Council of Chief State School Officers
American Institutes for Research
Wisconsin Center for Education Research

LONGITUDINAL STUDY OF THE EFFECTS OF PROFESSIONAL DEVELOPMENT ON IMPROVING MATHEMATICS AND SCIENCE INSTRUCTION (MSP PD STUDY)
YEAR 2 PROGRESS REPORT

Supported by
Math-Science Partnership RETA Grant
National Science Foundation

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This research report summarizes study results as of year two of a three-year longitudinal study conducted by Council of Chief State School Officers with subcontracts to American Institutes for Research (Washington, DC) and Wisconsin Center for Education Research (Madison, WI) supported by a grant from the National Science Foundation, Math Science Partnership Program, RETA grant ((EHR-0233505). For electronic version of this report, go to www.SECsurvey.org/ projects/MSP Study.

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EXECUTIVE SUMMARY

In fall 2002 the National Science Foundation (NSF) announced 24 major grants to establish Mathematics and Science Education Partnership (MSP) programs across the U.S. The overall program objective of these grants is to "increase the capacity of preK-12 educational systems and institutions of higher education to provide the requisites for learning to high standards in mathematics and science, and particularly to reduce the achievement gaps among student populations." One of the specific goals of MSP is "to contribute to the national capacity to engage in large-scale reform through participation in a network of researchers and practitioners, organized through the MSP program, that will study and evaluate educational reform and experimental approaches to the improvement of teacher preparation and professional development (Goal 3, NSF 02-061 program announcement)."

The present report summarizes progress after two years of a three-year study under the MSP RETA program. The study is being conducted by a research team comprised of staff from the Council of Chief State School Officers, American Institutes for Research, and Wisconsin Center for Education Research.

TESTING EFFECTIVENESS OF SURVEY TOOLS IN EVALUATION

One purpose of the MSP PD study is to test the use of teacher self-report survey and web-based tools for collecting, analyzing and reporting data on the quality of professional development, and the usefulness of these data tools for evaluating effects of professional development. The work is being conducted in four MSP sites from the first cohort of MSP grant sites (starting Fall 2002)—two comprehensive projects and two targeted projects.

• After the second year of three-year study design, we have demonstrated *the use of the Surveys of Enacted Curriculum (SEC) for analyzing differences in instructional practices and content of math and science teaching.* Teachers across the four MSP sites completed the surveys at an overall response rate greater than 80 percent. We demonstrate in this Report the use of these data for measuring differences in instruction at the baseline year. We also demonstrated the use of the SEC, a paper-and-pencil survey, and a Web-based monthly log for reporting on differences in the quality and distribution of professional development.

• The study has *developed, tested, and demonstrated the use of a web-based monthly Professional Development Activity Log (PDAL) system to regularly gather data from teachers on the professional development activities***.** The PDAL system had response rates as high as 62 percent in a single month, although the average rate was 57 percent in a single month; many teachers however, did not complete all months of the PDAL. The study has tested several methods of increasing response rates including online and CD training packages, postcards, incentive pay, and phone follow-ups. We will report on ways to improve PDAL response rates in the project's final report.

PRELIMINARY EVIDENCE OF EFFECTIVENESS OF MSP PROFESSIONAL DEVELOPMENT

The study is focusing on a sample of teachers targeted for MSP participation and non-participating comparison teachers in each MSP site. We found some empirical evidence that MSP initiatives are achieving their intended purpose of providing quality professional development activities for math and science teachers. For example, the four MSP program sites have instituted some of the structural features of high quality professional development activities identified in research literature, such as extended contact hours and prolonged activity span. These are among the structural features likely to set the conditions for teachers to receive intense, sustained, and in-depth learning opportunities, which, in turn, are expected to produce effects on teaching practice. Furthermore, we found that teachers targeted for participation in MSP programs tend to experience a stronger content focus in their professional development, particularly in science. Combined with sustained learning opportunities, the stronger content focus afforded by MSP programs is expected to allow teachers to incorporate new content and instructional strategies in their classrooms.

When the follow-up SEC data are made available in spring of 2005, we will test the most interesting and important hypothesis of this study: "after a year of MSP implementation, we expect teachers in the treatment group (i.e., teachers targeted for MSP participation) to exhibit higher quality instruction, as measured by the alignment of instruction with state content standards, than teachers in the comparison group, after controlling for any year 1 differences." Our analysis of the effects of professional development is based on a quasi-experimental analysis of teachers targeted for participation in MSP (for simplicity termed "treatment" teachers), and a group of non-participating comparison teachers, because random assignment of teachers to MSP and comparison groups was not feasible. Our analysis of the effects of professional development will be facilitated by our longitudinal study design, the collection of extensive baseline data to serve as potential control variables, and the use of such innovative instruments as the PDAL and SEC funded by NSF's RETA grant program.

I. Goals of Study

Introduction

In fall 2002 the National Science Foundation (NSF) announced 24 major grants to establish Mathematics and Science Education Partnership (MSP) programs across the U.S. The overall program objective of these grants is to "increase the capacity of preK-12 educational systems and institutions of higher education to provide the requisites for learning to high standards in mathematics and science, and particularly to reduce the achievement gaps among student populations." One of the specific goals of MSP is "to contribute to the national capacity to engage in large-scale reform through participation in a network of researchers and practitioners, organized through the MSP program, that will study and evaluate educational reform and experimental approaches to the improvement of teacher preparation and professional development (Goal 3, NSF 02-061 program announcement)."

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Organization of the Report

This progress report is organized in six main sections. First, in this section, we discuss the goals of the study. Then, in Section II, we turn to the study design and methodology. Section III describes data from the baseline survey of teachers, collected in year 1 of the study using the Survey of the Enacted Curriculum. Section IV describes initial data from the Professional Development Activity Log, collected in year 2 of the study. Section V illustrates program site-specific effects by using a single site. Finally, we summarize the initial findings of the study.

Research Questions

To assist NSF and the Math-Science Partnerships with the goal of improving capacity for evaluation of the models for improving teacher knowledge and skills, the CCSSO/AIR/WCER team is conducting a three-year empirical study that is testing an objective, reliable methodology for measuring the quality of professional development activities and using the data obtained to examine the effects professional development on improving the quality of instruction in mathematics and science education. More specifically, the study has three main research questions:

To what extent is the quality of the professional development supported by MSP activities consistent with research-based definitions of quality?

What effects do teachers' professional development experiences have on instructional practices and content taught in math and science classes? Are high-quality professional development activities more likely than lower-quality activities to increase the alignment of instructional content with state standards and assessments?

How can MSP projects use study findings and research tools tested in the study to improve professional development and evaluation based on measuring improvement in math and science instruction?

In this year 2 progress report, we describe the design and implementation of the study and some of the early findings regarding the first two research questions. In the final report at end of year three we will fully address all three research questions.

RATIONALE FOR THE STUDY: DEVELOPING AND TESTING A MODEL FOR EVALUATION

For decades, educators and policy-makers have seen statistics that demonstrate the lackluster performance of American students in the areas of mathematics and science. Despite years of efforts to improve both instructional practice as well as students' outcomes, there is still much room for further improvement. Recent results from the National Assessment of Educational Progress (NAEP) in mathematics and science show that although scores have improved in the 1990s, a majority of our students score below the proficient level in mathematics and science. In addition, the results from the Third International Mathematics and Science Study highlight the problems of wide variation in student performance in mathematics and science across our schools and the declining performance of U.S. students in the higher grades relative to other systems.

The TIMSS findings provide strong evidence that predominant teaching practices do not enable students to acquire the understanding or flexible skills for problem solving in mathematics or science. Of equal concern is the persistent gap between the achievement levels of poor and minority students with their more advantaged peers. The No Child Left Behind Act/ H.R. 1 codifies the national goal of closing the achievement gap of poor, minority, and limited English students with more advantaged students in our schools.

One major strategy for improving student performance and reducing the achievement gap is to set challenging content standards for *all* students. This strategy reflects a new kind of equity in education—one that has slowly shifted from equality of educational inputs to equality of educational outputs. But achieving this form of educational equity requires fundamental changes in what students are taught, and how they are taught. Education reforms, if they are to improve student achievement, must first change instructional practice at the classroom and school levels, and recent research has shown that one of the most powerful explanatory variables of the achievement gap between majority and minority students is the content of instruction.

The National Commission on Mathematics and Science Teaching for the 21st Century recommended in 2000 that the U.S.-- a) establish an ongoing system to improve the quality of mathematics and science teaching in grades K-12; and b) increase significantly the number of mathematics and science teachers and improve the quality of their preparation especially for teachers of low-income students. Clearly, many of our current science and mathematics teachers did not receive an adequate initial preparation for teaching. These teachers need continuing professional development in math-science content and pedagogy.

The Math-Science Partnership grants will serve as an important tool and catalyst in improving instructional practice in mathematics and science. The Partnership projects will bring together school districts, institutions of higher education, scientists and mathematicians, and professional organizations to promote world-class science and mathematics education for all students. MSP projects will emphasize a vital role for mathematicians, scientists and engineers in enhancing the capacity of the teacher workforce to provide challenging curriculum content. This will entail pre-service and in-service professional development of teachers as a central element of each MSP plan.

The MSP strategy clearly builds upon more than a decade of NSF support for and leadership in systemic reform. The goal of systemic initiatives in math and science of the 1990s was to ensure that efforts toward improvement were coherent, aligned, and consistent with challenging standards or curriculum frameworks for teaching and learning. However, evidence is still inconclusive regarding effects of professional development efforts in significantly changing instruction in math and science.

The CCSSO/AIR/WCER evaluation study will directly address the lack of large-scale, empirical evidence on the effects of professional development on mathematics and science instruction. This longitudinal study will measure the degree to which districts implement high-quality professional development, through MSP support, and examine the effects of such professional development on teachers' classroom practice. The study will also test the reliability of teacher surveys and logs for collecting, analyzing and reporting data on key characteristics of professional development and subsequent instructional practices and their alignment to state standards. Ultimately, the study should help evaluators, policy-makers and educators to better evaluate the effectiveness of professional development activities that teachers experience.

STUDY BUILDS ON RECENT DEVELOPMENT OF DATA COLLECTION AND ANALYSIS TOOLS

To achieve its goals, the study relies on the recent development of tools for measuring the key variables—alignment of instruction with standards and assessments, and the quality of professional development activities.

Surveys of Enacted Curriculum measure alignment of instruction with standards and assessments. If poor and minority children are to receive a high quality, standards-based education – and ultimately to reduce the achievement gap – then the instruction they receive must be aligned with the state content standards. Hence, a key element in understanding the impact of standards-based reform on student achievement is a measure of the alignment between the curricular content to which students are exposed and the content standards the state and district hope to implement. Indeed, this is a central element of this study of the effects of MSP professional development:

instructional quality is defined and measured as the degree of alignment between classroom instruction and standards

The MSP study builds on the advances in design and application of Surveys of Enacted Curriculum in math and science (Blank, Porter, Smithson, 2001; Porter, 2002; Blank, 2002). Teachers complete surveys which ask them to report on subject content and practices used in one course/grade during a school year, and time allocated to different instructional practices. Prior grants from NSF have also resulted in unique data reporting methods that are effective for various users and audiences, employing scales, item profiles, graphs, and content maps. The recent experimental design study supported by NSF, Data on Enacted Curriculum, tested the use of the curriculum data reports in improving instruction in math and science (see Blank, 2004, *Data on Enacted Curriculum (DEC) Study: Summary of Findings*).

The Surveys provide in-depth information on instructional content using a two-dimensional matrix design. The two dimensions are: (a) Topic Area, including more fine-grained subtopics, and (b) Expectations for Students, with a focus on the cognitive demand. Teachers are asked to report the amount of time spent on topics and then the expectations that are emphasized for the topics taught. [See further explanation of the Content Matrix in the Supplementary Materials.]

One important benefit of the Surveys of Enacted Curriculum is that the two-dimensional content matrix is used to analyze the content included in standards and assessments, as well as the content teachers cover in class, making it possible to compute an objective measure of alignment. Content coding and alignment analysis is accomplished through procedures developed and tested by Porter and Smithson (2001; Gamoran, et al, 1997).

Recent research identifies criteria of quality professional development. Over the past decade, a large body of literature has emerged on effective professional development, teacher learning, and teacher change (Carey & Frechtling, 1997; Cohen & Hill, 1998; Kennedy, 1998; Loucks-Horsley et al., 1998; Richardson & Placier, 2002). Despite the amount of research, relatively little systematic research has been conducted on the *effects* of different professional development programs on improving teaching or on improving student outcomes (see Kennedy, 1998; Supovitz, 2002).

A research team at AIR recently completed the National Evaluation of the Eisenhower Professional Development Program and developed a model to analyze the relationship between features of professional development and teachers' self-reported increases in knowledge and skills, and changes in teaching practice (Birman, et al, 2002; Desimone, 2002). On the basis of national data, AIR concluded that six key features of professional development are effective in improving teaching practice. Three are characteristics of the substance of the activity: (1) the degree to which the activity has **active learning** opportunities for teachers, (2) the extent to which the activity has a **content focus** on mathematics or science, and (3) the degree to which the activity promotes **coherence** in teachers' professional development by incorporating experiences that are consistent with teachers' goals and aligned with state standards and assessments (see Garet, et al., 1999;

Garet et al., 2001).The remaining three features are characteristics of the structure of the activity, that facilitate the core, substantive features: (4) the organization of the activity—whether it is a **reform type** such as a study group or teacher network, in contrast to a traditional workshop or conference, (5) the **duration** of the activity, including the total number of contact hours and the span of time over which it extends, and (6) the extent to which the activity has **collective participation** of groups of teachers from the same school, department, or grade. For the present study, these characteristics of quality were the foundation for developing a web-based Professional Development Activity Log (PDAL) to measure the features of the professional development in which teachers participate and to examine the effects of professional development on instruction.

Section II of the Year 2 report provides description of the study design, Section II briefly outlines the initial data from the baseline survey, and section IV summarizes the data from the monthly logs with teachers.

II. Study Design and Methods

The CCSSO/AIR/WCER team's longitudinal study design has three main steps:

(1) In year 1, prior to start of MSP professional development activities, develop and refine the data collection instruments, and then collect baseline data through teacher surveys to measure the instructional content and pedagogy teachers employ in mathematics and science instruction;

(2) In year 2, measure the characteristics of the professional development activities in which teachers participate through MSP; and

(3) In year 3, re-examine instructional practices, to determine if teachers' practice had indeed changed after participation in MSP-supported activities, and analyze the change in practices in relationship to degree of alignment with state content standards. A key contribution of the study is the measure of instruction both before and after professional development, and the analysis of improvement based on the goal of alignment with standards.

Exhibit 1 provides a graphic of the key tasks and scheduled activities for the three-year (2002-05) study design.

Exhibit 1: Conceptual Framework

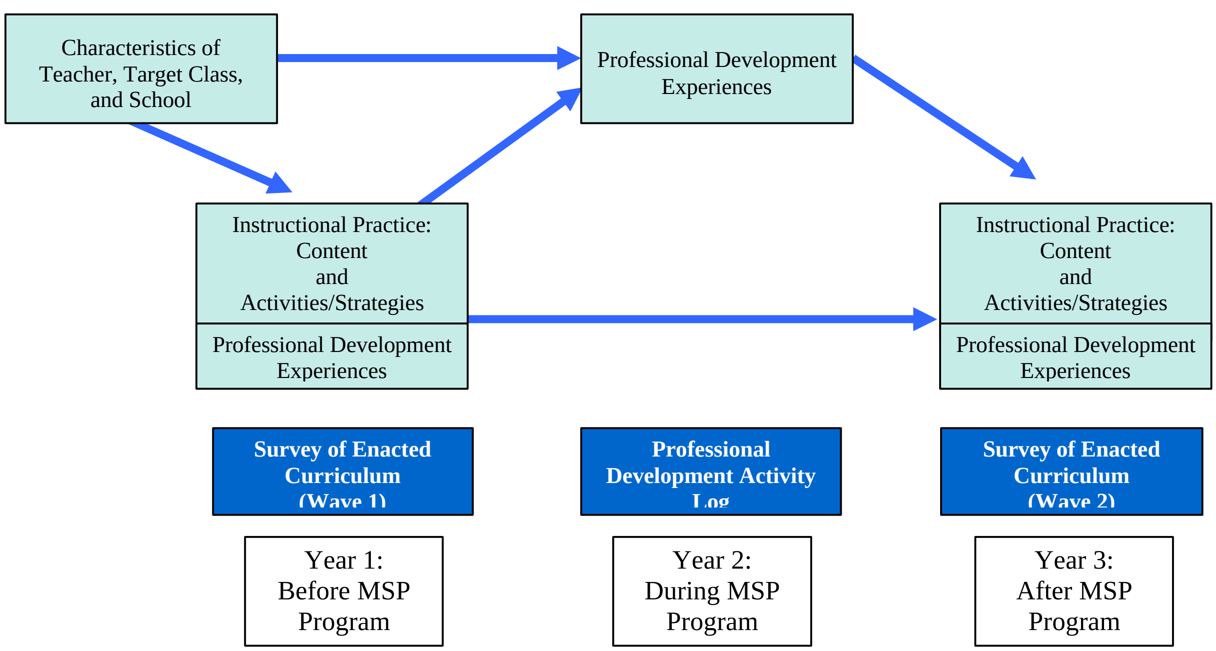


Exhibit 1 outlines the conceptual framework for the study and highlights key data collection activities and time frames. The initial study design included four selected MSP projects from the first cohort of NSF MSP awards (Fall 2002):

- Brockport/Rochester, NY
- Cleveland, OH
- Corpus Christi area, TX
- El Paso area, TX.

The projects were selected based on their MSP design, which was to provide professional development to middle school math and science teachers during the first year—allowing for measurement of change over time within a three-year scope of the study. A fifth MSP project, New Jersey, decided to use the Surveys of Enacted Curriculum as part of its evaluation design and collected data from math and science teachers in the 12-district target area of the study

Ideally, to obtain unbiased estimates of the effects of MSP professional development on instruction, teachers would be randomly assigned to participate in MSP or to serve as a control group. Given the fact that the MSP projects were already underway at the time our study began, random assignment was not feasible. Thus, the study uses a quasi-experimental design. Within each site, at the start of the baseline year (year 1), we worked with site staff to identify a group of teachers targeted for participation in MSP activities, and a matched set of comparison teachers not selected for participation.

The specific approach to matching the targeted and comparison teachers varied across the four sites, depending on the way each site organized its MSP efforts. In Brockport (site 1), the MSP project sought applicants for participation in MSP activities. We identified applicants who were selected for participation as the treatment group, and applicants not selected as the comparison group. In Cleveland (site 2), the MSP project selected teachers for participation in MSP activities, and identified math and science non-participating teachers to serve as a comparison group. In Corpus Christi area (site 3), all math teachers participating in MSP professional development in year 1 were selected as the treatment group, and other math and science teachers in the target schools are the comparison group. Finally, in El Paso area (site 4), the MSP project is using a school-based approach to the delivery of professional development. The project identified six middle schools for participation in MSP and identified five other schools located in the same districts as comparison schools.

In the text that follows, we refer to the teachers targeted for MSP participation in each site as the *treatment group*, and we refer to the teachers identified as comparisons as the *comparison group*. The nature of the professional development “treatment” received by teachers of course varied from site to site, and also within site. Thus our use of the term “treatment” should not be interpreted to mean that there is a single, standardized “MSP treatment.” Our use of the term “treatment” is simply a short-hand for “teachers targeted for MSP participation.” Because our treatment and comparison teachers were not randomly assigned, we have measured a large number of teacher characteristics at baseline (year 1), to use as potential control variables in our analyses of the effects of professional development, including teacher background, prior instruction, and participation in professional development. We believe these variables should help reduce potential biases in the analysis. But we cannot rule out the possibility that teachers in the treatment and comparison groups differ in unmeasured ways – for example, in motivation. Thus, conclusions about the effects of professional development should be interpreted as potential effects; a more rigorous design would be required to draw causal conclusions.

STUDY HYPOTHESES

In the study, we examine six hypotheses:

Hypothesis 1: In year 1, prior to the initiation of MSP, we expect sites to differ in the quality of the professional development teachers experienced and in the quality of classroom instruction as measured by the alignment with state content standards. We anticipate that differences in state and district policies, resources, and history will be reflected in differences across sites in professional development and instruction, as measured by the Wave 1 SEC.

Hypothesis 2: In year 1, we expect teachers in the treatment group (i.e., teachers targeted for MSP participation) to be similar to comparison teachers in background, in the quality of the professional development they experienced, and in the quality of classroom instruction they provided. While we were unable to use random assignment methods to allocate teachers to treatment and control conditions, we worked with each of the four MSP sites to create as closely matched a set of treatment and comparison teachers as possible.

Hypothesis 3: In year 2, the initial year of MSP implementation, we expect sites to differ in the quality of the professional development teachers experienced. We anticipate differences across sites in the quality of professional development during year 2, in part due to variation in state and district policies, resources, and history. In addition, we anticipate variation across sites in MSP professional development, since each local university-school district partnership adopted and implemented different strategies to achieve their MSP program goals, based in part on local curricula, knowledge and skills.

Hypothesis 4: In year 2, we expect that teachers in the treatment group (i.e., teachers targeted for MSP participation) experienced higher quality professional development than teachers in the comparison group. If MSP initiatives are effectively implemented in each of the program sites, we expect that teachers in the treatment group will show evidence of receiving professional development that is higher in quality than teachers in the comparison group (e.g., they will experience more opportunities for active learning, as well as activities that are more intensive and coherent).

Hypothesis 5: In year 3, after two years of MSP implementation, we expect teachers in the treatment group (i.e., teachers targeted for MSP participation) to exhibit higher quality instruction, as measured by the alignment of instruction with state content standards, than teachers in the comparison group, after controlling for any year 1 differences. If teachers in the treatment group do, in fact, benefit from high quality MSP-supported professional development over time, their instruction should improve as a result (e.g., better alignment with standards and assessment or the utilization of higher-order instructional strategies in their classroom).

STEPS COMPLETED IN STUDY AS OF YEAR 2 PROGRESS REPORT

At the end of the second year of the study (November 2004), the CCSSO/AIR/WCER team can report on six major steps carried out thus far:

(1) Baseline survey with teachers (year 1). Surveys of Enacted Curriculum administered to teachers on site (Spring 2003) to establish baseline for instruction and professional development prior to MSP. The surveys covered instruction during the 2002-03 school year, and professional development over the summer of 2002 and the 2002-03 school years. Project staff traveled to 4 sites to administer teacher surveys to treatment and control groups of teachers, or provided training to local staff to administer surveys. In each local site, group administration to teachers was the preferred method of administration. A total of 389 surveys were completed by mathematics and science teachers (See Exhibit 3 for a summary of the surveys completed by MSP site and treatment condition).

(2) On-site interviews and data collection (year 1). Interviews were conducted with MSP program coordinators and school district staff in spring 2003 to obtain core information about district standards, curricula, assessments and professional development activities supported by MSP.

(3) Monthly data on professional development through the web-based activity log (years 1-2). Study staff designed a web-based tool, and teachers were asked to complete monthly log reports of all professional development activities completed over a 15-month period (July 2003 through September 2004). Steps were taken to provide an orientation for teachers on using the tool, and follow-up calls and mailings were made to encourage use.

(4) Content coding of state standards and assessments for middle grade math and science for the states of the selected MSP sites (completed summer 2003). The coding results were used to analyze the degree of alignment between instruction and state standards—a measure of improvement.

(5) MSP evaluation workshop for project directors, evaluators, and district staff for training on use of the Survey tools within their sites (fall, 2003), to provide a method of dissemination of evaluation tools tested in the project. All Cohort 1 MSP grantees invited; with attendance by 50 participants supported by CCSSO RETA study grant and Utah State University RETA grant.

(6) Initial report on analysis of baseline data from SEC Teacher Surveys and analysis of data from Professional Development Activity Log (PDAL).

Section III of this report provides an analysis of variation in instructional practices and subject content taught across the study sample, using instructional scales and alignment content maps and indices, as well as an analysis of baseline professional development, drawing on SEC data collected in year 1 of the study. Section IV provides a preliminary analysis of variation in the professional development received by teachers during year 2 of the study, based on data from the PDAL.

Next Steps: Follow-up surveys with treatment and comparison group math and science teachers will be conducted in fall 2004 and spring 2005 to measure change in instruction and professional development over time.

SURVEYS OF ENACTED CURRICULUM: INSTRUMENTS AND PROCEDURES

CCSSO has worked with the AIR and WCER research team to develop a new, more in-depth approach to analyzing quality of professional development for teachers in math and science. One part of this approach has been to improve items on the Surveys of Enacted Curriculum (SEC) for collecting and reporting comparable and reliable data on detailed characteristics of many types of professional development activities experienced by math and science teachers.

Since 1998, CCSSO has partnered with researchers and a collaborative of states to develop, test, and implement a system of survey tools—called Surveys of Enacted Curriculum—which has a primary function of reporting comparable data on key indicators of classroom instruction (both content and practices). The survey data collection and reporting system allows for detailed analysis of the quality of instruction as well as the quality of teacher preparation and development in their assigned subject area.

The Surveys of Enacted Curriculum provide comprehensive data for analyzing teacher preparation, both quantitative course data and qualitative data on teacher views of their conditions for teaching and their own need for improvement. Three types of data are provided: Data on types and quality of current professional development, course preparation of teachers in their teaching field, and teacher beliefs about teaching and views about teaching conditions.

To carry out the goals of the MSP longitudinal study, the research team revised and improved the items in the SEC tool planned for collecting data from teachers, based on research on the characteristics of high-quality professional development. These revisions addressed two main problems found in reviewing data recently reported in the DEC project.

First, the DEC survey had teachers answer questions about groups of professional development activities by subject/topic (e.g. implementing standards). While such items do provide an overall summary analysis of professional development, they do not provide sufficient information about how the specific activities are delivered or carried out, for example through one-day workshop, a mentoring process, or a summer course. Without detailed information, the survey responses impede analysis of the quality features of specific activities.

Second, the items in the DEC project survey lacked a scale of responses from low to high for the quality criteria (e.g. content focus). The DEC items used yes/no responses, and there was an insufficient number of respond items to discern the degree to which the activity met a given criterion of quality. Teachers were only asked whether they felt the criterion was met.

Survey Items for MSP study. For the MSP study, the research team developed a set of from 4 to 8 specific questions to assess teacher responses to each of the quality characteristics (i.e., coherence, active learning, content focus, and collective participation*)*. Each item had a response scale constructed with a Likert-style format. For example, the items in the MSP survey version for science teachers to identify the degree of ***Active Learning*** in their professional development activities are the following:

Exhibit 2: Items on Quality of Professional Development: Active Learning
(New SEC Survey Items developed for MSP study)

Thinking again about all of your professional development activities in science or science education since June 1, 2002, how often have you:

		Never	Rarely	Some times	Often
111	Observed demonstrations of teaching techniques.	⓪	①	②	③
112	Led group discussions.	⓪	①	②	③
113	Developed curricula or lesson plans, which other participants or the activity leader reviewed.	⓪	①	②	③
114	Reviewed student work or scored assessments.	⓪	①	②	③
115	Developed assessments or tasks.	⓪	①	②	③
116	Practiced what you learned and received feedback.	⓪	①	②	③
117	Received coaching or mentoring in the classroom.	⓪	①	②	③
118	Gave a lecture or presentation to colleagues.	⓪	①	②	③

To review the complete revised Surveys of Enacted Curriculum section on Professional Development, see www.SECsurvey.org/tools. The review and revision process for items on quality of professional development was conducted in the MSP longitudinal study by the study project staff including researchers at CCSSO, AIR, and WCER, plus the expertise and assistance of the study advisory panel.

As a result of the PD items development and revision process under the MSP study, the total number of items addressing professional development in the Teacher Survey instrument doubled. The outcome was survey items that asked teachers to report on the characteristics of professional development activities which allowed for better analysis of quality. The format also was moved from a matrix to sets of items aimed toward each quality criterion. The responses by section are aggregated into summary scale measures. See Appendix C for graphic displays of data on professional development from the SEC baseline survey.

SEC Survey Administration, Sample Size and Response Rate

In spring 2003, teacher surveys were completed by a total of 214 mathematics and 185 science teachers in grades 6-12, across four MSP sites in three states. Five math and five science surveys were dropped because of partial survey completion or other missing information, yielding for analysis purposes a total sample of 389 teachers: 209 in mathematics and 180 in science (See Exhibit 3). Of these, 133 mathematics teachers and 88 science teachers are included in the treatment group. The comparison group is made up of 76 mathematics and 92 science teachers.

Exhibit 3: Year 1 Sample Responses to Survey of Enacted Curriculum and Professional Development Activity Log (July 2003-September 2004): By MSP Sites and Treatment Status

	Intended Sample	Year 1 SEC				PDAL			
		Math	Science	Total	Response Rate	Math	Science	Total	Completion Rate[1]
MSP Site									
Site 1	91	47	31	78	86%	37	18	55	60%
Site 2	180	78	99	177	98%	49	63	112	62%
Site 3	93	50	28	78	84%	34	23	57	61%
Site 4	112	34	22	56	50%	28	21	49	44%
Treatment Status									
Comparison	213	76	92	168	79%	45	54	99	46%
Treatment	263	133	88	221	84%	103	71	174	66%
MSP_Site*Treatment Status									
Site 1-Comparison	43	19	17	36	84%	12	8	20	47%
Site 1-Treatment	48	28	14	42	88%	25	10	35	73%
Site 2-Comparison	68	27	40	67	99%	14	15	29	43%
Site 2-Treatment	112	51	59	110	98%	35	48	83	74%
Site 3-Comparison	51	15	26	41	80%	6	22	28	55%
Site 3-Treatment	42	35	2	37	88%	28	1	29	69%
Site 4-Comparison	51	15	9	24	47%	13	9	22	43%
Site 4-Treatment	61	19	13	32	52%	15	12	27	44%
Total	**476**	**209**	**180**	**389**	**82%**	**148**	**125**	**273**	**57%**

Note: [1] PDAL completion rate represents the number of teachers who completed usable PDAL data among the intended sample.

Overview of the PDAL Methods

In order to examine the scope, nature, content, and quality of a wide array of professional development activities that teachers take part in over an extended period of time, AIR developed the Professional Development Activity Log (PDAL), in collaboration with CCSSO and WCER. This new tool is built on AIR's prior work on the National Evaluation of the Eisenhower Professional Development. The PDAL is a web-based, self-administered, longitudinal data collection tool with which teachers record their professional development experiences in detail with the assistance of a series of structured prompts.

Teachers log on to their password-protected web account and fill out their PDAL at least once a month, even if they did not participate in any PD activities. In the PDAL, teachers are prompted each month to answer the following questions about *each* PD activity in which they participated:

- Name of activity
- Number of hours spent on each activity and its duration
- Whether the activity is a one-time event or a continuous event (i.e., recurring over a number of months)
- Type of activity (e.g., workshop, summer institute, study group)
- Purpose of activity (e.g., strengthening subject matter knowledge)
- PD quality features (e.g., active learning, coherence, collective participation; see Garet et al., 1999; Garet et al., 2001)
- Content focus (e.g., algebraic concepts: absolute values, use of variables, etc.)
- Instructional practice – instructional strategy topics covered in each activity (e.g., use of calculators, computers, or other educational technology)
- Materials used during each activity

Teachers may revisit the PDAL over multiple sessions as necessary to complete their monthly logs. They may also modify their entries until they elect to "finalize" the month. Some teachers may not have activities to report for some of the months during the study period. These teachers can report their "inactive" PD status for the month by simply clicking on a button, which states, "I did not participate in any formal professional development activities this month."

PDAL RESPONDENTS

A total of 273 math and science teachers from 4 MSP sites have participated in the PDAL. Overall, 57% of the teachers in the sample completed the PDAL for at least one month. However, as Exhibit 3 shows, the rates vary by MSP sites and MSP program participation status. For example, sites 1, 2, and 3 achieved about the same rates: 60%, 62%, and 61%, respectively. But site 4 lagged behind, reaching only 44%. Treatment teachers were more likely to complete the PDAL compared with their non-treatment counterparts: 66% vs. 46%. For the purpose of the analysis for this report, we used the PDAL data that were completed by September 15, 2003. The data set includes logs covering the period from July 2003 through August, 2004. By September 15, 2004, 1,789 monthly logs have been completed by 273 teachers.

III. SURVEYS OF ENACTED CURRICULUM: BASELINE TEACHER SURVEY

Surveys were initially designed by CCSSO and WCER through prior studies (Blank, et al, 2001; Porter, 2002; Blank, 2004). The version for the present study was developed by the study team with assistance from the study advisory panel (See www.SECsurvey.org/ Tools). Teacher surveys were administered in spring 2003 with the assistance of local site coordinators. Training for administration of the surveys was provided project staff in each of the four sites. In most cases, administration of the surveys occurred during faculty meetings held specifically for survey completion. In some cases teachers were allowed to complete the surveys at their convenience, and either centrally collected and sent to WCER in bulk, or in a few cases sent individually be teachers. The highest response rates were noted in those places were group administration of the survey was conducted. The response rate across the four sites, based on our best estimates of anticipated program participation was 84%. [Appendix Table A for summary data.]

Surveys were received completed by a total of 214 mathematics and 185 science teachers in grades 6-12 across four MSP sites in three states. For analysis purposes, the following sample size with complete data was obtained:

	Math	Science
Complete	209	180
Treatment	133	88
Comparison	76	92

SEC DATA OVERVIEW

The SEC instruments collect a broad range of information about the educational context. The survey is organized into 10 sections that provide a good sense of the range of data collected:

School & Class Description	Instructional Readiness
Use of Homework	Teacher Opinions
Instructional Activities	Professional Development Activities
Instructional Influences	Teacher Characteristics
Use of Assessments	Instructional Content

Survey results are typically reported in profiles and scales. Profiles highlight results of individual items grouped by survey section. Scales report summary measures that aggregate individual items based on some common construct. Because of the sheer size and breadth of the data set, a variety of scale measures can and have been constructed. For information on the full set of scales employed in the initial analyses, the items they are constructed from, and measures of scale reliability, see Appendix B. Data from the Instructional Content section of the Survey are reported in two dimensional content maps or graphs—topics by expectations for learning (or cognitive demand). For the MSP project, the Instructional Activities scales were redesigned to parallel cognitive demand dimension of the content survey.

The following scales and summary measures are used in the initial analyses reported here:

Scales related to instructional practice

Assessment Use	Influence of Standards on Instruction
Climate of Trust	Perform Procedures
Communicate Understanding (science)	Demonstrate Understanding (math)
Analyze Information	Make Connections
Active Learning	

Scales related to professional development (PD) activities

Frequency of PD Activities	PD Hours
Active PD	Coherent PD
PD with collective participation	PD with focus on subject matter content
PD with focus on student data	PD with focus on standards & instruction
PD with focus on student learning	

Summary Measures related to Instructional Content

Topic Coverage	Categories of Cognitive Demand
Alignment to Tests	Alignment to Standards

In addition, we considered the following teacher characteristics in our initial analyses: teacher gender and ethnicity, class organization, class size, course type, teacher perception of student ability, teacher experience, and number of years teaching at this school.

In the analyses conducted for this report we ask two primary questions:

1) Do our treatment and comparison groups differ significantly on important characteristics (Hypothesis 2)?

2) What are the pre-existing relationships among key variables in the baseline data results? Also, where relevant, we note significant differences across the four participating sites (Hypothesis 1). While sites are likely to vary on some characteristics (and important to note), we anticipate that comparisons between the treatment and comparison groups will ideally yield little or no significant differences between the two groups on key variables related to MSP program treatments.

To answer these questions, analyses of variance and correlations were examined in concert with descriptive results for the variables identified above. Results of those analyses are reported here.

TEACHER CHARACTERISTICS

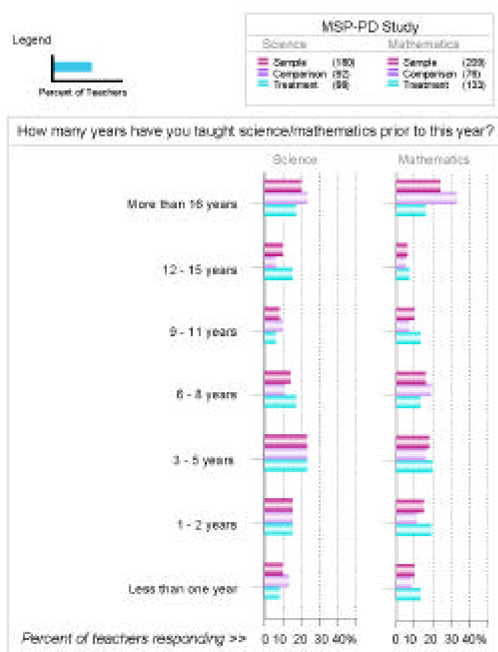
The SEC instruments collect data on the following teacher characteristics:

Gender
Ethnicity
 # Years teaching science/math
 # Years at current school
Highest degree held
Type of teaching certification(s) held

These variables were examined for significant differences between the treatment and comparison groups of teachers.

No significant differences were found between the treatment and comparison groups of mathematics teachers on the basis of gender, ethnicity, highest degree held, or certifications held. However, among responding science teachers we do note a higher proportion of female teachers in the treatment group (70%) than the comparison group (60%). The sample also indicates a significantly higher proportion of Hispanic or Latino teachers in the comparison group (21%) compared to the treatment group (9%). However, when mathematics and science teachers were grouped together, no significant differences were found between treatment and comparison groups in terms of either gender or ethnicity.

Exhibit 4
Teacher Experience
By Subject & Treatment vs. Comparison



As indicated in Exhibit 4 (right column), mathematics teachers in the comparison group report more years experience at teaching mathematics than those in the treatment group. Among science teachers no significant differences are noted between the comparison and treatment groups in terms of years of experience, or years in their current school (see Exhibit 4, left column).

INSTRUCTIONAL ACTIVITIES

The SEC data set provides five scale measures associated with instructional activities related to mathematics and science instruction. Though the instructional practice scales parallel one another across subject areas, it should be noted that the scales differ by subject both in terms of the specific survey items that define the scales, as well as (in some cases) slight difference in the conceptual constructs being measured. Listed by subject, these scale measures are:

Mathematics	Science
Perform Procedures	*Perform Procedures*
Demonstrate Understanding	*Communicate Understanding*
Conjecture, Hypothesize, Prove	*Analyze Information*
Make Connections	*Make Connections*
Active Learning	*Active Learning*

(See Appendix B for scale items/definitions and results of reliability analyses.)

No significant differences were found between the comparison and treatment groups on four of the five scale measures related to instructional activities (see Exhibit 5) and all six variables related to science instruction (see Exhibit 3), and these results indicate, in general teachers selected for MSP participation appeared to be similar in their instruction to comparison teachers. Only the Active Learning Scale for Mathematics indicates any significant difference among treatment and comparison teacher groups. Analyses of variance also indicate no statistically significant differences among sites on these measures, indicating that instructional approaches appeared similar across our sites.

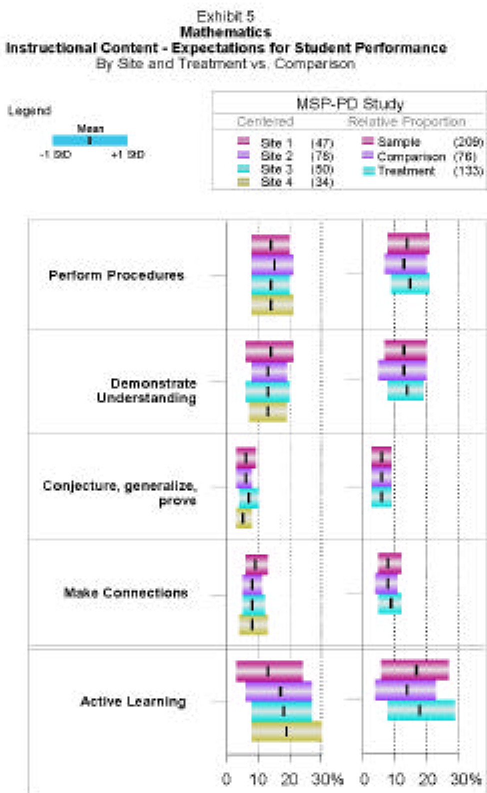
Note that the Active Learning scale shares some items with other scale measures (see Appendix B). These scales are being employed in an exploratory manner at this point, and only scales consisting of mutually exclusive items will be utilized in the formal analysis of longitudinal results.

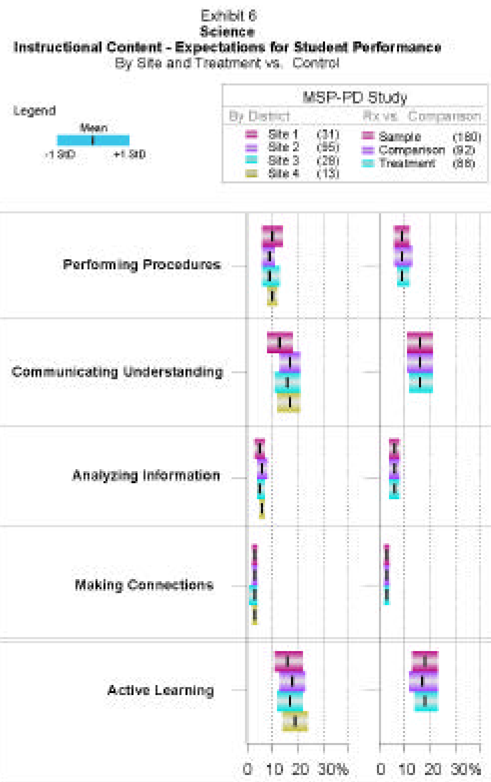
Four of the above measures parallel measures of cognitive demand collected in the instructional content section of the survey, but are based on items from the instructional practices section of the SEC surveys. While only "Making Connections" shows a significant and positive correlation with its cognitive demand counterpart ($r = .22$; $p = .003$), the general pattern of relative emphasis across the two sets of student expectation measures are similar (compare Exhibits 5 & 6 with Exhibits 7 & 8). While it might seem reasonable to expect higher correlations between similar measures calculated from the practice and the content sections of the survey, it should be noted that the content measures are orthogonal, and account for 100% or instructional time, while the measures based on instructional practice are not orthogonal and do not account for 100% of instructional time. We believe this measurement difference contributes to the low correlations for similar measures.

INSTRUCTIONAL CONTENT

In the SEC, instructional content is described in terms of subject –specific topic coverage and cognitive demand. K-8 mathematics uses a list of 103 mathematics topics, while the science includes 149 topics. Both subjects use five categories of cognitive demand (see above), though the specific description for each category varies by subject. Respondents are asked to report first on the total amount of instructional time (in class periods) spent on the various topics listed. Respondents then report the relative emphasis across each category of cognitive demand for every topic that receives some instructional time. Using this approach to content description allows investigators to examine results based on the intersection of topic and cognitive demand, as well as examination of each dimension (topic, cognitive demand) separately.

Summary results of instructional content are presented in two ways. Content summary measures report results separately for each of the two dimensions used to describe subject matter content (topics and cognitive demand). Content maps show the intersection of the two dimensions using a topographic or surface area map. Content maps of instruction, assessments, and standards are provided in Appendix G. Discussion here will be limited to marginal results for instructional content.





COGNITIVE DEMAND

Exhibits 7 & 8 display teacher reports of their emphases on the five cognitive demands. The pattern of emphases across categories of cognitive demand varies noticeably by subject. Mathematics teachers consistently report somewhat more emphasis on performing procedures and demonstrating understanding than the other categories. This pattern persists whether the sample is disaggregated by site or by treatment vs. comparison teachers. The only significant mean difference is noted for Conjecture, Generalize & Prove in Site 1, where somewhat less emphasis is reported for this category.

In science we note differences in the placement of relative emphases by sites, but none rising to the level of significance. When disaggregated by treatment vs. comparison, the results show that the two groups of teachers in the sample had similar averages and variation at the beginning of the study.

Exhibit 7
Mathematics
Instructional Content - Expectations for Student Performance
By Site and Treatment vs. Comparison

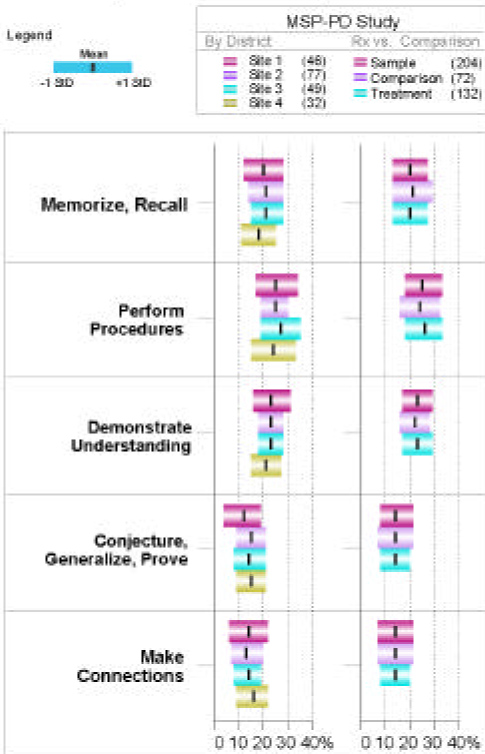
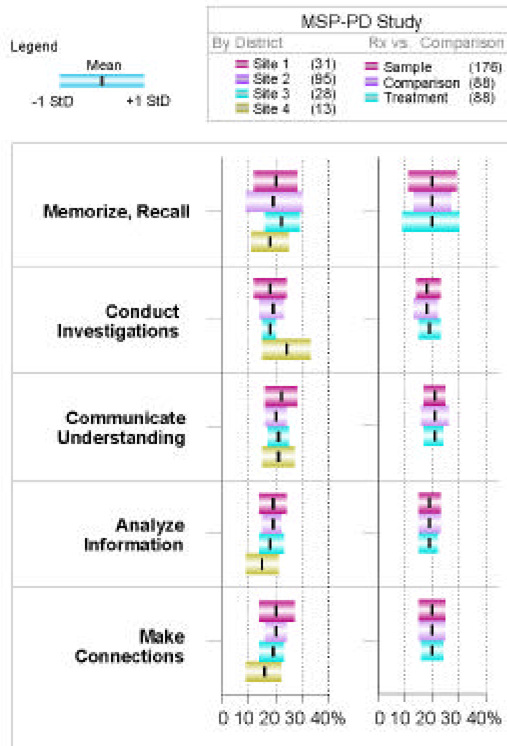


Exhibit 8
Science
Instructional Content - Expectations for Student Performance
By Site and Treatment vs. Comparison



TOPIC COVERAGE

Because the list of topics used to describe content differs between K-8 and high school grade levels, we conducted separate analyses of differences in topics covered by middle school and high school teachers. Since high school teachers were not the original focus of this study, and only two sites included high school teachers in the sample, results are presented here for middle school grades only. For K-8 mathematics instruction only one content area (Geometric Concepts) showed significant mean differences between comparison and treatment groups, with the comparison group reporting slightly less time spent on geometric concepts (12%) than reported for the treatment group (15%). In general, the data indicate consistency in mathematics topic coverage across treatment and comparison teachers in the sample, and across sites. Site 1 provides one exception to this pattern; comparison of mathematics topic coverage across sites reveals significantly greater variation among Site 1 mathematics teachers with respect to the amount of time spent using instructional technology. This is the only significant difference in topic coverage noted between sites, particularly insofar as Site 1 has increasing the amount of time using of instructional technology among mathematics teachers as a primary goal of their program initiative (see Fig. 6). For this reason it should also be noted that treatment teachers in site 1 report slightly more time spent on instructional technology (mean = 0.04) than do comparison teachers (mean = 0.03).

Because the topic list for science is much larger than mathematics, and organized into 25 content areas instead of 8, Exhibit 10 lists only those content areas for which significant mean differences were noted either among sites or between treatment and comparison groups. Of the content areas listed in Exhibit 10, only 'Energy' does not indicate significant variation between sites. Energy is however a content area where the mean difference between comparison and treatment groups is statistically significant, with the treatment group reporting more time on energy topics than the comparison group. Site 1 is particularly notable for the wide variation among teacher reports of time spent on topics related to Measurement & Calculation in Science and especially topics related to Science & Technology.

Exhibit 9
Mathematics
Content Coverage
By Site and Treatment vs. Comparison

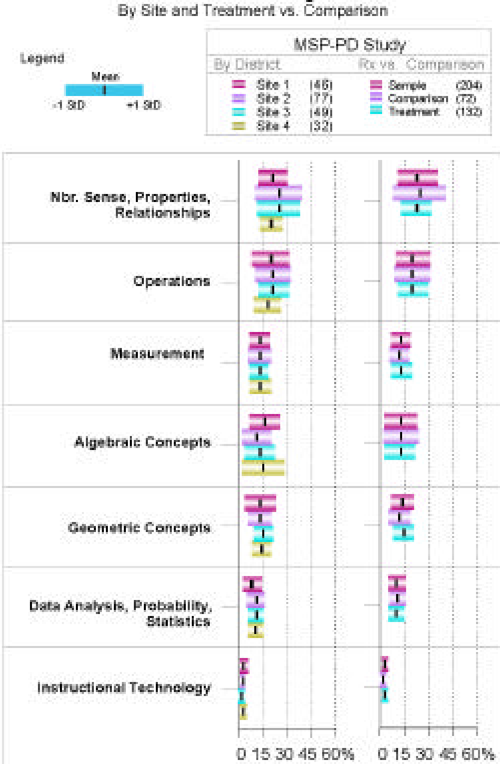
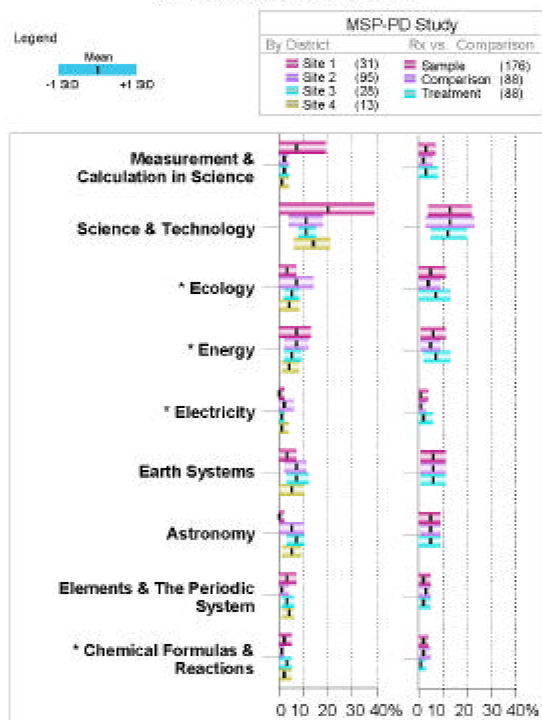


Exhibit 10
K-8 Science
Content Coverage
By Site and Treatment vs. Comparison



* Statistically significant mean difference between control and treatment group

ALIGNMENT ANALYSES

Alignment in these analyses is a quantitative measure used to describe the extent of similarity between instruction, assessments, and standards. Our alignment indicator has a range of 0 to 1, where 0 represents complete lack of alignment and 1 represents perfect alignment. For example, alignment measure of 1.00 between instruction and some assessment would indicate that only content represented on the assessment was taught, and that the relative proportion of time spent in instruction on any given topic at any given level of cognitive demand mirrored the relative proportion of score points on the assessment associated with that topic and category of cognitive demand. Similarly, an alignment measure of 0.00 between an instruction and some assessment would indicate that no topic assessed was included as part of instruction.

During year 1 of the project, mathematics and science content standards for each of the three states represented in the sample were content analyzed using the two-dimensional descriptive language employed for describing subject-matter content. State assessments were also content analyzed where access was available Exhibit 11 lists the standards and assessments that have been content analyzed for the three states represented in the sample. Note that while our study was originally designed to focus on middle school, two of the four sites participating in the study have programs that target both middle school and high school teachers. As a result, the sample includes high school teachers in sites 1 & 2. High school assessments and standards for State 2 only have been content analyzed at this point. To the extent possible, content analyses will be conducted in the upcoming year on standards and assessments missing in Exhibit 11, in order to provide relevant targets for measuring instructional alignment.

Exhibit 11

	Mathematics		Science	
	Assessment	Standards	Assessment	Standards
State 1	Gr. 8	Gr. 5-8	--	Gr. 5-8
State 1 (H.S.)	--	--	--	--
State 2	--	Gr. 5-7	Gr. 7	Gr. 7
State 2 (H.S.	Gr. 9	Gr. 9	Gr. 9	Gr. 9
State 3	Gr. 6 & 8	Gr. 6 & 8	--	Gr. 8

Where possible, an alignment index was calculated between instruction and the most relevant standard and/or assessment. Where possible, instructional alignment to a standard or assessment was targeted to the specific grade for which instruction was reported on. Thus in state 3, sixth grade mathematics teachers had alignment calculated on that state's grade 6 assessment and standards. Where the specific grade of instruction reported on was not available, the next closest grade was selected as the alignment target. For example grade 7 mathematics teachers in state 3 had alignment targeted to the grade 8 standards and assessment, while all science teachers in state 3 had their instruction aligned to the grade 8 science standards, since this was the only relevant target available. Because the content language differs between grades K-8 and high school, all middle school mathematics teachers in state 2 had their alignment index based on the grade band 5-7 mathematics standards for state 2.

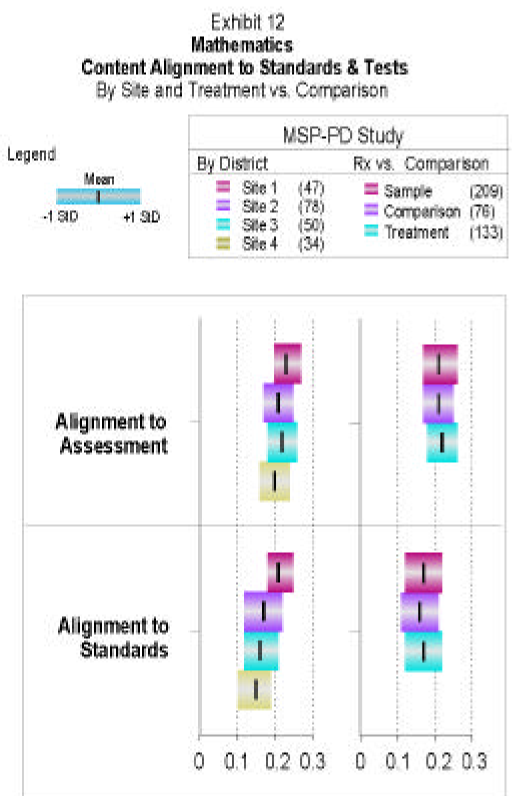
Alignment of Instruction to Assessments & Standards

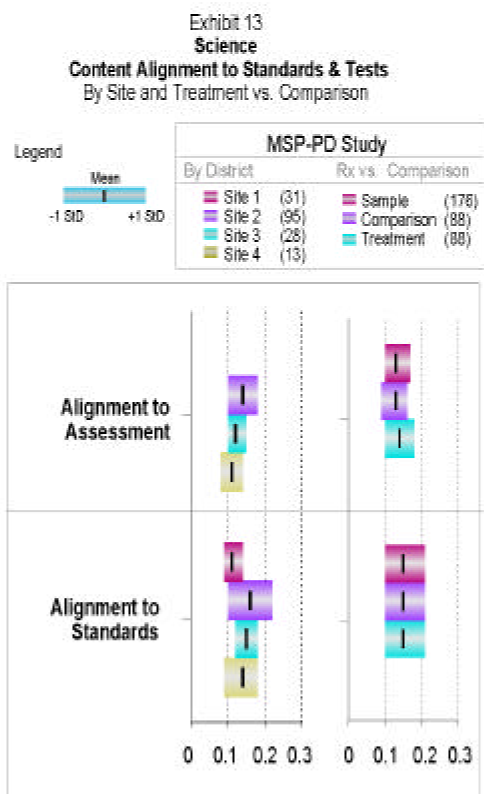
Using these parameters, alignment indices were calculated for targeted standards and assessments (where available). Across the sample of mathematics teachers alignment to the assessment ranged from 0.11 to 0.34, (mean = 0.21; std. dev. = 0.04), compared to a range of 0.05 to 0.30 (mn. = 0.17, and std dev. = 0.05) for standards.

As can be seen in Exhibit 12, the pattern of higher alignment of instruction to assessments than for instruction to standards persists across sites. Even in Site 1, with its substantially higher alignment to standards compared to the other sites, teachers' instruction (content coverage?) appears to be more highly aligned to assessments than to standards. While the treatment group shows slightly higher alignment of instruction to both standards and assessments, compared to the comparison group, these mean differences were not found to be significant upon analysis.

The alignment of teachers' instruction to both standards and assessments in Site 1were, however, significantly higher than in the other three sites. It is worth noting that the standards for State 1 (in which Site 1 is located) are set at the intermediate level grade band (grades 5-8), and represent the broadest range of target grades among the standards represented. State 2 (Site 2), with the next broadest target range (grades 5-7) for mathematics standards also had the next highest mean level across the sites, though not by a statistically significant amount. State 3 (Sites 3 & 4) in turn had the most specific targets, with grade 6 and grade 8 standards analyzed, and yielded the lowest mean level of alignment across the four sites. Whether this pattern of better alignment to more broadly defined targets over grade-specific targets will maintain as more documents and more descriptions of instruction become analyzed is not known. However such a pattern would be consistent with the perhaps too simplistic notion that a broader target is easier to hit.

Exhibit 13 reports alignment results for science. Across the four sites alignment to assessments ranged from 0.03 to 0.21 (mean = 0.13; std.dev. = 0.04), and 0.00 to 0.30 (mean = 0.15; std.dev. = 0.05) for standards. Science instruction reported by teachers in the sample appears to be somewhat better aligned to standards than to assessments. Though standards and assessments from more states would need to be analyzed and compared before we could say this pattern is persistent, it is a pattern consistent with the argument that science assessments are new to high stakes assessments, and are less visible to science teachers than are science standards. The site-by-site patterns are also interesting to consider. Alignment to standards for site 2 shows dramatically greater variation than seen in the other three sites, as well as the highest mean alignment measure across sites.





Alignment of Assessments to Standards

Most discussions about alignment concern alignment between standards and assessments. A key element of the assessment-based accountability component of the standards-based reform is the requirement that assessments be appropriately aligned to standards. While we have no theory-based criteria for what represents good alignment between standards and assessments using our quantitative approach to alignment, we do have a growing body of empirical results that give a sense of what currently represents typical alignment. For mathematics, alignment between state tests and standards typically runs between 0.31 and 0.47 (Porter, 2002).

Exhibit 14 reports alignment results between standards and assessments. The main diagonal of Exhibit 14 reports results for alignment between a given state's content standards and that same state's assessment, where we had a grade level match between standard and assessment. The off-diagonal measures report alignment for standards and same-grade assessments from other states. Assuming that recent efforts to align standards and assessments within states have been successful, we would expect to see the average alignment for a state's assessment to its own standards to be higher than the average alignment of state assessments to other state standards. The average for the main diagonal in Exhibit 14 is 0.40, while the off-diagonal alignment average is 0.29, supporting the expectation that state assessments will be more highly aligned to their own state content standards than to standards from other states.

Exhibit 14
Alignment of State Mathematics Assessments to Standards

	Assessments			
Standards	State 1 Gr.8	State 2 Gr.9	State 3 Gr.6	State 3 Gr.8
State 1 Gr.8	0.38		0.24	0.27
State 2 Gr.9		0.34		
State 3 Gr.6	0.36		0.48	
State 3 Gr.8	0.30			0.38

Exhibit 15 reports similar results for science. Note that no science assessments were available for analysis from State 1, and only one grade specific match between state standard and assessment was available for comparison. Due to the limited sample of science documents analyzed, particularly in matching grade-specific standards to same grade assessments, similar analyses are not possible at this time for science. With what data is available for looking at alignment between science standards and assessments, the pattern appears to suggest generally lower alignment in science than in mathematics. If this pattern persists with more analyses, we would expect that this is consistent with states only recently beginning to put attention on high-stakes science assessments and resulting interest in alignment between assessments and standards, whereas these issues have been a focus in mathematics for some years now.

Exhibit 15
Alignment of State Science Assessments to Standards

	Assessments		
Standards	State 1 Gr.8	State 2 Gr.7	State 3 Gr.5
State 1 Gr.8	--	0.14	0.23
State 2 Gr.7	--	0.15	0.17
State 3 Gr.8	--	0.15	0.15

RELATIONSHIPS AMONG KEY VARIABLES

In addition to simple descriptive statistics and analyses of variance, correlations between key variables (listed above, see SEC Data Overview) were examined to identify relationships existing at the baseline. In particular, relationships between professional development activities and instructional practice were examined for pre-existing (prior to treatment) relationships.

Among both mathematics and science teachers, several PD-related scales were significantly correlated with amount of assessment use and influence of standards are noted (see Exhibit 16).

Exhibit 16
Correlations between Classroom Assessment Use & Features of PD

	Mathematics		**Science**	
	r Value	*p* Value	*r* Value	*p* Value
PD Frequency	**0.31**	*0.000*	**0.42**	*0.000*
PD Hours	**0.26**	*0.000*	**0.35**	*0.000*
Active PD	**0.41**	*0.000*	**0.44**	*0.000*
Coherent PD	**--**		**0.43**	*0.000*
Collective PD	**0.18**	*0.010*	**0.22**	*0.004*
PD w/ Content Focus	**0.26**	*0.000*	**0.40**	*0.000*
PD w/ Data Focus	**0.32**	*0.000*	**0.46**	*0.000*
PD w/ Stndrds/Instr. Focus	**0.24**	*0.000*	**0.42**	*0.000*
PD w/ Student Lrng. Focus	**0.32**	*0.000*	**0.49**	*0.000*

While the results of Exhibit 16 indicate a strong relationship between the use of assessments in the classroom and participation in professional development activities, the causal relationship among these variables remains unclear. These data represent pre-existing, baseline relationships, and no evidence is available to determine whether PD fosters classroom assessment use, or vice versa. Examining these relationships for patterns of change after the second round of data collection, particularly among teachers in the treatment group, and with additional information on the nature of the professional development activities engaged in by teachers, should help to discern effects on these relationships of participation in MSP sponsored professional development activities.

Exhibit 17
Correlations between Influence of Standards on Practice & Features of PD

	Mathematics		Science	
	r Value	*p* Value	*r* Value	*p* Value
PD Frequency	**0.26**	*0.000*	**0.22**	*0.003*
PD Hours	**0.25**	*0.000*	**0.16**	*0.042*
Active PD	**0.26**	*0.000*	**0.30**	*0.000*
Coherent PD	**0.24**	*0.001*	**0.50**	*0.000*
Collective PD	**0.42**	*0.000*	**0.33**	*0.000*
PD w/ Content Focus	**0.64**	*0.000*	**0.63**	*0.000*
PD w/ Data Focus	**0.53**	*0.000*	**0.47**	*0.000*
PD w/ Stndrds./Instr. Focus	**0.67**	*0.000*	**0.63**	*0.000*
PD w/ Student Lrng. Focus	**0.37**	*0.000*	**0.46**	*0.000*

Similar relationships between professional development participation and the level of influence of standards on classroom practices can be seen in Exhibit 17, with significant and positive correlations reported for all PD-related scales. Again the nature of these relationships, especially with respect to cause and effect cannot be determined from these data.

While little can be said about the causal nature of the relationship between participation in professional development activities and either use of assessments in the classroom or the degree of influence of standards on classroom practice, the strong and persistent correlations between these variables do suggest the utility of these scales for looking at relationships between practice and professional development.

The strong relationships to participation in professional development activities noted above do not persist when looking at more specific classroom practices. For example, teachers' emphasis on active learning for their students is associated with three of the nine PD-related variables in mathematics, and only two for science (see Exhibit 18). Curiously, in mathematics the frequency of professional development participation is positively correlated to active learning, but not the amount of PD (PD hours). The reverse is true for science. Both subjects however show a positive correlation between active learning and professional development activities that engage teachers in active learning, as would be expected. Collective participation in professional development activities also shows a positive relationship with active learning in mathematics, but not science.

Exhibit 18
Correlations between Active Learning & Features of PD

Correlation between	Mathematics		Science	
Active Learning &	*r* Value	*p* Value	*r* Value	*p* Value
PD Frequency	**0.19**	*0.007*	**--**	
PD Hours	**--**		**0.18**	*0.022*
Active PD	**0.26**	*0.000*	**0.20**	*0.007*
Coherent PD	**--**		**--**	
Collective PD	**0.16**	*0.022*	**--**	
PD w/ Content Focus	**--**		**--**	
PD w/ Data Focus	**--**		**--**	
PD w/ Stndrds/Instr. Focus	**--**		**--**	
PD w/ Student Lrng. Focus	**--**		**--**	

Recall that two alignment variables were calculated based on teacher reports of instructional content and content analyses of relevant state standards and assessments. Correlation results for alignment to standards are reported in Exhibit 19. Only one PD-related variable appears related to alignment to standards for mathematics teachers, frequency of PD participation. However, a number of these variables are associated with alignment to standards among science teachers. In science at least, as alignment of instruction to standards goes up, so does the amount of participation in professional development reported. Additionally, several of the quality indicators of professional development appear to be associated with increased alignment to standards. Once again, causal statements are not warranted at this time, however we expect that in mathematics gains in alignment will be associated with participation in MSP-sponsored professional development activities.

Exhibit 19
Correlations between Alignment to Standards & Features of PD

Correlation between	**Mathematics**		**Science**	
Alignment to Standards &	*r* Value	*p* Value	*r* Value	*p* Value
PD Frequency	**0.15**	*0.050*	**0.30**	*0.000*
PD Hours	**--**		**0.17**	*0.037*
Active PD	**--**		**0.19**	*0.015*
Coherent PD	**--**		**0.20**	*0.014*
Collective PD	**--**		**--**	
PD w/ Content Focus	**--**		**0.20**	*0.011*
PD w/ Data Focus	**--**		**--**	
PD w/ Stndrds/Instr. Focus	**--**		**0.19**	*0.015*
PD w/ Student Lrng. Focus	**--**		**0.18**	*0.025*

CONCLUSIONS FOR SEC YEAR 1 DATA ANALYSES

As previously stated, the primary focus of year 1 SEC data analyses was to compare the characteristics of treatment and comparison teachers, and to determine any similarities and differences in the baseline data across sites.

With respect to treatment and comparison group characteristics, we note that mathematics teachers in the comparison group have somewhat more years experience on average than reported by mathematics teachers in the treatment group. Females are represented more among science teachers in the treatment group (70%) than the comparison group (60%). Latinos are more heavily represented among comparison group science teachers (21%), than their treatment group counterparts (9%). No other differences in teacher characteristics are noted for the treatment and comparison groups.

Only one scale measure related to student activities (Active Learning) showed significant differences between treatment and control groups, and only for mathematics, with treatment mathematics teachers reporting more use of active learning in the classroom than reported by comparison mathematics teachers. No significant differences in instructional activities were noted between treatment and comparison groups in science.

Teacher reports of instructional content indicate that treatment mathematics teachers spend slightly more time on Geometric Concepts than do comparison group mathematics teachers. No significant differences were noted on the content dimension of cognitive demand between treatment and comparison groups for either subject. While differences in content coverage were noted for both sites and treatment/comparison groups, because science typically shows great diversity of topic coverage among teachers, these results are not unexpected. No significant difference in mathematics topic coverage is noted between treatment and comparison groups. Similarly, no significant differences between groups are noted for either alignment measure.

Based on these analyses it is believed that the comparison and treatment groups are sufficiently similar to be useful for detecting differences in outcomes attributable to participation in MSP sponsored professional development activities. Additionally, a number of pre-existing relationships were noted among key variables (described above).   These pre-existing relationships will be taken into consideration, and to the extent necessary controlled for, in conducting the longitudinal analyses to follow Year 3 data collection.

IV. Professional Development Activity Log Results

In this section, we first describe how the PDAL was administered for this study, while underscoring the nature of the PDAL data and its analytic potential and advantages. Then, we explain how professional development scales were constructed and present basic descriptive statistics for the constructed scales. Lastly, we present the results of our preliminary data analysis that was undertaken to test hypotheses 3 and 4 for the study.

Administration of PDAL

The PDAL data collection was launched in July, 2003 and ended on November 15, 2004. Teachers who had completed the SEC year 1 and/or who taught in schools in the sample received an introduction packet in the mail. The packets included a letter introducing them to the PDAL, instructions on how to sign-on to and complete the PDAL, and a glossary of terms (e.g., definition of institute). Further, each teacher was provided with an email and toll-free phone number to call when they needed help with the PDAL.

Teachers were instructed to begin creating log entries for July, 2003. Subsequent month logs would be automatically generated for teachers to fill out starting from the first day of each month. Teachers were asked to complete reporting on a month by the 15th of the following month. Teachers created separate logs for each professional development activity they participated in each month. Teachers could revisit the PDAL (over multiple sessions) as necessary to complete their monthly activity logs. They could also modify their log entries until they chose to “finalize” the month. If the activity continued beyond the first month, they would continue to report on that same activity in following months. Teachers who did not have any professional development activities in a given month were asked to indicate their *inactive* status for the month by clicking on a specific link on their PDAL website, which states, “I did not participate in any formal professional development activities this month.” Regardless of their *active* or *inactive* status for the month, if teachers had participated in any informal activities, they were asked to report how many hours they engaged in informal self-directed learning activities in the month and if they used any of the informal self-directed learning in their classroom.[1]

We used several strategies to encourage teachers to respond to the PDAL. First, reminder emails were sent each month. At first, the emails simply reminded the users to fill out their PDAL. Over the course of the project, the emails included a list of all the activity logs the teachers had created for each month. This list also provided explicit instructions on what the teachers still had to do in order to complete their PDAL for a given month. Additionally, postcards were sent intermittently to teachers throughout the study (e.g., as a reminder at the beginning of the school year). Next, a subcontractor was hired to make

[1] Informal professional development was defined in the PDAL instructions as an independent, self-directed learning opportunity that teachers select themselves, on the basis of their personal or professional interests. Examples are using Internet sites to plan lessons or do research; reading a specific journal to learn of the latest research in their field; and meeting their fellow teachers in informal ways to expand their interests and knowledge.

monthly reminder phone calls to all in-scope teachers.[2] The subcontractor reminded the teachers to complete their current and outstanding monthly PDAL logs, provided technical assistance, recorded inactive months, and updated contact information. We made an incentive payment of $50 to the PDAL participants when they filled out the first month's log and another payment of $50 when they completed and finalized all their 15 months of the PDAL.

ADVANTAGES OF THE PDAL

The PDAL has a number of advantages over existing tools (Yoon et al., 2004). First, monthly logs are likely to provide accurate, time-sensitive information about teachers' PD experiences. By design, the PDAL allows teachers to enter real-time data as their PD activities occur. At the minimum, it collects information on teachers' PD activities in the immediate past month(s) and helps reduce a recall bias from retrospective data. Second, with the PDAL, we can avoid problems with data aggregation when teachers report their PD experiences that occurred over a period of time. Researchers can aggregate basic data to selected level(s) of aggregation for analysis (e.g., activity-level or teacher-level). Survey methods that ask teachers about their overall and cumulative PD experience cannot capture detailed activity-specific information. Third, because we take an inclusive approach to PD activities (i.e., not limited to MSP-sponsored activities), we can examine teachers' PD experiences in a larger context. Fourth, we emphasize behavioral indicators of teachers' PD experiences (e.g., the frequency and contact time; opportunities for active learning; collective participation). Fifth, by taking advantage of structured prompts for skip patterns, the PDAL generates context-sensitive questions. For example, if teachers indicate they did not cover certain content areas, the PDAL skips questions regarding those areas. This feature of the PDAL alleviates teachers' burden. Lastly, because teachers' log entries are automatically saved in a database as they respond, we reduce the chance of data entry errors. In sum, with the PDAL, we expect to obtain more valid and reliable data on teachers' specific PD experiences.

PATTERNS OF PARTICIPATION

The advantages of the PDAL come in large part from the nature of the data that it produces; the PDAL captures the complexity of teachers' participation in a wide variety of professional development activities.

The pattern of participation in professional development (PD) may vary widely by individual teachers, by the month of the year, or by the type of activities. To illustrate a variety of patterns of PD participation, we created hypothetical data. Exhibit 20 displays patterns of participation in 7 PD activities (A through G) by 5 teachers over the period of 8 months (July 2003 through February 2004). The total number of hypothetical monthly logs constructed for the combination of the 7 PD activities and 5 teachers is 20. Each "1" in the cell of Exhibit 20 represents a monthly log. First, some teachers may be more active in PD than others. As hypothetical data in Exhibit 20 illustrates, for example, Mr.

[2] Those who retired, moved out of school district, or taught a subject other than mathematics or science were treated as out-of-scope of the PDAL data collection.

Anderson participated in three activities (A, B, and C) during the 8-month period and completed 6 separate monthly logs for the activities. During the same period, however, Mrs. Smith kept only one monthly log for a single activity (G).

Second, the activity level may fluctuate by the month of the year. For example, four of five teachers were actively engaged in PD in August 2003, while only one teacher was active in PD in December 2003.

Exhibit 20: Basic monthly activity log data: Log-level data disaggregated by teacher by activity by month (hypothetical data)

Teacher	*Activity*	Jul-03	Aug-03	Sep-03	Oct-03	Nov-03	Dec-03	Jan-04	Feb-04	# of logs
Mr. Anderson	A	1	1							2
	B			1		1		1		3
	C				1					1
Ms. Lopez	A	1	1							2
	D					1	1	1	1	4
Mrs. Kelly	E		1	1						2
Mr. Lee	E	1	1	1						3
	F			1	1					2
Mrs. Smith	G					1				1
# of logs per month		3	4	4	2	3	1	2	1	20

Third, the pattern of participation in PD may be determined by the type of activity being offered. For instance, activities C and G are one-time events that occur within a single month. A typical district workshop and a national conference are examples of such one-time activities. Other activities like A, B, and D continue into following months. A study group or task force may be such continuous activities that require a teacher's prolonged involvement. Some continuous activities such as A and D are conducted in consecutive months, while others like B in non-consecutive months (e.g., every other month). Further, some teachers may attend multiple activities within a month. For example, Mr. Lee took part in activities E and F during September 2003. Still others may not have any activity to report for some of the months during the study period. For example, Mr. Anderson was inactive during October 2003 and February 2004.

Lastly, some activities (e.g., A and E) are commonly reported by more than one teacher, while others (e.g., B, C, and G) are reported by only a single teacher. For example, Mr. Anderson and Ms. Lopez filled out separate logs for activity A in which they shared common experience during July and August of 2003. Even for the common activity, two teachers may differ in their overall assessment of their PD experience. In sum, the PDAL exposes these various patterns of activity participation through collecting *disaggregate* monthly log data about each and every professional development activity (or lack thereof) that individual teachers experience over the course of the study period.

LEVELS OF THE PDAL DATA

As Exhibit 20 illustrates, a monthly log is the basic level (or unit) of raw data collected with the PDAL; that is, a record for an activity for a month. And it is a basic building block of a complex PDAL data structure. For instance, Mr. Anderson participated in three activities (A, B, and C) over a period of 8 months and completed 6 separate monthly logs: 2 for A, 3 for B, and 1 for C. More specifically, activity A may represent a summer institute that extended over a couple of month; activity B, which recurred in every other month over a span of 5 months, may be a mentoring activity; and activity C may reflect a district-sponsored workshop. Since the PDAL requests teachers to report about their PD on a monthly basis, we anticipate some variation in the quantity and quality of PD between the monthly logs that were created for the same activities. For example, between the two monthly logs submitted by Mr. Anderson for activity A, he may report different amount of contact hours and different amount of content focus depending on the month of reporting. In sum, as a disaggregate unit of observation, monthly logs for each activity will allow us to document in detail a great number of possibilities of PD activities with varying quantities and qualities that teachers experience over an extended period of time.

Using *disaggregate, monthly log level data* as basic building blocks, we can construct an array of new aggregate data that are useful to describe various PD activity profiles for teachers. First, we can produce *teacher-activity level data* by aggregating the basic monthly log level data across months for each activity. As the last column of Exhibit 20 displays, there are 9 sets of teacher-activity level data. They represent unique combinations between teachers and activities. For example, the first set of teacher-activity level data (as shown in the first row of Exhibit 20) represents Mr. Anderson's participation is Activity A, which can be produced by aggregating two monthly log records for July and August 2003. This set of teacher-activity combination is distinguished from another set of teacher-activity combination between Ms. Lopez and Activity A (as shown in the fourth row of Exhibit 20).

Hence, Mr. Anderson's PD profile can be summarized with three sets of teacher-activity level data, which represent his participation in three separate activities. Since the quality of one PD activity may differ from that of another, it is important to create separate measures of PD quality such as content focus or active learning for each activity. In the case of a one-time activity (e.g., activity C) which is bound to a month, there is no need to aggregate data across months. But, in the case of continuous activities such as A and B, we need to combine a series of monthly log records that Mr. Anderson filled out for the activities. For example, to obtain Mr. Anderson's total contact hours for activity A, we need to sum up the contact hours reported for July and August 2003. In addition, we can compute mean contact hours for the same activity. In a similar manner, we can compute other aggregate measures of PD quality such as coherence for each activity by averaging out corresponding quality indices across months. In this report, we introduce teacher-activity level data as one way of data aggregation and underscore its potential usefulness in describing various PD activity profiles for teachers.

Second, we can produce *activity level data* by aggregating the basic monthly log level data across months and teachers. As the last column of Exhibit 21 shows, a total of 20 monthly log records were aggregated to produce 7 different PD activity profiles (or 7 sets of activity level data). For example, 4 monthly logs created by Mr. Anderson and Ms. Lopez during July and August 2003 were combined to produce a profile for PD activity A. With this activity level profile, we can describe each activity's duration (e.g., total contact hours, mean contact hours, and span), type, purpose, and other quality features such as a mean level of active learning.

Exhibit 21: Activity-level data aggregated across months and teachers (hypothetical data)

Activity	Jul-03	Aug-03	Sep-03	Oct-03	Nov-03	Dec-03	Jan-04	Feb-04	# of logs aggregated
A	2	2	0	0	0	0	0	0	4
B	0	0	1	0	1	0	1	0	3
C	0	0	0	1	0	0	0	0	1
D	0	0	0	0	1	1	1	1	4
E	1	2	2	0	0	0	0	0	5
F	0	0	1	1	0	0	0	0	2
G	0	0	0	0	1	0	0	0	1

Third, we can produce *teacher level data* by aggregating the basic monthly log level data across months and activities. As the last column of Exhibit 22 demonstrates, a total of 20 monthly logs were aggregated to produce 5 different teacher PD profiles (or 5 sets of teacher level data). For example, 6 monthly logs created by Mr. Anderson during the 8-month period were combined to produce his PD profile. With this teacher level profile, we can describe each teacher's overall and cumulative PD experience such as duration (e.g., total contact hours, mean contact hours, and span), cumulative content focus, and other quality features such as a mean level of active learning and coherence. For example, Ms. Lopez's profile seems to indicate that her engagement in PD is more distributed over time than that of Mr. Lee.

Exhibit 22: Teacher-level data aggregated across months and activities (hypothetical data)

Teacher	Jul-03	Aug-03	Sep-03	Oct-03	Nov-03	Dec-03	Jan-04	Feb-04	# of logs aggregated
Mr. Anderson	1	1	1	1	1	0	1	0	6
Ms. Lopez	1	1	0	0	1	1	1	1	6
Mrs. Kelly	0	1	1	0	0	0	0	0	2
Mr. Lee	1	1	2	1	0	0	0	0	5
Mrs. Smith	0	0	0	0	1	0	0	0	1

In sum, the PDAL data represent a complex dataset that is multilevel or hierarchical in nature. Data from monthly logs are nested within activities and individual teachers.[3] Furthermore, teachers are nested within schools, which, in turn, are nested within school districts, which, in turn, are nested within MSP program sites. In the remainder of the section, we will use teacher level data solely to form a MSP site-specific profile to allow for cross-site comparisons on key quality features. Results on the basic monthly log level data analyses will be shown in Appendix D.

CONSTRUCTION OF PD SCALES

Since the PDAL was specifically designed to depict professional development activities according to research-based criteria of quality (Garet et al., 1999), we created a number of variables and scales to capture such quality features. As was briefly described in Section I, there are three structural features and three core features that are associated with high quality professional development. They are:

Three structural features
- Duration (e.g., contact hours and span)
- Type
- Collective participation

Three core features
- Active learning
- Coherence
- Content focus

DURATION OF PD ACTIVITY

As stated in the No Child Left Behind Act, high quality professional development activities should provide, among others, “sustained and intense” learning experiences. To estimate how sustained the professional development activities are, we asked teachers about two aspects of duration to assess the extent to which teachers were provided with sustained activities: the number of *contact hours* spent in the PD activity for the month and the *duration within the given month* over which the activity was conducted (ranging from 0=less than a day, 1=one day, 2=2-4 days, 3=a week, to 4=entire month). In addition, for continuous activities which extend beyond a given month, we created a new variable called *span*, which represents the period over which the sessions or components of the activity were spread.[4] We operationally defined the span by the number of inclusive months from the starting to the ending month.

[3] To use a technical term, monthly logs are cross-classified (or cross-nested) within activities and individual teachers (Raudenbush and Bryk, 2002).
[4] We plan to create a new duration variable by combining contact hours, duration within a given month, and span. This new variable should be able to indicate true duration over the entire study period with given usable non-missing data. This duration variable may range from less than a day, a day, 2-4 days, a week, 2 weeks to a month, 2-4 months, 5-7 months, 8 months to a year, to a year or longer.

Exhibit 23 displays our results for a number of duration-related variables such as contact hours and span. The results indicate that teachers vary widely in the amount of time they invested in their professional development activities. For example, an average amount of contact time per teacher per activity per month (Act_Hours) reported among 273 teachers was 16.89 hours with a standard deviation of 15.78.[5] To compute the average contact hours, we summed the contact hours reported for each of the monthly logs that a teacher filled out over the period of the study (producing the total contact hours for the teacher); then divided the total contact hours by total number of completed monthly logs (i.e., all the non-zero hour activity logs) (producing a teacher's mean contact hours per monthly log); and then finally averaged mean contact hours across teachers. For example, if Mr. Anderson reported 20, 20, 12, 12, 12, and 8 hours, respectively, for his 6 monthly logs, then his total contact hours would be 84 hours. And his mean contact hours is 14 (84 divided by 6). It is important to note that we are reporting the mean number of contact hours for months in which teachers participated in PD; it's not the mean for all months, which would be substantially lower, since we know that the teachers didn't have any PD in some of those months.

Since we expected some monthly or seasonal variation in time spent on PD activities, we computed average contact hours for each of the months during the study period. As Exhibit 23 shows, in fact, teachers were much more active in PD during the summer than during the winter. For example, the average contact hours for July 2003 and 2004 were 37.04 and 31.72, respectively, while those for December 2003 and January 2003 were 10.66 and 9.69, respectively.

It is also important to note that we report the average amount of contact hours (Act_Hours) instead of the total amount of contact hours in this report. If we reported the total amount of contact hours, which is a sum of the hours for all months reported, it would be subject to error since some teachers completed many months of log and some completed few.[6] Therefore, we computed the average amount of contact hours by dividing the sum of contact hours for all reported months by the number of months being reported.

[5] The results from the log-level data analysis (shown in Appendix D) are different from those from the teacher-level data analysis. For instance, the grand mean of entire activity contact hours drawn from entire 1,798 monthly logs reported by 273 teachers (15.37 hours) is not equal to the mean of mean contact hours for the 273 teachers (16.89 hours). This is because the number of logs completed by teachers is not the same. Some teachers filled out more logs than others. Given this unbalanced teacher representation, the grand mean of contact hours will be biased toward the mean contact hours reported by those teachers who completed more logs. It is common that the mean of means has smaller standard deviation than that of the grand mean. Generally, there is not much difference between these two mean figures.

[6] At the time of this writing, there are a great number of logs which are yet to be completed and "closed" by teachers. These "open" or yet-to-be-closed logs may turn out to be "inactive" monthly reports or missing data; alternatively they may be filled in with activities at the last minute close to the end of the PDAL data collection. Until the PDAL data collection is entirely over, we cannot determine how to deal with these open status logs. On this ground, we included in our analysis monthly log data that show "active" activities. In due time, when we take into account "inactive" months (i.e., zero hour for the month), the estimate of the average contact hours will be adjusted.

Since the "duration within a given month" variable was not quite a precise interval measure, we created a dummy variable (ActD_Duration) which indicates whether an activity extended at least two days for the month. The result indicates that the percentage of activity logs that extended at least two day was 58%. Another variable that relates to a criterion of sustained activities is whether or not teachers were engaged in a continuous activity that extends beyond a given month (Act_Continued) rather than in a one-time event activity that ends within a single month. The result shows that overall 63% of the activities were continuous. For continuous activities, we computed the span of the activities (Act_Span) as well as the sheer number of months for which logs were created (Act_Mo_N). The result indicates that continuous activities were spread on average over a span of 2.76 months, while they involved on average 2.16 months. Mean and standard deviation for duration variables (e.g., contact hours, duration within a given month, and span) are listed in Exhibit 23 for teacher-level data.

Exhibit 23: Descriptive Statistics for PDAL Variables: Based on Teacher-level Data

Variable	*Description*	*N*	*Mean*	*SD*	*Min*	*Max*
Activity Duration						
ActD_Duration	Activity lasted for 2-4 days or longer: 0=one day or less, 1= 2-4 days or longer	273	0.58	0.36	0	1
Act_Hours	Mean contact hours	273	16.89	15.78	1.0	105.0
Act_Continued	Activity is continued (0=no, 1=yes)	273	0.63	0.37	0.0	1.0
Act_Mo_N	Mean number of months	273	2.16	1.79	1.0	11.2
Act_Span	Mean activity span	273	2.76	2.44	1.0	14.0
Act_Consecutive	Activity occurs in consecutive months	223	0.67	0.40	0.0	1.0
meanAct_Hour307	Mean Activity Contact Hour during July 2003	150	37.04	29.60	1.0	150.0
meanAct_Hour308	Mean Activity Contact Hour during August 2003	150	14.85	16.23	1.0	80.0
meanAct_Hour309	Mean Activity Contact Hour during September 2003	117	13.71	19.99	1.0	160.0
meanAct_Hour310	Mean Activity Contact Hour during October 2003	148	12.62	17.10	1.0	160.0
meanAct_Hour311	Mean Activity Contact Hour during November 2003	117	12.39	18.52	1.0	160.0
meanAct_Hour312	Mean Activity Contact Hour during December 2003	96	10.66	16.23	1.0	140.0
meanAct_Hour401	Mean Activity Contact Hour during January 2004	98	9.69	17.26	1.0	160.0
meanAct_Hour402	Mean Activity Contact Hour during February 2004	101	11.46	12.92	1.0	80.0
meanAct_Hour403	Mean Activity Contact Hour during March 2004	96	11.12	11.09	1.0	60.0
meanAct_Hour404	Mean Activity Contact Hour during April 2004	62	13.25	13.06	1.5	70.0
meanAct_Hour405	Mean Activity Contact Hour during May 2004	74	12.38	10.19	2.0	60.0
meanAct_Hour406	Mean Activity Contact Hour during June 2004	49	27.00	20.35	1.0	80.0
meanAct_Hour407	Mean Activity Contact Hour during July 2004	49	31.72	19.58	3.0	80.0
meanAct_Hour408	Mean Activity Contact Hour during August 2004	25	23.01	16.57	2.5	60.0
PD Quality Measures						
ActiveLearn	Active learning (mean score): 0=never, 1=rarely, 2=sometimes, 3=often	270	1.14	0.60	0.0	3.0
Coherence	Coherence (mean score): 0=never, 1=rarely, 2=sometimes, 3=often	268	2.27	0.50	0.5	3.0
Collective	Collective participation at a given month (sum score): On the scale of 0 - 2: number of postive response to two collective participation items	269	0.72	0.58	0.0	2.0
Collective_Overall	Overall collective participation (sum score)	269	1.28	0.78	0.0	2.0
Content Focus Measures						
Purpose of PD						
Purp_Subject	Strengthening subject matter knowledge	262	0.75	0.31	0.0	1.0
Math Topics						
Topics_math	Total number of 1st-order topics covered in the activity	151	2.27	1.53	0.0	6.0
Intensetopic_math	Math topic intensity (contact hours divided by number of 1st-order topics)	151	5.41	8.55	0.0	80.0
Math Instructional Activities						
Problem_Routine	Routine math exercise/problem-solving: estimate, predict, apply, analyze, infer	139	0.67	0.26	0.0	1.0
Problem_Extended	Extended problem-solving	139	0.38	0.30	0.0	1.0
M_Perform_Procedure	Perform procedures (math)	142	0.49	0.24	0.0	1.0
M_Make_Connection	Make connections (math)	139	0.62	0.24	0.0	1.0
IA1_math	Number of broad instructional activities focused	151	3.02	1.29	0.0	5.0
IA2_math	Number of specific instructional strategies focused within broad instructional activities covered	143	13.64	7.48	0.0	35.0
Science Topics						
topics_science	Total number of 1st-order topics covered in the activity	125	5.00	4.28	0.0	24.5
intensetopic_science	Science topic intensity (contact hours divided by number of 1st-order topics)	125	5.06	6.24	0.0	36.3
Science Instructional Activities						
Lab_Work	Lab-based activities	111	0.71	0.25	0.0	1.0
Info_Collect	Collecting science data/info outside lab	112	0.70	0.27	0.0	1.0
S_Perform_Procedure	Perform procedures (science)	114	0.66	0.24	0.0	1.0
S_Make_Connection	Make connections (science)	111	0.62	0.30	0.0	1.0
IA1_science	Number of broad instructional activities focused	122	3.00	1.28	0.0	5.0
IA2_science	Number of specific instructional strategies focused within broad instructional activities covered	119	14.80	8.20	0.0	34.0

Lastly, it is important to note that currently the PDAL has only limited capacity to deal with certain types of *censored observations*. *Censoring* exists when incomplete information is available about the duration of professional development activities because of limited observation period. In other words, if PD activities started and ended within the PDAL period, the duration of the PD activities is unequivocally defined (without censored observation). However, if PD activities started either before the beginning of the PDAL data collection or PD activities continued after the end of the PDAL data collection, we would have censored observations. Exhibit 20 depicts a number of distinct situations regarding censored observations. In case of activities A and E, we are missing some unknown months of span for activities that began prior to the first log the teacher completed July 2003. On the other hand, in case of activity D (or possibly B), we are also missing some unknown months of span for activities that were still underway at the time of the last log the teacher submitted. Anticipating these potential problems, the PDAL asked teachers if it is their last month of participation in that activity. If it was their last month, the PDAL will provide uncensored observation. However, if it wasn't their last month, then we will have right-censored activity. The true duration of that activity would remain unknown. On the other hand, we failed to ask teachers if they were engaged in that activity prior to the first month of the PDAL. If they were, then we would have left-censored observations. We should have asked teachers for how long they have been engaged in the activity before they first reported on the activity. We plan to refine the PDAL to rectify this limitation.

ACTIVITY TYPE

Some types of PD activities are more common than others. And particular types of activities may be more conducive to effective learning and may have lasting effects on teachers' instructional practice. The PDAL asked the following question to identify the type of PD activity that teachers attended:

Which of the following best describes the activity? If more than one response fits the activity, pick the response that best describes the aspect of the activities in which you spent the most time. (Choose only one response):

- ❑ Participation in a workshop or in-service activity
- ❑ Participation in a summer institute
- ❑ Attendance at a college course
- ❑ Attendance at a conference
- ❑ Participation in a teacher study group
- ❑ Participation in a teacher network or collaborative of teachers
- ❑ Working with a mentor, coach, lead teacher, or observer
- ❑ Participation in a teacher committee or task force
- ❑ Engagement in informal self-directed learning

Despite a lengthy instruction on how to choose a single most appropriate response, many teachers picked more than one activity type, making the comparison of the prevalence of each type difficult. Despite this complication, it is apparent that participation in workshop or in-service activity was the most prevalent type of activity teachers took part in. Of 1,021 unique activities, 58% of them were workshop or in-service activities.[7] Participation in a teacher network or collaborative of teachers is a distant runner up (27%), followed by working with a mentor, coach, lead teacher, or observer (17%), attendance at a college course (16%), participation in a teacher study group (16%), and engagement in informal self-directed learning (16%). Attendance at a conference was the least prevalent type of activity (8%). Note that we asked about the activity type only on the first month in which a teacher participated in a particular activity. We assumed the type would remain the same across months.

COLLECTIVE PARTICIPATION

Collective participation relates to opportunities for teachers from the same educational setting to engage in joint professional development. To assess the level of collective professional learning opportunity, the PDAL asked the following two questions with a two-point scale of 0=no and 1=yes:

Teachers may participate in professional development activities alone or with groups of teachers from their school. For this professional development activity, with whom did you participate?

- ❑ I participated with most or all of the teachers from my school.
- ❑ I participated with most or all of the teachers from my department or grade level.

The scale of collective participation was created by combining these 2 items and computing a sum score. As Exhibit 24 shows, the reliability of the active learning scale, as indexed by Cronbach's alpha, was .54. As Exhibit 23 indicates, the average level of collective participation (Collective) was .72, which indicates that many teachers tend to participate in professional development alone rather than in group.

It is noteworthy that unlike active learning or coherence, collective participation, along with duration of activity, represents one of the structural features of PD. In other words, even if teachers answer differently from month to month about whether they participated with most or all of the teachers from their school or from department or grade level, the overall structure of the activity should stay the same over the span of the activity. For example, for a given month, teacher A reports that he participated in activity 1 with most of teachers from his school. In the next month, however, he may report otherwise about collective participation for the same activity. In this case, one may argue that even though teacher A's perception or report has changed from one month to another, the very structure of activity 1 that incorporated the nature of collective participation must remain the same over the span of the activity. For this reason, we created a new scale (Collective_Overall) that reflects an overall collective participation *over the span of*

[7] Even though there are 1,798 monthly logs completed, some of them were filled out for the same activities over months. For the same activities, we did not repeat a question about activity type. Therefore, the PD type variable is based on 1,021 unique activities.

activity to distinguish it from collective participation *at a given month* (Collective). We operationally defined the overall collective participation as having experienced collective participation at least one time over the span of the activity. The result shows that the average overall collective participation is 1.28, which is higher than the average of collective participation measured at given months (.72).

ACTIVE LEARNING

Active learning concerns the opportunities provided for teachers to become actively engaged in meaningful discussion, planning, and practice as part of the professional development activity. To measure active learning, the PDAL asked the following 8 questions with a four-point scale of 0=never, 1=rarely, 2=sometimes, and 3=often:

During this professional development activity this month, how often did you:

- Observe demonstrations of teaching techniques?
- Lead group discussions?
- Develop curricula or lesson plans, which other participants or the activity leader reviewed?
- Review student work or score assessments?
- Develop assessments or tasks as part of a formal professional development activity?
- Practice what you learned and receive feedback as part of a professional development activity?
- Receive coaching or mentoring in the classroom?
- Give a lecture or presentation to colleagues?

The scale of active learning (ActiveLearn) was created by combining these 8 items and computing a mean score. As Exhibit 24 shows, the reliability of the active learning scale, as indexed by Cronbach's alpha, was .85. And as Exhibit 23 demonstrates, the average level of active learning was 1.14 (with a standard deviation of .60), which indicates that opportunities for active learning provided for teachers were quite low.

Exhibit 24: Factors and Reliability of Professional Development Quality Constructs: Based on Teacher-level Data

Collective Participation In a Given Month

Variable	*Label*	*Factor 1*
i1490_1	I participated with most or all of the teachers from my school.	0.83
i1490_2	I participated with most or all of the teachers from my department or grade level.	0.83
	alpha with all items	0.54

Overall Collective Participation

Variable	*Label*	*Factor 1*
collect_sch	I participated with most or all of the teachers from my school.	0.84
collect_dept	I participated with most or all of the teachers from my department or grade level.	0.84
	alpha with all items	0.60

Active Learning

Variable	*Label*	*Factor 1*	*Factor 2*
i1488_1	Observe demonstrations of teaching techniques?	-0.02	0.86
i1488_3	Lead group discussions?	0.51	0.56
i1488_5	Develop curricula or lesson plans, which other participants or the activity leader reviewed?	0.80	0.22
i1488_6	Review student work or score assessments?	0.83	0.05
i1488_7	Develop assessments or tasks as part of a formal professional development activity?	0.84	0.23
i1488_8	Practice what you learned and receive feedback as part of a professional development activit	0.50	0.57
i1488_9	Receive coaching or mentoring in the classroom?	0.21	0.68
i1488_10	Give a lecture or presentation to colleagues?	0.53	0.50
	alpha with all items	0.85	

Coherence

Variable	*Label*	*Factor 1*
i1489_1	Designed to support the school-wide improvement plan adopted by your school?	0.73
i1489_2	Consistent with your department or grade level plan to improve teaching?	0.86
i1489_3	Consistent with your own goals for your professional development?	0.84
i1489_4	Based explicitly on what you had learned in earlier professional development activities?	0.69
i1489_5	Followed up with related activities that built upon what you learned as part of the activity?	0.82
	alpha with all items	0.83

Exhibit 24: Factors and Reliability of Professional Development Quality Constructs: Based on Teacher-level Data (Continued)

Routine Math Problem-Solving

Variable	*Label*	*Factor 1*
i1691_3	Students Work Individually - Explain their reasoning or thinking in solving a problem, using several sentences orally or in writing	0.58
i1691_4	Students Work Individually - Apply mathematical concepts to real-world problems	0.72
i1691_5	Students Work Individually - Make estimates, predictions or hypotheses	0.86
i1691_6	Students Work Individually - Analyze data to make inferences or draw conclusions	0.86
i2160_3	Students Work in Pairs or Small Groups - Talk about their reasoning or thinking in solving a problem	0.79
i2160_4	Students Work in Pairs or Small Groups - Apply mathematical concepts to real-world problems	0.80
i2160_5	Students Work in Pairs or Small Groups - Make estimates, predictions or hypotheses	0.89
i2160_6	Students Work in Pairs or Small Groups - Analyze data to make inferences or draw conclusions	0.85
	alpha with all items	0.91

Extended Math Problem-Solving

Variable	*Label*	*Factor 1*	*Factor 2*
i1691_7	Students Work Individually - Work on a problem that takes at least 45 minutes to solve	0.94	0.16
i1691_8	Students Work Individually - Complete or conduct proofs or demonstrations of their mathematical reasoning	0.23	0.89
i2160_7	Students Work in Pairs or Small Groups - Work on a problem that takes at least 45 minutes to solve	0.91	0.24
i2160_8	Students Work in Pairs or Small Groups - Complete or conduct proofs or demonstrations of their mathematical reasoning	0.16	0.91
	alpha with all items	0.80	

Laboratory-based Work

Variable	*Label*	*Factor 1*	
i2085_1	Lab Activities, Investigations, or Experiments - Make educated guesses, predictions, or hypotheses	0.55	0.55
i2085_2	Lab Activities, Investigations, or Experiments - Follow step-by-step directions	0.64	0.10
i2085_3	Lab Activities, Investigations, or Experiments - Use science equipment or measuring tools	0.70	0.12
i2085_4	Lab Activities, Investigations, or Experiments - Collect data	0.70	0.29
i2085_5	Lab Activities, Investigations, or Experiments - Change a variable in an experiment to test a hypothesis	0.25	0.77
i2085_6	Lab Activities, Investigations, or Experiments - Organize and display information in tables or graphs	0.24	0.69
i2085_7	Lab Activities, Investigations, or Experiments - Analyze and interpret science data	0.66	0.45
i2085_8	Lab Activities, Investigations, or Experiments - Design their own investigation or experiment to solve a scientific question	0.12	0.83
i2085_9	Lab Activities, Investigations, or Experiments - Make observations/classifications	0.80	0.29
	alpha with all items	0.86	

Collecting Science Data/Information Outside the Lab

Variable	*Label*	*Factor 1*
i2087_1	Collecting Science Data or Information - Have class discussions about the data	0.87
i2087_2	Collecting Science Data or Information - Organize and display the information in tables or graphs	0.69
i2087_3	Collecting Science Data or Information - Make a prediction based on the data	0.67
i2087_4	Collecting Science Data or Information - Analyze and interpret the information or data, orally or in writing	0.86
i2087_7	Collecting Science Data or Information - Make a presentation to the class on the data, analysis or interpretation	0.59
	alpha with all items	0.78

COHERENCE

Coherence concerns the extent to which professional development activities are perceived by teachers to be a part of a coherent program of teacher learning. To gauge the level of coherence of PD activities that teachers participated in, the PDAL asked the following 5 questions with a five-point scale of 0=never, 1=rarely, 2=sometimes, 3=often, and 9=N/A:

How often was this professional development activity?

- Designed to support the school-wide improvement plan adopted by your school?
- Consistent with your department or grade level plan to improve teaching?
- Consistent with your own goals for your professional development?
- Based explicitly on what you had learned in earlier professional development activities?
- Followed up with related activities that built upon what you learned as part of the activity?

The scale of coherence was created by combining these 5 items and computing a mean score. As Exhibit 24 displays, the reliability of the active learning scale, as indexed by Cronbach's alpha, was .83. The average level of coherence was 2.27 (with a standard deviation of .50), which indicates that teachers experienced quite coherent professional development across activities and over time.

CONTENT FOCUS

Content focus concerns how much emphasis was given in a PD activity on enhancing content knowledge and skills. We took a number of different approaches to collect information about content focus as well as content coverage. First, the PDAL asked teachers a single-item question asking directly about whether strengthening subject matter knowledge was a purpose of the PD activity they took part in. On this measure (Purp_Subject), PD was reported to be focused on content in 74% of all activity logs (See Exhibit 23).

Second, to examine on which specific content areas and topics were being focused, the PDAL presented to teachers a list of topical areas (separately for math or science) and asked them which topical areas were a primary focus in their professional development activity. For example, topical areas in math included:

- Number sense/Properties/Relationships
- Measurement
- Algebraic Concepts
- Geometric Concepts
- Operations
- Data Analysis/Probability/Statistics

What were the most common content topical areas focused in PD activities for math and science? In math, algebraic concepts were most often the main focus of PD, while measurement was least often focused: 40% vs. 27% of reported logs (see Table D1 in Appendix D). In science, nature of science was most frequently covered in PD, while nuclear chemistry was on the bottom of the list: 38% vs. 9% (See Table D1).

As a basic descriptive measure of content *coverage* (not content focus), we created a variable – separately for math and science – which represents the number of *topical areas* that were covered as a primary focus in a given activity.[8] As Exhibit 23 shows, on average math teachers were offered 2.27 topical areas in their PD given the 6 maximum areas. More topical areas were presented in science, which include such a wide array of topical areas as nature of science, botany, animal biology, human biology, evolution, energy, motion and forces, astronomy, nuclear chemistry – totaling 25 different topical areas. On average, science teachers were exposed to 5 topical areas in their PD.

For each topical area that was marked as being a primary focus in their PD activity, we then asked teachers which *specific topics* were of primary focus in their PD activity. For example, for the topical area of number sense/properties/relationships, we listed a number of specific topics that range from place value and whole numbers, to patterns and real number, and to mathematical properties. For example, within the topical area of number sense/properties/relationships, on average 3.28 topics were focused in math teachers' PD (See Exhibit 23).

As another related measure of content focus, we created a variable called topic intensity, which is operationally defined as contact hours divided by the number of topical areas being primarily focused in a given activity. In math, 5.41 hours were devoted per a focused topic, while 5.06 hours in science (See intensetopic_math and intensetopic_science in Exhibit 23).

Third, as a measure of content focus, we examined how many topics on instructional activities and strategies were covered and highlighted in PD. For example, in science, the PDAL asked teachers whether their PD was focused on any of the following *broad instructional activities* for use in their classroom:

- Laboratory Activities, Investigations, or Experiments
- Classroom Activities When Students Work in Pairs or Small Groups
- Collecting Science Data or Information
- Use of Calculators, Computers, or Other Educational Technology
- Assessments

And then for each instructional activity that was marked as being a primary focus in their PD, we further asked teachers which *specific instructional strategies* were a primary

[8] While content focus is part of core features associated with high quality professional development, content coverage is not. In other words, it is not necessarily desirable to have a more content coverage in PD. We created content coverage variables as an intermediate step to get at another measure of content focus, namely, topical intensity (which is discussed shortly).

focus in their PD activity. For example, for the instructional activity area of laboratory activities, investigations, or experiments, the PDAL asked the following questions: Did the PD focus on any of the following instructional strategies for use in your classroom (relating to laboratory activities, investigations, or experiments)?

- ❑ Make educated guesses, predictions, or hypotheses
- ❑ Follow step-by-step directions
- ❑ Use science equipment or measuring tools
- ❑ Collect data
- ❑ Change a variable in an experiment to test a hypothesis
- ❑ Organize and display information in tables or graphs
- ❑ Analyze and interpret science data
- ❑ Design their own investigation or experiment to solve a scientific question

As a basic descriptive measure of content *coverage* (not content focus), we created a variable – separately for math (IA1_math) and science (IA1_science) – that represents the number of instructional activities that were covered as a primary focus in a given PD activity. In addition, we counted the number of specific instructional strategies within broad instructional activities that were covered as a primary focus in a given PD – separately for math (IA2_math) and science (IA2_science). As Exhibit 23 indicates, on average 3 out of 5 broad instructional activities were of a primary focus in PD in math and science alike. Given instructional activities, 13.6 specific instructional strategies came to being focused in math, while 14.8 in science.

The *quantity* of instructional activities or strategies that are focused on in PD may not be useful in shedding light on whether teachers experienced high *quality* content focus. To differentiate the qualitative differences among instructional strategies being covered and focused in PD, we conducted an exploratory factor analysis. Among a number of factors that merged from the analysis of 35 instructional strategies covered in math, we identified two factors which we considered represent qualitatively distinct instructional strategies. We created two scales based on the factors: routine math problem-solving and extended math problem-solving. As Exhibit 24 demonstrates, the internal consistency among the variables within each of the two scales was high: .91 and .80 for routine math problem-solving and extended math problem-solving strategies, respectively. The routine math problem-solving scale reflects routine strategies commonly used in math instruction such as reasoning, applying concepts to real-world problems, making estimate, and analyzing data to make inferences; while the extended math problem solving scale represents somewhat more extensive (and possibly more in-depth) problem-solving such as working on a problem that takes at least 45 minutes to solve and completing or conducting proofs or demonstrations of mathematical reasoning. As can be seen in Exhibit 23, teachers were less exposed to extended problem-solving instructional strategies in their PD than to routine problem-solving instructional strategies: on average, 38% vs. 67% of their activities, respectively.

Using a similar procedure, we created two instructional strategy scales for science: laboratory-based work and science data/information collection outside the lab. The laboratory-based work scale involves an array of activities that are required to conduct lab or experiment based investigation such as generating hypotheses, following instructions, using equipments, collecting data, and analyzing data; the science data/information collection scale encompasses a host of data collection activities that take place outside the lab such as having class discussion about science data, organizing and displaying science data/information in tables and graphs, and making presentation to the class on the data, analysis or interpretation. As Exhibit 24 demonstrates, the internal consistency among the variables within each of the two scales was high: .86 and .78 for the scales of laboratory-based work and science data/information collection outside the lab, respectively. As Exhibit 23 shows, teachers reported that their PD was focused in these two strategies about equally: on average, about 70% in each of the two instructional strategies.

Lastly, we created two more scales that are based on specific instructional strategies – separately for math and science – to replicate the SEC's cognitive demand based scales: performing procedures and making connections (see Section III for items making up these two scales).

ANALYSIS OF PROFESSIONAL DEVELOPMENT DURING THE PROJECT PERIOD

Data from the Professional Development Activity Log are used to test Hypotheses 3 and 4 for the study.

- Hypothesis 3: In year 2, the initial year of MSP implementation, we expect sites to differ in the quality of the professional development teachers experienced.
- Hypothesis 4: In year 2, we expect teachers that in the treatment group (i.e., teachers targeted for MSP participation) experienced higher quality professional development than teachers in the comparison group.

Specifically, we examine whether teachers' PD experiences were similar or different in each of the following six quality features of professional development activities that were described in Sections II and IV. Analysis was conducted separately for data on math and science teachers as they employ different instructional strategies and experience different professional development.

DIFFERENCES IN PD AMONG MSP PROGRAM SITES

Mathematics Professional Development. We hypothesized that since each MSP program site emphasizes and implements different strategies to accomplish their program goals, some program-related variation between the four MSP sites may exist in terms of the quantity and quality of professional development that is being offered.

Consistent with our hypothesis, we found some differences in the quality of math PD between MSP program sites. First, as the top panel of Exhibit 25 indicates, teachers sampled from different MSP sites experienced PD activities of varying duration, mean contact time, and mean activity span. For example, teachers who are affiliated with the sites 1 and 2 – treatment and comparison teachers alike – attended PD with substantially longer in duration and with more mean contact hours than their counterparts in the two other sites. Site 1 teachers spent on average about twice as much time in PD as site 4 teachers did (22.5 vs. 11.9 hours). Further, site 1 teachers' activity span was a little more than twice as long as that of site 4 teachers' (3.3 vs. 1.5 months).

Second, we found no significant difference in opportunities for active learning among the 4 MSP sites. Third, we found some significant variation among the MSP sites in the degree to which teachers experienced coherent PD activities. Sites 1 and 3 teacher's benefited slight advantage over other sites, particularly site 4 teachers. Fourth, whether we examined the overall collective participation variable or the variable of collective participation at a given month, there was no significant difference among the four MSP sites.

Exhibit 25: Quality of Math Professional Development Activities Compared by MSP Site and Treatment Status: Based on Teacher-level PDAL Data

Category	N[1]	% Duration >2-4 days	Mean contact hours	Mean activity span	Active learning	Coherence	Collective partici-pation (Overall)	Collective participa-tion (At a given month)	Strengthen subject matter knowledge	Topic intensity	Routine math problem solving	Extended math problem solving	Perform procedures	Make connec-tions
MSP Site		***	**	***	ns	*	ns	ns	ns	ns	*	ns	ns	ns
Site 1	37	0.67	22.5	3.3		2.4					0.58			
Site 2	49	0.73	13.9	3.7		2.2					0.64			
Site 3	34	0.40	14.0	2.1		2.3					0.76			
Site 4	28	0.46	11.9	1.5		2.0					0.74			
Treatment		**	**	**	ns	ns	ns	*	ns	*	ns	ns	ns	ns
Comparison	45	0.46	11.2	2.1				0.86		2.5				
Treatment	103	0.64	17.7	3.1				0.62		6.7				
MSP_Site*Treatment		ns	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Site 1-Comparison	12		10.7											
Site 1-Treatment	25		28.2											
Site 2-Comparison	14		11.3											
Site 2-Treatment	35		15.0											
Site 3-Comparison	6		18.2											
Site 3-Treatment	28		13.1											
Site 4-Comparison	13		8.4											
Site 4-Treatment	15		14.9											

Note: [1] N may vary due to variable-wise missing data.
ns denotes non-significance, *<.05, **<.01, and ***<.001.

Lastly, we found a little evidence of significant variation in content focus between the MSP sites. Only in routine math problem-solving, MSP sites 3 and 4 were higher than the other two sites. However, the four sites equally emphasized extended math problem-solving or stressed subject matter knowledge in their PD.

Science Professional Development. Consistent with our expectation, we also found some significant differences in the quality of science PD among MSP program sites. First, as the top panel of Exhibit 25 shows, teachers affiliated with different MSP sites experienced PD activities of varying duration and activity span. For example, as with math teachers, science teachers who came from sites 1 and 2 – treatment and comparison teachers alike – attended PD with significantly longer duration and span than their counterparts in sites 3 and 4. Site 2 science teachers' activity span was over twice as long as that of site 4's counterparts (3.6 vs. 1.5 months). However, in terms of mean contact time, all 4 MSP sites weren't significantly different.

Second, we found no significant difference in opportunities for active learning, coherence, and collective participation among the 4 MSP sites.

Lastly, we found significant variation between the MSP sites in five of the eight content-related measures we analyzed. For example, site 1 teachers experienced the most intense science PD of all. Their average contact time per topical area (e.g., earth systems) was 9.4 hours, whereas that of site 3 and 4 teachers was about 3.5 hours. In contrast, however, site 1 teachers were least likely to get any of four instructional activities and strategies emphasized in their PD: lab-based work, science data/information collection, performing procedures, and making connections. In all of these four measures of content focus, site 2 scored highest of all four MSP sites.

In summary, we found that the four MSP program sites differed from each other in a number of PD quality measures both in math and science. This finding is consistent with our expectation that each site implements different strategies for their program goals and institutes professional development activities of different qualities. However, it is important to take caution to interpret these results given the preliminary nature of these analyses that are based on incomplete data and scales and variables still at their exploratory stage.

Exhibit 26: Quality of Science Professional Development Activities Compared by MSP Site and Treatment Status: Based on Teacher-level PDAL Data

Category	N[1]	% Duration >2-4 days	Mean contact hours	Mean activity span	Active learning	Coherence	Collective participa-tion (Overall)	Collective participa-tion (At a given month)	Strengthen subject matter knowledge	Topic intensity	Lab-based work	Science data/ informa-tion collection	Peform procedures	Make connec-tions
MSP Site		***	ns	***	ns	ns	ns	ns	ns	**	*	**	*	*
Site 1	18	0.69		2.2						9.4	0.55	0.53	0.53	0.48
Site 2	63	0.66		3.6						4.9	0.77	0.76	0.71	0.69
Site 3	23	0.39		1.6						3.6	0.71	0.70	0.64	0.57
Site 4	21	0.40		1.7						3.5	0.67	0.64	0.60	0.54
Treatment		*	ns	*	ns	ns	ns	ns	***	*	**	***	*	**
Comparison	54	0.48		2.2					0.61	3.6	0.64	0.61	0.60	0.52
Treatment	71	0.64		3.1					0.81	6.2	0.76	0.77	0.69	0.68
MSP_Site*Treatment		ns	ns	ns	ns	ns	ns	ns	ns	*	ns	ns	ns	ns
Site 1-Comparison	8									3.6				
Site 1-Treatment	10									14.0				
Site 2-Comparison	15									4.0				
Site 2-Treatment	48									5.2				
Site 3-Comparison	22									3.7				
Site 3-Treatment	1									0.9				
Site 4-Comparison	9									2.9				
Site 4-Treatment	12									3.9				

Note: [1] N may vary due to variable-wise missing data.
ns denotes non-significance, *<.05, **<.01, and ***<.001.

DIFFERENCES IN PROFESSIONAL DEVELOPMENT BETWEEN TREATMENT VS. COMPARISON GROUPS

Mathematics Professional Development. At the outset, we hypothesized that if MSP initiatives are effectively implemented in each of the program sites, we may anticipate that compared with comparison teachers, treatment teachers would benefit more from professional development that is higher in quality (e.g., more opportunities for active learning, more coherent and intense activity). Moreover, as the effectiveness of program implementation is expected to vary from site to site, the relative advantage of treatment teachers over their comparison counterparts may also differ from site to site.[9]

As we expected, we found that the treatment teachers experienced math PD activities that are quantitatively and qualitatively somewhat different from that experienced by their comparison counterparts on a few accounts. First, as the middle panel of Exhibit 25 indicates, the treatment teachers took part in PD activities that are characterized by a longer duration (e.g., more contact hours and longer activity span). For instance, treatment teachers had the mean contact time of 17.7 hours, while their colleagues in the comparison group had 11.2 hours. As the bottom panel of Exhibit 25 shows, however, the relative advantage of treatment group over comparison group was not equal across the four MSP sites. For example, the gap between the treatment vs. comparison groups was larger in site 1 (28.2 vs. 10.7 hours) than in site 2 (15.0 vs. 11.3 hours). Further, the general pattern of treatment group's edge over comparison group was reversed in site 3, where comparison teachers reported more contact hours than their treatment counterparts: 18.2 and 13.1 hours for comparison and treatment teachers, respectively.

Second, we detected no significant difference either in opportunities for active learning or in coherence between the treatment and comparison teachers' PD activities. Third, we found some significant difference between the treatment and comparison teachers in the degree to which teachers participate in PD activities collectively. Contrary to our expectation, the comparison teachers collectively attended math PD activities at a given month more often than their treatment group teachers did: 86% vs. 62% of time. However, there was no significant difference in terms of overall collective participation. It seems that MSP programs may not have relied on types of PD that required teachers' collective participation such as district-wide or school-wide workshops. If MSP programs' PD activities were instead primarily offered through college courses (that are presumably based on individual enrollment), we would expect that treatment teachers documented less collective participation.

Lastly, inconsistent with our expectation, there was very little difference in content focus between the treatment teachers' math PD and that of the comparison teachers. A

[9] Treatment teachers, by definition, take part in PD activities provided by any of the four MSP program sites. In addition, they may also participate in other PD activities that are offered by non-MSP programs. Therefore, we cannot attribute any difference between treatment and comparison teachers solely to the effect of MSP programs. It is quite possible that this difference may partly result from the lack of participation in PD activities on the part of the comparison teachers.

significant difference was detected only in one of several measures of content focus we gathered. The treatment teachers' topic intensity registered 6.7 hours, while the comparison teachers did only 2.5 hours. Recall that the topic intensity is a function of the mean contact hours and the number of topical areas focused. Since the treatment teachers had more contact hours and fewer – if not significantly fewer – topical areas focused in their PD than their comparison counters, the treatment teachers' topic intensity was substantially higher.

Science Professional Development. As was the case in math, we found that the treatment science teachers received PD activities that are quantitatively and substantively different from that experienced by their comparison counterparts on several accounts. First, as the middle panel of Exhibit 26 indicates, compared to comparison teachers, treatment teachers attended extended and sustained PD activities (i.e., longer in duration and activity span). For example, 64% of treatment teachers participated in PD activities that are at least 2 days long in duration at a given month, while 48% of their colleagues in the comparison group took part in such long PD activities. However, in terms of mean contact hours, the two groups were not different.

Second, contrary to our expectation, we failed to find any significant difference between the treatment and comparison teachers in such important features of PD quality as active learning, coherence, and collective participation. It is interesting to note that such a lack of quality difference was also observed between the 4 MSP sites. It seems that such PD quality features are particularly more difficult to institute compared to other features such as duration or content focus.

Lastly, we found a great deal of differences between the treatment and comparison teachers in their PD activities' content focus. In all measures of content focus, we found that the treatment teachers took part in the PD activities that were significantly more focused on content. In general, compared to their non-MSP counterparts, the MSP programs were more likely to provide PD activities that emphasize strengthening subject matter knowledge as its purpose, are more intense, and focus more on specific instructional strategies. For example, in the use of specific instructional strategies such as lab-based work and science data collection outside the lab, the treatment teachers were more likely to report that their PD was focused on such strategies than their colleagues in comparison group did.

This finding of a great deal of difference in the content focus of science PD activities between MSP programs and their non-MSP counterparts strikes an interesting contrast with only a slight difference in math PD. Recall that in math we found a significant difference only in one of six content focus measures (i.e., topic intensity) between treatment vs. comparison teachers, while in science we found such a significant difference in all measures.

However, we need take caution in interpreting the results regarding differences between treatment vs. control groups given the preliminary nature of these analyses that are based on incomplete data and scales and variables still at their exploratory stage.

V. ILLUSTRATION OF PROGRAM SITE-SPECIFIC EFFECTS

In this section, we report the result of analysis that we conducted to test some potential effects which may be specific to a particular MSP program site. By testing program-specific hypotheses, we may be able to determine if individual MSP program is accomplishing its goal. A case in point for this report is the MSP Program site 1 that emphasized the use of educational technology in their professional development for their teachers. We intend to extend this type of program-specific analysis for the final report.

For the site 1, we asked the following evaluation questions:

1. Is there any difference between the treatment and comparison teachers in the amount of instructional time they report spending with students in the use of computers, calculators, or other technology?
2. Is there any difference in the professional development of the treatment and comparison teachers regarding the topical emphasis on the instructional use of computers, calculators, or other technology?

With regard to the first question, we hypothesized that that there would be no reason why the treatment and comparison teachers should differ in their instructional use of technology in the baseline year unless the selection of the treatment teachers into the MSP program site 1 was based on that criterion (Hypothesis 1).[10] With regard to the second question, given the MSP site 1's emphasis on the integration of technology to instruction, we hypothesized that, compared to their comparison counterparts, the treatment teachers would experience more professional development activities that stress the use of computers, calculators, or other technology (Hypothesis 2).[11]

We analyzed Year 1 SEC data to address Hypothesis 1 regarding teachers' instructional practice at the baseline. In addition, we analyzed the PDAL data to test Hypothesis 2 about professional development activities that teachers attend during the project period.

As Exhibit 3 shows, the total of 91 teachers participated in the MSP Program site 1 study, of which 48 teachers were "treated" by engaging in any of its MSP program activities (treatment teachers), while 43 were not (comparison teachers). Of 91 teachers, 78 teachers completed Year 1 SEC while only 54 filled out PDAL.

Consistent with Hypothesis 1, there was little significant difference between the treatment and comparison teachers in terms of their instructional time in the use of technology such as computer and calculators in the baseline year (See Exhibit 27).

Consistent with Hypothesis 2, there was some significant difference between the treatment and comparison teachers in their professional development experiences, most

[10] This hypothesis is equivalent to Hypothesis 3 that was tested in Section IV. Since this test is conducted within a single MSP program, there is no need for hypotheses about difference between MSP sites, which were Hypotheses 1 and 2 in Section IV.
[11] This hypothesis is equivalent to Hypothesis 4 that was tested in Section IV.

likely due to the MSP program effect. Specifically, compared with their comparison counterparts, the treatment-group teachers experienced significantly higher amount of professional development activities that *focused on* the instructional use of computers, calculators, and other technology (see the second panel of Exhibit 28), even though the *coverage* of the topic involving such instructional technology did not differ significantly in each group's professional development (see the first panel of Exhibit 28).

Exhibit 27: Amount of Teachers' Instructional Activity Using Technology (Based on Year 1 SEC Data): By Subject Taught and By MSP Program Treatment Status

	Comparison			Treatment				
Mathematics	*Mean* [1]	*SD*	*N*	*Mean* [1]	*SD*	*N*	*F-value*	*p* [2]
How much of the total math instructional time do students in the target class use computers, calculators, or other technology to learn math?"	3.45	1.62	19	3.05	1.34	28	0.83	ns
When students in the target class are engaged in activities that involve the use of calculators, computers, or other educational technology as part of mathematics instruction, how much time do they:								
Learn facts	2.08	1.55	19	2.02	1.74	28	0.02	ns
Practice procedures	2.63	1.50	19	2.89	1.68	28	0.30	ns
Use sensors and probes	0.53	1.29	19	0.66	1.19	28	0.14	ns
Retrieve or exchange data or information (for example, using the Internet or partnering with another class)	0.74	1.39	19	1.70	1.70	28	4.16	*
Display and analyze data	1.92	1.85	19	2.27	1.69	28	0.44	ns
Develop geometric concepts (for example, using simulations)	0.95	1.50	19	1.39	1.54	28	0.97	ns
	Comparison			Treatment				
Science	*Mean* [1]	*SD*	*N*	*Mean* [1]	*SD*	*N*	*F-value*	*p* [2]
How much of the total science instructional time do students in the target class use computers, calculators, or other technology to learn science?	2.35	1.73	17	2.29	1.44	14	0.91	ns
When students in the target class are engaged in activities that involve the use of calculators, computers, or other educational technology as part of science instruction, how much time do they:								
Learn facts	3.12	1.36	17	3.07	0.92	14	0.01	ns
Practice procedures	3.12	1.32	17	2.57	1.34	14	1.30	ns
Use sensors and probes (for example, CBL's)	1.06	1.25	17	0.21	0.58	14	5.42	*
Retrieve or exchange data or information (for example, using the Internet or partnering with another class)	1.53	1.46	17	1.79	1.58	14	0.22	ns
Display and analyze data	2.00	1.34	17	2.08	1.59	14	0.02	ns
Develop problems using simulations	1.35	1.46	17	1.57	1.40	14	0.18	ns

Note: [1] The amount of instructional activity was measured on the scale of 0=none, 1=little, 2=some, 3=moderate, 4=considerable, and 5=almost all.
[2] *ns* stands for non-signficance, * <.05, ** <.01, and *** <.001.

More specifically, compared to their comparison teachers, math treatment teachers were more likely to experience professional development activities that are focused on presumably high-order instructional strategies for use in their classroom with their students such as displaying and analyzing data or developing geometric concepts. But no such group difference was found in the professional development activities that focus on low-order instructional strategies such as learning facts or practicing procedures. Even though the general pattern of difference between the treatment and comparison teachers was found similarly in math and science, the group difference was more noticeable in math than in science.

It is important to note that we need to take these findings with some caution. For example, due to its small sample size, we may not have been able to detect any real significant difference between treatment and comparison groups.

In sum, this test of hypotheses supports some evidence that the MSP program site 1 is accomplishing its goal of providing its teachers with high quality professional development activities that stress on the use of technology in math and science instruction.

Exhibit 28: Teachers' Professional Development Experience in the Use of Technology (Based on PDAL Data): By Subject Taught and By MSP Program Treatment Status

	Comparison			Treatment				
Mathematics	*Mean* [1]	*SD*	*N*	*Mean* [1]	*SD*	*N*	*F-value*	*p* [2]
Was an instructional topic in the "use of computers, calculators, or other technology to learn math" covered in this professional development activity?	0.64	0.34	12	0.78	0.22	25	2.29	ns
Did the professional development focus on any of the following instructional strategies for use in your classroom with your students (relating to calculators, computers, or other educational technology)?								
Learn facts	0.46	0.40	11	0.38	0.33	25	0.38	ns
Practice procedures	0.60	0.32	11	0.55	0.35	25	0.13	ns
Use sensors and probes	0.05	0.15	11	0.32	0.26	25	10.68	**
Retrieve or exchange data or information (for example, using the Internet or partnering with another class)	0.17	0.25	11	0.43	0.29	25	6.74	*
Display and analyze data	0.53	0.37	11	0.76	0.27	25	4.26	*
Develop geometric concepts (for example, using simulations)	0.11	0.20	11	0.47	0.34	25	10.96	**
	Comparison			Treatment				
Science	*Mean* [1]	*SD*	*N*	*Mean* [1]	*SD*	*N*	*F-value*	*p* [2]
Was an instructional topic in the "use of computers, calculators, or other technology to learn science" covered in this professional development activity?	0.46	0.41	8	0.71	0.32	9	1.92	ns
Did the professional development focus on any of the following instructional strategies for use in your classroom with your students (relating to calculators, computers, or other educational technology)?								
Learn facts	0.60	0.37	6	0.56	0.41	9	0.03	ns
Practice procedures	0.63	0.31	6	0.55	0.40	9	0.18	ns
Use sensors and probes (for example, CBL's)	0.07	0.10	6	0.54	0.38	9	8.68	*
Retrieve or exchange data or information (for example, using the Internet or partnering with another class)	0.72	0.34	6	0.69	0.31	9	0.03	ns
Display and analyze data	0.70	0.27	6	0.69	0.34	9	0.00	ns
Develop problems using simulations	0.10	0.17	6	0.77	0.24	9	34.67	***

Note: [1] The experience of professional development was measured on the scale of 0=no and 1=yes.
[2] *ns* stands for non-signficance, * <.05, ** <.01, and *** <.001.

VI. SUMMARY OF PRELIMINARY FINDINGS AND CONCLUSIONS: YEAR 2 OF MSP PD STUDY

SUMMARY OF RESULTS OF HYPOTHESIS TESTS

In this section, we briefly revisit and summarize the results, focusing on the general patterns that emerge from these tests of hypotheses. For this purpose, we produced summary tables – separately for math (Exhibit 29) and science (Exhibit 30) – which allow readers an overview of all the results that were presented in Sections III and IV. The summary tables show a number of cells filled in with a probability value of test statistics (in this case, based on a set of two-way ANOVAs).[12] The cells are intersections between two analytic components. The first component consists of the variables that were analyzed for the hypothesis tests. They are listed in rows and organized into four clusters (i.e., characteristics of the teacher and target class, instructional activities and strategies, the content of classroom instruction, and professional development). The second component is made up of six columns which represent hypotheses that were tested or will be tested. Under each hypothesis test, we indicated the source of data. For example, SEC1 data were used for the tests of hypotheses 1 and 2, while the PDAL data were used for the tests of hypotheses 3 and 4. The follow-up SEC data (SEC2) are scheduled to be collected in spring 2005, which will be used to test hypothesis 5.

In general, the results confirm the expectations set out in hypotheses 1-4. First, as expected, in our analysis of ***hypothesis 1***, we found some variation between MSP sites in the baseline year. For example, both in math and science, the level of teachers' instructional alignment with state standards and assessments differed significantly from site to site. The highest degree held by teachers and relational trust among teachers within schools was also significantly different between the MSP sites. Also, as expected, in our examination of ***hypothesis 2***, we found that the level of teachers' instructional alignment with state standards and assessments did NOT significantly differ between the treatment and comparison teachers in the baseline year, although there were some differences between mathematics and science teachers. In general, in math, there is very little pre-existing difference between the treatment and comparison teachers. In science, however, contrary to expectations, the treatment and comparison teachers experienced qualitatively different professional development activities in the baseline year.

As expected, in our analysis of ***hypothesis 3,*** we found some difference between the MSP sites in the features of professional development teachers experienced in year 2, particularly in some structural quality features (e.g., mean contact hours and span). As noted in Section IV, we also found some significant difference between the MSP sites in their PD activities' content focus, especially as it relates to topics on instructional activities. Consistent with ***hypothesis 4***, we also found differences between treatment and comparison teachers in the quality of the professional development experienced during

[12] The "ns" sign denotes that there is no significant difference between the groups under consideration; * sign means the probability (*p*) of finding the main effect by chance is less than .05; ** *p* of less than .01; and *** *p* of less than .001. Shaded cells represent not-applicable or non-existent measures. Blank cells under SEC2 represent the measures to be analyzed for the Final Report.

year 2. The treatment teachers experienced professional development activities that were longer in contact hours and span, and focused more on content compared with what their comparison counterparts' professional development activities.

Exhibit 29: Summary of Results of Hypothesis Tests: Math

Math	**Comparisons between MSP Program Sites**			**Treatment vs. Comparison Teachers**		
	Test of Hypothesis:			**Test of Hypothesis:**		
	1	**3**		**2**	**4**	**5**
Cluster of Variables	**SEC1[1]**	**PDAL[2]**	**SEC2[3]**	**SEC1[1]**	**PDAL[2]**	**SEC2[3]**
Teacher/Class/School Characteristics						
Course Type	ns			ns		
Number of Students in Target Class	ns			ns		
Achievement Levels of Students(Teacher perception)	**			ns		
Number of Years in Teaching	ns			*		
Number of Years in Teaching at This School	ns			*		
Highest Degree Held	***			ns		
Relational Trust	***			ns		
Instructional Activities/Strategies						
Assessment Use	*			ns		
Instructional Influece	***			ns		
Cognitive Demands: Memorize	ns			ns		
Cognitive Demands: Perform Procedures	ns			*		
Cognitive Demands: Communicate Understanding	ns			ns		
Cognitive Demands: Conjecture, Generalize, Prove	ns			ns		
Cognitive Demands: Make Connections	ns			*		
Content of Classroom Instruction						
Instructional Alignment with Standards	***			ns		
Instructional Alignment with Assessment	*			ns		
Cognitive Demands: Memorize	ns			ns		
Cognitive Demands: Perform Procedures	ns			ns		
Cognitive Demands: Communicate Understanding	ns			ns		
Cognitive Demands: Conjecture, Generalize, Prove	*			ns		
Cognitive Demands: Make Connections	ns			ns		
Breadth of Content Coverage	***			ns		
Topic Converage: Number Sense/Properties/Relationsh	ns			ns		
Topic Converage: Operations	ns			ns		
Topic Converage: Measurement	ns			ns		
Topic Converage: Algebraic Concepts	ns			ns		
Topic Converage: Geometric Concepts	ns			*		
Topic Converage: Data Analysis/Probability/Statistics	ns			ns		
Topic Converage: Instructional Technology	*			ns		
Professional Development						
Frequency	ns			ns		
% Duration >2-4 days		***			**	
Mean Contact Hours	ns	**		ns	**	
Activity Span		***			**	
Active Learning	*	ns		ns	ns	
Coherence	ns	*		ns	ns	
Collective participation (Overall)	***	ns		ns	ns	
Collective participation (At a given month)		ns			*	
Strengthen subject matter knowledge		ns			ns	
Number of topical areas focused		*			ns	
Topic Intensity		ns			*	
Routine Math Problem-Solving		*			ns	
Extended Math Problem-solving		ns			ns	
Perform Procedures		ns			ns	
Make Connections		ns			ns	
Number of instructional activities focused		ns			ns	
In-depth study emphasis (single item)	***			ns		
Content Emphasis	***			ns		
Data Emphasis	ns			ns		
Student Learning Emphasis	**			ns		
Standards & Instruction Emphasis	***			ns		

Note: [1] N of math teachers who responded to SEC1 (Year 1 Survey of Enacted Curriculum) is 210.
[2] N of math teachers who completed the PDAL (Professional Development Activity Log) is 138.
[3] SEC2 measures will be available in spring of 2005.
Shaded areas represent not-applicable or non-existent measures.
ns denotes not-significance, * p<.05, ** p<.01, and *** p<.001.

Exhibit 30: Summary of Results of Hypothesis Tests: Science

Science	Comparisons between MSP Program Sites			Treatment vs. Comparison Teachers		
	Test of Hypothesis:			Test of Hypothesis:		
	1	3		2	4	5
Cluster of Variables	SEC1[1]	PDAL[2]	SEC2[3]	SEC1[1]	PDAL[2]	SEC2[3]
Teacher/Class/School Characteristics						
Course Type	*			ns		
Number of Students in Target Class	ns			ns		
Achievement Levels of Students(Teacher perception)	*			*		
Number of Years in Teaching	ns			ns		
Number of Years in Teaching at This School	ns			ns		
Highest Degree Held	***			ns		
Relational Trust	*			ns		
Instructional Activities/Strategies						
Assessment Use	***			ns		
Instructional Influece	ns			ns		
Cognitive Demands: Memorize	ns			ns		
Cognitive Demands: Perform Procedures	ns			*		
Cognitive Demands: Communicate Understanding	ns			ns		
Cognitive Demands: Analyze Information	ns			ns		
Cognitive Demands: Make Connections	*			ns		
Content of Classroom Instruction						
Instructional Alignment with Standards	***			ns		
Instructional Alignment with Assessment	***			ns		
Cognitive Demands: Memorize	ns			ns		
Cognitive Demands: Perform Procedures	ns			*		
Cognitive Demands: Communicate Understanding	ns			ns		
Cognitive Demands: Analyze Information	ns			*		
Cognitive Demands: Make Connections	ns			*		
Breadth of Content Coverage	ns			ns		
Topic Converage[4]	ns			ns		
Professional Development						
Frequency	*			**		
% Duration >2-4 days		***			*	
Mean Contact Hours	**	ns		***	ns	
Activity Span		***			*	
Active Learning	*	ns		**	ns	
Coherence	ns	ns		**	ns	
Collective participation (Overall)	ns	ns		ns	ns	
Collective participation (At a given month)		ns			ns	
Strengthen subject matter knowledge		ns			***	
Number of topical areas focused		ns			ns	
Topic Intensity		**			*	
Laboratory Work		*			**	
Science Data/Information Collection		**			***	
Perform Procedures		*			*	
Make Connections		*			**	
Number of instructional activities focused		ns			***	
In-depth study emphasis (single item)	ns			ns		
Content Emphasis	ns			*		
Data Emphasis	ns			ns		
Student Learning Emphasis	ns			ns		
Standards & Instruction Emphasis	ns			ns		

Note: [1] N of science teachers who responded to SEC1 (Year 1 Survey of Enacted Curriculum) is 180.
[2] N of science teachers who completed the PDAL (Professional Development Activity Log) is 112.
[3] SEC2 measures will be available in spring of 2005.
[4] Some significant effects were found in some of the middle- and high school science topics
Shaded areas represent not-applicable or non-existent measures.
ns denotes not-significance, * p<.05, ** p<.01, and *** p<.001.

CONCLUSIONS: YEAR 2 OF STUDY

Testing Effectiveness of Survey Tools in Evaluation. One purpose of the MSP PD study is to test the use of teacher self-report survey and web-based tools for collecting, analyzing and reporting data on the quality of professional development, and the usefulness of these data tools for evaluating effects of professional development. The work is being conducted in four MSP sites from the first cohort of MSP grant sites (starting Fall 2002)—two comprehensive projects and two targeted projects

• After the second year of three-year study design, we have demonstrated *the use of the Surveys of Enacted Curriculum for analyzing differences in instructional practices and content of math and science teaching.* Teachers across the four MSP sites completed the surveys at an overall response rate greater than 80 percent. We demonstrated in the Year 2 Progress Report the use of the data for measuring differences in instruction at the baseline year, and reporting on differences in the quality and distribution of professional development. We mixed a paper-and-pencil survey of teachers and a Web-based monthly log with teachers. See edits in ES to make consistent.

• The study has *developed, tested, and demonstrated the use of a web-based monthly Professional Development Activity Log (PDAL) system to regularly gather data from teachers on the professional development activities***.** The PDAL system gained response rates as high as 62 percent in the 15 months of the test, although the overall average rate was 57 percent completing the monthly logs. The study has tested several methods of increasing response rates including online and CD training packages, postcards, incentive pay, and phone follow-ups. See edits in ES.

Preliminary Evidence of MSP Supporting Higher Quality Professional Development. The study is focusing on a sample of teachers targeted for MSP participation and non-participating comparison teachers in each MSP site. Upon completing the tests of a series of hypotheses, we found some empirical evidence to support the hypothesis that MSP initiatives are achieving their intended purpose of supporting quality professional development activities for math and science teachers. For example, the four MSP program sites have instituted some of the structural features of high quality professional development activities such as extended contact hours and prolonged activity span. These are among the structural features likely to set the conditions for teachers to receive intense, sustained, and in-depth learning opportunities, which, in turn, are expected to produce effects on teaching practice. Furthermore, we also found that teachers targeted for participation in MSP programs tend to experience a stronger content focus in their professional development, particularly in science. Combined with sustained learning opportunities, the stronger content focus afforded by MSP programs is expected to allow teachers to practice new content and instructional strategies they received in their classrooms.

When the follow-up SEC data are made available in spring of 2005, we will test the most interesting and important hypothesis of this study. At the outset of this report, we advanced Hypothesis 5, which states, in part, "after a year of MSP implementation, we expect teachers in the treatment group (i.e., teachers targeted for MSP participation) to exhibit higher quality instruction, as measured by the alignment of instruction with state content standards, than teachers in the comparison group, after controlling for any year 1 differences." Our analysis of the effects of professional development is based on a quasi-experimental analysis of teachers targeted for participation in MSP (for simplicity termed "treatment" teachers), and a group of non-participating comparison teachers. While random assignment of teachers to MSP and comparison groups would be ideal, this was not feasible in the current study. Thus, in order to assess the effect of teachers' professional development experiences on their instructional practice, it is essential to control for any differences found to exist at the baseline year between MSP sites as well as between "treatment" and comparison teachers. We have collected extensive baseline data which can be included as potential control variables. Including these variables in the analysis will strengthen the attribution of any improvement in instruction among the treatment teachers to the professional development experiences they had experienced over the period of the MSP program. Make changes to be consistent with edits in ES.

This test of the effects of PD on is made possible through our longitudinal study design and the use of such innovative instruments as the PDAL and SEC funded by NSF's RETA grant program. Make consistent with ES.

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Appendix A - Teacher Responses to Surveys of Enacted Curriculum Year 1 (2003) and Professional Development Activity Log (July 2003-Sept. 2004), MSP PD Study

	Intended Sample	Year 1 SEC				PDAL			
		Math	Science	Total	Response Rate	Math	Science	Total	Completion Rate[1]
MSP Site									
Brockport	91	47	31	78	86%	37	18	55	60%
Cleveland	180	79	99	178	99%	49	63	112	62%
Corpus Christi	93	50	28	78	84%	34	23	57	61%
El Paso	112	34	22	56	50%	28	21	49	44%
Treatment Status									
Comparison	213	77	92	169	79%	45	54	99	46%
Treatment	263	133	88	221	84%	103	71	174	66%
MSP_Site*Treatment Status									
Brockport-Comparison	43	19	17	36	84%	12	8	20	47%
Brockport-Treatment	48	28	14	42	88%	25	10	35	73%
Cleveland-Comparison	68	28	40	68	100%	14	15	29	43%
Cleveland-Treatment	112	51	59	110	98%	35	48	83	74%
Corpus Christi-Comparison	51	15	26	41	80%	6	22	28	55%
Corpus Christi-Treatment	42	35	2	37	88%	28	1	29	69%
El Paso-Comparison	51	15	9	24	47%	13	9	22	43%
El Paso-Treatment	61	19	13	32	52%	15	12	27	44%
Total	**476**	**210**	**180**	**390**	**82%**	**148**	**125**	**273**	**57%**

Note: [1] PDAL completion rate represents the number of teachers who completed usable PDAL data among the intended sample.

Appendix B - Mathematics Scales

		Reliability Coefficient	MEAN
Assessment Use		**0.727**	**1.786**
Q64	Short answer questions such as performing a mathematical	0.713	2.590
Q65	Extended response item for which student must explain or justify	0.663	2.240
Q66	Performance tasks or events (e.g. hands-on activities).	0.669	1.977
Q67	Individual or group demonstration, presentation.	0.671	1.392
Q68	Mathematics projects.	0.693	0.954
Q69	Portfolios.	0.726	0.857
Q70	Systematic observation of students.	0.730	2.498
Influence of Standards		**0.674**	**3.059**
Q71	Your state's curriculum framework or content standards.	0.543	4.217
Q72	Your district's curriculum framework or guidelines.	0.580	4.272
Q76	National mathematics education standards.	0.700	3.622
Q83	Provide mathematics instruction that meets mathematics content standards (district,	0.693	2.185
Q128	State mathematics content standards (e.g. what they are and how they are used).	0.609	1.968
Q129	Alignment of mathematics instruction to curriculum.	0.637	2.083
Climate of Trust		**0.823**	**2.792**
Q93	I am supported by colleagues to try out new ideas in teaching mathematics.	0.815	2.903
Q96	Mathematics teachers in this school trust each other.	0.784	2.727
Q97	It's OK in this school to discuss feelings, worries, and frustrations with other mathematics teachers.	0.789	2.958
Q98	Mathematics teachers respect other teachers who take the lead in school improvement efforts.	0.787	2.968
Q99	It's OK in this school to discuss feelings, worries, and frustrations with the principal.	0.783	2.579
Q100	The principal takes personal interest in the professional development of the teachers.	0.805	2.620
Perform Procedures		**0.758**	**2.307**
Q37	Solve *word problems* from a textbook or worksheet.	0.760	2.806
Q45	Solve *word problems* from a textbook or worksheet.	0.745	2.565
Q53*	Work with manipulatives (e.g. counting blocks, geometric shapes, or algebraic tiles) to understand concepts.	0.704	2.318
Q54*	Measure objects using tools such as rulers, scales, or protractors.	0.701	2.493
Q56*	Collect data by counting, observing, or conducting surveys.	0.687	2.014
Q59	Practice procedures	0.745	2.815
Q60**B**	Retrieve or exchange data or information (e.g. using the Internet or partnering with another class)	0.744	1.140
Communicative Understanding		**0.802**	**2.506**
Q29	Present or demonstrate solutions to a math problem to the whole class.	0.787	2.542
Q32*	Work in pairs or small groups on math exercises, problems, investigations, or tasks.	0.751	2.880
Q39	Explain their reasoning or thinking in solving a problem, using several sentences orally or in writing.	0.768	2.083
Q47	Talk about their reasoning or thinking in solving a problem.	0.749	2.569
Q57	Present information to others using manipulatives (e.g. chalkboard, whiteboard, posterboard, projector).	0.765	2.458

Note: Results for individual items in Reliability Coefficient column report coefficient if item is deleted.
* Item used in multiple scales (for exploratory purposes only).

Appendix B - Mathematics Scales (continued)

		Reliability Coefficient	MEAN
Analyze Information (Conjectures, Generalize, Prove Math)		**0.868**	**1.957**
Q41	Make estimates, predictions or hypotheses.	0.847	2.349
Q42	Analyze data to make interferences or draw conclusions.	0.837	2.293
Q44	Complete or conduct proofs or demonstrations of their mathematical reasoning.	0.849	1.403
Q49	Make estimates, predictions or hypotheses.	0.843	2.241
Q52	Complete or conduct proofs or demonstrations of their mathematical reasoning.	0.822	1.495
Make Connections (Solve new notions)		**0.861**	**2.164**
Q38	Solve non-routine mathematical problems (e.g. problems that require novel or non-formulaic thinking).	0.857	1.944
Q40	Apply mathematical concepts to "real-world" problems.	0.845	2.875
Q46	Solve non-routine mathematical problems (e.g. problems that require novel or non-formulaic thinking).	0.823	1.972
Q48	Apply mathematical concepts to "real-world" problems.	0.819	2.763
Q50	Apply data to make inferences or draw conclusions.	0.823	2.265
Q51	Work on a problem that takes at least 45 minutes to solve.	0.854	1.167
Active Learning		**0.853**	**2.217**
Q30	Use manipulatives (e.g. counting blocks, geometric shapes, or algebraic tiles), measurement instruments (e.g. rulers or protractors), and data collection devices (e.g. surveys or probes).	0.805	2.677
Q32*	Work in pairs or small groups on math exercises, problems, investigations, or tasks.	0.853	2.880
Q33	Do a mathematics actively with the class outside the classroom.	0.854	0.917
Q53*	Work with manipulatives (e.g. counting blocks, geometric shapes, or algebraic tiles) to understand concepts.	0.821	2.318
Q54*	Measure objects using tools such as rulers, scales, or protractors.	0.816	2.493
Q56*	Collect data by counting, observing, or conducting surveys.	0.816	2.014
PD Frequency	For the most recent school year, how often have you participated in:	**0.351**	**2.342**
q101a	Workshops or in-service training related to mathematics or mathematics education	0.452	5.337
q102a	Summer institutes related to mathematics or mathematics education	0.179	0.853
q103a	College courses related to mathematics or mathematics education	0.245	0.836
PD Hours	For the most recent school year, how many total hours have you participated in:	**0.461**	**16.264**
q101b	Workshops or in-service training related to mathematics or mathematics education	0.460	31.099
q102b	Summer institutes related to mathematics or mathematics education	0.066	10.533
q103b	College courses related to mathematics or mathematics education	0.504	7.161
Active Teacher Engagement PD		**0.767**	**1.145**
q111	Observed demonstrations of teaching techniques	0.743	1.442
q112	Led group discussions.	0.723	0.921
q113	Developed curricula or lesson plans, which other participants or the activity leader reviewed.	0.723	1.321
q114	Reviewed student work or scored assessments.	0.777	2.030
q115	Developed assessments or tasks as part of a formal professional development activity.	0.725	1.036
q116	Practiced what you learned and received feedback as part of a professional development activity.	0.732	1.279
q117	Received coaching or mentoring in the classroom.	0.755	0.612
q118	Given a lecture or presentation to colleagues.	0.751	0.521

Note: Results for individual items in Reliability Coefficient column report coefficient if item is deleted.

* Item used in multiple scales (for exploratory purposes only).

Appendix B - Mathematics Scales (continued)

		Reliability Coefficient	MEAN
Coherent PD Program		**0.752**	**1.878**
q119	Designed to support the school-wide improvement plan adopted by your school.	0.741	1.788
q120	Consistent with you mathematics department or grade level plan to improve teaching.	0.690	2.111
q121	Consistent with your own goals for your professional development.	0.686	2.174
q122	Based explicitly on what you had learned in earlier professional development activities.	0.734	1.623
q123	Followed up with related activities that built upon what you learned as part of the activity	0.688	1.693
Collective Participation (sum)		**0.677**	**0.652**
q124	I participated in professional development activities with most or all of the teachers from my school.	.	0.558
q125	I participated in professional development activities with most or all of the teachers from my department or grade level.	.	0.745
PD w/ Content Focus		**0.746**	**1.750**
q128*	State mathematics content standards (e.g. what they are and how they are used).	0.687	2.079
q129*	Alignment of mathematics instruction to curriculum.	0.658	2.177
q131*	In-depth study of mathematics or specific concepts within mathematics (e.g. fractions).	0.673	1.604
q132*	Study of how children learn particular topics in mathematics.	0.730	1.141
PD w/ Data Focus		**0.824**	**1.482**
q135*	Classroom mathematics assessment (e.g. diagnostic approaches, textbook-developed tests, teacher-developed tests).	0.836	1.313
q136*	State or district mathematics assessment (e.g. preparing for assessments, understanding assessments, or interpreting assessments).	0.724	1.663
q137*	Interpretation of assessment data for use in mathematics instruction.	0.704	1.470
PD w/ Standards & Instruction Focus		**0.830**	**1.689**
q128*	State mathematics content standards (e.g. what they are and how they are used).	0.804	2.079
q129*	Alignment of mathematics instruction to curriculum.	0.795	2.177
q131*	In-depth study of mathematics or specific concepts within mathematics (e.g. fractions).	0.809	1.604
q136*	State or district mathematics assessment (e.g. preparing for assessments, understanding assessments, or interpreting assessments).	0.787	1.663
q137*	Interpretation of assessment data for use in mathematics instruction.	0.789	1.470
PD w/ Student Learning Focus		**0.818**	**1.236**
q132*	Study of how children learn particular topics in mathematics.	0.750	1.141
q133	Individual differences in student learning.	0.736	1.258
q134	Meeting the learning needs of special populations of students (e.g. second language learners; students with disabilities).	0.779	1.049
q135*	Classroom mathematics assessment (e.g. diagnostic approaches, textbook-developed tests, teacher-developed tests).	0.801	1.313
q138	Technology to support student learning in mathematics.	0.836	1.421

Note: Results for individual items in Reliability Coefficient column report coefficient if item is deleted.
* Item used in multiple scales (for exploratory purposes only).

Appendix B - Science Scales

		Reliability Coefficient	MEAN
Assessment Use		**0.743**	**1.882**
Q64	Short answer questions (e.g. fill-in-the-blank).	0.735	2.306
Q65	Extended response item for which student must explain or justify solution.	0.689	2.210
Q66	Performance tasks or events (e.g. hands-on activities).	0.680	2.344
Q67	Individual or group demonstration, presentation.	0.694	1.613
Q68	Science projects.	0.721	1.215
Q69	Portfolios.	0.729	1.156
Q70	Systematic observation of students.	0.736	2.333
Influence of Standards		**0.761**	**3.011**
Q71	Your state's curriculum framework or content standards.	0.685	4.290
Q72	Your district's curriculum framework or guidelines.	0.719	4.172
Q76	National science education standards.	0.725	3.597
Q83	Provide science instruction that meets science content standards (district, state, or national).	0.764	2.134
Q128	State science content standards (e.g. what they are and how they are used).	0.735	1.903
Q129	Alignment of science instruction to curriculum.	0.723	1.968
Climate of Trust		**0.817**	**2.706**
Q93	I am supported by colleagues to try out new ideas in teaching science.	0.777	2.887
Q96	Science teachers in this school trust each other.	0.779	2.726
Q97	It's OK in this school to discuss feelings, worries, and frustrations with other science teachers.	0.775	2.790
Q98	Science teachers respect other teachers who take the lead in school improvement efforts.	0.780	2.844
Q99	It's OK in this school to discuss feelings, worries, and frustrations with the principal.	0.808	2.468
Q100	The principal takes personal interest in the professional development of the teachers.	0.808	2.522
Perform Procedures		**0.881**	**2.715**
Q29	Do a laboratory activity, investigation, or experiment.	0.859	2.968
Q38	Follow step-by-step directions.	0.866	3.134
Q39*	Use science equipment or measuring tools.	0.852	3.145
Q40	Collect data.	0.848	3.177
Q42	Organize and display information in tables or graphs.	0.853	2.968
Q45	Make observations/classifications.	0.857	3.247
Q58	Practice procedures.	0.890	2.366
Q59*	Use sensors and probes (e.g. Computer Based Labs)	0.894	0.715
Communicative Understanding		**0.884**	**2.060**
Q28	Write about science in a report/paper on science topics.	0.878	1.925
Q46	Complete written assignments from the textbook or workbook.	0.873	2.258
Q48	Write up results or prepare a presentation from a laboratory activity, investigation, experiment or a research project.	0.866	2.430
Q50	Work on a writing project or entries for portfolios seeking paper comments to improve work.	0.865	1.215
Q52	Have class discussions about the data.	0.868	2.349
Q53	Organize and display the information in tables or graphs.	0.864	2.328
Q56	Make a presentations to the class on the data, analysis, or interpretation.	0.858	1.914

Note: Results for individual items in Reliability Coefficient column report coefficient if item is deleted.
* Item used in multiple scales (for exploratory purposes only).

Appendix B - Science Scales (continued)

		Reliability Coefficient	MEAN
Analyze Information		**0.834**	**2.470**
Q43	Analyze and interpret science data.	0.810	3.016
Q54	Make a prediction based on the data.	0.742	2.290
Q55	Analyze and interpret the information or data, orally or in writing.	0.752	2.430
Q61	Display and analyze data.	0.852	2.145
Make Connections		**0.809**	**2.385**
Q37	Make educated guesses, predictions, or hypotheses.	0.773	2.882
Q41	Collect data.	0.692	2.392
Q44*	Design their own investigation or experiment to solve a scientific question.	0.749	1.882
Active Learning		**0.833**	**2.159**
Q29	Do a laboratory activity, investigation, or experiment.	0.789	2.968
Q31	Collect data (other than laboratory activities).	0.801	1.995
Q34*	Use computers, calculators or other educational technology or learn science.	0.816	2.253
Q39*	Use science equipment or measuring tools.	0.805	3.145
Q44	Design their own investigation or experiment to solve a scientific question.	0.791	1.882
Q59*	Use sensors and probes (e.g. Computer Based Labs).	0.834	0.715
PD Frequency	For the most recent school year, how often have you participated in:	**0.552**	**2.424**
q101a	workshops or in-service training related to science or science education	0.483	4.612
q102a	summer institutes related to science or science education	0.242	1.281
q103a	college courses related to science or science education	0.606	1.380
PD Hours	For the most recent school year, how many total hours have you participated in:	**0.502**	**14.083**
q101b	workshops or in-service training related to science or science education	0.293	20.273
q102b	summer institutes related to science or science education	0.154	11.843
q103b	college courses related to science or science education	0.648	10.132
Active Teacher Engagement PD		**0.830**	**1.219**
q111	Observed demonstrations of teaching techniques.	0.811	1.387
q112	Led group discussions.	0.794	0.927
q113	Developed curricula or lesson plans, which other participants or the activity leader reviewed.	0.805	1.439
q114	Reviewed student work or scored assessments.	0.825	1.610
q115	Developed assessments or tasks as part of a formal professional development activity.	0.799	1.734
q116	Practiced what you learned and received feedback as part of a professional development activity.	0.807	1.460
q117	Received coaching or mentoring in the classroom.	0.828	0.540
q118	Given a lecture or presentation to colleagues.	0.812	0.653
Coherent PD Program		**0.855**	**1.769**
q119	Designed to support the school-wide improvement plan adopted by your school.	0.852	1.606
q120	Consistent with you science department or grade level plan to improve teaching.	0.807	2.018
q121	Consistent with your own goals for your professional development.	0.797	2.036
q122	Based explicitly on what you had learned in earlier professional development activities.	0.835	1.500
q123	Followed up with related activities that built upon what you learned as part of the activity	0.835	1.685

Note: Results for individual items in Reliability Coefficient column report coefficient if item is deleted.
* Item used in multiple scales (for exploratory purposes only).

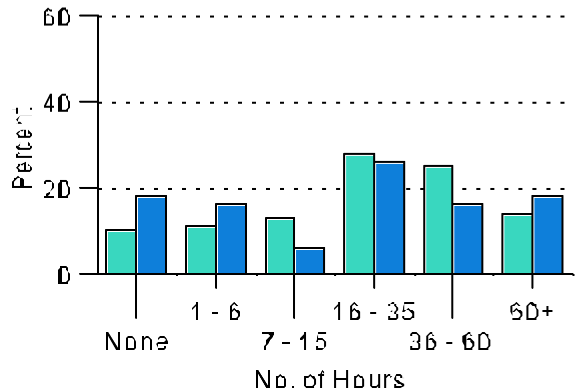
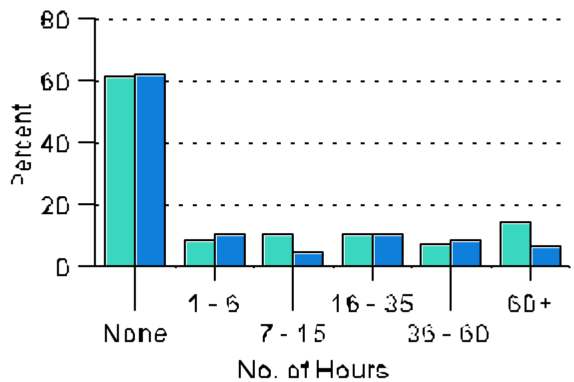
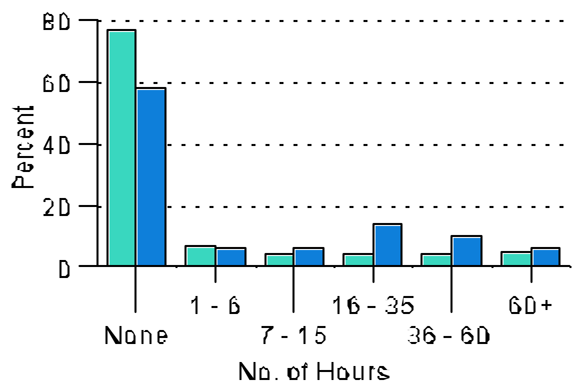
Appendix B - Science Scales (continued)

		Reliability Coefficient	MEAN
Collective Participation (sum)		**0.756**	0.508
q124	I participated in professional development activities with most or all of the teachers from my school.	.	0.444
q125	I participated in professional development activities with most or all of the teachers from my department or grade level.	.	0.573
PD w/ Content Focus		**0.839**	**1.676**
q128*	State science content standards (e.g. what they are and how they are used).	0.788	1.942
q129*	Alignment of science instruction to curriculum.	0.781	2.074
q131*	In-depth study of science or specific concepts within science (e.g. earth science).	0.782	1.512
q132*	Study of how children learn particular topics in science.	0.830	1.174
PD w/ Data Focus		0.826	1.311
q135*	Classroom science assessment (e.g. diagnostic approaches, textbook-developed tests, teacher-developed tests).	0.848	1.298
q136*	State or district science assessment (e.g. preparing for assessments, understanding assessments, or interpreting assessments).	0.705	1.430
q137*	Interpretation of assessment data for use in science instruction.	0.712	1.207
PD w/ Standards & Instruction Focus		**0.867**	**1.556**
q128*	State science content standards (e.g. what they are and how they are used).	0.858	1.942
q129*	Alignment of science instruction to curriculum.	0.861	2.074
q131*	In-depth study of science or specific concepts within science (e.g. earth science).	0.858	1.512
q136*	State or district science assessment (e.g. preparing for assessments, understanding assessments, or interpreting assessments).	0.860	1.430
q137*	Interpretation of assessment data for use in science instruction.	0.856	1.207
PD w/ Student Learning Focus		**0.865**	**1.261**
q132*	Study of how children learn particular topics in science.	0.839	1.174
q133	Individual differences in student learning.	0.813	1.298
q134	Meeting the learning needs of special populations of students (e.g. second language learners; students with disabilities).	0.826	1.198
q135*	Classroom science assessment (e.g. diagnostic approaches, textbook-developed tests, teacher-developed tests).	0.847	1.298
q138	Technology to support student learning in science.	0.858	1.339

Note: Results for individual items in Reliability Coefficient column report coefficient if item is deleted.
* Item used in multiple scales (for exploratory purposes only).

Major Types of Teacher Professional Development in Mathematics Education Activities
Reported by Teachers During Past 12 Months (SEC, Year 1)

Grade	
Middle School (N=166)	High School (N=50)

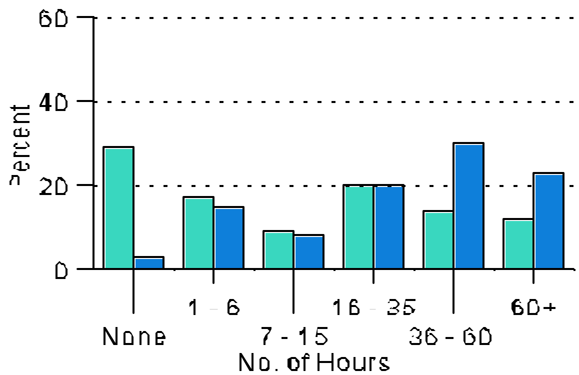
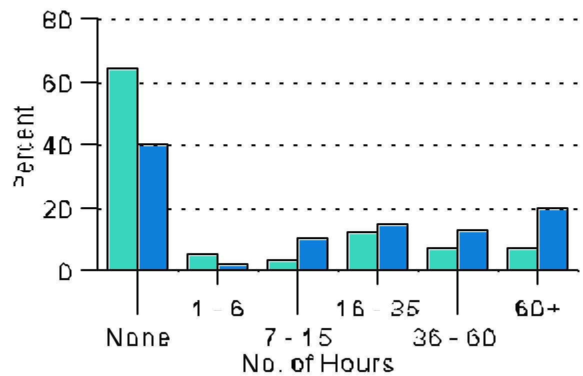
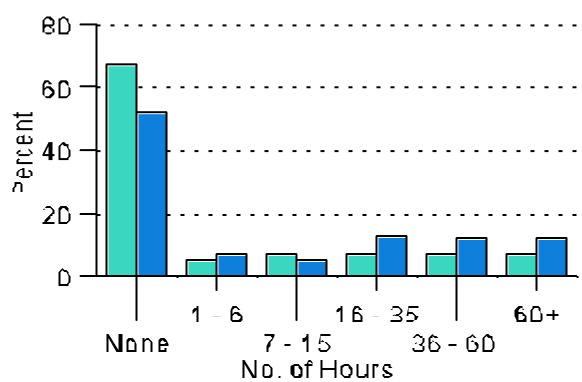
Professional Development in Math	Percent of Math Teachers
Workshops or in-service training related to mathematics or mathematics education	
Summer Institutes related to mathematics and mathematics education	
College courses related to mathematics or mathematics education	

Source: Survey of Enacted Curriculum, MSP Study: Year One Teacher Surveys, Spring 2003
CCSSO, AIR, WCER, National Science Foundation, MSP-RETA Grant

Major Types of Teacher Professional Development in Science Education Activities Reported by Teachers During Past 12 Months (SEC, Year 1)

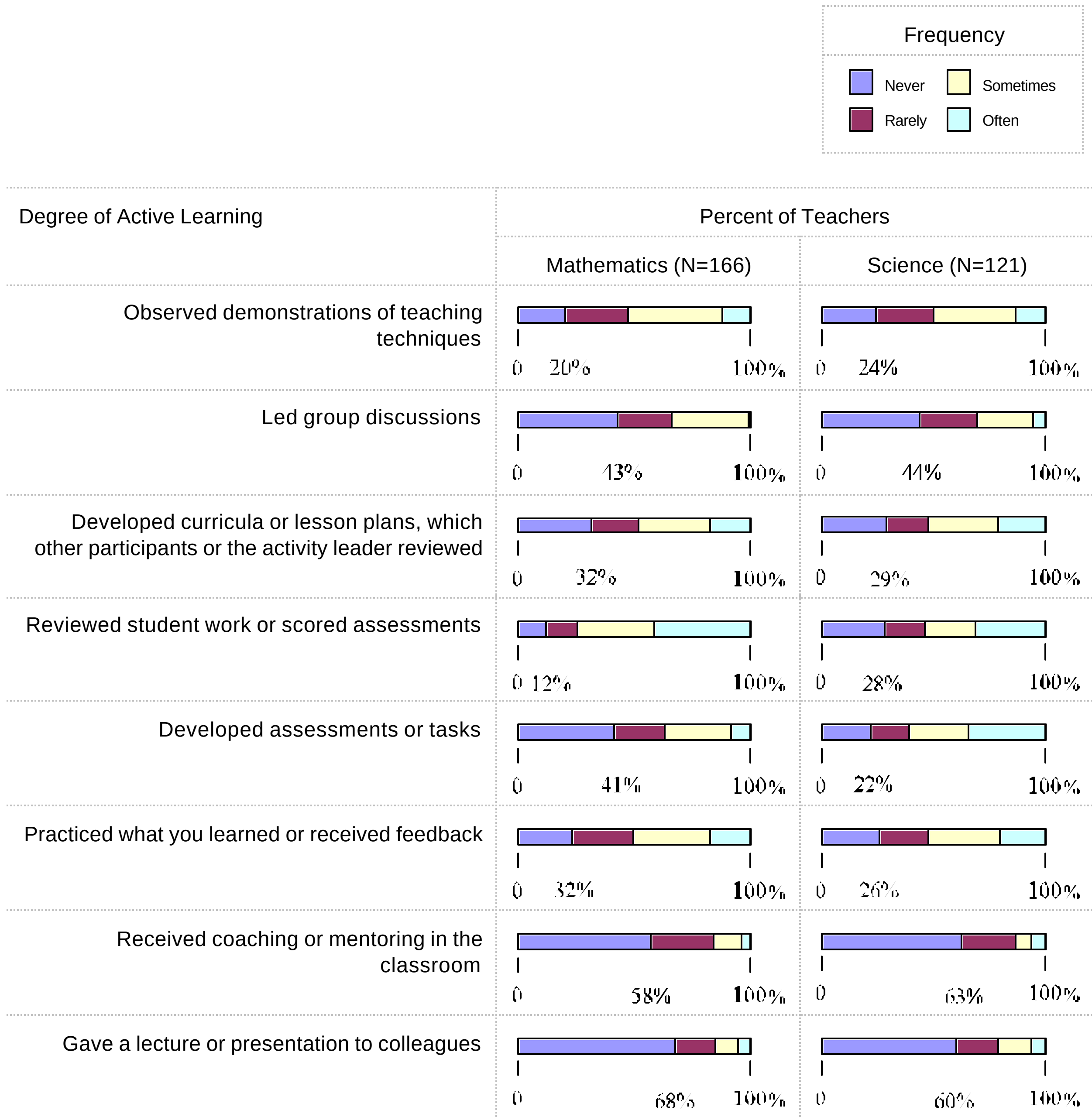
Grade

Middle School (N=121) | High School (N=60)

Professional Development in Science	Percent of Science Teachers
Workshops or in-service training related to science or science education	
Summer Institutes related to science or science education	
College courses related to science or science education	

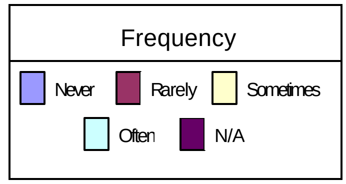
Source: Survey of Enacted Curriculum, MSP Study: Year One Teacher Surveys, Spring 2003
CCSSO, AIR, WCER, National Science Foundation, MSP-RETA Grant

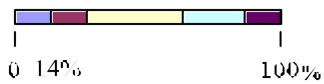
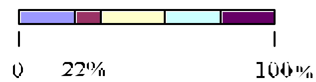
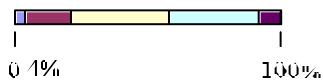
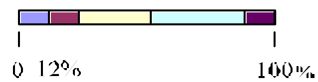
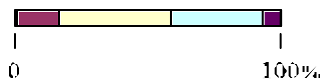
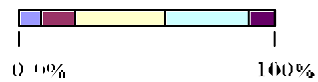
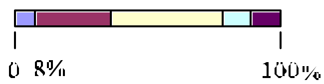
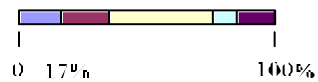
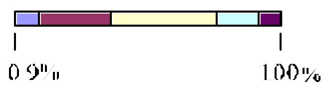
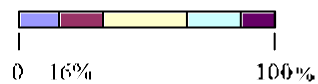
Active Learning of Professional Development Activities in Middle School Mathematics and Science



Source: Survey of Enacted Curriculum, MSP Study: Year One Teacher Surveys, Spring 2003
CCSSO, AIR, WCER, National Science Foundation, MSP-RETA Grant

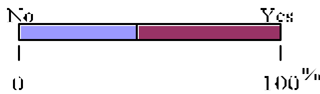
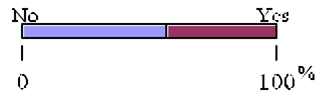
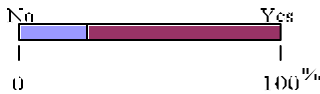
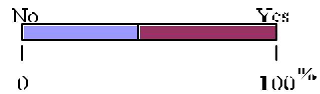
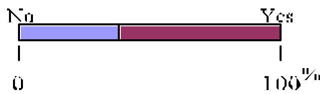
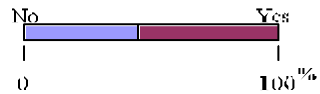
Coherence of Professional Development Activities in Middle School Mathematics and Science



Coherence of Professional Development	Percent of Teachers	
	Mathematics (N=166)	Science (N=121)
Designed to support the school-wide improvement plan adopted by your school		
Consistent with your department or grade		
Consistent with your own goals for your professional development		
Based explicitly on what you had learned in earlier professional development activities		
Followed up with related activities that built upon what you learned as part of the activity		

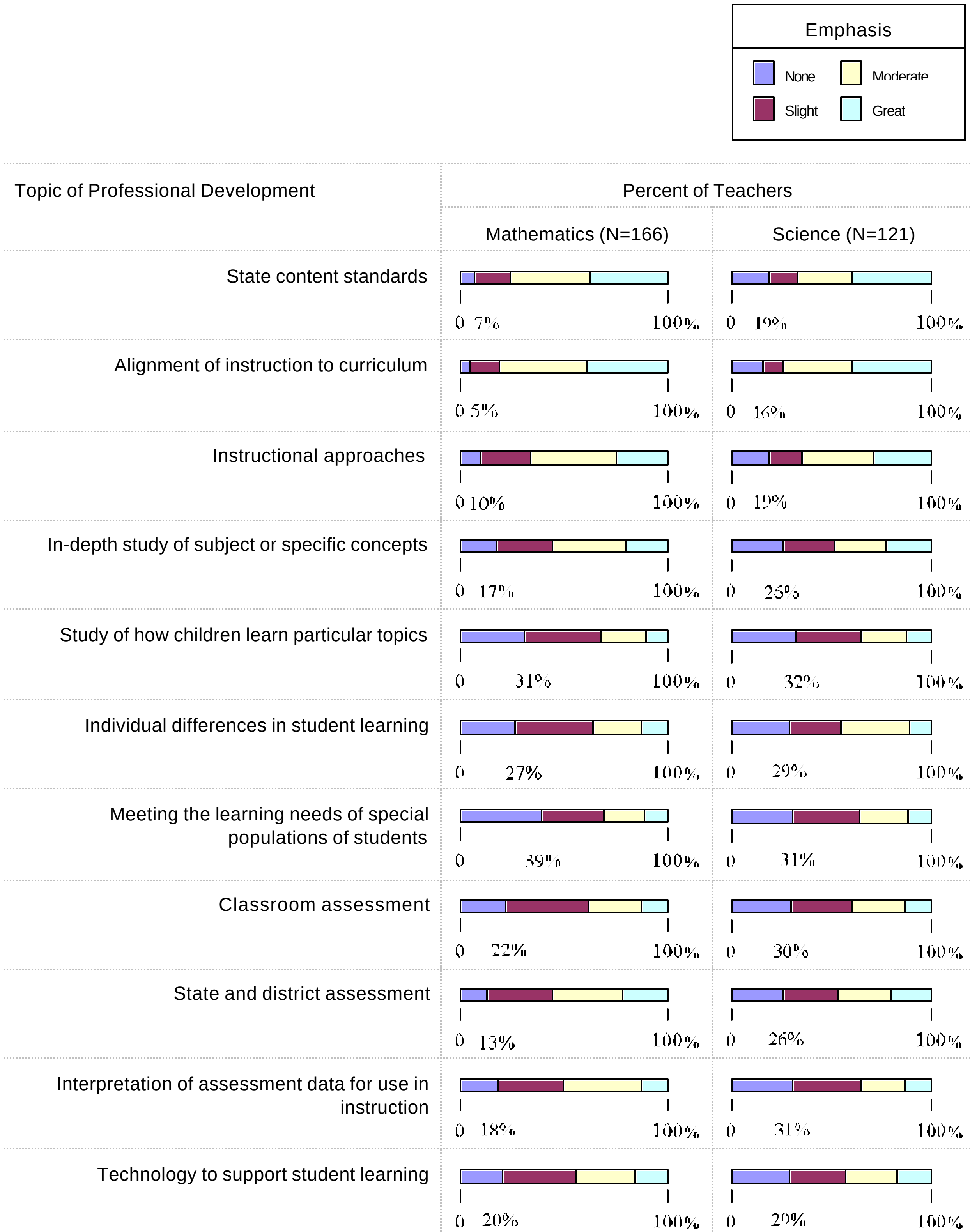
Source: Survey of Enacted Curriculum, MSP Study Yar One Teacher Surveys, Spring 2003
CCSSO, AIR, WCER, National Science Foundation, MSP-RETA Grant

Collegial Participation in Professional Development Activities in Middle School Mathematics and Science

Collegial Participation	Percent of Teachers	
	Mathematics (N=166)	Science (N=121)
Participated in professional development activities with most or all of the teachers from you school		
Participated in professional development activities with most or all of the teachers from your department or school level		
Participated in professional development activities not attended by other staff member from your school		
Discussed what was learned with other teachers in your school or department who did not attend the activity		

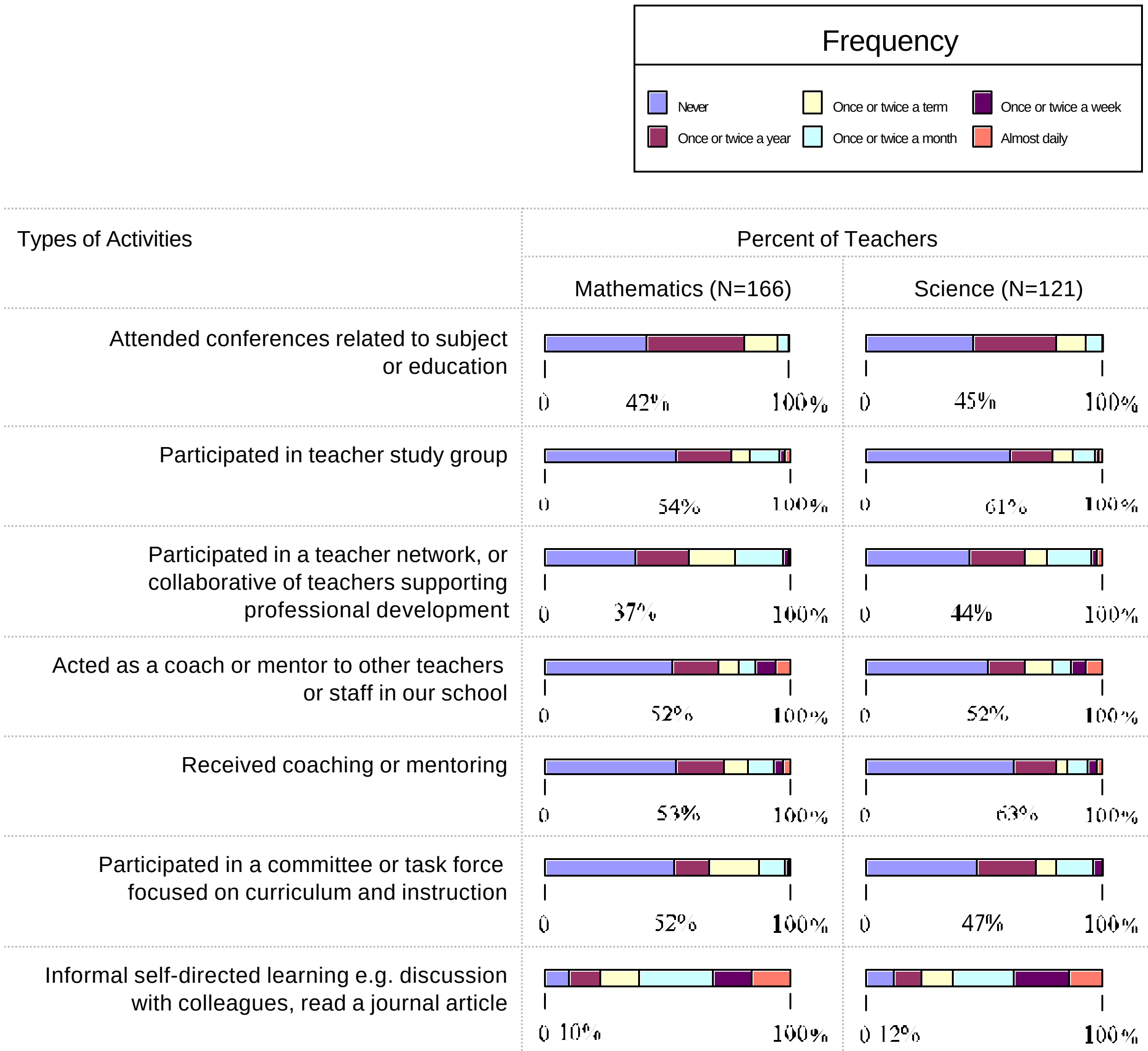
Source: Survey of Enacted Curriculum, MSP Study: Year One Teacher Surveys, Spring 2003
CCSSO, AIR, WCER, National Science Foundation, MSP-RETA Grant

Content Focus of Professional Development Activities in Middle School Mathematics and Science



Source: Survey of Enacted Curriculum, MSP Study: Year One Teacher Surveys, Spring 2003
CCSSO, AIR, WCER, National Science Foundation, MSP-RETA Grant

Types of Professional Development Activities Specific to Teaching and Learning Middle School Mathematics and Science



Source: Survey of Enacted Curriculum, MSP Study: Year One Teacher Surveys, Spring 2003
CCSSO, AIR, WCER, National Science Foundation, MSP-RETA Grant

Appendix D1. Descriptive Statistics for PDAL Variables: Based on Monthly Log Level Data (N=1,797)

Variable	*Description*	*N*	*Mean*	*SD*	*Min*	*Max*
Activity Duration, Contact Hours, and Span						
Act_Duration	How many days: On the scale of 0=less than a day, 1=one day, 2=2-4 days, 3=a week, 4=entire month.	1797	1.87	1.30	0.0	4.0
ActD_Duration	Activity duration dummy variable: 0=one day or less, 1= 2-4 days or longer	1797	0.58	0.49	0.0	1.0
Act_Hours	Activity Contact Hour	1797	15.37	19.22	1.0	160.0
Act_Hour307	Activity Contact Hour during July 2003	206	35.82	28.72	1.0	150.0
Act_Hour308	Activity Contact Hour during August 2003	215	13.84	15.34	1.0	80.0
Act_Hour309	Activity Contact Hour during September 2003	152	13.07	18.23	1.0	160.0
Act_Hour310	Activity Contact Hour during October 2003	216	11.01	14.94	1.0	160.0
Act_Hour311	Activity Contact Hour during November 2003	148	11.52	17.20	1.0	160.0
Act_Hour312	Activity Contact Hour during December 2003	130	9.35	14.34	1.0	140.0
Act_Hour401	Activity Contact Hour during January 2004	128	8.71	15.44	1.0	160.0
Act_Hour402	Activity Contact Hour during February 2004	140	10.74	12.28	1.0	80.0
Act_Hour403	Activity Contact Hour during March 2004	130	10.36	10.58	1.0	60.0
Act_Hour404	Activity Contact Hour during April 2004	88	11.66	12.48	1.0	70.0
Act_Hour405	Activity Contact Hour during May 2004	96	11.77	9.99	1.0	60.0
Act_Hour406	Activity Contact Hour during June 2004	58	25.26	20.78	1.0	80.0
Act_Hour407	Activity Contact Hour during July 2004	60	29.29	19.65	2.5	80.0
Act_Hour408	Activity Contact Hour during August 2004	30	20.97	16.87	1.0	60.0
Act_Continued	Activity is continued (0=no, 1=yes)	1797	0.69	0.46	0.0	1.0
Act_Mo_N	Activity months: Count of active months only	1797	3.04	2.59	1.0	12.0
Act_Span	Activity Span: Count of months from start to the end (inclusive months)	1797	3.95	3.54	1.0	14.0
Act_Consecutive	Activity occurred in consecutive months (0=no, 1=yes)	1295	0.55	0.50	0.0	1.0
Activity Type	Dummy variables (0=no, 1=yes)					
Act_workshop	PD Activity Type - Participation in a workshop or in-service activity	1021	0.58	0.49	0.0	1.0
Act_inst	PD Activity Type - Participation in a summer institute	1021	0.12	0.32	0.0	1.0
Act_college	PD Activity Type - Attendance at a college course	1021	0.16	0.37	0.0	1.0
Act_confer	PD Activity Type - Attendance at a conference	1021	0.08	0.27	0.0	1.0
Act_studygr	PD Activity Type - Participation in a teacher study group	1021	0.16	0.36	0.0	1.0
Act_network	PD Activity Type - Participation in a teacher network or collaborative of teachers	1021	0.27	0.44	0.0	1.0
Act_mentor	PD Activity Type - Working with a mentor, coach, lead teacher, or observer	1021	0.17	0.38	0.0	1.0
Act_taskforce	PD Activity Type - Participation in a teacher committee or task force	1021	0.10	0.29	0.0	1.0
Act_informal	PD Activity Type - Engagement in informal self-directed learning	1021	0.16	0.37	0.0	1.0
PD Quality Scales						
ActiveLearn	Active Learning (mean score): 0=never, 1=rarely, 2=sometimes, 3=often	1781	1.10	0.76	0.0	3.0
Coherence	Coherence (mean score): 0=never, 1=rarely, 2=sometimes, 3=often	1709	2.32	0.67	0.0	3.0
Collective	Collective Participation (sum score): On the scale of 0 - 2: number of postive response to two collective participation items	1766	0.62	0.73	0.0	2.0

Appendix D1. Descriptive Statistics for PDAL Variables: Based on Monthly Log Level Data (N=1,797)

Variable	*Description*	*N*	*Mean*	*SD*	*Min*	*Max*
Content Focus Measures						
Purpose of PD						
Purp_Subject	Strengthening subject matter knowledge	1689	0.71	0.46	0.0	1.0
Math Topics						
topics_math	Total number of 1st-order topics covered in the activity	990	1.95	2.10	0.0	6.0
topic_number	Number of Sub-topics Covered - Number sense/Properties/Relationships	989	3.28	5.26	0.0	16.0
topic_measure	Number of Sub-topics Covered - Measurement	990	2.44	4.61	0.0	15.0
topic_algebra	Number of Sub-topics Covered - Algebraic Concepts	990	5.53	7.50	0.0	21.0
topic_geometry	Number of Sub-topics Covered - Geometric Concepts	990	3.15	5.52	0.0	17.0
topic_operation	Number of Sub-topics Covered - Operations	989	2.95	5.38	0.0	16.0
topic_analysis	Number of Sub-topics Covered - Data Analysis/Probability/Statistics	989	3.42	5.30	0.0	15.0
cover_number	Math Content Covered - Number Sense/Properties/Relationships	989	0.35	0.48	0.0	1.0
cover_measure	Math Content Covered - Measurement	990	0.27	0.44	0.0	1.0
cover_algebra	Math Content Covered - Algebraic Concepts	990	0.40	0.49	0.0	1.0
cover_geometry	Math Content Covered - Geometric Concepts	990	0.31	0.46	0.0	1.0
cover_operation	Math Content Covered - Operations	989	0.28	0.45	0.0	1.0
cover_analysis	Math Content Covered - Data Analysis/Probability/Statistics	989	0.35	0.48	0.0	1.0
intensetopic_math	Math topic intensity (contact hours divided by number of 1st-order topics)	990	4.74	8.72	0.0	80.0
Science Topics						
topics_science	Total number of 1st-order topics covered in the activity	805	4.22	6.30	0.0	25.0
topic_nature_sc	Number of sub-topics covered - Nature of Science	805	1.20	1.70	0.0	5.0
topic_sc_tech	Number of sub-topics covered - Science and Technology	805	0.77	1.13	0.0	3.0
topic_health_env	Number of sub-topics covered - Science, Health and Environment	805	0.72	1.38	0.0	4.0
topic_measure_cal	Number of sub-topics covered - Measurement and Calculation in Science	805	2.59	4.21	0.0	12.0
topic_compo_live	Number of sub-topics covered - Components of Living Systems	804	1.13	2.47	0.0	7.0
topic_botany	Number of sub-topics covered - Botany	804	0.66	1.76	0.0	6.0
topic_animal_bio	Number of sub-topics covered - Animal Biology	804	0.97	2.50	0.0	8.0
topic_human_bio	Number of sub-topics covered - Human Biology	804	0.93	2.46	0.0	8.0
topic_ecology	Number of sub-topics covered - Ecology	804	0.71	1.80	0.0	6.0
topic_energy	Number of sub-topics covered - Energy	803	1.09	2.31	0.0	7.0
topic_motion_force	Number of sub-topics covered - Motion and Forces	803	1.03	2.49	0.0	8.0
topic_waves	Number of sub-topics covered - Characteristics and Behavior of Waves	803	0.33	0.89	0.0	3.0
topic_kinetics	Number of sub-topics covered - Kinetics	803	0.31	0.86	0.0	3.0
topic_matter	Number of sub-topics covered - Properties of Matter	803	0.74	1.81	0.0	6.0
topic_earth	Number of sub-topics covered - Earth Systems	803	1.31	2.91	0.0	9.0
topic_elem_period	Number of sub-topics covered - Elements and the Periodic System	802	0.39	1.10	0.0	4.0
topic_chemical_form	Number of sub-topics covered - Chemical Formulas and Reactions	801	0.48	1.38	0.0	5.0
topic_acid_base	Number of sub-topics covered - Acids, Bases, and Salts	801	0.55	1.65	0.0	6.0
topic_envi_chem	Number of sub-topics covered - Environmental Chemistry	801	0.47	1.42	0.0	5.0
topic_nuclear_chem	Number of sub-topics covered - Nuclear Chemistry	801	0.31	1.05	0.0	4.0
cover_nature_sc	Science Content Covered - Nature of Science	805	0.38	0.48	0.0	1.0

Appendix D1. Descriptive Statistics for PDAL Variables: Based on Monthly Log Level Data (N=1,797)

Variable	*Description*	*N*	*Mean*	*SD*	*Min*	*Max*
cover_sc_tech	Science Content Covered - Science and Technology	805	0.36	0.48	0.0	1.0
cover_health_env	Science Content Covered - Science, Health and Environment	805	0.26	0.44	0.0	1.0
cover_measure_cal	Science Content Covered - Measurement and Calculation in Science	805	0.34	0.47	0.0	1.0
cover_compo_live	Science Content Covered - Components of Living Systems	804	0.19	0.39	0.0	1.0
cover_botany	Science Content Covered - Botany	804	0.14	0.35	0.0	1.0
cover_animal_bio	Science Content Covered - Animal Biology	804	0.14	0.35	0.0	1.0
cover_human_bio	Science Content Covered - Human Biology	804	0.13	0.34	0.0	1.0
cover_ecology	Science Content Covered - Ecology	804	0.16	0.37	0.0	1.0
cover_energy	Science Content Covered - Energy	803	0.22	0.41	0.0	1.0
cover_motion_force	Science Content Covered - Motion and Forces	803	0.17	0.38	0.0	1.0
cover_waves	Science Content Covered - Characteristics and Behavior of Waves	803	0.13	0.33	0.0	1.0
cover_kinetics	Science Content Covered - Kinetics	803	0.12	0.33	0.0	1.0
cover_matter	Science Content Covered - Properties of Matter	803	0.17	0.37	0.0	1.0
cover_earth	Science Content Covered - Earth Systems	803	0.20	0.40	0.0	1.0
cover_elem_period	Science Content Covered - Elements and the Periodic System	802	0.12	0.33	0.0	1.0
cover_chemical_form	Science Content Covered - Chemical Formulas and Reactions	801	0.12	0.32	0.0	1.0
cover_acid_base	Science Content Covered - Acids, Bases, and Salts	801	0.11	0.31	0.0	1.0
cover_envi_chem	Science Content Covered - Environmental Chemistry	801	0.11	0.31	0.0	1.0
cover_nuclear_chem	Science Content Covered - Nuclear Chemistry	801	0.09	0.28	0.0	1.0
intensetopic_science	Science topic intensity (contact hours divided by number of 1st-order topics)	805	4.84	9.15	0.0	80.0
Math Instructional Activities (dummy variables)						
IA1_math	Number of reported 1st-order instructional activities (IA1)	986	2.85	1.82	0.0	5.0
Problem_Common	Common Math Problem-Solving	693	0.67	0.38	0.0	1.0
Problem_Extended	Extended Math Problem-Solving	692	0.39	0.41	0.0	1.0
M_Perform_Procedure	Cognitive Demands: Perform Procedures	823	0.48	0.34	0.0	1.0
M_Make_Connection	Cognitive Demands: Make Connections	693	0.62	0.35	0.0	1.0
Science Instructional Activities (dummy variables)						
IA1_science	Number of reported 1st-order instructional activities	797	2.86	1.89	0.0	5.0
Lab_Work	Laboratory-based Science Work	511	0.70	0.34	0.0	1.0
Info_Collect	Science Data/Information Collection	519	0.72	0.37	0.0	1.0
S_Perform_Procedure	Cognitive Demands: Perform Procedures	602	0.65	0.36	0.0	1.0
S_Make_Connection	Cognitive Demands: Make Connections	511	0.61	0.41	0.0	1.0

Appendix D2. Factors and Reliability of Professional Development Quality Constructs: Based on Monthly-log Level PDAL Data (N=1,797)

Collective Participation

Variable	***Label***	***Factor 1***
i1490_1	I participated with most or all of the teachers from my school.	0.82
i1490_2	I participated with most or all of the teachers from my department or grade level.	0.82
	alpha with all items	0.51

Active Learning

Variable	***Label***	***Factor 1***
i1488_1	Observe demonstrations of teaching techniques?	0.50
i1488_3	Lead group discussions?	0.70
i1488_5	Develop curricula or lesson plans, which other participants or the activity leader reviewed?	0.75
i1488_6	Review student work or score assessments?	0.66
i1488_7	Develop assessments or tasks as part of a formal professional development activity?	0.78
i1488_8	Practice what you learned and receive feedback as part of a professional development activity	0.73
i1488_9	Receive coaching or mentoring in the classroom?	0.61
i1488_10	Give a lecture or presentation to colleagues?	0.69
	alpha with all items	0.83

Coherence

Variable	***Label***	***Factor 1***
i1489_1	Designed to support the school-wide improvement plan adopted by your school?	0.73
i1489_2	Consistent with your department or grade level plan to improve teaching?	0.85
i1489_3	Consistent with your own goals for your professional development?	0.82
i1489_4	Based explicitly on what you had learned in earlier professional development activities?	0.77
i1489_5	Followed up with related activities that built upon what you learned as part of the activity?	0.82
	alpha with all items	0.85

Appendix D3. Descriptive Statistics for PDAL Variables: Based on Teacher-level Data (N=273)

Variable	*Description*	*N*	*Mean*	*SD*	*Min*	*Max*
Activity Duration, Contact Hours, and Span						
MeanDur	Duration (Mean)	273	1.85	0.93	0	4
MeanDDur	Mean of Activity Duration dummy variable: 0=one day or less, 1= 2-4 days or longer	273	0.58	0.36	0	1
SumHours	Total Contact Hours	273	101.14	123.39	1.0	1060.0
MeanHours	Mean Contact Hours	273	16.89	15.78	1.0	105.0
Act_mo_N	Average number of months	273	2.16	1.79	1.0	11.2
Act_Span		273	2.76	2.44	1.0	14.0
Act_Consecutive		223	0.67	0.40	0.0	1.0
meanAct_Hour307	Mean Activity Contact Hour during July 2003	150	37.04	29.60	1.0	150.0
meanAct_Hour308	Mean Activity Contact Hour during August 2003	150	14.85	16.23	1.0	80.0
meanAct_Hour309	Mean Activity Contact Hour during September 2003	117	13.71	19.99	1.0	160.0
meanAct_Hour310	Mean Activity Contact Hour during October 2003	148	12.62	17.10	1.0	160.0
meanAct_Hour311	Mean Activity Contact Hour during November 2003	117	12.39	18.52	1.0	160.0
meanAct_Hour312	Mean Activity Contact Hour during December 2003	96	10.66	16.23	1.0	140.0
meanAct_Hour401	Mean Activity Contact Hour during January 2004	98	9.69	17.26	1.0	160.0
meanAct_Hour402	Mean Activity Contact Hour during February 2004	101	11.46	12.92	1.0	80.0
meanAct_Hour403	Mean Activity Contact Hour during March 2004	96	11.12	11.09	1.0	60.0
meanAct_Hour404	Mean Activity Contact Hour during April 2004	62	13.25	13.06	1.5	70.0
meanAct_Hour405	Mean Activity Contact Hour during May 2004	74	12.38	10.19	2.0	60.0
meanAct_Hour406	Mean Activity Contact Hour during June 2004	49	27.00	20.35	1.0	80.0
meanAct_Hour407	Mean Activity Contact Hour during July 2004	49	31.72	19.58	3.0	80.0
meanAct_Hour408	Mean Activity Contact Hour during August 2004	25	23.01	16.57	2.5	60.0
sumAct_Hour307	Sum Activity Contact Hour during July 2003	150	49.19	40.50	1.0	180.0
sumAct_Hour308	Sum Activity Contact Hour during August 2003	150	19.84	19.99	1.0	104.0
sumAct_Hour309	Sum Activity Contact Hour during September 2003	117	16.98	22.13	1.0	160.0
sumAct_Hour310	Sum Activity Contact Hour during October 2003	148	16.07	18.04	1.0	160.0
sumAct_Hour311	Sum Activity Contact Hour during November 2003	117	14.57	19.46	1.0	160.0
sumAct_Hour312	Sum Activity Contact Hour during December 2003	96	12.66	16.48	1.0	140.0
sumAct_Hour401	Sum Activity Contact Hour during January 2004	98	11.37	17.42	1.0	160.0
sumAct_Hour402	Sum Activity Contact Hour during February 2004	101	14.88	15.75	1.0	80.0
sumAct_Hour403	Sum Activity Contact Hour during March 2004	96	14.03	14.12	1.0	80.0
sumAct_Hour404	Sum Activity Contact Hour during April 2004	62	16.56	16.49	2.0	80.0
sumAct_Hour405	Sum Activity Contact Hour during May 2004	74	15.26	12.92	2.0	62.0
sumAct_Hour406	Sum Activity Contact Hour during June 2004	49	29.90	21.54	1.0	80.0
sumAct_Hour407	Sum Activity Contact Hour during July 2004	49	35.87	21.96	3.0	82.0
sumAct_Hour408	Sum Activity Contact Hour during August 2004	25	25.16	16.95	2.5	60.0

Appendix D3. Descriptive Statistics for PDAL Variables: Based on Teacher-level Data (N=273)

Variable	*Description*	*N*	*Mean*	*SD*	*Min*	*Max*
PD Quality Measures						
ActiveLearn	Active learning (mean score): 0=never, 1=rarely, 2=sometimes, 3=often	270	1.14	0.60	0.0	3.0
Coherence	Coherence (mean score): 0=never, 1=rarely, 2=sometimes, 3=often	268	2.27	0.50	0.5	3.0
Collective	Collective participation at a given month (sum score): On the scale of 0 - 2: number of postive response to two collective participation items	269	0.72	0.58	0.0	2.0
CollectiveSum	Overall collective participation (sum score)	269	1.28	0.78	0.0	2.0
Content Focus Measures						
Purpose of PD						
Purp_Subject	Strengthening subject matter knowledge	262	0.75	0.31	0.0	1.0
Math Topics						
topics_math	Total number of 1st-order topics covered in the activity	151	2.27	1.53	0.0	6.0
intensetopic_math	Math topic intensity (contact hours divided by number of 1st-order topics)	151	5.41	8.55	0.0	80.0
Math Instructional Activities						
Problem_Common	Common math exercise/problem-solving: estimate, predict, apply, analyze, infer	139	0.67	0.26	0.0	1.0
Problem_Extended	Extended problem-solving	139	0.38	0.30	0.0	1.0
M_Perform_Procedure	Perform procedures (math)	142	0.49	0.24	0.0	1.0
M_Make_Connection	Make connections (math)	139	0.62	0.24	0.0	1.0
IA1_math	Number of broad instructional activities focused	151	3.02	1.29	0.0	5.0
IA2_math	Number of specific instructional strategies focused within broad instructional activities covered	143	13.64	7.48	0.0	35.0
Science Topics						
topics_science	Total number of 1st-order topics covered in the activity	125	5.00	4.28	0.0	24.5
intensetopic_science	Science topic intensity (contact hours divided by number of 1st-order topics)	125	5.06	6.24	0.0	36.3
Science Instructional Activities						
Lab_Work	Lab-based activities	111	0.71	0.25	0.0	1.0
Info_Collect	Collecting science data/info outside lab	112	0.70	0.27	0.0	1.0
S_Perform_Procedure	Perform procedures (science)	114	0.66	0.24	0.0	1.0
S_Make_Connection	Make connections (science)	111	0.62	0.30	0.0	1.0
IA1_science	Number of broad instructional activities focused	122	3.00	1.28	0.0	5.0
IA2_science	Number of specific instructional strategies focused within broad instructional activities covered	119	14.80	8.20	0.0	34.0

Appendix D4. Factors and Reliability of Professional Development Quality Constructs: Based on Teacher-level PDAL Data (N=273)

Collective Participation In a Given Month

Variable	*Label*	*Factor 1*
i1490_1	I participated with most or all of the teachers from my school.	0.83
i1490_2	I participated with most or all of the teachers from my department or grade level.	0.83
	alpha with all items	0.54

Overall Collective Participation

Variable	*Label*	*Factor 1*
collect_sch	I participated with most or all of the teachers from my school.	0.84
collect_dept	I participated with most or all of the teachers from my department or grade level.	0.84
	alpha with all items	0.60

Active Learning

Variable	*Label*	*Factor 1*	*Factor 2*
i1488_1	Observe demonstrations of teaching techniques?	-0.02	0.86
i1488_3	Lead group discussions?	0.51	0.56
i1488_5	Develop curricula or lesson plans, which other participants or the activity leader reviewed?	0.80	0.22
i1488_6	Review student work or score assessments?	0.83	0.05
i1488_7	Develop assessments or tasks as part of a formal professional development activity?	0.84	0.23
i1488_8	Practice what you learned and receive feedback as part of a professional development activit	0.50	0.57
i1488_9	Receive coaching or mentoring in the classroom?	0.21	0.68
i1488_10	Give a lecture or presentation to colleagues?	0.53	0.50
	alpha with all items	0.85	

Coherence

Variable	*Label*	*Factor 1*
i1489_1	Designed to support the school-wide improvement plan adopted by your school?	0.73
i1489_2	Consistent with your department or grade level plan to improve teaching?	0.86
i1489_3	Consistent with your own goals for your professional development?	0.84
i1489_4	Based explicitly on what you had learned in earlier professional development activities?	0.69
i1489_5	Followed up with related activities that built upon what you learned as part of the activity?	0.82
	alpha with all items	0.83

Appendix D4. Factors and Reliability of Professional Development Quality Constructs: Based on Teacher-level PDAL Data (N=273)

Common Math Problem-Solving

Variable	***Label***	***Factor 1***
i1691_3	Students Work Individually - Explain their reasoning or thinking in solving a problem, using several sentences orally or in writing	0.58
i1691_4	Students Work Individually - Apply mathematical concepts to real-world problems	0.72
i1691_5	Students Work Individually - Make estimates, predictions or hypotheses	0.86
i1691_6	Students Work Individually - Analyze data to make inferences or draw conclusions	0.86
i2160_3	Students Work in Pairs or Small Groups - Talk about their reasoning or thinking in solving a problem	0.79
i2160_4	Students Work in Pairs or Small Groups - Apply mathematical concepts to real-world problems	0.80
i2160_5	Students Work in Pairs or Small Groups - Make estimates, predictions or hypotheses	0.89
i2160_6	Students Work in Pairs or Small Groups - Analyze data to make inferences or draw conclusions	0.85
	alpha with all items	0.91

Extended Math Problem-Solving

Variable	***Label***	***Factor 1***	***Factor 2***
i1691_7	Students Work Individually - Work on a problem that takes at least 45 minutes to solve	0.94	0.16
i1691_8	Students Work Individually - Complete or conduct proofs or demonstrations of their mathematical reasoning	0.23	0.89
i2160_7	Students Work in Pairs or Small Groups - Work on a problem that takes at least 45 minutes to solve	0.91	0.24
i2160_8	Students Work in Pairs or Small Groups - Complete or conduct proofs or demonstrations of their mathematical reasoning	0.16	0.91
	alpha with all items	0.80	

Appendix D4. Factors and Reliability of Professional Development Quality Constructs: Based on Teacher-level PDAL Data (N=273)

Laboratory-based Work

Variable	*Label*	*Factor 1*	
i2085_1	Lab Activities, Investigations, or Experiments - Make educated guesses, predictions, or hypotheses	0.55	0.55
i2085_2	Lab Activities, Investigations, or Experiments - Follow step-by-step directions	0.64	0.10
i2085_3	Lab Activities, Investigations, or Experiments - Use science equipment or measuring tools	0.70	0.12
i2085_4	Lab Activities, Investigations, or Experiments - Collect data	0.70	0.29
i2085_5	Lab Activities, Investigations, or Experiments - Change a variable in an experiment to test a hypothesis	0.25	0.77
i2085_6	Lab Activities, Investigations, or Experiments - Organize and display information in tables or graphs	0.24	0.69
i2085_7	Lab Activities, Investigations, or Experiments - Analyze and interpret science data	0.66	0.45
i2085_8	Lab Activities, Investigations, or Experiments - Design their own investigation or experiment to solve a scientific question	0.12	0.83
i2085_9	Lab Activities, Investigations, or Experiments - Make observations/classifications	0.80	0.29
	alpha with all items	0.86	

Collecting Science Data/Information Outside the Lab

Variable	*Label*	*Factor 1*
i2087_1	Collecting Science Data or Information - Have class discussions about the data	0.87
i2087_2	Collecting Science Data or Information - Organize and display the information in tables or graphs	0.69
i2087_3	Collecting Science Data or Information - Make a prediction based on the data	0.67
i2087_4	Collecting Science Data or Information - Analyze and interpret the information or data, orally or in writing	0.86
i2087_7	Collecting Science Data or Information - Make a presentation to the class on the data, analysis or interpretation	0.59
	alpha with all items	0.78

Appendix D5. Quality of Math Professional Development Activities Compared by MSP Site and Treatment Status: Based on Teacher-level PDAL Data (N = 148)

Variable	Category	N[1]	% Duration >2-4 days	Mean contact hours	Mean activity span	Active learning	Coherence	Collective participation (Overall)	Collective participation (At a given month)
MSP Site			***	**	***	ns	*	ns	ns
	Brockport	37	0.67	22.5	3.3		2.4		
	Cleveland	49	0.73	13.9	3.7		2.2		
	Corpus Christi	34	0.40	14.0	2.1		2.3		
	El Paso	28	0.46	11.9	1.5		2.0		
Treatment			**	**	**	ns	ns	ns	*
	Comparison	45	0.46	11.2	2.1				0.86
	Treatment	103	0.64	17.7	3.1				0.62
MSP_Site*Treatment			ns	*	ns	ns	ns	ns	ns
	Brockport-Comparison	12		10.7					
	Brockport-Treatment	25		28.2					
	Cleveland-Comparison	14		11.3					
	Cleveland-Treatment	35		15.0					
	Corpus Christi-Comparison	6		18.2					
	Corpus Christi-Treatment	28		13.1					
	El Paso-Comparison	13		8.4					
	El Paso-Treatment	15		14.9					

Note: [1] N may vary due to variable-wise missing data.
ns denotes non-significance, *<.05, **<.01, and ***<.001.

Appendix D5. Quality of Math Professional Development Activities Compared by MSP Site and Treatment Status: Based on Teacher-level PDAL Data (N = 148)

Variable	Category	N[1]	Strengthen subject matter knowledge	Number of topical areas focused	Topic intensity	Common math problem solving	Extended math problem solving	Perform procedures	Make connections	Number of instructional activities focused
MSP Site			ns	*	ns	*	ns	ns	ns	ns
	Brockport	37		1.9		0.58				
	Cleveland	49		2.2		0.64				
	Corpus Christi	34		2.9		0.76				
	El Paso	28		2.0		0.74				
Treatment			ns	ns	*	ns	ns	ns	ns	ns
	Comparison	45			2.5					
	Treatment	103			6.7					
MSP_Site*Treatment			ns	ns	ns	ns	ns	ns	ns	ns
	Brockport-Comparison	12								
	Brockport-Treatment	25								
	Cleveland-Comparison	14								
	Cleveland-Treatment	35								
	Corpus Christi-Comparison	6								
	Corpus Christi-Treatment	28								
	El Paso-Comparison	13								
	El Paso-Treatment	15								

Note: [1] N may vary due to variable-wise m
ns denotes non-significance, *<.05,

Appendix D6. Quality of Science Professional Development Activities Compared by MSP Site and Treatment Status: Based on Teacher-level PDAL Data (N = 125)

Variable	Category	N[1]	% Duration >2-4 days	Mean contact hours	Mean activity span	Active learning	Coherence	Collective participation (Overall)	Collective participation (At a given month)
MSP Site			***	ns	***	ns	ns	ns	ns
	Brockport	18	0.69		2.2				
	Cleveland	63	0.66		3.6				
	Corpus Christi	23	0.39		1.6				
	El Paso	21	0.40		1.7				
Treatment			*	ns	*	ns	ns	ns	ns
	Comparison	54	0.48		2.2				
	Treatment	71	0.64		3.1				
MSP_Site*Treatment			ns	ns	ns	ns	ns	ns	ns
	Brockport-Comparison	8							
	Brockport-Treatment	10							
	Cleveland-Comparison	15							
	Cleveland-Treatment	48							
	Corpus Christi-Comparison	22							
	Corpus Christi-Treatment	1							
	El Paso-Comparison	9							
	El Paso-Treatment	12							

Note: [1] N may vary due to variable-wise missing data.
ns denotes non-significance, *<.05, **<.01, and ***<.001.

Appendix D6. Quality of Science Professional Development Activities Compared by MSP Site and Treatment Status: Based on Teacher-level PDAL Data (N = 125)

Variable	Category	N[1]	Strengthen subject matter knowledge	Number of topical areas focused	Topic intensity	Lab-based work	Science data/ information collection	Peform procedures	Make connections	Number of instructional activities focused
MSP Site			ns	ns	**	*	**	*	*	ns
	Brockport	18			9.4	0.55	0.53	0.53	0.48	
	Cleveland	63			4.9	0.77	0.76	0.71	0.69	
	Corpus Christi	23			3.6	0.71	0.70	0.64	0.57	
	El Paso	21			3.5	0.67	0.64	0.60	0.54	
Treatment			***	ns	*	**	***	*	**	***
	Comparison	54	0.61		3.6	0.64	0.61	0.60	0.52	2.5
	Treatment	71	0.81		6.2	0.76	0.77	0.69	0.68	3.3
MSP_Site*Treatment			ns	*	*	ns	ns	ns	ns	ns
	Brockport-Comparison	8		7.0	3.6					
	Brockport-Treatment	10		4.5	14.0					
	Cleveland-Comparison	15		5.3	4.0					
	Cleveland-Treatment	48		4.4	5.2					
	Corpus Christi-Comparison	22		5.0	3.7					
	Corpus Christi-Treatment	1		10.7	0.9					
	El Paso-Comparison	9		3.0	2.9					
	El Paso-Treatment	12		7.1	3.9					

Note: [1] N may vary due to variable-wise m
ns denotes non-significance, *<.05,

Appendix E1. Amount of Teachers' Instructional Activity Using Technology (Based on Year 1 SEC Data): By Subject Taught and By MSP Program Treatment Status

	Comparison			Treatment				
Mathematics	*Mean* [1]	*SD*	*N*	*Mean* [1]	*SD*	*N*	*F-value*	*p* [2]
How much of the total math instructional time do students in the target class use computers, calculators, or other technology to learn math?"	3.45	1.62	19	3.05	1.34	28	0.83	ns
When students in the target class are engaged in activities that involve the use of calculators, computers, or other educational technology as part of mathematics instruction, how much time do they:								
Learn facts	2.08	1.55	19	2.02	1.74	28	0.02	ns
Practice procedures	2.63	1.50	19	2.89	1.68	28	0.30	ns
Use sensors and probes	0.53	1.29	19	0.66	1.19	28	0.14	ns
Retrieve or exchange data or information (for example, using the Internet or partnering with another class)	0.74	1.39	19	1.70	1.70	28	4.16	*
Display and analyze data	1.92	1.85	19	2.27	1.69	28	0.44	ns
Develop geometric concepts (for example, using simulations)	0.95	1.50	19	1.39	1.54	28	0.97	ns

	Comparison			Treatment				
Science	*Mean* [1]	*SD*	*N*	*Mean* [1]	*SD*	*N*	*F-value*	*p* [2]
How much of the total science instructional time do students in the target class use computers, calculators, or other technology to learn science?	2.35	1.73	17	2.29	1.44	14	0.91	ns
When students in the target class are engaged in activities that involve the use of calculators, computers, or other educational technology as part of science instruction, how much time do they:								
Learn facts	3.12	1.36	17	3.07	0.92	14	0.01	ns
Practice procedures	3.12	1.32	17	2.57	1.34	14	1.30	ns
Use sensors and probes (for example, CBL's)	1.06	1.25	17	0.21	0.58	14	5.42	*
Retrieve or exchange data or information (for example, using the Internet or partnering with another class)	1.53	1.46	17	1.79	1.58	14	0.22	ns
Display and analyze data	2.00	1.34	17	2.08	1.59	14	0.02	ns
Develop problems using simulations	1.35	1.46	17	1.57	1.40	14	0.18	ns

Note: [1] The amount of instructional activity was measured on the scale of 0=none, 1=little, 2=some, 3=moderate, 4=considerable, and 5=almost all.
[2] *ns* stands for non-signficance, * <.05, ** <.01, and *** <.001.

Appendix E2. Teachers' Professional Development Experience in the Use of Technology (Based on PDAL Data): By Subject Taught and By MSP Program Treatment Status

	Comparison			Treatment				
Mathematics	*Mean*[1]	*SD*	*N*	*Mean*[1]	*SD*	*N*	*F-value*	*p*[2]
Was an instructional topic in the "use of computers, calculators, or other technology to learn math" covered in this professional development activity?	0.64	0.34	12	0.78	0.22	25	2.29	ns
Did the professional development focus on any of the following instructional strategies for use in your classroom with your students (relating to calculators, computers, or other educational technology)?								
Learn facts	0.46	0.40	11	0.38	0.33	25	0.38	ns
Practice procedures	0.60	0.32	11	0.55	0.35	25	0.13	ns
Use sensors and probes	0.05	0.15	11	0.32	0.26	25	10.68	**
Retrieve or exchange data or information (for example, using the Internet or partnering with another class)	0.17	0.25	11	0.43	0.29	25	6.74	*
Display and analyze data	0.53	0.37	11	0.76	0.27	25	4.26	*
Develop geometric concepts (for example, using simulations)	0.11	0.20	11	0.47	0.34	25	10.96	**

	Comparison			Treatment				
Science	*Mean*[1]	*SD*	*N*	*Mean*[1]	*SD*	*N*	*F-value*	*p*[2]
Was an instructional topic in the "use of computers, calculators, or other technology to learn science" covered in this professional development activity?	0.46	0.41	8	0.71	0.32	9	1.92	ns
Did the professional development focus on any of the following instructional strategies for use in your classroom with your students (relating to calculators, computers, or other educational technology)?								
Learn facts	0.60	0.37	6	0.56	0.41	9	0.03	ns
Practice procedures	0.63	0.31	6	0.55	0.40	9	0.18	ns
Use sensors and probes (for example, CBL's)	0.07	0.10	6	0.54	0.38	9	8.68	*
Retrieve or exchange data or information (for example, using the Internet or partnering with another class)	0.72	0.34	6	0.69	0.31	9	0.03	ns
Display and analyze data	0.70	0.27	6	0.69	0.34	9	0.00	ns
Develop problems using simulations	0.10	0.17	6	0.77	0.24	9	34.67	***

Note: [1] The experience of professional development was measured on the scale of 0=no and 1=yes.
[2] *ns* stands for non-signficance, * <.05, ** <.01, and *** <.001.

Appendix F: Summary of Results of Hypothesis Tests: Math

Math	**Comparisons among MSP Program Sites**			**Treatment vs. Comparison Teachers**		
	Test of Hypothesis:			**Test of Hypothesis:**		
	1	**3**		**2**	**4**	
Cluster of Variables	**SEC1[1]**	**PDAL[2]**	**SEC2[3]**	**SEC1[1]**	**PDAL[2]**	**SEC2[3]**
Teacher/Class/School Characteristics						
Course Type	ns			ns		
Number of Students in Target Class	ns			ns		
Achievement Levels of Students(Teacher perception)	**			ns		
Number of Years in Teaching	ns			*		
Number of Years in Teaching at This School	ns			*		
Highest Degree Held	***			ns		
Relational Trust	***			ns		
Instructional Activities/Strategies						
Assessment Use	*			ns		
Instructional Influece	***			ns		
Cognitive Demands: Memorize	ns			ns		
Cognitive Demands: Perform Procedures	ns			*		
Cognitive Demands: Communicate Understanding	ns			ns		
Cognitive Demands: Conjecture, Generalize, Prove	ns			ns		
Cognitive Demands: Make Connections	ns			*		
Content of Classroom Instruction						
Instructional Alignment with Standards	***			ns		
Instructional Alignment with Assessment	*			ns		
Cognitive Demands: Memorize	ns			ns		
Cognitive Demands: Perform Procedures	ns			ns		
Cognitive Demands: Communicate Understanding	ns			ns		
Cognitive Demands: Conjecture, Generalize, Prove	*			ns		
Cognitive Demands: Make Connections	ns			ns		
Breadth of Content Coverage	***			ns		
Topic Converage: Number Sense/Properties/Relation	ns			ns		
Topic Converage: Operations	ns			ns		
Topic Converage: Measurement	ns			ns		
Topic Converage: Algebraic Concepts	ns			ns		
Topic Converage: Geometric Concepts	ns			*		
Topic Converage: Data Analysis/Probability/Statistics	ns			ns		
Topic Converage: Instructional Technology	*			ns		
Professional Development						
Frequency	ns			ns		
% Duration >2-4 days		***			**	
Mean Contact Hours	ns	**		ns	**	
Activity Span		***			**	
Active Learning	*	ns		ns	ns	
Coherence	ns	*		ns	ns	
Collective participation (Overall)	***	ns		ns	ns	
Collective participation (At a given month)		ns			*	
Strengthen subject matter knowledge		ns			ns	
Number of topical areas focused		*			ns	
Topic Intensity		ns			*	

Appendix F: Summary of Results of Hypothesis Tests: Math

	1	3		2	4	
Cluster of Variables	**SEC1[1]**	**PDAL[2]**	**SEC2[3]**	**SEC1[1]**	**PDAL[2]**	**SEC2[3]**
Common Math Problem-Solving		*			ns	
Extended Math Problem-solving		ns			ns	
Perform Procedures		ns			ns	
Make Connections		ns			ns	
Number of instructional activities focused		ns			ns	
In-depth study emphasis (single item)	***			ns		
Content Emphasis	***			ns		
Data Emphasis	ns			ns		
Student Learning Emphasis	**			ns		
Standards & Instruction Emphasis	***			ns		

Note: [1] N of math teachers who responded to SEC1 (Year 1 Survey of Enacted Curriculum) is 210.
[2] N of math teachers who completed the PDAL (Professional Development Activity Log) is 138.
[3] SEC2 measures will be available in spring of 2005.
Shaded areas represent not-applicable or non-existent measures.
ns denotes not-significance, * p<.05, ** p<.01, and *** p<.001.

Appendix F: Summary of Results of Hypothesis Tests: Science

Science	Comparisons between MSP Program Sites			Treatment vs. Comparison Teachers		
	Test of Hypothesis:			Test of Hypothesis:		
	1	3		2	4	
Cluster of Variables	SEC1[1]	PDAL[2]	SEC2[3]	SEC1[1]	PDAL[2]	SEC2[3]
Teacher/Class/School Characteristics						
Course Type	*			ns		
Number of Students in Target Class	ns			ns		
Achievement Levels of Students(Teacher perceptio	*			*		
Number of Years in Teaching	ns			ns		
Number of Years in Teaching at This School	ns			ns		
Highest Degree Held	***			ns		
Relational Trust	*			ns		
Instructional Activities/Strategies						
Assessment Use	***			ns		
Instructional Influece	ns			ns		
Cognitive Demands: Memorize	ns			ns		
Cognitive Demands: Perform Procedures	ns			*		
Cognitive Demands: Communicate Understanding	ns			ns		
Cognitive Demands: Analyze Information	ns			ns		
Cognitive Demands: Make Connections	*			ns		
Content of Classroom Instruction						
Instructional Alignment with Standards	***			ns		
Instructional Alignment with Assessment	***			ns		
Cognitive Demands: Memorize	ns			ns		
Cognitive Demands: Perform Procedures	ns			*		
Cognitive Demands: Communicate Understanding	ns			ns		
Cognitive Demands: Analyze Information	ns			*		
Cognitive Demands: Make Connections	ns			*		
Breadth of Content Coverage	ns			ns		
Topic Converage [4]	ns			ns		
Professional Development						
Frequency	*			**		
% Duration >2-4 days		***			*	
Mean Contact Hours	**	ns		***	ns	
Activity Span		***			*	
Active Learning	*	ns		**	ns	
Coherence	ns	ns		**	ns	
Collective participation (Overall)	ns	ns		ns	ns	
Collective participation (At a given month)		ns			ns	
Strengthen subject matter knowledge		ns			***	
Number of topical areas focused		ns			ns	
Topic Intensity		**			*	
Laboratory Work		*			**	
Science Data/Information Collection		**			***	
Perform Procedures		*			*	
Make Connections		*			**	
Number of instructional activities focused		ns			***	
In-depth study emphasis (single item)	ns			ns		

Appendix F: Summary of Results of Hypothesis Tests: Science

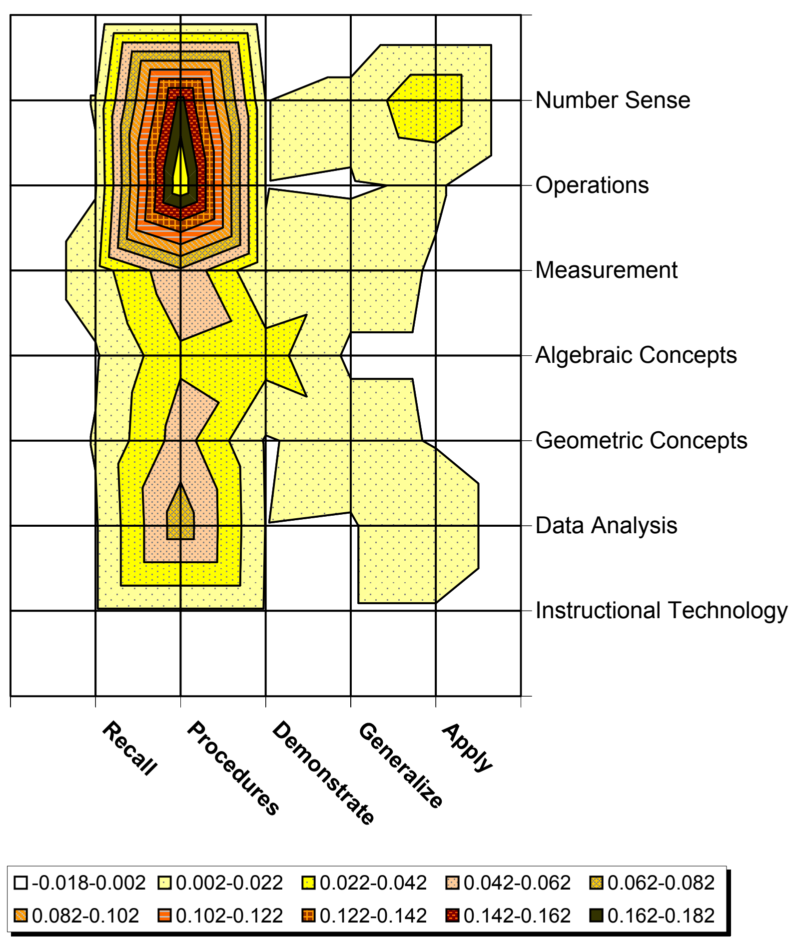
Science	**Comparisons between MSP Program Sites**				**Treatment vs. Comparison Teachers**		
	Test of Hypothesis:				**Test of Hypothesis:**		
	1	**3**			**2**	**4**	
Cluster of Variables	**SEC1[1]**	**PDAL[2]**	**SEC2[3]**		**SEC1[1]**	**PDAL[2]**	**SEC2[3]**
Content Emphasis	ns				*		
Data Emphasis	ns				ns		
Student Learning Emphasis	ns				ns		
Standards & Instruction Emphasis	ns				ns		

Note: [1] N of science teachers who responded to SEC1 (Year 1 Survey of Enacted Curriculum) is 180.
[2] N of science teachers who completed the PDAL (Professional Development Activity Log) is 112.
[3] SEC2 measures will be available in spring of 2005.
[4] Some significant effects were found in some of the middle- and high school science topics
Shaded areas represent not-applicable or non-existent measures.
ns denotes not-significance, * p<.05, ** p<.01, and *** p<.001.

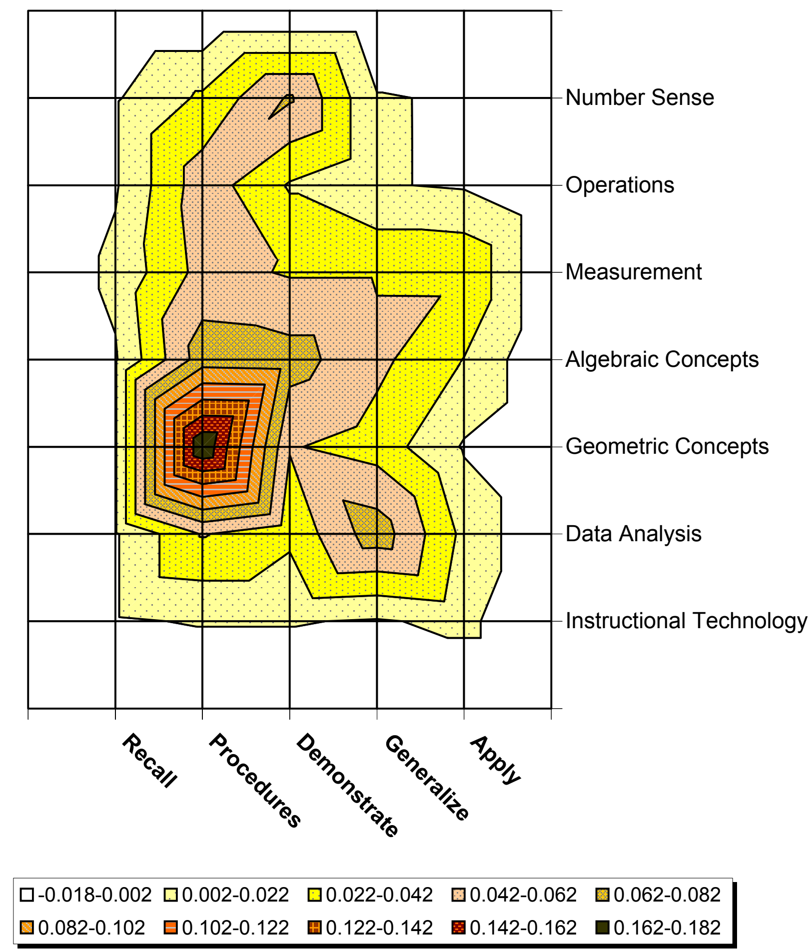
Appendix G

Alignment Index: **0.21**
Re-centered **0.35**

State I Gr. 7 Mathematics Assessment (2003)
All Content Areas

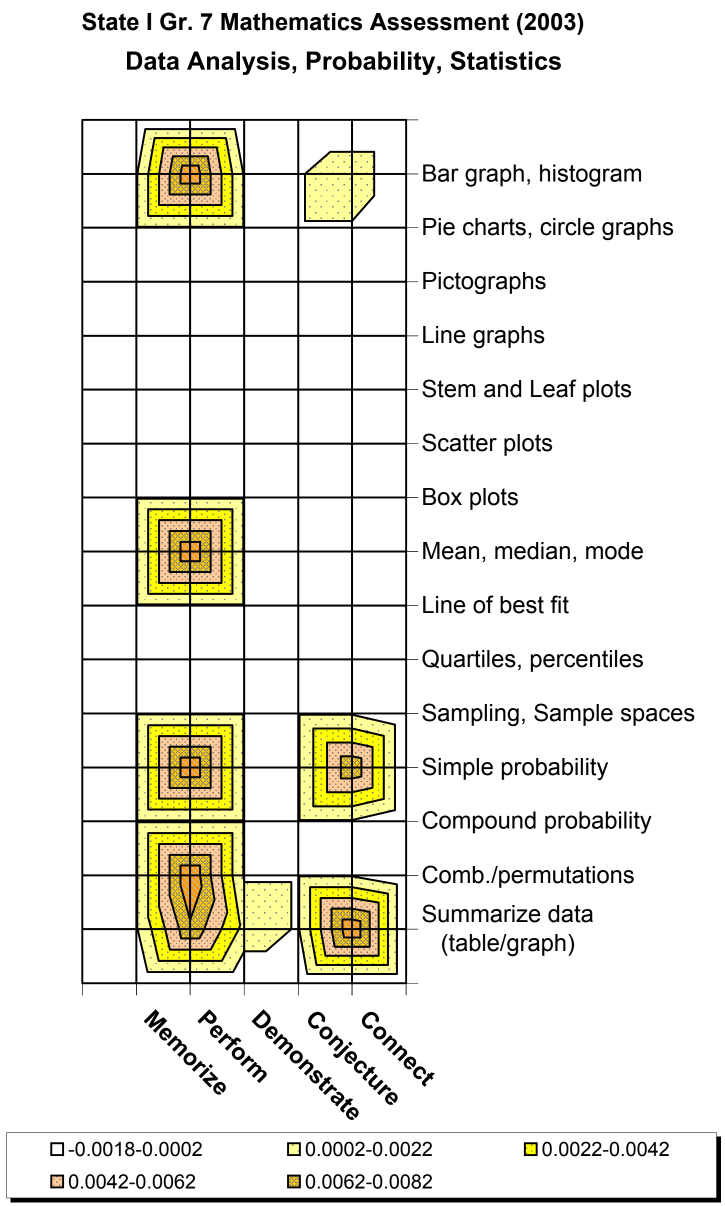


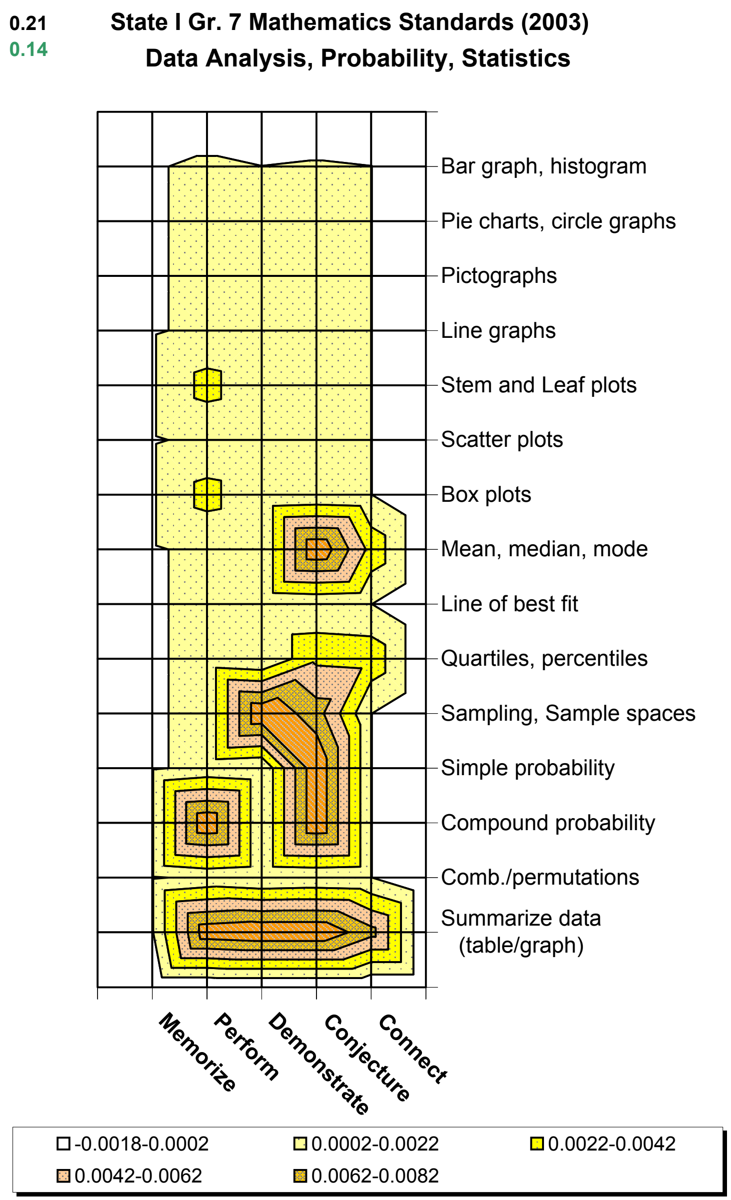
State I Gr. 7 Mathematics Standards (2003)
All Content Areas



Contour Interval = 2%
Re-centered Alignment uses aggregated data for each content area to perform calculation.

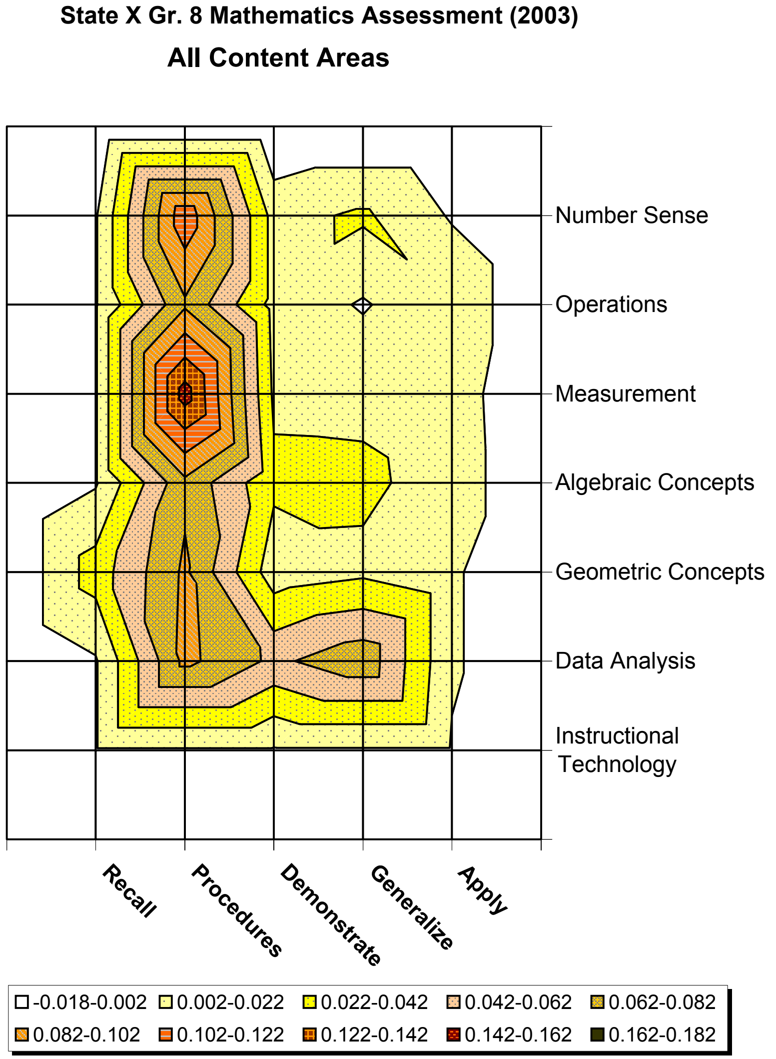
Alignment Index: 0.21
Re-Centered 0.14

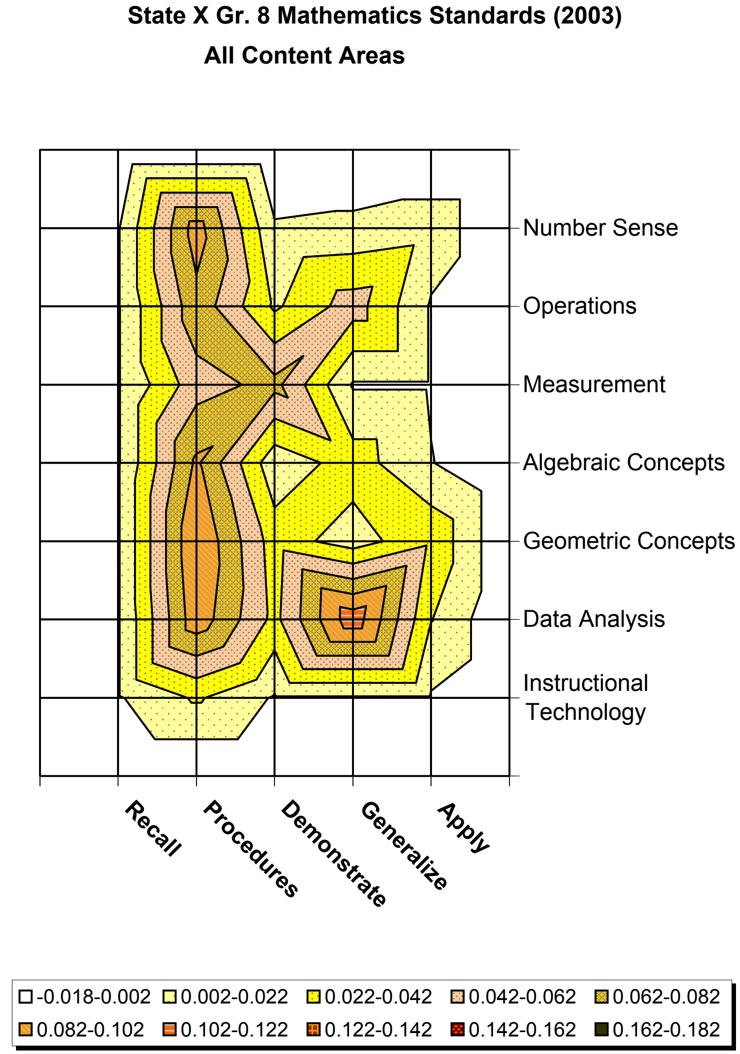




Contour Interval = 0.2%
Re-centered adjusts data to reflect this content area only.

Alignment Index: 0.37
Re-centered 0.70



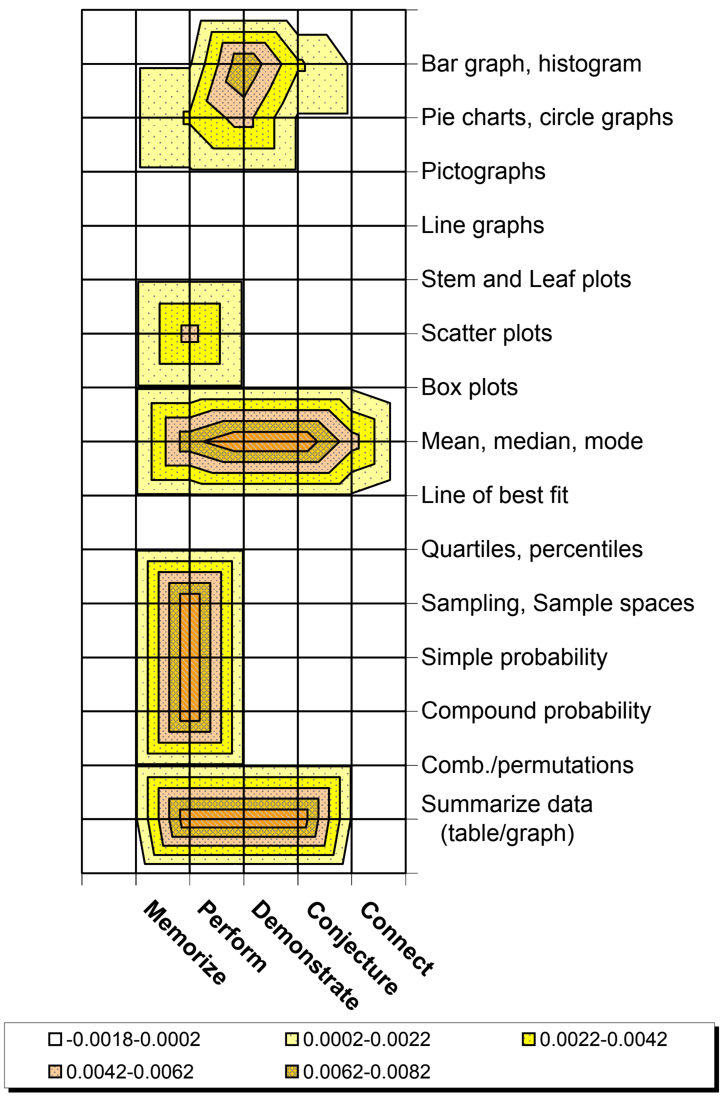


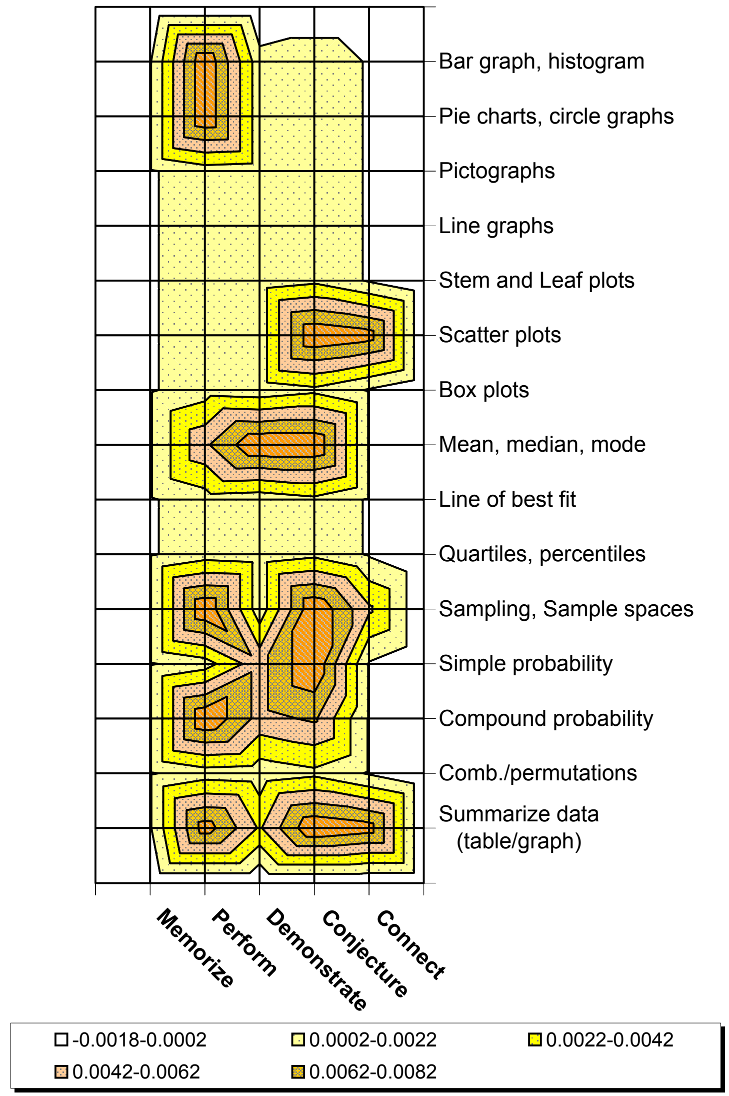
Contour Interval = 2%
Re-centered Alignment uses aggregated data for each content area to perform calculation.

State X Gr. 8 Mathematics Assessment (2003)
Data Analysis, Probability, Statistics

Alignment Index: 0.37
Re-Centered 0.41

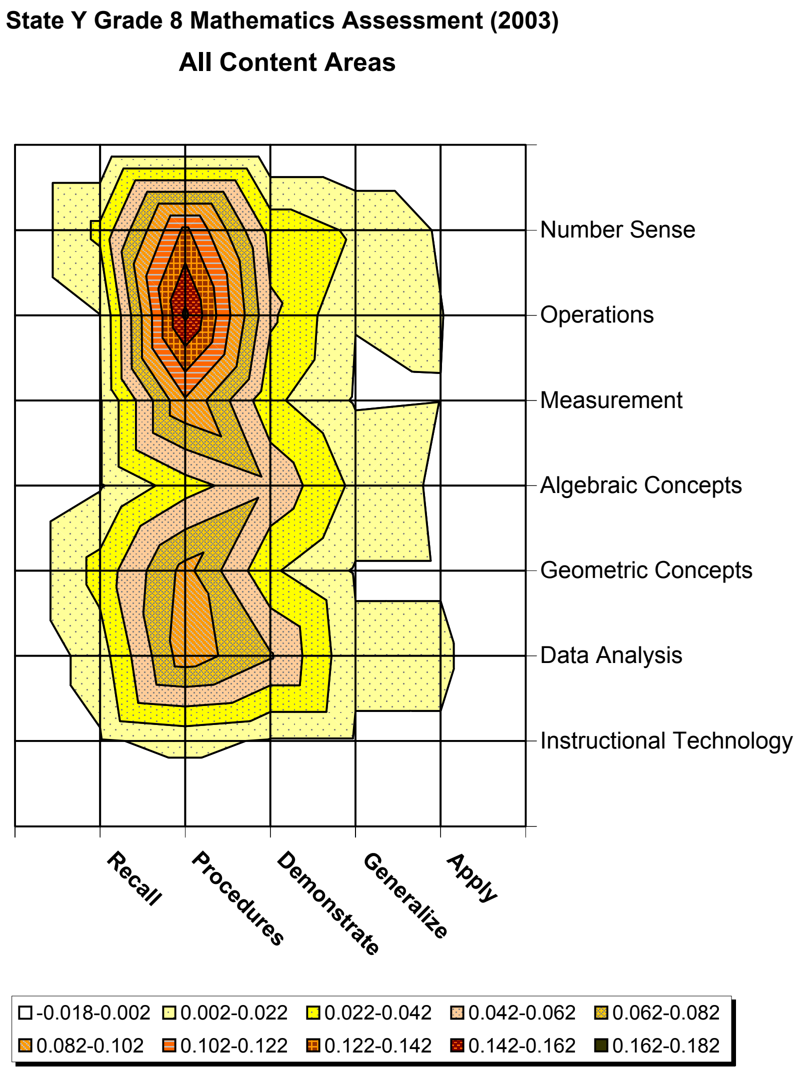
State X Gr. 8 Mathematics Standards (2003)
Data Analysis, Probability, Statistics

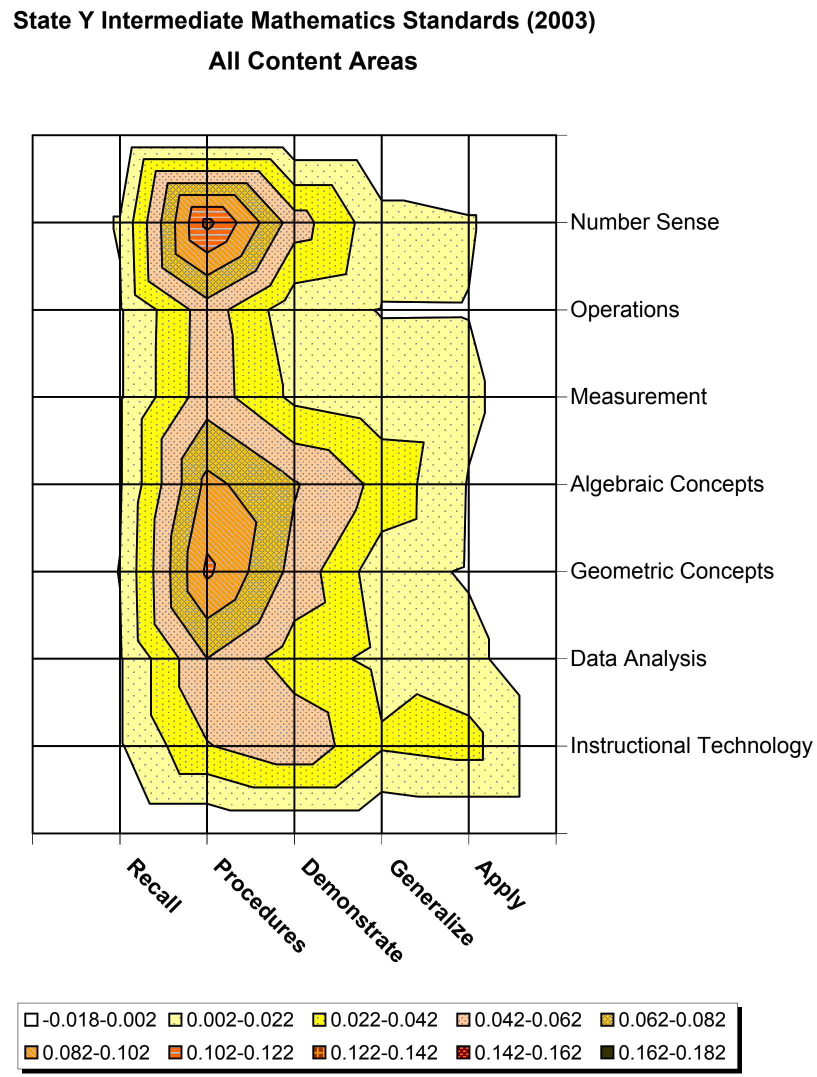




Contour Interval = 0.2%
Re-centered adjusts data to reflect this content area only.

Alignment Index: 0.39
Re-centered 0.64

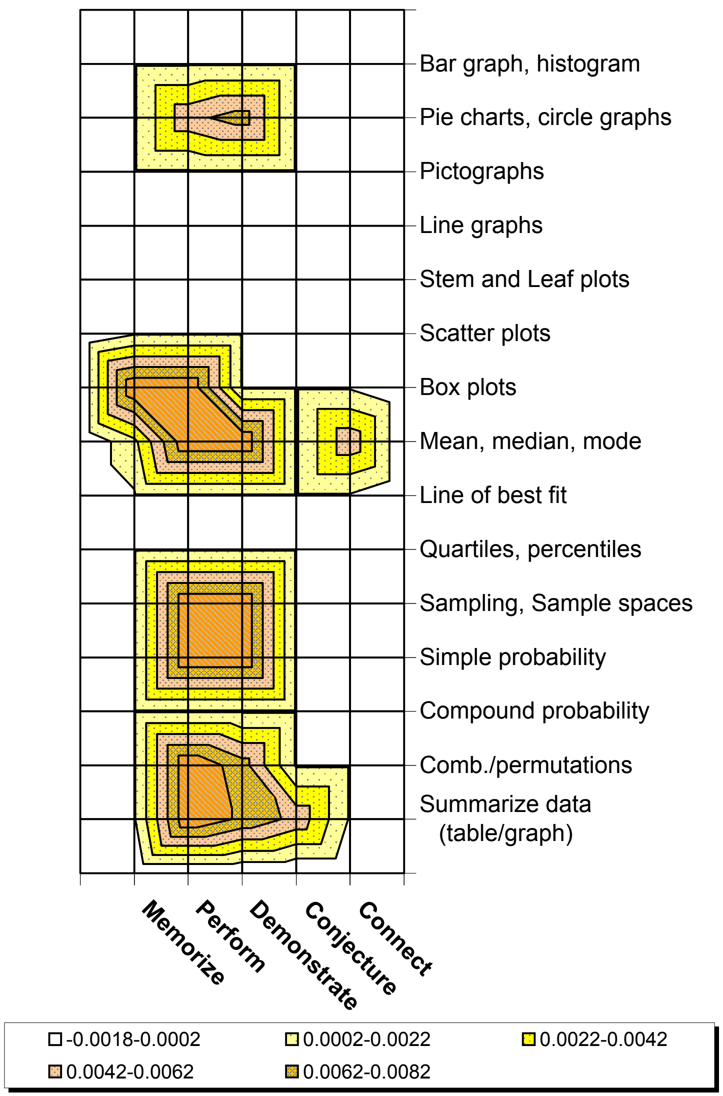




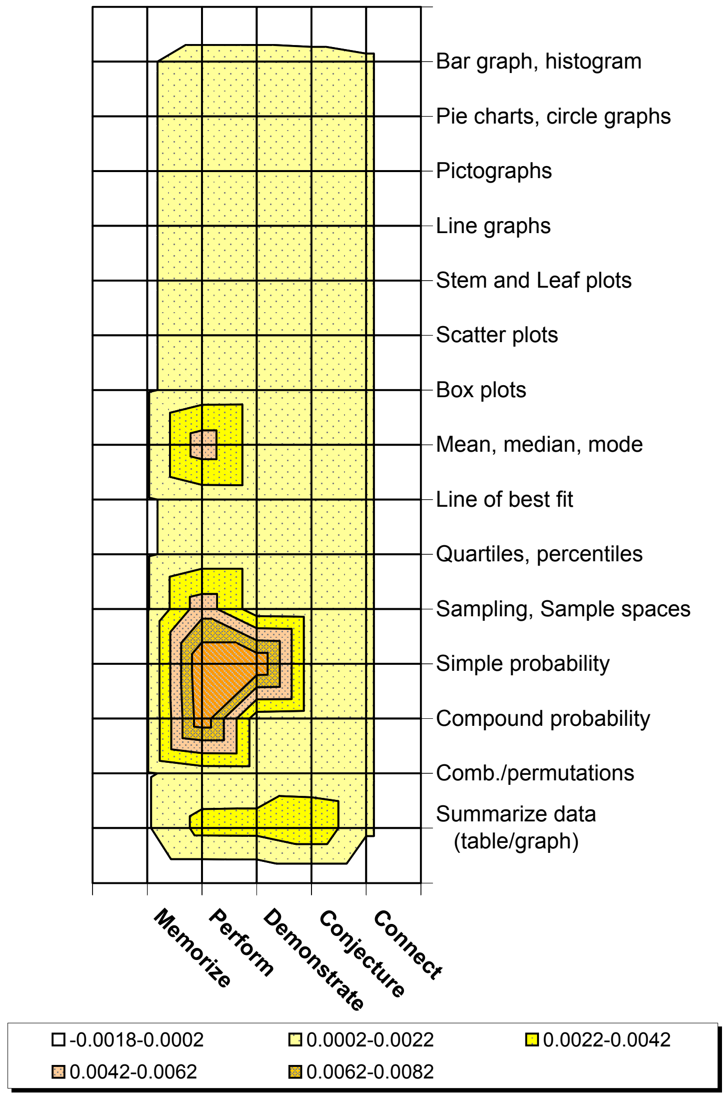
Contour Interval = 2%
Re-centered Alignment uses aggregated data for each content area to perform calculation.

State Y Grade 8 Mathematics Assessment (2003)
Data Analysis, Probability, Statistics

Alignment Index: **0.39**
Re-Centered **0.42**



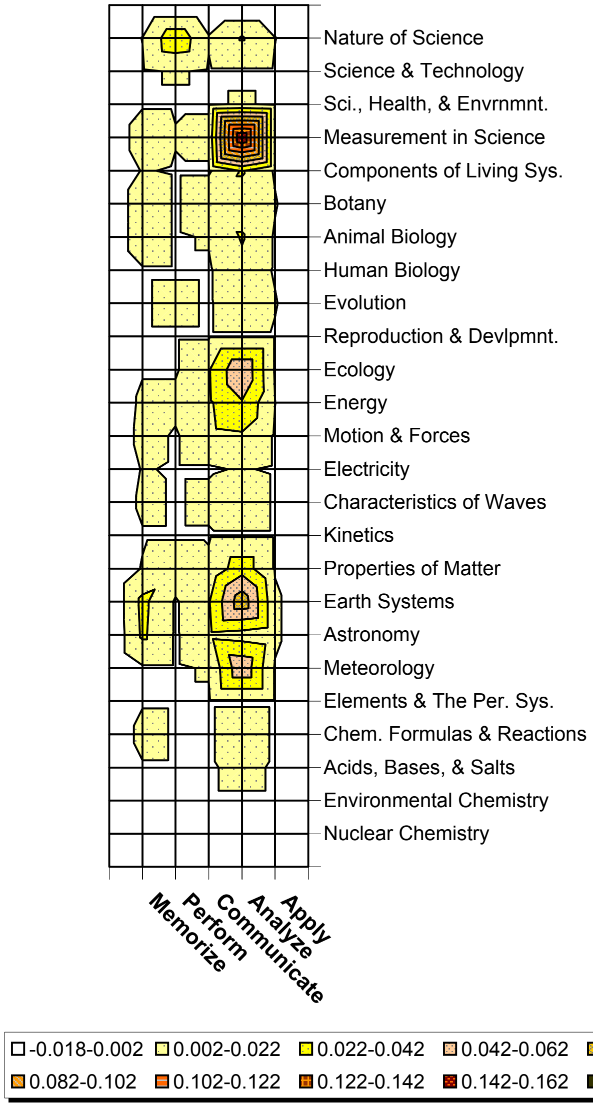
State Y Intermediate Mathematics Standards (2003)
Data Analysis, Probability, Statistics



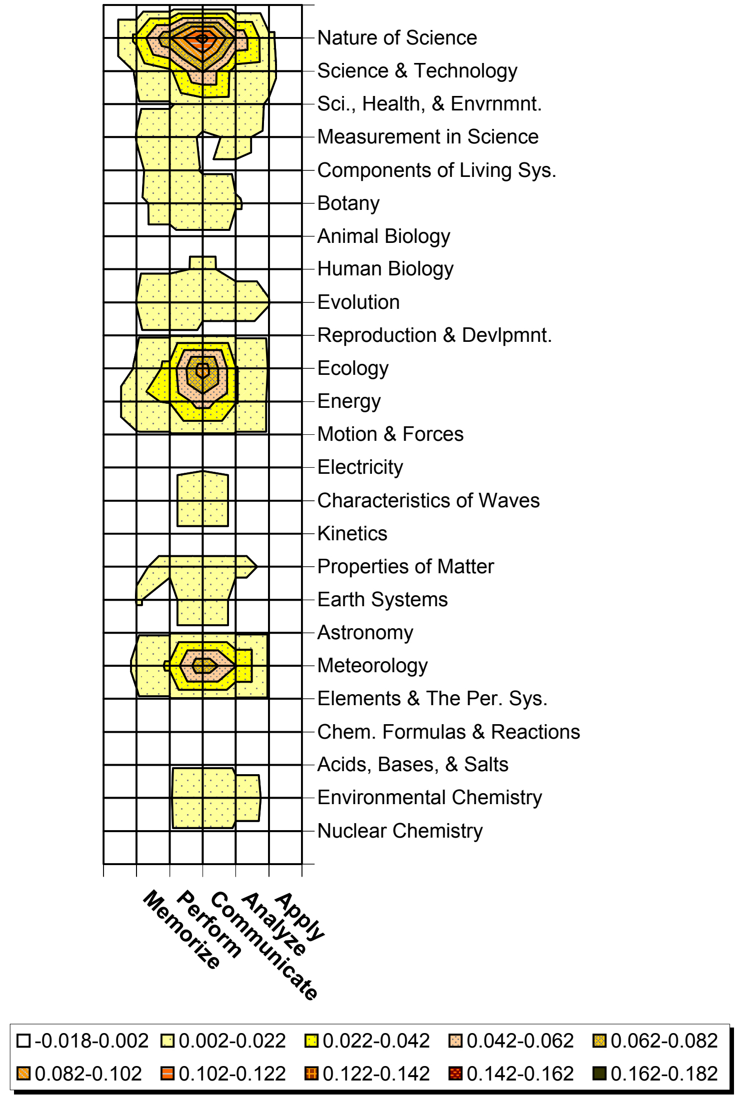
Contour Interval = 0.2%
Re-centered adjusts data to reflect this content area only.

State I Grade 7 Science Assessment (2003)
All Content Areas

Alignment Index: **0.16**
Re-centered **0.29**

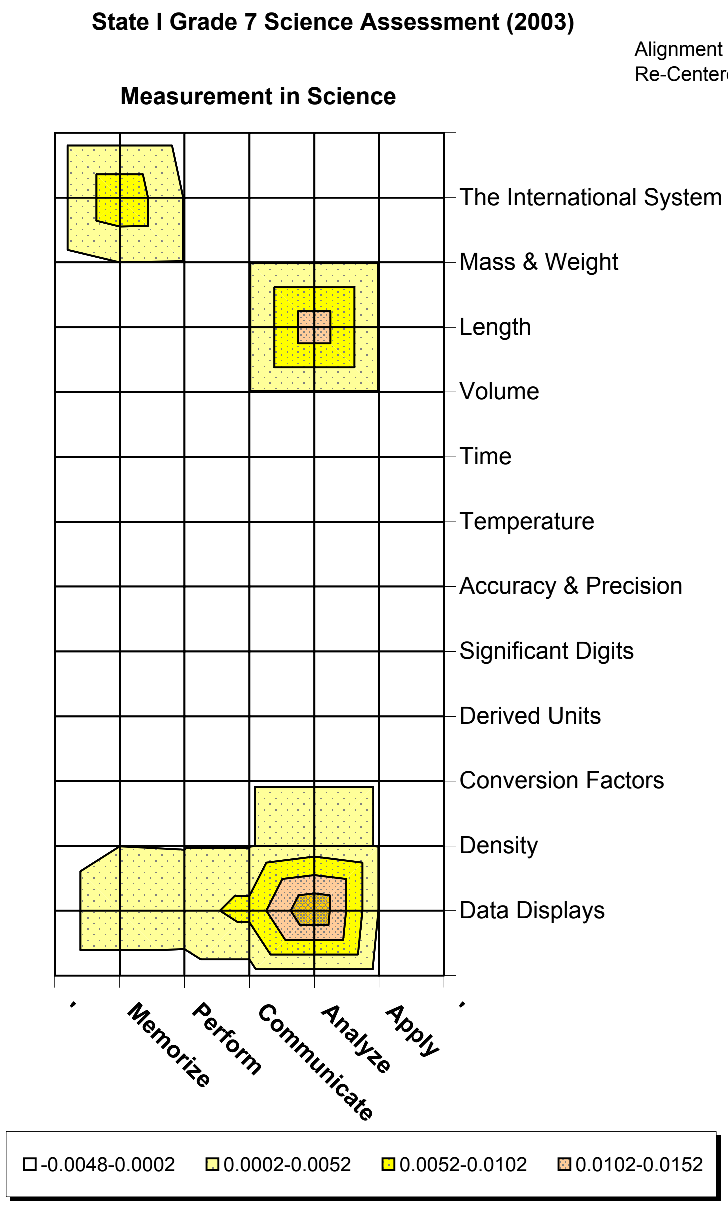


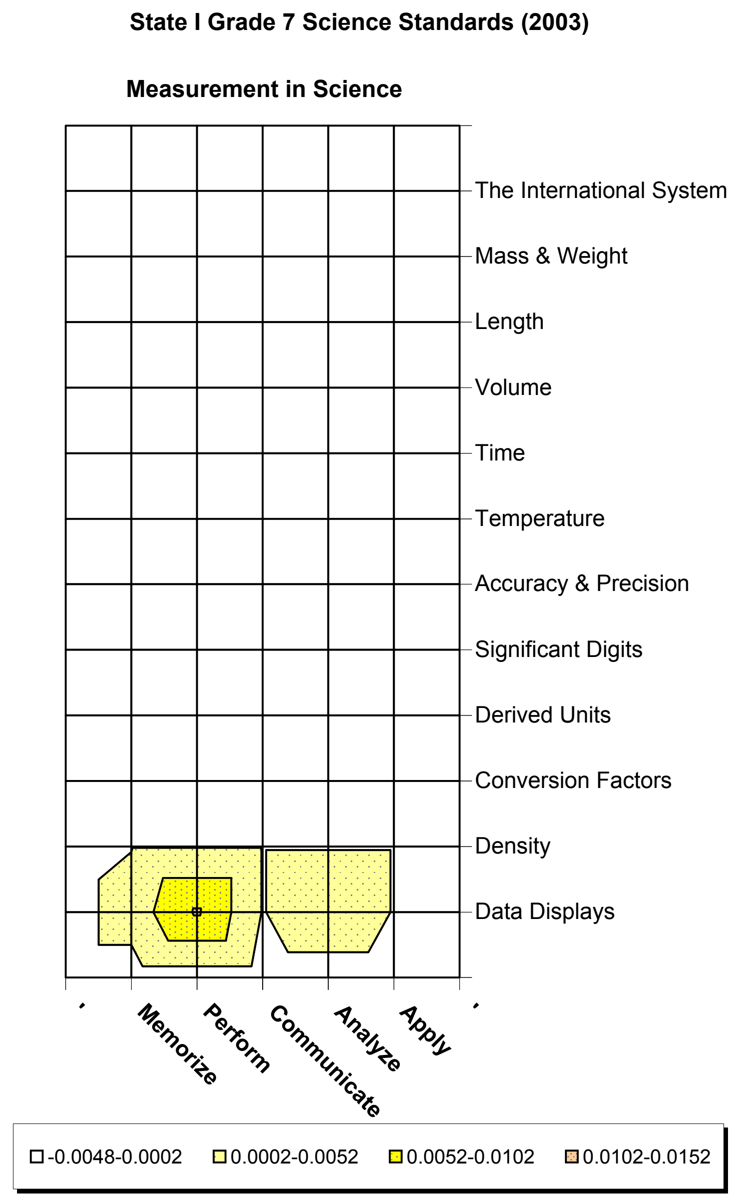
State I Grade 7 Science Standards (2003)
All Content Areas



Contour Interval = 2%
Re-centered Alignment uses aggregated data for each content area to perform calculation.

Alignment Index: 0.16
Re-Centered 0.26





Contour Interval = 0.5%
Re-centered adjusts data to reflect this content area only.