Indicators of Quality of Teacher Professional Development and Instructional Change Using Data from Surveys of Enacted Curriculum: Findings from NSF MSP-RETA Project

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Longitudinal Study of the Effects of MSP-supported Professional Development on Improving Mathematics and Science Instruction

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INDICATORS OF QUALITY OF TEACHER PROFESSIONAL DEVELOPMENT AND INSTRUCTIONAL CHANGE USING DATA FROM SURVEYS OF ENACTED CURRICULUM: FINDINGS FROM NSF MSP-RETA PROJECT

The Surveys of Enacted Curriculum (SEC) provide a robust set of indicator measures to support investigation into educational practice and the influence of educational policies and programs on that practice. The data set is currently being applied with projects in more than 20 states varying in purpose from school and classroom-level use for data-driven improvement of instructional strategies to district-level evaluation of effects of initiatives to analyzing alignment with standards at the district or state level. The Survey data provide key indicators of instructional practice for state and local educators, researchers, and program evaluators. In conjunction with content analyses of content standards and assessments, SEC data provide a powerful set of measures for analyzing the relationship between the intended, enacted, and assessed curricula. This paper summarizes study findings and methods of using the SEC data to analyze effects of professional development on improving instruction in science and mathematics.

GOALS OF MSP-RETA STUDY OF PROFESSIONAL DEVELOPMENT

One of the goals of the National Science Foundation's Mathematics-Science Partnership (MSP) program 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)." In 2002, an MSP-RETA project grant was awarded to the Council of Chief State School Officers (CCSSO) to conduct an empirical study of the quality of professional development provided through MSP supported projects that would test new survey-based tools for analyzing the effectiveness of teacher professional development. A team led by CCSSO with partners at American Institutes for Research and the Wisconsin Center for Education Research conducted the study.

The present paper describes findings from the study team's longitudinal analysis of data from Surveys of Enacted Curriculum with teachers of math and science in four MSP grantee sites. Data were collected from teachers at two points in time—in year one (spring 2003) prior to the start of MSP professional development activities, and in year three (spring 2005) following two years of MSP activities. The study included teachers in MSP-supported professional development opportunities (treatment group) and other math and science teachers in the target districts (control group). Details concerning the study rationale based on prior research and the study design are outlined in the Year 2 Study Report (CCSSO, 2004).

Research Questions. To assist NSF and the Math-Science Partnerships toward the goal of improving methods of evaluating the professional development models for improving teacher knowledge and skills, the study team designed a three-year empirical study to demonstrate and test an objective, reliable methodology for measuring the quality of professional development activities. The study data are being analyzed to measure the effects teacher professional development opportunities 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?

EXECUTIVE SUMMARY: FINDINGS ON EFFECTS OF MSP PROFESSIONAL DEVELOPMENT

With the time series data collected from math and science teachers in MSP-supported professional development programs and comparison teachers, our study team has analyzed effects of MSP professional development programs. The following findings from our analysis highlight the significant differences between treatment and comparison groups and the significant differences in instruction following professional development:

More Time in Professional Development for MSP teachers. Over the two-year period of the study, teachers in MSP-supported professional development reported significantly more time spent in professional development, as compared to comparison teachers. Significant differences in time in professional development were found for science teachers in PD workshops, mathematics teachers in PD summer institutes, and math and science teachers taking coursework in higher education. MSP program teachers had significantly greater overall time spent in professional development activities than the teachers in the comparison group.

Subject Content Focus of Professional Development. *Mathematics teachers* in MSP programs reported significantly greater math content in their PD activities than teachers in the comparison group, and the *MSP teachers'* professional development had significantly greater focus on standards and instruction.

Preparation of Teachers. In year 3 of the study, *mathematics teachers* in MSP programs reported they were better prepared to teach challenging math content as compared to non-MSP teachers, and *teachers in MSP* programs were better prepared to teach a more diverse group of students than comparison teachers.

Change in Instructional Practices. From year 1 to year 3 of the study, instructional practices of *mathematics teachers in MSP* professional development showed significantly greater time and emphasis on: a) demonstrating understanding of mathematics, b) analysis of information, and c) active learning by students, as compared to the practices of comparison teachers.

Over the two-year time frame of the study, *science teachers* (both treatment and comparison groups) showed significant increases in two areas of practice: a) the amount of time they reported engaging students in active learning of science and b) analyzing information. This finding is consistent with science education reform initiatives that emphasize inquiry-based science instruction.

Increased Alignment of Instruction to Standards. Two indicators of quality of professional development were positively associated with greater alignment of instruction in mathematics—*coherence of professional development* for teachers and professional development with more *focus on mathematics content* were both positively related to greater instructional alignment to math standards.

Over the course of the two-year study, we found that all groups—MSP and comparison teachers—in math and science had significant increases in the alignment of instruction to standards. In addition, *science teachers* participating in MSP programs had less aligned instruction in year 1 and had greater variation in science instruction content than teachers in the comparison group; however, the MSP science teachers showed increased alignment of instruction over time and by year 3 had matched the alignment of comparison teachers. Moreover, while variation among MSP science teachers remained greater than the comparison group, variation by year 3 was significantly reduced. Thus, science teachers participating in MSP programs increased the alignment of instruction with standards, and MSP science teachers as a group became more consistent in the science content they taught.

THE SEC DATA SET

The SEC instruments in their entirety provide many hundreds of data points for collecting teacher reports of their opinions, practice, instructional content, professional development experiences, as well as descriptions of teacher and class characteristics. For convenience, and to gain the psychometric power of scale measures, results can be reported using a set of scales and other indicator measures to summarize the data and to investigate relationships, patterns, and if discernable, causal models for understanding the descriptions of practice contained in the full data set. The summary measures from SEC data can be grouped into the following categories: (Listed below are names of Survey items and scales used in our analysis to give other potential SEC users full information.)

Classroom Characteristics *(What is the course/grade? What students are taught?)*

The classroom characteristics measured by the SEC include course type, grade level, duration, class size, demography of students, and their teacher-perceived abilities.

Q3 (question 3)	Course Type
Q4 (question 4)	Grade Level (0-12; 0 = kindergarten)
Q5 (question 5)	Class Size
Q6 (question 6)	Percent Female
Q7 (question 7)	Percent Minority
Q11 (question 11)	Class Achievement Make-up (as perceived by teacher)
Q12 (question 12)	Percent LEP

(See Appendix A for response options)

Instructional Practice *(How does instruction provided in math (or science) differ between classes and teachers*? *3-5 items are grouped as a scale*)

During classroom activities, students are expected to:

Scale: Perform Procedures	PERFPROC
Scale: Demonstrate Understanding	DEMUND
Scale: Analyze Information	ANLYZ
Scale: Make Connections	CNNCT
Scale: Active Learning	ACLRN
Scale: Use Multiple Assessments	TSTUSE

(See Appendix B for Scale Items and Reliability Information)

Teacher Opinions & Beliefs *(What are teacher views of their preparation, colleagues, students, subject knowledge, and school?)*

Scale:	Influence of Standards on Practice	INFLST
Scale:	Professional Collegiality & Trust	PRCOLL
Scale:	Readiness for Innovative Practice	CNTRDY
Scale:	Readiness to Serve Multiple Populations of Students	EQTYRDY

Professional Development Activities *(What are the characteristics of teacher professional development?)*

Type of PD Activity by time/frequency:

Scale		*Scale*	
WRKHRS	Workshop Hours	WRKFRQ	Workshop Frequency
INSTHRS	Institute Hours	INSTFRQ	Institute Frequency
CRSHRS	Coursework Hours	CRSFRQ	Coursework Frequency
PDHRS	Sum of All PD Hours	PDFRQ	Sum of All PD Frequency

Quality of PD activity:

Scale	
PDCOLL	Collective Participation in PD
PDACTIV	PD with Active Engagement of Teachers
PDCOHER	PD part of Coherent PD Program

Content focus of PD activity:

Scale	
PDCNT	PD with a focus on subject matter content
PDSTIN	PD with a focus on standards and instruction
*PDDATA	PD with a focus on student data
*PDSTLRN	PD with a focus on student learning

(*These scales share some items with previous two focus scales; use selectively.)

Instructional Content *(What subject content was taught in the class?)*

Characteristics of Coverage:

Measure	
NBRTPC	Number of Topics Taught
DEPTH	Avg. # Class Periods per Topic
TPCCLS	Avg. # Topics per Class Period

Content Area Coverage:

Measure	
MX1	Number Sense, Properties & Relationships
MX2	Operations
MX3	Measurement
MX4	Algebraic Concepts
MX5	Geometric Concepts
MX6	Data Analysis, Probability, Statistics
MX7	Instructional Technology

Expectations for Student Performance:

Measure	
CGDB	Recall Facts, Definitions, Formulas
CGDC	Perform Procedures
CGDD	Demonstrate Understanding
CGDE	Conjecture, Hypothesize, Prove
CGDF	Solve Non-Routine Problems, Make Connections

Alignment Indices *(What is the extent of consistency between instruction and standards/assessment?)*

Measure	
ALNSTD	Alignment to Grade-Relevant State Content Standards
ALNTST	Alignment to Grade-Relevant State Assessment
ALNCTM	Alignment to NCTM Standards
ALNAEP	Alignment to NAEP Mathematics Framework
ALNSES	Alignment to National Science Education Standards

STUDY DESIGN AND METHODS

To achieve the study goals within the defined time frame, CCSSO research team decided to build the data collection and analysis around the advances in survey approaches for analyzing classroom instruction and teacher preparation provided in the Surveys of Enacted Curriculum in math and science (Blank, Porter, Smithson, 2001; Porter, 2002; Blank, 2002). The existing instruments were improved for the study by adding new survey items addressing the types and quality of professional development received by teachers. Additionally, the study team developed, tested, and applied a monthly teacher Professional Development Activity Log using an online, web-based system. The purpose of the PD Activity Log was to gain more detailed data on the quality of specific activities as reported by teachers. Thus, the overall MSP-RETA project was designed to test new survey-based methods for analyzing the quality of professional development, as well as to use these methods to determine the effects of MSP-based professional development on subsequent instructional practices and curriculum delivered in classrooms.

In the Surveys of Enacted Curriculum, teachers report on the subject content and practices they used in one course/grade during a school year and the time allocated to different instructional practices. The survey data can be used for the purpose of evaluation, as in the present study. The data can also be used directly by schools and teachers to guide improvement in instruction. (In a separate study supported by NSF, CCSSO tested the use of the SEC data reports with school staff to assist them in improving instruction in math and science—see Blank, 2004, *Data on Enacted Curriculum (DEC) Study: Summary of Findings*).

The Survey data provide in-depth information on instructional content using a two-dimensional matrix design: (a) Topic Area, including more fine-grained subtopics and (b) Expectations for Students, with a focus on the cognitive demand. (See examples of the pre-designed content charts with instructional data by standards or assessment at www.SEConline.org). Teachers are asked to report the amount of time spent on topics and then the expectations that are emphasized for the topics taught. 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).

MSP SITES IN PROFESSIONAL DEVELOPMENT STUDY

The MSP-RETA-supported Longitudinal study was based on data collected from teachers in four MSP grantee programs from Cohort 1 (starting Fall 2002). The grantees accepted the invitation from CCSSO to participate and agreed to assist in collecting data from teachers in MSP-supported professional development and a control group of teachers at the same grade level. Each participating site included middle grades (6-8) math and science teachers. The four study sites were:

SUNY Brockport is leading a targeted MSP that focuses on providing a four-week summer institute and school-year coaching for 50-75 secondary math and science teachers each year. The PD curriculum emphasizes use of educational technology software in teaching secondary mathematics and science course content. Most teachers are from Rochester, NY public schools.

Cleveland Municipal School District targeted MSP has the purpose of increasing achievement gains of Cleveland students in the areas of science and math through the implementation of content and inquiry-based science and math curricula at the middle school and high school levels. The method employed by the Cleveland MSP is the implementation of teacher continuing education programs at John Carroll University, Cleveland State University, Case Western Reserve University, and the Educational Development Corporation that provide professional development in inquiry-based methods and in-depth math and science content to annual cohorts of 100 teachers.

The El Paso Mathematics and Science Partnership (comprehensive MSP) focuses on achievement of all students in mathematics and science at high levels of proficiency, and it involves partnership among twelve school districts, the University of Texas at El Paso (UTEP), El Paso Community College (EPCC), and other partners in the El Paso area. The program focuses on advancing teacher quality, quantity, and diversity through training staff developers for K-12 classrooms, building the skills of math/science teachers through the Masters of Arts in Teaching Mathematics and Science program, and support for new teachers through traditional and alternative induction and recruitment efforts.

South Texas AIMS PreK-16 (targeted MSP**)** provides content-focused summer institutes and two-three day workshops for middle grades mathematics teachers across nine small rural districts. Teachers are offered a series of curriculum-specific summer workshops for improved teaching of algebra and geometry and workshops during the school year on teaching specific concepts and content areas in the middle grades. Each year from 50-75 teachers begin the training series.

SURVEY DATA COLLECTED IN MSP STUDY

Sample Response rate. The study sample and response rates are summarized in Table 1. In spring 2003, the Year 1 SEC was administered in the four sites. Teacher surveys were completed by a total of 209 mathematics and 180 science teachers in grades 6-12, across four MSP sites in three states. Of these, the treatment group had 133 mathematics and 88 science teachers, and the comparison group in year one was comprised of 76 mathematics and 92 science teachers.

In the Year 3 survey, a total of 174 teachers completed the follow-up survey (using an identical instrument as in year 1), comprised of 97 mathematics and 77 science teachers.
The activity log was administered across 15 months beginning in year 2 was completed by 273 teachers.

Review of the response totals from SEC Year 1, Year 3, and PDAL show that overall the Year 1 SEC survey had a high response rate from the intended sample (82%) of those teachers requested to complete it. By Year 3 of the study, less than half of the teachers in the study sample at the Year 1 survey (389) were also in the sample surveyed in Year 3 (174), or a 45% retention rate. For the monthly PD activity logs, almost 6 of 10 SEC teachers (57%) participated in the monthly log system requested for the 15-month period.

Findings on Use of Surveys in the Longitudinal Study. Review of the study survey results from administration of the Survey of Enacted Curriculum in study year 1 and year 3, we can make several observations concerning the use of the survey tool in this type of evaluation. Our findings draw on data from on-site focus group interviews with teachers and local staff, and feedback from MSP directors.

- SEC instruments proved to be an effective tool for describing instructional activities, subject content taught, teacher opinions, and PD activities engagement. The teacher survey results provide a rich data source for analyzing instructional differences across schools and districts at one point in time and to measure change over time.
- The two methods of data collection–year-end survey and monthly log–proved to have different problems for gaining high rates of participation. However, use of the two methods provided cross-validation of data. The analysis of results from teachers reporting with both methods using common items showed a high correlation of responses (CCSSO, Year 2 report, 2004).
- SEC surveys gain high response when there is strong cooperation from program administrators especially to gain time for on-site administration. That is, the local programs adopt the SEC as an important tool for their own local use, thus allowing greater time and attention to teacher participation, data completeness, and follow-up responses.
- The strength of the PD log method is obtaining data on specific PD activities—a retrospective survey such as SEC asks teachers to report on all activities during a period of time. With the PD monthly log, teachers report on the quality characteristics of each PD activity for that month, and thus analyses can be conducted on the quality of each activity rather than groups of activities over time.
- A limitation of the longitudinal data from year 1 to year 3 is the retention response rate (45%). Two main factors produced this problem:
  a) The SEC requires local commitment and planning at the school and district level, but the study and data collection plan was managed nationally and then through MSP-program level staff. Schools and some districts had a weak buy-in to the study and the data collection.
  b) Teachers had to be followed over a two-year period. Lack of information and access to individual teachers made follow-up difficult. Many teachers in the study changed schools and districts from year 1 to 3. However, we found that cash incentives were effective for cooperation of control and treatment group teachers.
- The use of longitudinal data collection with an experimental design is critical for evaluating effects of professional development on teacher practices and instructional alignment. However, these methods pose a challenge for studies involving multiple study sites across the nation. This study found that resources were needed to create incentives for local cooperation with data collection efforts and to gain full participation of control group teachers as well as treatment group teachers in the target programs.

ANALYSIS OF LONGITUDINAL RESULTS FOR MSP-PD MATHEMATICS AND SCIENCE

The variable measures outlined above provide the key measures used to examine change in instructional practice over the two-year time span of the study. A series of data analyses were conducted with the teacher survey data, and the results are reported here. First, differences between treatment and comparison groups were examined to determine if any MSP-PD program effects could be attributed based on SEC results. As has been previously noted, round two of SEC data collection with teachers resulted in a dramatic attrition among comparison teachers. Due to the attrition, the final longitudinal sample of comparison teachers is small and thus it is difficult to make conclusive attributions of the effects of the MSP professional development activities. A secondary set of analyses was then conducted on the treatment group and comparison groups separately to examine change over time among the teachers in each of the two groups. Finally, results are reported across the full sample of teachers, regardless of their membership in either the treatment or comparison groups of teachers.

For each of these sets of analyses a common set of questions are pursued. First, what are the extent, nature, and quality of the professional development activities engaged in by teachers during the study period? Second, what changes in instructional practice are noted, and how are these associated with various characteristics of professional development? Third, and a key element of the study, does participation in professional development appear to lead to increased alignment of instruction to state and national standards?

Sample Size

Table 1 indicates the number of mathematics teachers participating at time 1 and again at time 2 in both the treatment and comparison groups. While significant attrition can be noted for both groups, the loss of comparison teachers is particularly noticeable. The circumstances of these and suggestions for future data collection efforts are discussed elsewhere. Here it is sufficient to report the numbers, so that the reader is aware of the samples sizes when interpreting results.

Table 1

MSP-PD Survey Counts				
	Mathematics Surveys		**Science Surveys**	
	Year 1	Year 3	Year 1	Year 3
Total # Surveys:	227	97	208	77
Included for Analysis	209	97	180	77
Brockport MSP				
Treatment	28	22	14	8
Control	19	9	17	3
Total	52	31	31	11
Cleveland MSP				
Treatment	51	28	59	37
Control	27	4	40	7
Total	84	32	99	44
Corpus Christi MSP				
Treatment	35	17	2	0
Control	15	3	26	10
Total	53	20	28	10
El Paso MSP				
Treatment	19	12	13	6
Control	15	2	9	6
Total	38	14	22	12
All				
Treatment	133	79	88	51
Control	76	18	92	26
Total	209	97	180	77

For the analyses in this paper, we focus on Year 3 teacher sample data. Results reported represent either year 3 teacher reports or change measures (calculated for each teacher) from year 1 to year 3 for the year 3 sample of teachers. While significant findings were found in our longitudinal analysis, the results should be treated with caution especially in interpreting results with the comparison groups where the response rates were small in year 3.

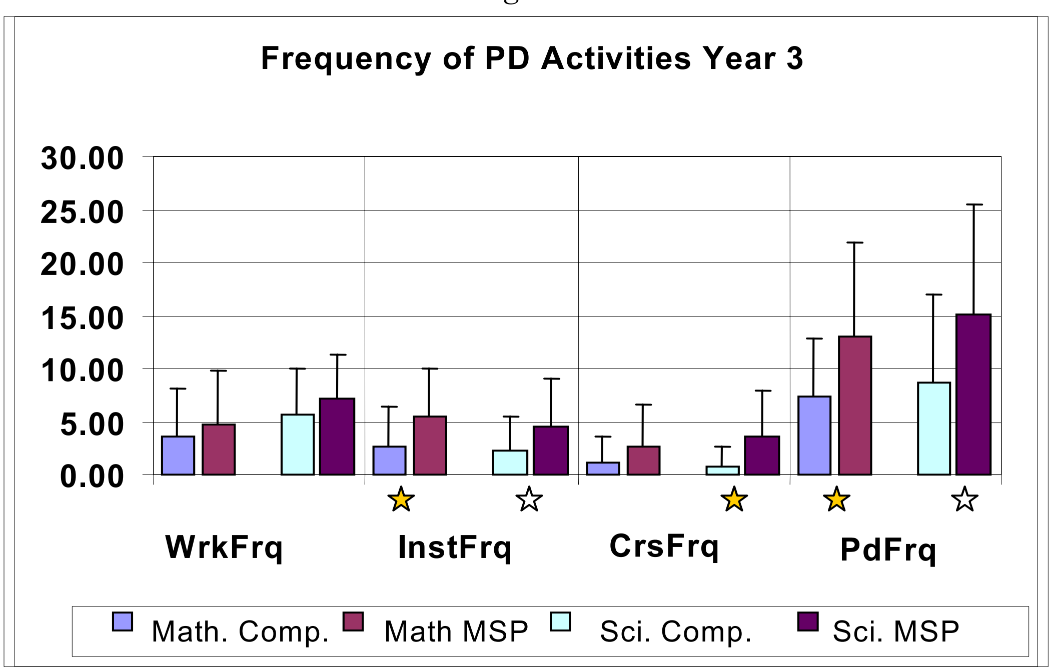
Amount and Frequency of Professional Development Participation

Professional Development Activities *(What are the characteristics of teacher professional development?)*

Scale		*Scale*	
WRKHRS	Workshop Hours	WRKFRQ	Workshop Frequency
INSTHRS	Institute Hours	INSTFRQ	Institute Frequency
CRSHRS	Coursework Hours	CRSFRQ	Coursework Frequency
PDHRS	Sum of All PD Hours	PDFRQ	Sum of All PD Frequency

Figure 1 presents year 3 results for teacher reports on the frequency of their engagement in PD activities. Responses cover three types of professional development activities—workshops, institutes, and university coursework. In addition to these three measures, an aggregate measure of PD frequency was calculated by summing across teacher responses for workshops, institutes, and coursework. On each measure, treatment teachers reported higher frequencies during the time period of the study. Of these reported differences in responses among treatment and comparison teachers, frequency of participation in institutes, the aggregate summary measure of PD frequency were found to be statistically significant among both mathematics and science teachers. In addition, science teachers in the treatment group reported significantly higher frequencies for coursework.

Figure 1

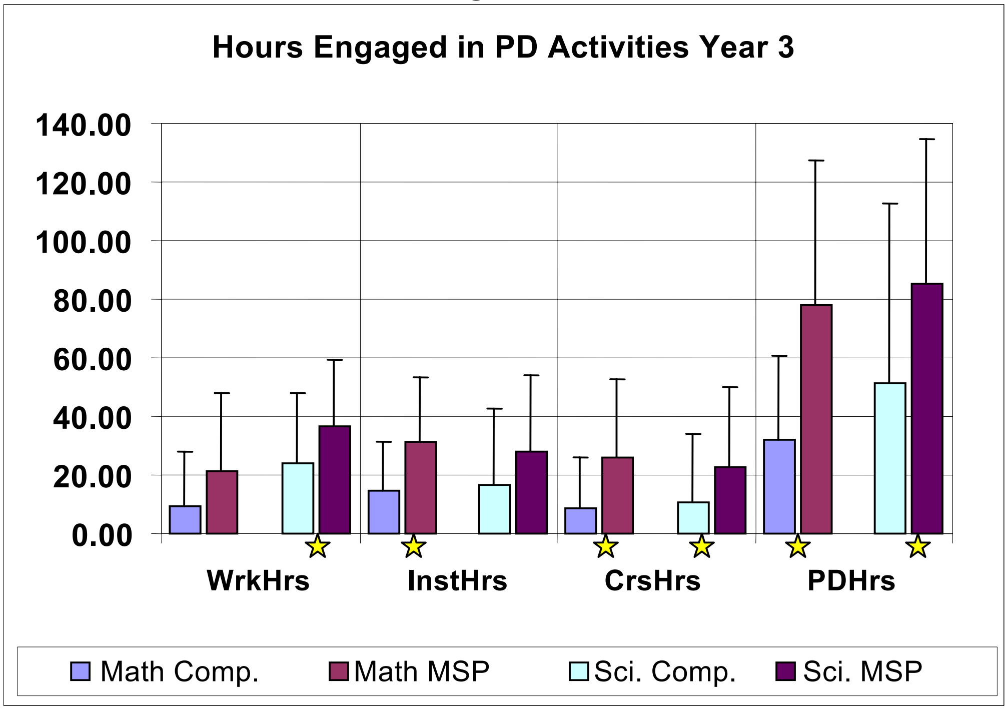


☆ Significant mean difference ($p < 0.05$) ☆ Significant mean difference Yr.1 & Yr.3.
[Note: Whiskers report plus or minus one standard deviation.]

[Further information on data analyses, see Appendix C for significance tests results, D for Longitudinal analysis graphs by district, E for example content analysis charts]

A similar pattern is found for teacher responses to questions regarding the amount of time they were engaged in professional development activities during the period of this study. These results are reported in Figure 2.

Figure 2



☆ Significant mean difference ($p < 0.05$)

The data in Figure 2 show that during the study period MSP program teachers reported significantly more time (as compared to comparison teachers) in science workshops, mathematics institutes, and math and science coursework, and MSP program teachers had significantly greater overall time spent in professional development activities than the teachers in the comparison group. (See Appendix C for all significant ANOVA results for all summary measures reported here.)

These results fit well with what we know about the nature of the professional development programs offered through the four MSP projects examined. Three projects (Brockport, AIMS, and El Paso) made extensive use of summer institutes, while the fourth project, Cleveland MSP, used university fall and spring semester courses for delivery of their professional development treatment.

While the results fit what we would expect to be reported by treatment teachers during the study period, one might question the nature of differences between the comparison and treatment groups on these measures at the beginning of the study. While baseline/year-one data are not repeated here (see MSP Study year 2 report for baseline results, see www.SECsurvey.org/projects), it is worth noting that none of these variables showed significant differences between the treatment and comparison groups at the baseline.

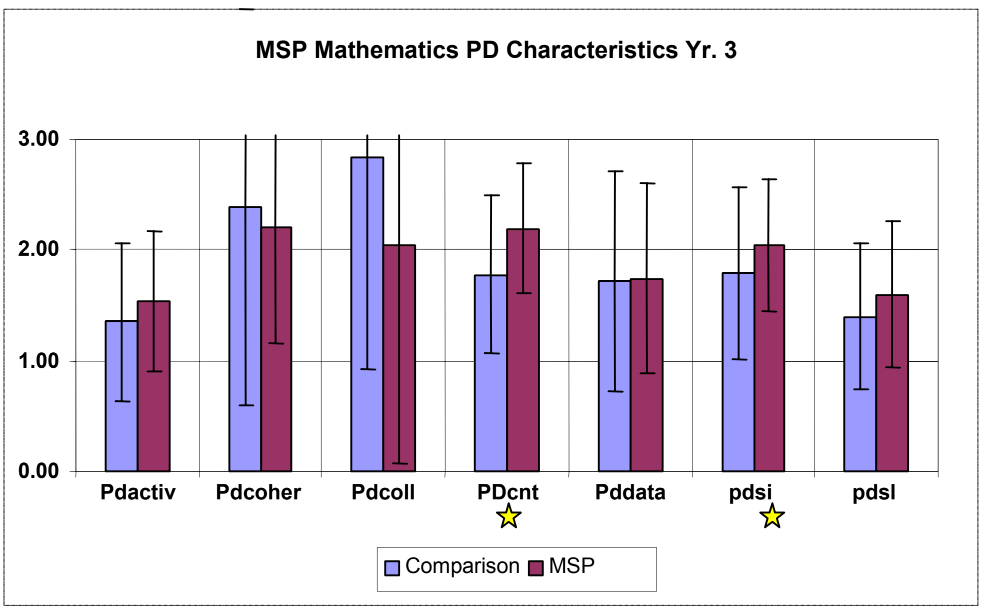
Indicators of Quality PD Characteristics

While increased participation by treatment teachers in professional development activities suggests that the MSP programs provided more professional development opportunities for teachers, the critical question for evaluation of MSP is the quality of activities that were experienced. The SEC data set utilizes four quality professional development scale measures from items in the Surveys of Enacted Curriculum. These items and scales were constructed from research in National Study of the Eisenhower Professional Development Program (Garet, et al, 2001). The following scale measures were analyzed in the present study:

Scale	
PDACTIV	PD with Active Engagement of Teachers
PDCOHER	PD part of Coherent PD Program
PDCOLL	Collective Participation in PD
PDCNT	PD with a focus on subject matter content
PDSTIN	PD with a focus on standards and instruction
*PDDATA	PD with a focus on student data
*PDSTLRN	PD with a focus on student learning

(*These scales share some items with previous two focus scales; use selectively.)

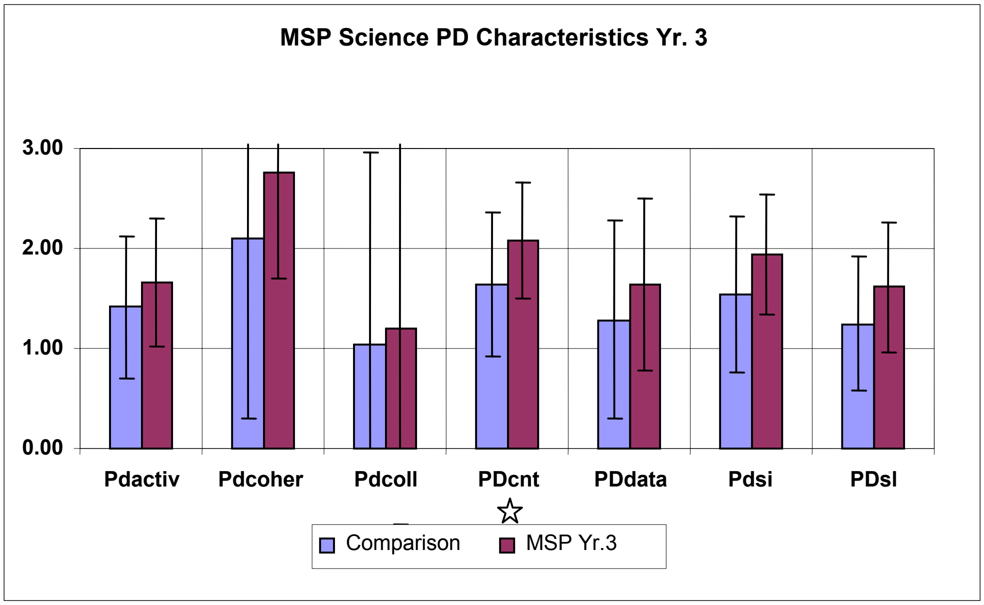
Figure 3



☆ Significant mean difference ($p < 0.05$)

Results of all seven indicator measures of quality of professional development for year 3 mathematics teacher reports are presented in Figure 3. While Year 3 measures for the treatment group tend toward higher values on all but collective participation (PDCOLL), only the results for professional development focused on subject matter content (PDCNT) and standards and instruction report significant mean differences between treatment and comparison teachers. Similar but weaker results are seen for science. Only professional development focused on content demonstrated a significant mean difference between comparison and treatment teachers. However, this group difference also existed at the baseline (see Figure 4) and both groups reported similar levels of increase on this measure over the time of the study.

Figure 4



☆ Significant mean difference ($p < 0.05$)

While only one characteristic of quality professional development can be associated with the treatment group, it is an important one. As will be demonstrated in results reported below, professional development activities that focus on subject matter content are associated with increases in teacher reports of readiness to teach subject matter content and increases in alignment of instruction to standards.

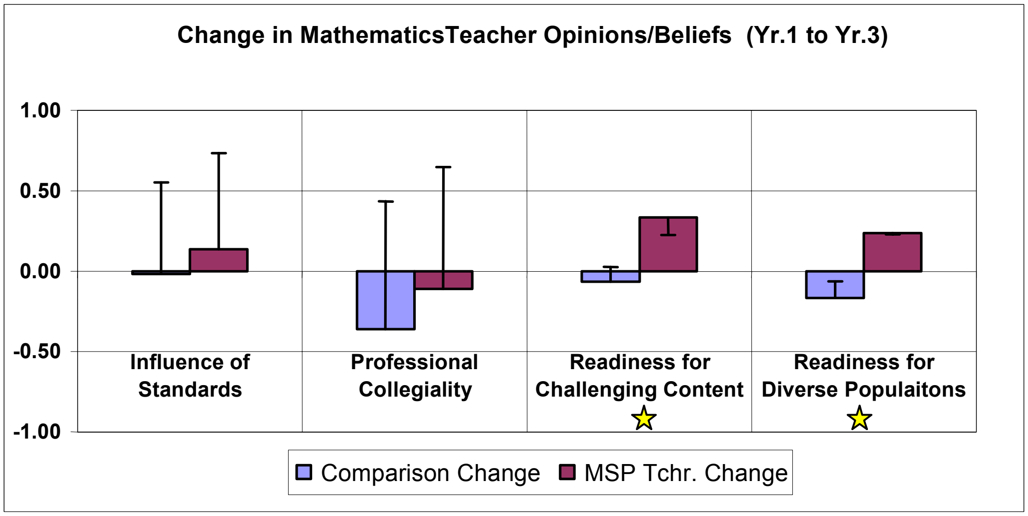
Change in Teacher Opinions and Beliefs

A second measure of change related to teacher professional development is the opinions and beliefs of teachers about their practice and their teaching environment. Figure 5 presents results for four scale measures related to teacher opinions and beliefs. Scale measures are reported for teacher views on:

Variable	*Scale*	*What is measured*
INFLST	Influence of standards	Extent to which teachers instruction in their subject is influenced or guided by state content standards
PRCOLL	Professional collegiality	Teacher views on the degree to which teachers in the school work together
CNTRDY	Readiness for challenging content	Teacher beliefs on how prepared they are to teach their assigned subject
EQTYRDY	Readiness for diverse populations	Teacher beliefs on how well prepared they are to teach students with different backgrounds or needs

Study results show wide divergence in teacher reports on the influence of standards and professional collegiality across all teachers. While no significant differences between comparison and treatment groups were noted for science, mathematics comparison teachers reported significantly less professional collegiality in year 3 compared to year 1, while treatment teachers reported being better prepared to teach challenging content and being prepared to teach a more diverse group of students in year 3 than they were in year 1.

Figure 5



☆ Significant mean difference ($p < 0.05$)

Change in Math Teacher Reports of Instructional Practice

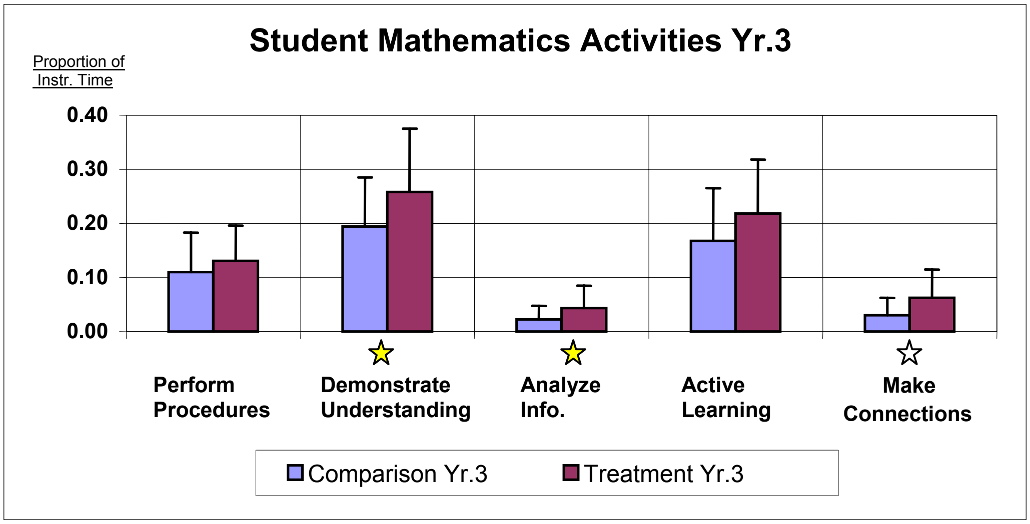
The next question we examine is whether teacher reports of changes in instructional practice during the timeframe of the study can be attributed to MSP program participation. The scales reported in Figure 6 focus on the following expectations for student performance during their classroom practices.

During classroom activities, students are expected to:

Scale: Perform Procedures	PERFPROC
Scale: Demonstrate Understanding	DEMUND
Scale: Analyze Information	ANLYZ
Scale: Make Connections	CNNCT
Scale: Active Learning	ACLRN

Results reported in Figure 6 indicate that in the follow-up (year 3) survey, teachers in the MSP treatment teachers reported more time spent in instructional activities that engaged students in demonstrating understanding and analysis than reported by comparison teachers. It is worth noting that the difference in mean measures between comparison and treatment teachers on the use of active learning nears significance (*p=0.056).* Finally, treatment teachers also reported more instructional time focused on 'making connections,' however, this group difference was also noted for the baseline year and so cannot be attributed to participation in an MSP program.

Figure 6



★ Significant mean difference ($p < 0.05$) ☆ Significant mean difference Yr.1 & Yr.3.

Discussion of findings on change in instruction. The analysis has focused on differences between comparison and MSP teachers. While comparison groups offer the opportunity to present evidence supporting attributions of MSP program effects, not finding significant results should not be taken to indicate a failure of the program to achieve its program goals. Comparison teachers are not a strict 'control' group as you might have in a clinical trial for some new medication, where the control subjects receive no 'treatment.' Comparison teachers did not refrain from taking advantage of a variety of professional development offerings, whether sponsored by the school, district, regional service agency, or other professional development provider.

When looking for program effects through treatment/comparison grouping, MSP programs are in a sense being compared to all other professional development opportunities available to teachers. It should be noted that this constitutes a more challenging accomplishment than simply demonstrating that participation in MSP activities has an effect on instructional practice. If we were to draw an analogy to a clinical drug trial, it would be as if the control group was allowed to take any medications they wished, including perhaps generic forms of the same or similar medicine as under trial. With that in mind, insofar as the few group effects noted in the SEC results reflect the objectives of the professional development opportunities offered through MSP sponsorship, those results should be considered fairly strong evidence of programmatic effects.

Where we do not see significant differences between groups, the question becomes, did teachers in general change practice in areas detectable with the SEC instruments? If so, was the change in a positive or negative direction; i.e., do SEC indicators suggest that positive changes in classroom practice are improving over time? In some ways, this is the more interesting question, as it speaks to the larger question of the effects of efforts to improve instructional practice, and in so doing, lead to increased student achievement. Sample-wide results from SEC longitudinal data suggest an encouraging picture of instructional change.

Tables 2 & 3 report significant changes in science and mathematics instruction reported across all teachers during the study period. Over the two-year time frame of the study, science teachers increased the amount of time they reported engaging students in active learning and analyzing information. While modest, the increase is significant and is in keeping with science reform initiatives emphasizing inquiry-based science instruction.

Table 2

Significant Change -Science		Year 1	Year 3
Analyze	*Mean*	**0.06**	**0.07**
	Std. Dev.	*0.023*	*0.036*
Active Learning	*Mean*	**0.29**	**0.34**
	Std. Dev.	*0.075*	*0.122*

Proportion of instructional time.
Mean difference significance *($p < 0.05$)*

Table 3

Significant Change - Math		Year 1	Year 3
Test Use	*Mean*	**1.76**	**1.95**
	Std. Dev.	*0.652*	*0.747*
Content Readiness	*Mean*	**2.05**	**2.32**
	Std. Dev.	*0.618*	*0.524*

Response Metric

Test Use	Content Readiness
0 = None	0 = Not well prepared
1 = 1-4 times / year	1 = Somewhat prepared
2 = 1-3 times / month	2 = Well prepared
3 = 1-3 times / week	3 = Very well prepared
4 = 4-5 times / week	

Changes in mathematics instruction, summarized across all mathematics teachers for the study timeframe can be characterized by an increase in the amount of time associated with testing, as well as an increase in teachers' opinion of their readiness to present challenging mathematics content. While increased assessment time may be an unfortunate outcome for some, it is reflective of the current standards-based environment. Moreover, the increase in teachers' opinion of their readiness to deliver challenging mathematics content should be good news in light of repeated concerns over teacher mathematics content knowledge. While a change in attitude is not the same as a change in behavior, it may be taken as a promising early indicator of favorable change in teachers' content knowledge.

Change in Teacher Reports of Instructional Content

Of key interest to this study is the nature of change in mathematics and science instructional content. The Surveys of Enacted Curriculum provide a variety of measures for examining instructional content. SEC measures associated with content *coverage* include:

<u>*Characteristics of Coverage:*</u>

Variable	*Measure*
NBRTPC	Number of Topics Taught
DEPTH	Avg. # Class Periods per Topic
TPCCLS	Avg. # Topics per Class Period

Analyses of the characteristics of Content Coverage reveal no significant differences either between treatment and control groups, or between time 1 and time 2 measures. However, the sample of teachers included in the analyses include classes in grades 5 through 12, and many of these teachers may have changed grade level and/or course assignments between year 1 and year 3 reporting. Thus it is not surprising that no strong patterns emerge from the descriptive data on the characteristics of content topics covered. Nonetheless, it is informative to look at the descriptive results from these measures in order to consider the broad picture of mathematics and science instruction they portray.

Figure 7

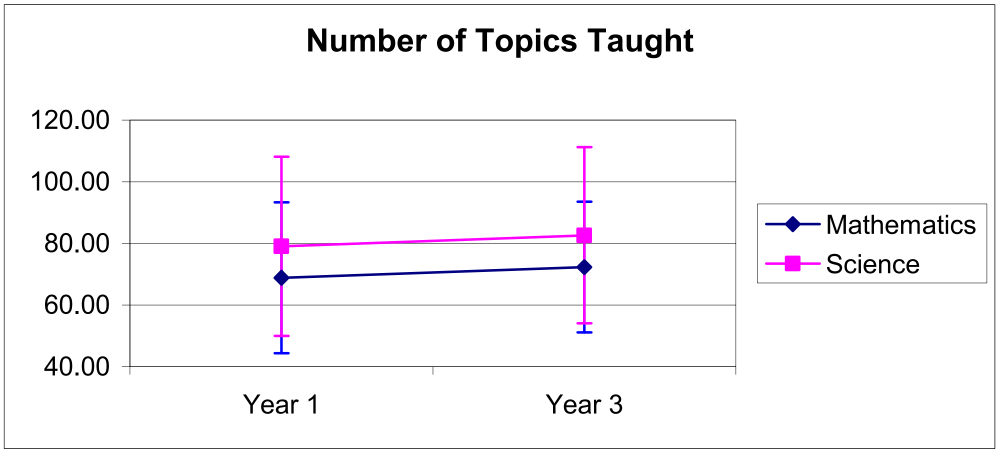
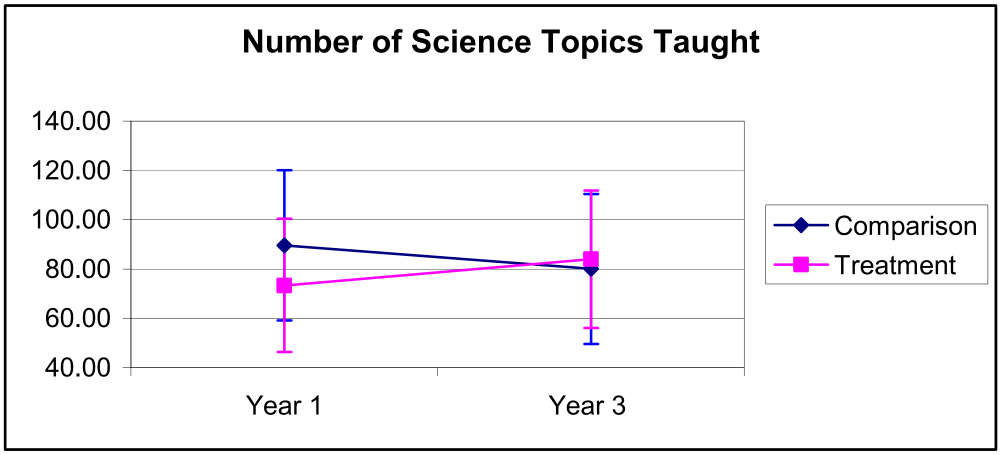


Figure 7 reports the number of topics taught in mathematics and science at the baseline and at year 3. The trends show that science teachers cover about 10 more topics per year than the number reported by mathematics teachers (69 vs. 79 at year 1), and this difference remained consistent over the period of the study. As the figure also indicates, teachers vary widely in the number of topics they reported covering over the course of a school year. By year 3 of the study, teachers increased an average of 4 topics to the breadth of their instructional content, regardless of whether they were mathematics, science, comparison, or treatment teachers.

The most striking differences noted in terms of the breadth of topic coverage are seen among science teachers, looking at differences in reports of treatment and comparison teachers. Figure 8 reports these results.

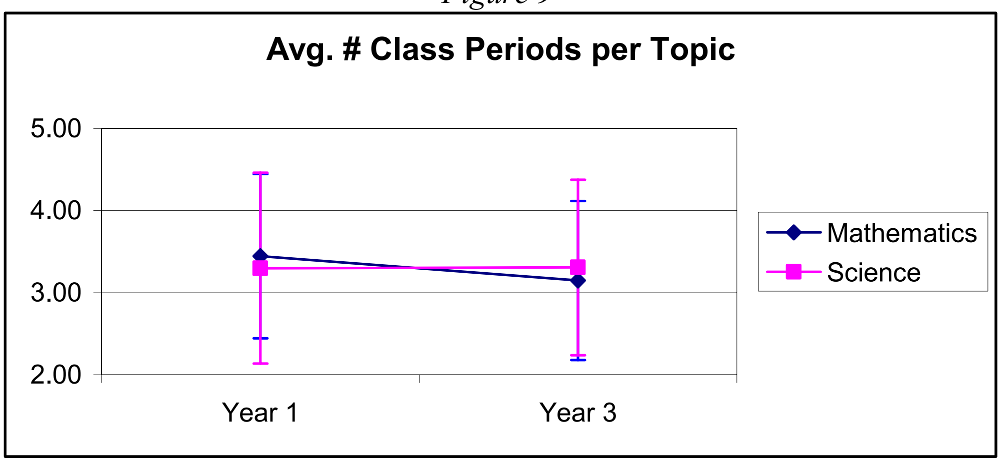
Figure 8



As indicated by Figure 8, treatment teachers tended to add topics over the course of the study, while the comparison teachers as a group reduced the number of topics reported. Curiously, while the two groups show significant mean differences at year 1 *(p=0.033)*, by year 3 they appear almost identical in terms of the number of topics and variation across teachers.

In addition to the breadth of content coverage, the SEC data set reports on depth of coverage, defined here as the average number of class periods a given topic is taught.

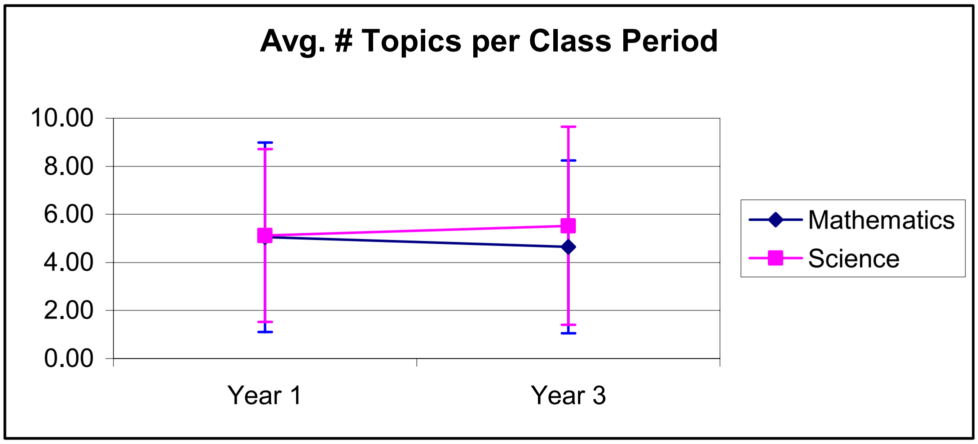
Figure 9



As can be seen from Figure 9, science instruction remained virtually unchanged in terms of the average number of class periods a given topic is covered. Mathematics teachers reported a slight drop in the average number of class periods. Though the amount is minimal (0.29 or slightly more than a quarter of a class period), the difference between baseline and year 3 results approaches significance *(p=0.066)*.

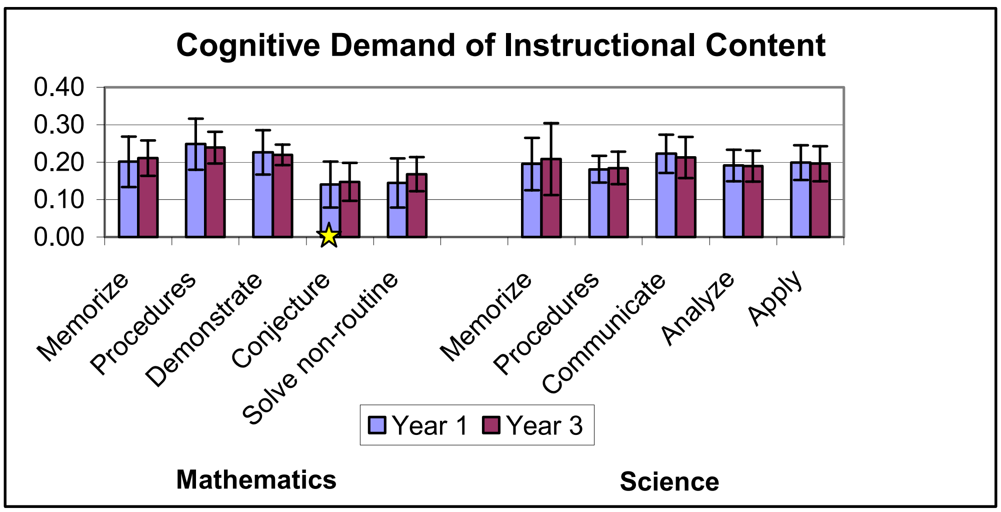
The third characteristic of content coverage addressed in this report looks at the number of topics covered during an average class period. Figure 10 indicates that mathematics and science teachers covered an average of 5 topics per class period. The variation across teachers, whether mathematics or science is dramatic, ranging from about 1 topic per class period, to more than ten topics per class period.

Figure 10



The final characteristic of content coverage examined here concerns the distribution of instructional time across categories of cognitive expectations for student engagement with instructional content. Results for math and science are reported in Figure 11.

Figure 11



☆ Significant mean difference ($p < 0.05$)

The only significant results reported concern the increase in time for student engagement in solving non-routine mathematics problems from year 1 to year 3. No differences were found between treatment and comparison groups with reference to other areas of cognitive demand.

Alignment Effects

Underlying the concept of alignment used in the SEC data system is the hypothesis that student performance on assessments is at least in part a function of the relationship between the content assessed and the content for which the student has had adequate opportunity to learn. In other words, students will perform better on tests that cover content covered in classroom instruction than on tests that cover content that has not been covered during classroom instruction. Naturally other factors will play a role in student achievement, but everything else being equal, alignment of content coverage (the enacted curriculum) to assessed content will be an important factor in predicting student achievement.

The alignment index derived from SEC instruments and content analyses of assessment and standards documents endeavors to provide a valid and reliable quantitative measure representing this relationship between content taught and content assessed. While the hypothesis asserted above has compelling face value, the utility of the alignment index to serve this purpose must be demonstrated. The best evidence to date supporting the utility of this alignment index is its power in predicting student achievement gains (i.e., predictive validity). In Upgrading Mathematics study, Gamoran, Porter, Smithson, and White (1997) found a strong positive correlation between student achievement gains and content alignment. While replication of the results are needed and being undertaken with a number of participating states in both mathematics and English Language Arts at various grade levels, the alignment index is an effective measure for determining outcomes of professional development and other programmatic efforts.

Alignment Indices *(What is the extent of consistency between instruction and standards/assessment?)*

Variable	*Measure*
ALNSTD	Alignment to Grade-Relevant State Content Standards
ALNTST	Alignment to Grade-Relevant State Assessment
ALNCTM	Alignment to NCTM Standards
ALNAEP	Alignment to NAEP Mathematics Framework
ALNSES	Alignment to National Science Education Standards

For the purposes of this study alignment is a measure of particular interest. One of the central questions of the study is whether high-quality professional development activities are more likely than lower-quality activities to increase the alignment of instructional content with state standards and assessments.

Table 4
Correlation of PD Quality Indicators to Alignment - Mathematics

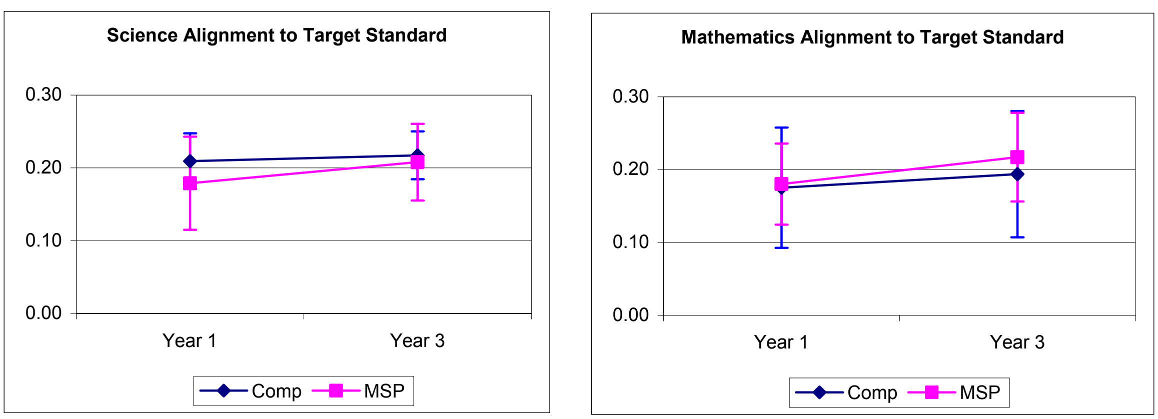
Pearson Correlation PD Quality to Alignment	Year 3 Alignment to Test	Year 3 Alignment to Standard
Coherent PD yr3		**0.21**
Sig. (2-tailed)		*0.049*
N		**88**
PD Cnt. Focus yr3		**0.37**
Sig. (2-tailed)		*0.000*
N		**86**
PD Data Focus yr3	**0.29**	**0.36**
Sig. (2-tailed)	**0**	*0.001*
N	**92**	**86**
PD Stnd/Instr. yr3	**0.24**	**0.40**
Sig. (2-tailed)	*0.022*	*0.000*
N	**92**	**86**

Results reported for mathematics teachers participating in the study provide confirming evidence that a moderate and statistically significant relationship exists for several indicators of PD quality and instructional alignment (see Table 4). In particular, a coherent professional development program and professional development focused on mathematics content are both positively associated with instructional alignment to standards. Interestingly, only professional development activities with a focus on data or standards and instruction show a relationship with test alignment. (Note that the three PD focus measures share some items in common. See Appendix B for details.) Unfortunately, results for science teachers in the study revealed no similar relationships with alignment, whether to test or standard, and any of the SEC professional development quality indicators.

Whether one selects the relevant standard or assessment as a preferred alignment target is an interesting question in itself, and arguments can be presented in favor of both as being the more appropriate target. For the purposes of this report, we will present results for both but consider standards as the preferred target, though, the authors would expect test alignment to be more predictive of student achievement gains. The rationale for giving preference to standards over assessments is that the theory of standards-based reform calls for standards to drive instruction, not assessment. Federal requirements for alignment of state assessments to standards are intended to insure that instructional alignment to standards will imply alignment to tests. Moreover, standards purposely reference content not easily assessed in order to insure that students receive both the depth and breadth of content coverage necessary to meet calls for challenging content for all students.

Alignment as an Outcome Measure. The role of content standards and related curricular documents in standards-based reform is to provide teachers and others a description of goals, objectives, and content 'targets' that teachers should strive to 'meet.' In the language of the SEC, the enacted curriculum should be aligned with the intended curriculum (e.g., content standards, curriculum frameworks, grade level expectations, benchmarks, etc.). Thus, one measure of the success of standards-based reform efforts is the extent to which instructional alignment to standards increases over time.

Figure 12

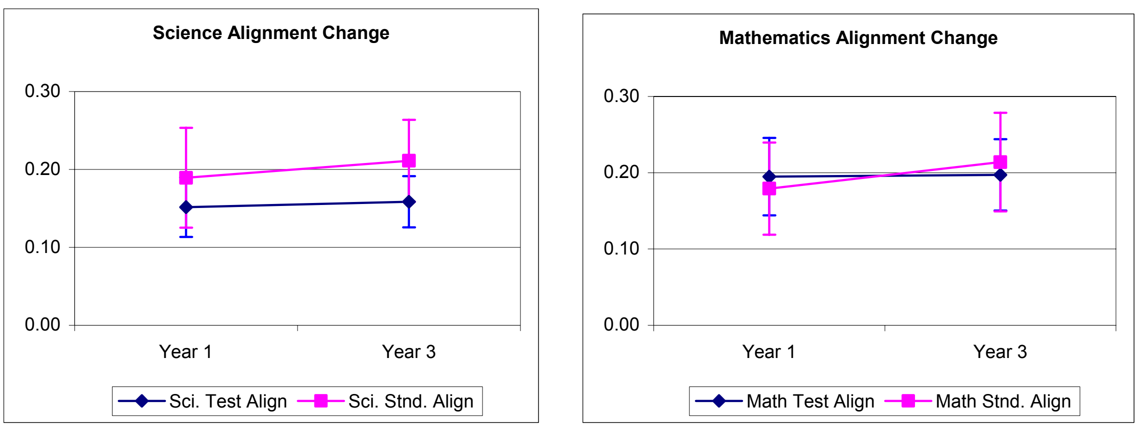


We begin our discussion of alignment results for the present study looking at changes in alignment from time 1 (Administered Spring, 2003) to time 3 (Administered Spring, 2005) among treatment and comparison teachers. Comparing MSP to comparison teachers, no treatment effect is found for any alignment variables. That is, changes in alignment to standards and/or assessments as determined from teacher reports of instructional content cannot be attributed to participation in MSP-sponsored professional development programs. It is not clear to what extent this is due to sample size (as a result of large attrition of comparison teacher participation in year 3 surveys) or non-MSP program effects. While group differences are not significant, and in any case slight, Figure 12 reveals a slightly steeper slope (i.e., greater alignment gain) for the MSP teacher groups in both math and science. Indeed the patterns across the two subjects are strikingly similar, with one noticeable difference. Science teachers participating in MSP programs started at the baseline somewhat lower in alignment and with greater variation across teachers than found with the comparison group and increased their alignment over time to match alignment with comparison teachers at year 3. Moreover, while variation among MSP science teachers remained greater than the comparison group, it reduced from the baseline. Thus, science teachers participating in MSP programs became more aligned and somewhat more consistent in their reporting of science instructional content.

In contrast, mathematics teachers participating in MSP programs began at the baseline with identical alignment measures as the comparison group. The MSP group did, however, show less variation in their alignment than comparison teachers. Nonetheless, as with science, mathematics teachers participating in MSP programs show an increase in alignment to the targeted content standards over the course of the study.

This gain in alignment for MSP teachers is statistically significant (*p=.000*) for mathematics and science (*p=.014)*.

Figure 13



Despite these positive results for MSP teachers, as already noted, no significant grouping differences were found with respect to alignment. While sample size may have some effect here, it is the case that comparison teachers also increased their alignment to standards. Indeed, if we look at mathematics and science teachers without regard to whether they were comparison or MSP teachers, we see a moderate and significant increase in alignment to standards for both subjects over the course of the study. Interestingly, alignment measures to targeted assessments remain essentially flat over the two-year time span.

While this may not be great news for MSP program effects, it is certainly good news for education more generally. The implication here is that the enacted curriculum is changing and in positive directions for two important subject areas. Moreover, these results suggest that as desired, standards, not assessments drive instruction. Whether we can attribute this change to one or another program, or to professional development efforts more generally, what can be said is that for those teachers for whom we had measures for two points in time, analyses of SEC data reveal statistically significant increases in alignment to standards between Spring 2003 and Spring 2005.

CONCLUSIONS

Education leaders making decisions on designs for professional development programs in mathematics and science, including leaders of math-science partnerships supported by national or state funds, seek valid, reliable, cost-effective methods of evaluating program effects. The longitudinal study of professional development supported through NSF MSP grants has demonstrated that survey data collection can be effective in gathering consistent, reliable data from teachers participating in a range of activities across schools, districts, and sites. The study demonstrated the benefits of a longitudinal time series design in analyzing differences across programs based on research-based measures of quality, as well as for determining the differential effects of professional development on instruction.

Our analysis showed that coherence and content focus were two characteristics of MSP professional development that had significant effects on change in instruction of participating teachers. The Surveys' data were useful in measuring instructional change for math and science teachers using the scales of instructional practices, indices of alignment between standards and instructional content, as well as teacher self-reports of their level of preparation to teach their subject.

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Appendix A
Response Options for Key Survey Items & Scales

Classroom Characteristics

Course Type (Q3)

Mathematics	Science
0 = Other	0 = Other
1 = Elementary Math	1 = Elem./Middle Sch. Science
2 = Middle Sch. Math	2 = General Science
3 = Pre-algebra	3 = Life Science
4 = Algebra	4 = Physical Science
5 = Integrated Math	5 = Earth Science
6 = Geometry	6 = Biology
7 = Trigonometry	7 = Chemistry
8 = Advanced Math	8 = Physics
9 = Calculus	9 = Coordinated/Integrated Science

Class Size (Mathematics & Science)

0 = 10 or less
1 = 11 to 15
2 = 16 to 20
3 = 21 to 25
4 = 26 to 30
5 = 31 or more

Percent Minority (Q7), Percent Female (Q8), Percent LEP/ELL (Q12)

0 = Less than 10%
1 = 10%
2 = 20%
3 = 30%
4 = 40%
5 = 50%
6 = 60%
7 = 70%
8 = 80%
9 = 90%+

Estimate of Class Achievement Level (Q11)

1 = High Achievement Levels
2 = Average Achievement Levels
3 = Low Achievement Levels
4 = Mixed Levels of Achievement

Appendix A (cont.)
Response Options for Key Survey Items & Scales

Instructional Practice & Student Activities (Q18-63: Mathematics) (Q18-62: Science)

Amount of Instructional Time
0 = None
1 = Little (10% or less of instructional time)
2 = Some (11-25% of instructional time)
3 = Moderate (26-50% of instructional time)
4 = Considerable (more than 50% of instructional time)

Assessment Use (Q64-71: Mathematics) (Q63-70: Science)

Frequency of Use
0 = Never
1 = 1-4 times per year
2 = 1-3 times per month
3 = 1-3 times per week
4 = 4-5 times per week

Instructional Influences (Q72-81: Mathematics) (Q71-80: Science)

0 = Not applicable (not included in calculations of item means)
1 = Strong negative influence
2 = Somewhat negative influence
3 = Little or no influence
4 = Somewhat positive influence
5 = Strong positive influence

Classroom Instructional Readiness (Q82-91: Mathematics) (Q81-90: Science)

0 = Not well prepared
1 = Somewhat prepared
2 = Well prepared
3 = Very well prepared

Teacher Opinions & Beliefs (Q92-101: Mathematics) (Q91-100: Science)

0 = Strongly disagree
1 = Disagree
2 = Neutral/Undecided
3 = Agree
4 = Strongly Agree

PD Activities: Frequency & Duration (Q102-104: Mathematics) (Q101-103: Science)

PD Frequency	PD Duration
0 = Never	0 = N/A
1 = Once	1 = 1-6 hours
2 = Twice	2 = 7-15 hours
3 = 3-4 times	3 = 16-35 hours
4 = 5-10 times	4 = 36-60 hours
5 = greater than 10 times	5 = 61+ hours

Appendix B
SEC Mathematics Scales

Mathematics Scales

	Reliability Coefficient
Assessment Use (TSTUSE)	**0.727**
Q65 Short answer questions such as performing a mathematical	
Q66 Extended response item for which student must explain or justify	
Q67 Performance tasks or events (e.g. hands-on activities).	
Q68 Individual or group demonstration, presentation.	
Q69 Mathematics projects.	
Q70 Portfolios.	
Q71 Systematic observation of students.	
Influence of Standards (INFLST)	**0.674**
Q72 Your state's curriculum framework or content standards.	
Q73 Your district's curriculum framework or guidelines.	
Q77 National mathematics education standards.	
Q84 Provide mathematics instruction that meets mathematics content standards (district,	
Q129 State mathematics content standards (e.g. what they are and how they are used).	
Q130 Alignment of mathematics instruction to curriculum.	
Climate of Trust (PRCOLL)	**0.823**
Q94 I am supported by colleagues to try out new ideas in teaching mathematics.	
Q97 Mathematics teachers in this school trust each other.	
Q98 It's OK in this school to discuss feelings, worries, and frustrations with other mathematics teachers.	
Q99 Mathematics teachers respect other teachers who take the lead in school improvement efforts.	
Q100 It's OK in this school to discuss feelings, worries, and frustrations with the principal.	
Q101 The principal takes personal interest in the professional development of the teachers.	
Content Readiness (CNTRDY)	**0.871**
Q82 Teach mathematics at our assigned level.	
Q83 Integrate mathematics with other subjects.	
Q84 Provide mathematics instruction that meets mathematics content standards.	
Q85 Use a variety of assessment strategies (incl. objective and open-ended formats.)	
Q86 Teach problem solving strategies.	
Q87 Teach mathematics with manipulatives such as counting blocks or geometric shapes	
Equity Readiness (EQTYRDY)	**0.791**
q88 Teach students with physical disabilities.	
q89 Teach classes for students with diverse abilities.	
q90 Teach mathematics to students from a variety of cultural backgrounds.	
q91 Teach mathematics to students who have limited english proficiency.	

Appendix B
SEC Mathematics Scales

Perform Procedures (PERFPROC) **0.758**

Q37 Solve *word problems* from a textbook or worksheet.
Q45 Solve *word problems* from a textbook or worksheet.
Q53* Work with manipulatives (e.g. counting blocks, geometric shapes, or algebraic tiles) to understand concepts.
Q54* Measure objects using tools such as rulers, scales, or protractors.
Q56* Collect data by counting, observing, or conducting surveys.
Q59 Practice procedures
Q61 Retrieve or exchange data or information (e.g. using the Internet or partnering with another class)

Demonstrate Understanding of Mathematical Ideas (DEMUND) **0.802**

Q29 Present or demonstrate solutions to a math problem to the whole class.
Q32* Work in pairs or small groups on math exercises, problems, investigations, or tasks.

Q39 Explain their reasoning or thinking in solving a problem, using several sentences orally or in writing.
Q47 Talk about their reasoning or thinking in solving a problem.
Q57 Present information to others using manipulatives (e.g. chalkboard, whiteboard, posterboard, projector).

Reliability Coefficient

Analyze Information (Conjectures, Generalize, Prove Math) (ANLYZ) **0.868**

Q41 Make estimates, predictions or hypotheses.
Q42 Analyze data to make interferences or draw conclusions.
Q44 Complete or conduct proofs or demonstrations of their mathematical reasoning.
Q49 Make estimates, predictions or hypotheses.
Q52 Complete or conduct proofs or demonstrations of their mathematical reasoning.

Make Connections (Solve novel problems) (CNNCT) **0.861**

Q38 Solve non-routine mathematical problems (e.g. problems that require novel or non-formulaic thinking).
Q40 Apply mathematical concepts to "real-world" problems.
Q46 Solve non-routine mathematical problems (e.g. problems that require novel or non-formulaic thinking).
Q48 Apply mathematical concepts to "real-world" problems.
Q50 Apply data to make inferences or draw conclusions.
Q51 Work on a problem that takes at least 45 minutes to solve.

Active Learning (ACLRN) **0.853**

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).

Q32* Work in pairs or small groups on math exercises, problems, investigations, or tasks.

Q33 Do a mathematics actively with the class outside the classroom.
Q53* Work with manipulatives (e.g. counting blocks, geometric shapes, or algebraic tiles) to understand concepts.
Q54* Measure objects using tools such as rulers, scales, or protractors.
Q56* Collect data by counting, observing, or conducting surveys.

Appendix B
SEC Mathematics Scales

PD Frequency (Sum) (PDFRQ)		**0.351**
q102frq	Workshops or in-service training related to mathematics or mathematics education	
q103frq	Summer institutes related to mathematics or mathematics education	
q104frq	College courses related to mathematics or mathematics education	
PD Hours (Sum) (PDHRS)	For the most recent school year, how many total hours have you participated in:	**0.461**
q102hrs	Workshops or in-service training related to mathematics or mathematics education	
q103hrs	Summer institutes related to mathematics or mathematics education	
q104hrs	College courses related to mathematics or mathematics education	
Active Teacher Engagement PD (PDACTIV)		**0.767**
q112	Observed demonstrations of teaching techniques	
q113	Led group discussions.	
q114	Developed curricula or lesson plans, which other participants or the activity leader reviewed.	
q115	Reviewed student work or scored assessments.	
q116	Developed assessments or tasks as part of a formal professional development activity.	
q117	Practiced what you learned and received feedback as part of a professional development activity.	
q118	Received coaching or mentoring in the classroom.	
q119	Given a lecture or presentation to colleagues.	
	Reliability Coefficient	
Coherent PD Program (PDCOHER)		**0.752**
q120	Designed to support the school-wide improvement plan adopted by your school.	
q121	Consistent with you mathematics department or grade level plan to improve teaching.	
q122	Consistent with your own goals for your professional development.	
q123	Based explicitly on what you had learned in earlier professional development activities.	
q124	Followed up with related activities that built upon what you learned as part of the activity	
Collective Participation (sum) **(PDCOLL)**		
q125	I participated in professional development activities with most or all of the teachers from my school.	.
q126	I participated in professional development activities with most or all of the teachers from my department or grade level.	.
PD w/ Content Focus (PDCNT)		**0.746**
q129*	State mathematics content standards (e.g. what they are and how they are used).	
q130*	Alignment of mathematics instruction to curriculum.	
q132*	In-depth study of mathematics or specific concepts within mathematics (e.g. fractions).	
q133*	Study of how children learn particular topics in mathematics.	

PD w/ Data Focus (PDDATA)	**0.824**
q136* Classroom mathematics assessment (e.g. diagnostic approaches, textbook-developed tests, teacher-developed tests).	
q137* State or district mathematics assessment (e.g. preparing for assessments, understanding assessments, or interpreting assessments).	
q138* Interpretation of assessment data for use in mathematics instruction.	
PD w/ Standards & Instruction Focus (PDSTIN)	**0.830**
q129* State mathematics content standards (e.g. what they are and how they are used).	
q130* Alignment of mathematics instruction to curriculum.	
q131* Instructional approaches (e.g. use of manipulatives)	
q132* In-depth study of mathematics or specific concepts within mathematics (e.g. fractions).	
q137* State or district mathematics assessment (e.g. preparing for assessments, understanding assessments, or interpreting assessments).	
q138* Interpretation of assessment data for use in mathematics instruction.	
PD w/ Student Learning Focus (PDSTLRN)	**0.818**
q133* Study of how children learn particular topics in mathematics.	
q134 Individual differences in student learning.	
q135 Meeting the learning needs of special populations of students (e.g. second language learners; students with disabilities).	
q136* Classroom mathematics assessment (e.g. diagnostic approaches, textbook-developed tests, teacher-developed tests).	
q139 Technology to support student learning in mathematics.	

* *Item shared with another scale.. Use one or the other scale for analysis.*

Appendix B
SEC Science Scales

Science Scales

		Reliability Coefficient
	Assessment Use (TSTUSE)	**0.743**
Q64	Short answer questions (e.g. fill-in-the-blank).	
Q65	Extended response item for which student must explain or justify solution.	
Q66	Performance tasks or events (e.g. hands-on activities).	
Q67	Individual or group demonstration, presentation.	
Q68	Science projects.	
Q69	Portfolios.	
Q70	Systematic observation of students.	
	Influence of Standards (INFLST)	**0.761**
Q71	Your state's curriculum framework or content standards.	
Q72	Your district's curriculum framework or guidelines.	
Q76	National science education standards.	
Q83	Provide science instruction that meets science content standards (district, state, or national).	
Q128	State science content standards (e.g. what they are and how they are used).	
Q129	Alignment of science instruction to curriculum.	
	Climate of Trust (PRCOLL)	**0.817**
Q93	I am supported by colleagues to try out new ideas in teaching science.	
Q96	Science teachers in this school trust each other.	
Q97	It's OK in this school to discuss feelings, worries, and frustrations with other science teachers.	
Q98	Science teachers respect other teachers who take the lead in school improvement efforts.	
Q99	It's OK in this school to discuss feelings, worries, and frustrations with the principal.	
Q100	The principal takes personal interest in the professional development of the teachers.	
	Content Readiness (CNTRDY)	**0.896**
q81	Teach science at our assigned level.	
q82	Integrate science with other subjects.	
q83	Provide science instruction that meets science content standards.	
q84	Use a variety of assessment strategies (incl. objective and open-ended formats.)	
q85	Manage a class of students engaged in hands-on laboratory activities	
q86	Teach science with manipulatives such as counting blocks or geometric shapes	
	Equity Readiness (EQTYRDY)	**0.827**
q87	Teach students with physical disabilities.	
q88	Teach classes for students with diverse abilities.	
q89	Teach science to students from a variety of cultural backgrounds.	
q90	Teach science to students who have limited english proficiency.	

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
SEC Science Scales

	Reliability Coefficient
Perform Procedures (PERFPROC)	**0.881**
Q29 Do a laboratory activity, investigation, or experiment.	
Q38 Follow step-by-step directions.	
Q39* Use science equipment or measuring tools.	
Q40 Collect data.	
Q42 Organize and display information in tables or graphs.	
Q45 Make observations/classifications.	
Q58 Practice procedures.	
Q59* Use sensors and probes (e.g. Computer Based Labs)	
Communicate Understanding of Scientific Concepts (COMUND)	**0.884**
Q28 Write about science in a report/paper on science topics.	
Q46 Complete written assignments from the textbook or workbook.	
Q48 Write up results or prepare a presentation from a laboratory activity, investigation, experiment or a research project.	
Q50 Work on a writing project or entries for portfolios seeking paper comments to improve work.	
Q52 Have class discussions about the data.	
Q53 Organize and display the information in tables or graphs.	
Q56 Make a presentations to the class on the data, analysis, or interpretation.	
Analyze Information (ANLYZ)	**0.834**
Q43 Analyze and interpret science data.	
Q54 Make a prediction based on the data.	
Q55 Analyze and interpret the information or data, orally or in writing.	
Q61 Display and analyze data.	
Make Connections (CNNCT)	**0.809**
Q37 Make educated guesses, predictions, or hypotheses.	
Q41 Collect data.	
Q44* Design their own investigation or experiment to solve a scientific question.	
Active Learning (ACLRN)	**0.833**
Q29 Do a laboratory activity, investigation, or experiment.	
Q31 Collect data (other than laboratory activities).	
Q34* Use computers, calculators or other educational technology or learn science.	
Q39* Use science equipment or measuring tools.	
Q44 Design their own investigation or experiment to solve a scientific question.	
Q59* Use sensors and probes (e.g. Computer Based Labs).	

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
SEC Science Scales

PD Frequency (PDFRQ)	For the most recent school year, how often have you participated in:	**0.552**
q101a	workshops or in-service training related to science or science education	
q102a	summer institutes related to science or science education	
q103a	college courses related to science or science education	
PD Hours (Sum) (PDHRS)	For the most recent school year, how many total hours have you participated in:	**0.502**
q101b	workshops or in-service training related to science or science education	
q102b	summer institutes related to science or science education	
q103b	college courses related to science or science education	
Active Teacher Engagement PD (PDACTIV)		**0.830**
q111	Observed demonstrations of teaching techniques.	
q112	Led group discussions.	
q113	Developed curricula or lesson plans, which other participants or the activity leader reviewed.	
q114	Reviewed student work or scored assessments.	
q115	Developed assessments or tasks as part of a formal professional development activity.	
q116	Practiced what you learned and received feedback as part of a professional development activity.	
q117	Received coaching or mentoring in the classroom.	
q118	Given a lecture or presentation to colleagues.	
Coherent PD Program (PDCOHER)		**0.855**
q119	Designed to support the school-wide improvement plan adopted by your school.	
q120	Consistent with you science department or grade level plan to improve teaching.	
q121	Consistent with your own goals for your professional development.	
q122	Based explicitly on what you had learned in earlier professional development activities.	
q123	Followed up with related activities that built upon what you learned as part of the activity	
		Reliability Coefficient
Collective Participation (sum) **(PDCOLL)**		**0.756**
q124	I participated in professional development activities with most or all of the teachers from my school.	.
q125	I participated in professional development activities with most or all of the teachers from my department or grade level.	.
PD w/ Content Focus (PDCNT)		**0.839**
q128*	State science content standards (e.g. what they are and how they are used).	
q129*	Alignment of science instruction to curriculum.	
q131*	In-depth study of science or specific concepts within science (e.g. earth science).	
q132*	Study of how children learn particular topics in science.	

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
SEC Science Scales

PD w/ Data Focus (PDDATA)	**0.826**
q135* Classroom science assessment (e.g. diagnostic approaches, textbook-developed tests, teacher-developed tests).	
q136* State or district science assessment (e.g. preparing for assessments, understanding assessments, or interpreting assessments).	
q137* Interpretation of assessment data for use in science instruction.	
PD w/ Standards & Instruction Focus (PDSTIN)	**0.867**
q128* State science content standards (e.g. what they are and how they are used).	
q129* Alignment of science instruction to curriculum.	
q131* In-depth study of science or specific concepts within science (e.g. earth science).	
q136* State or district science assessment (e.g. preparing for assessments, understanding assessments, or interpreting assessments).	
q137* Interpretation of assessment data for use in science instruction.	
PD w/ Student Learning Focus (PDSTLRN)	**0.865**
q132* Study of how children learn particular topics in science.	
q133 Individual differences in student learning.	
q134 Meeting the learning needs of special populations of students (e.g. second language learners; students with disabilities).	
q135* Classroom science assessment (e.g. diagnostic approaches, textbook-developed tests, teacher-developed tests).	
q138 Technology to support student learning in science.	

* *Item shared with another scale.. Use one or the other scale for analysis.*

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 C

Analyses of Variance Tables

	ANOVA Table	Treatment vs. Comparison						
Item Level Results								
Item	**Homework Activities**			Sum of Squares	df	Mean Square	F	Sig.
Q18	Complete computational exercises or	Between Groups	(Combined)	12.59	1	12.59	6.51	*0.011*
year 1	procedures from a textbook or worksheet.	Within Groups		398.09	206	1.93		
		Total		410.67	207			
Q20	Explain their reasoning or thinking in solving a	Between Groups	(Combined)	8.69	1	8.69	5.99	*0.016*
year 3	problem using several sentences.	Within Groups		130.64	90	1.45		
		Total		139.33	91			
Q22	Collect data as part of mathematics	Between Groups	(Combined)	5.13	1	5.13	4.60	*0.035*
year 3	homework.	Within Groups		100.40	90	1.12		
		Total		105.53	91			
Q23	Work on an assignment, report, or project that	Between Groups	(Combined)	4.11	1	4.11	5.85	*0.016*
year 1	takes longer than one week to complete.	Within Groups		145.19	207	0.70		
		Total		149.30	208			
Item	**Instructional Practices**							
Q31	Work individually on mathematics exercise,	Between Groups	(Combined)	13.06	1	13.06	8.14	*0.005*
year 1	problems, investigations or tasks.	Within Groups		332.25	207	1.61		
		Total		345.31	208			
Q35	Maintain and reflect on a mathematics	Between Groups	(Combined)	9.19	1	9.19	6.56	*0.012*
year 3	portfolio of their own work.	Within Groups		125.95	90	1.40		
		Total		135.14	91			
Item	**Professional Development Freq. & Duration**							
Q103a	PD Institute Frequency	Between Groups	(Combined)	112.80	1	112.80	5.91	*0.017*
year 3		Within Groups		1718.10	90	19.09		
		Total		1830.90	91			
Q103b	PD Institute Hours	Between Groups	(Combined)	3720.96	1	3720.96	8.09	*0.006*
year 3		Within Groups		40911.57	89	459.68		
		Total		44632.53	90			
Q104b	PD College Coursework Hours	Between Groups	(Combined)	4172.64	1	4172.64	6.84	*0.010*
year 3		Within Groups		53660.96	88	609.78		
		Total		57833.60	89			

Appendix C

Analyses of Variance Tables

	ANOVA Table	Treatment vs. Comparison						
Scale Results								
Variable	**Professional Development Scales**			Sum of Squares	df	Mean Square	F	Sig.
PDfreq year 3	Overall PD Frequency	Between Groups	(Combined)	444.93	1	444.93	6.25	*0.014*
		Within Groups		6408.94	90	71.21		
		Total		6853.87	91			
PDhrs year 3	Overall PD Hours	Between Groups	(Combined)	31125.94	1	31125.94	14.66	*0.000*
		Within Groups		191090.80	90	2123.23		
		Total		222216.74	91			
PDcnt year 3	Professional Development with a focus on subject-matter content.	Between Groups	(Combined)	2.81	1	2.81	7.00	*0.010*
		Within Groups		35.39	88	0.40		
		Total		38.21	89			
PDstin year 3	Professional Development with a focus on standards & instruction.	Between Groups	(Combined)	1.83	1	1.83	4.45	*0.038*
		Within Groups		36.17	88	0.41		
		Total		38.00	89			
PDstlrn year 1	Professional Development with a focus on student learning.	Between Groups	(Combined)	2.30	1	2.30	5.02	*0.027*
		Within Groups		43.03	94	0.46		
		Total		45.33	95			
Variable	**Student Activity Scales**							
DemundP year 3	Proportion of time that students spend engaged in activities involving demonstrating understanding of math concepts.	Between Groups	(Combined)	0.06	1	0.06	4.66	*0.034*
		Within Groups		1.15	90	0.01		
		Total		1.21	91			
AnlyzP year3	Proportion of time that students spend engaged in activities involving analysis of mathematical information.	Between Groups	(Combined)	0.01	1	0.01	4.44	*0.038*
		Within Groups		0.13	89	0.00		
		Total		0.14	90			
CnnctP year3	Proportion of time that students spend engaged in activities involving solving non-routine problems.	Between Groups	(Combined)	0.01	1	0.01	6.23	*0.014*
		Within Groups		0.22	90	0.00		
		Total		0.23	91			
CnnctP year 1	Proportion of time that students spend engaged in activities involving solving non-routine problems.	Between Groups	(Combined)	0.02	1	0.02	5.72	*0.019*
		Within Groups		0.36	93	0.00		
		Total		0.38	94			

Appendix C
Analyses of Variance Tables

Significant Change Over Time	(All mathematics teachers with year 1 and year 3 reports.)								
	Paired Samples Test	Paired Differences			95% Confidence Interval of the Difference				
Items		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
q102a	Workshop frequency	-1.34	5.42	0.57	-2.47	-0.21	-2.36	90	*0.020*
q103a	Institute frequency	4.07	4.84	0.51	3.06	5.07	8.02	90	*0.000*
q104a	Coursework frequency	1.32	4.17	0.44	0.45	2.19	3.02	90	*0.003*
q102b	Workshop hours	-11.23	31.74	3.33	-17.84	-4.62	-3.38	90	*0.001*
q103b	Institute hours	15.27	27.22	2.90	9.51	21.04	5.26	87	*0.000*
q104b	Coursework hours	14.50	28.64	3.05	8.43	20.57	4.75	87	*0.000*
ipt32**	Small-group time	0.02	0.07	0.01	0.01	0.03	2.79	90	*0.006*
Scales									
PDfreq	overall PD frequency	4.04	8.93	0.94	2.18	5.90	4.32	90	*0.000*
PDhrs	overall PD hours	18.00	58.83	6.17	5.75	30.25	2.92	90	*0.004*
PDactiv	PD w/ Active Learning	0.26	0.70	0.07	0.12	0.41	3.55	89	*0.001*
PDcoher	Coherent PD prog.	0.36	1.35	0.15	0.07	0.66	2.47	83	*0.016*
PDcoll	Collective participation	0.90	2.00	0.21	0.48	1.32	4.30	90	*0.000*
PDcnt	PD w/ content focus	0.28	0.83	0.09	0.11	0.45	3.19	88	*0.002*
PDdata	PD w/ data focus	0.32	0.90	0.10	0.13	0.51	3.37	88	*0.001*
PDstlrn	PD w/ stud. lrng. Focus	0.29	0.85	0.09	0.11	0.47	3.22	88	*0.002*
TstUse	Test Use	0.19	0.65	0.07	0.05	0.32	2.75	91	*0.007*
CntRdy	Readiness for Innovative Practice	0.27	0.64	0.07	0.14	0.40	4.06	91	*0.000*
PerfProcR*	Procedural activities	-0.28	0.83	0.09	-0.45	-0.10	-3.17	91	*0.002*
DemundR*	Demo. Understanding activities	-0.31	0.99	0.10	-0.51	-0.10	-2.99	91	*0.004*
AnlyzR*	Analysis activities	-0.33	0.97	0.10	-0.53	-0.13	-3.23	91	*0.002*
AclrnR*	Active Learning	-0.19	0.85	0.09	-0.36	-0.01	-2.10	91	*0.039*
CnnctR*	Making Connections activities	-0.30	0.94	0.10	-0.50	-0.11	-3.12	91	*0.002*
Alignment									
ALNSTD	Targeted Content Standards	0.04	0.06	0.01	0.03	0.05	5.80	76	0.000
ALNAEP	NAEP Framework	0.05	0.06	0.01	0.04	0.07	6.37	58	0.000
ALNCTM	NCTM Content Standards	-0.02	0.06	0.01	-0.03	0.00	-2.05	58	0.045

* Scale based upon raw data response (does not take into account time reported on other activities)

** Scale/item converted to proportion of instructional time, taking into account all activities reported on

Appendix C
Analyses of Variance Tables

Item	ANOVA Table	Treatment vs. Comparison						
Item Level Results								
Item	**Homework Activities**			Sum of Squares	df	Mean Square	F	Sig.
Q18 year 3	Read about science in books, magazines, or articles	Between Groups	(Combined)	8.38	1	8.38	8.13	*0.006*
		Within Groups		73.24	71	1.03		
		Total		81.62	72			
Q20 year 3	Solve science problems that require computation.	Between Groups	(Combined)	19.44	1	19.44	13.83	*0.000*
		Within Groups		99.81	71	1.41		
		Total		119.25	72			
Q21 year 1	Revise and improve students' own work (e.g. tests, homework, assignments)	Between Groups	(Combined)	12.39	1	12.39	9.59	*0.003*
		Within Groups		56.85	44	1.29		
		Total		69.24	45			
Q21 year 3	Revise and improve students' own work (e.g. tests, homework, assignments)	Between Groups	(Combined)	10.31	1	10.31	6.56	*0.013*
		Within Groups		111.68	71	1.57		
		Total		121.99	72			
Q22 year 1	Collect data or information about science	Between Groups	(Combined)	5.25	1	5.25	4.28	*0.045*
		Within Groups		53.97	44	1.23		
		Total		59.22	45			
Q22 year 3	Collect data or information about science.	Between Groups	(Combined)	16.67	1	16.67	8.44	*0.005*
		Within Groups		138.24	70	1.97		
		Total		154.91	71			
	Instructional Practices							
Q23 year 1	Work on an assignment, report, or project that takes longer than one week to complete.	Between Groups	(Combined)	9.26	1	9.26	6.07	*0.018*
		Within Groups		67.19	44	1.53		
		Total		76.46	45			
Q26 year 3	Listen to the teacher explain something to the class as a whole about science.	Between Groups	(Combined)	7.20	1	7.20	6.80	*0.011*
		Within Groups		75.17	71	1.06		
		Total		82.37	72			
Q27 year 1	Work individually on science assignments.	Between Groups	(Combined)	6.76	1	6.76	5.57	*0.023*
		Within Groups		54.56	45	1.21		
		Total		61.32	46			
Q28 year 3	Write about science in books, magazines, articles (not textbooks)	Between Groups	(Combined)	6.24	1	6.24	4.38	*0.040*
		Within Groups		101.27	71	1.43		
		Total		107.51	72			
Q29 year 3	Do a laboratory activity, investigation, or experiment.	Between Groups	(Combined)	14.95	1	14.95	10.46	*0.002*
		Within Groups		101.52	71	1.43		
		Total		116.47	72			

	ANOVA Table	Treatment vs. Comparison						
Item Level Results (cont.)								
	Instructional Practices (cont.)							
Q30 year 3	Collect data (other than laboratory activities).	Between Groups	(Combined)	9.74	1	9.74	8.06	*0.006*
		Within Groups		85.77	71	1.21		
		Total		95.51	72			
Q31 year 3	Collect data (other than laboratory activities).	Between Groups	(Combined)	13.52	1	13.52	8.77	*0.004*
		Within Groups		109.47	71	1.54		
		Total		122.99	72			
Q33 year 3	Do a science activity with the class outside the classroom or science laboratory (for example, field trips	Between Groups	(Combined)	6.05	1	6.05	5.08	*0.027*
		Within Groups		84.58	71	1.19		
		Total		90.62	72			
Q34 year 3	Use computers, calculators or other educational technology to learn science.	Between Groups	(Combined)	7.61	1	7.61	4.08	*0.047*
		Within Groups		132.41	71	1.86		
		Total		140.02	72			
Q36 year 3	Take a quiz or test.	Between Groups	(Combined)	12.24	1	12.24	7.23	*0.009*
		Within Groups		120.15	71	1.69		
		Total		132.39	72			
ipt19* year 3	Proportion of homework time spent answering questions from a science textbook or worksheet.	Between Groups	(Combined)	0.18	1	0.18	6.36	*0.014*
		Within Groups		1.89	66	0.03		
		Total		2.07	67			
ipt20* year 3	Proportion of homework time spent solving problems that require computation.	Between Groups	(Combined)	0.05	1	0.05	4.92	*0.030*
		Within Groups		0.60	66	0.01		
		Total		0.65	67			
ipt25* year 3	Proportion of time spent listening to the teacher explain something about science.	Between Groups	(Combined)	0.03	1	0.03	6.30	*0.014*
		Within Groups		0.31	71	0.00		
		Total		0.34	72			
ipt27* year 1	Work individually on science assignments.	Between Groups	(Combined)	0.02	1	0.02	8.20	*0.006*
		Within Groups		0.10	45	0.00		
		Total		0.12	46			
ipt27* year 3	Work individually on science assignments.	Between Groups	(Combined)	0.04	1	0.04	8.55	*0.005*
		Within Groups		0.30	71	0.00		
		Total		0.33	72			
ipt31* year 3	Collect data (other than laboratory activities).	Between Groups	(Combined)	0.01	1	0.01	5.66	*0.020*
		Within Groups		0.13	71	0.00		
		Total		0.14	72			

** Scale/item converted to proportion of instructional time, taking into account all activities reported on

Appendix C
Analyses of Variance Tables

	ANOVA Table	Treatment vs. Comparison						
Professional Development Items								
q101a	PD Workshop Frequency	Between Groups	(Combined)	74.60	1	74.60	4.05	*0.048*
year 1		Within Groups		1308.93	71	18.44		
		Total		1383.53	72			
q101b	PD Workshop Hours	Between Groups	(Combined)	1960.49	1	1960.49	3.91	*0.052*
year 1		Within Groups		35578.79	71	501.11		
		Total		37539.28	72			
q101b	PD Workshop Hours	Between Groups	(Combined)	2508.34	1	2508.34	4.82	*0.031*
year 3		Within Groups		36412.27	70	520.18		
		Total		38920.61	71			
q102a	PD Institute Frequency	Between Groups	(Combined)	91.84	1	91.84	5.27	*0.025*
year 3		Within Groups		1219.81	70	17.43		
		Total		1311.65	71			
q103a	PD Coursework Frequency	Between Groups	(Combined)	122.73	1	122.73	8.29	*0.005*
year 3		Within Groups		1050.74	71	14.80		
		Total		1173.48	72			
q103b	PD Coursework Hours	Between Groups	(Combined)	2784.03	1	2784.03	4.33	*0.041*
year 3		Within Groups		43746.55	68	643.33		
		Total		46530.59	69			
Content Marginals								
NbrTpc	Number of Topics Covered	Between Groups	(Combined)	3778.90	1	3778.90	4.74	*0.033*
year 1		Within Groups		48640.85	61	797.39		
		Total		52419.75	62			
cgdB	Memorize/Recall Instructional Content	Between Groups	(Combined)	0.04	1	0.04	5.14	*0.027*
year 3		Within Groups		0.53	61	0.01		
		Total		0.57	62			
cgdC	Perform Procedures with Instructional Content	Between Groups	(Combined)	0.01	1	0.01	5.82	*0.019*
year 1		Within Groups		0.07	61	0.00		
		Total		0.08	62			
cgdD	Demonstrate Understanding of Instructional Content	Between Groups	(Combined)	0.01	1	0.01	4.11	*0.047*
year 1		Within Groups		0.15	61	0.00		
		Total		0.16	62			
cgdE	Apply Concepts, Make Connections with Instructional Content	Between Groups	(Combined)	0.01	1	0.01	6.44	*0.014*
year 3		Within Groups		0.12	61	0.00		
		Total		0.14	62			
mx13	Instructional Content: Motion & Forces	Between Groups	(Combined)	0.01	1	0.01	6.05	*0.019*
year 3		Within Groups		0.07	35	0.00		
		Total		0.08	36			

Appendix C
Analyses of Variance Tables

	ANOVA Table	Treatment vs. Comparison						
Professional Development Scales								
Pdfreq year 3	Overall PD Frequency	Between Groups	(Combined)	747.74	1	747.74	7.91	*0.006*
		Within Groups		6710.31	71	94.51		
		Total		7458.05	72			
PDhrs year 3	Overall PD Hours	Between Groups	(Combined)	18405.44	1	18405.44	6.46	*0.013*
		Within Groups		199419.83	70	2848.85		
		Total		217825.28	71			
PDcoher year 1	Coherent PD Program	Between Groups	(Combined)	3.84	1	3.84	6.37	*0.014*
		Within Groups		41.62	69	0.60		
		Total		45.46	70			
PDcnt year 1	Professional Development with a focus on subject-matter content.	Between Groups	(Combined)	3.99	1	3.99	6.91	*0.010*
		Within Groups		40.97	71	0.58		
		Total		44.96	72			
PDcnt year 3	Professional Development with a focus on subject-matter content.	Between Groups	(Combined)	3.28	1	3.28	4.80	*0.032*
		Within Groups		48.42	71	0.68		
		Total		51.70	72			
Pddata year 1	Professional Development with a focus on data.	Between Groups	(Combined)	2.74	1	2.74	4.37	*0.040*
		Within Groups		44.58	71	0.63		
		Total		47.32	72			
Pdstin year 1	Professional Development with a focus on standards & instruction.	Between Groups	(Combined)	2.61	1	2.61	4.85	*0.031*
		Within Groups		38.25	71	0.54		
		Total		40.86	72			

Appendix C
Analyses of Variance Tables

	ANOVA Table	Treatment vs. Comparison						
Instructional Practice Scales								
TstUse year 1	Use of Classroom Assessments	Between Groups	(Combined)	1.44	1	1.44	5.34	*0.025*
		Within Groups		12.16	45	0.27		
		Total		13.61	46			
TstUse	Use of Classroom Assessments	Between Groups	(Combined)	1.91	1	1.91	4.68	*0.034*
		Within Groups		29.03	71	0.41		
		Total		30.94	72			
CntRdy year 3	Readiness for Innovative Practice	Between Groups	(Combined)	2.00	1	2.00	7.47	*0.008*
		Within Groups		19.00	71	0.27		
		Total		21.00	72			
PerfProcR year 3	Student activities involving performance of procedures	Between Groups	(Combined)	5.59	1	5.59	6.99	*0.010*
		Within Groups		56.79	71	0.80		
		Total		62.38	72			
CommR* year 3	Student activities involving communicating understanding of science concepts.	Between Groups	(Combined)	10.78	1	10.78	11.66	*0.001*
		Within Groups		65.61	71	0.92		
		Total		76.38	72			
AnlyzR* year 3	Student activities involving analysis of science information.	Between Groups	(Combined)	6.81	1	6.81	6.31	*0.014*
		Within Groups		76.68	71	1.08		
		Total		83.49	72			
AclrnR* year 3	Student activities involving use of active learning strategies.	Between Groups	(Combined)	7.94	1	7.94	10.76	*0.002*
		Within Groups		52.41	71	0.74		
		Total		60.35	72			
CnnctR* year 3	Student activities involving applying concepts and making connections.	Between Groups	(Combined)	15.28	1	15.28	12.79	*0.001*
		Within Groups		84.83	71	1.19		
		Total		100.11	72			
CnnctP** year 1	Proportion of instructional time students apply concepts and make connections.	Between Groups	(Combined)	0.00	1	0.00	4.88	*0.032*
		Within Groups		0.00	45	0.00		
		Total		0.00	46			
CnnctP** year 3	Proportion of instructional time students apply concepts and make connections.	Between Groups	(Combined)	0.00	1	0.00	10.31	*0.002*
		Within Groups		0.01	71	0.00		
		Total		0.02	72			

* Scale based upon raw data response (does not take into account time reported on other activities)

** Scale/item converted to proportion of instructional time, taking into account all activities reported on

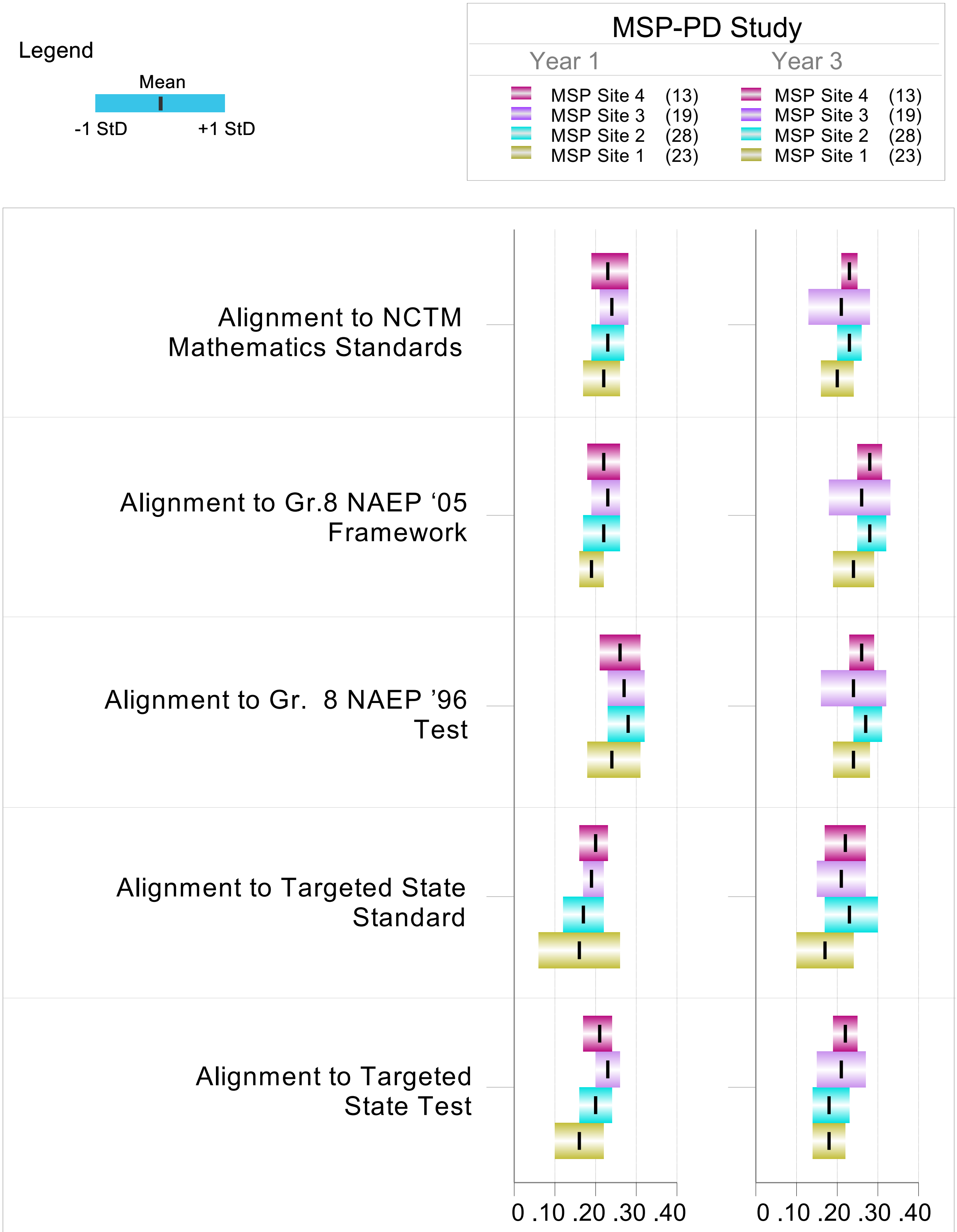
Appendix C
Analyses of Variance Tables

	Change Over Time Paired Samples Test	(All science teachers with year 1 and year 3 results.) Paired Differences Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	t	df	Sig. (2-tailed)
Items									
ipt34***	Activities involving Ed. Tech.	0.02	0.07	0.01	0.00	0.05	2.10	41	*0.04*
Q102a	PD Institute Frequency	2.07	4.52	0.71	0.65	3.50	2.93	40	*0.01*
Q103a	PD Coursework Frequency	1.48	4.64	0.72	0.03	2.92	2.06	41	*0.05*
Scales									
InflSt	Influence of Standards on Instr.	0.15	0.39	0.06	0.03	0.28	2.55	41	*0.01*
CntRedi	Readiness for Innovative Pract.	0.20	0.56	0.09	0.03	0.37	2.31	41	*0.03*
EqRedi	Readiness for Diverse Populations	0.18	0.53	0.08	0.02	0.35	2.26	41	*0.03*
Pdfreq	Overall PD Frequency	4.55	10.60	1.64	1.24	7.85	2.78	41	*0.01*
Student Activities									
ProcR*	Procedural activities	-0.75	0.81	0.13	-1.01	-0.50	-6.02	41	*0.00*
CommR*	Communicate understanding	-0.49	0.88	0.14	-0.76	-0.22	-3.61	41	*0.00*
AnlyzR*	Analyze information activities	-0.43	1.06	0.16	-0.76	-0.10	-2.64	41	*0.01*
AnlyzP**	Analyze information activities	0.01	0.03	0.01	0.00	0.02	2.62	41	*0.01*
AclrnR*	Active Learning	-0.53	0.70	0.11	-0.75	-0.31	-4.90	41	*0.00*
AclrnP**	Active Learning	0.05	0.11	0.02	0.01	0.08	2.87	41	*0.01*
CnnctR*	Make Connection activities	-0.70	0.86	0.13	-0.97	-0.43	-5.29	41	*0.00*
Alignment									
TrgStd	Targeted Science Standards	-0.02	0.06	0.01	-0.04	0.00	-2.44	59	*0.01*
TrgNSE	Natl. Sci. Education Standards	-0.02	0.04	0.01	-0.03	0.00	-2.36	23	*0.03*

* Scale based upon raw data response (does not take into account time reported on other activities)
** Scale/item converted to proportion of instructional time, taking into account all activities reported on

Appendix D

Mathematics
Alignment Results
By District



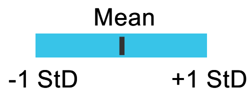
Appendix D

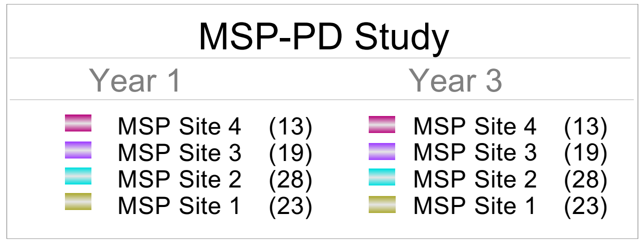
Mathematics

Standards Influence & Professional Collegiality Scales

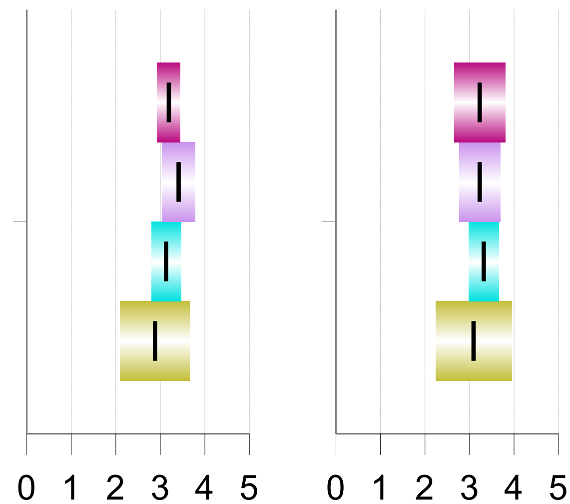
By District

Legend



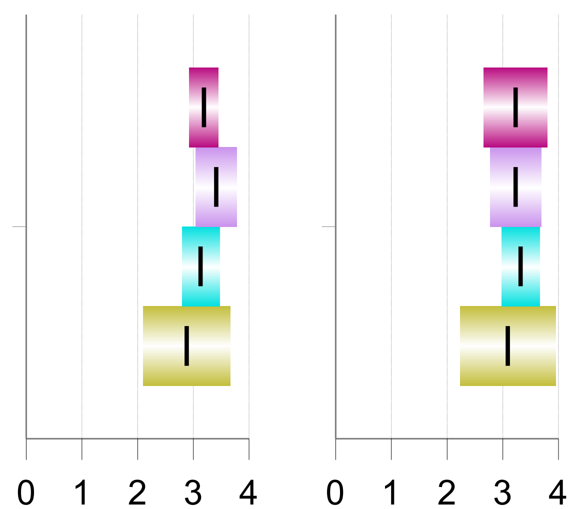


Influence of Standards on Mathematics Instruction



0 = Not Applicable
1 = Strong Negative Influence
2 = Somewhat Negative Influence
3 = Little or No Influence
4 = Somewhat Positive Influence
5 = Strong Positive Influence

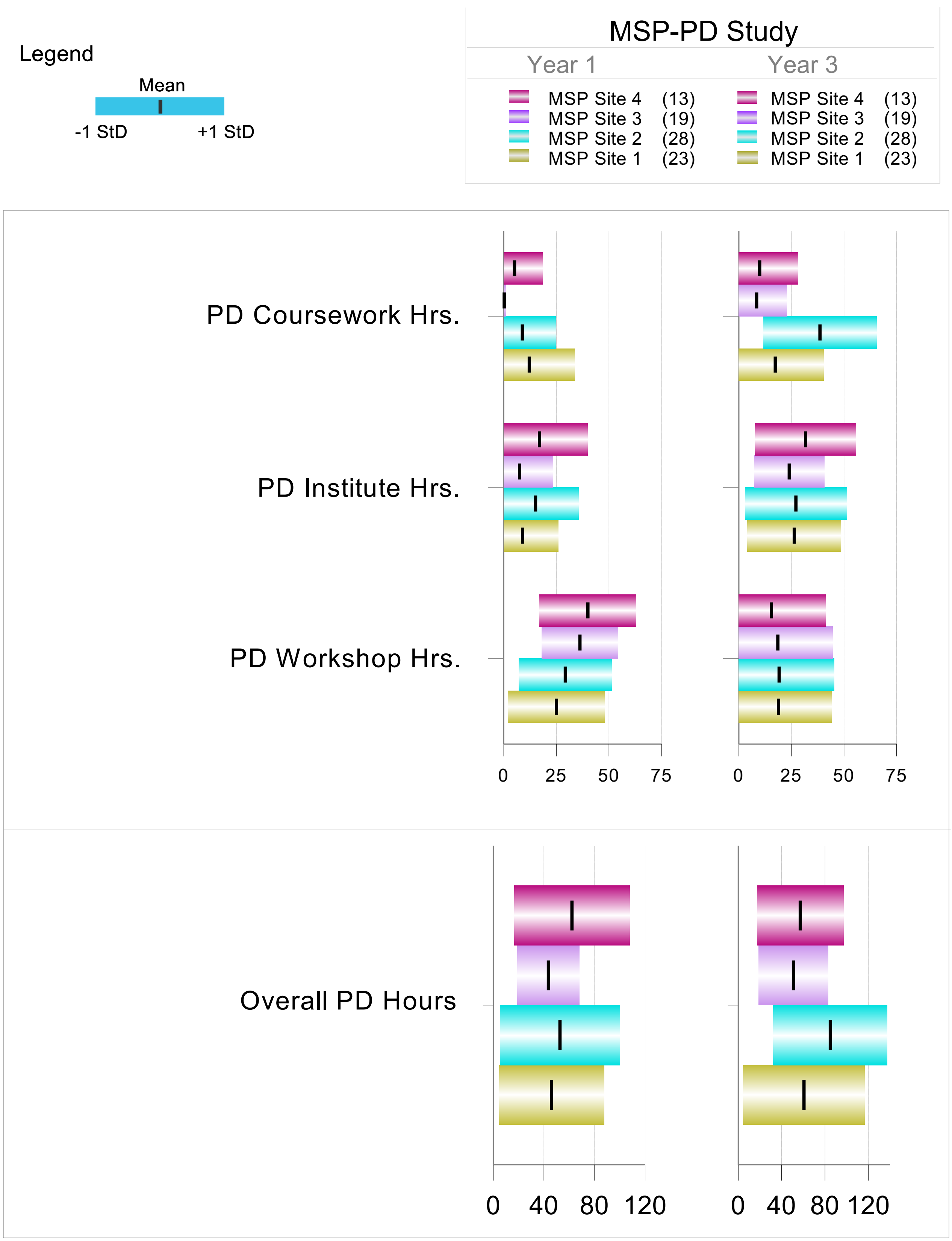
Professional Collegiality & Trust



0 = Strongly Disagree
1 = Disagree
2 = Neutral/Undecided
3 = Agree
4 = Strongly Agree

Appendix D

Mathematics
Amount of Professional Development Activities
By District

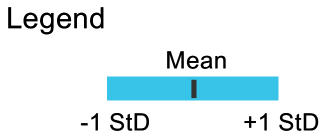


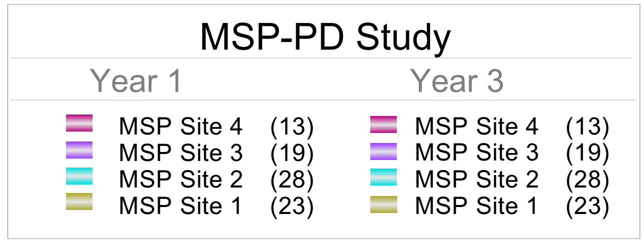
Appendix D

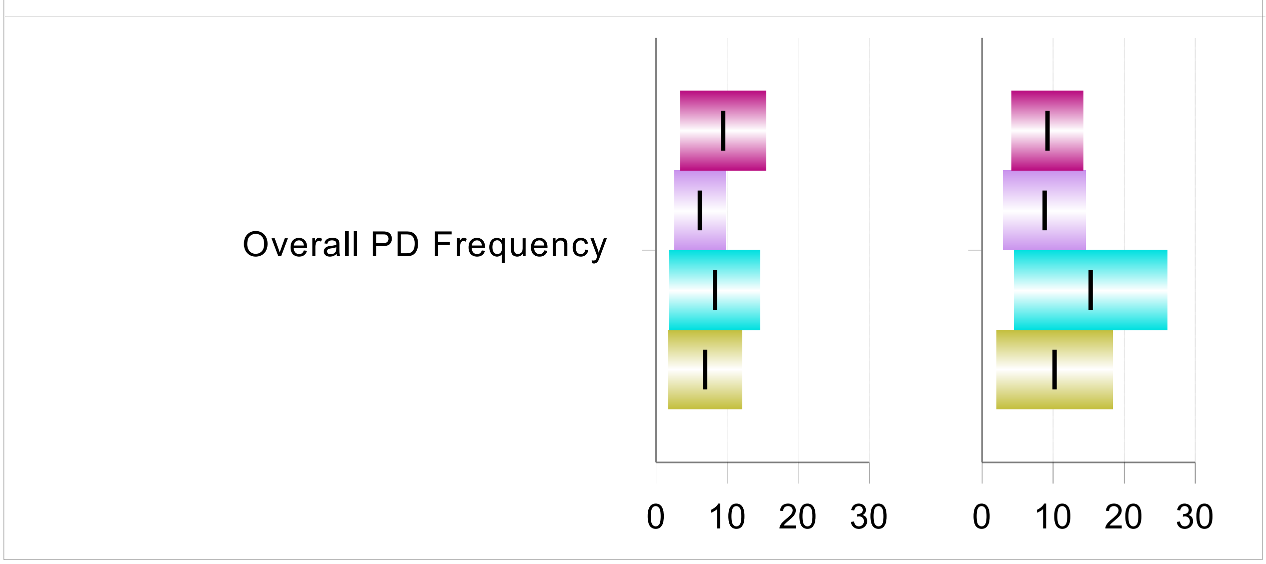
Mathematics

Frequency of Professional Development Activities

By District





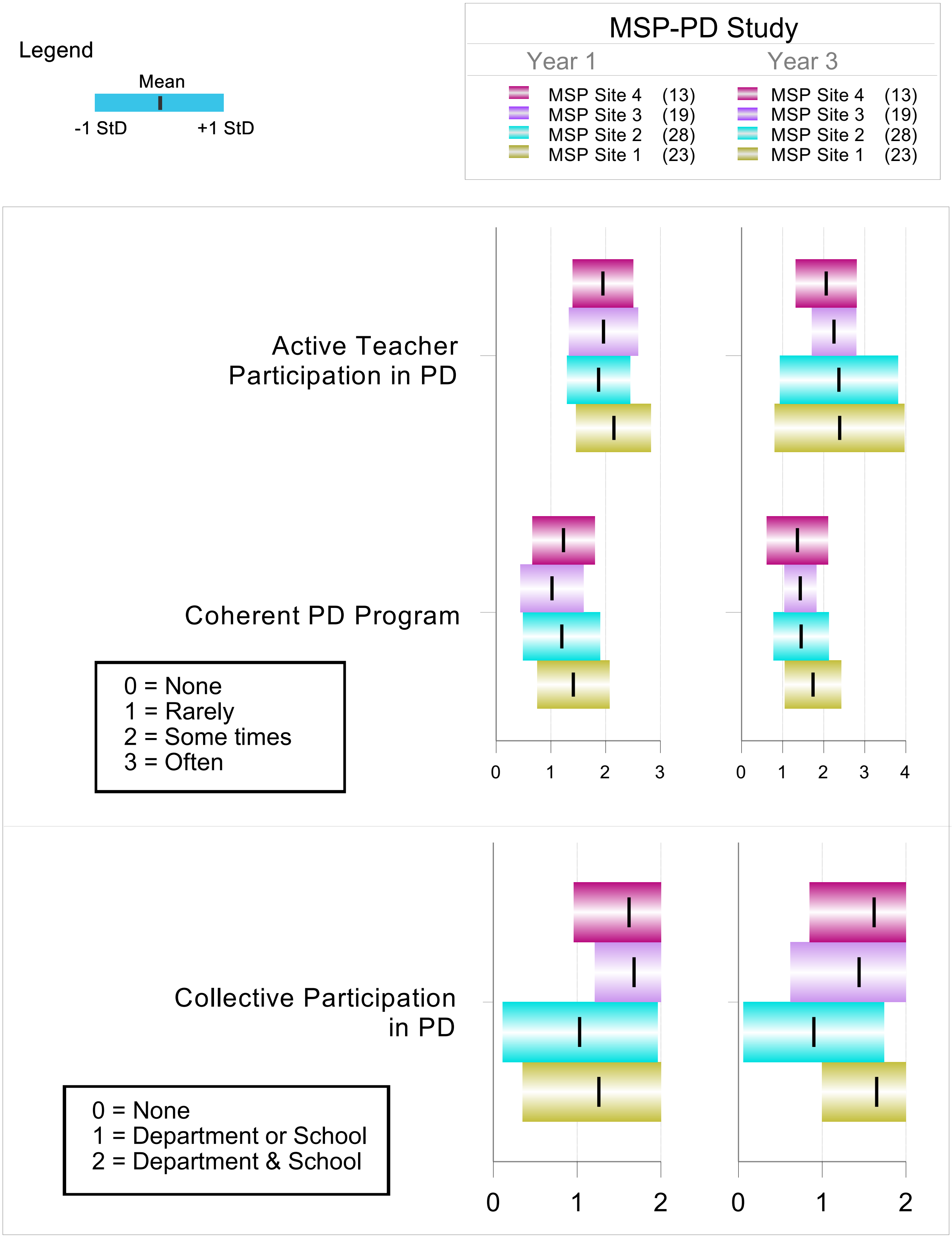


Appendix D

Mathematics

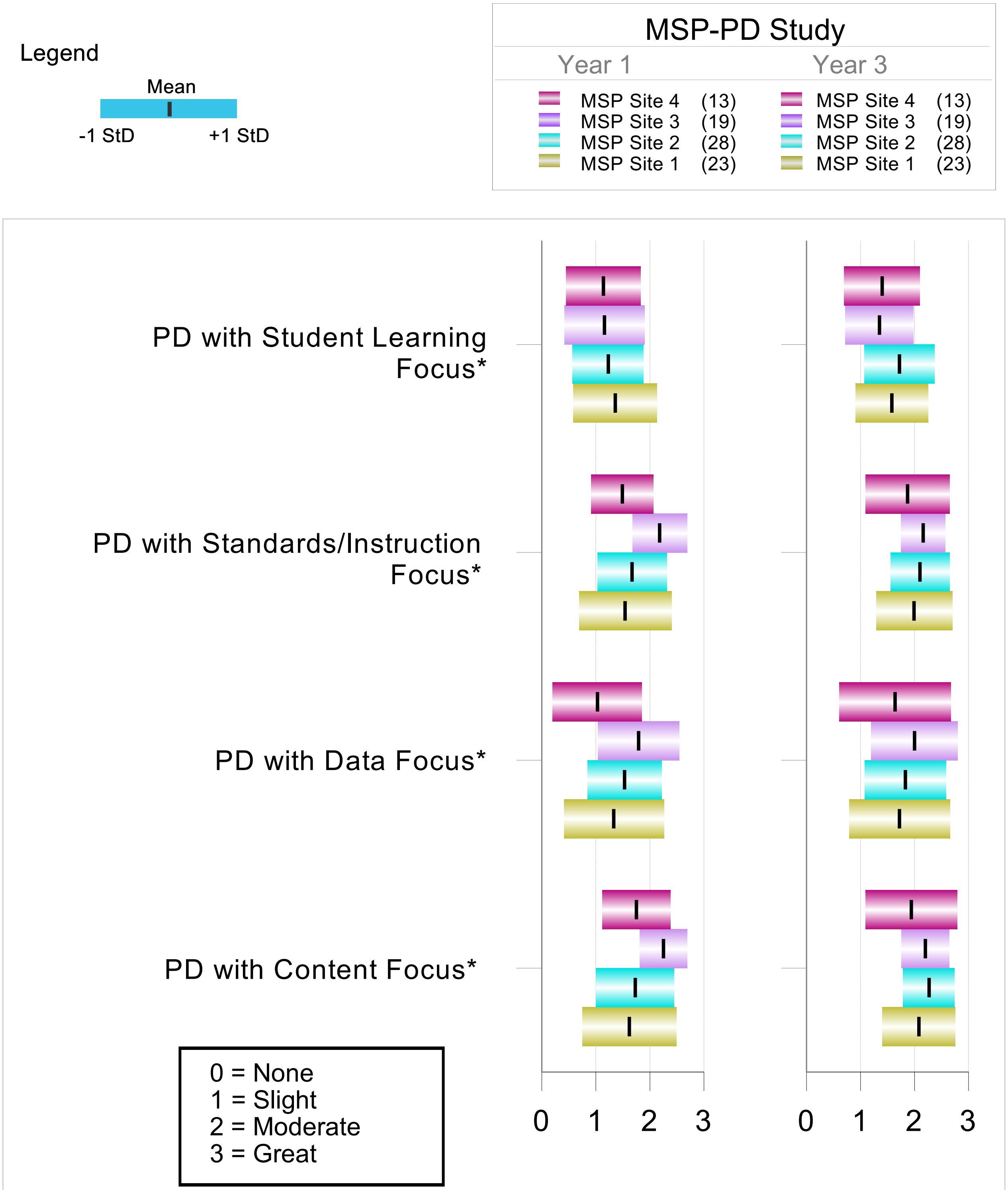
Characteristics of Professional Development Activities

By District



Appendix D

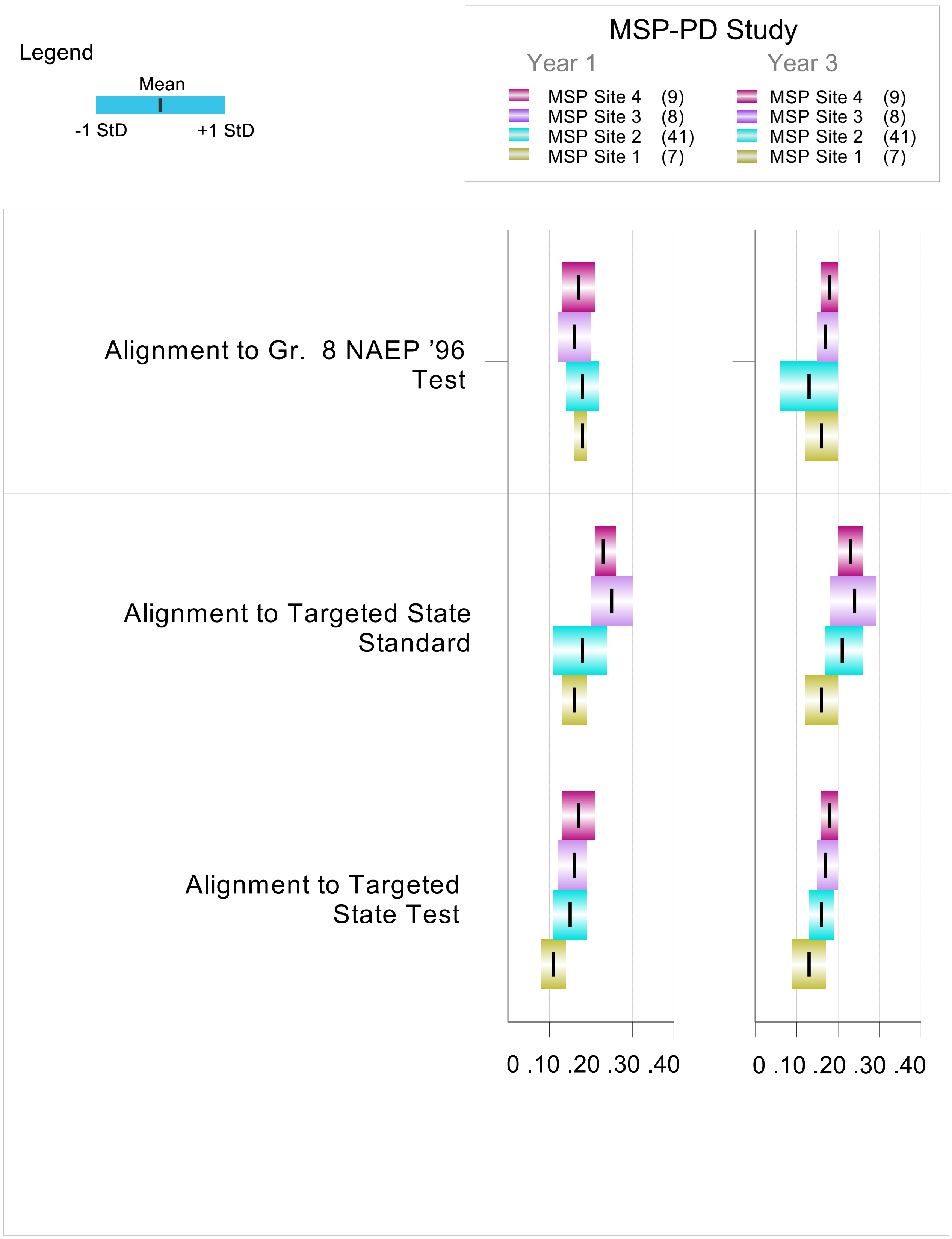
Mathematics
Focus of Professional Development Activities
By District



* These scales share some common items and should be used separately for analysis purposes.

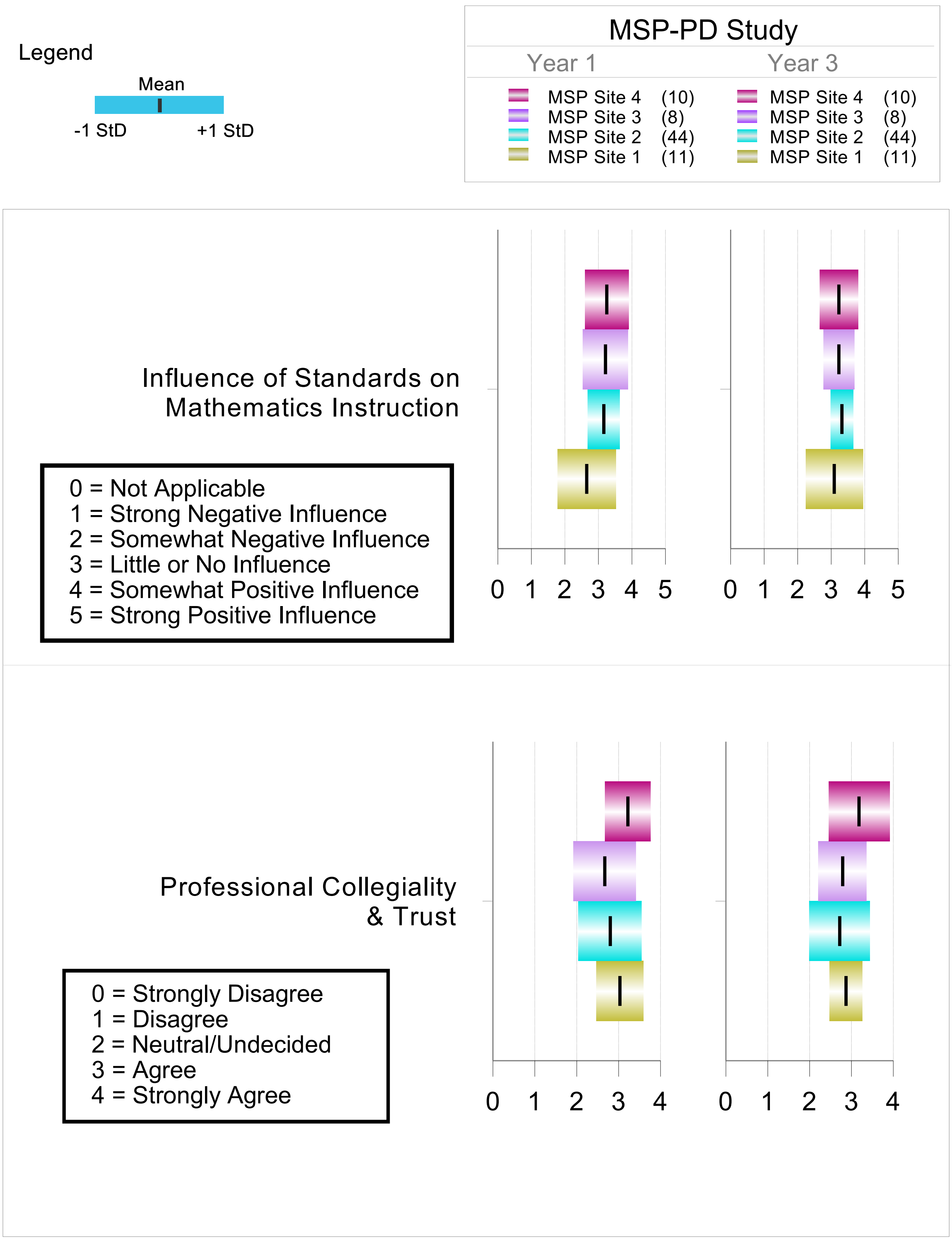
Appendix D

Science
Alignment Results
By District



Appendix D

Science
Standards Influence & Professional Collegiality Scales
By District



Appendix D

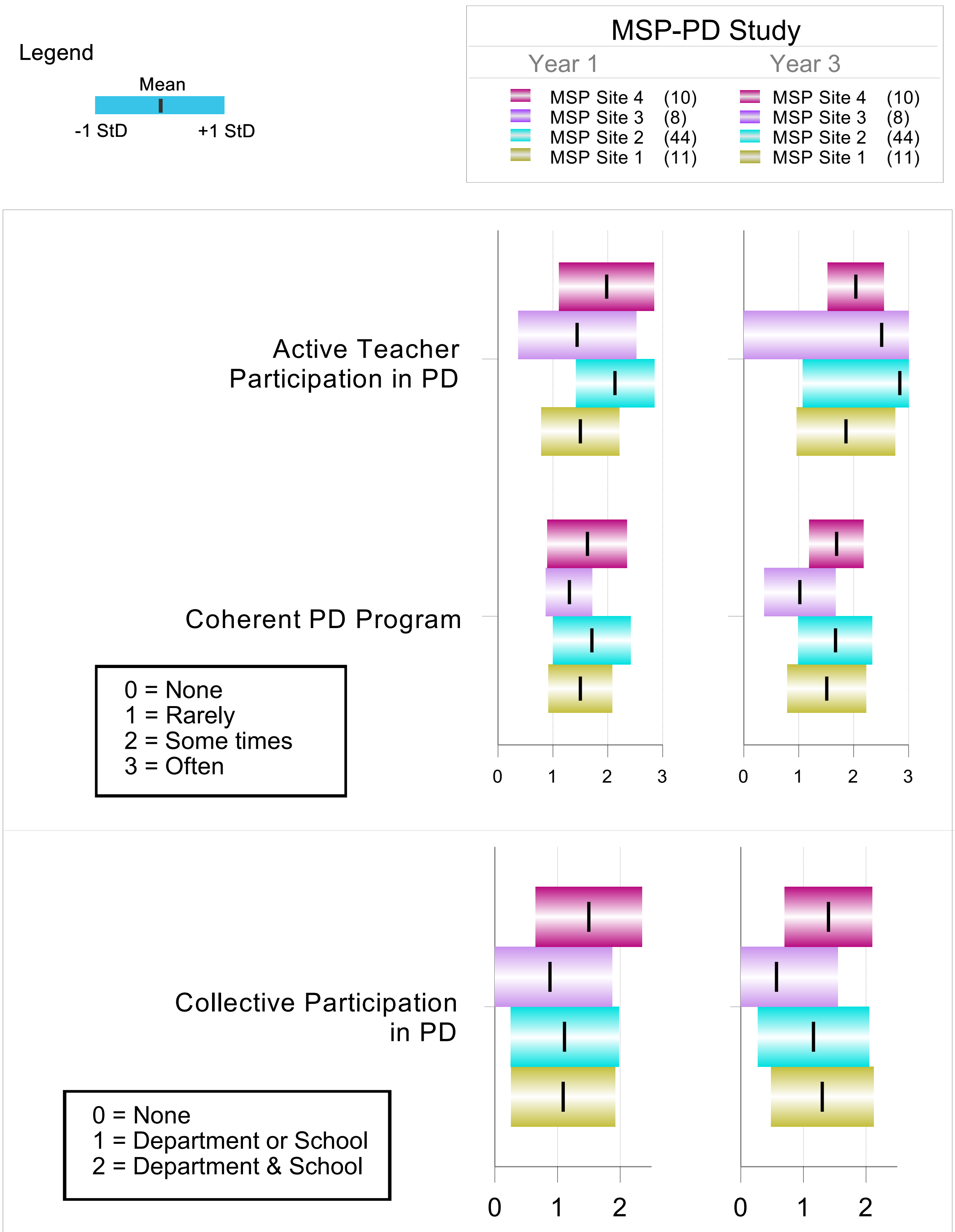
Science

Frequency of Professional Development Activities

By District

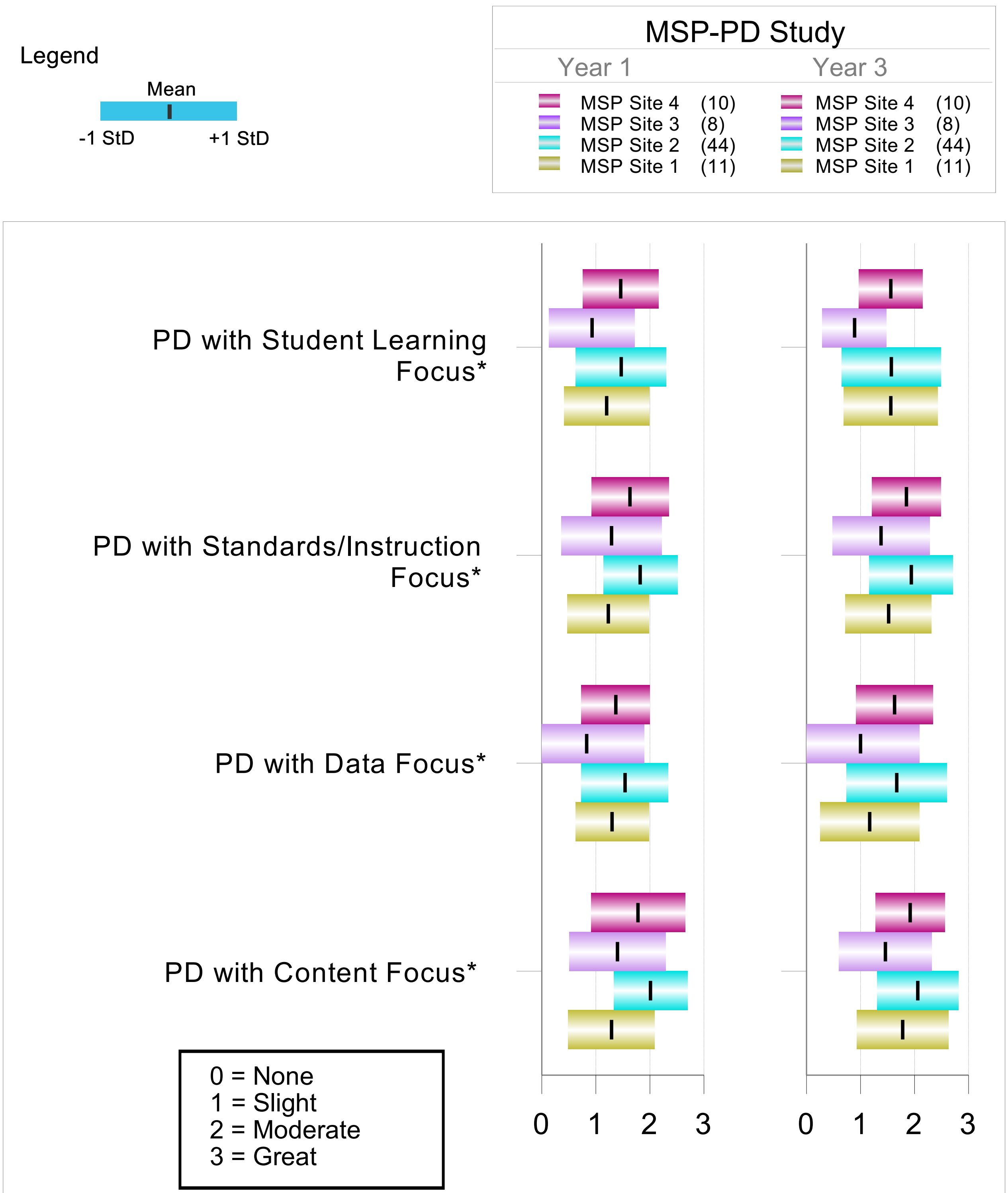
Appendix D

Science
Characteristics of Professional Development Activities
By District



Appendix D

Science
Focus of Professional Development Activities
By District



* These scales share some common items and should be used separately for analysis purposes.

Appendix E - Mathematics Content   Texas

Percentage of Overall Mathematics Instructional Time

Alignment Re-centered: 0.5211

☐	= Not Covered
(light yellow)	= < 2.5%
(light orange)	= < 5.0%
(orange)	= < 7.5%
(dark orange)	= >= 7.5%

Administration Year:	2005	2005
Sample Selection:	Texas Data	TX Stnd (2003) Gr. 8
Report By:	All Data	All Data

Update

☐ Show Data Tables

Count: 77   1

☐ Number Sense / Properties / Relationships

☐ Operations

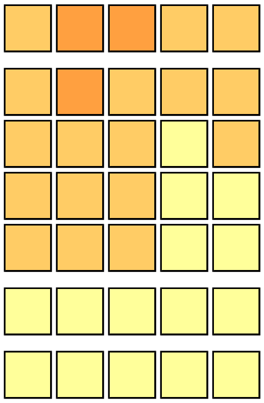
☐ Measurement

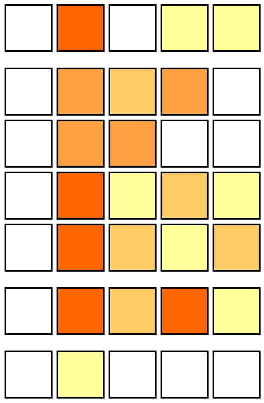
☐ Algebraic Concepts

☐ Geometric Concepts

☐ Data Analysis / Probability / Statistics

☐ Instructional Technology





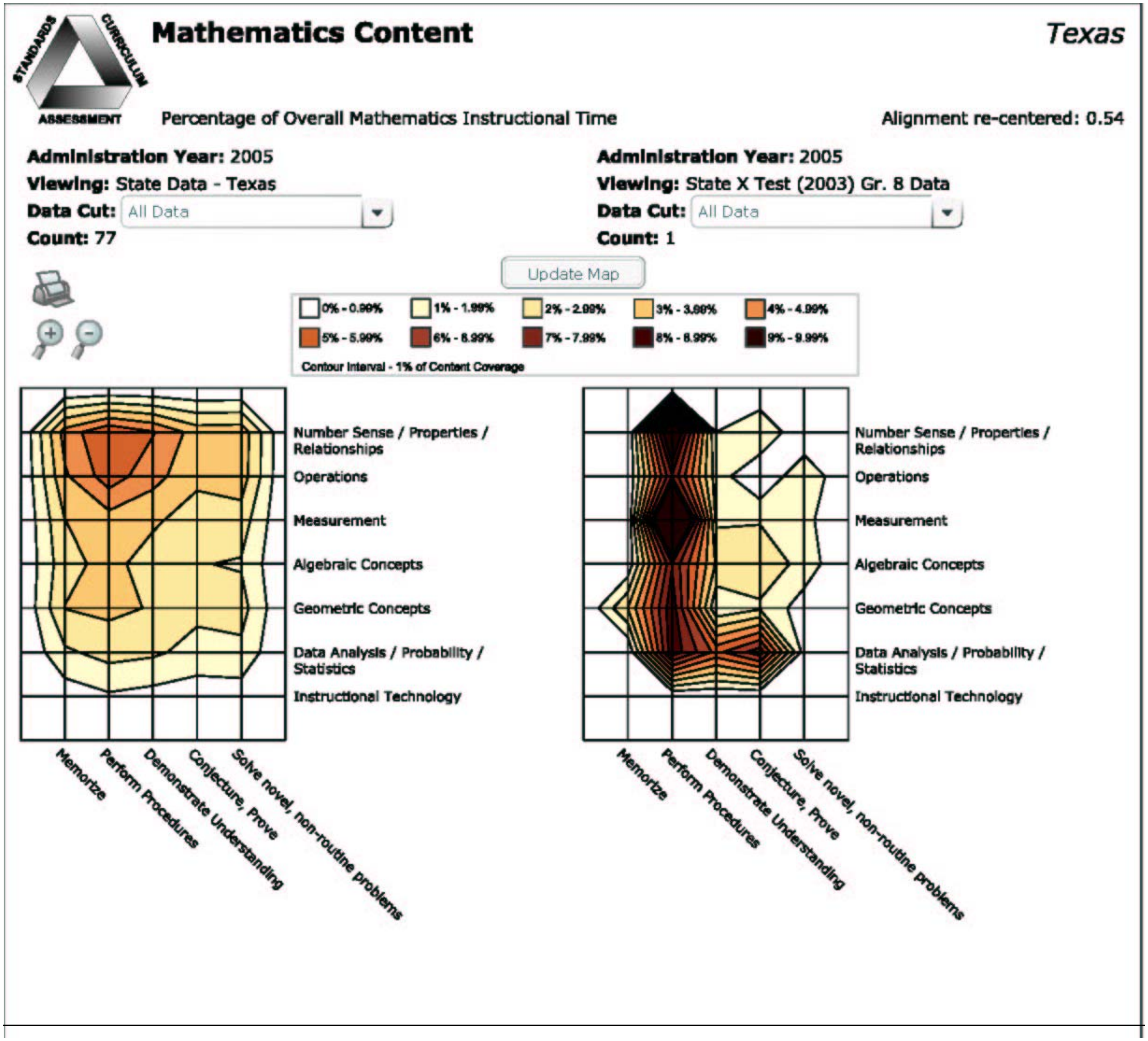
Student Expectations

I. Memorize
II. Perform Procedures
III. Demonstrate Understanding
IV. Conjecture, Prove
V. Solve novel, non-routine problems

I. II. III. IV. V.   I. II. III. IV. V.

Display Selected Fine Grain Charts   Return to Report Generator

Appendix E


Mathematics Content
Texas
STANDARDS
CURRICULUM
ASSESSMENT
Percentage of Overall Mathematics Instructional Time
Alignment re-centered: 0.54
Administration Year: 2005
Viewing: State Data - Texas
Data Cut: All Data
Count: 77
Administration Year: 2005
Viewing: State X Test (2003) Gr. 8 Data
Data Cut: All Data
Count: 1
Update Map
0% - 0.99%
1% - 1.99%
2% - 2.99%
3% - 3.99%
4% - 4.99%
5% - 5.99%
6% - 6.99%
7% - 7.99%
8% - 8.99%
9% - 9.99%
Contour Interval - 1% of Content Coverage
Number Sense / Properties / Relationships
Operations
Measurement
Algebraic Concepts
Geometric Concepts
Data Analysis / Probability / Statistics
Instructional Technology
Memorize
Perform Procedures
Demonstrate Understanding
Conjecture, Prove
Solve novel, non-routine problems

Appendix E - Science Content Texas

Percentage of Overall Science Instructional Time

= Not Covered
= < 2.5%
= < 5.0%
= < 7.5%
= >= 7.5%

Alignment Re-centered: 0.453

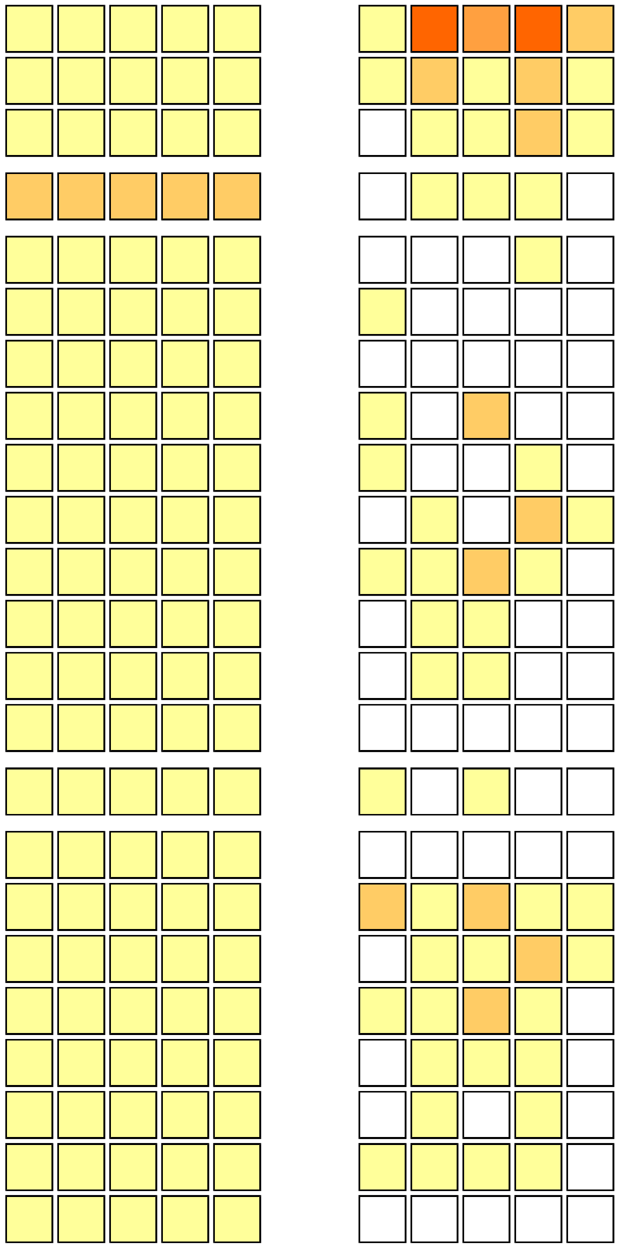
Administration Year:	2005	2005
Sample Selection:	Texas Data	TX Stnd Gr. 8
Report By:	All Data	All Data

Update

☐ Show Data Tables

Count: 36 1

☐ Nature of Science
☐ Science and Technology
☐ Science, Health and Environment
☐ Measurement & Calculation in Science
☐ Components of Living Systems
☐ Botany
☐ Animal Biology
☐ Human Biology
☐ Evolution
☐ Reproduction & Development
☐ Ecology
☐ Energy
☐ Motion & Forces
☐ Electricity
☐ Characteristics & Behaviors of Waves
☐ Kinetics
☐ Properties of Matter
☐ Earth Systems
☐ Astronomy
☐ Meteorology
☐ Elements & The Periodic System
☐ Chemical Formulas & Reactions
☐ Acids, Bases, & Salts



☐ Environmental Chemistry

☐ Nuclear Chemistry

Student Expectations

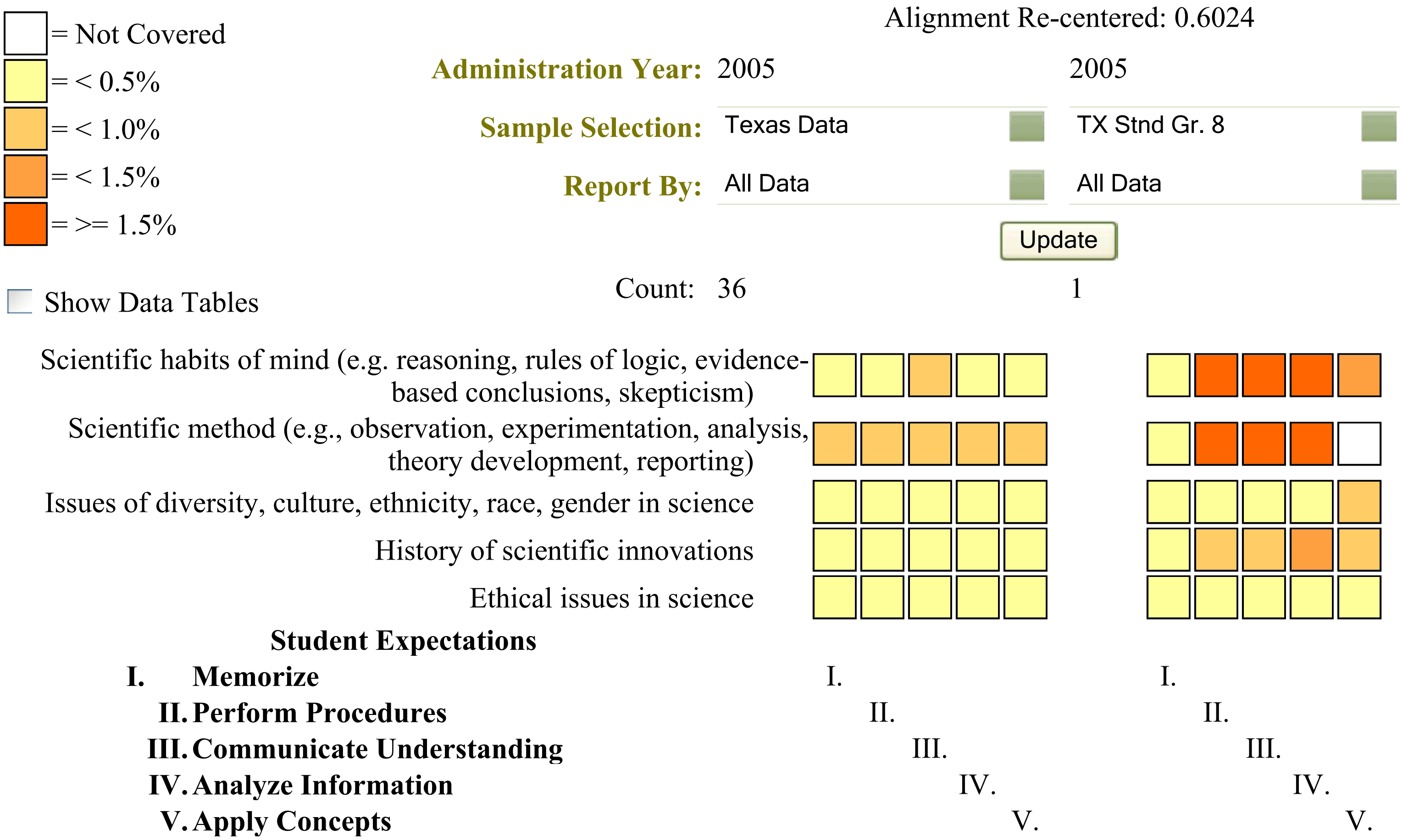
I. Memorize
II. Perform Procedures
III. Communicate Understanding
IV. Analyze Information
V. Apply Concepts

I.	II.	III.	IV.	V.	I.	II.	III.	IV.	V.

Display Selected Fine Grain Charts | Return to Report Generator

Appendix E - ScienceContent: Nature of Science Texas

Percentage of Overall Science Instructional Time



Next Selected Fine Grain Chart

Coarse Grain Chart