 percent of projects for both mathematics and science). The remaining projects used self-report by teachers to assess their content knowledge, or other types of tests.

The two most commonly reported assessments utilized for mathematics were the *Learning Mathematics for Teaching (LMT)* test (37 percent of projects) and the *Diagnostic Mathematics Assessments for Middle School Teachers* (13 percent); for science, they were the *MOSART: Misconception Oriented Standards-Based Assessment* (14 percent) and the *Diagnostic Teacher Assessments in Mathematics and Science (DTAMS)* (14 percent). Note that projects could have reported using more than one assessment instrument, and more than one assessment type.

Among projects that measure classroom practices and beliefs, nearly half of projects (49 percent) reported using surveys or ratings by teachers, students, or other MSP participants. Additionally, 39 percent of projects used a standardized test, and 20 percent of projects used a locally developed test. The most commonly reported assessments utilized to measure classroom practices and beliefs were the *Survey of Teacher Attitudes and Beliefs* (26 percent of projects), the *Surveys of Enacted Curriculum* (14 percent), and the *Reformed Teaching Observation Protocol (RTOP)* (14 percent).

<b>Exhibit 23</b>			
<b>Types of Assessments Utilized to Assess Teacher Outcomes, Performance Period 2008</b>			
<b>Assessment Type</b>	<b>Percent of Projects</b>		
	<b>Mathematics Content Knowledge (N=307)</b>	<b>Science Content Knowledge (N=285)</b>	<b>Classroom Practices and Beliefs (N=307)</b>
Standardized test	57%	40%	39%
Locally developed test, not tested for validity and reliability	27	37	12
Locally developed test, tested for validity and reliability	16	16	8
Surveys or ratings	4	5	49
Other measure	9	13	33

*Source: Annual Performance Report item VII.D.1*  
*Percents total more than 100 percent because respondents could check more than one category.*  
*Only projects that provided professional development in each area and subsequently assessed those teachers responded to this question.*  
*The non-response rate for each content area was as follows: Mathematics content knowledge: 28 percent; Science content knowledge: 27 percent; and Classroom practices and beliefs: n/a.*

### **Assessment of Student Achievement**

As shown in Exhibit 24, almost all of the MSP projects (95 percent) that measured student achievement in *mathematics* reported using standardized tests. However in *science*, only approximately half of MSP projects (53 percent) that measured student achievement reported using standardized tests. This 42 percentage point difference in the use of standardized tests in mathematics and science could be due to the fact that statewide student assessments in science are often not administered in many grades, and even if there is grade-level alignment, the assessment often fails to

include items covering the relevant content targeted by MSP. For example a project from Kentucky noted:

*“[T]he KCCT data only involved students and teachers at the 4<sup>th</sup> grade level and above. This is a K–5 grant and finding state standardized data for over half of the grant participants is impossible. That leaves a large hole in the amount and quality of data that the program can use to evaluate how it is meeting the goals of the grant” (Storey, 2009).*

Projects that measured student achievement in science also commonly reported using locally developed tests (29 percent) and/or other types of tests (31 percent) to assess student achievement in science.

<b>Exhibit 24</b>		
<b>Types of Assessments Utilized to Assess Student Achievement, Performance Periods 2006–2008</b>		
<b>Assessment Type</b>	<b>Percent of Projects</b>	
	<b>Mathematics (N=257)</b>	<b>Science (N=229)</b>
Standardized test	95%	53%
Local test, valid & reliable	6	19
Local test, not valid & reliable	7	10
Self-report	2	1
Other type of test	3	31

*Source: Annual Performance Report item VII.D.1*  
*Percents total more than 100 percent because respondents could check more than one category.*  
*The non-response rate for each content area was as follows: Mathematics: 40 percent; and Science: 41 percent.*  
*Only projects that provided professional development in each area and subsequently assessed students responded to this question.*

## Measures of Classroom Instruction

MSP projects also measured the extent to which teachers applied lessons from their MSP professional development to their classroom instruction. As shown in Exhibit 25, in PP08 about two-thirds of projects used questionnaires or other forms of self-reporting by teachers (68 percent) and/or engaged in direct classroom observation (67 percent) to assess participants’ understanding and use of the content and strategies learned during MSP activities. The classroom observations can provide more objective, performance-based assessments of teacher classroom practices, while the questionnaires and other forms of self-reporting can provide valuable insights into teachers’ opinions about how their MSP experience improved their teaching methods.

Projects reported other approaches to measuring classroom instruction as well, some of which were used in conjunction with classroom observation or questionnaires. Twenty-two percent of projects reported reviewing journals in which participants tracked lesson plans and reflected on classroom practice. One-fourth of projects (25 percent) reported using “other” assessment methods, which included examining student assessment data and projects, as well as various other types of teacher self-reporting.

**Exhibit 25****Methods of Evaluating the Application of MSP Professional Development to Classroom Instruction, Performance Period 2008**

<b>Measures</b>	<b>Percent of Projects (N=611)</b>
Questionnaire/Self-report	68%
Classroom observation	67
Journals	22
Videotaping	9
Interviews/Focus groups	8
Lesson plan analysis	7
Blogs	5
Other	25

*Source: Annual Performance Report item VII.E*  
*Percents total more than 100 percent because respondents could check more than one category.*  
*The non-response rate was 2 percent in PP08.*

***Evaluation Findings***

As part of their evaluations, MSP projects are required to assess changes in teachers' content knowledge in mathematics and/or science during the years in which they receive intensive professional development. Projects reported the number of MSP teachers who significantly increased their content knowledge in mathematics and/or science topics on project pre- and post-assessments.

**Teacher Outcomes**

In mathematics, 36,546 teachers received professional development in PP08, and 43 percent of these teachers had pre- and post-assessment data available during the year.<sup>22</sup> This represents a substantial increase from PP07 and PP06, when 34 percent of teachers had assessment data in mathematics (Exhibit 27).

In science, the number of teachers receiving professional development and the percent of teachers with assessment data continued to increase in PP08 from previous years, as displayed in Exhibit 26. In PP08, 31,762 teachers received professional development in science, which is an increase of about 20 percent from PP07 and almost 90 percent from PP06. Additionally, 47 percent of teachers receiving professional development in science had pre- and post-assessment data available in PP08, which is a 4 percentage point increase from PP07 and a 7 percentage point increase from PP06.

<sup>22</sup> Projects are required to administer pre- and post-tests to each teacher who received professional development at least one during the course of the grant. MSP grants are typically three years long.

<b>Exhibit 26</b>						
<b>Numbers of Teachers Served and Percents of Teachers Assessed, Performance Periods 2006–2008</b>						
Content Area	Total Number of Teachers Served			Percent of Teachers with Content Assessments (Pre-Post)		
	PP06	PP07	PP08	PP06	PP07	PP08
Mathematics	34,797	34,567	36,546	34%	34%	43%
Science	16,838	26,552	31,762	40	43	47

*Source: Annual Performance Report items VIII.A. 1, 2, 4, 5*  
*Individual teachers who received professional development in both mathematics and science may be double counted.*

Exhibit 27 presents data for those teachers who were assessed for gains in content knowledge. Among the teachers assessed, approximately two-thirds (67 percent) showed significant gains in mathematics content knowledge and nearly three-quarters (73 percent) showed significant gains in science content knowledge. Furthermore, approximately half of these gains were found on standardized tests (57 percent of teachers in mathematics and 40 percent in science), that often are not directly aligned to the material being taught.

<b>Exhibit 27</b>			
<b>Overall Percent of Teachers with Significant Gains In Content Knowledge, of Those Teachers with Pre-Post Content Assessments, Performance Periods 2006–2008</b>			
Content Area	PP06	PP07	PP08
Mathematics	71%	68%	67%
Science	80	73	73

*Source: Annual Performance Report items VIII.A. 2, 3, 5, 6*  
*Individual teachers who received professional development in both mathematics and science may be double counted.*  
*The non-response rate for each content area was: Mathematics: 8 percent; Science: 9 percent.*

## Student Outcomes

Projects also reported the numbers of students served, assessed, and scoring at the proficient level or above in state assessments in both mathematics and science. As shown in Exhibit 28, in PP08 over 1.4 million students were taught by teachers who received professional development in mathematics, and over 1.2 million students were taught by teachers who received professional development in science (for science, this is an increase of about 50 percent from PP07; the figures for mathematics had a more modest increase).

<b>Exhibit 28</b>						
<b>Numbers of Students Served and Percents of Students Assessed, Performance Periods 2006–2008</b>						
Content Area	Total number of students taught by MSP teachers			Percent of students with content assessments		
	PP06	PP07	PP08	PP06	PP07	PP08
Mathematics	1,198,464	1,284,911	1,442,254	47%	48%	43%
Science	568,571	844,749	1,252,853	22	30	26

*Source: Annual Performance Report items VIII.B. 1, 2, 5, 6*

State assessment data were reported for 43 percent of students in mathematics and for 26 percent of students in science, which reflects slight decreases from the previous year (see Exhibit 29). As noted

above, the fact that state assessment data were available for fewer than half of students may be due to the misalignment that often exists between the subjects taught and the assessments available for students, particularly in science, where at the federal level it is only required that assessments be offered in three grade levels.

Projects reported large increases from the previous years in the proportion of students with assessment data scoring at the proficient level or above both in mathematics and in science. In mathematics, the proportion of students scoring at the proficient level or above (58 percent) increased by 13 percentage points from PP07. In science, the proportion of students scoring at the proficient level or above (58 percent) increased by 9 percentage points from PP07, and doubled the PP06 figure.<sup>23</sup> Furthermore, these numbers should be considered in light of the requirement that MSP projects are expected to include high-need/low-performing districts in their partnerships.

<b>Exhibit 29</b>			
<b>Overall Percent of Students Taught by MSP Teachers Scoring at Proficient Level or Above, Performance Periods 2006–2008</b>			
<b>Content Area</b>	<b>Proficient Level or Above</b>		
	<b>PP06</b>	<b>PP07</b>	<b>PP08</b>
Mathematics	47%	45%	58%
Science	29	49	58

*Source: Annual Performance Report items VIII.B. 2, 3, 4, 6, 7, 8*  
*The non-response rate for each content area was: Mathematics: 17 percent; Science: 19 percent.*  
*In PP06, the percent scoring at basic or above in mathematics was 64 and in science was 41. In PP07 the percents were 52 in mathematics and 50 in science.*

## Impacts of MSPs at the State Level

A number of reports discussed the positive impacts their project had beyond the school in which it originated, affecting the state as a whole. In some cases, teachers across districts and counties participated in the same professional development or support network (such as a listserv) or collaborated on materials and assessments. Within a state, such collaboration can work to unite teachers, administrators, and specialists in a common vision for improvement of math and science education. Below are two quotes from project directors attesting to the statewide impacts their projects have had.

*“The professional development has provided the foundation for a shared vision and understanding of what high-quality elementary mathematics teaching and learning is and what it looks like in the classroom. Overall, the project has helped South Dakota establish statewide capacity for improving elementary mathematics education. The South Dakota project includes all ESAs and reaches schools and districts in every region of the state. This strategy has prompted statewide leadership to build at multiple levels of the system, impacting elementary mathematics across the entire state of South Dakota—sending a common, consistent message about improving mathematics teaching and providing multiple supports to reach this goal” (McAdaragh, 2009).*

<sup>23</sup> The reader should note that these numbers were aggregated across all grade levels and schools.

*“We have been asked to conduct data meetings, establish professional learning teams, and help conduct AMSTI Nights for parents at most of our schools in addition to what we are already doing in the schools...Governor Riley routinely expresses his support of AMSTI in the media. He follows the external evaluations and is working to secure funds to make AMSTI services available to all Alabama schools” (Feldman, 2009).*

## Chapter 5: Highlights from Select MSP Projects

In this chapter, we provide highlights from MSP projects representative of partnerships across the country. Three of the projects highlighted are those with at least one component of their evaluation that passed the rigorous *Criteria for Classifying Designs of MSP Evaluations* rubric requirements described in Appendix C; the remaining 16 projects were selected based on their use of interesting and innovative models. The majority of summaries of the projects' efforts and achievements that follow are adapted from summaries collected directly from projects expressly for this chapter;<sup>24</sup> these summaries were supplemented, as needed, with information from Performance Period 2008 APRs, MSP materials including internal and external evaluations, and presentations at MSP conferences. Our intent in presenting this small fraction of the 626 existing MSP projects is to provide concrete examples of how MSP projects are actually being implemented and the results their project directors and evaluators are observing.

Overall, the MSP projects highlighted in this chapter represent efforts in 17 different states (see Exhibit 33), including 3 rural locations, that served a wide variety of participants in various math- and/or science-gear professional development initiatives. Across the 19 MSP projects, 7 provided both math and science professional development, while 6 focused on science and 6 on math exclusively. Fourteen of the 19 projects aligned their professional development to the standards; 10 projects used inquiry-based strategies; 8 projects included a focus on technology; and four projects included a focus on science literacy.

Projects also varied in terms of the grade level of teachers targeted: 3 served teachers across all school levels; 3 were designed for elementary school teachers only; 5 for elementary and middle school teachers; 1 for middle school teachers only; 4 for middle and high school teachers; and 3 for high school teachers only.

The majority of MSP projects (16) provided summer institutes or workshops with follow-up activities during the school year while 3 focus on professional development during the school year. Five projects included field experience or internships in their professional development, and seven projects complemented their school-year trainings with professional learning communities. Three projects offered the opportunity to enroll in graduate courses and to potentially earn a master's degree or an education credential, and 4 projects offered participants the opportunity to attend conferences. Four projects included a focus on developing leadership skills in the areas they teach, and three specifically trained teacher leaders. All projects included evaluations that indicated they were making progress toward their partnerships' goals.

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<sup>24</sup> Four MSP projects included in this chapter (West Contra Costa Unified School District, Communities of Learners in Math and Science (CLIMS), Math & Science Partnership: Physics/Chemistry Unraveled, and Institutes for the Understanding of Science and Math Integrating Investigation and Technology) did not provide a summary expressly for this chapter. Instead, summaries were written based on their APRs and evaluation reports.

**Exhibit 33 Selected MSP Projects**

<b>MSP Project</b>	<b>State</b>	<b>Participants</b>	<b>Content Area</b>	<b>Professional Development</b>
Alabama Math, Science and Technology Initiative-University of Alabama at Birmingham	AL	K–12 <sup>th</sup> grade teachers	Math and Science	Summer institute & follow-up activities during the school year, including on-site support
Developing Mathematics Coaches/Teachers Leaders in Arkansas Schools	AR	K–8 <sup>th</sup> grade coaches and teacher leaders	Math	Summer institute & follow-up sessions during the school year
Yavapai County Math and Science Partnership-MSP2	AZ	K–5 <sup>th</sup> grade teachers	Science	Summer workshop & 8 Friday/Saturday workshops during the academic year
Collaboration for Success in Science Partnership	CA	4 <sup>th</sup> –5 <sup>th</sup> grade teachers	Science	Summer institute & follow-up activities during the school year with PLCs
West Contra Costa Unified School District*	CA	4 <sup>th</sup> –8 <sup>th</sup> grade teachers	Math and Science	Summer institute & follow-up activities during the school year
Communities of Learners in Math and Science (CLIMS)	GA	Middle and high school teachers	Math and Science	Professional Learning Communities & trainings during the academic year
NUI-ITEAMS (Northern Illinois University)	IL	Middle and high school teachers	Math and Science	Master’s degree program with face-to-face and on-line coursework; summer internship
Franklin High School MSP	LA	High school teachers	Math and Science	Summer institute including field studies & Saturday follow-up workshops, conferences
Math & Science Partnership: Physics/Chemistry Unraveled*	MD	High school teachers	Science	15-month academies including 2 day-long training and a five full-day summer sessions
Embracing Mathematics, Assessment & Technology in HS (EMATHS)	MI	High school teachers	Math	After school Lesson Study PLCs & Summer Institute or 8 days during the academic year
New Hampshire Education and Environment Team	NH	K–12 <sup>th</sup> grade teachers	Science	Summer residential workshop & follow-up activities during the school year
The Allentown School District Science Teacher Leadership Project	PA	K–8 <sup>th</sup> grade teachers	Science	Summer institute, fall and spring workshops, and study groups during the academic year
Subject Content Articulation of Science and Mathematics	PR	Elementary and middle school teachers	Math and Science	Summer institute & Saturday academies; graduate courses
Technology, Inquiry, Pedagogy, and Standards	SC	Middle School teachers	Math and Science	Summer institute & follow-up activities including classroom observations
South Dakota Counts	SD	Elementary teacher leaders	Math	Summer institute & Graduate Education Certificate Program
Reaching for Excellence in Middle and High School Science Partnership*	TN	5 <sup>th</sup> –12 <sup>th</sup> grade teachers	Science	Summer leadership institute & follow-up activities during the school year
Creating Mathematics Excellence	WI	Regular and special ed teachers	Math	Summer institute & follow-up activities during the school year, conference attendance
Northern Wisconsin Rural Partnership	WI	3 <sup>rd</sup> –8 <sup>th</sup> grade teachers	Math	Summer institute & follow-up activities including in-school consultations
Maximizing Mathematics Achievement in Boone County Schools	WV	5 <sup>th</sup> -12 <sup>th</sup> grade educators	Math	Summer institute & follow-up activities during the school year; blogs and on-line coursework

*Sources:* summaries collected directly from MSPs expressly for this chapter; Performance Period 2008 APRs

\* *Projects with final year evaluations that passed the rubric*

**MSP Project Name:** Alabama Math, Science and Technology Initiative–University of Alabama at Birmingham (AMSTI-UAB)

**State (APR ID):** Alabama (AL061006)

**Partners:** University of Alabama at Birmingham, Alabama State Department of Education, and seven school districts

**Project Director:** Michael Wyss

**Number of Participants:** 525 teachers in grades K–5, 128 middle school teachers; 48 high school teachers (participants were selected through an application process requiring a minimum of 80 percent participation rate for all science and math teachers at the school)

### **Background:**

The Alabama Math, Science and Technology Initiative–University of Alabama at Birmingham (AMSTI-UAB) endeavored to provide high quality math and science inquiry-based professional development through summer institutes and on-site mentoring to increase understanding and skills for effective, research based teaching. The program also provided the materials needed to implement these inquiry-based strategies through state funding.

### **Description of Professional Development:**

The project’s model of professional development included two 2-week intensive grade- and subject-specific summer institutes run by AMSTI trainers and Master Teachers who engaged participants in hands-on, inquiry-based lessons and activities that participants in turn use with their students. Some of the modules for science included FOSS and STC. Math pull-out units were used from existing curricula and were chosen for their high quality inquiry-based instruction along with their match to state and national standards. Units on Notebooking, Global Learning and Observations to Benefit the Environment (GLOBE), Cooperative Grouping, and Assessment were also incorporated during the training. On-going support provided through math and science specialists within the participants’ classrooms provided mentoring/coaching in the implementation of strategies developed during the summer institute. AMSTI also provided teachers with on-site support following their professional development.

### **Results:**

AMSTI’s evaluation compared school performance on standardized tests to the previous year. This analysis reported improvement in five of the six grades tested. Using data from the state’s Alabama Reading and Mathematics Test (ARMT), the Office of Community Affairs at the University of Alabama evaluated the Elementary and Middle School adopters in the AMSTI-UAB service region. In Grades 3, 4, 5, 7 and 8, gains were reported in moving students to higher levels of performance (“meets standards” and “exceeds standards”). In 7<sup>th</sup> grade math, 8 percent of the tested student population reportedly moved from “did not meet standards” and “partially meets standards,” to “meeting or exceeding standards.” Evaluators also found that teacher content knowledge showed improvement between pre- and post-tests in both math and science as well.

This was the best professional development I’ve been to in 20 years!

AMSTI strategies have taught my third grade students how to work cooperatively to solve problems, given them multiple ways to explore concepts, and most importantly taught them how to think.

– AMSTI participants

**MSP Project Name:** Developing Mathematics Coaches/Teachers Leaders in Arkansas Schools

**State (APR ID):** Arkansas (AR070614)

**Partners:** University of Central Arkansas, Conway Public Schools, Pulaski County Special School District, nine educational service cooperatives, and the Arkansas Educational Television Network (AETN)

**Project Director:** Stephen R. Addison

**Number of Participants:** 270 mathematics coaches and teacher leaders

**Background:**

The Developing Mathematics Coaches/Teachers Leaders in Arkansas Schools partnership sought to transform K–8 mathematics teaching through developing building and district level facilitators who are themselves exemplary teachers and who have the ability to develop such skills in the teachers they work with in their schools and districts. In recent years Arkansas schools have made increasing use of discipline-based academic coaches. These academic coaches are now called instructional facilitators and the state has recently developed a licensure endorsement that focuses on coaching methodologies. The project has integrated with these academic coaches to enhance its impact.

**Description of Professional Development:**

The Developing Mathematics Coaches/Teachers Leaders in Arkansas Schools’ professional development sessions modeled learning strategies including modeling with manipulatives, using technology, promoting discourse, and cognitively guiding instruction. Math topics for professional development were based on Arkansas Math Frameworks. All professional development sessions were led by IHE faculty. These sessions included a 1-week math content intensive session and eight sessions during the school year, with additional contact at school sites. Many sessions focused on technology, with faculty who specialize in teaching geometry with technology leading technology-intensive sessions. Further supporting the use of technology, the sessions were held in the studios of the Arkansas Educational Technology Network. Typically there were approximately 60 participants in the studios at AETN, with the rest of the participants either participating in real-time through compressed video at the educational cooperatives or viewing the sessions later (the participating cooperatives recorded the sessions). The sessions were also added to the Arkansas Ideas portal, which is a service of AETN and makes professional development workshops available to all licensed teachers in Arkansas via password-protected access to the AETN Internet portal. The session videos were used by participants to reinforce and revisit the regular sessions.

**Results:**

Project evaluators assessed teacher content knowledge gains using the Ball Assessment for Middle Grade Mathematics. Pre- and post-test scores showed a statistically significant gain over the course of the project. As the project came to an end, some educational cooperatives chose to extend their participation by continuing to fund additional monthly sessions.

**MSP Project Name:** Yavapai County Math and Science Partnership–MSP2 Science

**State (APR ID):** Arizona (AZ080906)

**Partners:** Yavapai County Educational Service Agency, Northern Arizona University/Center for Science Teaching and Learning, and seven school districts

**Project Director:** Melissa Lawrence

**Number of Participants:** 33 K–5 teachers in 2009-2010 (Cohort III); 27 K–5 teachers in 2008-2009 (Cohort II), and 28 K–5 teachers in 2008-2007 (Cohort I)

**Background:**

The goal of the Yavapai County Math and Science Partnership–MSP2 Science project was to increase the content knowledge of partner K–5 elementary school teachers in physical and life sciences, and expose them to inquiry-based teaching strategies to communicate scientific concepts effectively to their students. The project worked towards four measurable objectives and used formative evaluation as a guide for on-going program development and refinement to meet the objectives of: 1) increasing the number of K–5 elementary school teachers with understanding of the foundational scientific concepts of physical and life sciences; 2) increasing teacher knowledge of pedagogical strategies that embed inquiry and active student learning into science lessons; 3) increasing teacher understanding of the importance and application of aligned science instruction to the Arizona Science Standards; and 4) increasing the amount of time teachers devote to teaching science.

**Description of Professional Development:**

The Yavapai County Math and Science Partnership–MSP2 Science professional development focused on content knowledge, pedagogy and teaching strategies. The modules, presented by IHE faculty, utilized active investigations and interpretation, and embedded inquiry and literacy into science instruction in order to deepen participants’ understanding of the Arizona Science Standards. The project aimed to increase participants’ capacity through deep exposure to modeling, investigation, use of inquiry-based materials, and research-based, hands-on learning during the institutes and the follow-up sessions. Professional development also focused on how students learn, how to examine instructional implications, how to identify key concepts and specific ideas, and how these relate to the Arizona State Science Standards. Professional development included eight Friday/Saturday workshops during the academic year, followed by a four-day workshop in June.

**Results:**

The project’s formative evaluation reported steady progress toward meeting project goals, with 19 out of 26 Cohort II teachers demonstrating statistically significant increases in life science content knowledge as measured by the Diagnostic Teacher Assessment in Mathematics and Science (DTAMS) using a pre- to post-test comparison design. Additionally, evaluators reported that 18 out of 20 participants demonstrated gains in pedagogical content knowledge with pre- to post-test gains on the Reformed Teaching Observation Protocol (RTOP) from 21.5 to 41.7.

I will change the way I teacher science from now on. Inquiry! Inquiry! Inquiry!

My teaching will become more inquiry based. I usually ask most of the questions—I want my kids to do the questioning.

I will continue to implement more inquiry embedded learning in the classroom. I will leave more questions unanswered by me, challenging students to puzzle them out for themselves. I will use more concept maps, webs and drawings.

– MSP2 Science Participants

**MSP Project Name:** Collaboration for Success in Science Partnership (CSSP)

**State (APR ID):** California (CA080715)

**Partners:** Chapman University, California State University-Fullerton, Orange County Department of Education, and five school districts

**Project Director:** Amy Edmundson

**Number of Participants:** 50 4<sup>th</sup> and 5<sup>th</sup> grade teachers

**Length of Professional Development:**

**Background:**

This partnership had five goals: 1) improve achievement in science for all students with particular attention paid to closing the achievement gap for English learners; 2) immerse teachers in ongoing professional development in which they experience, collaborate, practice, evaluate, coach, implement, study, and disseminate powerful lessons; 3) increase teachers' confidence with science content knowledge to enable them to implement research-based science strategies; 4) increase IHE outreach to practicing teachers and give science professors intimate knowledge about teaching to effectively recruit science majors into education careers; 5) leverage county office services, experts, and resources to increase support for elementary teachers in science education.

**Description of Professional Development:**

During CSSP professional development, which included 60 hours of intensive instruction in a summer academy and 24 hours of follow-up, participating teachers were exposed to student lessons that were embedded with inquiry and research-based strategies to improve science literacy. Participants also learned in-depth science content from college professors. Professional development related to embedding English learners as well as inquiry strategies into the content and lab presentations demonstrated not only *what* to teach but *how* to teach it. Teachers had the opportunity to collaborate, practice, observe, modify, and analyze these lessons with students. Teachers also participated in Professional Learning Communities (PLCs) to analyze lessons, data, and student work. PLC teams worked together to develop and create a lesson at CSSP family science night. Participants presented strategies at a grant-sponsored conference and created a final classroom product (including PowerPoint lessons, Big Books, Webquests, and Science Games) that could be used in their own classrooms and shared with non-participating colleagues.

**Results:**

Project evaluators found that participating students' average increase from matched pre- to post-test scores was statistically significant for overall performance as well as for performance in all three subject areas—life, earth, and physical science—when compared to students of comparison teachers. Comparison students also made gains in all areas, but on average the point gains were higher for participating students. Trend analysis conducted by evaluators indicates that students of CSSP teachers increased their overall performance on the science California Standards Test each year, especially those students scoring at or above the proficient level. Between year 1 and year 3, this percentage increased almost 21 points, from 37% to 58%. CSSP teachers reported increases in (a) the amount of time spent on science topics, (b) more varied use of research-based teaching strategies (statistically significant), and (c) confidence with science content. Trend analysis conducted by project evaluators also indicated that from the start of year 2 to the end of year 3, both 4<sup>th</sup> and 5<sup>th</sup> grade teachers made gains in content knowledge and teachers further demonstrated their ability to create higher quality lesson plans for classroom instruction.

**MSP Project Name:** West Contra Costa Unified School District (WCCUSD)

**State (APR ID):** California (CA080725)

**Partners:** West Contra Costa Unified School District, UC Berkeley/Lawrence Hall of Science

**Project Director:** Renee Franklin

**Number of Participants:** 70 teachers (34 5<sup>th</sup>–8<sup>th</sup> grade math teachers and 36 4<sup>th</sup>–5<sup>th</sup> grade science teachers)

**Background:**

From this project experience, WCCUSD has developed a new, exciting professional development model based on content and pedagogical delivery, lesson design, data analysis, and coaching. The district expects this new design to be used in future professional development endeavors in all subject matters. The goal of the professional development was to increase teachers' knowledge and skills and ultimately to increase student learning in mathematics and science.

**Professional Development:**

The components of this model were 80 hours of intensive professional development annually with 30+ hours and follow-up activities that included instructional support, classroom-based planning, coaching, and observation. Since the project began in August 2006, teachers involved had accumulated an average of 186 hours of intensive professional development and 69 hours of coaching. The mathematics content was presented with problem solving integrated throughout. The teachers were encouraged to link the district's middle-grades curricula to the state standards and appropriate assessments. The science activities were designed to build teachers' science content knowledge, teach strategies for integrating literacy and second language learning instruction, and model effective teaching practices. The science content was focused on some of the major life and physical science standards for grades 4 and 5.

**Results:**

The project examined teacher results using a one-group pre-post design, and they examined student results using a more rigorous quasi-experimental design with a comparison group.<sup>25</sup> The project reported that teachers became more confident and knowledgeable about how to teach concepts of the standards, and that teachers began to move from a totally teacher-directed approach to an increase in hands-on, inquiry-focused instruction. Through cross-grade articulation, teachers became more aware of what students need to know and be able to do in each grade and how to better prepare students for rigorous mathematics and science courses in upper grades. Coaching helped teachers recognize the value of engaging in meaningful reflection on a lesson and the production of standards-based lessons that are rigorous and motivating for all students.

In examining teacher content knowledge gains in mathematics and science, the project reported mixed findings, none of which were statistically significant compared to a comparison group. In examining student achievement, while growth was found for 5<sup>th</sup> grade science students on the California Standards Test (CST), they performed worse than the comparison group. No differences were found between treatment and comparison students in mathematics. Both groups showed a decline in the percentage of students scoring at the advanced and proficient levels.

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<sup>25</sup> The student evaluation passed the rigorous guidelines set forth in the *Criteria for Classifying Designs of MSP Evaluations* rubric (see Appendix C for more details).

**MSP Project Name:** Communities of Learners in Mathematics and Science (CLIMS)

**State (APR ID):** Georgia (GA070649)

**Partners:** Jackson County School District and the University of Georgia

**Project Director:** Deborah Riddleberger

**Number of Participants:** 90 middle and high school teachers

**Background:**

The Communities of Learners in Mathematics and Science (CLIMS) project is a two-year partnership between the Jackson County School District and the University of Georgia. The aim of the project was to increase student achievement in mathematics and science by increasing teacher content knowledge and their ability to use mathematics in science applications; implementing interdisciplinary connections in the classroom; increasing the use of research-based classroom practices; and developing a continuum of skill building for mathematics and science in grades 6 through 12. Finally, the project hopes to transform schools into communities of learners and develop leadership for sustained improvement of instruction.

**Description of Professional Development:**

A key component of the CLIMS project and of its professional development activities were the mathematics and science Professional Learning Communities (PLCs) in each school of the Jackson County School System. Activities of the PLCs included teacher collaboration in lesson plan preparation, the development of a continuum of skill building from one grade level to the next, teacher content knowledge acquisition, peer observations of teaching, and improvements of the teaching process through discussion and analysis of research-based teaching methods. Each PLC met monthly throughout the school year. PLCs of mathematics and science in each school had a joint meeting each quarter, and worked on enhancing teacher collaboration and both vertical and horizontal alignment of the mathematics and science curriculum. In addition to the professional development provided by the PLCs, project CLIMS provided many additional opportunities for professional development of CLIMS teacher participants, including trainings by the regional educational service agency, high school mathematics and science learning facilitators, and CLIMS leadership and high school learning facilitators.

**Results:**

The project reported significant teacher gains on the Learning Mathematics for Teaching – Number Concepts and Operations. Furthermore, more than three-quarters of the teachers considered that the professional learning communities were very effective and beneficial for them and for the school, and they believed that the efforts of the PLCs would help accomplish the goal of improving student achievement. They indicated increased knowledge about project-based learning and appreciated the opportunity to collaborate, interact, and develop materials with other teachers.

Because of the coordination between teachers in science, we are focusing more on the standards and are giving each other feedback on ideas and lessons. The sharing has improved our instruction which has improved test scores. Also, the coordination between mathematics and science is allowing us to reinforce the concepts in the different disciplines.

*-- CLIMS participant*

**MSP Project Name:** NUI-ITEAMS (Northern Illinois University)

**State (APR ID):** Illinois (IL080919)

**Partners:** Northern Illinois University, West Aurora School District 129, Harlem School District 122

**Project Director:** Mansour Tahernezehadi

**Participants:** 26 high school and middle school teachers from math, science, and career/technical education

**Background:**

The purpose of this program was to improve the mathematics and science achievement of middle and high school students by increasing their content knowledge and teaching skills and preparing them to deliver robust, research-based learning experiences based on technology.

**Description of Professional Development:**

THE NUI-ITEAMS professional development model incorporated 33 semester hours of coursework for participants, including courses and six workshops. Participating teachers graduated with a Master's of Science Degree in Engineering Education (MSTEE). Courses were taught by faculty from NIU's College of Engineering and Engineering Technology with assistance from NIU's College of Education and College of Liberal Arts and Sciences. Coursework included designing lessons as teams, probability and statistics in engineering, and on-line simulation exercises in engineering. Teachers toured state-of-the art labs at NIU, learned about emerging technologies through problem-based inquiry learning, and created lesson plans for their classrooms. Participants also learned and practiced various pedagogical approaches in a face-to-face format and completed a unit on adolescent identity development through on-line wiki-based delivery. Additionally, teachers participated in summer internship experiences. The project aimed to break down the barriers between high school and middle school career education/technology and general education teachers as they create interdisciplinary learning experiences for their students in nanotechnology, energy engineering, homeland security, and modern manufacturing engineering.

**Results:**

The project's evaluation utilized a time series design including qualitative and quantitative assessments. Evaluators' analysis of a pre- and post-test of 40 items indicated a statistically significant difference, with the post-test indicating higher levels of content knowledge. The test assessed teachers' mathematics, science, and engineering technology knowledge. Additionally analyses were conducted using teacher portfolios. The journals and portfolios were assessed by two independent coders using an implementation of inquiry-learning based on Rezba, Aldridge, and Rhea (1999). Evaluators also reported that the beginning of the year mean rating for the 23 teacher participants who finished the year was 1.3, mid-year was 2.1, and end of year 2.9. Evaluators also found that teachers increased their integration of career education and general education: at the beginning of the year, teachers were more apt to see the value in either career education or general education and placed the two approaches in silos (1.3 on a 4-point scale of "isolated" to "integrated" view). By the end of the year, the mean rating increased to 3.6. Additionally, by the end of the first year, nearly three-fourths of the teacher participants' observed classroom instruction was rated as "accomplished" or "exemplary" by evaluators. All teachers were observed by at least one observer during the year to provide baseline data on instructional practices. Lastly, evaluators found statistically significant increases in students' knowledge between the pre- and post-test scores on each of the three content tests.

**MSP Project Name:** Franklin High School MSP

**State (APR ID):** Louisiana (LA080618)

**Partners:** Franklin Parish School Board, University of Louisiana at Monroe, five other school districts

**Project Director:** Anne Holcomb

**Number of Participants:** 25 high school teachers

**Background:**

The vision of this project was to create and support an algebra and physical science education community wherein university and school system partners shared responsibilities for creating an educational environment where students had the opportunity to meet national and state standards and beyond, guided by knowledgeable, highly-skilled educators. The Delta Regional Educator’s Academy (DREAM) at the University of Louisiana at Monroe (ULM) administered this MSP program.

**Description of Professional Development:**

The project included a three-week summer institute designed to increase the content knowledge of participating teachers and provide them with standards-based lessons to deliver the content and skills contained in the Benchmarks of the Louisiana Algebra and Physical Science Frameworks. Teachers were engaged through hands-on activities and experiments, extensive field studies, technology training, and literacy strategies in both physical science and Algebra I. The area served by the project is classified as a low socioeconomic region, and there are few opportunities for these teachers and students to be exposed to new trends in education. One half day was devoted to Quality Science and Mathematics (QSM) grant writing. The academic year components included five Saturday follow-up workshops and an invitation to attend the Louisiana Association of Teachers of Mathematics (LATM) conference or the Louisiana Science Teachers Association (LSTA)/National Science Teachers Association (NSTA) conference. During the second year of the project, participants visited the Livingston Laser Interferometer Gravitational-wave Observatory (LIGO) in Livingston, Louisiana.

**Results:**

Data from the Franklin High School MSP project showed that the participants were impacted in numerous ways. Specific evidence of impact was seen through increased content knowledge from the summer institute, classroom observations, teaching awards, grant awards, and through teacher self-reports of gained confidence. As noted from University staff classroom observations, teachers had embraced many of the concepts taught during the MSP workshops. Results on the state-developed pretest and posttest covering the curriculum topics in Algebra I and Physical Science showed an increase in teacher content knowledge of 15 percentage points.

The impact of participation was really a re-invigoration of spirit. I was stagnating a bit and this really helped me renew my techniques and taught me new ones. Especially the probes!

All of my classes have benefited from the activities and probes that I have been using. So many children struggle with math and the activities really help them grasp concepts.

*--Franklin MSP participants*

Partnership: Physics/Chemistry Unraveled

**State (APR ID):** Maryland (MD080702)

**Partners:** Four institutions of higher education and ten local school systems

**Project Director:** Sandra Graff

**Number of Participants:** 114 physics and chemistry teachers

**Background:**

The Math & Science Partnership: Physics/Chemistry Unraveled expanded an ongoing partnership training model in physics to include LEAs and new institutions of higher education while duplicating its model in chemistry content. The partnership's key goals included ensuring teacher mastery of physical science content knowledge and application of new instructional skills; increasing teachers' positive attitudes toward teaching science; and increasing students' science knowledge and positive attitude toward science. The content, processes and materials of this project were aligned with Maryland Science Standards and Voluntary State Curriculum in science and represented best practices in science education. The embedded use of technology supported the Maryland Teacher Technology Standards and Maryland Student Technology Literacy Standards.

**Professional Development:**

The instructional model throughout the 15-month academies was designed and delivered by a training team consisting of IHE science faculty members, instructional coaches, and one or more high school level master science teachers. The fall 2008 and spring 2009 day-long training and the five full-day summer sessions incorporated multiple activities taught by various members of the training team. Emphasis was placed on teaching the science content using inquiry/active learning strategies that included extensive hands-on investigations using appropriate science equipment and technology, small group discussions, some short presentations by a training team member, field trips, and more. The activities, which alternated between classroom and laboratory settings, were chosen to address the physics or chemistry curricular goals based on national science standards and the Maryland Science Curriculum and to model effective pedagogy. A key to the partnership and a critical component of the academies' professional development design was the provision of ongoing support to teachers in their classrooms by instructional coaches. The partnership believed that with the provision of ongoing, active support to participating teachers, their incorporation of academy-based science content and pedagogy was more likely to occur and science instruction would improve.

**Results:**

Evaluators used a quasi-experimental design for testing gains in teacher content knowledge.<sup>26</sup> Teachers' content knowledge in chemistry and physics increased from pre- to post-test, as measured by total score on the MOSART test total, and these increases were found to be statistically significant. Teachers' attitudes toward science and science instruction were also found to reflect better knowledge of the NRC National Science Education Standards. Finally, the content knowledge of students of participating teachers as measured by the MOSART tool were found to increase for elementary and middle school students (these changes were not evaluated for statistical significance due to the design of data collection).

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<sup>26</sup> The evaluation of teacher content knowledge passed the rigorous guidelines set forth in the *Criteria for Classifying Designs of MSP Evaluations* rubric (see Appendix C for more details).

**MSP Project Name:** Embracing Mathematics, Assessment & Technology in HS (EMATHS)

**State (APR ID):** Michigan (MI080902)

**Partners:** Macomb ISD and eleven high schools

**Project Director:** Deborah J. Ferry

**Number of Participants:** 49 high school teachers

**Background:**

The overarching goal of Embracing Mathematics, Assessment & Technology in High School (EMATHS) focused not only on enabling mathematics teachers to successfully implement the new Michigan Department of Education (MDE) course/credit requirements for Algebra I, Algebra II, and Geometry but also for their students to achieve the new MDE High School Graduation Requirements for Mathematics. This project worked towards increasing mathematic content knowledge, research-based pedagogical practice, and embedded usage of classroom technology for high school teachers throughout Macomb County and three other satellite sites. EMATHS collaborated with STEM faculty from three institutions of higher education to plan, design, and critique the curriculum for the professional development.

**Description of Professional Development:**

The professional development was planned and delivered by two master high school teachers and one mathematics education consultant. With input from STEM faculty, mathematically rich tasks were developed and selected to help teachers and their students discover and deepen their understanding of mathematical concepts interconnectedness. Professional development was offered in three formats: 1) as 8 six-hour days during summer institutes, and/or 2) 8 six-hour days during the school year, including some Saturdays, and 3) after school hours Lesson Study Professional Learning Communities (PLCs). Within the PLC Lesson Study phase, teams of teachers participated in modified Lesson Study involving classroom observations using established protocols. During the professional development, best practices were modeled through using problems in context, open-ended questions, small-group problem solving, embedded technology, multiple solutions, and whole group discussions.

**Results:**

EMATHS was evaluated using a quasi-experimental model with mixed evaluation techniques and instruments for data collection and analysis. Data from the content assessments showed that twenty-two teachers had significant gains in Algebra II and fourteen teachers had significant gains in Geometry. Therefore, thirty-six out of forty-nine teachers had significant gains. In

I thought of two words, “change” and “growth,” I feel sums it all up. I feel my curriculum is going to change, but it is going to grow, it’s going to be better. The students—it’ll be a change for them...more hands-on, variety of ways for them to learn...the curriculum, so that’ll allow them to grow, and definitely help me change my thinking and ways of doing things and thus allows me to grow.

*--EMATHS participant*

addition, the focus groups revealed a common impact across all sites. The impact of collegiality had been sighted time and time again between participants of the professional development, school-wide, district-wide, county-wide, and in satellites across the county lines. The participants enjoyed the dialog and sharing of resources and instructional strategies. Additionally, several sites initiated list serves to sustain the Professional Development when questions arise during the instructional year.

**MSP Project Name:** New Hampshire Education and Environment Team (NHEET)

**State:** New Hampshire (NH080203)

**Partners:** University of New Hampshire; Granite State College; Plymouth State University; NH Fish and Game Personnel; USDA Forest Service Personnel; NH Department of Environmental Services; USDA Natural Resources Conservation Services; Antioch University New England faculty

**Project Director:** Erin Hollingsworth

**Number of Participants:** Seven school districts have participated and over 60 teacher-leaders and 150 additional science teachers

**Background:**

The goal of New Hampshire Education and Environment Team (NHEET) was to build the capacity of New Hampshire school districts to transform their teaching practices such that they achieve genuine science literacy for all students, as envisioned in the New Hampshire Frameworks for Science Literacy. This program focused on three objectives: 1) train, advise, and support teacher-leaders to advocate for science literacy as envisioned in the NH Frameworks for Science Literacy; 2) advise and support teacher-leaders to reorient science teaching at their schools into a vertically-integrated scope and sequence for science literacy; and 3) engage all teachers of science from participating districts in the use of inquiry and field investigations to deepen their knowledge and practice in natural science.

**Professional Development:**

The NHEET professional development model spans 18 months. It provides 8 days of professional development to the teacher-leaders, several days of professional development for teachers of science in their districts, and ongoing technical assistance to support district-level curriculum reform. Professional development activities focus on the use of inquiry, field investigations, science notebooks, and constructivist, hands-on activities from Projects Learning Tree, WET, WILD, HOME and the GLOBE program. In addition, teachers experience a vertical model for K-12 life science instruction and then adapt this model for changing their district science curriculum. This model is presented in *Scope and Sequence Models for Building Vertical Science Literacy* and uses pre-field, field, and post-field experiences—as well as culminating activities—across the following three strands: Atmosphere, Weather and Climate; Water and Watersheds; and Ecosystems and Habitats. The project partners also rely heavily on the Concerns-Based Adoption Model to monitor and address teacher-leaders’ concerns and needs as they relate to adopting a new program. Finally, an online learning community provides additional support and resources to participating teacher leaders.

**Results:**

NHEET evaluators reported that a pre- and post-test assessment showed significant improvement in changes in teacher content knowledge in natural science. The project also reports that teachers and students are using and analyzing data from field studies in authentic ways, which allows students to hone their science process skills. Finally, much has been accomplished in reorienting each district’s science curriculum. Teachers have worked together with their administrators in creating visions of science literacy, thus setting a common foundation and lens in which to make curriculum decisions with.

This program has taught me to weed out the science content that is above my students’ grade level, lessen the number of readings in my science units, add more inquiry and field investigations, and incorporate the use of science notebooks more fully. By organizing my students’ thinking more logically in science notebooks and "getting their feet wet" with inquiry and field word, I know they will grow to love science even more.

-NHEET participant

**MSP Project Name:** The Allentown School District Science Teacher Leadership Project

**State:** Pennsylvania (PA070712)

**Partners:** Allentown School District, Cedar Crest College, the Da Vinci Science Center

**Project Director:** William Gibbard

**Number of Participants:** 50 fellows (K–8 teachers)

**Background:**

The Allentown Science Teacher Leadership Project (STLP), a continuation of the Da Vinci Teacher Leader Institute, worked to enhance the teaching of science in the Allentown School District. The project attempted to increase elementary-certified teachers’ knowledge of science content and the process of science inquiry and thereby to improve instruction and, ultimately, student outcomes.

**Professional Development:**

Allentown STLP Fellows participated in two weeks of intensive inquiry-based professional development on science content, inquiry process skills, and leadership in a three-year rotation (physical science, life science, and earth science). This design was selected to model excellent science instruction, using the district’s FOSS curriculum, and to teach major ideas from the Pennsylvania Standards, Anchors, and the Standards Aligned System. Following the intensive professional development, Fellows returned to school and recruited teams of their peers (107) to form small study groups that met during the school year and conducted a self-directed study in science instruction. Fellows and peers also attended fall and spring workshops. At these workshops, the faculty-teacher-professional developer team presented additional workshop sessions, reinforcing critical content, emphasizing classroom applications, and reinforcing some of the topics identified as important by study groups.

**Results:**

STLP evaluators reported that pre- and post-test measurements of STLP Fellows’ science knowledge using the independently validated MOSART and DTAMS tests of teacher science knowledge showed significant improvement in each year. Additionally, evaluator’s classroom observations using the Reformed Teaching Observation Protocol (RTOP) protocol reported both Fellows and peers exhibited a highly effective instructional strategies (mean = 80) while comparison teachers, on the other hand, typically exhibited far fewer effective behaviors (mean = 40). Evaluators’ annual evaluation of both curriculum-based (FOSS unit) assessments and standardized tests showed that students in the classrooms of Fellows had significantly higher science achievement than students in the classrooms of comparison teachers: a

I made connections I’ve never been able to make before because this isn’t science taught by grade level or course number but as an aggregate from many knowledgeable people who love science!

When I started teaching middle school level science I was not confident enough to try new experiments. I stuck to the book because I was in unfamiliar territory. When our district said they were going to a hands-on, inquiry-based science curriculum I knew my classroom was about to change and that I had better be ready to change with it.

– STLP Participants

multivariate regression analysis of 1100 students showed that students showed a significant improvement in science PSSA scores for every year they spent in the classroom of a Fellow or peer.

**MSP Project Name:** Subject Content Articulation of Science and Mathematics with emphasis on technology application and curriculum innovation aligning the curriculum with content standards (ACMITCC, abbreviation in Spanish)

**State:** Puerto Rico (PR070601)

**Participants:** Inter American University of Puerto Rico, Barranquitas Campus, and 12 school districts, consisting of 57 elementary and secondary participating schools, including 5 private schools

**Project Director:** Rosa C. Rodriguez Morales, Ed.D.

**Number of Participants:** 140 elementary and middle school teachers

**Background:**

The ACMITCC’s main objective was to offer professional development in mathematics and science content aligned to curriculum standards to teachers in grades 4 through 9. This project gave special attention to the study of specific areas in mathematics and science. For mathematics, these included topic areas such as reconstruction of geometric figures, problem solving, proportions and percentages, cardinal number expressions and equations, graphs and statistics, measurements, and relations. For science, these included topic areas such as the scientific method, the cell, matter transformations, energy, hydrosphere, atomic structure, electric field lines, light and heat, microsattelites, global warming, and construction.

**Description of Professional Development:**

The ACMITCC provided each participating teacher the opportunity to participate in its summer institute, Saturday academy and graduate courses. The workshops offered in each subject area integrated the use of technology, all in conjunction with the standards already established by the Puerto Rican Department of Education. Participants developed lesson plans and integrated research in action that included the participation of their students in the classroom. The project aimed to assist participating teachers in becoming role models for their peers in their schools, taking on leadership in the content areas that they teach. Teachers also participated in field trips to learn about the environment and ecology. At the end of sessions, participants turned in a portfolio containing all the work done as part of the project.

**Results :**

Project evaluators reported success in promoting teachers’ knowledge acquisition regarding the topics covered. This assertion is based on the finding that all the post-tests completed by participants possessed statistically significant larger mean scores than those of the pre-tests. Evaluators’ analysis of the data collected from the administration of general exams to teachers also indicated that the workshops were successful: post-tests had higher means than pre tests as evidenced by the inferential statistics analyses performed. Evaluators reported that the pre- and post-tests administered to the students of the teachers participating in the project indicated gains in knowledge as the post-test means were higher than the pre-test means in all groups (all comparisons demonstrated statistically significant gains).

Strengthening my pedagogical skills and learning new ways of presenting knowledge makes my teaching more effective and this in turn, has increased my self-confidence as a teacher, changed my perception of math, and enabled me to provide a higher quality of education.

*-- ACMITCC Participant*

I have learned a lot about science and have learned to appreciate the Earth and our environment. I want to keep on learning much more about science and our planet.

*--Student of ACMITCC Participant*

**MSP Project Name:** Technology, Inquiry, Pedagogy, and Standards (TIPS)

**State:** South Carolina (SC090401)

**Partners:** University of South Carolina, SC Coalition for Mathematics and Science (SC CMS), and 10 middle schools

**Project Director:** Christine Lotter

**Number of Participants:** 15 middle school instructional coaches; 42 teachers from the participating coaches' schools

**Background:**

The Technology, Inquiry, Pedagogy, and Standards (TIPS) program was designed to improve the content knowledge and inquiry-based instruction of South Carolina middle school science and mathematics teachers. The program's collaboration with the existing SC Coalition for Mathematics and Science middle school instructional coach program allowed for sustained enactment of the professional development goals in local schools. The program design aligned an instructional coach from each partner school with participating science and mathematics teachers from that school. The intent was for teachers to learn science or mathematics content through inquiry-based instructional strategies to ultimately improve student learning across the state.

**Professional Development:**

The program began with an intensive 2-week institute to increase teacher and coach content knowledge and the use of inquiry-based practices. Participating teachers and instructional coaches were arranged into one of five grade-level content area teams (ecology, geology, simple machines, geometry, or algebra) in which they participated in inquiry-based lessons. In addition to the content instruction, the teachers practiced teaching new inquiry lessons to small groups of middle school students during the institute. Before and after this practice teaching, the instructional coaches worked with the teachers to reflect on and build their inquiry-based instructional skills. Academic year follow-up included three four-hour workshops and observations of teachers' enactments in their classrooms.

**Results:**

Evaluators found that participating teachers showed improved mathematics and science content knowledge through their scores on locally developed pre-unit and post-unit tests aligned to the SC state standards. Using the Reformed

Teaching Observation Protocol (RTOP) to score teachers' classroom observations, evaluators found positive changes between the teachers' ability to teach through inquiry from before to after their participation in the program. Teachers also pre-tested and post-tested their middle school students using locally created tests that were aligned with the South Carolina content standards covered in the units they learned during the summer institute. Evaluators reported that, on average, students showed medium effect size gains in their content knowledge from pre-test to post-test.

More than anything this week I learned how to break down major algebra concepts like expressions, equations, formulas, etc. into hands-on, real-world problems that students can relate to. So many times teachers teach a skill without any type of concrete model for the students and my 6<sup>th</sup> grade students still need the concrete representation. I will definitely use this style of teaching in my classroom next year and in the future.

*– TIPS Participant*

**MSP Project Name:** South Dakota Counts  
**State (APR ID):** South Dakota (SD060723)

**Partners:** Sioux Falls School District, Iverness Research Associates, Technology and Innovation in Education, and Black Hills State University

**Statewide Project Contact:** June Apaza

**Number of Participants:** 152 teacher leaders and 8 mathematics specialists

### **Background:**

In 2006, the South Dakota Department of Education created an initiative to improve mathematics instruction at the elementary-level across the state. The three-year project, *South Dakota Counts*, aimed to increase the capacity of elementary teachers throughout South Dakota to provide high-quality mathematics instruction. *South Dakota Counts* involves collaborations between the South Dakota's seven Education Service Agencies (ESAs) and the Sioux Falls School District (who together comprise the eight project grantees), the Center for the Advancement of Mathematics and Science Education at Black Hills State University (BHSU) in Spearfish, and Technology in Education (TIE) in Rapid City.

### **Description of Professional Development:**

The professional development focused on various topic areas in mathematics, such as number sense, algebra, and geometry, as well as Cognitively Guided Instruction and leadership training. Each year,

regional mathematics specialist and teacher leaders attended a six-day summer institute. The project implemented a blend of face-to-face workshops, academic courses and “train the trainer” models of professional development. Mathematics specialists and teacher leaders could earn graduate-level mathematics education certificates, and add extra coursework to earn master’s degrees or K-12 mathematics specialist endorsements. In addition, the mathematics specialists received training in how to best support teacher

leaders in their districts to improve their classroom practice, and to provide professional development to other teachers in their schools. Principals from participating schools received "Lenses on Learning" training (developed by Education Development Center) to help prepare them to provide support and instructional leadership with regard to mathematics.

Before SD Counts I would present the lesson from the book instructing the students how they were supposed to solve the problems for the assignment. I gave them timed tests and taught standard algorithms. Now I present real-life story problems and the students work together to solve the problems.

My students are much more confident in taking a risk to solve math problems. They're also much more confident in sharing. They used to look at a problem and say, "I don't get it" before they'd even give it a try. Now they try to see who can find the most ways to solve those problems. They have many more tools to use and they're active participants.

--SD Counts participants

### **Results:**

The project’s evaluation showed that many teachers across the state are attempting to change their teaching practice, and attitudes and beliefs about mathematics teaching and learning have changed considerably as a result of this project. For example, the majority of respondents (82 percent) reported that their participation in the project has had considerable to a very great influence on how they teach mathematics. Among the 150 teacher leaders that took the pre- and post-tests, the project reported significant growth in algebra, number sense, and geometry.

**MSP Project Name:** Reaching for Excellence in Middle and High School Science Partnership

**State (APR ID):** Tennessee (TN070111)

**Partners:** East Tennessee State University and nine school districts

**Project Director:** Jack Rhoton

**Number of Participants:** 38 5<sup>th</sup>–8<sup>th</sup> grade teachers; 31 9<sup>th</sup>–12<sup>th</sup> grade science teachers

**Background:**

The Reaching for Excellence in Middle and High School Science Partnership project was designed to build a strong partnership between East Tennessee State University (ETSU) and nine school districts in Northeast Tennessee, most of them rural, low-income, and low-achieving. The project sought to increase teacher content and pedagogical knowledge, increase student learning, increase the number of teachers participating in standards-based professional development, and provide teachers training on standards-based resources and materials. The program also built teacher leadership in science.

**Description of Professional Development:**

The Reaching for Excellence in Middle and High School Science Partnership implemented a 12-day summer science leadership institute for middle and high school science teacher participants to gain enhanced content and pedagogical knowledge in science. The institute was taught by ETSU science faculty in biology, chemistry and physics, and incorporated a number of varied experiences and lessons to support nine major learning activities (approximately 1.5 days were devoted to each learning activity). The summer institute focused on both science content and teaching and learning inquiry. Institute topics were presented in the context of how they should be delivered in the classroom. Participants engaged in a variety of science investigations in the areas of biology, chemistry, and physics, with topics for investigations driven by participants, student data, and local and state science standards. The summer workshop was followed by academic year training activities for each participant. After participants returned to their respective schools to implement the science program, seven university science faculty provided ongoing support by visiting each participant over six days. During these visits university faculty modeled science lessons to students, provided in-service sessions for teachers, and supported teachers in their classroom environment.

**Results:**

Project evaluators employed a comparison group design, comparing the performance of MSP teachers and a sample of teachers who taught at the same schools as MSP teachers. Both MSP teachers and comparison teachers, who volunteered to participate in the project’s study, were given a multiple choice test on the workshop content developed by the MSP faculty who taught at the workshop. MSP teachers were given the test on the first and last days of the summer workshop. The comparison teachers were given the pretest and 12 days later completed the post-test, so the time interval was the same for both groups of teachers. Evaluators found that the MSP group’s gain from pre- to post-test was statistically significantly larger than that of the comparison group. Evaluators also found, using a similar matched comparison group design in which they compared students in classes taught by participants and students of comparison teachers in the same subject and grade, that elementary, middle, and high students in classes taught by MSP teachers also increased their achievement at a significantly higher rate than those in the comparison group.<sup>27</sup>

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<sup>27</sup> The student evaluation passed the rigorous guidelines set forth in the *Criteria for Classifying Designs of MSP Evaluations* rubric. The evaluation of teacher content knowledge did not meet the guidelines (see Appendix C for more details).

**MSP Project Name:** Creating Mathematics Excellence–CME

**State:** Wisconsin (WI070902)

**Partners:** Chetek School District, CESA #11, University of Wisconsin-Stout

**Project Director:** Anne Wallisch

**Number of Participants:** 65 regular and special education mathematics teachers

**Background:**

The Creating Mathematics Excellence (MSP) partnership consisted of 14 rural and high poverty school districts in western Wisconsin and the University of Wisconsin–Stout. This partnership served the needs of over 5,000 students and 65 teachers of regular and special education.

**Description of Professional Development:**

The project was designed to engage participants in a rigorous yearlong professional development structure which included a 2 week content summer academy followed by intensive classroom observation and feedback to include a “Lesson Study” and reflection component. Supporting this intensive instructional model, participants maintained current and reflective communication using a blogging format, a data retreat to closely match their work to the achievement of their students, and a university credit structure. An Assessment Conference is utilized each year to assess content-specific student “constructed response” assessments, supported by rubric development, and based on previously studied summer academy content strand work. Participants also attended a Math Visions Conference to fully explore the ongoing needs of the participants and their local districts and students. Specific activities included guided discussions of leadership training needs, classroom practice of research-based instructional strategies, and data sets reflective of student growth and local co-teaching models, as well as others.

**Results:**

CME evaluators’ comparison of pre- and post-test score gains on the Diagnostic Teacher Assessment in Mathematics and Science (DTAMS) for Statistics & Probability among participants was statistically significant. Evaluators found that the comparison group made no significant pre-post gains while the CME participant group showed significant gains on the use of the Learning Mathematics for Teaching (LMT) assessment for algebra and geometry. This assessment measures the math knowledge that teachers need to teach mathematics effectively and recognize the errors students make and be able to recognize their source. CME evaluators also reported that students of participating teachers scored significantly higher on standardized tests than the students of those teachers within the comparison group and that 100 percent of the participating teachers particularly appreciated the role of the Data Retreat Conference in identifying, synthesizing and evaluating of their local student data and curriculum development.

I have never in my 24 years of teaching been privileged to work with my teaching colleagues in the creation of “open-ended” tasks that we could assess together with a rubric and discuss real students responses across a grade level. This activity not only added to my math content knowledge but added tremendously to my understanding of student thinking and their “real” needs in the math classroom.

– CME Participant

**MSP Project Name:** Northern Wisconsin Rural Partnership for Mathematics Education

**State:** Wisconsin (WI070905)

**Partners:** Viterbo University, 18 school districts in Northern Wisconsin, and the Wisconsin Academy Staff Development Initiative (WASDI)

**Project Director:** Billie Earl Sparks

**Participants Affected:** 57 3<sup>rd</sup>–8<sup>th</sup> grade teachers from 18 school districts

**Background:**

The Northern Wisconsin Rural Partnership for Mathematics Education sought to enhance mathematics learning in grades 3–8 in 18 mostly rural school districts in northern Wisconsin by increasing the mathematical knowledge necessary for teaching at these grade levels. The project also had a goal of helping rural teachers reduce their isolation by establishing a network of colleagues in similar schools who are connected through their face-to-face meetings and are then connected on-line to these colleagues and mathematics professors.

**Description of Professional Development:**

Each year two of Wisconsin’s model academic standards were targeted for content enhancement of the teachers in a 2-week summer institute. Two academic year 2-day sessions were also conducted to enhance areas taught in previous years. Demonstration, hands-on activity, presentation, discussion, written reflections, and observation were a part of this model. All classes were taught by retired members of the faculty of the Mathematics Department at the University of Wisconsin-Eau Claire, which allowed these faculty members to also have flexible time to consult with participants in their schools during the academic year. These in-school consultations also allowed for scaling up by time being spent with other staff members as well. A focus throughout was deep understanding of the mathematics content by the teachers and modeling of how lessons they teach should incorporate understanding and sense-making. The in-school work allowed for coaching toward this incorporation of teacher learning in student lessons.

**Results:**

The Learning Mathematics for Teaching (LMT) teacher knowledge assessment was administered at the first February 2008 meeting with the teachers, and again at the October 2008 and July 2009 sessions. Evaluators found statistically significant gain among participants in content knowledge for teaching. Comparison teachers in comparable schools (25 teachers also in high-need schools) also took the LMT in March 2008; these teachers will take the assessment again in 2010 so evaluators can make comparisons between the comparison group and participants in terms of gains in knowledge of mathematics content.

I believe that this course has significantly changed the way I will teach math, but it has also changed the way I now view and use math. It has encouraged me to be more open-minded, to look for alternate ways to solve a problem. The sharing of strategies that you included in the course really developed this.

One way I believe this project has given me the opportunity to learn how to help kids make sense of mathematics relates to my new understanding of the difference between teaching arithmetically and teaching algebraically. The past two weeks have shown me that in many ways, I was still dispensing mathematics through arithmetic eyes. I am looking forward to starting a new school year with a framework that is centered on algebraic thinking.

– Wisconsin Rural Partnership for Mathematics Education  
Participants

**MSP Project Name:** Maximizing Mathematics Achievement in Boone County Schools  
**State (APR ID):** West Virginia (WV061103)  
**Partners:** Boone County Schools, Marshall University Graduate School, and Brickstreet Mutual Insurance  
**Project Director:** Nora Dotson  
**Facilitators:** Roger Bennett and Nancy Booth  
**Number of Participants:** 32 5<sup>th</sup>-12<sup>th</sup> grade educators

**Background:**

Educators from ten of the fourteen schools in the county system participated in *Maximizing Mathematics Achievement in Boone County Schools*. The overarching goal of the program was to increase the content knowledge of classroom teachers in mathematics. Working in conjunction with Marshall Graduate College, the project focused on the areas that needed the most improvement according to the state standardized academic test and American College Testing (ACT) data.

**Professional Development:**

Each summer, two weeks of intensive study were presented on three specific areas of mathematics: geometry, algebra, and technical mathematics. The class work involved hands-on standards based instructional practices that included research, technology, blogs and on-line class work, and current teaching strategies. Two full days were dedicated to developing a collegial learning community. These sessions were also used to introduce the group to computer fluency and basic knowledge of using a computer. To increase this usage and knowledge of 21st Century skills, a wiki and blog site was developed. The Boone County MSP Teacher Leaders wiki was the first of its type on the state wiki site. The participants used this wiki to collaborate on philosophical questions, strategies for teaching, and the implementation of their studies. Weekly visits occurred at each of the ten schools with one-on-one assistance from the facilitator. Participants had the opportunity to be observed by the facilitator, observe other teachers, participate in co-teaching, or observe modeled lessons. Participants also received training in the adopted curricula: Investigations, Connected Mathematics, Cognitive Tutor, and the 21st Century Algebra On-line Units from the West Virginia Department of Education (WVDE). Twelve members of the grant attended the West Virginia Council of Teachers of Mathematics Conference in 2008. Six members were chosen for the WVDE supported Teacher Leadership Institute which is an intensive week-long professional development to increase the teachers' technology skills and to foster potential leadership in teachers. The corporate sponsor responded to the groups needs with additional monetary resources and training in their expertise.

**Results:**

The project reported that the teachers in the treatment group improved their content knowledge and skills through each year of the MSP project. While the educational level, experience, and assignment of the teachers entering the program varied greatly ranging from certified secondary mathematics specializations to special education inclusion teachers, 81 percent made significant gains during the final year of the program. Professional growth was observed through the interaction of the teachers in the learning community – working collaboratively; shared problem-solving, improved reasoning skills, and enhanced comfort level with the technology. Important changes were demonstrated by the Survey of Enacted Curriculum in the way in which the teachers utilized the time in class and the level of engagement of the students in the learning process. Through the collaboration with Marshall University Graduate College all participants were given the opportunity to receive twelve graduate hours through the three years of the grant.

## Chapter 6: Summary and Conclusions

The MSP program was created in 2001 to fund collaborative partnerships between high-need school districts and mathematics, science, and engineering departments at institutions of higher education (IHEs) for the purpose of providing intensive content-rich professional development to teachers and other school staff and thus improving classroom instruction and ultimately student achievement in mathematics and science. Each year since the program's inception, it has funded more projects and served more participants, who, in turn, have served more students. In Performance Period 2008 (PP08), 626 individual MSP projects were in operation throughout the country. These projects provided professional development to over 57,000 educators who taught over 2.8 million students, and in some cases, these educators also trained their fellow teachers, thus influencing an even larger number of teachers and students.

In accordance with the legislation, MSP projects established partnerships between school districts and IHEs as well as with a wide variety of other organizations. More than 3,900 faculty members from mathematics, science, engineering, and other departments at IHEs were involved with the MSP projects.

Over half of MSP projects (59 percent) in PP08 conducted summer institutes, a model of professional development designed to provide a period of intensive study of STEM content over a relatively short period of time. Nearly all of the projects that offered summer institutes also conducted follow-up activities, with the aim of enhancing or extending the knowledge gained by participants over the summer. Projects that provided summer institutes with follow-up activities provided participants with a median of 96 hours of professional development. The remaining 41 percent of MSP projects in PP08 primarily delivered professional development during the school year, with shorter summer sessions often included. These projects provided participants with a median of 80 hours of professional development.

All projects are required to administer pre- and post-tests during the year(s) in which their teachers were receiving intensive professional development. The most frequently reported assessments of teacher content knowledge in mathematics were standardized tests (57 percent), followed by locally developed tests (43 percent). The reverse was true in science. Forty percent of projects used standardized tests to measure teacher content knowledge in science, while over half of projects (53 percent) used locally developed tests. The main advantage of standardized tests is that they have already been tested for validity and reliability, and thus their results can be compared in a normative context. However, standardized tests are not available in all disciplines and are often not well aligned with the context taught. Thus, many projects developed their own assessments to measure growth in teacher content knowledge of the material taught, although they may not have had strong psychometric properties.

Two-thirds of participants (67 percent) who were assessed in mathematics showed significant gains in their content knowledge, and nearly three-fourths of teachers (73 percent) who were assessed in science showed significant gains in their content knowledge.

Increases were seen in PP08 in the proportion of students taught by MSP teachers who scored at the proficient level or above in state assessments of mathematics or science. In mathematics, the proportion of students scoring the proficient level or above (58 percent) increased by 13 percentage

points from PP07. In science, the proportion of students scoring the proficient level or above (58 percent) increased by 9 percentage points from PP07, and doubled the PP06 figure.

Projects are attempting to implement rigorous evaluation designs. Three percent of projects reported using experimental designs, and 49 percent of projects reported using quasi-experimental designs with comparison groups. However, upon review of the designs of final year projects, it was found that many of the projects that reported using quasi-experimental designs in fact used one-group designs comparing outcomes for MSP participants between pre- and post-test.

The *Criteria for Classifying Designs of MSP Evaluations* (see Appendix B) were developed to identify projects that successfully implemented rigorous evaluation designs. The criteria were applied to the final evaluation reports of the 49 projects that completed an experimental or comparison group design and submitted complete data. Three of these projects met the rigorous criteria. These three projects varied from one another across the types of program offerings, the content area and grade levels targeted, and the number of professional development hours offered.

Ultimately, success of the MSP program will be determined by the success of its projects in providing effective professional development to teachers across the nation. The MSP program will continue to study the effectiveness of these efforts in order to develop our understanding of what constitutes high quality, effective professional development.

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## Appendix A: Challenges Reported by Projects in Implementation and Evaluation

This appendix documents some of the implementation and evaluation challenges reported by projects. All of the descriptions provided in this section are based on project reports, and may not be representative of the most common issues faced. However, they provide concrete examples of some of the challenges faced by MSP projects in implementing and evaluating their professional development programs. Key challenges reported by many projects include recruiting participants for professional development, retaining participants throughout the study period, recruiting a comparison group of teachers, obtaining administrator support, and measuring teacher and student gains. These challenges are discussed in more detail below, along with innovative solutions that some projects have employed.

### *Recruiting Teachers*

One of the most common challenges projects reported on is recruiting teachers to participate in the professional development. Issues raised included concern about completing the necessary assessments, questions about the need for additional training, and the difficulty teachers have in finding time to participate in the professional development. Many projects reported that teachers were apprehensive about completing the required pre- and post-tests due to concern that these tests would be used to assess their job performance. Some projects reported needing to emphasize to the participants that the assessments would only be used to evaluate the overall project, and not individual teacher performance.

One project administrator reported meeting resistance from teachers who questioned the need for additional content knowledge in math or science in the early elementary grades.

*While the grant provides some classes that would offer this background, many teachers do not see the need for it since, they “only” teach first grade, for example. It has been difficult to convince elementary teachers that they and their students would benefit from additional content instruction in mathematics. (McAdaragh, 2009)*

MSP projects reported that another challenge in recruiting teachers to participate in intensive professional development is finding times that fits with teachers’ schedules. Furthermore, some states reported that the already increased professional development requirements in their states caused additional difficulty in recruiting teachers. Particularly, two-week summer institutes sometimes proved to be a hurdle in drawing teachers. A project in California reported that offering more than one summer institute helped resolve this issue.

*To accommodate last-minute rehiring and provide more flexibility, two sessions of the institute were offered, one in June/July and the other in August immediately before the start of school. The institute was designed to provide a total of 80 intensive hours. All 48 teachers completed at least the grant-stipulated 60 hours of training, and 90 percent of the group completed all 80 hours that were offered. Of those 48, all but one continued with school-year follow-up activities. (Ormseth, 2009)*

### ***Retaining Teachers Throughout the Study Period***

Many of the same issues with teacher recruitment surfaced as issues with retention. Several projects struggled with the question of providing incentives to teachers to attend professional development outside of their contractual hours, but deemed it fiscally impractical to pay them to attend, particularly funding such participation for multiple years. Some projects found that it was possible to offer training for graduate credit as an alternative incentive, although this was not necessarily an attractive offer for teachers at the top of the pay scale, who did not stand to benefit from increased salary due to additional college credit. Projects commonly reported suffering attrition due to the difficulty in scheduling the professional development at times convenient for teachers, as well as due to turnover and layoffs, and school and district reorganization, including school closures.

A rural area reported having scheduling difficulties, particular to its situation.

*It is always a geographical challenge to orchestrate activities that combine our eighteen rural school districts. Our most remote districts must spend hours in travel time for each activity which quite often gets disrupted because of weather or transportation issues. We have used video and phone conferences with limited success. (Gotham, 2009)*

Logistical challenges, however, were not unique to rural areas.

*One challenge is the number of "singleton" and combination classrooms and the number of WISE II sites. WISE II could not include WISE I participants or participants in the district's other CaMSP (Math) and focuses on high-need Title I sites. To meet those competing demands, the program serves more than a dozen sites across the city. Some sites have fewer than three participants This makes planning meetings challenging at some sites as some teachers have no grade-level partner or teach two grades and must decide which meeting to participate in. (Sackett, 2009)*

A project in Connecticut reported offering professional development during the school day and surmounting scheduling challenges by providing substitute teachers.

*Contracted cooperating teachers (CSPs) covered participants' classes once or twice each month. This time during the school day enabled teachers to practice coaching more often and with less stress. The CSPs were long-term intermittent substitutes who consistently worked with a participant and his or her class over the course of the year. This support helped institutionalize coaching and removed pressure on participants to use their planning times, and time before and after school, to complete coaching expectations. (Carver, 2009)*

### ***Forming a Comparison Group***

In addition to the challenges reported by projects in recruiting teacher to participate in the professional development, some projects reported even greater challenges finding teachers willing to serve in a comparison group. These teachers would be required to participate in assessments without the benefit of receiving the professional development. Many projects reported using incentives for comparison groups, including stipends (sometimes pending completion of pre- and post-tests), materials, or other professional development. They also emphasized to the control group the important role they were playing in the research.

Finding a sufficient number of comparison teachers sometimes proved difficult, particularly in areas where there were not a sufficient number of similar teachers to serve in a comparison group or in districts in which most of the teachers were participating in an MSP project.

*A challenge for the current design of the evaluation is meeting the requirement that control schools satisfy the criterion of “non-treatment” mandated by the quasi-experimental design. Now that the VMI has been educating teachers for over ten years and has trained teacher leaders who represent nearly 90% of the school districts in Vermont, the penetration of VMI content in the practice of schools that may not be part of a particular cohort but part of a previous cohort may invalidate future comparisons. (Gross, 2009)*

A project in California reported that they recruited comparison teachers by selecting schools throughout the state with the California Department of Education’s 2006-2007 School Accountability Report Card Database based on key characteristics and contacting their department chairs to request participation (Vu-Tran, 2009). Other projects similarly suggested a statewide or national database of comparison groups. These databases also helped to address the variability in the level of education and specialty among teachers in treatment and comparison groups.

### ***Administrator Support to Project Implementation***

A theme that emerged in many of the reports was that administrator support was a key determinant in a project’s success. Several projects wrote that administrator approval and involvement allowed their projects to move forward, during all stages. In order to ensure a responsive program that catered to the needs of teachers and administrators, a project from New York appointed a representative to each school.

*The grant made sure to have at least one point person in each of the schools to help coordinate with teachers, and grant personnel regularly visited the schools, checking on the needs of the administrators and teachers. Because of this good level of communication, the grant personnel were able to react quickly to their needs by shifting a larger portion of the professional development outside of regular school hours. (Wainwright, 2009)*

One project commented on the important role of administrative support during evaluation.

*For this evaluation, the school districts needed to provide the data early and sort it by the students of the participant-teachers, much additional work for them. Having included the districts as partners from an early stage, holding regular meetings with their administrators, and making the data needs clearly known seemed to encourage cooperation. (Eagle, 2009)*

Similarly, some projects that had minimal administrative discussed a lack of buy-in of the program.

*...Last year, we expressed concerns about the continued participation of one of the district teams... Their administrator representative was weak in leveraging the district’s engagement. We met with the superintendent to discuss the district’s level of commitment and document the value in professional development, yet they ultimately pulled out of the program. (Hollingsworth, 2010)*

Several MSP projects focusing on science reported obstacles in enlisting administrative support of their projects, particularly those schools struggling to achieve Adequate Yearly Progress (AYP).

*Several schools within the district have failed to meet AYP and numerous building-wide initiatives aimed at increasing reading and mathematics have been implemented as a result. This atmosphere has posed several challenges to the implementation of our [science] program. Some teachers have increased responsibilities due to new initiatives underway at their schools. Several of the teachers in the program have been moved to new positions due to district shuffling. One science teacher is now in a position unrelated to science. (Langrall, 2009)*

*Our major challenge continues to be the ability to engage teachers in teaching science in a district where many schools are struggling to make AYP in math and reading. This year's data suggests that work on science inquiry, may in fact be an important tool to help those struggling schools. (Gibbard, 2009)*

### ***Measuring Teacher Gains***

Many projects reported difficulty finding appropriate assessment to measure teacher gains in the specific areas in which they focus.

*[We had] difficulty in finding appropriate measures of teacher content knowledge. We successfully evaluate teacher application and implementation of project methodologies though classroom observation. We have more difficulty in finding an appropriate instrument for evaluating teacher understanding of watersheds as complex, living systems. (Zoellick, 2009)*

A project in Puerto Rico brought up the lack of appropriate assessments in Spanish for its teachers.

*Teacher's knowledge has been assessed with locally developed tests, and self-report data. This is due to the lack of availability in Spanish of standardized tests often used in the US for this purpose. It must be noted that most teachers here do not feel confident enough answering tests prepared in English. The Puerto Rico Department of Education is engaged in developing instruments to test teacher's knowledge in math and science areas. (Caceres, 2009)*

One project reported using an assessment developed by its university partner that incorporated scoring.

*Our greatest success in our evaluation practices was in the use of the Teacher Content Knowledge Test. In the past we wrote and scored our own test. We felt as if our teachers had learned a lot, but our test was difficult to score and never yielded results. This year, we had little trouble scoring the test and with the help of the University's Research and Development Center, we obtained a wealth of item level data. (Maxwell, 2009)*

Several projects reported used measures from the Learning Mathematics for Teaching Project, which provides technical assistance in using its instruments.

*The use of the Learning Mathematics for Teaching Measures proved very enlightening. 61% of the teachers made significant gains in not even a year of the project which indicates that we are addressing needs and doing so in a way that makes real sense to the participants and that they are buying into our model and approach. (Sparks, 2009)*

### **Measuring Student Gains**

Along with the difficulties reported by some projects in identifying appropriate teacher assessments, many projects reported issues identifying appropriate assessments to measure gains in student achievement. However, developing assessments better aligned with the content requires significant time and funds. One issue noted by many projects was that whereas students take math assessments each year, they do not necessarily take science assessments each year, making it difficult to measure gains. Additionally, statewide assessments are usually not available for early elementary grades:

*The KCCT data only involved students and teachers at the 4th grade level and above. This is a K-5 grant and finding state standardized data for over half of the grant participants is impossible. That leaves a large hole in the amount and quality of data that the program can use to evaluate how it is meeting the goals of the grant. (Storey, 2009)*

Finally, another commonly cited challenge in measuring student achievement was the inaccessibility of and/or protracted timeline involved in acquiring student data. Not only did this sometimes prevent projects from evaluating student progress for the current year, but it affected projects' ability to incorporate changes to the next year's program based on results.

*Acquiring [student assessment] data for this project during the 2007-2009 academic years was very difficult. We had to rely on the teachers themselves to collect [student assessment] scores and deliver the data to us...not all teachers had access to these scores. An alternative access to [student assessment] data was through the district office...[however] districts do not organize [student assessment] data in a manner that was easy to access for our needs. We requested data by teacher...[which] were organized by student ID number. Therefore we had to provide lists of students to the districts for the data management team to search and extract each individual score. (Becker, 2009)*

*Standardized test results are not available in a timely manner. The state test results were not available until late November. These are the results that would reflect the previous years' implementation of new teaching strategies. As you can see, this makes this aspect of analysis and reporting more limited. (Garrity, 2009)*

*[Another] challenge is the accessibility of data from state sources to enable the matching of students needed to execute the quasi-experimental designs required by MSP. While the state now makes these data available at a central location, the time and travel needed to complete the analysis is sometimes beyond the resources of the evaluation... This increases the time and expense of data collection and analysis, and limits the ability to follow new lines of inquiry that may arise during the analysis process. (Gross, 2009)*

## Appendix B: Criteria for Classifying Designs of MSP Evaluations

This appendix includes the *Criteria for Classifying Designs of MSP Evaluations* used to determine the number of projects that successfully conducted rigorous evaluations. The criteria were developed as part of the Data Quality Initiative (DQI) through the Institute for Education Sciences (IES) at the U.S. Department of Education. The results of the review of final year MSP projects according to these criteria are presented in Appendix C.

### Criteria for Classifying Designs of MSP Evaluations

- ❑ **Experimental study**—the study measures the intervention’s effect by randomly assigning individuals (or other units, such as classrooms or schools) to a group that participated in the intervention, or to a control group that did not; and then compares post-intervention outcomes for the two groups.
- ❑ **Quasi-experimental study**—the study measures the intervention’s effect by comparing post-intervention outcomes for treatment participants with outcomes for a comparison group (that was not exposed to the intervention), chosen through methods other than random assignment. For example:
  - *Comparison-group study with equating*—a study in which statistical controls and/or matching techniques are used to make the treatment and comparison groups similar in their pre-intervention characteristics.
  - *Regression-discontinuity study*—a study in which individuals (or other units, such as classrooms or schools) are assigned to treatment or comparison groups on the basis of a “cutoff” score on a pre-intervention non-dichotomous measure.
- ❑ **Other**
  - The study uses a design other than a randomized controlled trial, comparison-group study with equating, or regression-discontinuity study, including *pre-post* studies, which measure the intervention’s effect based on the pre-test to post-test differences of a single group, and comparison-group studies without equating, or non-experimental studies that compare outcomes of groups that vary with respect to implementation fidelity or program dosage.

## Criteria for Assessing whether Experimental Designs Were Conducted Successfully and Yielded Scientifically Valid Results

### A. Sample size

- Met the criterion**—sample size was adequate (i.e., based on power analysis with recommended significance level=0.05, power=0.8, and a minimum detectable effect informed by the literature or otherwise justified).
- Did not meet the criterion** —the sample size was too small.
- Did not address the criterion.**

### B. Quality of the Measurement Instruments

- Met the criterion**—the study used existing data collection instruments that had already been deemed valid and reliable to measure key outcomes; or data collection instruments developed specifically for the study were sufficiently pre-tested with subjects who were comparable to the study sample.
- Did not meet the criterion** —the key data collection instruments used in the evaluation lacked evidence of validity and reliability.
- Did not address the criterion.**

### C. Quality of the Data Collection Methods

- Met the criterion**—the methods, procedures, and timeframes used to collect the key outcome data from treatment and control groups were the same.
- Did not meet the criterion**—instruments/assessments were administered differently in manner and/or at different times to treatment and control group participants.

### D. Data Reduction Rates (i.e., Attrition Rates, Response Rates)

- Met the criterion**—(1) the study measured the key outcome variable(s) in the post-tests for at least 70% of the original study sample (treatment and control groups combined) or there is evidence that the high rates of data reduction were unrelated to the intervention, **and** (2) the proportion of the original study sample that was retained in follow-up data collection activities (e.g., post-intervention surveys) and/or for whom post-intervention data were provided (e.g., test scores) was similar for both the treatment and control groups (i.e., less or equal to a 15-percent difference), or the proportion of the original study sample that was retained in the follow-up data collection was different for the treatment and control groups, but sufficient steps were taken to address this differential attrition in the statistical analysis.

- Did not meet the criterion**—(1) the study failed to measure the key outcome variable(s) in the post-tests for 30% or more of the original study sample (treatment and control groups combined), and there is no evidence that the high rates of data reduction were unrelated to the intervention; *or* (2) the proportion of study participants who participated in follow-up data collection activities (e.g., post-intervention surveys) and/or for whom post-intervention data were provided (e.g., test scores) was significantly different for the treatment and control groups (i.e., more than a 15-percent difference) and sufficient steps to address differential attrition were not taken in the statistical analysis.
  
- Did not address the criterion.**

#### **E. Relevant Statistics Reported**

- Met the criterion**—the final report includes treatment and control group post-test means, and tests of statistical significance for key outcomes; or provides sufficient information for calculation of statistical significance (e.g., mean, sample size, standard deviation/standard error).
  
- Did not meet the criterion**—the final report does not include treatment and control group post-test means, and/or tests of statistical significance for key outcomes; or provide sufficient information for calculation of statistical significance (e.g., mean, sample size, standard deviation/standard error).
  
- Did not address the criterion.**

## Criteria for Assessing whether Quasi-Experimental Designs Were Conducted Successfully and Yielded Scientifically Valid Results

### A. Baseline Equivalence of Groups

- Met the criterion**—there were no significant pre-intervention differences between treatment and comparison group participants on variables related to the study’s key outcomes; or adequate steps were taken to address the lack of baseline equivalence in the statistical analysis.
- Did not meet the criterion**—there were statistically significant pre-intervention differences between treatment and comparison group participants on variables related to the study’s key outcomes; and no steps were taken to address lack of baseline equivalence in the statistical analysis.
- Did not address the criterion.**

### B. Sample size

- Met the criterion**—sample size was adequate (i.e., based on power analysis with recommended significance level=0.05, power=0.8, minimum detectable effect size informed by the literature or otherwise justified).
- Did not meet the criterion**—the sample size was too small.
- Did not address the criterion.**

### C. Quality of the Measurement Instruments

- Met the criterion**—the study used existing data collection instruments that had already been deemed valid and reliable to measure key outcomes; or data collection instruments developed specifically for the study were sufficiently pre-tested with subjects who were comparable to the study sample.
- Did not meet the criterion** —the key data collection instruments used in the evaluation lacked evidence of validity and reliability.
- Did not address the criterion.**

### D. Quality of the Data Collection Methods

- Met the criterion**—the methods, procedures, and timeframes used to collect the key outcome data from treatment and comparison groups were the same.
- Did not meet the criterion**—instruments/assessments were administered differently in manner and/or at different times to treatment and comparison group participants.

### E. Data Reduction Rates (i.e., Attrition Rates, Response Rates)

- Met the criterion**—(1) the study measured the key outcome variable(s) in the post-tests for at least 70% of the original study sample (treatment and comparison groups combined) or

there is evidence that the high rates of data reduction were unrelated to the intervention, *and* (2) the proportion of the original study sample that was retained in follow-up data collection activities (e.g., post-intervention surveys) and/or for whom post-intervention data were provided (e.g., test scores) was similar for both the treatment and comparison groups (i.e., less or equal to a 15-percent difference), or the proportion of the original study sample that was retained in the follow-up data collection was different for the treatment and comparison groups, and sufficient steps were taken to address this differential attrition were not taken in the statistical analysis.

- Did not meet the criterion**—(1) the study failed to measure the key outcome variable(s) in the post-tests for 30% or more of the original study sample (treatment and comparison groups combined), and there is no evidence that the high rates of data reduction were unrelated to the intervention; *or* (2) the proportion of study participants who participated in follow-up data collection activities (e.g., post-intervention surveys) and/or for whom post-intervention data were provided (e.g., test scores) was significantly different for the treatment and comparison groups (i.e., more than a 15-percent) and sufficient steps were not taken to address differential attrition in the statistical analysis.

- Did not address the criterion.**

#### **F. Relevant Statistics Reported**

- Met the criterion**—the final report includes treatment and comparison group post-test means, and tests of statistical significance for key outcomes; or provides sufficient information for calculation of statistical significance (e.g., mean, sample size, standard deviation/standard error).
- Did not meet the criterion**—the final report did not include treatment and comparison group post-test means, or tests of statistical significance for key outcomes; or provide sufficient information for calculation of statistical significance (e.g., mean, sample size, standard deviation/standard error).
- Did not address the criterion.**

## Appendix C: Review of Projects with Rigorous Designs

This appendix presents a review of final projects that reported using an experimental or quasi-experimental design. The goal of the review was to determine the extent to which projects successfully conducted rigorous evaluations that had the potential to yield findings that could be considered reliable and valid. To this end, we conducted detailed reviews of projects' evaluations in order to assess the extent to which they met *a priori* criteria specifying key research elements that would be expected to be found in rigorous evaluations of interventions. In this chapter we describe how the review was conducted as well as the criteria used to assess the rigor of projects' evaluations. In addition, we present the results of the review, discuss the rigor of these evaluations, and make recommendations that may help improve future MSP project evaluations.

### *Methodology Used for Review*

The primary source of information used in the review was the final evaluation report for each project. This information was supplemented by information provided in annual performance reports (APRs) of PP08. If projects were missing key pieces of information that prevented a final determination of whether the project met the rubric criteria or not, reviewers requested the specific missing information from project staff. If the staff did not return information that allowed reviewers to complete the review, the project was classified as having not met the rubric criteria.

The review process proceeded in two stages:

1. Defining the set of projects for review, by first identifying the projects that were in their last year of funding and then selecting projects whose evaluations met specific criteria for inclusion; and
2. Assessing and scoring of project evaluations against a rubric to assess data quality and rigor of implementation of the evaluation.

Each of these stages is described below.

### **Defining the Set of Project Evaluations**

The first step in the review was to identify the projects whose evaluations would be considered in the review (Exhibit 30). Out of the 626 projects funded in PP08, only the 204 projects that reported that PP08 was their final year were reviewed (33 percent).

Because the purpose of this review was to learn about the rigorous impact evaluations that projects conducted, we limited our discussion to those projects that used a research design appropriate for testing the impact of an intervention.<sup>28</sup> Thus, we narrowed the set of projects to those that reported implementing an evaluation that used an experimental design, also known as a randomized control trial (RCT) (i.e., where teachers, classrooms, or schools are randomly assigned to a treatment or control group), or a quasi-experimental, matched-comparison (QED) design (i.e., where teachers, classrooms, or schools are assigned to a treatment or control group by some method other than

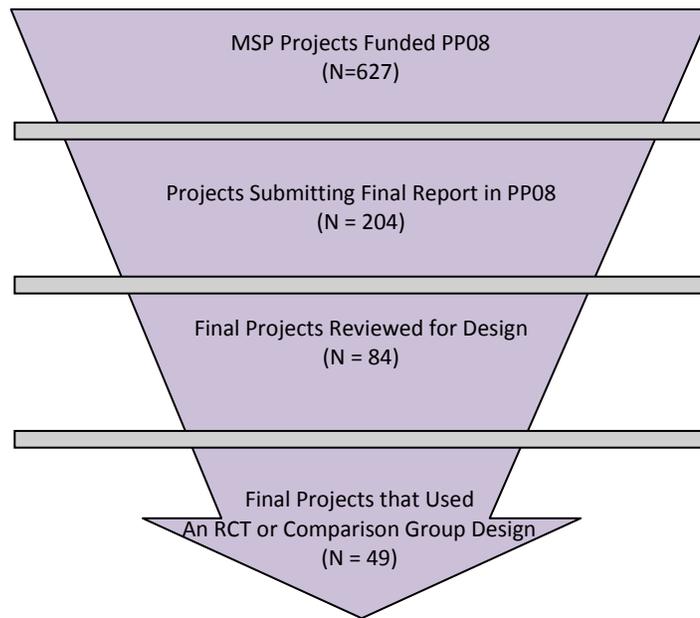
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<sup>28</sup> For more information on selecting a design that will provide rigorous evidence of effectiveness, see U.S. Department of Education (2003).

random assignment). This reduced the set to 84 projects, which became the focus of our initial review.

After examining the details of the evaluation designs for these 84 projects, we further limited the set to the 49 MSP project evaluations that indeed implemented an experimental or quasi-experimental design with a comparison group and provided sufficient data from both groups to review their evaluations. In this step, we excluded some projects because they did not provide sufficient detail about their evaluations,<sup>29</sup> and others because their designs did not include an appropriate comparison group, even though they had been labeled as using an experimental or quasi-experimental design. For example, some projects evaluated pre- and post-test scores for only a treatment group, or compared treatment group scores to established benchmarks. The remainder of our discussion focuses on what we learned from reviewing the evaluations of these 49 projects.

**Exhibit 30**  
**Sample of MSP Projects Reviewed for Rigor of Evaluations**



*Sources: Final evaluation reports, annual performance reports, and related documents submitted by MSP projects.*

Most of the MSP projects included multiple evaluations of diverse outcomes. In our review, we considered only those aspects of research conducted to study potential impacts of programs on teacher content knowledge, teacher practices, or student achievement. If a project conducted research on more than one of these three domains it was considered to have conducted multiple “evaluations.” Reviewers assessed each of these evaluations within a project independently so that only those design elements relevant to the specific evaluation being assessed were considered. Across the final set of 49 projects, 85 unique evaluations were identified. The majority of the evaluations looked at student

<sup>29</sup> Projects that were missing individual data elements were contacted for additional information, but projects that were not able to provide data for the comparison group, or that provided insufficient information to determine the overall design, could not be included in our review.

achievement (56 percent), followed by teacher content knowledge (31 percent), and classroom practices (13 percent). Our assessment of the rigor of these 85 evaluations follows.

### Assessing MSP Evaluations for Rigor

We reviewed the information available about each of the 85 evaluations to determine the extent to which projects followed the recommendations for evaluation design and implementation specified in the *Criteria for Classifying Designs of MSP Evaluations* (hereafter referred to as the rubric), developed by Westat as part of the Data Quality Initiative (DQI) at the Institute for Education Sciences (IES) within the U.S. Department of Education (see Appendix B). The six criteria specified in the rubric for assessing the MSP evaluations were:

- Baseline equivalence of groups;
- Adequate sample size;
- Use of valid and reliable (or sufficiently tested) measurement instruments;
- Use of consistent methods, procedures, and time frames to collect key outcome data from the treatment and comparison groups;
- Sufficient response and retention rates; and
- Reports of relevant statistics and their statistical significance.

To pass the rubric, evaluations must satisfy the requirements of each criterion. Of the 85 evaluations reviewed, 4 evaluations conducted by three projects successfully met all of the rubric’s criteria. Three of the evaluations examined interventions’ impacts on student achievement, and one studied impacts on teacher content knowledge

Since the rubric was developed and approved *after* the PP08 projects had already designed their evaluations, it is not surprising that a large number of evaluations could not meet all of the criteria. The insights generated from identifying common issues preventing projects from meeting various criteria are valuable. These insights resulted in recommendations to strengthen the rigor of the evaluation designs of future projects. Exhibit 31 presents the number of evaluations that passed each criterion. In the review that follows, we discuss the MSP evaluations’ performance on each of the rubric’s six criteria and present recommendations for future project evaluations.

<b>Exhibit 31 Number and Percent of Evaluations that Met Each Criterion for Rigorous Research Design, Performance Period 2008</b>	
<b>Rubric Criterion</b>	<b>Number (Percent) of Evaluations (N=85)</b>
Baseline equivalence of groups	27 (32%)
Sample size	26 (31)
Quality of the measurement instruments	60 (71)
Quality of the data collection methods	68 (80)
Data reduction rates	26 (31)
Relevant statistics reported	46 (54)

*Sources: Final evaluation reports, annual performance reports, and related documents submitted by MSP projects.*

## ***Baseline Equivalence***

**Description.** No significant pre-intervention differences exist between treatment and comparison group participants on variables related to key outcomes, or groups have similar background characteristics. Establishing baseline equivalence analytically is a requirement for quasi-experimental evaluations only; baseline equivalence can be assumed in evaluations in which random assignment was carried out successfully.

**Justification.** Findings from quasi-experimental studies in which baseline equivalence of groups has been demonstrated (or differences have been controlled for in analyses) are considered to be more rigorous. Baseline equivalence suggests that the groups compared were drawn from the same population and that it is less likely that differences between the groups being attributable to the interventions studied have potential alternative explanations or confounding factors and biases.

**Screening requirements.** Evaluations pass the baseline equivalence criterion when their evaluation design meets at least one of the following three conditions:

- 1.1 – Uses an experimental design (i.e., random assignment) that should yield probabilistically equivalent groups and therefore is not required to demonstrate baseline equivalence.
- 1.2 – Uses a quasi-experimental design and test for and finds no statistically significant pre-intervention differences between groups on variables related to key outcomes.
- 1.3 – Uses a quasi-experimental design and controls for baseline differences in the analysis.

**Results.** Overall, 27 of the 85 evaluations (32 percent) passed the baseline equivalence criterion. Projects that did not meet this criterion failed to examine whether the intervention and comparison groups were similar to one another on pretests or key predictors; they found baseline differences in the groups that were not taken into account in analyses; or information critical for complete assessment of baseline equivalence was missing. Evaluations that met the criterion randomly assigned participants to groups, demonstrated that there were no significant pre-intervention differences between treatment and comparison group participants on variables related to key outcomes, or accounted for differences found in analyses.

### **Recommendations.**

1. Report key characteristics that are associated with outcomes for each group, such as pretest scores and teaching experience. Always include sample sizes when reporting statistics.
2. Test for group mean differences on key characteristics with the appropriate statistical test (e.g., chi-square for dichotomous characteristics, t-test for continuous characteristics). Report the test statistics, such as t-statistic and p-values.
3. Establish baseline equivalence using the exact sample included in the analyses of impacts. Thus, when reporting baseline equivalence, it would be helpful to only include in the tables and inference tests those participants who are also included in the impact analyses.

## *Sample Size*

**Description.** Sample size is adequate based on a power analysis, or on meeting predetermined thresholds for the number of students, teachers, or schools needed to have adequate power.

**Justification.** Sufficient sample size is needed to build confidence in the results. When calculating adequate sample sizes, the standard practice is to use a significance level of .05 and power (i.e., the probability of detecting an actual difference if it exists) of .80 to estimate an appropriate sample size.

**Screening requirements.** An evaluation passes if we could confirm that the evaluation's sample size for the evaluation was adequate, that is, when there was sufficient sample size at the level of assignment or analysis.

**Results.** Fewer than one-third of the 85 evaluations (26 evaluations, 31 percent) had adequate sample sizes to detect differences in the outcomes measured. Due to the relatively small size of individual MSP projects, it is often difficult to meet this criterion unless evaluations are performed evaluating the effects of multiple similar MSP projects. The evaluations that failed to meet this criterion had sample sizes that were smaller than that recommended, or information critical for complete assessment of sample size and power was missing.

### **Recommendations.**

1. Conduct a power analysis at the design stage of an evaluation to ensure that the study will have a large enough sample to be able to detect an effect size that is appropriate to the topic being studied; and report the calculations of the power analysis as well as the previous research and assumptions about effect sizes it is based on.
2. If a power analysis is not conducted, ensure that the minimum thresholds below are met.
  - *Teacher outcomes:* 12 schools (for school- or district-level interventions) or 60 teachers (for teacher- or classroom-level interventions)
  - *Student outcomes:* 12 schools (for school- or district-level interventions) or 18 teachers (for teacher- or classroom-level interventions) or 130 students (for student-level interventions)
3. Always report the sizes of all groups included in analysis (both main groups and subgroups) clearly and completely.

## Quality of Measurement Instruments

**Description.** Quality of measures is demonstrated through use of existing data collection instruments that have already been deemed valid and reliable to measure key outcomes; data collection instruments developed specifically for the study that are sufficiently pretested; or data collection instruments composed of items from a validated and reliable instrument(s).

**Justification.** Evaluations need to use instruments that accurately capture the intended outcomes for a group similar to the one being included in the study.

**Screening requirements.** All instruments used to measure outcomes must have face validity, that is, they must appear to measure what they purport to assess. In addition, the instrument used should be deemed valid and reliable.

**Results.** Sixty of the 85 evaluations (71 percent) were measured with an appropriate instrument. The projects that met the criterion used at least one student achievement, teacher content knowledge, or classroom practice outcome measure that was widely used or had been previously been demonstrated to be reliable and valid (either by the researchers themselves or by others). Among the 60 evaluations that passed, 54 (63 percent) were measured using an existing instrument in its entirety (see Exhibit 32). Thirteen (16 percent) created a new assessment using items from existing instruments that have been validated and deemed reliable; 4 evaluations (5 percent) used a full scale from an existing instrument, that is, the full subset of items (e.g., all geometry questions from a mathematics test); and 9 evaluations (15 percent) used selected items from existing instruments. Completely new instruments were developed and validated for 13 evaluations (15 percent) that passed this criterion. Finally, for 5 evaluations (6 percent), the types of measures used were not clearly described.

<b>Exhibit 32</b>	
<b>Percent of Evaluations that Pass Quality of Measurement Instrument Criterion, by Instrument Creation Method</b>	
<b>Instrument Creation Method</b>	<b>Number (Percent) of Passing Evaluations (N=85)</b>
Used full existing instrument	54 (63%)
Used full scale from existing instrument(s)	4 (5)
Used items selected from existing instrument(s)	9 (11)
Created all items	13 (15)
Not clear	5 (6)

*Sources: Final evaluation reports, annual performance reports, and related documents*

### Recommendations.

1. Use instruments that have been shown to have accurate and consistent scores (i.e., have demonstrated reliability and validity). Where possible, use instruments that have demonstrated reliability and validity for a population similar to the population being studied.
2. If you are creating an assessment for the project, assess and report validity and reliability of scores in a pilot study using a population similar to the respondents in the evaluation. For

example, if the focus of the project is upper elementary school teachers, it might also have 5<sup>th</sup> grade teachers in a school not participating in its program complete a pilot version of the assessment. The pilot results could then be used for assessing the reliability and validity of the instrument.

3. When selecting items from an existing measurement instrument:
  - a. Describe previous work that demonstrates that the scores are valid and reliable with a population similar to the current study;
  - b. Provide references to the manual or other studies discussing the validity and reliability of scores; and
  - c. Use full subscales rather than choosing items from across subscales where possible.

## *Quality of Data Collection Methods*

**Description.** The methods, procedures, and time frames used to collect the key outcome data from treatment and comparison groups are the same or similar enough to limit the possibility of observed differences being attributed to another factor.

**Justification.** Using consistent methods and procedures and collecting data within a similar time frame helps to ensure that observed differences are not attributable to the passage of time or to differences in testing conditions.

**Screening requirements.** Evaluations pass the data collection methods criterion if evaluators used the same methods, procedures, and time frame to collect data from the treatment and comparison groups. Since most projects did not specify the data collection procedures used for both groups, if there was no reason to believe there were differences, evaluations were given the benefit of the doubt on this criterion.

**Results.** Sixty-eight of the 85 evaluations (80 percent) did not pass the data collection methods criterion. Either these projects reported that the data procedures and timeframes for the intervention and comparison groups were the same, or this was assumed in absence of contrary reports. Projects that did not pass this criterion reported issues with data collection or differing timeframes for data collection that resulted in the intervention and comparison groups receiving different assessments or having their data collected at different points in time. When this occurs, it becomes difficult for the researchers to attribute differences found between the groups to the intervention rather than the differences in data collection.

### **Recommendations.**

1. Collect data from both the treatment and comparison groups for every evaluation. If data cannot be collected from all members of both groups for resource reasons, consider randomly selecting a subset of respondents from both the treatment and control group. For example, if the project can support classroom observations of 20 teachers, select 10 from the treatment group and 10 from the comparison group.
2. Fully describe and document the data collection procedures.

## *Data Reduction Rates*

**Description.** Key post-test outcomes are measured for at least 70 percent of the original sample (treatment and comparison groups combined). In addition, where there is differential attrition of more than 15 percentage points between groups, this difference is accounted for in the statistical analysis.

**Justification.** Significant sample attrition can bias results, since the participants who drop out of the study may differ from those who remain. It is also important to consider the differential attrition between the treatment and control groups, which can create systematic differences between the groups.

**Screening requirements.** To pass, the evaluation must meet one of the three conditions described below:

- 5.1. Post-test data for 70 percent of original sample AND less than 15 percent difference in retained sample between treatment and control groups.
- 5.2. Sufficient steps have been taken in the statistical analysis to address the difference.
- 5.3. There is evidence that attrition is unrelated to the intervention.

When attrition rates were not provided in the evaluation, where we could we calculated attrition rates by subtracting the post-test N from the pretest N and dividing by the pretest N.

**Results.** Twenty-six of the 85 evaluations (31 percent) passed the data reduction rates criterion. Projects that passed this criterion reported having low attrition (defined for this report as the retention of at least 70 percent of the original sample), and the attrition differential between the two groups was also low (below 15 percentage points between groups); or they had high attrition or a high differential attrition that was not related to the intervention and was taken into account in the analyses.

### **Recommendations.**

1. Identify the unit of assignment (unit at which groups were created) and unit of analysis (unit at which outcomes are measured and analyzed).
2. Report the number of units of assignment and units of analysis at the beginning and end of the study.
3. If reporting on subgroups, report sample sizes for all subgroups.
4. Implement a plan for keeping sample participants involved with the study.

## ***Relevant Statics Reported***

**Description.** Final report includes treatment and comparison group post-test means and tests of statistical significance for key outcomes *or* provides sufficient information for calculation of statistical significance (e.g., mean, sample size, standard deviation/ standard error).

**Justification.** Reporting relevant statistics provides critical context for interpreting the reported outcomes and indicates where an observed difference is larger than what would likely be created by chance.

**Screening requirements.** An evaluation passes if either of the following conditions is met:

- 6.1. Post-test means and test of significance for key outcomes are included in the evaluation.
- 6.2. Evaluation provides sufficient information to calculate statistical significance (e.g., reports of mean, sample size, standard deviations/standard error).

**Results.** 46 of the 85 evaluations (54 percent) passed the relevant statistics reported criterion. These evaluations included in their reports post-test treatment and comparison group means and tests of statistical significance for key outcomes; or they provided information that could be used to derive them.

### **Recommendations.**

1. For each evaluation, report mean, standard deviation (or error), and sample size. If reporting a regression model or ANOVA analysis, report the model as usual as well as the mean and standard deviation (or error).
2. Report appropriate test for differences between groups (e.g., t-statistic and p-value if continuous outcome).

## Summary

Given the limited resources available for evaluations, it is not surprising that only a small percent of total projects met the standards of rigor required for this review. However, many projects are learning about the necessary conditions for conducting a rigorous evaluation, and projects are attempting to conduct the most rigorous designs feasible. Forty-nine projects conducted 85 evaluations of the impacts of their interventions on teacher content knowledge, classrooms practices, or student achievement using an experimental or quasi-experimental design. Four evaluations conducted by three projects successfully met all of the rubric's criteria. Looking across the criteria, evaluations were most likely to meet the criteria for *quality of the data collection methods* (80 percent of the evaluations), followed by *quality of the measurement instruments* (71 percent of the evaluations), *relevant statistics reported* (54 percent of the evaluations). The remaining 3 sets of criteria (e.g., *baseline equivalence of groups*, *baseline equivalence of groups*, and *data reduction rates*) were met by 31 to 32 percent of the evaluations.

A common issue across evaluations was that projects reported too little information for reviewers to be able to determine whether they had met the rubric criteria or not. The number of projects missing key pieces of information varied across criteria as follows:

- Baseline equivalence: 6 evaluations (7 percent)
- Sample size: 17 evaluations (20 percent)
- Quality of measures: 15 evaluations (18 percent)
- Data reduction rates: 49 evaluations (58 percent)

With one exception (data collection quality), if projects reported too little specific information describing a specific design element in their evaluation report, reviewers concluded that the criterion for that design element had not been met due to insufficient information.<sup>30</sup> This was particularly an issue with attrition rates; more than half of the evaluations reviewed were missing key pieces of information that would allow reviewers to fully understand how much attrition there was in the groups of participants being studied. In the future, projects can remedy this issue by reporting in detail all of the elements of the evaluation design and implementation specified in the criteria. It is possible that more projects would meet the rubric criteria in the future if they more fully reported on their evaluations.

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<sup>30</sup> In absence of reports of problems with data collection procedures or timelines, reviewers assumed that they were the same for the treatment and comparison groups.

## Appendix D: 2008 State MSP Appropriations

MSP appropriations to states ranged from \$890,414 up to \$21,906,182, with an average of \$3,356,175 and a median of \$2,039,376.

<b>Exhibit C.1 MSP Appropriations to the States</b>			
<b>State</b>	<b>Total Funding Amount</b>	<b>State</b>	<b>Total Funding Amount</b>
AK	\$890,414	MT	\$890,414
AL	\$3,149,164	NC	\$5,265,048
AR	\$1,980,113	ND	\$890,414
AZ	\$3,752,270	NE	\$890,414
CA	\$21,906,182	NH	\$890,414
CO	\$1,861,934	NJ	\$3,018,806
CT	\$1,135,602	NM	\$1,511,150
DC	\$890,414	NV	\$1,073,276
DE	\$890,414	NY	\$10,867,365
FL	\$8,676,445	OH	\$5,902,883
GA	\$5,563,620	OK	\$2,209,464
HI	\$890,414	OR	\$1,818,976
IA	\$1,050,636	PA	\$5,586,114
ID	\$890,414	PR	\$7,398,451
IL	\$6,250,212	RI	\$890,414
IN	\$3,039,746	SC	\$2,757,962
KS	\$1,101,001	SD	\$890,414
KY	\$2,677,458	TN	\$3,552,527
LA	\$4,033,542	TX	\$17,989,209
MA	\$2,362,518	UT	\$942,150
MD	\$1,799,682	VA	\$2,805,969
ME	\$890,414	VT	\$890,414
MI	\$5,644,380	WA	\$2,658,511
MN	\$1,603,816	WI	\$2,098,638
MO	\$3,116,959	WV	\$1,174,794
MS	\$2,718,752	WY	\$890,414