Mathematics and Science Partnerships: Summary of the Fiscal Year 2005 Annual Reports

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Executive Summary

For more than half a century, Congress has funded legislative initiatives to foster and enhance education in mathematics, science, and technology and preserve the country's leadership in these areas. In recent years, attention to mathematics and science education has increased as national and international academic achievement tests have revealed shortcomings in student performance in comparison to students in other nations.

Research has shown that there is an important relationship between teachers' subject matter knowledge and student achievement; however, a substantial share of math and science teachers in the United States lack specialized training in these areas. The Mathematics and Science Partnerships Program (MSP) was designed to address this gap. Created under the No Child Left Behind Act of 2001, MSP funds professional development activities for mathematics and science teachers in high-need school districts with the goal of improving teachers' content knowledge and teaching skills and increasing student achievement.

Administered by the U.S. Department of Education, 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 schools or school districts and science, technology, engineering, and mathematics faculty from institutes of higher education. The purpose of the partnerships is to:

- Improve and upgrade the status and stature of mathematics and science teaching by encouraging institutes of higher education to improve mathematics and science teacher education;
- Focus on the education of mathematics and science teachers as a career-long process;
- Bring mathematics and science teachers together with scientists, mathematicians, and engineers to improve their teaching skills; and
- Develop more rigorous mathematics and science curricula that are aligned with state and local academic achievement standards expected for postsecondary study in engineering, mathematics, and science.

Federal support for MSP has increased substantially since the program's inception in fiscal year (FY) 2002: from $12.5 million to $100 million in FY 2003, when MSP became a state-administered formula grant program. In FY 2005, states awarded $180 million in MSP funds to 436 local MSP partnerships (projects). Together, these partnerships provided professional development services to more than 37,000 teachers nationwide.

This report describes the activities and outcomes of MSP projects in FY 2005. It is based on annual performance reports and project narratives for FY 2005 submitted by 375 local MSP projects as of July 2007.[1]

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1 Annual reports from the FY 2005 projects were submitted on a rolling basis, reflecting variation in project start dates. Of the 436 MSP projects funded in FY 2005, 375 (86 percent) had submitted annual reports as of July 2007 and could therefore be included in this report.

The report focuses on three questions:

- What are the characteristics of MSP projects and participants?
- What professional development models and activities are being funded?
- What have been the outcomes of the program?

The performance reports and project narratives analyzed for this report provide an important baseline description of MSP program participants and services. All of the projects that submitted annual reports in FY 2005 reported on either their first or their second year of program activities, so most were engaged in project start-up and early implementation activities. As a result, most program outcomes reported at this time focus on program activities, such as the number of teachers served rather than program impacts on teacher content knowledge and student achievement. Future years' reports will provide a much richer set of data for analyzing the impact of the MSP program on teachers and students.

Characteristics of MSP Projects and Participants

In FY 2005, federal MSP resources totaling $180 million were distributed to the 50 states, District of Columbia, and Puerto Rico through formula grants. The states funded a total of 436 local MSP projects, with grants ranging from $10,000 to $3.5 million and more than half the projects receiving between $100,000 and $500,000. Local projects also received a modest amount of supplemental funding from other federal sources and from local educational agencies.

More than 37,000 elementary and high school teachers participated in MSP projects in FY 2005. The number of teachers served by individual MSP projects ranged widely, but the median number of teachers served per MSP project was 41 (half of the projects served 41 or fewer teachers and half served more than 41).[2]

Recognizing that MSP grants can only address part of a school district's professional development needs, many states prioritized MSP funding for projects that targeted a particular grade or grade span or a particular subject area (i.e., either mathematics or science). A large share of FY 2005 projects targeted the middle school grades (6 through 8), with somewhat fewer projects working in the elementary and high school grade ranges. Across all grade spans, a higher percentage of projects reported serving mathematics teachers than science teachers. In addition to mathematics and science teachers, MSP projects also provided professional development activities to special education teachers and school administrators in all grade levels.

Although some of the teachers served by MSP projects had already been designated "highly qualified" by their states in response to the No Child Left Behind legislation,[3] a majority of MSP projects (59 percent) reported serving teachers who had not achieved this designation. These projects contributed to state goals of increasing the number of highly qualified teachers as well as raising the qualifications of math and science teachers beyond the state designations.

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[2] Some projects served a very large number of teachers and these showed the average (mean) upward to 86.

[3] No Child Left Behind requires states to bring all teachers to the "highly qualified" standard.

MSP projects were encouraged to assess the professional development needs of individual schools and teachers and use this information as the basis for determining which schools and teachers should participate in the MSP program. Consistent with this guidance, a majority of projects cited need as a basis for selecting teachers and schools, although willingness to volunteer for the program was also an important factor in the selection process.

Professional Development Models and Activities

MSP projects reporting in FY 2005 followed one of two main models for providing professional development to teachers. Most projects (86 percent) followed a direct training approach, in which all teachers participating in the project received training and professional development services directly, usually through intensive, two-week summer institutes and follow-up activities during the school year. The remainder of projects trained a cadre of teachers to be "teacher leaders," with the expectation that these teachers would share their increased knowledge with a larger group of teachers in their schools or districts. Although only 51 projects focused primarily on creating teacher leaders, other projects used teachers as mentors and coaches in their professional development activities.

In both models, professional development training was typically led by the science, technology, engineering, and mathematics (STEM) faculty from institutes of higher education. STEM faculty developed coursework and other activities to increase teachers' content knowledge in a given mathematics or science subject area. They also supported teachers in applying the content learned in a summer institute to their teaching or work with other teachers. During the school year, STEM faculty provided supplemental professional development activities to reinforce what was taught in the summer. For example, STEM faculty often provided additional training sessions to teachers at their schools or on the university campus. They also observed teachers in their classrooms and supported them in translating their newly-gained content knowledge into student learning and achievement.

Overall, most MSP projects provided a substantial amount of professional development training. On average, projects reported providing 129 hours of professional development per teacher, a sizeable increase over many past short-term professional development efforts in math and science education (Weiss et al., 2001). Most MSP projects (88 percent) combined intensive summer institutes with follow-up activities during the school year, including study groups, workshops, seminars, college courses developed specifically for MSP participants, and distance learning courses. A small number of MSP projects used a different approach for providing professional development services – either summer institutes only or some combination of study groups, workshops, seminars, college courses, and distance learning.

The MSP projects funded in FY 2005 were somewhat more likely to focus on mathematics than science. Of the 375 projects analyzed for this report, 161 (43 percent) focused on mathematics, 100 (27 percent) focused on science, and 114 (30 percent) focused on both mathematics and science. The most common mathematics topics were number operations, algebra, geometry (including measurement), and data analysis. Much of the work in the number operations and algebra strands focused on topics that students typically find difficult, such as operations with rational numbers (fractions, decimals, and percents), ratios, and proportions. In science, MSP projects typically addressed the traditional topics of physical, life, and earth and space science. Within these broad topics, some projects specified a particular area or combination of areas of study. For example, in physical science, some projects studied chemistry or physics. In earth and space science, some projects examined astronomy, environmental science, or geology.

In addition to the core mathematics and science subject matter, MSP projects often examined the relationship of technology to the topic area and/or reviewed district or state standards in that area. Projects also explored the integration of mathematics and science topics, pedagogy, student learning, and assessment. Although some projects provided training at a more advanced level than teachers could use in the classroom, most explicitly linked the content of their professional development activities to teachers' classroom needs.

Program Outcomes

In FY 2005, MSP projects reported on program outcomes for either their first or second year of operations. As a result, data on program impacts on teachers and students are somewhat limited. However, among those projects that implemented an evaluation design that allows measurement of the project's impact on teachers:

- More than three quarters of K-5 teachers assessed (76 percent) significantly increased their content knowledge as a result of the MSP program.

A subset of MSP projects reported on the percentage of students scoring at the proficient level or above in state assessments of mathematics or science:

- 158 MSP projects reported on the percentage of students scoring at the proficient level or above in state assessments of mathematics. Among these projects, mathematics proficiency was highest at the elementary level (60 percent), followed by the middle and high school levels (51 and 48 percent, respectively). *All grade ranges showed gains in mathematics proficiency from the previous assessments.* The percent of students scoring proficient increased by an average of 7 percentage points at the elementary level, 4 percentage points at the middle school level, and 3 percentage points at the high school level.

- 78 MSP projects reported on the percentage of students scoring at the proficient level or above in state assessments of science. Across all the projects, an average of 55 percent of students scored proficient or higher, with little variation across grade levels. *All grade ranges reported gains in science proficiency from the previous assessments.* The percent of students scoring proficient increased by an average of 11 percentage points at the elementary level, 5 percentage points at the middle school level, and 3 percentage points at the high school level.

In addition to increases in teacher content knowledge and student achievement, MSP projects in FY 2005 reported school-level changes prompted by the program and designed to build schools' capacity to support standards-based teaching and learning. For example, projects reported developing standards-based curricular units and incorporating standards into existing curricula. Projects also cited principals and district administrators becoming instructional leaders as an important school-level outcome of MSP.

Many projects described how MSP increased collaboration among staff within a school, among participating schools, and between school districts and institutions of higher education. Projects also reported that MSP provided an opportunity for schools to receive mentoring services from experts in the field, as was the program's intent.

Lessons Learned and Next Steps

FY 2005 was the year in which many MSP projects moved from the planning stage to operations. Local projects developed professional development models, recruited teacher participants, and provided training through summer institutes and follow-up activities. STEM faculty from institutes of higher education worked with schools and districts to increase teachers' understanding of critical topics in mathematics and science and to help teachers translate that knowledge into more effective classroom instruction.

Without exception, MSP projects reported substantial progress in meeting their goals. However, projects also found establishing effective working partnerships to be an ongoing challenge, requiring considerable attention and support from all partners. In FY 2005, projects were continuing to learn about each partner's expertise and how best to combine their respective skills effectively. They were also learning valuable lessons about how to organize partnerships between schools and institutes of higher education and how to engage teachers in professional development activities. Subsequent years' reports will be better able to document whether and how these lessons learned have translated into improved teacher knowledge and higher student achievement.

Introduction

For more than half a century, Congress has funded legislative initiatives designed to foster and enhance education in mathematics, science, and technology and preserve the country's leadership in these areas. In recent years, attention to mathematics and science education has increased as national and international academic achievement tests have revealed shortcomings in student performance in comparison to students in other nations (U.S. Department of Education, 2002a). Research has shown that there is an important relationship between teachers' subject matter knowledge and student achievement (Cochran-Smith and Zeichner, 2005; Darling-Hammond and Bransford, 2005; Goldhaber and Brewer, 1998; Goldhaber and Brewer, 2000; Grossman, 2005; Ma, 1999; Monk, 1994; Wenglinsky, 2002; Wilson, Floden and Ferrini-Mundy, 2001). In particular, studies have emphasized the importance of teachers' college major and years of teaching experience. For example, analysis of the 2000 National Assessment of Educational Progress (NAEP) data showed that 8th grade teachers who had majored in math or math education produced higher math scores among their students than did those majoring in other subjects. Furthermore, students of teachers with 11 or more years of experience scored higher than students of teachers with two years or less experience.

In spite of the importance of teacher content knowledge to high student achievement, recent studies have found that a substantial share of math and science teachers in the United States lack college-level training in these areas. For example, a 2002 Department of Education study found that in the 1999-2000 school year, about 50 percent of middle school math teachers lacked a major or minor in math and 40 percent of middle school science teachers lacked a major or minor in science (U.S. Department of Education, 2002b). A 2006 study showed that three quarters of 4th grade math and science teachers lacked specialization in those subjects and that low-income communities had even lower percentages of qualified teachers (U.S. Department of Education, 2006).

It was in response to these and other concerns that Congress created the Mathematics and Science Partnerships program (MSP) as part of the No Child Left Behind Act of 2001. The legislation explicitly recognized the important contributions of both the U.S. Department of Education (the Department) and the National Science Foundation (NSF) to the MSP program.[4] The Department of Education makes grants to states to support professional development programs in mathematics and science for elementary and secondary teachers with a goal of increasing student achievement in these subject areas.

As described in Exhibit 1, the core of the MSP program is its support of collaborative partnerships for teacher professional development between K-12 schools in high-need school districts and science, technology, engineering, and mathematics (STEM) faculty from institutions of higher education (IHEs). The purpose of the partnerships is to increase teacher content knowledge with the ultimate goal of improving student achievement in mathematics and/or science. STEM faculty play a variety of roles in the partnerships, including overall project management in some cases, but tend to provide leadership in developing and delivering training to teachers to increase their content knowledge.

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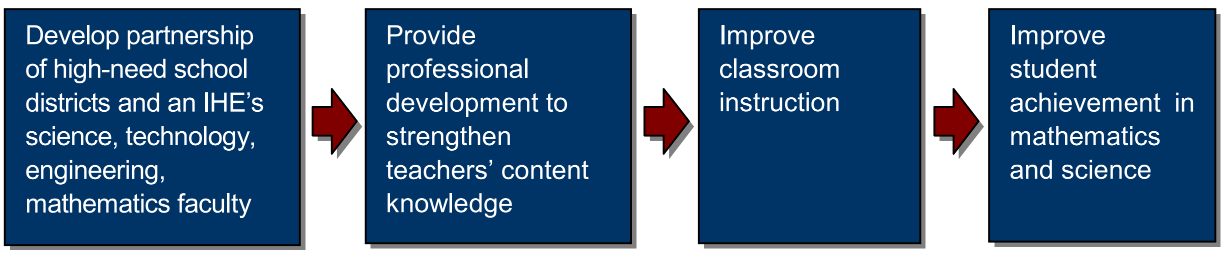
[4] The U.S. Department of Education was charged with supporting collaborative partnerships through teacher professional development programs, with particular attention to increasing teacher content knowledge and student achievement, especially in low-achieving schools and districts. The NSF was charged with supporting basic research and curricula development for mathematics and science as well as improving teacher professional training.

MSP partnerships typically focus their professional development activities around a summer institute that provides multiple, intensive learning experiences over a two-week period. These learning experiences include lectures, problem solving, and research activities that make use of the STEM faculty's sophisticated laboratory equipment and other university resources. Teachers then apply the content they have learned to their teaching during the school year and receive follow-up training, such as additional content development sessions with STEM faculty and classroom observations. Although improving teacher content knowledge directly via a summer institute with in-school follow-up is the predominant model of professional development, some projects used alternative formats such as mentoring, coaching, lesson study groups, and distance learning.

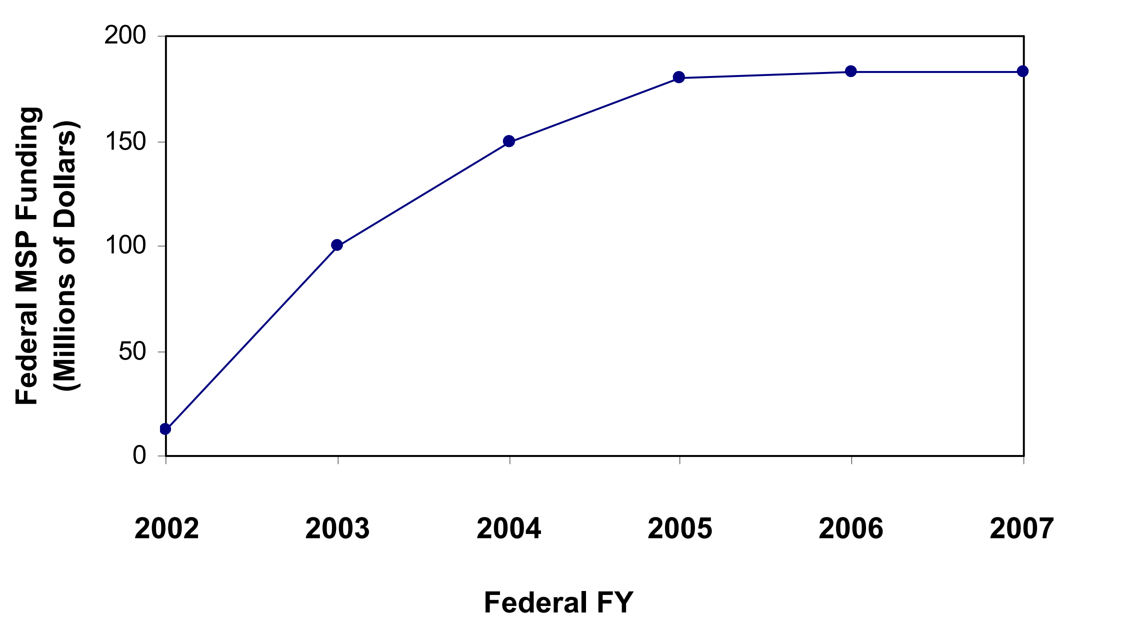
Exhibit 1. Conceptual Model of Mathematics and Science Partnerships Program



Overview of MSP Funding and Grant Cycle

Federal support for MSP has increased substantially since 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 (Exhibit 2). In FY 2005, states awarded funds to 436 local partnerships (projects) that collectively provided professional development services to an estimated total of more than 37,000 teachers nationwide.

Exhibit 2. MSP Program Funding

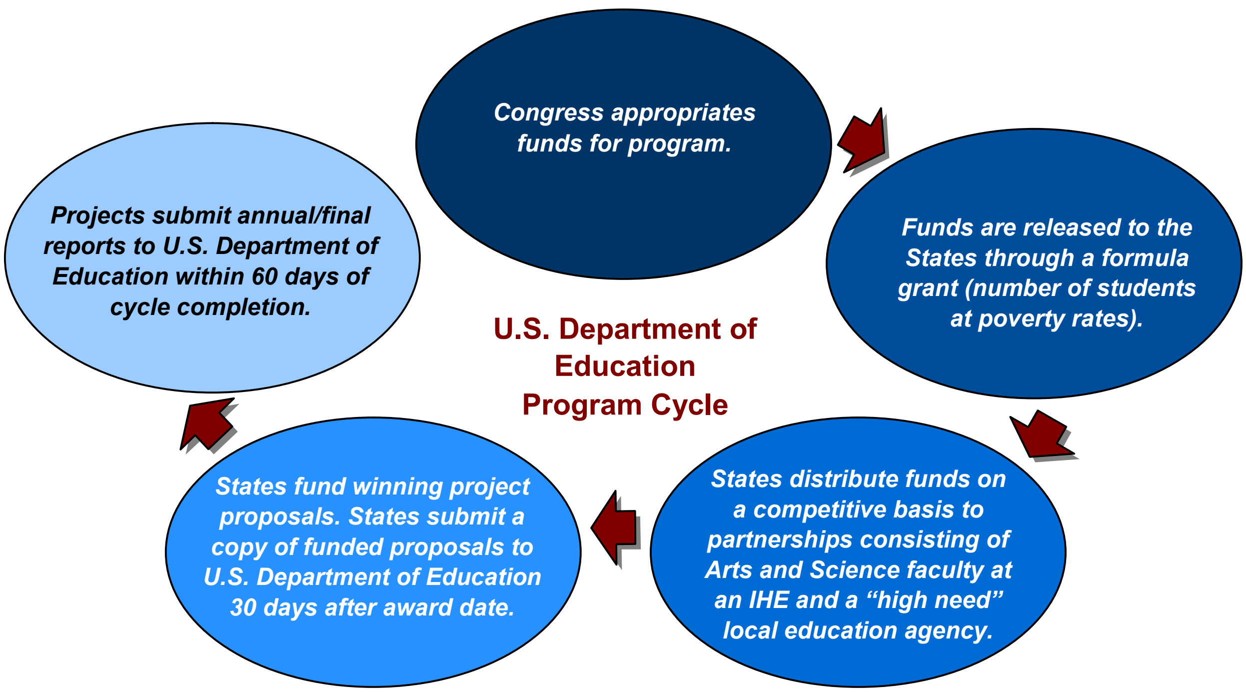


The administration of the MSP program involves an annual cycle of activities conducted at federal, state, and local agency and organization levels (Exhibit 3). The Department of Education is charged with distributing MSP program funds to state education agencies as formula grants based upon the number of children in the state between the ages of 5 and 17 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.[5] In turn, the states are required to (1) define "high need" schools and teachers; (2) run a discretionary grant competition to identify MSP projects proposed for high-need schools; and (3) distribute funds to projects with rigorous evaluation and accountability plans to measure the *impact* of MSP partnerships on teacher knowledge and student learning.

State MSP grants are up to three years in duration. However, the law requires all funded MSP *projects* to submit an annual performance report to the U.S. Department of Education demonstrating progress towards achieving project goals. The law requires annual reporting on two components: 1) improvement in teacher content knowledge and 2) improvement in student achievement.

Exhibit 3. MSP Grant and Funding Cycle



Methodology and Contents of the Report

This report, the Summary of the FY 2005 MSP Annual Reports, draws upon the annual performance reports submitted by MSP projects to analyze the activities and outcomes of MSP projects as they

[5] The American Virgin Islands, Guam, Mariana Islands, and Samoa have pooled their MSP funds as part of their consolidated budget.

completed program implementation for FY 2005.[6] The annual reports include responses to a survey instrument, a narrative report, and additional documentation of MSP activities. They describe project-level program goals, participants, professional development activities, and evaluation findings.

This Summary report describes the 375 projects that had submitted annual reports for FY 2005 as of July 2007.[7] All of these projects reported on their first or second year activities, depending on their initial year of funding. As a result, the annual reports summarized here describe the beginning and continuing phases of these projects, not the projects' full implementation. Analysis of future annual reports will provide more comprehensive information about the impact of the MSP program on teachers and students.

This Summary report uses several data sources and analytic approaches, which are described in detail in Appendix C. First, quantitative data reported in the Project Profile reports were analyzed for all 375 projects to provide descriptive statistics on the MSP program. These descriptive statistics are presented in exhibits throughout the report. The number of projects reported in each exhibit (i.e., the "n") varies from exhibit to exhibit because of missing data and because some reporting categories are not relevant to all projects. Appendix C provides details on how each exhibit was constructed, including the number of projects reporting data for that field.

The qualitative data in the narrative reports of the 375 projects were analyzed for information on the nature of the partnerships, the roles of the partners, the professional development methods used, and program outcomes. In analyzing program outcomes, we paid particular attention to the projects' evaluations, as projects with strong research designs were most likely to provide good evidence of teacher and student outcomes. (Appendix B provides further discussion of projects that used an experimental research design to evaluate outcomes.) Finally, we reviewed the state MSP evaluation reports from seven states to gain insights into MSP implementation from the state perspective.

Throughout the report, we cite examples from 13 local MSP projects across the country. These projects were selected because they illustrate different partnership and program approaches. In the report, the projects are identified by state only; the full names of the projects are provided in Appendix A.

The remainder of the report is organized around three main research questions:

- What are the characteristics of MSP projects and participants?
- What models of professional development are used by MSP projects?
- What have project-level and state MSP evaluations revealed about the impact of the program on teacher qualifications and student achievement?

After examining each of these questions in detail, the report concludes with a summary of MSP program achievements and a discussion of lessons learned and recommendations for improving the program in the future.

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6 This report describes data for FY 2005. However, given the 27-month period in which states may disburse funds, projects may be awarded funds from a combination of two fiscal years. Hence, some project funding described in this report may be from the FY 2004 national disbursement to states.

7 Annual reports from the FY 2005 projects were submitted on a rolling basis in 2006 and 2007, reflecting variation in project start dates. Of the 436 MSP projects funded in FY 2005, 375 (86 percent) had submitted annual reports as of July 2007, the cut-off for inclusion in this report.

Characteristics of MSP Projects and Participants

What did the FY 2005 MSP Projects look like? What kind of partnerships did MSP projects put in place, and what were the roles of each of the partners? How did projects select participants for their projects? What kinds of teachers were involved in MSP projects, and how many teachers participated?

This chapter presents both quantitative and qualitative information on the 375 MSP projects that submitted annual reports for FY 2005 to help describe key program characteristics. The information is organized into four categories: sources and amounts of funding, partnerships, methods of participant selection, and characteristics of MSP teachers.

Sources and Amounts of Funding

In FY 2005, federal MSP resources totaling $180 million were distributed to all 50 states, the District of Columbia, and Puerto Rico through formula grants.[8] The funding levels of individual MSP projects for FY 2005 (August 2005 – July 2006) ranged from $10,000 to $3.5 million, with 81 percent of projects receiving $500,000 or less (Exhibit 4). The distribution of funding did not change substantially between FY 2004 and FY 2005.

Exhibit 4. MSP Project Budgets from State MSP Grants

Project Budgets	FY 2004 Percent (Number) of Projects	FY 2005 Percent (Number) of Projects
$100,000 or less	22% (51)	20% (69)
$100,001 to $200,000	23% (54)	29% (100)
$200,001 to $500,000	32% (77)	32% (107)
$500,001 to $1,000,000	17% (41)	14% (47)
$1,000,001 or more	6% (15)	5% (18)
Total	100% (238)	100% (341)

Additional sources of federal funds were also available for some MSP projects. In FY 2005, 35 projects reported receiving funds from other federal sources (Exhibit 5). These additional federal funds ranged from less than $1,000 to more than $1,000,000. More projects received additional federal funds in FY 2005 than in FY 2004, although the funding amounts were somewhat lower. For example, 31 percent of projects that reported receiving additional federal funds in FY 2005 received more than $50,000 or less, compared to 50 percent of projects in 2004.

8 The American Virgin Islands, Guam, Mariana Islands, and Samoa have pooled their MSP funds as part of their consolidated budget.

Exhibit 5. MSP Project Budgets: Additional Federal Funds		
Additional Federal Funds	**FY 2004** **Percent (Number) of Projects**	**FY 2005** **Percent (Number) of Projects**
$10,000 or less	21% (6)	23% (8)
$10,001 to $50,000	29% (8)	46% (16)
$50,001 to $100,000	21% (6)	11% (4)
$100,001 to $500,000	18% (5)	14% (4)
$500,001 or more	11% (3)	6% (2)
Total	100% (28)	100% (35)

In addition to MSP funds and other federal funds, 77 projects reported receiving funding from local educational agencies (LEAs) in FY 2005 to support MSP activities. Typically, funds from this source were between $10,001 and $50,000, although the level of funding ranged widely among projects (Exhibit 6). The amount of LEA funding received by MSP projects was similar between FY 2005 and FY 2004, although more projects reported receiving LEA funds in FY 2005.

Exhibit 6. MSP Project Budgets: Funds from Local Education Agencies (LEAs)		
Local Education Agency	**FY 2004** **Percent (Number) of Projects**	**FY 2005** **Percent (Number) of Projects**
$5,000 or less	20.5% (10)	18.0% (14)
$5,001 to $10,000	16.0% (8)	16.0% (12)
$10,001 to $50,000	31.0% (15)	35.0% (27)
$50,001 to $100,000	12.0% (6)	10.0% (8)
$100,001 or more	20.5% (10)	21.0% (16)
Total	100% (49)	100% (77)

Combining funds received from all sources, the distribution of total funding is similar to the distribution of federal MSP funds shown in Exhibit 4, with 79 percent of FY 2005 projects reporting total budgets of $500,000 or less (Exhibit 7). This reflects the importance of the federal MSP program as a funding source.[9]

Exhibit 7. MSP Project Budgets: Total Funds from All Sources		
Total funds from all sources	**FY 2004** **Percent (Number) of Projects**	**FY 2005** **Percent (Number) of Projects**
$100,000 or less	18% (44)	17% (62)
$100,001 to $200,000	26% (62)	30% (110)
$200,001 to $500,000	32% (76)	32% (116)
$500,001 to $1,000,000	15% (37)	12% (42)
$1,000,001 or more	9% (21)	9% (34)
Total	100% (240)	100% (364)

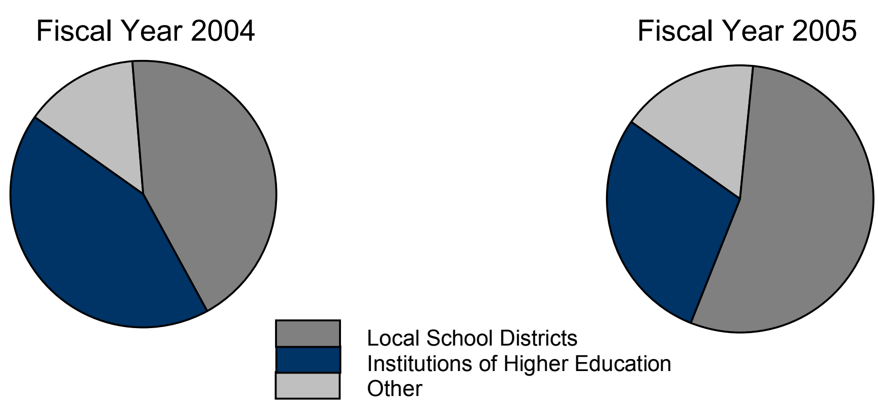
9 In FY 2005, MSP projects reported receiving a total of $120,054,855 in federal MSP program funds and $152,257,862 from all funding sources. This indicates that 79 percent of funding for MSP projects originated from federal MSP funding distributed by state grants.

Partnerships

The MSP program requires that all local mathematics and science partnerships include at least (1) an engineering, mathematics, or science department of an institution of higher education and (2) a high-need local educational agency (often a high-need school district). However, local MSP projects may bring on other types of partners as well. Eligible partners include: the engineering, mathematics, science, or teacher training departments of other institutions of higher education; additional local educational agencies, including public charter schools, public or private elementary schools or secondary schools, and school consortia; businesses; and nonprofit or for-profit organizations with demonstrated effectiveness in improving the quality of mathematics and science teachers.

On average, MSP projects reporting in FY 2005 had six partners, although the number of partners ranged from 2 to 46.[10] Irrespective of the number of organizations within a partnership, only one entity serves as the fiscal agent for the MSP grant. In addition to distributing funds, the fiscal agent often organizes and manages the activities of the MSP project. Typically the fiscal agent is either the local school district or the IHE. In FY 2005, 54 percent of MSP projects had local school districts as their fiscal agents and 29 percent had IHEs (Exhibit 8). The remaining 17 percent of projects had other types of organizations as their fiscal agents, including professional associations, educational cooperatives and consortia, curriculum developers, and state science museums. In FY 2004, a somewhat larger share of projects had IHEs as their fiscal agents.

Exhibit 8. Organizations Serving as Fiscal Agent for MSP Grants



Note: Percentages are based on 275 projects reporting in FY 2004 and 375 projects reporting in FY 2005.

The MSP fiscal agent and other partners often play multiple roles within the MSP program. MSP partnerships typically engage in a range of activities, with roles and responsibilities allocated among the partners based on areas of expertise. Overall, MSP projects reported underaking the following activities in FY 2005:

- Designing and planning professional development models and curricula;

[10] The number of partners is based on the analysis of descriptive characteristics from Project Profiles from 370 reporting projects. The wide range in number of partners reported reflects the fact that some projects reported each partnering school district as an individual partner, while others reported "local school districts" as a single partner.

- Recruiting participants for professional development activities;
- Providing/delivering professional development services;
- Providing technical assistance to K-12 schools and teachers;
- Conducting teacher and student assessments;
- Monitoring teachers' application of professional development training to classroom teaching;
- Mentoring/coaching K-12 teachers; and
- Evaluating MSP services.

School districts typically take primary responsibility for recruiting and selecting K-12 teachers to participate in MSP professional development activities. In many projects, school districts also help implement the professional development program, administer student and teacher assessments, and conduct MSP evaluations. By contrast, IHE faculty typically take the lead in designing the professional development materials and delivering instruction to participating teachers through summer institutes and follow-up training activities. However, IHE faculty frequently take on a variety of other roles, including providing overall leadership of the project and working on project evaluation activities.

Following are some examples MSP partnerships across the country.[11]

Partnerships

Complementary Roles of Partners

A Vermont MSP is a partnership of science and education faculty from three state colleges and the state university, educational professionals from the state department of education, and a national education professional development and training organization. The partners are integrated into the project management team. The program director is a Biology professor who was granted a year-long sabbatical to work on the project full time. Another professor coordinates the mentoring component of the project, assisted by a staff person from the national education training organization. A consultant to one of the school districts participating in the project coordinates the project's teacher leadership component. Supporting this management team is a faculty panel that helps set policy and shape the direction of the program. The panel includes scientists from the state colleges and state university, experts in science pedagogy, state department of education and school district personnel, and a teacher.

Extending IHE and K-12 Partnerships

In Minnesota, the American Indian Science and Engineering Society, the Science Museum of Minnesota, and Bemidji State University have partnered for a three-year effort to increase the number of Native American students in science. The project provides summer institutes, training sessions during the academic year, and online resources.

In FY 2005, one of the training sessions featured a group of science and engineering graduate students from Johns Hopkins University who are involved in an NSF-funded program focused on K-12 education. The graduate students gave presentations on their areas of research and then

[11] The full names of all the projects cited as examples are provided in Appendix A.

offered to work with the teachers during the school year to develop classroom materials. Following this session, partnerships were formed between individual JHU students and MSP teachers, and MSP teachers and project staff were invited to Baltimore to learn more about John Hopkins University's K-12 program. In this way, the MSP has been able to extend its impact on K-12 education.

Replicating the MSP Model

In Colorado, a partnership that began between a university and neighboring school districts has continued to grow through regular contact between university staff and teachers. Graduate fellows from the university participate in teachers' classrooms on a weekly basis, and faculty participate monthly. Building on the success of the MSP partnership, the school district and university have gone on to partner on other grants. In addition, the university has extended the model to another university, which under a separate grant will provide MSP course offerings to teachers in the western part of the state. Faculty from this second university also serve as consultants and evaluators for the original MSP project.

International Partners

An Illinois MSP project developed out of teachers' interest in astronomy and space science. Participating teachers have access to an area observatory, which is staffed by university faculty with a commitment to K-12 outreach and teacher professional development. The project has also partnered with the Japan Science Foundation and a Tokyo science museum. The science museum has given the MSP partners access to an Internet-controlled telescope on the roof of the museum as well as constellation video cameras around the world.

Methods of Participant Selection

MSP projects were encouraged to identify needs of individual schools and teachers for professional development services and use this information as the basis for selecting which schools and teachers should participate in the MSP program. Consistent with this guidance, a majority of MSP projects in FYs 2004 and 2005 cited "need" as a basis for selecting both schools and teachers, although usually in combination with other selection criteria. As shown in Exhibit 9, 69 percent of MSP projects in FY 2005 reported using need as a basis for selecting schools and 56 percent reported using need as a basis for selecting teachers.[12] However, an even larger share of projects (82 percent in FY 2005) reported selecting teachers based at least in part on who volunteered for the program.[13] The prevalence of volunteer-based criteria for selecting teachers suggests that successful teacher recruitment takes account not only of teacher needs but also of their interest and willingness to participate in MSP services.

Some projects used administrative guidelines as one of the criteria for selecting schools and teachers. In FY 2005, 24 percent of projects used administrative guidelines as a basis for selecting schools and

[12] Because projects were permitted to report more than one selection criterion, the percentages in Exhibit 9 do not sum to 100.

[13] In both FY 2004 and FY 2005, most projects reported using a combination of several selection criteria, including need, volunteers, and others. Three percent of projects (12) reported using need-based criteria alone, 12 percent (43) reported using volunteer criteria alone, and 27 percent (98) reported using both need and volunteers but no other criteria. Projects were not asked to rank the criteria used in order of importance, so we have little information on how the criteria were used together.

38 percent used administrative guidelines as a basis for selecting teachers. It is possible that these administrative criteria may also have included some combination of needs and/or interest.

Exhibit 9. Participation Selection Criteria for Schools and Teachers				
	Schools		Teachers	
Participation selection criteria	FY 2004 Percent (No.) of Projects	FY 2005 Percent (No.) of Projects	FY 2004 Percent (No.) of Projects	FY 2005 Percent (No.) of Projects
Based on need	71% (178)	69% (255)	56% (139)	56% (205)
Volunteer	42% (106)	46% (169)	74% (186)	82% (301)
Administrative selection	25% (63)	24% (87)	42% (105)	38% (141)
Random assignment for experimental design	3% (8)	3% (11)	3% (7)	4% (13)
Other	6% (16)	7% (27)	12% (31)	13% (47)

Note: Percentages are based on 250 projects reporting on schools and/or teachers in FY 2004 and 369 projects reporting in FY 2005. The percentages do not total 100 percent because projects reported one or more responses to this question.

Only a small proportion of projects (3 percent for schools and 4 percent for teachers in FY 2005) reported that participants were selected using random assignment procedures. For these projects, teachers and students were randomly assigned to "intervention" and "control" groups, with the "intervention" group receiving MSP professional development services and the "control" group not receiving those services. Because the two groups would be evenly matched at the time of random assignment, any difference in student and teacher outcomes could be attributed to the MSP intervention. Although this method of participant selection was not common, some projects implementing a rigorous evaluation design used random assignment for the selection of program participants in order to strengthen their assessment of the impact of MSP services.

Characteristics of Participating Teachers

The central focus of the MSP program is the provision of professional development services to mathematics and science teachers in order to increase their content knowledge. The logic is that with deeper knowledge of their subject matter, teachers will be better able to help their students increase their knowledge of mathematics and science. In this section, we present data reported by FY 2004 and 2005 MSP projects on the number of teachers served, the grade range and subjects taught by these teachers, and their professional qualifications, in order to understand the types of teachers that are participating in the program.

Number of Teachers Served

Altogether, more than 37,000 elementary and high school teachers are estimated to have participated in MSP projects in FY 2005.[14] However, the number of teachers participating in individual projects varied widely. For example, one project reported serving only four teachers, while another reported serving as many as 1,625 teachers. Among the 363 MSP projects that provided data on the number of

[14] A total of 363 MSP projects reported on the number of teachers served in FY 2005. The total number of teachers served was 31,100, an average of 85.6 per project. Applying this average to all 436 MSP projects funded in FY 2005 results in an estimate of 37,355 teachers served. This estimate assumes that the non-reporting projects have similar characteristics to those that submitted reports.

teachers served in FY 2005, the average (mean) number of teachers served per MSP project was 86, and the median number of teachers per project was 41.[15]

Exhibit 10 shows the distribution of FY 2004 and FY 2005 projects by the number of teachers served. In FY 2005, about one quarter of projects reported serving 25 or fewer teachers, just over one half reported serving between 25 and 100 teachers, and about one fifth reported serving more than 100 teachers. The distribution was similar in FY 2004, although a somewhat higher percentage of projects reported serving more than 100 teachers.

Exhibit 10. Total Number of Teachers Served by MSP Projects

Number of teachers served	FY 2004 Percent (No.) of Projects	FY 2005 Percent (No.) of Projects
25 or fewer	25% (62)	25% (91)
26-50	28% (68)	34% (123)
51-100	22% (55)	21% (76)
101-200	14% (35)	10% (36)
201 or more	11% (28)	10% (37)
Total	100% (248)	100% (363)

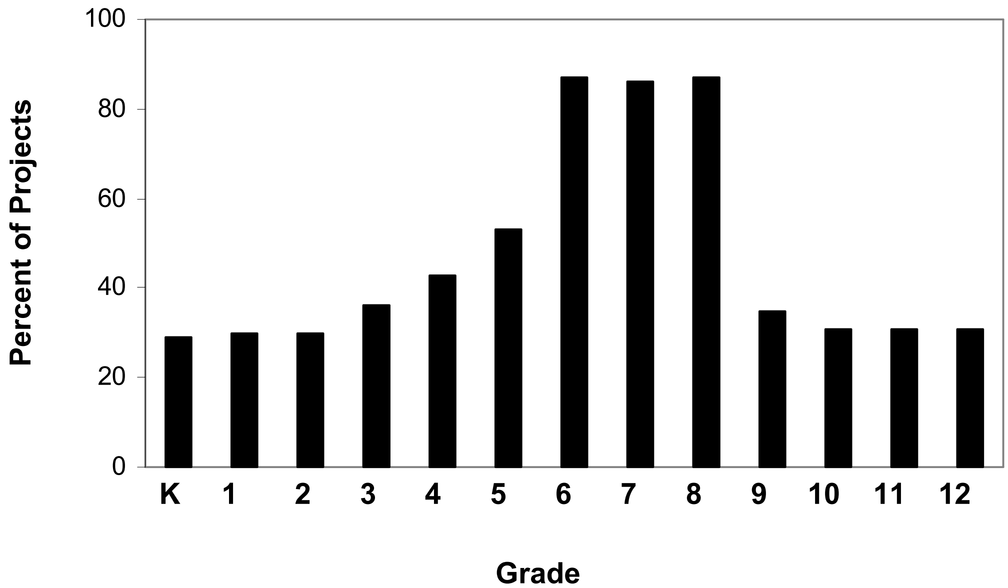
The number of teachers served is closely related to the unit of intervention targeted. For example, some projects targeted individual teachers or classes for intervention, drawing teachers identified as high-need from a number of schools across a district or districts. Under this approach, not all the teachers in a given school would necessarily receive MSP services and the number of teachers served would likely be small compared to projects that chose to serve all teachers in selected high-need schools. The largest unit targeted was an entire school district in which professional development intervention was applied districtwide, affecting a very large number of teachers. In general, projects that targeted individual teachers served a smaller number of teachers than projects that targeted entire schools or districts.

Grade Range and Subjects Taught by Participating Teachers

The amount of MSP funding available to states is not sufficient to meet all of their needs for professional development in math and science. As a result, many states focus their MSP resources on projects that target a particular grade or grade span and/or on one of the two subject areas (mathematics or science) in order to focus program impacts on the areas of greatest need. As shown in Exhibit 10, a large share of FY 2005 projects targeted the middle school grades (grades 6 through 8), with somewhat fewer projects working in the elementary and high school grade ranges.

15 The median of 41 means that 50 percent of reporting MSP projects served 41 or fewer teachers and 50 percent served more than 41 teachers. The fact that the mean number of teachers per project is approximately twice as large as the median suggests that the mean is heavily skewed by a few outliers, such as the project that reported serving more than 1,000 teachers.

Exhibit 11. Grades Targeted in MSP Programs for FY 2005



Note: Based on the analysis of project profile and narrative reports from 374 reporting projects. The percentages do not total 100 percent because some projects targeted multiple grade levels.

This finding is further illustrated in Exhibit 12, which presents the percent of FY 2005 projects that reported serving teachers or administrators from elementary, middle, or high schools. Although most projects reported serving at least some teachers from all grade spans (elementary, middle, and high), a larger share of projects served middle school teachers than elementary school teachers or high school teachers. For example, 78 percent of projects served middle school mathematics teachers, 50 percent served elementary school mathematics teachers, and 37 percent served high school mathematics teachers. Similarly, 63 percent of projects served middle school science teachers, compared to 38 percent serving elementary school science teachers and 32 percent serving high school science teachers.

Across all grade spans, a larger percentage of projects reported serving mathematics teachers than science teachers or special education teachers. Nevertheless, among projects serving the middle school grades, the three instructional specialty areas were well represented. More than three quarters of projects served middle school mathematics teachers, 63 percent served middle school science teachers, and 55 percent served middle school special education teachers. In addition, school administrators participated in about a quarter of the elementary and middle school projects (24 and 28 percent, respectively). The involvement of school administrators indicates an effort by some projects to meet the legislative recommendation of an integrated and comprehensive approach to teacher professional development.

Exhibit 12. Percent of Projects that Reported Serving Teachers at Elementary, Middle, and High Schools, by Subjects						
Targeted audience	**Elementary Schools (K-5)**		**Middle Schools (6-8)**		**High Schools (9-12)**	
	FY 2004 Percent (No.) of Projects	**FY 2005 Percent (No.) of Projects**	**FY 2004 Percent (No.) of Projects**	**FY 2005 Percent (No.) of Projects**	**FY 2004 Percent (No.) of Projects**	**FY 2005 Percent (No.) of Projects**
Regular math teachers	53% (110)	50% (147)	83% (172)	78% (232)	40% (82)	37% (110)
Regular science teachers	22% (46)	38% (111)	51% (106)	63% (186)	25% (51)	32% (95)
Special education teachers	37% (77)	31% (91)	59% (122)	55% (164)	20% (41)	21% (62)
School administrators	28% (57)	24% (72)	29% (59)	28% (83)	13% (26)	13% (38)

Note: Percentages are based on 206 projects reporting in FY 2004 and 296 projects reporting in FY 2005. The percentages do not total 100 percent because projects reported one or more responses to this question.

Professional Qualifications of Participating Teachers

One of the initial goals of the MSP program was to increase the number of math and science teachers designated "highly qualified" by their states. However, this program goal was somewhat subsumed by the No Child Left Behind legislation, which, starting in FY 2004, required states to bring *all* teachers up to the standard of "highly qualified." In FY 2005, MSP projects contributed to the broader effort by their states to help teachers become highly qualified at the same time as working to increase the number of math and science teachers with advanced degrees or certification.

The vast majority of MSP projects reporting data in FY 2005 reported serving at least one "highly qualified" teacher and at least one teacher with an advanced degree or certification.[16] However, 65 percent of projects reported serving teachers who had not been designated highly qualified. This suggests that the program is likely to have contributed substantially to the broader effort by states to bring teachers to the highly qualified standard in addition to increasing the qualifications of math and science teachers beyond the state designation. In addition, some projects used their MSP funding to train teachers who were already highly qualified to be "teacher leaders" or "teacher specialists," people who could in turn provide professional development training to less qualified teachers in their schools. This allowed the projects to provide professional development services to a large number of teachers (e.g., districtwide) with limited resources.

[16] In FY 2005, 339 projects reported data on the type of teachers served (highly qualified, not highly qualified, or with advanced degrees or certification). Among these projects, 93 percent served highly qualified teachers and 83 percent served teachers with an advanced degrees or certification.

Professional Development Models and Activities

What professional development approaches are MSP projects using to increase teacher qualifications in mathematics and science? What kinds of activities are teachers participating in? What subject matter is being covered? This chapter examines how MSP projects in FY 2005 approached the program goal of increasing student achievement in mathematics and science through teacher professional development. The chapter explores the professional development models in use, the specific learning activities within those professional development models, and the mathematics and science content focus.

The findings of this chapter are based on descriptive information about professional development activities across all reporting MSP projects. In addition, we conducted a detailed qualitative analysis of the narrative reports submitted by 172 MSP projects with especially strong research designs.[17] These projects were selected because they were most likely to provide good evidence of teacher and student outcomes, so they are not necessarily representative of the MSP program as a whole. Nevertheless, analysis of summary data from all 375 projects reporting in FY 2005 suggests that the information on professional development approaches presented in this chapter are largely valid for the program as a whole.

Professional Development Models

The MSP projects reporting in FY 2005 typically used one of two professional development models to increase teacher content knowledge in mathematics and science. As shown in Exhibit 13, the great majority of projects (86 percent) used a model of increasing teacher content knowledge directly by providing intensive learning experiences, usually through summer institutes. Summer institutes and other approaches to increasing teacher content knowledge are described in more detail below.

Exhibit 13. Professional Development Models Used by Projects

Model	Percent (Number) of Projects
Increasing Teacher Content Knowledge	86% (324)
Creating Teacher Leaders	14% (51)
Total	100% (375)

The second professional development model, employed by fewer projects, involves training "teacher leaders" in content knowledge and leadership and then having those teacher leaders train other teachers. Teacher leaders were typically former classroom teachers, some of whom continued to teach part-time or return to full-time teaching after a period of leadership. The MSP teacher-leader projects provided training in both math and science content knowledge as well as in leadership. Trained leaders then worked with teachers, often in their own classrooms or through study groups, to improve content knowledge and apply this knowledge to their own practice. Projects typically used teacher leaders in an ongoing fashion throughout the school year. Teacher leaders supported teachers by modeling, instruction, observing classroom teaching, or by clarifying mathematics or science concepts.

[17] Among the 375 projects that submitted data in FY 2005, 180 were identified as having strong research designs. Of these 180 projects, 172 submitted Project Narratives and/or Evaluation Reports that could be used for in-depth qualitative analysis.

Only 51 of the 375 projects analyzed reported using teacher leaders as their primary professional development approach; however, many projects that used the teacher-content-knowledge approach in their summer institutes also reported using teacher leaders in their follow-up activities. Some MSP projects refer to teacher leaders as coaches or mentors rather than teacher leaders. However, common to all these projects is the training of a core group of professionals to work with a number of teachers to improve their math or science content knowledge, typically in their own school setting.

Professional Development Activities

Projects used a wide variety of activities to support, enhance, and extend content knowledge and teacher leadership development. Given the prevalence of the teacher-content-knowledge model, summer institutes with follow-up during the school year were the most common professional development activity among MSP projects. As shown in Exhibit 14, 90 percent of MSP projects conducted summer institutes, and most also funded follow-up training activities (usually school-based professional learning). Projects that did not use summer institutes tended to use a combination of professional development activities, such as on-site professional learning along with online coursework. Few projects funded a single professional development activity.

Exhibit 14 also shows the average number of hours devoted to each category of professional development activity. Overall, most MSP projects provided a substantial amount of professional development training. Across all activities, projects provided an average of 129 hours of professional development per teacher, a sizeable increase over many past short-term professional development efforts in math and science education (Weiss et al., 2001). Summer institutes plus follow-up, the most common activity, averaged 137 hours, the equivalent of 17 eight-hour days. Combination activities had the longest duration (206 hours), and content workshops had the shortest duration (89 hours).

Exhibit 14. Types and Duration of Professional Development Activities

Professional Development Activities	Percent (Number) of Projects	Mean Duration (Hours)[a]
Summer institute	2.0% (8)	99
Summer institute + follow-up[b]	88.0% (322)	137
On-site professional learning	1.5% (6)	105
College coursework	1.5% (6)	137
Content and pedagogical content knowledge workshops	1.0% (3)	89
Combination/other[c]	6.0% (22)	206
Summary information	100% (367)	129

[a] Mean duration of professional activities is based on 324 reporting projects.

[b] "Follow-up" includes one or more of the following activities: on-site professional learning, study groups, online coursework, distance learning networks, resource development, and short-term professional development.

[c] "Combination/Other" includes one or more of the following activities: on-site professional learning in combination with other activities, coaching/mentoring, study groups, online coursework, college coursework, distance learning networks, resource development, and short-term professional development.

Activities within Professional Development Models

Across all MSP projects reporting in FY 2005, the most common method of delivering professional development to teachers was summer institutes combined with follow-up activities during the school year. In this section, we provide several examples of summer institutes conducted by MSP projects across the country, followed by a discussion of the other types of professional development activities funded through the program: on-site professional learning, study groups, college coursework, distance learning networks, and other activities, including resource development.

Summer Institutes

Most summer institutes were designed to provide intensive professional development and training fulltime over a two-week period. Teachers often volunteered to participate in the summer institutes, but might be assigned to an institute if the MSP project operated school or districtwide. Summer institutes were typically led by STEM faculty from IHEs who developed coursework and activities designed to increase teachers' content knowledge in a given mathematics or science subject area. STEM faculty generally also spent time helping teachers think about how to apply the content learned in the summer institute to their teaching; projects also typically provided additional training during the school year to reinforce what was taught in the summer. For example, STEM faculty often provided follow-up training to teachers at their schools or on the university campus. STEM faculty also observed teachers in their classrooms and supported them in translating their newly gained content knowledge into student learning and achievement.

STEM faculty and other professional development providers used a variety of teaching strategies in the summer institutes. These included lectures, demonstrations, problem solving, applications, question and answer sessions, research, and opportunities for reflection among the participants. In addition, some trainers used technology, such as computer programs, to facilitate content development.

Following are some examples of MSP summer institutes held in FY 2005.

Summer Institutes

Math Summer Institute

A California MSP provided professional development to middle school mathematics teachers through intensive summer work and on-going support during the school year. Participating teachers attended summer institutes in both 2005 and 2006, with a curriculum based on teacher surveys and analysis of student achievement data in mathematics. During the mornings, teachers deepened their mathematics content knowledge in alignment with the California mathematics standards. In particular, teachers were challenged to focus on knowing and understanding the big ideas and issues related to algebra and how these key ideas related to the K-7 curriculum and to the college-preparatory curriculum. In the afternoons, teachers participated in lesson study groups, designing research lessons focused on increasing student achievement in identified areas. During the school year, teachers met monthly and continued to examine issues related to mathematics content, effective instructional strategies, and assessment as evidenced in the research lessons presented by members of the group. In addition, teachers were provided individual coaching and mentoring, including classroom observations and feedback.

Summer Science Institute

A Pennsylvania MSP provided professional development to middle school science teachers during the summer of 2005 and the 2005/06 academic year. The summer programs focused on content and pedagogy in science and included: a one-week program at the Franklin Institute, a science museum in Philadelphia; a two-week program at the College of Engineering at Drexel University; and several three-day workshops at the Martin Luther King High School in Philadelphia.

The Franklin Institute program was facilitated by museum staff, experts in science content and the inquiry-based pedagogical model. Program content was aligned with the District's standardized core science curriculum implemented in the Fall of 2004, and targeted content to be covered during the first marking period. Professional development opportunities were offered throughout the school year to cover the material for the subsequent marking periods.

The instructors for the summer program followed an inquiry-based pedagogical model. Inquiry is an experientially-based model that uses discovery methods in science teaching to promote a higher level of learning. Learning situations are set up for students to take on the role of scientists by motivating them to observe, question, and explain scientific events. Additionally, they are prompted to design and perform tests to support or challenge their theories, conduct data analysis, draw conclusions, and create models based on their experiment. One of the purposes of using an inquiry-based teaching model in the summer program was to educate teachers about the model and to provide examples of how this type of teaching could be used in their classrooms.

Summer Institute Focused on Physical and Life Sciences

In a Vermont MSP, teachers from a high-need school district and local learning collaborative began their one-year program in August 2006 with a summer institute entitled "Hands on a Watershed." The institute was field-based and took the teachers from mountain streams to Lake Champlain on a week-long study integrating the physical and life sciences. The course was team-taught by a professor of Geology and a graduate student from the University of Vermont, and a pedagogy specialist from Johnson State College.

Summer Institute Integrated with Summer School

In a Louisiana MSP, the summer institute was integrated into the summer school program, with teachers teaching summer school one day and participating in the institute the next. In the institute sessions, teachers examined the summer curriculum, its mathematical content and the specific activities to be implemented during summer school and the academic year. Participants who were teaching summer school implemented the summer institute activities in their classrooms. Each week following classroom implementation participants shared experiences, evaluated what occurred, and discussed strategies for effective student learning.

The summer institute focused on the mathematics content in the new state curriculum as well as the material taught in summer school remediation for grades 6-8. University faculty provided instruction in mathematics, modeled effective teaching strategies, and discussed vertical development of concepts. Teachers then redelivered the same material at the middle school level in succeeding summer school classroom sessions. Teachers assessed understanding and met for debriefing discussions during the summer institute. Questions or difficulties with content were analyzed and resolved. The participants who were not teaching summer school also benefited from the issues raised through actual classroom experiences. The opportunity to learn, practice, and analyze strengthened teachers' content knowledge as well as their confidence for successful delivery of mathematics content. Grade level math content groups discussed strategies for implementing the state curriculum in their specific grade levels.

Academic year follow-up supported the summer institute learning experience through monthly Saturday workshops. The follow-up training reinforced the cyclical model of "learn, practice, assess and reflect." The university mathematics content coordinator provided further daily assistance in middle schools. Participants also had the option to earn credit for a three-hour graduate course in mathematics. By the end of the project year, all middle school teachers who were not highly qualified when they entered the project achieved that goal.

Most MSPs in FY 2005 sought to reinforce the learning that occurred during the summer institutes with follow-up and supplemental professional development activities during the school year. Exhibit 15 shows the distribution of follow-up activities used by the 322 MSP projects that provided summer institutes plus follow-up. Examples of each of these activities are provided below.

Exhibit 15. Types of Summer Institute Follow-up Activities

Summer Institute Follow-up Activities	Percent (Number) of Projects
On-site professional learning	81% (261)
Study groups	34% (108)
Online coursework	21% (69)
Distance learning networks	13% (41)
Other follow-up (including coaching/mentoring, resource development, short term professional development, school meetings, etc.)	81% (262)

Note: Percentages are based on 322 projects that reported data about the types of summer institute follow-up professional activities. The percentages do not total 100 percent because projects reported one or more responses to this question.

On-site Professional Learning

On-site professional learning was the most prevalent follow-up activity for summer institutes. Eighty-one percent of projects provided some type of on-site professional learning. For many projects, particularly those implementing a specific math or science curriculum/program, on-site professional learning during the school year focused on applying the content knowledge gained during the summer institute to classroom teaching. However, in some projects, such as those profiled below, teachers worked closely with STEM faculty and other project staff on independent research projects that deepened their content knowledge and understanding of academic research.

On-Site Professional Learning

Environmental Data Collection and Other Projects

In Minnesota, an MSP encouraged K-12 mathematics and science teachers to work on research projects with science and engineering graduate students from Johns Hopkins University (JHU) in Baltimore. For example, in FY 2005 two MSP teachers worked on an environmental sensors project in which they planned to install sensors at their schools and compare the data recorded to environmental data collected at schools in Baltimore using the same sensors. Another project was designed to engage K-12 students in the invention process by encouraging them to develop inventions for presentation at an event attended by representatives from Minnesota Inventors and the National Inventors Hall of Fame. JHU graduate students and three MSP teachers also began working on a wind energy project expected to be completed in FY 2006.

Independent Research with STEM Faculty

In a Vermont MSP, teachers began by increasing their science content knowledge through summer coursework and then had an opportunity to reinforce and expand that learning by carrying out an independent, inquiry-based project under the direction of a research scientist. In FY 2005, teachers worked with scientists from a variety of institutions throughout the U.S and abroad including: the University of Vermont, Middlebury College, Johnson, Castleton, and Lyndon State Colleges, Cornell University, Villanova University, Vermont Institute of Natural Science, Shoals Marine Laboratories, Woods Hole Oceanographic Institution, Green Mountain College, and Earth Watch. In total, 21 scientists mentored these projects.

After completing the project, each teacher presented the project findings in a power point presentation or professional poster, both formats utilized current computer technologies. The science research was presented to colleagues, school principals and superintendents, arts and science faculty and higher education administrators in a day-long symposium. At the Vermont Science Teacher's Association Meeting (VSTA) in March 2005, one of the MSP teachers presented a session on teachers and scientists collaborating in the classroom. Her fifth grade class was present with their posters summarizing the research projects they had conducted on global warming in collaboration with a scientist. The teacher had conducted her research project under the direction of this scientist who was also in attendance at the VSTA meeting. The student posters were in the format that a scientist would have organized and presented. It was apparent that learning how to think like a scientist had transferred from the scientist to the teacher and ultimately to the teacher's students. The student posters were later presented at the Arctic Science Forum in Washington, D.C.

Study Groups

Thirty-four percent of MSP projects in FY 2005 reported using study groups for follow-up training. Study groups allowed teachers to examine in-depth how particular mathematics or science concepts could be taught effectively to students. Study groups often followed the Japanese Lesson Study model of planning, teaching, debriefing, and teaching the lesson again. Study groups were typically composed of groups of teachers, sometimes led by a STEM faculty member or other content specialist.

Study Groups

Use of Lesson Study to Create Research Lessons

During the course of the 2005 Summer Institute and follow-up sessions, teachers in a California MSP worked in Lesson Study groups to develop research lessons. One teacher from each group was videotaped teaching the research lesson, and the group analyzed student engagement and understanding throughout the course of the lesson. The study groups then shared their findings with other teachers in the district as they worked to develop strategies to engage all learners. The first research lessons resulting from the study groups were not as strong as the project's Leadership Team had hoped. However, as teachers continued to plan throughout the school year, the Leadership Team saw increased evidence of the variety of strategies modeled and emphasized during the summer institutes and monthly follow-up meetings. During the 2006 Institute, teachers continued to work in Lesson Study groups to develop research lessons to be observed and debriefed during the fall of 2006.

The Leadership Team observed increases in the quality of these lessons between 2005 and 2006, in particular a shift from planning lessons from the point of view of the teacher to thinking more about how students are learning. However, the Team also discovered that implementing the concepts discussed during summer institutes and follow-up sessions in the classroom is a difficult task for teachers. As a result, the Leadership Team planned to provide additional time for lesson study as well as classroom observation and feedback during the 2006-2007 year.

Group Activities in Mathematics

In an Alaska MSP, group activity assignments during the school year provided teachers with opportunities to collaborate. A number of students formed an algebra study group facilitated by a mathematics professor from the University of Alaska Anchorage (UAA). This group worked on solving problems requiring analysis of linear data, modeling with variables, and graphical representation. Another UAA professor offered a seminar on Alaska Native mathematics. In addition, a few groups of teachers created math trails for their students using a school or community site; some submitted their trail to the National Math Trail. Finally, five MSP teachers gave half-day seminars to other teachers in their districts, disseminating the knowledge learned at the summer institutes and workshops.

College Course Work (Online and On-site)

Some MSP projects offered college coursework to participating teachers, typically focusing on mathematics or science content, as part of their professional development activities. While some projects used existing courses, many projects created their own courses to meet specific participant needs for content knowledge. Courses were offered online at colleges and universities or at school locations throughout the summer and school year. MSP teachers enrolled in courses to receive content credit and advanced degrees.

Online courses provided a variety of uses and benefits for participants. Projects reported that online courses facilitated training in rural areas, accommodated teachers' schedules, and enabled IHE faculty with many commitments to be involved in MSP. Some projects used online courses as their principal communication tool, while others used online courses in conjunction with classroom sessions.

College Course Work in Mathematics and Science

A Georgia project provided online undergraduate courses in mathematics and science specifically designed to strengthen the content knowledge of middle grade teachers. Web-based discussion forums and email provided the primary venue for contact among teachers, supervisors, and instructors, but face-to-face sessions were used for content clarification and reflection. Special education teachers and a significant number of co-teaching teams enrolled in the courses. Through these courses, regular education and special education teachers began a dialogue that became richer as the program progressed through Years I and II. In particular, co-teaching has moved to a new level of cooperating. The special education teachers are gaining science and mathematics content knowledge, and the regular education teachers are becoming more comfortable with co-planning because of the improved content knowledge base among the special education teachers.

Distance Learning Networks

Thirteen percent of MSP projects in FY 2005 reported using distance learning networks. Professional development through distance learning included online course work, interactive websites, supplementary Web assignments, and electronic meetings such as videoconferencing to increase K-12 teachers' content knowledge and foster communication among participants.

Distance Learning Networks

One Mississippi MSP used the project website to create an online database of information and resources related to the project. The website included: participants' group lesson plans; supplemental curriculum activities and resources provided by a partner organization; lessons from the university content experts; links to state and national benchmarks; a list of interactive science Web sites; course forms; assignments; calendar of events, visits; and contact information. The project also made DVDs of the group lesson plan presentations and videoconferences available to all project participants. The website was linked to the project's Learning Management System, where participants could submit assignments, access materials that were proprietary to the project, and find information about each upcoming activity.

During the 2005-2006 school year, the MSP project website received more than 9,000 page views, averaging 785 a month, from participants as well as from other teachers interested in the project. In their evaluations of the website, MSP participants noted that having all of the forms and resources readily accessible was very beneficial. Participants also said they liked how easily they could contact other participants through the contact information on the website.

Other Activities

Most MSP projects offered a variety of professional development services to accommodate the varied needs and circumstances of participating schools and teachers. As shown in Exhibit 15 above, 81 percent of projects (262 projects) conducted summer institutes with "other" follow-up activities that do not fall into the category of on-site professional learning, study groups, online coursework, or distance learning. These "other" types of follow-up include:

- Evening and Saturday institutes;
- Field experiences;
- Classroom observations by IHE faculty and peers;
- Content coordinator assistance;
- Writing teams;
- Curriculum training, online textbook support;
- Content training for students
- Resource development;
- Short-term professional development (conferences, workshops, and seminars); and
- Community development.

For a few projects, the ***creation of resources*** represented the major professional development effort or supplemented other professional development activities. Resource development teams were composed of MSP teacher groups, sometimes led by IHE faculty. The resources developed included curricula (aligned with state or local standards), inquiry-based resources, or resources focused on local resources or issues.

Resource Development

Online Science Education Resource

The school district partner of a Pennsylvania MSP launched a website in January 2005 that is an online resource for teachers and students in science. The site includes links to the state's core curriculum and standards for science (assessment checklists and test preparation packets with accompanying lesson suggestions), current topics, news and updates, science downloads, information for science fairs, teacher professional development postings and MSP-specific curriculum companions, and links to resources available from the Franklin Institute, a nationally-renowned science museum and key partner in the MSP. The website is used by both teachers and students, and has received approximately 35,000 hits to date since November 2005.

Online Algebra Program

One California project focused on designing and producing an online algebra program. The program is aligned with the state content standards for mathematics and aims to help teachers expand their content knowledge of mathematics and pedagogy, with the intention of creating a more rigorous mathematics curriculum countywide. The program includes videotapes of exemplary mathematics teachers, lessons to address the needs of students who are struggling with certain concepts, strategies for special needs and English learners, lessons that have been correlated to state standards, and adopted instructional materials.

Finally, a small number of projects used ***short-term professional development*** in their intervention. Short-term professional development consisted of workshops, seminars, and conferences of one or a few days' duration, focused on particular mathematics or science content, local standards, or specific approaches to teaching inquiry. These short-term activities were typically closely linked to other professional development activities. For example, one project provided a science safety workshop course for all mathematics and science teachers in each participating school district. The workshop led to the implementation of a total science safety program for each school in the project, including the development of a chemical hygiene plan for each school. At the same time, the schools were engaged in developing sustainable, ongoing professional development in science safety for new and current faculty.

Content Focus of Professional Development Models

In their project abstracts and narrative reports, MSP projects described the mathematics and/or science focus of their work. As shown in Exhibit 16, 43 percent of MSP projects reporting in FY 2005 addressed only mathematics content in their professional development work, 27 percent addressed only science, and 30 percent addressed both mathematics and science.

Further, projects typically indicated that their approach was to study one or perhaps a few topics in depth, although some projects also addressed connections among concepts within and across disciplines. Many projects also focused on mathematics and/or science content standards at the national, state, and/or local level.

Exhibit 16. Mathematics and/or Science Content Focus of Professional Development Model

Content	Percent (Number) of Projects
Mathematics	43% (161)
Science	27% (100)
Mathematics and Science	30% (114)
Total	100% (375)

Projects' narrative reports described a wide range of mathematics topics/content areas addressed in the professional development activities provided to participating teachers. Using the broad topic categories defined in national mathematics standards (NCTM, 2000), the most prevalent mathematics topics among MSP projects included: number and operations, algebra, geometry, and data analysis. Measurement was often included within the geometry coursework. Much of the work in the number operations and algebra strands focused on typically difficult topics that are crucial for success in algebra, such as operations with rational numbers (fractions, decimals, and percents), ratios and proportions.

In science, MSP projects typically addressed traditional topics of physical, life, or earth and space science. Within these broad topics, some projects specified a particular area or combination of areas of study. For example, in physical science, some projects studied chemistry or physics. In earth and space science, some projects examined astronomy, environmental science, or geology.

For both mathematics and science topics, MSP projects often examined the relationship of technology to the topic and/or reviewed the relevant standards at the district or state level. Projects also reported that they explored topics related to the central math or science content under study. These included integration of math and science topics, pedagogy, student learning, and assessment.

Following are two examples of the math and science content of MSP projects.

Examples of Math and Science Content of MSP Projects

Middle School Mathematics

In a California project, middle school teachers expressed the need to learn about specific topics for their grade levels that they found challenging for their students. The 5th grade teachers were primarily concerned with issues relating to numbers sense (fractions, decimals, integers, long division) and with graphing number sentences on a coordinate grid. For 6th grade, most of the concerns centered on issues related to ratios and proportions, probability and statistics, and three-dimensional geometry, whereas 7th grade teachers' concerns were across all of the strands. Fractions and percents were mentioned several times as were inequalities. As a result of this needs assessment, which closely matched student achievement data, the Leadership Team decided to organize the intensive professional development in stages. During the 2005 Intensive Institute, all teachers focused on Number Sense and Algebraic and Functions with the 2005-06 follow-up sessions dedicated to continuing and extending this work. During the 2006 Intensive Institute, 5th – 7th grade teachers focused on probability and statistics while Algebra 1 teachers addressed issues related to Algebra. Both groups also continued to focus on Number Sense topics, fractions, ratios and proportions, and integers, in particular.

Earth Systems Science

In an Oregon project, content instruction in Earth systems science was provided to grades 3-12 teachers in two mini-sessions with independent work between the mini-sessions. Sessions consisted of modeling inquiry methods applied to earth science topics, field work in earth science guided by a local geologist, and content instruction in earth systems science. Teachers completed and carried out an observed inquiry lesson. At the end of the school year, the teachers reconvened to conduct a scientific ballooning expedition to over 100,000 feet. They worked for 16 hours in teams of two to construct balloon payloads, designed to withstand extreme near-space conditions and collect visual, temperature, light, and humidity data. The payloads were launched using a helium balloon system provided by the partnering university and a NASA consortium. The teachers then spent 10 hours tracking and locating the balloon payloads using GPS and ham radio technology. They used the collected data to design inquiry lessons for implementation in their classrooms for the following school year.

Evaluation of MSP Implementation and Effectiveness

Each MSP project is required, as part of its program plan, to design and implement an evaluation that allows for a rigorous test of the effectiveness of MSP. The evaluation 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.

The requirement for a rigorous evaluation of MSP projects was specified in the No Child Left Behind legislation and was a departure from previous programs aimed at increasing teachers' content knowledge and student achievement in mathematics and science. To support MSP projects in their efforts to design and implement systematic, strong evaluations, the federal MSP office worked closely with the states, providing technical assistance opportunities and resource materials tailored to MSP evaluation. The Department of Education has also provided ongoing support to state MSP coordinators and local MSP project directors through conference calls, conferences, and a resource website.

In this chapter, we discuss the evaluation activities of MSP projects and present preliminary data on program outcomes. Because projects were in their first or second year of program operations in FY 2005, most of the evaluation data relates to program implementation rather than outcomes for teachers and students. More data on the impact of MSP on teacher content knowledge and student achievement will be available in future years when the projects are fully implemented.

Evaluation Designs

Exhibit 17 summarizes the evaluation approaches reported by MSP projects in FY 2005, with 2004 data for comparison. Because some projects incorporated more than one approach into their evaluation design, the percentages in the exhibit do not sum to 100.

Exhibit 17. Types of Evaluation Designs used by Projects

Evaluation Design Categories	FY 2004 Percent (No.) of Projects	FY 2005 Percent (No.) of Projects
Experimental design – using random assignment of schools, teachers, and/or students to MSP (Treatment) vs. no-MSP (Control) groups	10% (23)	3% (12)
Quasi-experimental design – using various methods, other than random assignment to compare schools, teachers, and/or students with and without MSP services (e.g., pre-post comparisons, matched comparison groups)	35% (82)	48% (168)
No control/comparison groups – using post-Professional Development-test only and/or other one-time data collection methods	54% (128)	47% (164)
Other (e.g., case studies, formative research)	30% (72)	29% (101)

Note: Percentages are based on 237 projects reporting in FY 2004 and 348 projects reporting in FY 2005.

Few projects, three percent in 2005, reported using an experimental research design, the most rigorous form of evaluation.[18] This low percentage is likely due to the relative newness of the MSP program, although the percent of projects reporting experimental research designs was somewhat higher in 2004.[19] The largest share of MSP projects, 48 percent in FY 2005, reported using a quasi-experimental evaluation design, in which outcomes of teachers and students in MSP projects are compared to teachers and students not in MSP projects without setting up rigorous treatment and control groups. The use of quasi-experimental evaluation designs increased by 13 percentage points between FY 2004 and FY 2005.

Although few projects were able to use a true experimental design, the increase in quasi-experimental designs shows the projects' commitment to using the most rigorous evaluation design possible. Based on the narrative reports from MSP projects, the quasi-experimental evaluations typically involved comparisons of pre-intervention and post-intervention measures of teachers' mathematics and/or science content knowledge. Some quasi-experimental evaluations used matched comparison groups, in which the content knowledge of teachers who participated in MSP and was compared to another group of teachers who did not participate in MSP but who had similar baseline characteristics to the MSP teachers, such as length of experience in teaching and type of teaching certification. Some projects also reported using a longitudinal design, in which teachers and/or students would be followed over multiple years to determine the extent and retention of knowledge gains.

Forty-seven percent of MSP projects in FY 2005 did not use control or comparison groups. This represents a 7 percentage point decrease from FY 2004, which may indicate increasing maturity of the projects as they move to more rigorous research designs. In addition, 29 percent of MSP projects used other evaluation methods besides comparison of outcomes between control or comparison groups. These other methods often included case studies and other forms of qualitative research. Projects that reported using multiple evaluation designs sometimes selected the "other design" category to document the breadth of their approaches.

In FY 2005, MSP projects were often involved in conducting start-up tasks, such as formalizing partnerships and implementing professional development for the first time. Others were revising, enhancing, or further developing their professional development models. Evaluation activities included collecting baseline data through needs assessments of schools and teachers and pilot testing professional development activities, materials, and data collection methods. Typically, the main purpose of these evaluation efforts was to document and review the progress of initial program activities. Some projects, for example, collected only posttest data from teachers after they received MSP professional development services.

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18 In experimental evaluations, schools, teachers, or students are randomly assigned to treatment or control groups. The outcomes of the treatment and control groups are then compared to measure program impacts. Appendix B of this report provides further discussion of MSP projects with experimental evaluation designs.

19 The decrease between 2004 and 2005 may be due, in part, to clearer guidelines issued by the Department on what constitutes an experimental research design and when experimental design is appropriate.

Data Collection Tools

Projects reported using a variety of data collection tools to document and assess the outcomes of MSP professional development activities on teachers and students. Data collected on ***teachers' content knowledge and teaching skills*** included:

- Externally developed measures of teacher content knowledge with evidence of validity and reliability (e.g., Diagnostic Mathematics Assessments for Middle School Teachers, Bush, University of Louisville; Learning Mathematics for Teaching, Hill and Ball, University of Michigan)
- State teacher certification tests or instruments based on certification tests (e.g., Praxis);
- Teacher surveys to examine teacher attitudes and confidence about teaching mathematics or science; teacher self-assessments of their content knowledge; teacher descriptions of their classroom practices (e.g., Surveys of Enacted Curriculum, Council of Chief State School Officers);
- Principal surveys and interview protocols to collect principals' assessments of teacher content knowledge;
- Class observation instruments to assess teachers' instructional practices (e.g., Inside the Classroom Observation and Analytic Protocol, Horizon Research Inc.; Reformed Teaching Observation Protocol, CRESMET, Arizona State University); and
- Teacher journals or portfolios to record their use of content knowledge, preparation for instruction, lesson delivery strategies, student engagement, and assessment of their own professional growth and growth of students.

Assessment of ***student achievement*** among the FY 2005 MSP projects mostly involved the use of state assessment data. Fifty-four percent of all 375 projects used the state mathematics test data, while 30 percent used state science assessment data. The larger percentage of projects using state mathematics tests reflects the fact that more MSP projects in FY 2005 focused on mathematics teachers than science teachers. In addition, science testing under the No Child Left Behind requirements was implemented later than reading and mathematics testing, meaning that state testing data on science was less available for MSP evaluations. Other measures of student outcomes reported by projects included:

- Locally designed tests of students' content knowledge in mathematics and science, developed by K-12 teachers and/or IHE faculty participating in MSP;
- District-developed tests of mathematics and science knowledge aligned to state standards; and
- Student surveys to examine student attitudes about and interest/confidence in mathematics and science.

Evaluation Findings

The logic underlying the MSP program posits that the provision of professional development services to mathematics and science teachers will help increase their content knowledge in these subjects, which in turn will improve their instruction, thereby increasing student achievement in these subjects. This section summarizes the evaluation findings reported in FY 2005 on teacher content knowledge, teaching skills, and student achievement. Outcomes related to partnership collaborations are also discussed.

Teacher Content Knowledge

Given that many MSP projects in FY 2005 were focused on start-up and early implementation activities, we only have limited information on how MSP professional development activities affected teacher content knowledge. Many projects only reported preliminary findings about increases in teachers' content knowledge based on pre- and post-tests, indicating that more definitive findings would be available in future reports. However, some projects did implement an evaluation design that allowed for a statistical test of significance to determine the extent of MSP impact on K-5 teacher knowledge.

Based on available FY 2005data, 76 percent of K-5 teachers who received content assessments in mathematics and/or science significantly increased their content knowledge (Exhibit 18). Data are only presented for K-5 teachers because this is the only group for which projects were required to report on significant gains in teacher content knowledge in the original annual performance reporting form.[20] These data represent a small fraction of the total number of teachers served by the MSP program. The results suggest that at least for the group assessed, the program is achieving the goal of increasing content knowledge most of the time.

Exhibit 18. Percent of K-5 Teachers with Significant Gains in Content Knowledge of Those K-5 Teachers with Content Assessments

Type of Content Gains for K-5 Teachers	Number of K-5 Teachers Assessed	Number of Teachers with Significant Gains	Percent of Teachers with Significant Gains
Mathematics content knowledge	4,937	3,158	64%
Science content knowledge	1,364	1,128	83%
Mathematics and/or science content knowledge	5,637	4,286	76%

Note: The individual percentages of mathematics and science teachers do not total the combined percentage because some projects reported significant gains in both mathematics and science for the same teachers. Data in this table are from 99 projects reporting on significant gains in K-5 mathematics, 60 projects in K-5 science, and 128 projects in K-5 mathematics and/or science.

[20] The annual performance report has since been updated so data for this measure will be available for teachers of all K-12 grade levels for FY 2006.

Teaching Skills and Other Teacher Outcomes

In addition to increased content knowledge, MSP projects reported improvements in teaching skills and increased leadership skills among participating teachers. For example, projects described anecdotally increased use of inquiry-based and standards-based instructional strategies. Projects also reported that teachers began to incorporate more technology in classroom instructional activities, use hands-on activities more frequently, and conduct differentiated instruction more than they had before receiving MSP professional development services. In addition, many projects described an increase in teachers' confidence about their content knowledge and teaching ability.

Some projects reported that teachers took on more leadership roles, such as attending or presenting at professional conferences, communicating with experts in the community, and becoming more active in teachers' or other professional associations as a result of their participation in MSP. Projects that implemented the "teacher leader" model of professional development focused explicitly on teacher leadership skills in addition to content knowledge.

Findings about Student Achievement in Mathematics and Science

Because this report is analyzing MSP projects at an early stage of program implementation, it is unrealistic to expect conclusive findings regarding gains in student achievement. However, some projects described preliminary findings of increased mathematics and science content knowledge among students taught by MSP-trained teachers.

For example, projects reported an aggregate percent proficiency across all students served by the project, along with the percent of change from the previous assessment. Exhibit 19 shows the average percentage of students scoring at the proficient level or above in state assessments of mathematics or science across all MSP projects that reported this data. In FY 2005, an average of 55 percent of students in classrooms of MSP teachers scored at the proficient level or above in state assessments of mathematics or science, up 6 percentage points from the previous assessment. Because projects did not typically report the number of students assessed, the data are not weighted by project size.

Exhibit 19. Mean of Project-reported Percents of Students Who Scored at Proficient or Above in Mathematics and/or Science State Assessments

School Level	Mean % Proficient	Mean % Change from Previous Assessment
All (Elementary, Middle, and High)	55%	6%

Note: Percentages are based on 158 projects reporting mathematics scores, and 78 projects reporting science scores. The total number reporting combined mathematics and science projects is 195 (less than the sum of the individual math and science projects). This is because some projects reported both mathematics and science proficiency scores.

Exhibits 20 and 21 provide further detail on proficiency scores for mathematics and science. Forty-two percent of the MSP projects in FY 2005 (158 projects) reported the percentage of students scoring at the proficient level or above in state assessments of mathematics. Across all grade levels, the average of the project-reported student proficiency levels in mathematics was 53 percent (Exhibit 20). Proficiency was highest at the elementary level (60 percent), followed by the middle and high school levels (51 and 48 percent, respectively).

All grade ranges showed gains in mathematics proficiency from the previous assessments. Proficiency increased by 7 percentage points for elementary school students, 4 percentage points for middle school students, and 3 percentage points for high school students.

Exhibit 20. Mean of Project-reported Percents of Students Who Scored at Proficient or Above in Mathematics State Assessments		
School Level	**Mean % Proficient**	**Mean % Change**
Elementary	60%	7%
Middle	51%	4%
High	48%	3%
All (Elementary, Middle, and High)	53%	5%
Note: Percentages are based on 158 projects reporting mathematics scores.		

In science, 21 percent of MSP projects in FY 2005 (78 projects) reported the percentage of students scoring at the proficient level or above in science (Exhibit 21). Across all grade levels, the average of the project-reported student proficiency levels in science was 55 percent, similar to the mathematics proficiency scores. As with the mathematics scores, all grade ranges reported positive average gains in science proficiency from the previous assessments, with the greatest gains at the elementary school level.

Exhibit 21. Mean of Project-reported Percents of Students Who Scored at Proficient or Above in Science State Assessments		
School Level	**Mean % Proficient**	**Mean % Change**
Elementary	54%	11%
Middle	55%	5%
High	57%	6%
All (Elementary, Middle, and High)	55%	7%
Note: Percentages are based on 78 projects reporting science scores.		

Findings about Changes in Schools and Collaboration among Partners

In addition to increases in teacher content knowledge and student achievement, MSP projects in FY 2005 reported school-level changes prompted by the program and designed to build schools' capacity to support standards-based teaching and learning. For example, projects reported developing standards-based curricular units and incorporating standards into existing curricula. Projects also cited principals and district administrators becoming instructional leaders as an important school-level outcome of MSP.

All projects created partnerships between school districts and an institution of higher education (IHE). Many projects described how MSP increased collaboration among staff within a school, among participating schools, and between school districts and IHEs. Projects also reported that MSP provided an opportunity for schools to receive mentoring services from experts in the field, as was the program's intent.

Findings from Statewide Evaluations

In FY 2005, six states (California, Delaware, Louisiana, New Jersey, New York, and Wisconsin) submitted evaluation reports that covered all of the MSP projects in the state. Overall, the majority of the states employed mixed method evaluation approaches including pre/post content knowledge tests, surveys, interviews, focus groups, journals, classroom observations, and site visits. Statewide evaluations reported on both implementation findings and outcomes for teachers and students. In terms of implementation, statewide evaluations described teacher characteristics, recruitment goals, hours of professional development. For both teacher and student outcomes, most of the statewide evaluations found positive gains on content and achievement tests. However, student outcomes were evaluated less frequently than teacher outcomes.

The scope and findings of each of the six statewide evaluations are summarized below.

California

California's MSP program is focused on increasing the academic achievement of students in mathematics (grade 5 through Algebra I) and in science (grades 4 through 8). Within these content guidelines, however, individual projects are based on regional needs and are accordingly diverse in nature. A total of 31 projects received MSP funding across two cohorts (Cohort 1 and Cohort 2). Twenty of these projects focused on mathematics only, 9 focused on science only, and 12 focused on both math and science. The number of school districts in each partnership ranged from 1 to 46, and the size of the districts ranged from 7 to 725 schools. The number of teachers served was determined by the individual projects and ranged from 13 to 450.

California requires each MSP project to conduct a local evaluation and is also conducting a three-year statewide evaluation. The statewide evaluation is collecting data on program implementation and outcomes using both qualitative and quantitative data collection methods including site visits, observations of professional development, teacher and partner surveys, teacher demographic and participation data, and a matched control/treatment study for teacher and student outcomes. The evaluation is organized according to the implementation of the five key features required of each partnership- best practices, teacher outcomes, student outcomes, and recommendations and next steps.

The five key features required of each partnership are: 1) partnership driven, 2) teacher quality, 3) challenging courses and curricula, 4) evidence-based design and outcomes, and 5) institutional change and sustainability. For the partnership-driven feature, the evaluators found that most projects targeted a manageable number of partner districts (typically between one and three), and that pre-existing relationships among partners increased the efficiency of professional development. For example, partners from Cohort 1 projects also participated in Cohort 2 projects, increasing the efficiency of those projects. In addition, the evaluation found that in most partnerships both the IHE and LEA partners were actively involved and project governance and that leadership was strong.

With respect to teacher quality, partnerships have exceeded their targets in terms of number of teacher participants, but not in terms of the expected 104 hours of professional development. However, the number of hours of professional development increased for Cohort 2 projects. Projects provided professional development using a variety of methods, but most included coaching and/or lesson study in their models. Training was of high quality, and most teachers reported satisfaction and positive effects on their content knowledge. The professional development focused on both content and pedagogy with attention to depth rather than breadth. Involvement in professional development was local and voluntary for a cohort of teachers, and increased access was provided to rural schools through the MSP program.

All partnerships operated on a theory that increased content knowledge and translation into effective instructional practice will lead to challenging courses and curricula, the third key feature of partnerships. One partnership created an online series of courses, and another partnership developed a new algebra training course for teachers. Lesson study was commonly employed to refine standards-based lessons. Some projects exposed teachers to instructional resources such as science kit modules based on standards and state-approved mathematics textbooks and supplemental activities. A few partnerships offered online courses or supplemental online assignments.

In terms of evidence-based design and outcomes, the fourth key feature, evaluators found that the Cohort 2 models were designed to impact the classroom with increasing curriculum mapping and reflective lesson planning. Most teachers believed that the professional development would impact student achievement scores, and most partnerships were able to collect student achievement data. Partnerships utilized either an internal or external evaluator. Twenty-one partnerships administered teacher pre- and post-content assessments, and more projects used local student assessments in Cohort 2.

For the fifth feature of institutional change and sustainability, the evaluators found that the MSP program was encouraging districts to focus on mathematics and science teaching and curricula in addition to their prior primary focus on English and language arts. The districts are trying to institutionalize coaching and close the achievement gap in mathematics. IHE involvement varied across partnerships but was generally stronger in Cohort 2 projects including the provision of master's programs and for credit options to teachers. The IHE faculty found their involvement in the partnership to be mutually beneficial. Nearly half of the personnel salaries are being leveraged from existing funds in Cohort 2.

Through site visits to the projects, evaluators identified best practices associated with each of the five required partnership features. They found that long-standing partnerships as well as those aimed at continuous improvement were important in being partnership-driven. Strong teacher quality was indicated by several effective forms of coaching and lesson study. Challenging courses and curricula were reflected in new courses to advance content and pedagogy as well as instructional tools such as pacing guides. Some partnerships demonstrated evidence-based design and outcomes through in-depth evaluations, including the design of local teacher and student assessments. The ongoing, active participation of IHEs and leveraging of funds contributed to institutional change and sustainability.

The evaluators developed two extensive teacher databases that collect teacher demographic and participation data for the treatment and comparison groups. As described for the above, the number of teacher participants exceeded expectations. The expectation of providing 104 professional development hours per teacher, however, has not been met. Local evaluators are currently analyzing teacher outcome data for pre- and post- teacher content assessments. This data will be available in an upcoming statewide evaluation report.

The statewide evaluation is also evaluating student outcomes. To date, evaluators have collected baseline data for a matched comparison study of student mathematics and science achievement scores. For the first cohort, regression analyses indicate that the mathematics performance of students with MSP teachers was significantly higher than the matched comparison group.

Based on the available data, the evaluation team presented two major recommendations for California's MSP program. The first is to strengthen professional development models by providing definitions for "intensive" and "follow up" activities and integrating MSP with other statewide initiatives in mathematics, re-examining the scope of partnerships at the beginning and midpoints of projects, and encouraging more involvement by LEAs. The second recommendation is to strengthen the research models of the partnerships through stronger local evaluations, improvement of the alignment of the contract period, reporting, and research design for cohorts, technical assistance for teacher and student assessments, improvements in statewide data collection and accessibility, and teacher/student outcome studies in science.

Delaware

Delaware funded two MSP projects in the northern and southern part of the state that were both focused on improving secondary mathematics instruction for at-risk students in grades six to 10. The projects were structured around teachers videotaping one another during instruction and then watching and critiquing their own and others' techniques. By observing instruction, teachers were attempting to understand which strategies were effective for students and which were not. The projects focused on three main components: 1) Design and Implementation of the Lesson, 2) Mathematics Content, and 3) Classroom Culture.

The evaluators prepared an observation protocol as the major measure of teaching quality with a set of indicators that addressed each of the three components. Observers were trained until they reached an adequate level of inter-rater reliability. Observers visited 47 classrooms in October and 37 of the same classrooms again seven months later. Teachers' performance against each indicator under each component was rated using a three-level scale: "close to ideal," "getting there," or "not even close."

Results were reported by comparing differences in ratings of the component indicators between the fall and spring observations. For the first component, *Design and Implementation of the Lesson*, there was improvement in nearly all of the indicators between the fall and spring observations. Teachers showed progress in defining and communicating the mathematical purpose of the lesson, engaging students with important ideas, stimulating investigation and exploration, achieving a collaborative approach to learning, promoting student interaction, considering students' prior experiences, and adjusting to different student learning styles. In two areas, asking higher order questions and "wrapping up" the lesson, only half of the teachers were either "close to ideal" or "getting there." The evaluators emphasized the importance of these indicators for promoting inquiry, ensuring conceptual closure for students, and assessing impact by teachers.

For the second component, *Mathematics Content*, indicator ratings were similar between fall and spring assessments. Ratings of how challenging and accessible the content was to students were high across teachers. In addition, teachers did not make any conceptual errors during the lesson observations. While two-thirds of the teachers connected the lesson concepts to other mathematics or real world content in the fall, this fraction decreased in the spring observations. Performance was poor on the remaining two indicators: balancing content between concepts and fluency and including mathematical abstraction as appropriate.

There were encouraging results across most indicators for the third component, *Classroom Culture*. The majority of teachers promoted the production of ideas and questions from students, created a climate of respect for students' ideas, and enhanced productivity via their classroom management styles. Two indicators of classroom culture, however, are in need of improvement. Just under one quarter of the teachers failed to always expect or value the participation of all students. In addition, students' ideas were explored, explained, or challenged for less than a quarter of the time.

On the whole, teachers made positive changes in multiple aspects of the two components of Design and Implementation of the Lesson and Classroom Culture. There was little change, however, in the other component, Mathematics Content. The evaluators surmise that it is easier for teachers to restructure lessons and enhance the classroom climate than it is to increase the rigor of mathematical content.

Louisiana

In FY 2005 Louisiana funded 23 MSP projects, 12 of which received first-time funding and 11 of which were approved for a second year of funding. The projects served approximately 566 mathematics and science middle school teachers who volunteered to participate and sometimes gained highly qualified status through the MSP program. Nine universities and 38 school districts were involved in the partnerships. The projects utilized two- to three-week summer institutes focused on adult-level content. School year follow-up sessions focused on connecting the content to classroom practice.

The state evaluation used data from pre- and post-tests administered to teachers for the summer institutes, state student assessment data, and teacher survey data. Teacher content tests were developed by university faculty in order to address the unique nature of each project. Student assessment and teacher survey data were collected by the state's web-based data system. Data were analyzed using statistical and qualitative procedures.

Teacher content assessments were comprised of multiple-choice and constructed response items. The evaluators cautioned on the utility of comparing scores across projects because of the different tests used. However, all projects showed gains in teacher content knowledge, and 21 of the 23 projects showed statistically significant gains.

Evaluators compared outcomes for two student groups: students whose teachers participated in the MSP program and students in the same grade and school whose teachers did not participate in MSP. Both student groups took the same state criterion-referenced test during the spring, and the demographic characteristics of both groups were similar. The state test measured students' knowledge of state standards in the content area. Students received scale scores that corresponded to one of five achievement levels. In mathematics, the mean scaled score for students whose teachers participated in MSP projects was significantly higher than for students whose teachers did not participate in MSP. These scores also indicate that a higher percentage of students with MSP teachers achieved a proficiency level than students with teachers who did not participate in MSP. The science scores were not as positive as the mathematics scores and varied across grade levels. While grade 5 and 6 students with MSP teachers had higher achievement than same level students with teachers who did not participate in MSP, this was not true for grade 7 and 8 students. Further investigation may explain these differences, but the evaluators postulate that the content areas addressed by the MSP projects may not have been tested at the 7th and 8th grade levels for students.

Mathematics and science teacher survey results were similar. Teachers participated in the projects in order to gain highly qualified status, increase their content knowledge and teaching skills, and gain a better understanding of the state-adopted curriculum and grade level expectations. The vast majority of teacher participants reported that their goals for the projects had been met.

The evaluators concluded that teacher content knowledge increased in both mathematics and science. The better performance by students with mathematics teachers who participated in MSP indicates an effect on student achievement as well. The mixed results for science achievement warrant further study. In addition, more in-depth investigation of the summer institutes and follow-up activities may provide greater understanding of the effectiveness of the MSP program.

New Jersey

The New Jersey Department of Education awarded MSP funds to three institutions of higher education to develop MSP projects throughout the state. The MSP projects all serve middle school math and/or science teachers, but each has unique curricula and professional development schedules.

The evaluation began in April 2006 and will continue until April 2008. Evaluation activities to date have focused on professional development. Data has been collected and analyzed for lead agency training, participant teacher training, teacher pre- and post-assessments, and professional development observations.

The purpose of the lead agency training was to inform the lead agency of the goals of the evaluation, obtain feedback from the lead agency on the proposed evaluation activities, and collaborate on solutions to perceived issues. The training was conducted separately for each lead agency to account for their individual implementation strategies. In all cases, the training occurred prior to the summer institutes. Each training was highly successful, due in large part to the support of the principal officers of the lead agencies.

Similarly, the evaluators conducted trainings for participating teachers to inform them of the goals of the evaluation and of their responsibilities. In particular, the evaluator addressed questions and concerns about data confidentiality. Teachers seemed to understand the value of the evaluation, and all signed consent forms for the study. This training was carried out on the first day of each summer institute.

Pre- and post-assessments were administered at the beginning and end of each summer institute. Teachers responded to items about their demographic characteristics (pre-test only), use of standards for instruction, instructional practices, and content area knowledge. Although each lead agency developed their own content area items, the evaluators recommended relevant assessment resources and also reviewed and provided feedback on the final items. Pre-and post assessment data has been analyzed for two of the three lead agencies. Analyses of teacher content knowledge for all three lead agencies will be provided in the next evaluation report.

Finally, the evaluation team observed five of the professional development activities of each MSP partnership. Four observations were conducted during the summer institutes, and the fifth occurred during school year follow-up. The purpose of the observations was to document the content and pedagogy offered to participants. The evaluators used a structured observation protocol, a modified version of the Horizon instrument that included indicators on the design of the session, implementation, content, pedagogy and materials, and culture. The summer institutes of all partnerships were rated highly, receiving an overall average rating of four on a scale of one to five. Key factors responsible for the high rating included comfortable learning environments, intellectual engagement with appropriate content, modeling of questioning strategies leading to discovery of new concepts, thorough planning resulting in good pacing of activities, and an inquiry-based approach that emphasized transfer of content to successful practice.

Future evaluation activities include documenting follow-up professional development, finalizing analysis of pre- and post-assessments, providing assistance to lead agencies in developing teacher and student comparison groups, and analyzing comparison group data.

New York

The New York state evaluation used a survey instrument to collect demographic data on teachers, schools, and students as well as outputs, outcome measurement tools, and outcomes for specific goals across each of the state's MSP projects. Sample goals and data were provided for one of the New York MSP projects. Their goals included 1) implementing a high-quality MSP project, 2) increasing content knowledge of participating science teachers, 3) improving the quality of science instruction of participating teachers, and 4) improving student achievement in science.

For the first goal of implementing a high-quality MSP project, the project held a summer institute supplemented by a series of workshops and specific trainings. Outcome measurement tools included teacher surveys, focus groups, and interviews as well as site visit logs, classroom observation protocols, and document review. More than 95 percent of teachers rated their professional development, instruction, and project activities highly.

The second project goal was to increase the content knowledge of participating science teachers. A pre- and post- Environmental Science Content knowledge test was administered. Other tools included a classroom observation protocol and teacher surveys, focus groups, and interviews. Fifty-seven percent of the teachers increased their score on the pre-post content test by a minimum of one point, while 46 percent of the teachers increased their score by at least 10 percent. In terms of self-reported data, 99 percent of teachers found that the professional development activities provided them with adequate time to gain familiarity with the subject matter. In addition, more than 99 percent of teachers stated that the workshops prepared them to implement activities with their students.

For the third goal of improving the quality of science instruction of participating teachers, teacher reported data from surveys, focus groups, and interviews was collected along with data from site visit logs and classroom observation protocols. For instructional outcomes, 95 percent of teachers reported that they planned to use the summer institute content in their instruction, but there was a one percent decrease in the number of teachers reporting that they organize students in groups. For the supplemental workshops, there was a 21 percent increase in the number of teachers who use the local environment to teach science, and a six percent increase in the number of teachers who used inquiry-based science activities.

For the fourth and final goal of improving student achievement in science, student state achievement test data was collected and analyzed. Teacher focus group and interview data were collected. Teacher survey data will be collected in the upcoming year. The analysis of state student achievement data indicated that 51 percent of students whose teachers participated in the MSP project met or exceeded the state standard on science achievement tests. In addition, six percent more students with MSP teachers met or exceeded the state standard on science achievement tests for grades 4 and 8 as compared to students of those same years from the previous baseline year.

Wisconsin

The Wisconsin state evaluation summarized information from the three documents (Project Profile, Project Narrative, and Evaluation Report) that each of the states 10 MSP projects submitted to the Department of Education. The evaluation found that there was substantial diversity among the projects evident in the wide range of professional development activities conducted through summer institutes and during the school year, including: certificate programs, classroom visits, support groups, short-term professional development, online courses, and online support networks.

Projects targeted their professional development to individual teachers rather than whole schools. Across the state, more than 300 teachers participated in MSP projects with a typical number of 30 teachers per project. Middle school mathematics teachers were served by most projects, but some elementary, high school, science, special education, and general education teachers participated as well. With the prevalence of middle school mathematics teacher participants, the content of the professional development activities was most often focused on mathematics topics. Other topics included integration of technology, alternative assessment, inquiry activities, and an inquiry oriented/investigative classroom environment. All projects were similar in focusing on teacher implementation of content and improved student achievement. Two projects specifically asked teachers to conduct pre-and post-tests of student learning about the new professional development content.

Two projects had planned to use a quasi-experimental design with comparison groups, but both were unable to recruit a sufficient number of comparison teachers. None of the Wisconsin projects, therefore, were able to conduct a comparison group design. Evaluation tools for most projects included pre- and post teacher content knowledge assessments designed by course instructors or evaluators. Across projects, other common tools used were teacher surveys, reflective journals, and focus groups.

The most common finding across the projects was that teacher content knowledge improved as a result of MSP professional development activities. The evaluation found statistically significant gains in teacher content knowledge pre- and post assessments, supported by teacher reports of increased content knowledge. Many projects also reported improvements in classroom instruction. Projects encouraged teachers to implement the new content and instructional strategies through classroom action plans, action research projects, videotaping of instruction and critique of videos with an instructional resource teacher, and sharing and critique of lesson plans, instructional strategies, and assessments.

The MSP partnerships created new collaborations between IHEs and LEAs to design, implement, and monitor new graduate level or professional development courses. Collaborations also developed among teacher groups across grade levels and across districts in geographically isolated areas.

Finally, the evaluators summarized the lessons learned across projects for increasing student achievement and refining the state leadership role. To increase student achievement, they recommended extending the length of MSP projects, encouraging teachers to develop alternative assessments, requiring teachers to document changes in classroom practice, targeting teams of teachers and administrators from the same building, providing clear purposes about the MSP program, and providing more support to teachers during the academic school year. For state leadership, they suggested addressing high need teachers and schools, requiring annual documentation of project implementation changes and formative assessments, and improving the quality of project reporting, evaluations, and classroom observations.

Summary and Conclusions

The MSP program was created in 2001 to provide professional development services to elementary and secondary level mathematics and science teachers in order to improve student achievement in these areas. By FY 2005, 374 individual MSP projects were in operation across the country, providing professional development services to an estimated 37,000 teachers. Overall, the projects served more middle school teachers than elementary or high school teachers, and more mathematics teachers than science teachers. However, many projects served teachers across grade ranges and subject areas. In addition, special education teachers and program administrators also received MSP professional development services, although in smaller numbers.

Most MSP projects in FY 2005 provided professional development through summer institutes followed by additional training and monitoring during the school year. Within this broad framework, the professional development activities were quite varied. In addition to summer institutes, projects used study groups, workshops, seminars, college courses developed specifically for MSP participants, as well as distance learning courses to reinforce learning. Most projects reported providing an average of 137 hours of professional development per teacher served, a sizeable increase over many past short-term professional development efforts. The content of MSP professional development activities was somewhat more likely to focus on mathematics topics than science topics, leading to the larger proportion of mathematics than science teachers participating in MSP. However, some projects focused primarily on science and others addressed both mathematics and science topics.

Summary of Achievements

During FY 2005 the MSP program moved from planning to operation. Data on project funding suggest that states tried different approaches to distribute program resources to reach the goals of their initiatives most efficiently. States established criteria and procedures for selecting MSP projects, reviewed applications, and provided technical assistance to selected partnerships.

Once funded, local projects began to design professional development programs, recruit teacher participants, and implement professional development activities and follow-up services. During this program year, university faculty worked with K-12 schools to design professional development activities that were applicable to classroom teaching.

Establishing effective working partnerships is an ongoing challenge for the MSP program, requiring considerable attention and support from all partners. In FY 2005, projects reported that they were continuing to learn about each partner’s expertise and how best to combine their skills effectively.

Projects also heeded the legislative guidance about incorporating rigorous evaluation into their activities and plans. In FY 2005, projects with strong research designs were beginning to provide a set of promising teacher content and student achievement findings. Given that most projects at this time were in an early implementation phase, their evaluations often focused on process and implementation. At the same time, many projects collaborated with IHE partners and external evaluators to design evaluations, identify assessment instruments, and collect baseline data on teacher content knowledge and student achievement, thereby laying a solid foundation for measuring program impact in coming years. Future annual reports will likely substantially expand our understanding of who is participating in MSP, the types of professional development activities provided, and the extent to which the program is meeting its goals of increasing teacher content knowledge and student achievement.

Lessons Learned to Enhance Future Program Achievements

Without exception, MSP projects reported substantial achievements in meeting their goals. In addition, projects offered various lessons learned from their experiences. While many of the lessons learned were site-specific, some were more broadly applicable. Following is a summary of recommendations and promising practices culled from the narrative reports of projects with strong research designs.

With respect to partnerships and collaboration, the projects offered the following suggestions:

- **Ensure regular communication among all MSP participants.** Partnerships require frequent and timely communication among all involved to ensure that goals and benchmarks are being met. School leadership, building principals, in particular, need to be involved in all aspects of the planning and delivery of MSP projects. .
- **Organize partnership activities around a school model.** Projects organized around individual teachers or multiple districts may miss the opportunity to develop a learning community within a school building.

To ensure strong teacher participation in the partnerships, projects should:

- **Implement strategies to enhance teacher recruitment**, including recruiting early and actively, providing incentives such as continuing education credits, recruiting large numbers of teachers from a few schools rather than a few teachers from many schools, and extending the length of the grant support. Projects should also have a plan to limit teacher attrition.
- **Identify and enroll teachers who most need professional development in math and/or science.** Teachers in greatest need of professional development are teachers who did not major or minor in math or science or who have taken few, if any, science or math content courses, as well as teachers who work with low academic achieving students. Building administrators can help identify teachers in greatest need of professional development.
- **Keep content knowledge development as the central goal for the project.** Projects can help maximize teacher learning by: scheduling professional development at optimal times for teacher participation, using hands-on and inquiry-based learning methods, encouraging group project work that reinforces classroom learning, and ensuring that the content is both rigorous and carefully linked to classroom implementation.

A number of factors are important to the success of a project, including

- **Strong IHE faculty** IHE faculty play a key role in providing professional development to MSP teachers, designing and leading summer institutes and follow-up projects during the school year. It is important that the project's teaching faculty are able to model research-based pedagogical strategies in their teaching. IHE faculty should also expect and prepare for a higher level of engagement in the classes than they may be used to in their undergraduate courses. Faculty who are effective in teaching adult learners and can model sound pedagogical strategies are a limited resource. Consequently, projects should consider recruiting faculty from more than one IHE to ensure high quality teaching in all professional development activities.

- **The teacher-leader model.** Some projects found the teacher-leader model promising. However, more work needs to done to refine how this model is used in schools to help teachers and their students most effectively.
- **Provide multiple professional development sessions over the course of the year.** States and individual projects have found that long-term, sustained professional development is more effective in increasing teachers' content knowledge than single, one-time professional development sessions.

The projects provided advice about evaluation:

- **Design and implement strong evaluations**. Projects should take the cost of the evaluation into consideration when developing their project and evaluation designs. Evaluations that use random controlled trials (RCT) designs with pre- and post-assessments of teacher and student knowledge provide the most valid and reliable data on the efficacy of the intervention, though other pre-test/post-test designs also yield reliable data. Evaluations that rely on self-reported data are less reliable than other designs.

Finally, the following suggestion is aimed at the state and national policy level:

- **Increase the length of MSP grants to ensure systemic change.** Some project reports described the importance of having enough time to develop trusting relationships with all MSP partners. The full three years that are allowed in the legislation should be given more frequently.

MSP: Outlook for Future Years

In FY 2005, the MSP program moved from planning to operations. Local projects developed professional development models, recruited teacher participants, and provided training through summer institutes and follow-up activities. Faculty from institutes of higher education worked closely with schools and districts to increase teachers' understanding of critical topics in mathematics and science and to help teachers' translate that knowledge into more effective classroom instruction.

While MSP projects reported substantial progress in meeting their goals, projects also found establishing effective working partnerships to be an ongoing challenge requiring considerable attention and support from all partners. In FY 2005, projects continued to learn about each partner's expertise and how best to combine their skills effectively. They also learned valuable lessons about how to organize partnerships between schools and universities and how to engage teachers in professional development activities. In future years' reports, we expect to see effective partnership operations, the implementation of well-developed professional development models, and more comprehensive use of rigorous methods of evaluation to document improved teacher knowledge and higher student achievement.

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Appendix A: Projects Highlighted in Report

State	Project Name
Alaska	Journeys in Mathematics
California	Making Algebra Accessible
California	Getting Ready for Algebra
Colorado	Physical Science and Mathematics in the Middle School Classroom
Georgia	Mathematics and Science Partnership: Dougherty County School System
Illinois	Astronomy Resources Connecting Schools (ARCS)
Louisiana	East Baton Rouge/Louisiana State University-Baton Rouge Mathematics Partnership Program
Minnesota	Southeast Minnesota Inquiry-Based Science Project
Minnesota	Teaching Relevant Inquiry-Based Environmental Science (TRIBES)
Mississippi	Advancing Teachers of Middle School Science (ATOMS)
Oregon	North Coast Highly Qualified Science Teacher Initiative
Pennsylvania	School District of Philadelphia/Drexel University/Franklin Institute/Math/Science Partnership
Vermont	Vermont Science Initiative

Appendix B: Findings from Projects with Experimental Evaluation Designs

In FY 2005, 3 percent of projects (12 projects) reported that they were implementing experimental evaluation designs. Experimental designs are 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. Outcomes are then analyzed for each group, with the difference between treatment group outcomes and control group outcomes attributable to the impact of the intervention.

Project narrative and local evaluation reports for the 12 projects reporting experimental designs were examined in detail to learn more about their evaluation activities. Four of the 12 projects actually used random assignment to create professional development treatment or control groups. Five projects used a quasi-experimental design in which they sought to compare the content knowledge of teachers participating in MSP before and after receiving professional development to a similar group of teachers not participating in MSP. One of the five quasi-experimental projects had intended to conduct an experimental design evaluation, but was unable to establish a control group and so used pretest and posttest measures of teachers' content knowledge as an alternate design. One project did not use control or comparison groups, but instead used other evaluation methods such as documenting the number and characteristics of teachers who became highly qualified, student achievement scores of participating schools, and pretests, surveys, and interviews about content knowledge and perceptions of professional development participants. Another project used an experimental design to evaluate an algebra curriculum rather than professional development. The final project that reported an experimental design did not provide enough information in the narrative report to fully assess the evaluation design.

The four projects that conducted experimental evaluations using random assignment reported a range of professional development interventions and outcomes. For example, one study attempted to reduce the number of temporarily certified mathematics and science teachers by increasing their teacher content knowledge through a summer institute with follow-up. Two similar projects (one in math and one in science) evaluated the impact of a constructivist professional development model on teacher content knowledge and student achievement. Finally, one study developed a comprehensive professional development model in mathematics with a summer institute and school year follow-up, but focused the experimental evaluation on a third program component – collaboration among middle and high school teachers around the study of student work. The following brief descriptions provide a picture of how these projects designed, implemented, and evaluated their professional development interventions.

Mathematics and Science Professional Development for Teachers with Emergency and Temporary Certifications

A project in Pennsylvania sought to reduce the number of mathematics and science teachers with temporary (as opposed to permanent) certifications by providing a summer institute and follow-up professional development activities. More than 120 teachers with emergency and temporary certifications in mathematics or science participated in the study. Sixty mathematics and science teachers were randomly selected to be in the treatment group and 60 were randomly selected to be in the control group. Only the treatment group received professional development services.

The professional development services provided to science teachers in the treatment group consisted of: a one-week science content session offered by IHE faculty from one institution, four week-long workshops on the environmental science topics by IHE faculty from another institution; and five three-day workshops on laboratory based science from a third institution. Mathematics teachers participated in workshops on geometry and algebra taught by IHE faculty from one of the partner institutions.

IHE faculty evaluated the teachers' content knowledge with standardized tests as well as sample PRAXIS tests in mathematics and science. While there was no significant difference between the treatment and control groups on the mathematics and science content pretests, the treatment group receiving professional development performed statistically significantly better on the posttests.

Nearly 2,400 students received instruction from participating teachers. Their achievement was measured by common grade level assessments, the Terra Nova assessments in science, and the PSSA math test. As with the teacher assessments, there was no significant difference between the treatment and control group pretests in mathematics and science. However, the treatment student group scored also scored statistically significantly better on the posttests.

Finally, the researchers used classroom observations and lesson plan review to assess key aspects of teachers' practice. The control group used experiments, manipulatives, and/or technology in 18 percent of their lessons, while the treatment group used these tools in 47 percent of their lessons.

A Constructivist Model of Professional Development for Two Partnerships

Two Michigan projects, one focused on grades 3-8 mathematics and the other on grades 5-9 science, evaluated a Constructivist Model of professional development, which asserts that people learn by constructing their own understanding. To enact this model, both projects utilized two-week summer institutes (80 hours) followed by monthly Learning Community and Study Group meetings (42 hours) during the school year and a one-week wrap-up workshop (40 hours) during the next summer.

For both projects, the content of the summer institutes was determined by (1) analysis of the most recent student performance outcomes for the districts, schools, and teachers involved, (2) a pretest that addressed the state content standards and benchmarks, and (3) a teacher completed needs assessment. The math project studied Number, Algebra, Geometry, and Measurement. The science project studied the organization of living things (life science), matter and energy (physical science), the geosphere, and the solar system, galaxy, and universe (Earth and space science). The Constructivist Model was facilitated in the summer institutes by IHE faculty lectures supported by master teacher consultants. The master teacher consultants helped teachers apply the content to real life experiences and integrate it into lessons and assessments developed for use in teachers' classrooms.

Both projects recruited teachers from high need districts. The math project recruited 99 teachers, with 50 randomly assigned to the treatment group and 49 assigned to the control group. The science project recruited 91 teachers, with 47 randomly assigned to the treatment group and 44 to the control group.

Teacher content knowledge was assessed for both projects with state tests based on released MCCT items. For the mathematics project, there was a slight but not significant gain for the treatment group in the posttest. The science project has just collected pretest data at this point in their study.

Student content knowledge was measured by the state mathematics and science assessments. While mathematics teachers in the treatment group did not show significant gains, students did. A regression analysis indicated that the treatment students had a significant advantage in obtaining higher gains on the posttest. Student data for the science project is forthcoming.

Assessing the Impact of an Added Learning Community Intervention for Secondary Mathematics

An example of a random-assignment, experimental-design evaluation was provided by a Michigan project that is working with 21 rural school districts. This project recruited 125 teachers in grades 6 through 12 who are teaching mathematics.

The project's professional development intervention consists of three components:

1) *School Year Professional Development Programs:* Three full-day professional development programs are provided each school year. The first day is an introduction for administrators and all grades 6-8 math teachers. The second day examines what comprises good math teaching, and the third day focuses on specific content (transformational geometry, matrices, and animation in 2005-06; algebraic thinking, real number system and its properties in 2006-07).

2) *Summer Institute:* The summer institute in 2006 held eight six-hour sessions focused on statistics, Cabri Jr., application on graphing calculators, two and three-dimensional geometry, and making mathematical arguments. The 2007 institute will address rate of change and family of functions for three six-hour sessions.

3) *Tuning-Protocol Sessions (for experimental group only):* In tuning protocol sessions, middle and high school teachers collectively analyze students' work in order to understand students' thinking. The emphasis of the sessions is on building and sustaining collaborative, disciplined, and reflective thinking about mathematics among teachers.

Embedded in the comprehensive evaluation is an experimental research project to determine the effects of the added learning community intervention, the Tuning-Protocol Sessions, in a subgroup of participating districts. Nine districts were randomly assigned to the experimental treatment group and nine districts were assigned to the control group. Teachers in the treatment-group districts participated in 12 learning community sessions in which they methodically used the tuning protocol to facilitate collaboration, articulation, and coherence across grade levels with a focus on the quality of student work. All teachers in the study received full-day school-year and summer institute professional development.

To date, the evaluation team has collected baseline data for the study. Data collection instruments include teacher content knowledge assessments (Learning Mathematics for Teaching, Hill and Ball, for middle school teachers and project-developed assessment for high school teachers), student content knowledge assessments (state mathematics tests), teacher survey, teacher and building principal interviews, and lesson observations. Data on program implementation has been collected through questionnaires, observations, and interviews.

Early analyses indicate that although participation in the program is strong, teacher content knowledge requires improvement, teacher practice is teacher-centered and dominated by procedures, teachers' use of technology and manipulatives is limited, interactions between middle and high school teachers are few outside of the project, and student achievement is insufficient.

Appendix C: Methodology

This appendix describes the methodology used in the FY 2005 analysis of the Mathematics and Science Partnerships Program. The analyses are based upon information submitted by the MSP projects in their FY 2005 annual performance reports to the U.S. Department of Education. The annual performance reports included responses to a survey instrument (Project Profile), a narrative report, local and/or state evaluation reports (if available), and any additional documentation of MSP activities. The reports described project-level program goals, participants, professional development activities, and evaluation findings.

The review of the annual performance reports involved multiple analytic approaches. Quantitative data reported in the Project Profiles were analyzed using descriptive statistics, and narrative text data for a sample of projects' narrative reports were content-analyzed using a qualitative analysis system (NVivo). The statistical and narrative analyses are explained below in more detail.

Statistical Methodology

This section describes the methodology used in the statistical reporting for FY 2005 of the Mathematics and Science Partnerships program.

Study Design and Sample

The study was designed as a census data collection of the entire population of MSP projects. There are 436 MSP projects in the population of MSP projects. Of these, 86 percent (n = 375) provided data in time for the study analysis. Thus, the full population can be thought of as consisting of two kinds of projects: those that were willing and able to respond (n=375 responders) and those that were either unwilling or unable to respond (n=61 non-responders). We treat the responses from the n=375 responders as representative of the full population of 436 projects. The n=375 responders are *not a sample* from the full population, but instead are a *census* of the entire population of the type of projects that are willing and able to respond (responders). Therefore, our uncertainty about whether a mean or proportion calculated from the n=375 would be different than a mean or proportion from the entire population of 436 projects has nothing to do with sampling error, and is entirely a matter of potential non-response bias. Since there was no sample, and no sampling error, we do not produce confidence intervals around means or proportions, as confidence intervals are designed to tell us something about uncertainty about a mean or proportion due to having a sample rather than a census. We do not produce p-values for comparisons between groups, as those types of tests would tell us whether the observed difference between two groups represent a real population difference, or whether the observed difference may be due to sampling error. These data are not a sample, so there is no sampling error. (The numbers and percentages presented in this report are not estimates of the full 436 MSP project population characteristics; instead, they are the true population characteristics of the "responder" projects and cannot be assumed to represent the entire population of 436 projects.) There may, however, be non-response bias in the reported figures.

Non-response bias is the extent to which the full population mean or proportion differs from the mean or proportion obtained from the n=375 responder projects. Non-response bias can occur if the n=61 non-responder projects would have given systematically different survey responses (if they had responded) than the n=375 responder projects. There is no way to know how similar or different the responses of non-responder projects would be if those responses were known. We can, however, put bounds on how different the population mean could possibly be from the mean of the n=375 projects. Since the response rate was high (86%), there is relatively little threat of serious non-response bias. For example, suppose that 20 percent of the n=375 responder projects had budgets of $100,000 or less. How different could the full population proportion of projects with budgets of $100,000 or less be from the 20 percent found for the responder districts? Suppose none of the n=61 non-responders had budgets of $100,000 or less. Then the full population proportion of projects with that budget level would be (.86 * .20) + (.14 * 0) = 0.172, or 17.2 percent. At the other extreme, what if all of the of the n=61 non-responders had budgets of $100,000 or less? Then the full population proportion with that budget level would be (.86 * .20) + (.14 * 1) = 0.312. Thus, we know that the true population proportion with that budget level must be between 17.2 and 31.2 percent.

The exhibit below shows the bounds around other proportions. For example, if 50 percent of the n=375 responder projects answered "yes" to a survey item, we know that the true proportion in the full population of 436 projects cannot be lower than 43.0 or greater than 57.0 percent.

Proportion of Responding Projects that Answered "Yes" to the Question	Lower Bound on Potential Bias	Upper Bound on Potential Bias
0.1	0.086	0.226
0.2	0.172	0.312
0.3	0.258	0.398
0.4	0.344	0.484
0.5	0.430	0.570
0.6	0.516	0.656
0.7	0.602	0.742
0.8	0.688	0.828
0.9	0.774	0.914

Lower Bound Formula = (.86 * Proportion Yes in Response) + (.14 * Lowest possible answer)
Upper Bound Formula = (.86 * Proportion Yes in Response) + (.14 * Highest possible answer)

Expanded Data Tables

This appendix presents detailed information on FY 2005 reported statistics in order to provide a more comprehensive picture of the data. The tables below provide ranges and quintiles to expand on the information presented in select tables in the main report. Where appropriate, standard deviations are also presented. The standard deviation measures the spread of the data around the mean, measured in the same units as the data. The standard deviation provides a measure of statistical dispersion, allowing us to assess the distribution of the data and thereby serving as a measure of uncertainty around the mean. Large standard deviations typically occur when the data is widely dispersed, or when there are outliers in the data, indicating that the mean may not be a reliable prediction for the average MSP project; small standard deviations show that many data points are close to the mean. Assuming that our data are normally distributed, for any given statistic we can reasonably assume that approximately 68% of MSP projects are within one standard deviation of the mean, about 95% of the projects are within two standard deviations of the mean, and approximately 99.7% of MSP projects lie within three standard deviations of the mean. (The data on funding amounts are most likely not normally distributed.)

Further information on the FY 2004 numbers presented in this report can be found in the first year FY 2004 report.

Exhibit 4. MSP Project Budgets from State MSP Grants

Three-hundred-forty-one projects provided data on funding from State MSP Grants in FY 2005. Reported project funding dollar amounts are categorized into five distinct categories. Any project reporting a dollar figure within the specified range was counted toward the reported percentage in that row. Rows are mutually exclusive. Projects with dollar amounts of 0 or missing were excluded from this analysis. Frequencies were run on each category (as displayed in the appropriate rows), and each frequency was divided by the total number reporting in this field (341) to produce the appropriate percentage.

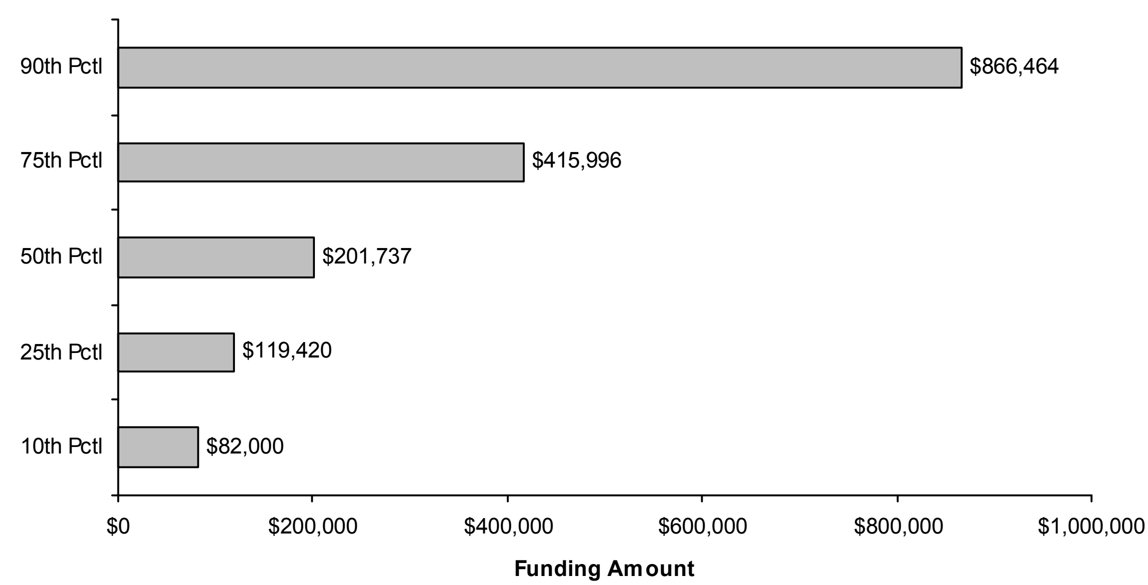
Exhibit 4. MSP Project Budgets from State MSP Grants

Project Budgets	FY 2004 Percent (Number) of Projects	FY 2005 Percent (Number) of Projects
$100,000 or less	22% (51)	20% (69)
$100,001 to $200,000	23% (54)	29% (100)
$200,001 to $500,000	32% (77)	32% (107)
$500,001 to $1,000,000	17% (41)	14% (47)
$1,000,001 or more	6% (15)	5% (18)
Total	100% (238)	100% (341)

Exhibit 4.1. MSP Project Budgets from State MSP Grants, FY 2005 Additional Information

Minimum	Maximum	Mean	Median	Std Dev
$10,000	$3,539,372	$352,067	$201,737	$407,858

Exhibit 4.2. MSP Project Budgets from State MSP Grants, FY 2005 Quintiles



How to read Exhibit 4.2: 90 percent of MSP project budgets from State MSP Grants were $866,464 or less; 75 percent were $415,996 or less; 50 percent were $201,737 or less, etc.

Exhibit 5. MSP Project Budgets: Additional Federal Funds

Thirty-five projects provided data on funding from Additional Federal Funds in FY 2005. Reported project funding dollar amounts are categorized into five distinct categories. Any project reporting a dollar figure within the specified range was counted toward the reported percentage in that row. Rows are mutually exclusive. Projects with dollar amounts of 0 or missing were excluded from this analysis. Frequencies were run on each category (as displayed in the appropriate rows), and each frequency was divided by the total number reporting in this field (35) to produce the appropriate percentage.

Exhibit 5. MSP Project Budgets: Additional Federal Funds

Additional Federal Funds	FY 2004 Percent (Number) of Projects	FY 2005 Percent (Number) of Projects
$10,000 or less	21% (6)	23% (8)
$10,001 to $50,000	29% (8)	46% (16)
$50,001 to $100,000	21% (6)	11% (4)
$100,001 to $500,000	18% (5)	14% (5)
$500,001 or more	11% (3)	6% (2)
Total	100% (28)	100% (35)

Exhibit 5.1. MSP Project Budgets: Additional Federal Funds, FY 2005 Additional Information

Minimum	Maximum	Mean	Median	Std Dev
$960	$1,785,277	$128,400	$28,314	$317,760

Exhibit 5.2. MSP Project Budgets: Additional Federal Funds, FY 2005 Quintiles

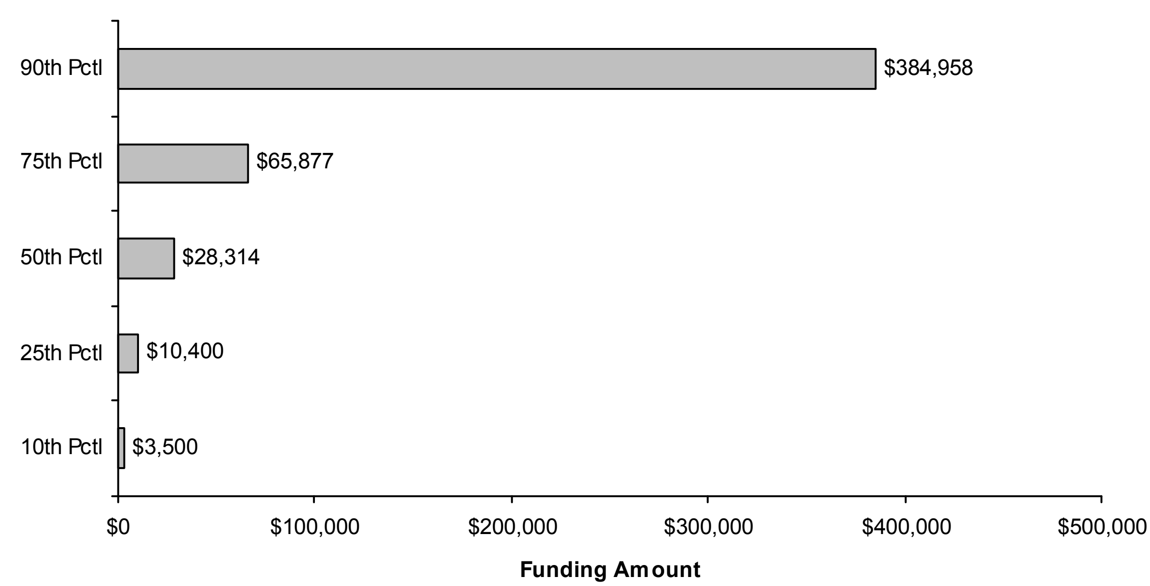


Exhibit 6. MSP Project Budgets: Funds from Local Education Agencies (LEAs)

Seventy-seven projects provided data on funding from Local Education Agencies in FY 2005. Reported project funding dollar amounts are categorized into five distinct categories. Any project reporting a dollar figure within the specified range was counted toward the reported percentage in that row. Rows are mutually exclusive. Projects with dollar amounts of 0 or missing were excluded from this analysis. Frequencies were run on each category (as displayed in the appropriate rows), and each frequency was divided by the total number reporting in this field (77) to produce the appropriate percentage.

Exhibit 6. MSP Project Budgets: Funds from Local Education Agencies (LEAs)

Local Education Agency	FY 2004 Percent (Number) of Projects	FY 2005 Percent (Number) of Projects
$5,000 or less	20.5% (10)	18% (14)
$5,001 to $10,000	16.0% (8)	16% (12)
$10,001 to $50,000	31.0% (15)	35% (27)
$50,001 to $100,000	12.0% (6)	10% (8)
$100,001 or more	20.5% (10)	21% (16)
Total	100% (49)	100% (77)

Exhibit 6.1. MSP Project Budgets: Funds from Local Education Agencies (LEAs), FY 2005 Additional Information

Minimum	Maximum	Mean	Median	Std Dev
$200	$424,198	$64,892	$24,000	$93,044

Exhibit 6.2. MSP Project Budgets: Funds from Local Education Agencies (LEAs), FY 2005 Quintiles

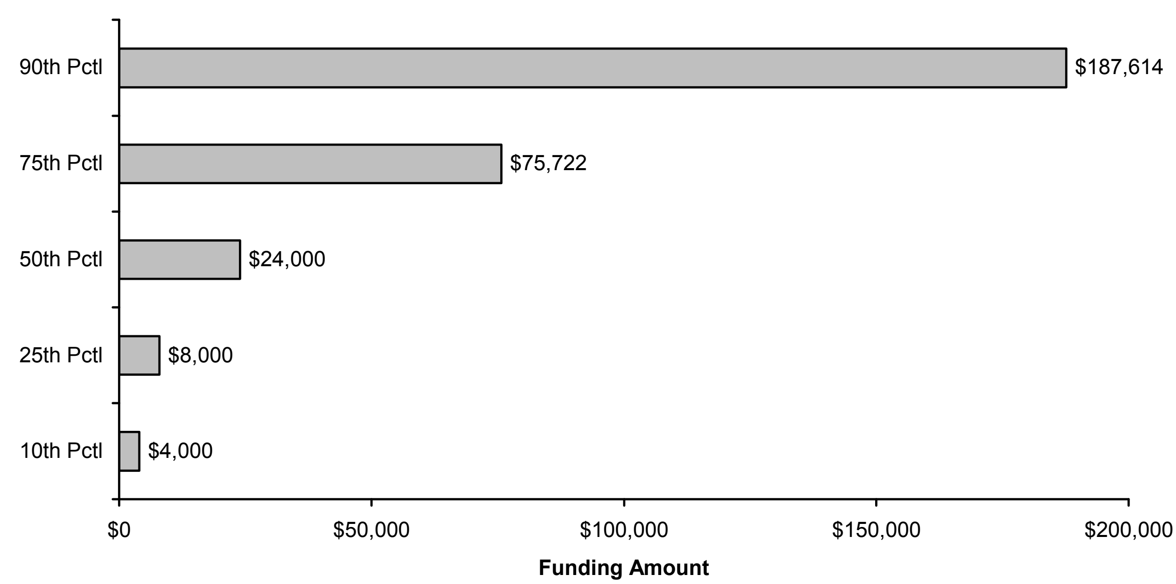


Exhibit 7. MSP Project Budgets: Total Funds from All Sources

Three-hundred-sixty-four projects provided data on total funding from all sources in FY 2005. Reported project funding dollar amounts are categorized into five distinct categories. Any project reporting a dollar figure within the specified range was counted toward the reported percentage in that row. Rows are mutually exclusive. Projects with dollar amounts of 0 or missing were excluded from this analysis. Frequencies were run on each category (as displayed in the appropriate rows), and each frequency was divided by the total number reporting in this field (364) to produce the appropriate percentage.

Exhibit 7. MSP Project Budgets: Total Funds from All Sources

Total funds from all sources	FY 2004 Percent (Number) of Projects	FY 2005 Percent (Number) of Projects
$100,000 or less	18% (44)	17% (62)
$100,001 to $200,000	26% (62)	30% (110)
$200,001 to $500,000	32% (76)	32% (116)
$500,001 to $1,000,000	15% (37)	12% (42)
$1,000,001 or more	9% (21)	9% (34)
Total	100% (240)	100% (364)

Exhibit 7.1. MSP Project Budgets: Total Funds, FY 2005 Additional Information

Minimum	Maximum	Mean	Median	Std Dev
$1,500.00	$ 11,415,678	$419,033	$215,929	$764,584

Exhibit 7.2. MSP Project Budgets: Total Funds, FY 2005 Quintiles

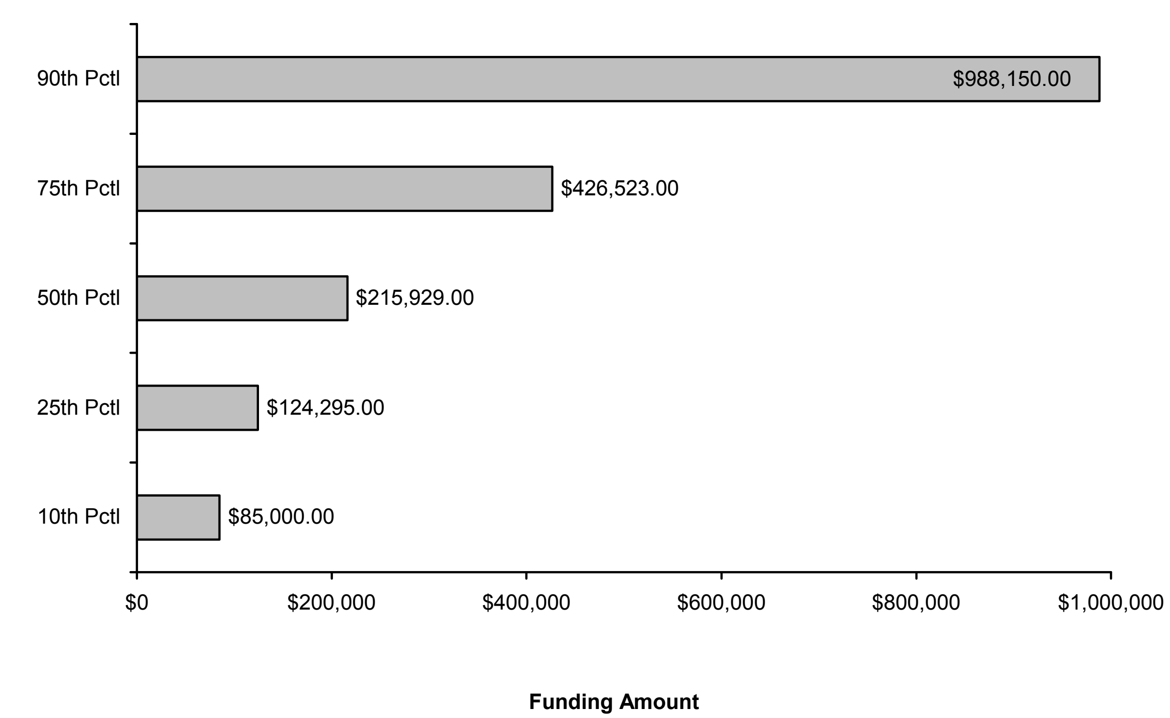


Exhibit 9. Participation Selection Criteria for Schools and Teachers

Three-hundred-sixty-nine projects reported data on five participant selection criteria for schools and/or teachers. Any project that reported using any of the five selection methods was added to the total number of projects using that method for schools, and the same process was repeated for teachers. Separating the figures for schools and teachers, the total number of schools and teachers using a certain selection method (as reported in the rows) was then divided by the total number of projects reporting data in this field (369) to produce the reported percentages. Projects may have reported using more than one selection method, so the rows are not mutually exclusive. In cases where a project reported using more than one selection method, the project was counted toward the total count of all selection methods that they used. So, for example, if Project A reported using both "Volunteer" and "Administrative Selection" methods for schools, then Project A was counted toward the total 169 projects using "Volunteer" for schools and toward the total 87 projects using "Administrative Selection" for schools.

Exhibit 9. Participation Selection Criteria for Schools and Teachers

Participation selection criteria	Schools		Teachers	
	FY 2004 Percent (No.) of Projects	FY 2005 Percent (No.) of Projects	FY 2004 Percent (No.) of Projects	FY 2005 Percent (No.) of Projects
Based on need	71% (178)	69% (255)	56% (139)	56% (205)
Volunteer	42% (106)	46% (169)	74% (186)	82% (301)
Administrative selection	25% (63)	24% (87)	42% (105)	38% (141)
Random assignment for experimental design	3% (8)	3% (11)	3% (7)	4% (13)
Other	6% (16)	7% (27)	12% (31)	13% (47)

Note: Percentages are based on 250 projects reporting on schools and/or teachers in FY 2004 and 369 projects reporting in FY 2005. The percentages do not total 100 percent because projects reported one or more methods of selection.

Exhibit 10. Total Number of Teachers Served by MSP Projects

Three-hundred-sixty-three projects reported data on the number of teachers served within the project. Reported numbers of teachers served are categorized into five distinct categories. Any project reporting a figure within the specified range is counted toward the percentage in that row. Rows are mutually exclusive. Projects with numbers of teachers as 0 or missing were excluded from this analysis. Frequencies were run on each category (as displayed in the appropriate rows), and each frequency was divided by the total number reporting in this field (363) to produce the appropriate percentage.

Exhibit 10. Total Number of Teachers Served by MSP Projects

Number of teachers served	FY 2004 Percent (No.) of Projects	FY 2005 Percent (No.) of Projects
25 or fewer	25% (62)	25% (91)
26-50	28% (68)	34% (123)
51-100	22% (55)	21% (76)
101-200	14% (35)	10% (36)
201 or more	11% (28)	10% (37)
Total	100% (248)	100% (363)

Exhibit 10.1. Total Number of Teachers Served by MSP Projects, FY 2005 Additional Information				
Minimum	**Maximum**	**Mean**	**Median**	**Std Dev**
4.00	1625.00	85.68	41.00	140.12

Exhibit 10.2. Total Number of Teachers Served by MSP Projects, FY 2005 Quintiles

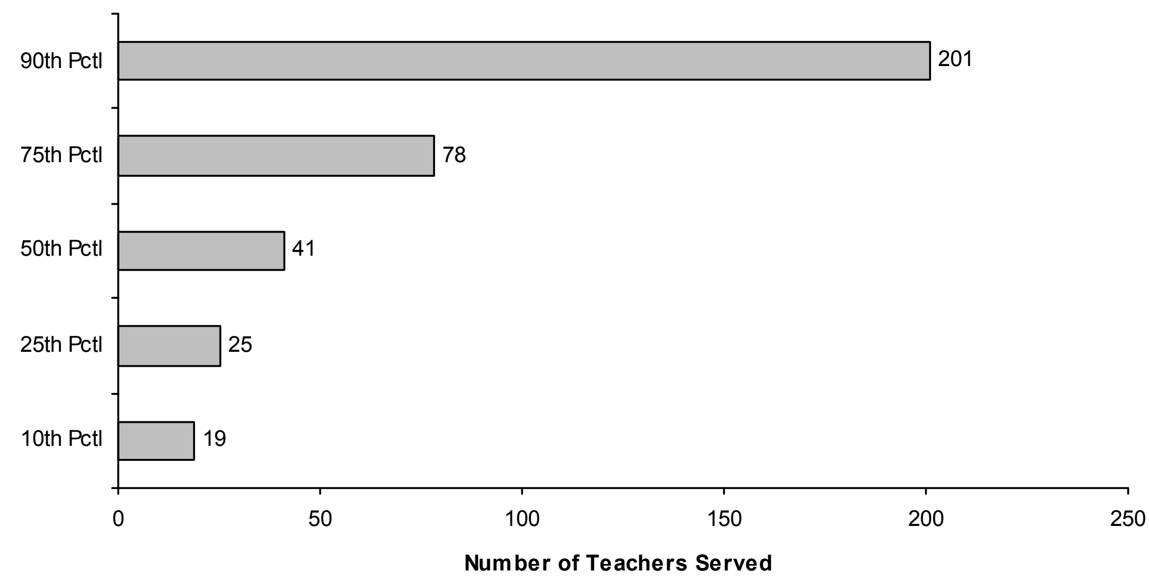


Exhibit 10.3. Total Number of Teachers Served by MSP Projects, FY 2005, graphed

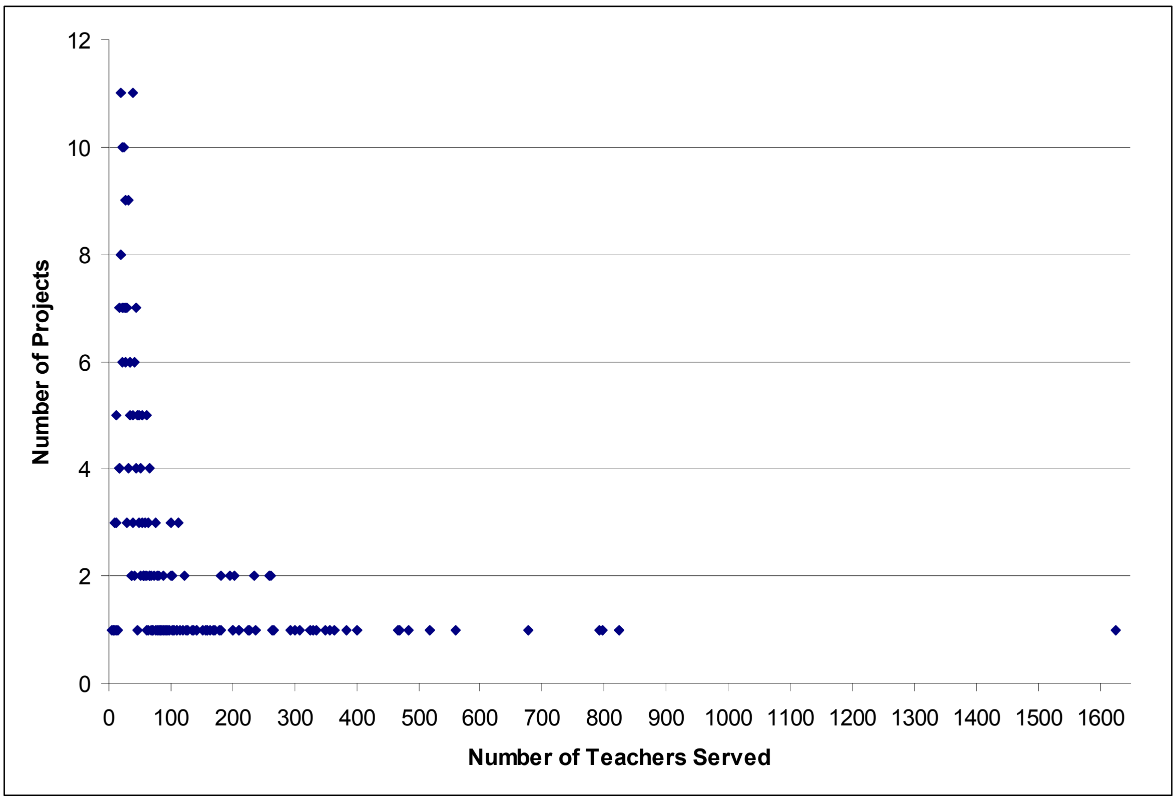


Exhibit 12. Percent of Projects that Reported Serving Teachers at the Elementary, Middle, and High School Levels, by Subjects

Two-hundred-ninety-six projects reported data on the number of teachers served within the project, subdivided by subject and school level. Any project reporting a figure within a specified grouping was counted toward the percentage in that row. Any project that reported serving one or more teachers within each category was counted once toward the total number of projects serving teachers in each category; so, rows are not mutually exclusive. Frequencies were run on each category (as displayed in the appropriate rows), and each frequency was divided by the total number reporting in this field (296) to produce the appropriate percentage. For example, each project that served any number of Regular Mathematics Teachers from Elementary Schools was given a value of one; these "ones" were then summed to find the total number of projects (147) serving Regular Mathematics Teachers from Elementary Schools; this 147 was then divided by the total number of projects (296) to produce the reported value of 50%.

Exhibit 12. Percent of Projects that Reported Serving Teachers at the Elementary, Middle, and High School Levels, by Subjects

Targeted audience	Elementary Schools (K-5)		Middle Schools (6-8)		High Schools (9-12)	
	FY 2004 Percent (No.) of Projects	FY 2005 Percent (No.) of Projects	FY 2004 Percent (No.) of Projects	FY 2005 Percent (No.) of Projects	FY 2004 Percent (No.) of Projects	FY 2005 Percent (No.) of Projects
Regular math teachers	53% (110)	50% (147)	83% (172)	78% (232)	40% (82)	37% (110)
Regular science teachers	22% (46)	38% (111)	51% (106)	63% (186)	25% (51)	32% (95)
Special education teachers	37% (77)	31% (91)	59% (122)	55% (164)	20% (41)	21% (62)
School administrators	28% (57)	24% (72)	29% (59)	28% (83)	13% (26)	13% (38)

Note: Percentages are based on 206 projects reporting in FY 2004 and 296 projects reporting in FY 2005. The percentages do not total 100 percent because projects reported one or more responses to this question.

The expanded tables below (Exhibits 12.1 through 12.8) report on the actual numbers of teachers each project reported serving within each category. While the number of teachers within each category within a project in Exhibit 12 are irrelevant (all that matters in producing Exhibit 12 statistics is whether the projects served any teachers in each category), Exhibits 12.1 through 12.8 provide further details on how many teachers within each category projects served. For example, looking at Exhibit 12.1, one can see that 147 projects served Regular Mathematics Teachers from Elementary Schools (this same number is also found in Exhibit 12, row 1, column 3). Among projects that served any mathematics teachers, the minimum number of Regular Mathematics Teachers from Elementary Schools served in any given project was 1, and the maximum number served within a single project was 498. On average, projects that served any mathematics teachers served about 53 Regular Mathematics Teachers from Elementary Schools.

Exhibits 12.2 through 12.8 also show the quintiles among projects serving teachers within each category. Exhibits 12.2 through 12.5 provide quintiles first grouped by audience type (mathematics teachers, science teachers, special education teachers, and administrators), then subdivided by school level. Exhibits 12.6 though 12.8 present the quintiles in a reverse view: the charts are grouped first by school level, and then subdivided by audience type.

Exhibit 12.1. Number of Teachers Served (within projects that served the specified teacher type) at Elementary, Middle, and High Schools, by Subjects, FY 2005 Additional Information						
Targeted audience and School level	**N Projects Reporting**	**Minimum**	**Maximum**	**Mean**	**Median**	**Std Dev**
Regular mathematics teachers, Elementary schools	147	1	498	52.58	14	99.31
Regular mathematics teachers, Middle schools	232	1	372	33.45	17	52.31
Regular mathematics teachers, High schools	110	1	252	15.99	6	30.63
Regular science teachers, Elementary schools	111	1	650	42.18	15	88.97
Regular science teachers, Middle schools	186	1	800	26.08	13	66.20
Regular science teachers, High schools	95	1	800	21.76	7	83.41
Special education teachers, Elementary schools	91	1	102	8.13	3	16.10
Special education teachers, Middle schools	164	1	400	10.63	4	34.64
Special education teachers, High schools	62	1	400	10.32	2	50.53
School administrators, Elementary schools	72	1	51	10.40	5	12.79
School administrators, Middle schools	83	1	30	5.79	3	6.51
School administrators, High schools	38	1	23	4.63	2	5.16

Note: At all grade levels and subjects, the smallest number of teachers served was one, and the largest number served varies greatly across subjects and grade levels. The number of regular elementary mathematics teachers served has the greatest variation across projects, ranging from 1 to 498 with a standard deviation of about 99 (a large standard deviation, indicating a wide spread in the data).

Exhibit 12.2. Number of Mathematics Teachers Served within Projects that Served Any Mathematics Teachers, at Elementary, Middle, and High Schools, FY 2005 Quintiles

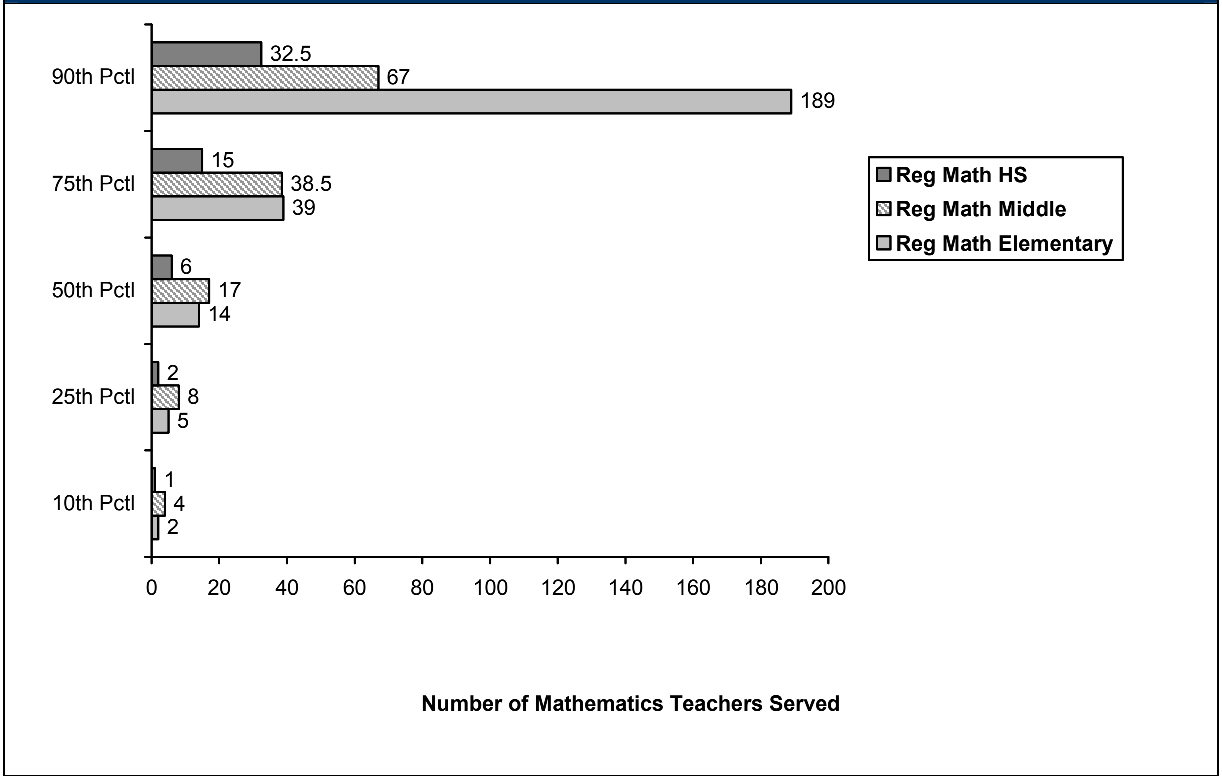


Exhibit 12.3. Number of Science Teachers Served within Projects that Served Any Science Teachers, at Elementary, Middle, and High Schools, FY 2005 Quintiles

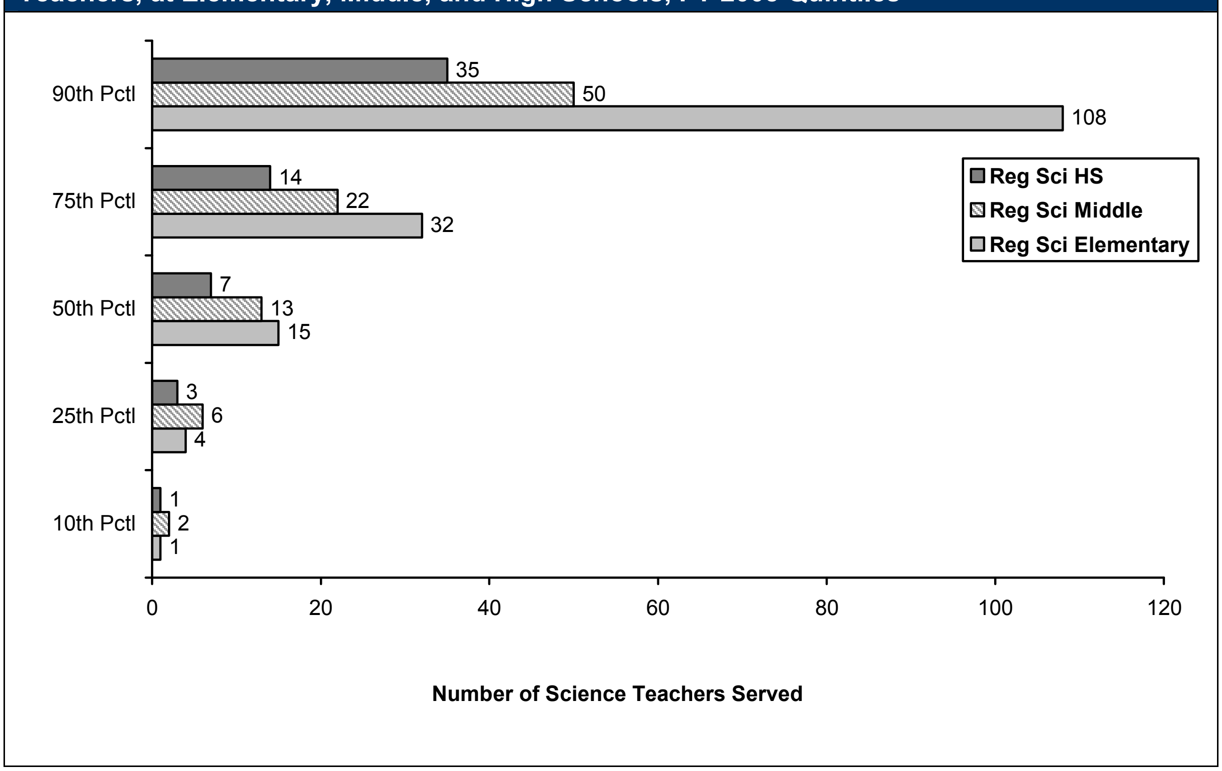


Exhibit 12.4. Number of Special Education Teachers Served within Projects that Served Any Special Education Teachers, at Elementary, Middle, and High Schools, FY 2005 Quintiles

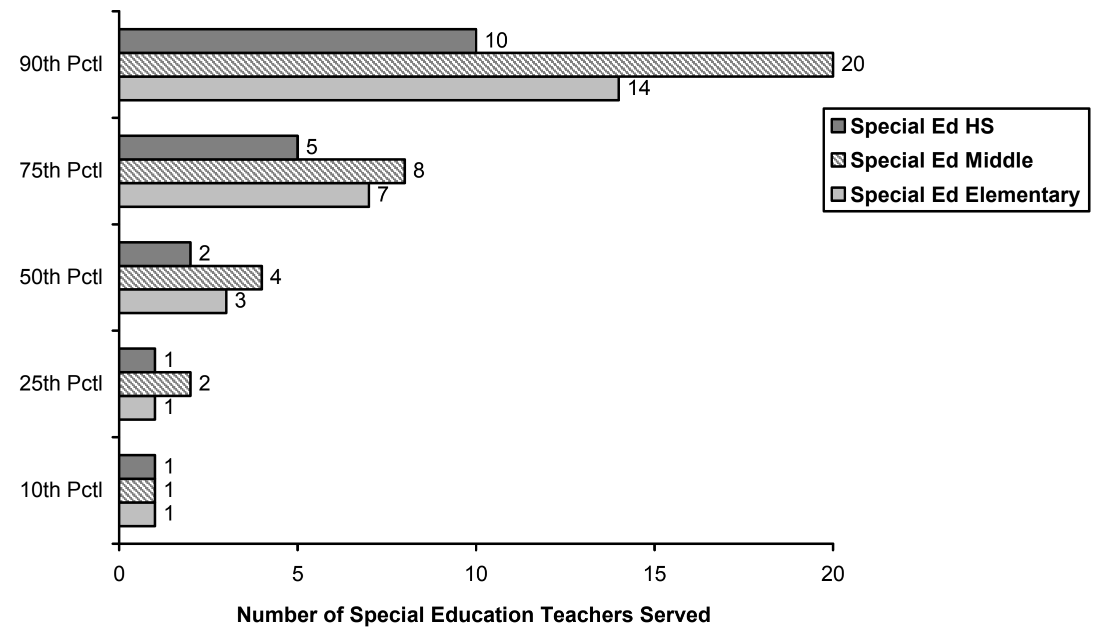


Exhibit 12.5. Number of Administrators Served within Projects that Served Any Administrators, at Elementary, Middle, and High Schools, FY 2005 Quintiles

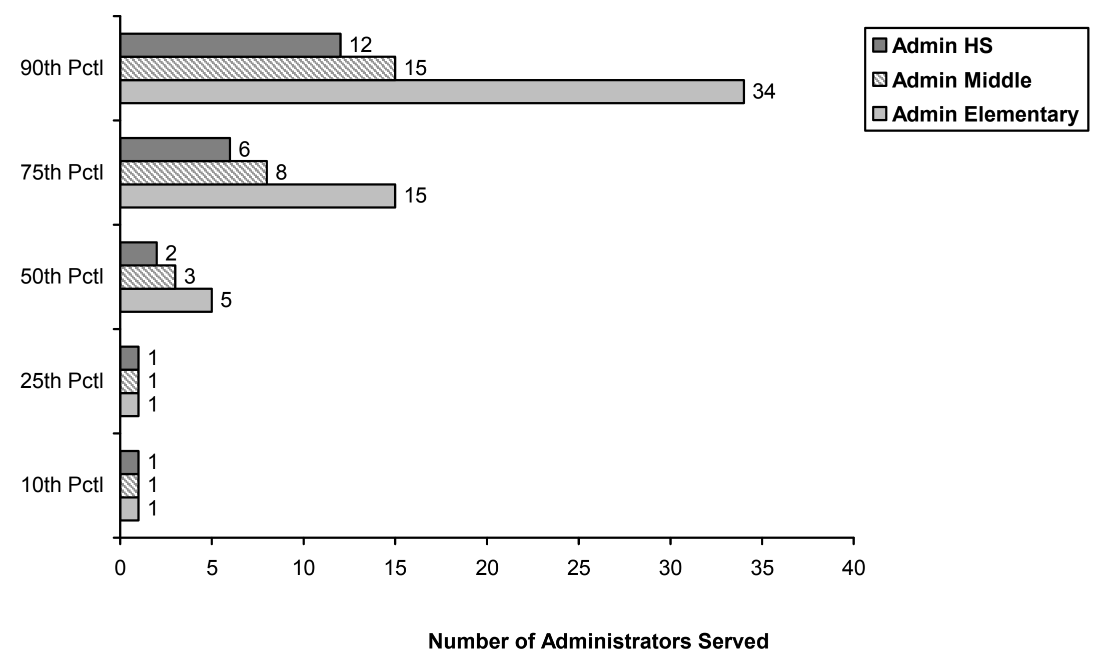


Exhibit 12.6. Number of Elementary School Teachers Served within Projects that Served Any Elementary Teachers, by Subject, FY 2005 Quintiles

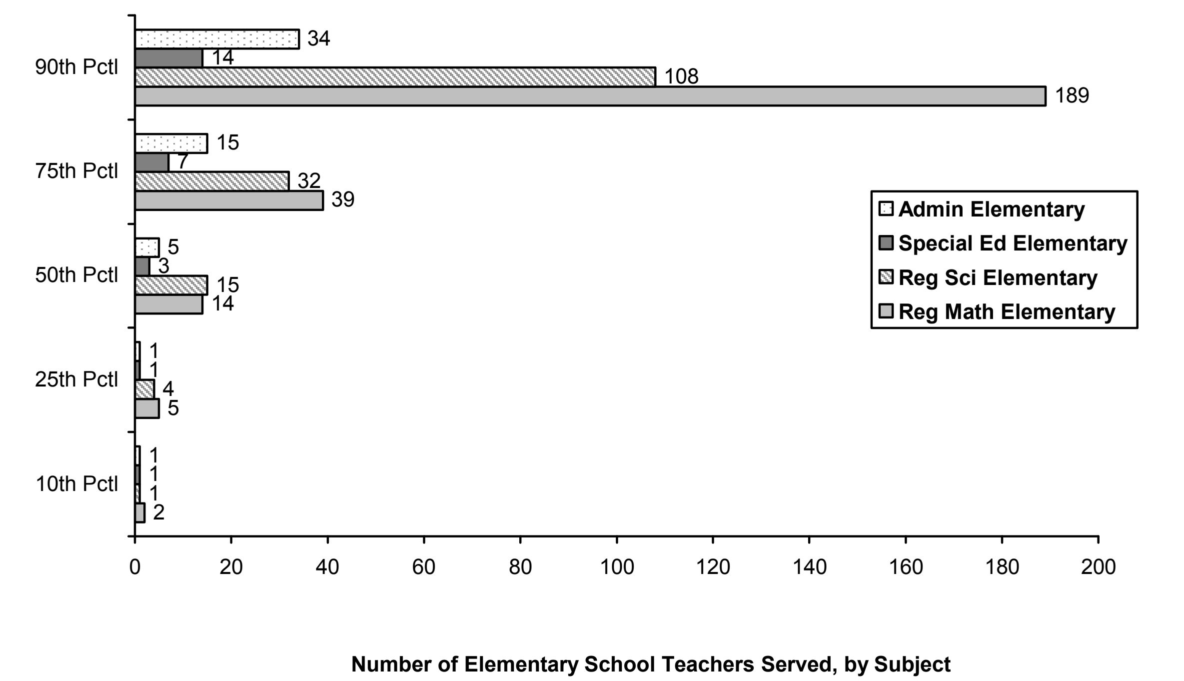


Exhibit 12.7. Number of Middle School Teachers Served within Projects that Served Any Middle School Teachers, by Subject, FY 2005 Quintiles

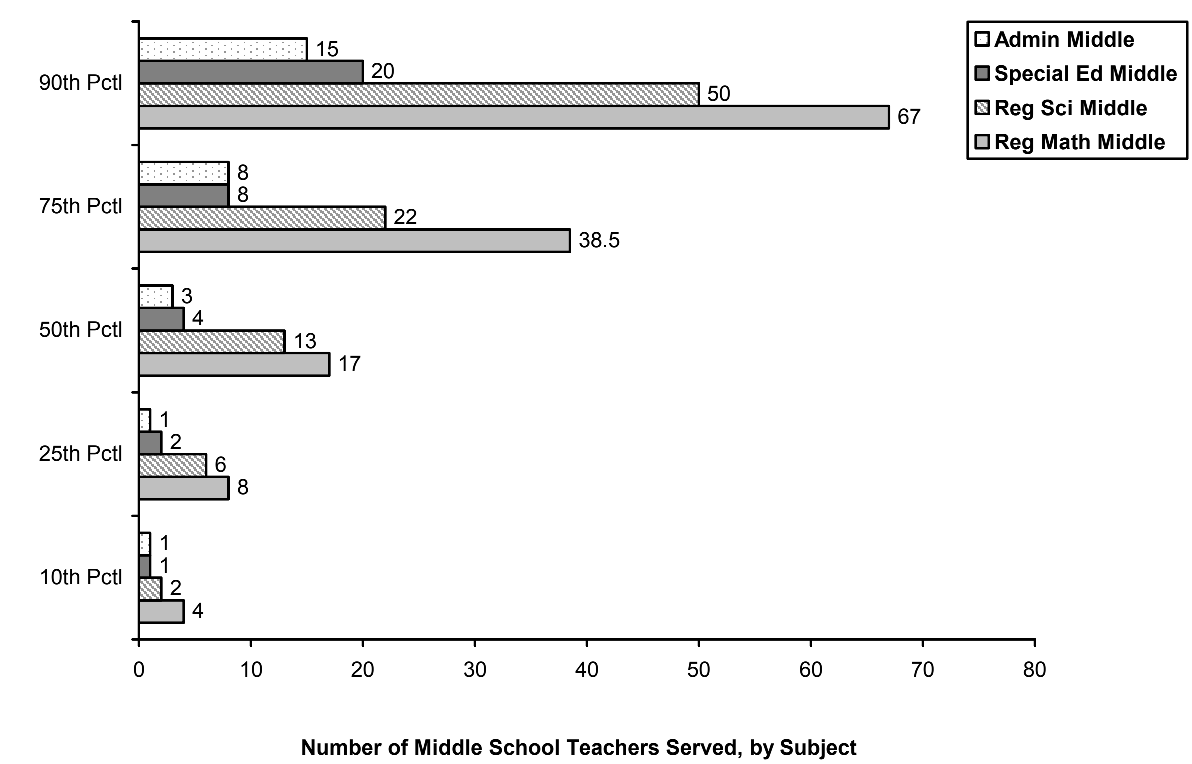


Exhibit 12.8. Number of High School Teachers Served within Projects that Served Any High School Teachers, by Subject, FY 2005 Quintiles

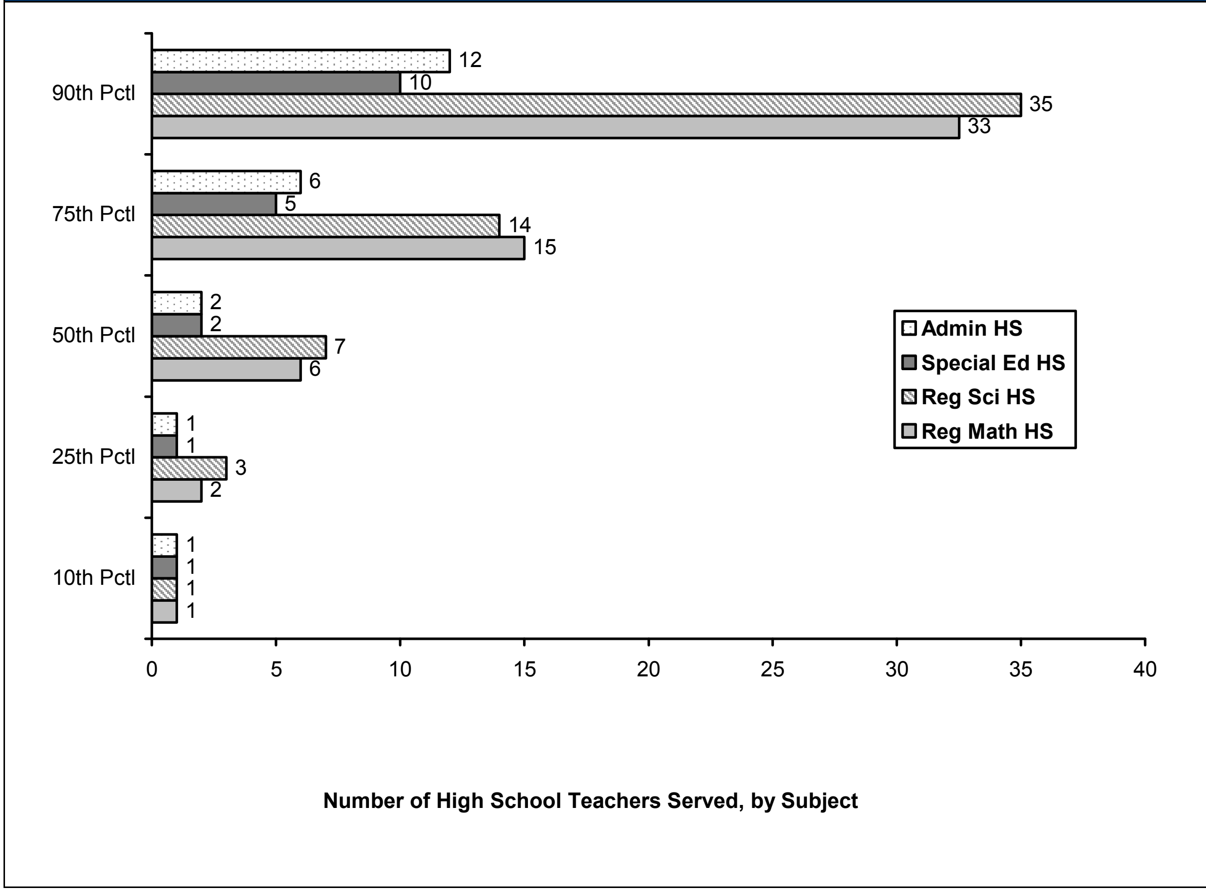


Exhibit 17. Percent of Projects Using Various Types of Evaluation Designs

Three-hundred-forty-eight projects reported data on the type of evaluation design used. There are four possible categories of evaluation designs, and each project could report using more than one design. Any project that reported having used a particular evaluation design was counted toward the reported number in that row. Rows are not mutually exclusive. The number of projects using each design was divided by the total number of projects reporting data in this field (348) to produce the reported percentages.

Because projects could have reported using more than one type of evaluation design, Exhibit 17.1 provides information on which designs were used in conjunction, and how many projects reported using each reported "set" (i.e. Experimental Design and Other Designs) of multiple designs. Sets of designs that were not used (i.e. Experimental Design and Quasi-Experimental Design) are not displayed; only those sets that were reported are displayed.

Exhibit 17. Types of Evaluation Designs used by Projects		
Evaluation Design Categories	**FY 2004** **Percent (No.) of Projects**	**FY 2005** **Percent (No.) of Projects**
Experimental design – using random assignment of schools, teachers, and/or students to MSP (Treatment) vs. no-MSP (Control) groups	10% (23)	3% (12)
Quasi-experimental design – using various methods, other than random assignment to compare schools, teachers, and/or students with and without MSP services (e.g., pre-post comparisons, matched comparison groups)	35% (82)	48% (168)
No control/comparison groups – using post-Professional Development-test only and/or other one-time data collection methods	54% (128)	47% (164)
Other (e.g., case studies, formative research)	30% (72)	29% (101)
Note: Percentages are based on 237 projects reporting in FY 2004 and 348 projects reporting in FY 2005. The percentages do not total 100 percent because some projects provided more than one response to this question, reflecting the use of multiple evaluation approaches.		

Exhibit 17.1. Numbers of Projects Using Various "Sets" of Types of Evaluation Designs	
Evaluation Design Sets	**Number of Projects**
Experimental design & No control/comparison groups	4
Experimental design & Other	1
Experimental design & No control/comparison groups & Other	1
Experimental design only	6
Quasi-experimental design & No control/comparison groups	26
Quasi-experimental design & Other	18
Quasi-experimental design & No control/comparison groups & Other	9
Quasi-experimental design only	115
No control/comparison groups & Other	28
No control/comparison groups only	96
Other only	44

Exhibit 18. Percent of K-5 Teachers Who Achieved Significant Gains in Content Knowledge of Those K-5 Teachers Who Took Content Assessments

Ninety-nine projects reported data on whether K-5 teachers achieved significant gains in mathematics content knowledge, 60 projects reported data on whether K-5 teachers achieved significant gains in science content knowledge, 31 projects reported these data for *both* mathematics and science content knowledge, and 128 projects reported data on whether K-5 teachers achieved significant gain in mathematics *and/or* science content knowledge (these 128 projects could have reported math only, science only, or both math and science). Projects reported the number of teachers found to have made statistically significant gains in each content knowledge area. To produce the statistics reported in Exhibit 18, a sum of the numbers of teachers with significant gains reported in each project produces the total number of teachers with significant gains. Also, the total number of teachers assessed was found by summing this reported number across projects. The number of teachers with significant gains (i.e. 3,158 in mathematics) was then divided by the total number of teachers assessed (i.e. 4,937 in mathematics) to produce the percentage in each row.

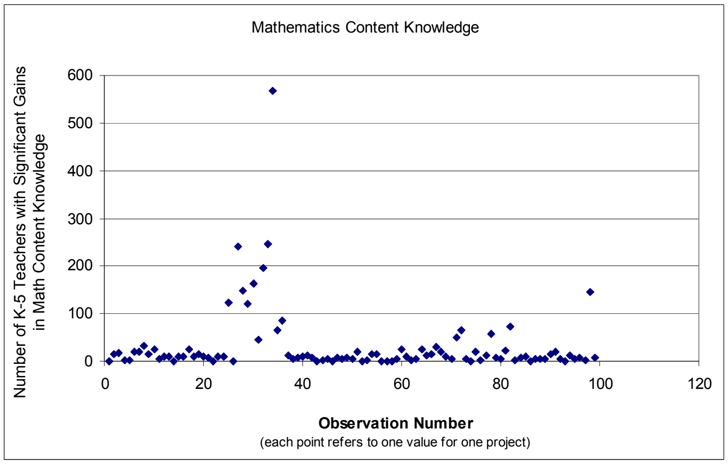
Exhibit 18. Percent of K-5 Teachers Who Achieved Significant Gains in Content Knowledge of Those K-5 Teachers Who Took Content Assessments			
Type of Content Gains for K-5 Teachers	**Number of K-5 Teachers Assessed**	**Number of Teachers with Significant Gains**	**Percent of Teachers with Significant Gains**
Mathematics content knowledge	4,937	3,158	64%
Science content knowledge	1,364	1,128	83%
Mathematics and/or science content knowledge	5,637	4,286	76%

Note: The individual mathematics and science percentages of teachers do not total the combined percentage because some projects reported significant gains in both mathematics and science for the same teachers. Data in this table are from 99 projects reporting on significant gains in K-5 mathematics, 60 projects in K-5 science, and 128 projects in K-5 mathematics and/or science.

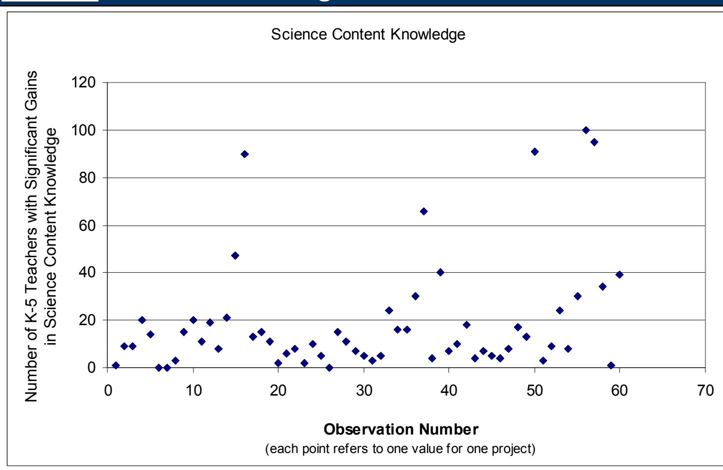
Exhibit 18.1. Number of K-5 Teachers within Projects Who Achieved Significant Gains in Content Knowledge of Those K-5 Teachers Who Took Content Assessments, FY 2005 Additional Information						
Type of Content Gains for K-5 Teachers	**Number of Projects Reporting**	**Minimum**	**Maximum**	**Mean**	**Median**	**Std Dev**
Mathematics content knowledge	99	0	567	31.90	9.00	72.65
Science content knowledge	60	0	100	18.80	10.50	23.78
Mathematics and/or science content knowledge	168	0	567	44.10	16.00	90.59

Note: Within individual projects the minimum *is smallest number of teachers who achieved significant gains on a content knowledge assessment, whereas* maximum *is the largest number of teachers who showed significant gains on a content knowledge assessment. The standard deviations are larger than the means because the data are dispersed unevenly; large outliers skew the mean and increase the size of the standard deviation (see Supplements to Exhibit 18.1). The large differences between the means and the medians are also a function of the uneven dispersion of the data. The medians provide a more accurate representation of the data.*

Supplement to Exhibit 18.1. Number of K-5 Teachers Who Achieved Significant Gains in Mathematics Content Knowledge of Those K-5 Teachers Who Took Content Assessments, FY 2005



Supplement to Exhibit 18.1. Number of K-5 Teachers Who Achieved Significant Gains in Science Content Knowledge of Those K-5 Teachers Who Took Content Assessments, FY 2005



Supplement to Exhibit 18.1. Number of K-5 Teachers Who Achieved Significant Gains in Mathematics and/or Science Content Knowledge of Those K-5 Teachers Who Took Content Assessments, FY 2005

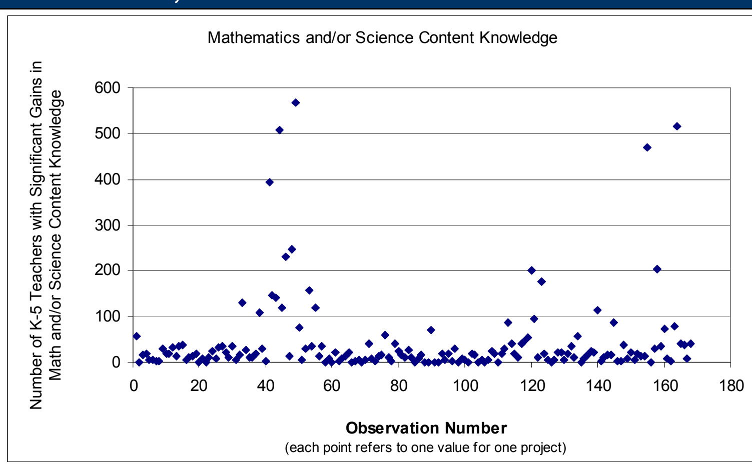
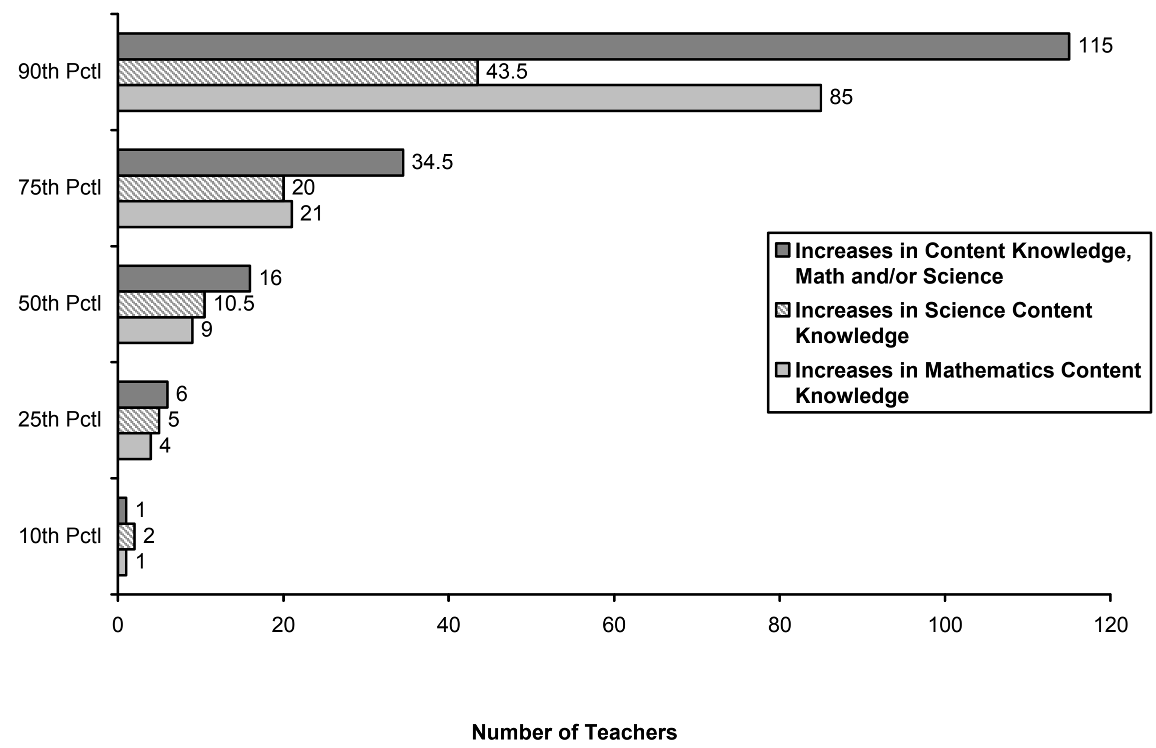


Exhibit 18.2. Number of K-5 Teachers Who Achieved Significant Gains in Content Knowledge of Those K-5 Teachers Who Took Content Assessments, within Projects, FY 2005 Quintiles



Exhibits 19, 20, and 21. Means of Project-reported Percents of Students Who Scored at Proficient or Above in State Assessments

Exhibits 19, 20, and 21 present the means of project-reported percentages of students who scored at proficient or above on state assessments. Because we do not have school-level or student-level data, we are unable to calculate a grand mean for all students. Instead, the mean of the project-reported percents is the only estimable number.

Individual projects reported a single aggregate percent proficiency score along with the percent change from the previous assessment. The percent proficiency and change scores were aggregated across all students served by MSP teachers. However, projects did not typically report the number of students assessed. Therefore, Exhibits 19, 20 and 21 present the overall means of these project-reported percentages of students scoring at proficient or above on State assessments across grade levels and subject areas. Because the number of students upon which project-reported proficiency percents are based is unavailable, the data presented are not weighted by school size, thus possibly skewing the mean percentage. In order to give a broader picture of the data, the table below presents descriptive statistics on the project-reported percents.

Exhibits 19.1-19.3, 20.1-20.4, and 21.1-21.4 provide more detailed descriptions of these project-reported percents so that one may acquire a better understanding of the data. Ranges and quintiles of the project-reported percents of proficiency and change are provided in detail below.

Exhibit 19. Mean of Project-reported Percents of Students Who Scored at Proficient or Above in Mathematics and/or Science State Assessments

Exhibit 19. Mean of Project-reported Percents of Students Who Scored at Proficient or Above in Mathematics and/or Science State Assessments		
School Level	**Mean % Proficient**	**Mean % Change**
All (Elementary, Middle, and High)	55%	6%
Note: Percentages are based on 158 projects reporting mathematics scores, and 78 projects reporting science scores. The total number of projects reporting mathematics and science combined is 195 (less than the sum of the individual math and science projects, because some projects reported both mathematics and science proficiency scores.		

Exhibit 19.1. Mean of Project-reported Percents of Students Who Scored at Proficient or Above in Mathematics and/or Science State Assessments, FY 2005 Additional Information					
Number of Projects Reporting	**Minimum % Proficient**	**Maximum % Proficient**	**Mean % Proficient**	**Median % Proficient**	**Std Dev of % Proficient**
195	1.16	93.00	55	54.65	19.80

Exhibit 19.2. Mean of Project-reported Percents of Change from the Previous Assessment of Students Who Scored at Proficient or Above in Mathematics and/or Science State Assessments, FY 2005 Additional Information					
Number of Projects Reporting	**Minimum % Change**	**Maximum % Change**	**Mean % Change**	**Median % Change**	**Std Dev of % Change**
149	-11.56	53.00	6	3.00	10.29

Exhibit 19.3. Mean of Project-reported Percents of Students Who Scored at Proficient or Above in Mathematics and/or Science State Assessments, FY 2005 Additional Information

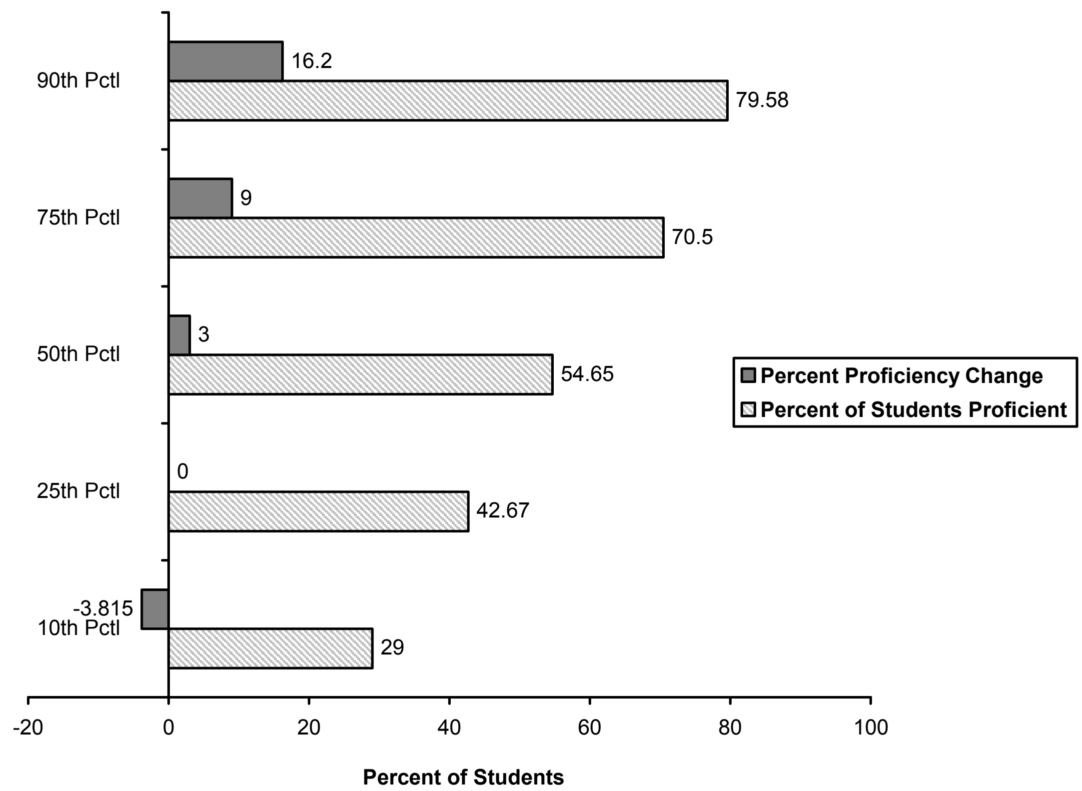


Exhibit 20. Mean of Project-reported Percents of Students Who Scored at Proficient or Above in Mathematics State Assessments

Exhibit 20. Mean of Project-reported Percents of Students Who Scored at Proficient or Above in Mathematics State Assessments		
School Level	**Mean % Proficient**	**Mean % Change**
Elementary	60%	7%
Middle	51%	4%
High	48%	3%
All (Elementary, Middle, and High)	53%	5%
Note: Percentages are based on 158 projects reporting mathematics scores.		

Exhibit 20.1. Mean of Project-reported Percents of Students Who Scored at Proficient or Above in Mathematics State Assessments, FY 2005 Additional Information

School Level	Number of Projects Reporting	Minimum % Proficient	Maximum % Proficient	Mean % Proficient	Median % Proficient	Std Dev of % Proficient
Elementary	86	1.33	100.00	59.80	62.22	21.40
Middle	143	0.99	91.60	51.27	52.00	20.30
High	49	3.00	99.00	47.65	52.20	26.55
All	158	0.99	100.00	52.91	52.20	22.75

Exhibit 20.2. Mean of Project-reported Percents of Change from the Previous Assessment of Students Who Scored at Proficient or Above in Mathematics State Assessments, FY 2005 Additional Information

School Level	Number of Projects Reporting	Minimum % Change	Maximum % Change	Mean % Change	Median % Change	Std Dev of % Change
Elementary	79	-21.00	100.00	6.90	2.40	16.53
Middle	111	-21.00	51.00	3.83	2.00	9.81
High	46	-24.00	38.00	2.79	0.93	11.04
All	125	-24.00	100.00	4.51	2.00	12.46

Note: The minimum percent-change figures reported here are negative numbers, indicating that some schools actually had declines in the proficiency scores of their students on mathematics State assessments in FY 2005 compared to the previous assessment year. The large standard deviations, as well as the minimum and maximum figures, indicate that there is a wide spread in the data on student proficiency scores across projects. For example, see the supplement to Exhibit 20.2 below.

Supplement to Exhibit 20.2. Mean of Project-reported Percents of Change from the Previous Assessment of Students Who Scored at Proficient or Above in Mathematics State Assessments, Elementary Level, FY 2005

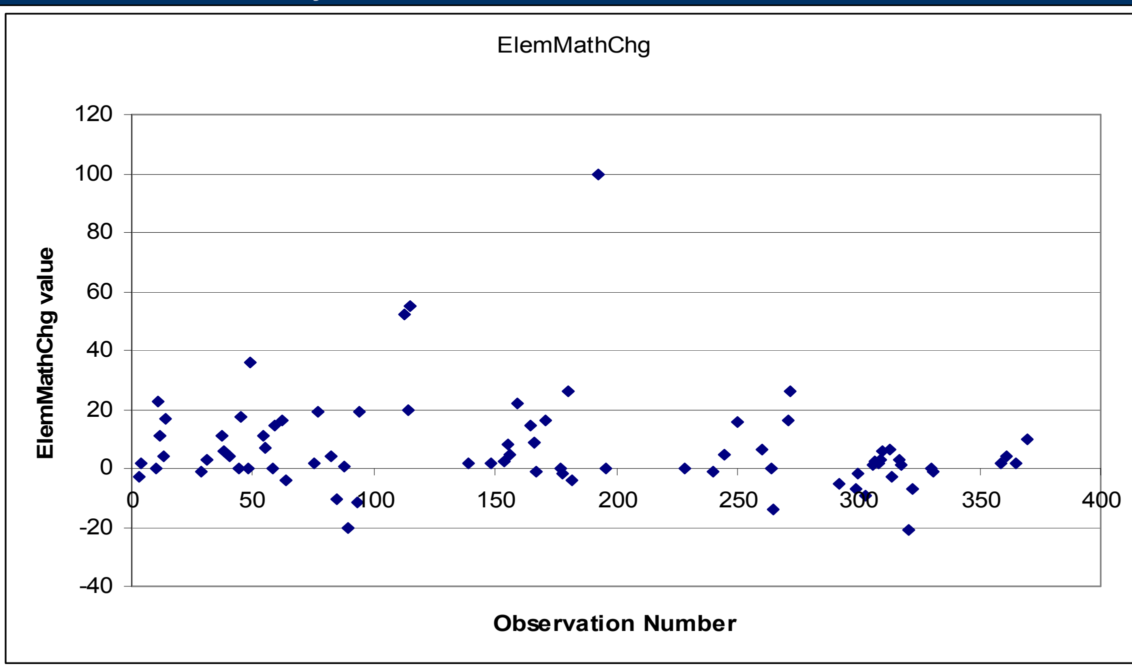


Exhibit 20.3. Mean of Project-reported Percents of Students Who Scored at Proficient or Above in Mathematics State Assessments, FY 2005 Quintiles

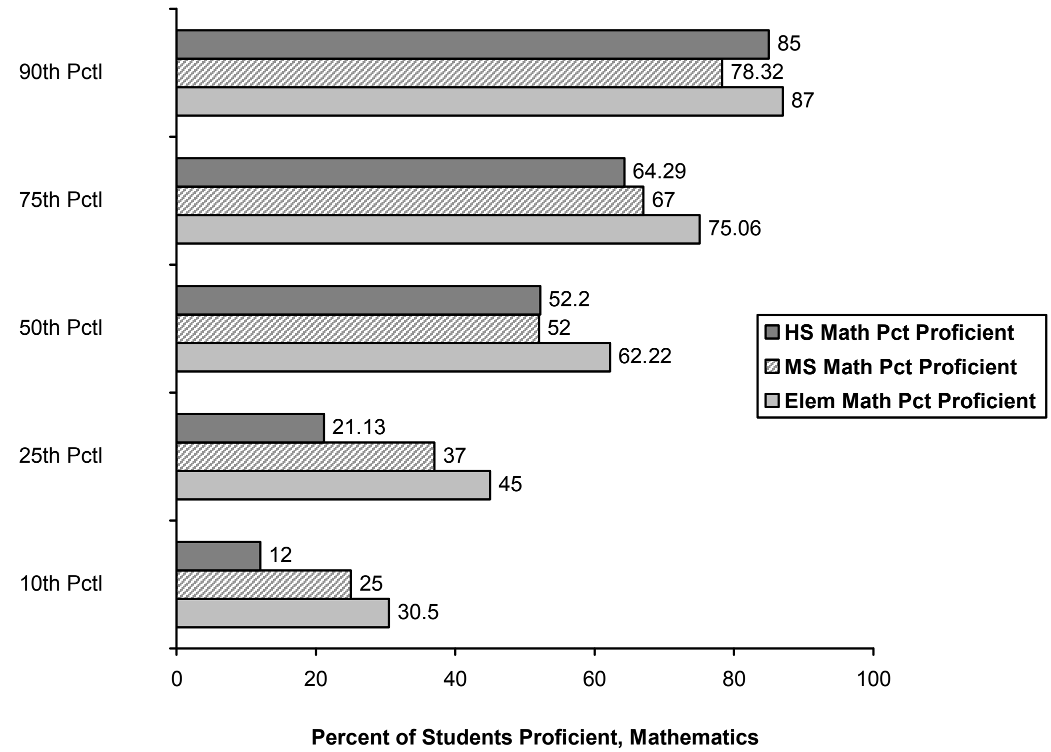


Exhibit 20.4. Mean of Project-reported Percents of Change from the Previous Assessment of Students Who Scored at Proficient or Above in Mathematics State Assessments, FY 2005 Quintiles

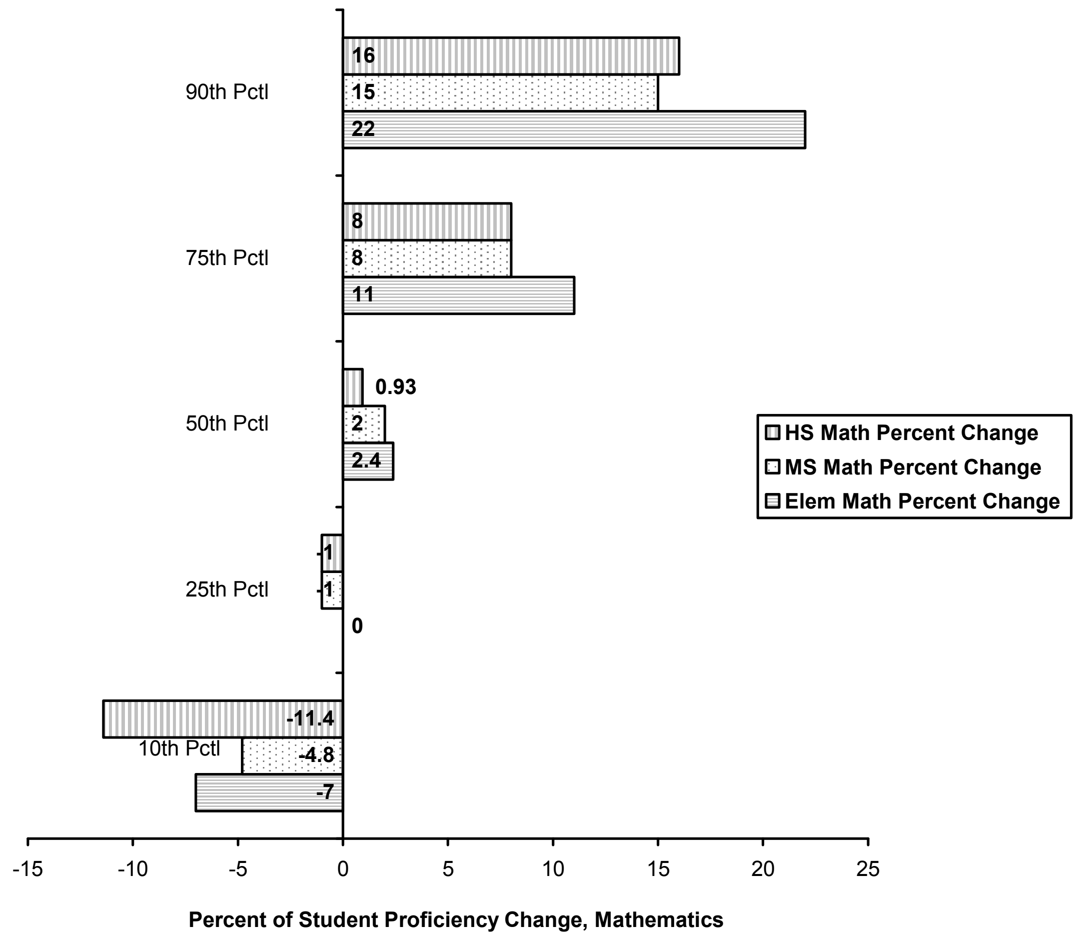


Exhibit 21. Mean of Project-reported Percents of Students Who Scored at Proficient or Above in Science State Assessments

Exhibit 21. Mean of Project-reported Percents of Students Who Scored at Proficient or Above in Science State Assessments

School Level	Mean % Proficient	Mean % Change
Elementary	54%	11%
Middle	55%	5%
High	57%	6%
All (Elementary, Middle, and High)	55%	7%

Note: Percentages are based on 78 projects reporting mathematics scores.

Exhibit 21.1. Mean of Project-reported Percents of Students Who Scored at Proficient or Above in Science State Assessments, FY 2005 Additional Information						
School Level	Number of Projects Reporting	Minimum % Proficient	Maximum % Proficient	Mean % Proficient	Median % Proficient	Std Dev of % Proficient
Elementary	38	10.00	92.00	54.27	58.88	23.47
Middle	64	8.00	100.00	54.70	52.00	20.27
High	13	29.08	82.63	57.38	54.90	18.33
All	78	8.00	100.00	55.45	54.90	62.07

Exhibit 21.2. Mean of Project-reported Percents of Change from the Previous Assessment of Students Who Scored at Proficient or Above in Science State Assessments, FY 2005 Additional Information						
School Level	Number of Projects Reporting	Minimum % Change	Maximum % Change	Mean % Change	Median % Change	Std Dev of % Change
Elementary	24	-9.00	53.00	11.20	8.75	14.56
Middle	35	-21.40	53.00	4.56	2.60	13.49
High	16	-4.60	47.00	5.51	0.00	12.36
All	50	-21.40	53.00	7.09	2.60	13.47

Note: The minimum percent change figures reported here are negative numbers, indicating that some schools actually had declines in the proficiency scores of their students on science State assessments in FY 2005 compared to the previous assessment year. The large standard deviations, as well as the minimum and maximum figures, indicate that there is a wide spread in the data on student proficiency scores across projects. For example, see the supplement to Exhibit 20.2 above.

Exhibit 21.3. Mean of Project-reported Percents of Students Who Scored at Proficient or Above in Science State Assessments, FY 2005 Quintiles

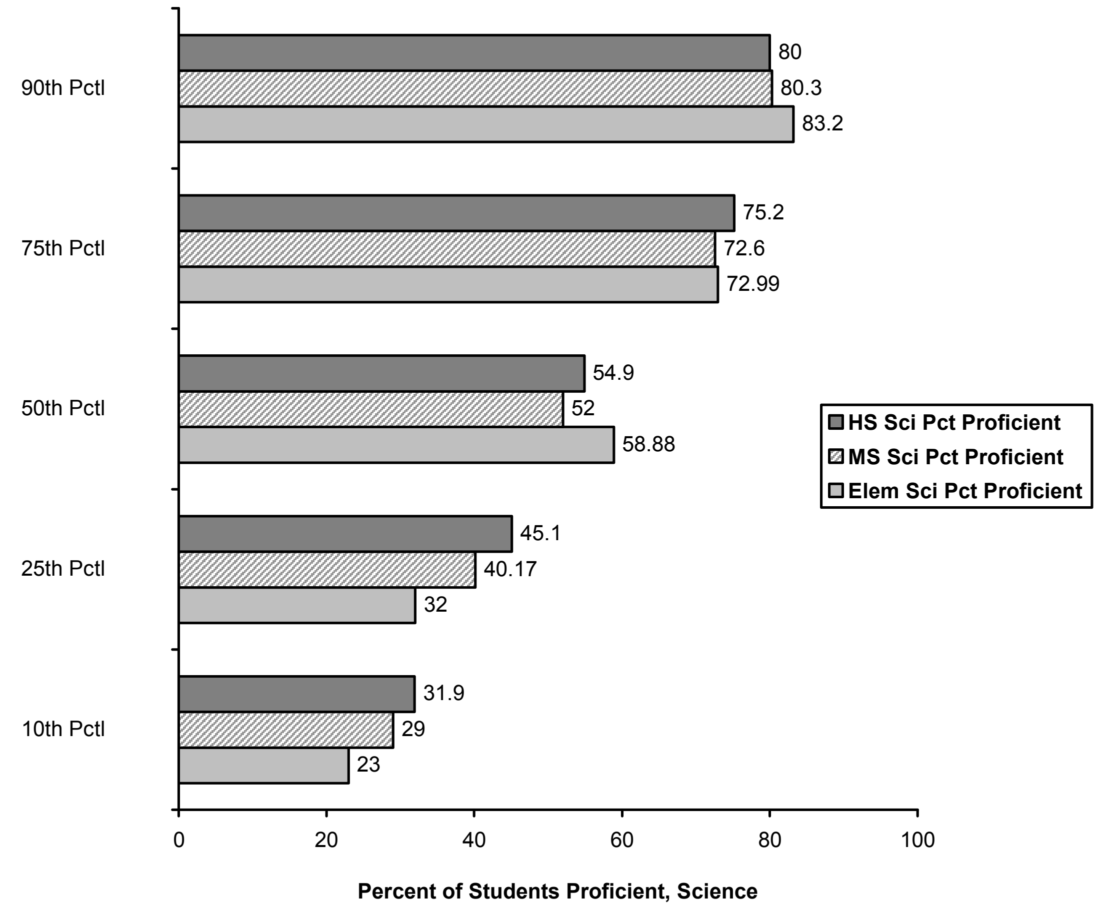
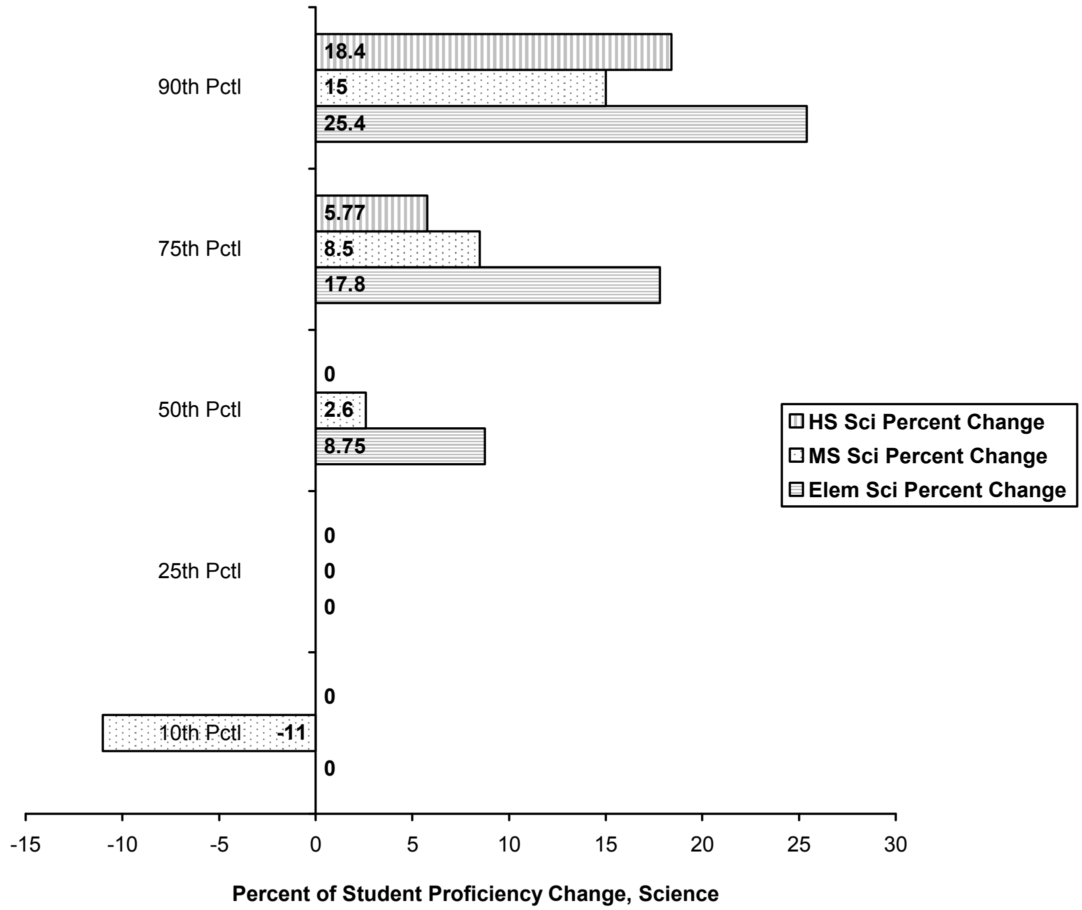


Exhibit 21.4. Mean of Project-reported Percents of Change from the Previous Assessment of Students Who Scored at Proficient or Above in Science State Assessments, FY 2005 Quintiles



Narrative Analyses

The narrative study involved two related analyses: coding of descriptive characteristics and narrative categories (project themes). For each analysis, a small sample of reports was reviewed to determine coding categories.

Coding of Descriptive Characteristics

Key descriptive characteristics, important in illustrating the MSP program, were identified from an initial review of abstracts and related information submitted in Project Profiles (data collection instruments developed for the MSP program that collects descriptive and impact data on the effectiveness of the project).

The analysis was then extended to the full sample of Project Profiles. Three-hundred-seventy-five projects submitted Project Profiles that were used for the coding of descriptive characteristics.

The following descriptive characteristics (when data were available) were coded for each project.

Individual Grade Levels

- K-12 (Note: If projects were characterized as elementary, we assumed grade levels, K-5; if middle school, we assumed grade levels, 6-8, if high school, we assumed grade levels 9-12; if secondary, we assumed grade levels, 6-12.)

Mathematics and Science Content

- Mathematics
- Science
- Mathematics and Science

Models of Professional Development

- Increasing teacher content knowledge directly
- Creating teacher leaders
- Other (specify)

PD Type and Duration (Hours)

- Summer Institutes
- Summer Institutes + follow-up (specify follow-up activities)
- On-line coursework
- Distance learning networks
- On-site professional learning experience (with follow-up)
- Study groups
- Other (specify activities)

Number of Partners

Areas of Responsibility Among MSP Partners (specify responsibilities for LEAs, IHEs, and other partners)

- Fiscal agent
- Host PD
- Design PD
- Deliver PD
- Evaluation
- Facilities
- Release time for teachers
- Student assessment data
- Other (specify)

Primary Target Group*

- Individual Teachers
- One School
- Set of Schools within a District
- Set of Schools Across District Lines
- District
- Other (specify)

School Location*

- Urban
- Rural
- Suburban
- Combination/Other (specify)

*Data for these categories were not available from many project abstracts in our initial and complete analysis. We did not include them in the summary report as available data were sparse.

Coding of Narrative Categories

The purpose of the qualitative examination was to provide an in-depth analysis of selected project-level categories about general characteristics, professional development, and evaluation. Categories were identified from an initial review of Project Narratives (summary of the work of the project over a 12-month period including a brief description of the activities carried out under the project, project performance, and supplemental information) and local or state evaluations (when available). The text was analyzed with NVivo, a qualitative software program.

The analysis was then extended to the full sample of Project Narratives and Evaluation Reports, which was comprised of those projects that reported strong research designs (experimental or quasi-experimental, e.g., a design with a well-matched comparison group is preferred to a pre-post design, although both are considered quasi-experimental). Of 180 projects that had strong research designs, 172 projects submitted Project Narratives and/or Evaluation Reports that were used for coding of project-level themes.

Text related to the following narrative categories (when data were available) was coded for each project. Bolded categories indicate high priority themes for analysis, and plain text categories indicate lower priority themes that were analyzed as time permitted. As part of the qualitative analysis, the experimental research design designations identified in the Project Profile reports were confirmed or disconfirmed.

Description of Project

- **Lessons Learned**
- Partners and their Roles
- **Project Highlights**
- Other Key Information on Project (Including Innovative Activities, Best Practices, Anticipated Outcomes, Dissemination Plans, Future Plans, etc.)

Characteristics of Professional Development

- **Practices/Strategies**
    - **Teaching/Learning Content**
    - **Applying Content to Classroom Practice**
    - **Mentoring/Coaching**
    - **Study Groups**
    - **Resource Development**
    - **Other**

- **Content**
    - **Math Content Only**
        - Number & Operations
        - Algebra
        - Geometry
        - Measurement
        - Probability and Statistics
        - Problem Solving
        - Reasoning and Proof
        - Calculus
        - Technology
        - Math Pedagogy
        - Math Standards
        - Math Assessment
        - Connections to Other Content Areas
        - Other

    - **Science Content Only**
        - Scientific Inquiry
        - Physical Science
        - Chemistry
        - Physics
        - Life Science/Biology
        - Earth Science
        - Astronomy
        - Environmental Science
        - Technology
        - Engineering
        - Science Pedagogy
        - Science Standards
        - Science Assessment
        - Connections to Other Content Areas
        - Other

    - Other Content

- Needs of Districts/Participants

- **Professional Development Highlights**

- Other Professional Development Information

Project Evaluation

- **Evaluation Design and Analysis Methods**
    - Random Assignment
    - Quasi-Experimental
    - Comparison to Norms

- One-group pre-post
- One-group post-test only
- Other

- **Teacher Assessments**
  - **Teacher Content Knowledge Assessment**
  - **Classroom Observation Protocol**
  - Instruments Used
  - Timing of Measurement
  - Content of Measure
  - Teacher Reflection
  - Other

- **Student Assessments**
  - **Math State Assessment**
  - **Science State Assessment**
  - Instruments Used
  - Timing of Measurement
  - Content of Measure
  - Other

- **Teacher Findings**
  - **Changes in Content Knowledge**
  - Changes in Beliefs and Attitudes
  - Changes in Pedagogy
  - Other

- **Student Findings**
  - Changes in Content Knowledge
  - Changes in Beliefs and Attitudes
  - Changes in Pedagogy
  - Other

- **School-Level Findings**

- **Evaluation Highlights**

- Other Evaluation Information
  - Implementation Process Evaluation
  - Intervention Impact Evaluation
  - Evaluation of Partnership
  - Data Collection Methods
  - Internal or External Evaluator

- Other