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# Math Science Partnership of Southwest Pennsylvania

## Measuring Progress Toward Goals

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EDUCATION

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# Summary

The National Science Foundation's (NSF's) Math and Science Partnership program began in 2002 with the goals of providing a challenging curriculum for every student, increasing the quality and diversity of mathematics and science teachers, engaging a network of researchers and practitioners in partnership, and disseminating research-based materials. In 2003, the Allegheny Intermediate Unit (AIU) received a grant under this program to establish the Math Science Partnership of Southwest Pennsylvania (MSP).

The MSP brings together 53 K–12 school districts in Southwestern Pennsylvania; four regional, small- to medium-sized, teaching-oriented, private institutions of higher education (IHEs); and four intermediate units (IUs). Its goals are to increase K–12 students' knowledge of mathematics and science, improve the quality of the K–16 educator workforce, and create sustainable coordination of partnerships in the IUs. Initially funded for five years, the project end date was subsequently extended by two years.

The purpose of this monograph is to summarize key findings regarding the project's progress toward meeting its goals. Analyses draw on data collected through the MSP's first five years of implementation, information from surveys of teachers and principals, qualitative data from participating IHEs, educator participation records, and assessments of student achievement.

## MSP Intervention Strategies

The MSP used three crosscutting intervention strategies to accomplish its goals. The first is *professional development for content and leadership* through academies and seminars for K–12 educators and IHE faculty. The overriding purpose of these activities is to equip teachers with the content, pedagogy, and leadership skills necessary to become effective leaders in their institutions. The second strategy is *curriculum alignment and pedagogical and course refinement*, enacted at the K–12 level through the use of curriculum frameworks and research-based curriculum materials and at the IHE level through the contributions of K–12 teachers who work with faculty on IHE campuses to refine IHE courses. The third strategy is *support for and dissemination of research-based resources and tools*, primarily through conferences and networks connecting educators using research-based curricula. Importantly, these intervention strategies are not distinct and separable, but rather are intertwined in a design uniting K–12 and IHE educators in working to achieve the goals of the MSP. Table S.1 describes the primary activities used by the MSP to enact these strategies.

**Table S.1**
**Primary Activities of the MSP**

| Intervention Strategy | MSP Activity | Description |
|---|---|---|
| Professional development for content and leadership | Leadership action teams and Leadership Action Academies | Leadership action teams represent each school district and IHE. The teams meet at the Leadership Action Academies to assess the strengths and weaknesses of their institutions and to develop action plans for improvement. |
| | Teacher Leadership Academies and on-site academies | Teacher Leadership Academies provide professional development on leadership and content for selected teachers, who then lead on-site academies to disseminate the MSP professional development to teachers in their own districts. |
| | Principal seminars | Seminars for principals aim to build a deeper understanding of effective mathematics and science instruction and to develop effective observing and conferencing techniques. |
| | Content short courses | Vouchers and stipends support teachers who attend professional development courses in math or science content areas sponsored by IHE partners and others. |
| Curriculum alignment and pedagogical and course refinement | Teacher fellows | The teacher fellow program provides support for teachers to spend one or two terms at a partner IHE where they work with IHE faculty to refine two IHE courses, take a college course, and participate in MSP activities. |
| | Curriculum frameworks | The MSP developed a curriculum framework for science and refined the one for math, with the six to eight "big ideas" to be taught in these disciplines at each K–12 grade level. |
| Support for and dissemination of research-based materials | Network Connections conference | This daylong conference is held twice per year for leadership action teams and other math and science teachers and IHE faculty to explore research-based resources and tools. |
| | Educator networks | Networking activities assist districts in implementing challenging courses and curricula. Groups of teachers and coaches using a common curriculum meet to share best practices. |

NOTE: MSP activities are shown in the table as addressing one specific intervention strategy on which they are likely to have the greatest overall impact. However, most actually address additional intervention strategies. For example, the teacher fellow activity addresses not only curriculum alignment and pedagogical and course refinement, but also professional development for content and leadership.

## Evaluation Design

The evaluation questions addressed in this monograph are based on the MSP's goals:

- What progress has been made during the implementation of the MSP toward *increasing K–12 students' math and science achievement*, and to what extent can the progress be attributed to the MSP?
- What progress has been made during the implementation of the MSP toward *increasing the quality of the K–16 educator workforce*, and to what extent can the progress be attributed to the MSP?
- What progress has been made during the implementation of the MSP toward *creating sustainable partnerships*, and to what extent can the progress be attributed to the MSP?

The findings reported here draw on evaluation data related to the project's short-, mid-, and long-term outcomes. It is important to note that the project continues to collect evaluation

data. Partners on the assessment and evaluation team are collecting data from case studies of K–12 school districts, observations of MSP events, interviews with key project personnel, and assessments of teacher learning during professional development, as well as continuing to collect and analyze student achievement data.

This monograph describes analyses and findings related to the three evaluation questions. These analyses rely chiefly on mathematics and science achievement data for K–12 students, survey data from K–12 educators, and IHE qualitative data. In addition to these sources, analyses make use of data from a database of educator participation in MSP activities; a statewide database on school district demographics, finances, and achievement; and the project's entries in an NSF-sponsored database that collects information on all math and science partnership projects annually.

Analytic approaches to addressing the evaluation questions can be summarized as follows. Changes in K–12 student mathematics and science test scores are analyzed using three statistical approaches to examine the relationship of those changes to educator participation in the project. Changes in midterm outcomes associated with the quality of the K–16 educator workforce are examined through both qualitative analyses of IHE data and statistical analyses of survey data to examine the relationship of changes to educator participation in the project. Finally, the sustainability of partnerships is examined using indicators drawn from qualitative analysis of IHE data, such as the development of partnership, the implementation of challenging courses through mechanisms established by the MSP, and changes in institutional policies and practices.

## Descriptive Summary of K–12 Participation

Over the course of the first four years of the project, 58 percent of mathematics and science educators in the MSP districts participated in project activities. Overall, 3,568 educators participated in math-related activities, and 1,321 participated in science-related activities, though science participation was increasing in the later years. This difference between math and science may be due to the ongoing pressures to improve mathematics achievement, along with the phase-in of lower-stakes state science assessments during the project. On average, the total number of hours that each participant spent engaging in MSP activities over the four years was similar for the two subject areas. The mean total individual participation was 25.1 hours for math and 27.6 hours for science (the medians were 15.0 hours for math and 10.3 hours for science). Combining math and science, the sum of individual-level participation over four years ranged from 0.5 to 306 hours but was in the range of five to 50 hours for most participants.

## Overall Findings on MSP Progress Toward Its Goals

Achievement analyses found that MSP school districts experienced trends of increase in student mathematics and science scores during the project. For mathematics, similar trends were observed throughout Pennsylvania; for science, there was no external reference for comparison. Further analyses examined the relationship between educators' MSP participation and students' math and science achievement. MSP participation measures were developed to account for differences in the potential impact of educators who play a leadership role, as opposed to

educators who teach but do not play a leadership role. These measures were then used in three distinct analytic strategies for statistically modeling the relationship between educator participation and student achievement. Results of these analyses showed only a few significant relationships between MSP participation by educators and student math achievement. These significant relationships appeared among many nonsignificant findings and were inconsistent across cohorts and analyses—as a result, they do not enable us to draw any overall conclusion about the effects of the MSP on changes in math or science achievement.

Analyses of K–12 survey and IHE qualitative data examined evidence of change in midterm outcomes related to the quality of the K–16 educator workforce. Generally, educators at both the K–12 and IHE levels reported changes in leadership and instruction that are consistent with the MSP theory of action. K–12 teachers reported that MSP activities increased their awareness and understanding of math and science concepts and how students think about math and science and helped them change their teaching practices. They also reported that the professional development in which they participated was more often relevant to their needs and was focused on instructional approaches and individual student learning. Principals reported that the principal seminars influenced their views and behaviors as principals. IHE faculty reported a greater emphasis on student-centered instruction and more awareness of different pedagogical techniques. These findings suggest that the activities of the MSP may be having the intended effect on midterm outcomes associated with increasing the quality of the educator workforce. However, further statistical analyses of the relationship between participation in MSP activities and survey scales tracking key midterm outcomes did not provide evidence that the MSP is responsible for the changes reported by educators. Data from the K–12 case studies may be helpful in interpreting these findings.

IHE analyses examined the development of sustainable partnerships in the MSP and found positive indications of partnership development between IHE and K–12 educators, between IHEs, and between departments within IHEs. Moreover, analyses found modest progress toward a broader definition of scholarship in IHE faculty reward systems, an important factor in partnership development. Participation in MSP activities, along with revisions to IHE courses through the teacher fellow program, helped faculty embrace a wider variety of approaches to presenting the material to their students. As a result of these changes, faculty members were optimistic that students would become more engaged in coursework and take responsibility for their own learning.

## Conclusion

In sum, the evaluation found numerous indications that changes are occurring that are consistent with the MSP theory of action. Thus, MSP partners appear to be making progress toward the three MSP goals, though attempts to statistically link this progress to MSP participation were not successful. There are several limitations to note. The evaluation was designed to be selective in its data collection and analyses, primarily assessing the project's achievement of its goals and the major pathways toward achieving those goals. In addition, the evaluation relies on self-report data from a sample of participants and is subject to common potential biases associated with such data. Finally, and importantly, if the MSP intervention strategies require more than four years to achieve project goals, analyses reported here may not detect the impact. This monograph concludes RAND Education's MSP evaluation activities; however,

it is important to note that it does not constitute a final evaluation of the MSP. The project, including data collection and evaluation activities, is expected to continue through a forecasted end date in 2010.