Does Teacher Content Preparation Moderate the Impacts of Professional Development?

A Longitudinal Analysis of LSC Teacher Questionnaire Data

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INTRODUCTION

In 1995 the National Science Foundation initiated the Local Systemic Change (LSC) through Teacher Enhancement program to improve instruction in science, mathematics, and technology. Through the LSC program, 88 individual projects were funded, typically in 1 of 4 targeted areas—K–8 science, K–8 mathematics, 6–12 mathematics, or 6–12 science—though some projects targeted 2 of these 4 areas (e.g., K–12 mathematics, or K–8 science and mathematics). LSC projects were expected to provide 130 hours of professional development to each targeted teacher over the course of its funding, with the emphasis on preparing teachers to implement exemplary science and mathematics instructional materials and lessons in their classes.[1]

As part of the cross-site core evaluation, random samples of teachers in each LSC project completed a teacher questionnaire at various time points during the project. Heck and Crawford (2004) performed extensive longitudinal analyses on these data looking at the impact of the LSC program on teacher attitudes toward *Standards*-based teaching, perceptions of pedagogical and content preparedness, and use of traditional and *Standards*-based teaching practices. Given the recent emphasis on the importance of content preparation in the designation of teachers as "highly qualified," an important follow-up question emerged: Does teacher content preparation, as measured by the extent and nature of their college coursework in mathematics/science, moderate the impact of LSC professional development on the variety of attitudes, beliefs, and practices measured? This study seeks to answer the following questions:

1. Are teachers with stronger college content preparation different than teachers with less strong preparation on the outcomes measured by the teacher questionnaire?

2. Does teacher college content preparation moderate the relationship between LSC professional development and these outcomes?

This follow-up study builds on the work of Heck and Crawford (2004). A series of three-level hierarchical linear models (HLM), with time points nested in teachers nested in projects, was used to investigate relationships between college content preparation, amount of LSC professional development, and a variety of teacher attitudes, beliefs, and practices. The analyses were run first using data from all LSC projects. Follow-up analyses were conducted separately for projects targeting K–8 mathematics and for projects targeting K–8 science.

SAMPLE

Between 1997 and 2003, over 70,000 teachers submitted questionnaires as part of the LSC core evaluation. For these analyses, the dataset was reduced by the removal of teacher leaders (who are not representative of the typical teacher targeted by the LSCs) and teachers who were missing questionnaire data on key variables of interest (i.e., hours of LSC professional development or college-level content preparation). Teachers were also dropped from the analyses

[1] Prior to 1999, the requirement for K–8 projects was 100 hours.

if their college-level content preparation decreased over time. The final data set used in these analyses includes data from 56,950 questionnaires, representing 41,071 unique teachers and 85 LSC projects.

The LSC core evaluation requires projects to collect questionnaire data from either a random sample of 300 teachers or their entire targeted population, if 350 or fewer teachers.[2] Because this sampling design leads to unequal probabilities of teachers being selected to receive a questionnaire, sampling weights are used in these analyses. The weights were used at the time-point level to account for unequal probability of selection, due to variation in both project size (i.e., number of targeted teachers) and sample size across time. The weight for teachers in each project was calculated as the ratio of the project size to the number of questionnaires received from that project. Table 1 shows the raw and weighted distribution of teachers in the sample by subject and grade range, as well as the number of projects targeting each subject/grade-range.

Table 1
Teachers and Projects Included in Analyses by Subject/Grade-Range

	***Number* of Projects**	***Number* of Teachers**	***Percent* of Teachers**	**Weighted *Percent* of Teachers**
K–8 Science	42	19,950	49	57
K–8 Mathematics	29	13,504	33	33
6–12 Mathematics	19	5,851	14	9
6–12 Science	7	1077	3	1
Total	**85**†	**40,382**‡	**100**	**100**

† The sum of the projects is greater than the total as some projects target more than one subject/grade-range.
‡ The total number of teachers without missing data for all of the variables used in these analyses. It is important to note that each outcome variable had different patterns of missing data; the analysis of each outcome is based on slightly different numbers of cases.

ANALYSIS AND RESULTS

The clustered design of the LSC data (time points nested within teachers nested within projects) necessitated the use of hierarchical linear modeling to avoid incorrect estimates of program effects. This technique allows for the partitioning of variance into the multiple levels of time, teachers, and projects; different factors can be included to explain variation at each level of the nested data structure (Raudenbush & Bryk, 2002).

Six of the seven outcomes of interest in these analyses were based on composite scores calculated from groups of related questionnaire items. These six outcomes are teachers':

- Attitudes toward *Standards*-based teaching;
- Perceptions of pedagogical preparedness;

[2] Beginning with the 1999-2000 data collection year, projects also administered teacher questionnaires to a "program sample." The program sample was purposively selected to gather longitudinal data, with the size of each project's sample proportional to project size. The analyses presented in this report draw upon longitudinal data collected as part of the program sample and those collected serendipitously (teachers randomly selected at multiple time points).

- Perceptions of mathematics/science content preparedness;
- Use of traditional teaching practices;
- Use of investigative teaching practices; and
- Use of teaching practices that foster an investigative classroom culture.

In addition to the composites, the amount of time devoted to science instruction in self-contained elementary classes was also an outcome of interest.

For each outcome, a three-level hierarchical linear model (time points nested within teachers nested within projects) was used to investigate the relationships among the extent of teacher participation in LSC professional development, whether or not teachers had strong college-level content preparation, and each outcome variable. In addition, several demographic factors (at both the teacher and school level) were controlled for in these models, including teacher experience level and the school community type.

The independent variables included at the time point level (level 1) were:

- Project year (i.e., the number of years since the project was funded);
- Extent of teacher participation in LSC professional development;
- Teacher experience level;
- Teacher perception of principal support;
- Teacher college-level content preparation in mathematics or science; and
- The interaction between teacher's content preparation and extent of participation in LSC professional development.

The independent variables included at the teacher level (level 2) were:

- Number of students enrolled in the teacher's school;
- Percent of students in the teacher's school classified as non-Asian minority;
- Percent of students in the teacher's school eligible for free/reduced-price lunch;
- Percent of students in the teacher's school classified as limited-English proficient; and
- Type of community in which the teacher's school is located.

The independent variables included at the project level (level 3) were:

- Number of teachers targeted by the LSC project; and
- Subject/grade-range targeted by the LSC project (for the overall analyses only).

Teacher experience level was coded as "novice" (0–5 years taught), "experienced" (6–10 years taught), or "very experienced" (11 or more years taught). A set of dummy coded variables were created based on these categories, and the experienced group was omitted from the analyses as the comparison group.

The college-level content preparation variable, coded as "strong" or "less strong," was computed based on teacher responses to several questionnaire items, and the criteria varied by subject and grade range. The criteria used are presented in Table 2.

Table 2
Criteria for Coding Teachers as Having a "Strong" College-Level Content Background, by Subject/Grade-Range

	Criteria
K–8 Science	• At least three semesters of college science courses; **and** • At least one semester each in life, physical, and earth/space science.
K–8 Mathematics	• at least three semesters of college mathematics courses.
6–12 Science	High school and middle school teachers: • Eight or more courses in at least one content area (life science/biology, Earth/space science, chemistry, physics/physical science, or engineering/technology) and certification in that area; **or** • Four to seven courses in at least two content areas and certification in at least one of those areas. Middle school teachers were also considered to have strong college content preparation if they had: • Four to seven courses in one content area and one to three courses in a second content area; **or** • One to three course in each content area.
6–12 Mathematics	• A major or minor in mathematics or mathematics education; and certification to teach mathematics

Teachers not meeting these criteria were classified as having less strong college-level content preparation. As mentioned previously, teachers who did not provide enough information to make a determination about college-level content preparation were dropped from the analyses.

The distributions of continuous variables were examined to determine whether they met the assumption of normality for the statistical approach employed. Outcome variables with extreme skewness or kurtosis were transformed using a transformation that yielded the best overall correction. Table 3 shows descriptive statistics for the original and transformed values of the outcome variables in the overall sample, as well as the composite score for perceived principal support, which is used as an independent variable in the analyses.[3] Tables 4–8 show descriptive statistics for the other independent variables included in the models for the overall sample. Descriptive statistics for the K–8 mathematics and K–8 science analyses are shown in Appendix A.

[3] Unless otherwise noted, all statistics are based on weighted data.

Table 3
Descriptive Statistics for Composite Variables (Overall Sample)

	Minimum	Maximum	Mean	Standard Deviation
Attitudes Toward *Standards*-Based Teaching				
Original	25.00	100.00	86.88	10.03
Transformed—Box and Cox	-24.13	0.00	-9.58	5.87
Teachers' Perceptions of Pedagogical Preparedness				
Original	25.00	100.00	76.98	13.76
Transformed—Squared	6.25	100.00	61.16	20.50
Content Preparedness				
Original	25.00	100.00	65.32	18.37
Transformed—Box and Cox	-67.54	0.00	-32.85	16.77
Traditional Practices				
Original	20.00	100.00	61.85	20.35
Transformed—Box and Cox	-53.72	0.00	-30.72	13.69
Investigative Culture				
Original	20.00	100.00	79.72	13.92
Transformed—Square Root	-35.44	0.00	-15.41	8.45
Investigative Practices				
Original	20.00	100.00	53.51	14.49
Transformed—Box and Cox	-100.47	0.00	-52.44	18.27
Perceived Principal Support				
Original	20.00	100.00	75.56	14.78
Transformed—Divided by 100, Squared	0.04	1.00	0.59	0.21
Minutes of Instruction (K–5 Science)				
Original	0.00	427.50	110.97	59.99
Transformed—Box and Cox	-1.45	93.28	34.59	14.29

Table 4
Descriptive Statistics for Time-Point-Level Variables (Overall Sample)

	Percent of Questionnaires (N = 56,950)
Extent of Teacher Participation in LSC Professional Development	
0 hours	34
1-9 hours	11
10–19 hours	10
20–39 hours	12
40–59 hours	9
60–79 hours	6
80–99 hours	5
100–129 hours	6
130-159 hours	2
160-199 hours	1
200 or more hours	3
Prior Teaching Experience	
0–5 years	32
6–10 years	17
11 or more years	51
Project Year	
0 (Baseline)	13
1	18
2	28
3	14
4	11
5	12
6	3
Content Preparation	
Strong preparation	58
Less strong preparation	42

Table 5
Descriptive Statistics for Teacher-Level Variables (Overall Sample)

	Minimum	Maximum	Mean	Standard Deviation
Number of students in school				
Original	7.00	3250.00	675.52	360.34
Transformed—Box and Cox	2.51	26.20	15.90	2.60
Percent of student body classified as Non-Asian minority				
Original (in hundreds)	0.00	1.00	0.47	0.35
Transformed—Box and Cox	-1.33	0.00	-0.62	0.44
Percent of students in school eligible for free/reduced-price lunch (FRL)				
Original (in hundreds)	0.00	1.00	0.50	0.31
Transformed—Box and Cox	-4.00	0.00	-0.55	0.36
Percent of Students in school classified as limited-English proficient (LEP)				
Original (in hundreds)	0.00	1.00	0.14	0.21
Transformed—Box and Cox	-1.18	0.00	-2.31	1.18

Table 6
Descriptive Statistics for Teacher-Level Categorical Variables: Community Type (Overall Sample)

	Percent of Teachers
Rural	10
Town or Small City	15
Suburban	24
Urban	51

Table 7
Descriptive Statistics for Project-Level Variables: Number of Total Teachers (Overall Sample)

	Minimum	Maximum	Mean	Standard Deviation
Original	21.00	2052.00	752.27	564.59
Transformed—Square Root	4.58	45.30	25.40	10.40

Table 8
Descriptive Statistics for Project-Level Categorical Variables: Project Subject/Grade-Range (Overall Sample)

	Percent of Projects
K–8 Mathematics	30
K–8 Science	43
6–12 Mathematics	20
6–12 Science	7

HLM 6.02 was used for all analyses. All predictor variables were entered using grand-mean centering except for project year which was entered uncentered. Categorical variables were entered as sets of dummy-coded variables and were also grand-mean centered using weighted effect coding. The technique of grand-mean centering rescales the variables to have a mean of 0 but leaves other characteristics of the variables unchanged; positive values indicate a score above the mean and negative values indicate a score below the mean. Given the centering techniques employed in this study, the intercept in the regression output represents the mean of the outcome variable at the beginning of the typical LSC project (project year 0) for teachers with the mean value of all other predictors in the model. Note that the intercepts of different models are not directly comparable due to differences in the transformations used for each outcome. The magnitudes of the intercepts and fixed effects are also not directly interpretable because they are based on transformed values of the predictors and outcomes.

HLM 6.02 estimates three-level hierarchical linear models using restricted maximum likelihood (REML). All fixed effects were included in the model regardless of their statistical significance, as the role of many predictors was to control for demographic characteristics rather than to explain variation in the outcomes. Random effects were tested for inclusion in each model to determine whether the relationship of each time-point and teacher/school predictor varied across projects.

To build the models, first all level 1 (time-point level) predictors were entered as fixed effects in the model. For the hours of professional development variable, quadratic and cubic component were included in the models, in addition to the linear component. These components allow for the modeling of a non-linear relationship between amount of professional development and each outcome. All level 1 predictors were included in subsequent models regardless of whether or not they were statistically significant, with the exception of the quadratic and cubic components of professional development, which were retained only if they were significant during this first step. The random effects of the time-point level variables were then tested to determine whether there was significant variation across teachers that could potentially be explained with higher level predictors.

Next, the level 2 (teacher level) predictors were entered as fixed effects at the intercept and for the time-point level effects with significant variation across teachers. All fixed effects were included in subsequent models regardless of whether they were statistically significant. The random effects of the teacher/school-level variables were then tested to determine whether there was significant variation across projects that could potentially be explained with the project-level predictors.

The level 3 (project level) predictors were then entered at the intercept and for the teacher level effects with significant variation across projects. All fixed effects were included in subsequent models regardless of whether they were statistically significant. Last, the random effects of the level 2 variables were re-tested to determine whether significant unexplained variation remained in the teacher level predictors. These final models are included in Appendix B.

The fixed-effects estimates of main effects and standard errors for each model are shown in Tables 9–15. HLM 6.02 incorporates sampling weights by estimating fixed effects only with robust standard errors.

Table 9
Fixed Effects and Standard Errors for Attitudes Toward *Standards*-Based Teaching

	Overall	K–8 Science	K–8 Mathematics
Level 1 Variables			
Intercept	-9.59*** (0.10)	-9.41*** (0.14)	-8.66*** (0.22)
Professional Development Hours	0.74*** (0.09)	1.04*** (0.09)	0.77** (0.23)
Professional Development Hours Squared			
Professional Development Hours Cubed			
Content Preparation (Strong)	0.23*** (0.07)	0.65*** (0.10)	0.73*** (0.14)
Professional Development Hours x Content Preparation	-0.09 (0.09)	-0.01 (0.14)	-0.25 (0.23)
Professional Development Hours Squared x Content Preparation	—	—	—
Professional Development Hours Cubed x Content Preparation	—	—	—
Project Age	-0.20*** (0.03)	-0.18*** (0.03)	-0.24*** (0.06)
Teacher Perception of Principal Support	6.29*** (0.14)	6.11*** (0.20)	6.81*** (0.30)
1–5 years teaching experience	0.22* (0.11)	0.30 (0.18)	0.11 (0.20)
11 or more years teaching experience	-0.76*** (0.11)	-0.80*** (0.16)	-0.56** (0.21)
Level 2 Variables			
Number of students enrolled in school	-0.13*** (0.02)	-0.09** (0.03)	-0.16*** (0.03)
Percent of student classified as non-Asian minority	1.20*** (0.26)	1.62*** (0.40)	0.53 (0.44)
Percent of student classified limited-English proficient	0.19** (0.06)	0.20 (0.10)	0.06 (0.13)
Percent of student eligible for free/reduced-price lunch	-0.17 (0.22)	-0.68* (0.29)	0.44 (0.39)
Rural Community	-0.09 (0.14)	-0.03 (0.19)	-0.51* (0.21)
Suburban Community	0.13 (0.12)	0.18 (0.16)	0.26 (0.25)
Town or Small City	0.00 (0.12)	0.07 (0.11)	-0.15 (0.25)
Level 3 Variables			
Number of teachers targeted by LSC project	-0.01 (0.01)	-0.02 (0.01)	—
K–8 Mathematics	-0.02 (0.18)	—	—
6–12 Mathematics	-2.00*** (0.30)	—	—
6–12 Science	-0.33 (0.37)	—	—

˜ p < 0.10; * p < 0.05; ** p < 0.01; *** p < 0.001

Table 10
Fixed Effects and Standard Errors for Perceptions of Pedagogical Preparedness

	Overall	K–8 Science	K–8 Mathematics
Level 1 Variables			
Intercept	59.67*** (0.32)	59.51*** (0.49)	62.90*** (0.76)
Professional Development Hours	11.21*** (1.50)	15.51*** (1.71)	5.81*** (0.58)
Professional Development Hours Squared	-8.00*** (2.08)	-10.03*** (2.69)	—
Professional Development Hours Cubed	2.67*** (0.76)	3.08** (1.03)	—
Content Preparation (Strong)	5.16*** (0.29)	6.01*** (0.52)	6.12*** (0.33)
Professional Development Hours x Content Preparation	-4.95* (2.12)	-6.21˜ (3.42)	-2.27*** (0.48)
Professional Development Hours Squared x Content Preparation	5.00 (3.27)	6.45 (5.25)	—
Professional Development Hours Cubed x Content Preparation	-1.68 (1.18)	-2.00 (1.85)	—
Project Age	0.85*** (0.10)	0.42** (0.15)	0.62*** (0.14)
Teacher Perception of Principal Support	28.85*** (0.68)	31.84*** (1.31)	30.16*** (1.43)
1–5 years teaching experience	-2.08*** (0.28)	-1.19*** (0.30)	-3.52*** (0.62)
11 or more years teaching experience	1.36*** (0.26)	0.96* (0.39)	2.59*** (0.57)
Level 2 Variables			
Number of students enrolled in school	-0.01 (0.07)	-0.09 (0.11)	0.08 (0.14)
Percent of student classified as non-Asian minority	1.18 (0.75)	1.08 (1.18)	-1.37 (1.02)
Percent of student classified limited-English proficient	-0.15 (0.14)	0.44* (0.21)	-0.79 (0.21)
Percent of student eligible for free/reduced-price lunch	-2.44*** (0.64)	-3.74** (1.14)	-0.75 (0.84)
Rural Community	-2.05*** (0.56)	-1.97** (0.64)	-2.21* (1.02)
Suburban Community	-0.24 (0.34)	0.15 (0.43)	-0.98 (0.76)
Town or Small City	-0.84 (0.57)	-1.42* (0.62)	-1.09 (1.23)
Level 3 Variables			
Number of teachers targeted by LSC project	0.07* (0.03)	-0.08* (0.04)	0.03 (0.06)
K–8 Mathematics	1.42* (0.64)	—	—
6–12 Mathematics	-3.09*** (0.83)	—	—
6–12 Science	-0.69 (1.55)	—	—

˜ p < 0.10; * p < 0.05; ** p < 0.01; *** p < 0.001

Table 11
Fixed Effects and Standard Errors for Perceptions of Content Preparedness

	Overall	K–8 Science	K–8 Mathematics
Level 1 Variables			
Intercept	-31.36*** (0.32)	-37.11*** (0.50)	-28.02*** (0.46)
Professional Development Hours	3.08*** (0.29)	3.54*** (0.29)	3.07*** (0.56)
Professional Development Hours Squared			
Professional Development Hours Cubed			
Content Preparation (Strong)	6.73*** (0.25)	5.73*** (0.22)	6.00*** (0.29)
Professional Development Hours x Content Preparation	-0.93** (0.33)	-0.53 (0.34)	-0.90 (0.54)
Professional Development Hours Squared x Content Preparation	—	—	—
Professional Development Hours Cubed x Content Preparation	—	—	—
Project Age	0.46*** (0.10)	0.02 (0.08)	1.25*** (0.25)
Teacher Perception of Principal Support	13.00*** (0.47)	15.72*** (0.67)	14.66*** (1.09)
1–5 years teaching experience	-0.84*** (0.25)	-1.27*** (0.26)	-0.88* (0.42)
11 or more years teaching experience	0.24 (0.22)	0.90** (0.29)	-0.26 (0.34)
Level 2 Variables			
Number of students enrolled in school	0.32*** (0.07)	0.09 (0.07)	0.35** (0.10)
Percent of student classified as non-Asian minority	1.21˜ (0.66)	1.88* (0.90)	0.10 (0.82)
Percent of student classified limited-English proficient	-0.44** (0.15)	-0.21 (0.16)	-1.10** (0.35)
Percent of student eligible for free/reduced-price lunch	-0.98˜ (0.57)	-1.22˜ (0.72)	-0.61 (1.07)
Rural Community	-1.58** (0.49)	-1.15˜ (0.62)	-3.45** (1.00)
Suburban Community	-0.72˜ (0.37)	-0.42 (0.40)	-1.44 (0.92)
Town or Small City	-1.42*** (0.36)	-1.64** (0.48)	-1.63 (1.42)
Level 3 Variables			
Number of teachers targeted by LSC project	0.02 (0.03)	0.01 (0.04)	0.07˜ (0.03)
K–8 Mathematics	7.28*** (0.64)	—	—
6–12 Mathematics	11.34*** (0.76)	—	—
6–12 Science	13.45*** (0.79)	—	—

˜ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 12
Fixed Effects and Standard Errors for Traditional Teaching Practices

	Overall	K–8 Science	K–8 Mathematics
Level 1 Variables			
Intercept	-28.98*** (0.34)	-36.66*** (0.61)	-23.18*** (0.66)
Professional Development Hours	-0.36 (0.22)	0.24 (0.30)	0.06 (0.54)
Professional Development Hours Squared			
Professional Development Hours Cubed			
Content Preparation (Strong)	1.40*** (0.14)	1.28*** (0.18)	1.82*** (0.27)
Professional Development Hours x Content Preparation	0.02 (0.20)	-0.15 (0.27)	0.18 (0.37)
Professional Development Hours Squared x Content Preparation	—	—	—
Professional Development Hours Cubed x Content Preparation	—	—	—
Project Age	-0.02 (0.07)	-0.21** (0.07)	0.23 (0.19)
Teacher Perception of Principal Support	4.18*** (0.41)	4.06*** (0.53)	4.67*** (0.64)
1–5 years teaching experience	0.20 (0.17)	0.22 (0.21)	0.04 (0.43)
11 or more years teaching experience	0.22 (0.19)	0.13 (0.27)	0.42 (0.37)
Level 2 Variables			
Number of students enrolled in school	0.24** (0.08)	0.33*** (0.09)	0.24** (0.09)
Percent of student classified as non-Asian minority	1.56** (0.52)	1.66* (0.82)	2.30** (0.77)
Percent of student classified limited-English proficient	-0.25 (0.24)	-0.39* (0.16)	-0.25* (0.12)
Percent of student eligible for free/reduced-price lunch	-0.23 (0.60)	-0.60 (0.74)	0.03 (0.85)
Rural Community	0.13 (0.32)	0.20 (0.51)	-0.58 (0.54)
Suburban Community	0.05 (0.25)	-0.12 (0.43)	-0.43 (0.45)
Town or Small City	0.18 (0.30)	-0.29 (0.48)	-0.17 (0.40)
Level 3 Variables			
Number of teachers targeted by LSC project	0.00 (0.04)	-0.17*** (0.04)	0.15* (0.07)
K–8 Mathematics	12.55*** (0.83)	—	—
6–12 Mathematics	14.92*** (0.89)	—	—
6–12 Science	9.75*** (1.15)	—	—

˜ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 13
Fixed Effects and Standard Errors for Investigative Classroom Culture

	Overall	K–8 Science	K–8 Mathematics
Level 1 Variables			
Intercept	-15.33*** (0.20)	-15.84*** (0.23)	-13.68*** (0.43)
Professional Development Hours	7.47*** (0.69)	8.94*** (1.24)	8.20*** (1.46)
Professional Development Hours Squared	-5.64*** (0.95)	-7.80*** (1.75)	-6.36*** (1.75)
Professional Development Hours Cubed	1.66*** (0.34)	2.43*** (0.61)	1.85** (0.57)
Content Preparation (Strong)	0.95*** (0.14)	1.56*** (0.15)	1.58*** (0.13)
Professional Development Hours x Content Preparation	0.33 (0.81)	-0.59 (1.34)	-1.44 (1.15)
Professional Development Hours Squared x Content Preparation	-0.93 (1.13)	0.52 (2.02)	0.59 (1.71)
Professional Development Hours Cubed x Content Preparation	0.28 (0.41)	-0.30 (0.71)	-0.08 (0.60)
Project Age	0.01 (0.06)	-0.09 (0.07)	0.05 (0.10)
Teacher Perception of Principal Support	8.02*** (0.32)	8.52*** (0.37)	7.85*** (0.63)
1–5 years teaching experience	0.16 (0.12)	0.32~ (0.19)	0.23 (0.21)
11 or more years teaching experience	-0.79*** (0.12)	-0.67*** (0.18)	-0.75*** (0.20)
Level 2 Variables			
Number of students enrolled in school	-0.05 (0.03)	-0.05 (0.04)	-0.03 (0.08)
Percent of student classified as non-Asian minority	-0.37 (0.37)	-0.60 (0.57)	0.04 (0.70)
Percent of student classified limited-English proficient	0.15 (0.09)	0.30** (0.10)	-0.06 (0.17)
Percent of student eligible for free/reduced-price lunch	-1.12** (0.35)	-1.78*** (0.45)	-0.21 (0.53)
Rural Community	-0.19 (0.28)	-0.09 (0.41)	0.51 (0.46)
Suburban Community	-0.01 (0.17)	-0.07 (0.26)	0.02 (0.29)
Town or Small City	0.06 (0.19)	-0.29 (0.30)	0.51 (0.47)
Level 3 Variables			
Number of teachers targeted by LSC project	-0.02 (0.02)	0.00 (0.02)	-0.08* (0.03)
K–8 Mathematics	1.36*** (0.37)	—	—
6–12 Mathematics	-0.14 (0.50)	—	—
6–12 Science	-1.43* (0.69)	—	—

~ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 14
Fixed Effects and Standard Errors for Investigative Teaching Practices

	Overall	K–8 Science	K–8 Mathematics
Level 1 Variables			
Intercept	-52.91***	-50.13***	-50.91***
	(0.44)	(0.52)	(0.78)
Professional Development Hours	22.91***	24.65***	21.55***
	(1.81)	(2.07)	(3.89)
Professional Development Hours Squared	-21.97***	-21.65***	-23.79***
	(2.46)	(3.08)	(5.41)
Professional Development Hours Cubed	6.75***	6.43***	7.99***
	(0.90)	(1.18)	(1.92)
Content Preparation (Strong)	3.34***	4.97***	4.87***
	(0.34)	(0.48)	(0.46)
Professional Development Hours x Content Preparation	-3.95~	-3.68	-3.89
	(2.12)	(2.40)	(3.99)
Professional Development Hours Squared x Content Preparation	4.59	2.62	6.62
	(3.08)	(3.79)	(5.51)
Professional Development Hours Cubed x Content Preparation	-1.60	-0.71	-2.68
	(1.13)	(1.47)	(1.94)
Project Age	-0.22~	-0.17	-0.80***
	(0.12)	(0.14)	(0.23)
Teacher Perception of Principal Support	16.19***	18.52***	17.24***
	(0.55)	(0.75)	(1.66)
1–5 years teaching experience	0.17	0.28	-0.41
	(0.28)	(0.42)	(0.48)
11 or more years teaching experience	-0.51~	-0.53	-0.08
	(0.26)	(0.37)	(0.59)
Level 2 Variables			
Number of students enrolled in school	-0.22**	-0.14	-0.03
	(0.08)	(0.10)	(0.13)
Percent of student classified as non-Asian minority	2.48*	0.78	5.22***
	(1.11)	(1.43)	(1.20)
Percent of student classified limited-English proficient	0.31~	0.53***	-0.05
	(0.18)	(0.15)	(0.37)
Percent of student eligible for free/reduced-price lunch	-0.73	-2.34~	0.11
	(0.86)	(1.23)	(1.01)
Rural Community	0.37	-0.49	1.40
	(0.73)	(0.84)	(1.04)
Suburban Community	0.20	-0.66	0.96
	(0.53)	(0.61)	(0.75)
Town or Small City	0.50	-1.01	2.26*
	(0.44)	(0.66)	(0.96)
Level 3 Variables			
Number of teachers targeted by LSC project	0.03	-0.01	0.03
	(0.05)	(0.04)	(0.07)
K–8 Mathematics	-2.76*	—	—
	(1.18)		
6–12 Mathematics	-9.89***	—	—
	(1.46)		
6–12 Science	-0.78	—	—
	(1.62)		

~ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 15
Fixed Effects and Standard Errors for
Minutes of Instruction Devoted to Science (K–5 Self-Contained Classes)

	K–5 Science
Level 1 Variables	
Intercept	35.80*** (0.73)
Professional Development Hours	13.46*** (1.95)
Professional Development Hours Squared	-10.47*** (2.60)
Professional Development Hours Cubed	3.01** (0.96)
Content Preparation (Strong)	2.49*** (0.30)
Professional Development Hours x Content Preparation	-2.05 (1.65)
Professional Development Hours Squared x Content Preparation	-0.29 (2.75)
Professional Development Hours Cubed x Content Preparation	0.72 (1.09)
Project Age	-0.09 (0.57)
Teacher Perception of Principal Support	4.35*** (0.64)
1–5 years teaching experience	0.09 (0.36)
11 or more years teaching experience	-0.96** (0.30)
Level 2 Variables	
Number of students enrolled in school	0.20* (0.07)
Percent of student classified as non-Asian minority	-0.38 (0.95)
Percent of student classified limited-English proficient	-0.03 (0.19)
Percent of student eligible for free/reduced-price lunch	-1.67˜ (0.85)
Rural Community	2.02*** (0.54)
Suburban Community	0.98˜ (0.49)
Town or Small City	1.37*** (0.33)

˜ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Relationships between Professional Development, College-Level Content Preparation, and Attitudes toward *Standards*-Based Teaching

Key results from the analyses for the attitudes toward *Standards*-based teaching composite are summarized in Figure 1. Both college-level content preparedness and amount of professional development had significant positive relationships with this outcome for the overall analysis, as well as for the separate K–8 science and K–8 mathematics analyses. Teachers participating in more hours of LSC professional development scored higher on this composite than teachers participating in fewer hours, and teachers with strong content preparation scored higher than those with less strong content preparation.

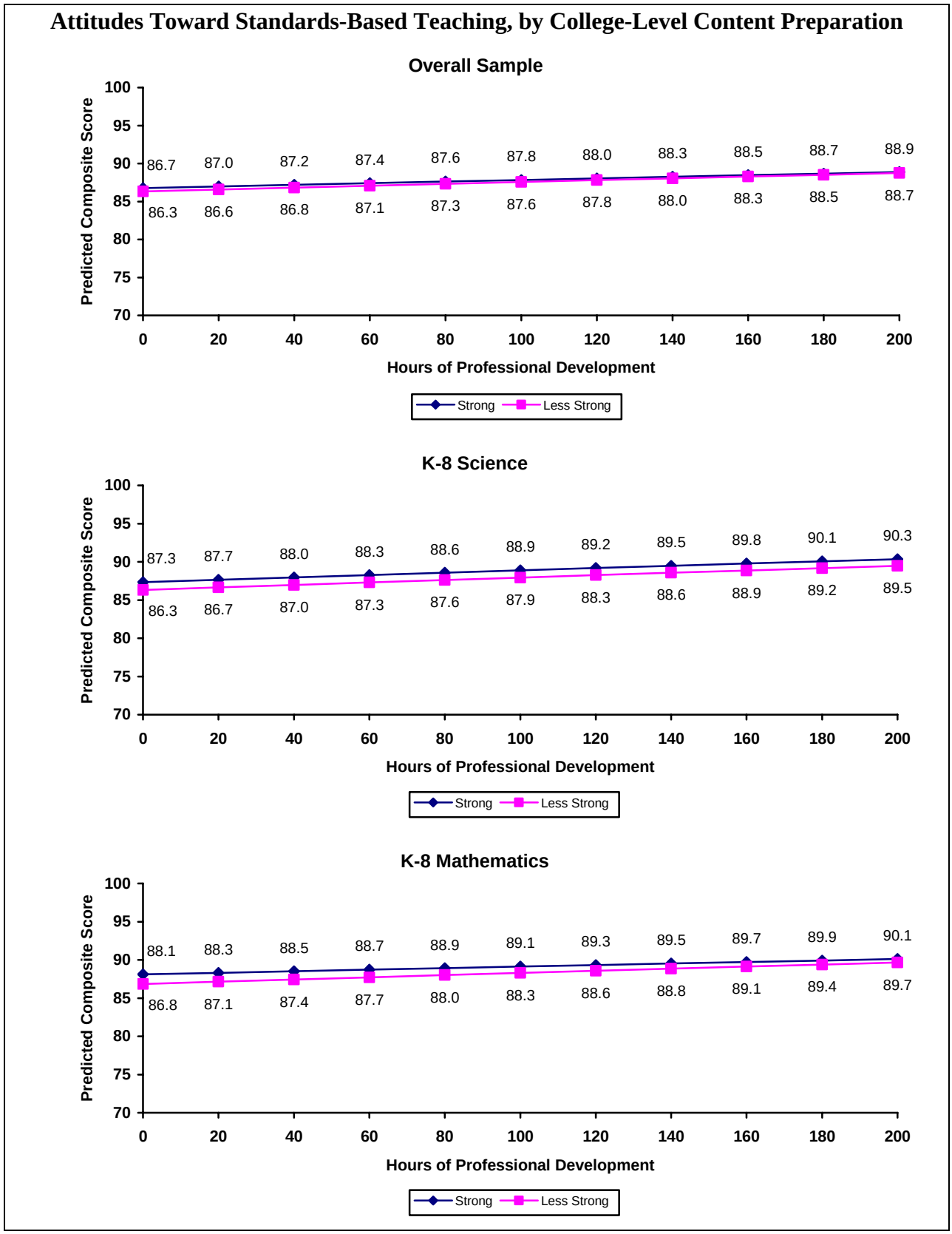
Attitudes Toward Standards-Based Teaching, by College-Level Content Preparation
Overall Sample
Predicted Composite Score
100
95
90
85
80
75
70
86.7 87.0 87.2 87.4 87.6 87.8 88.0 88.3 88.5 88.7 88.9
86.3 86.6 86.8 87.1 87.3 87.6 87.8 88.0 88.3 88.5 88.7
0 20 40 60 80 100 120 140 160 180 200
Hours of Professional Development
Strong
Less Strong
K-8 Science
Predicted Composite Score
100
95
90
85
80
75
70
87.3 87.7 88.0 88.3 88.6 88.9 89.2 89.5 89.8 90.1 90.3
86.3 86.7 87.0 87.3 87.6 87.9 88.3 88.6 88.9 89.2 89.5
0 20 40 60 80 100 120 140 160 180 200
Hours of Professional Development
Strong
Less Strong
K-8 Mathematics
Predicted Composite Score
100
95
90
85
80
75
70
88.1 88.3 88.5 88.7 88.9 89.1 89.3 89.5 89.7 89.9 90.1
86.8 87.1 87.4 87.7 88.0 88.3 88.6 88.8 89.1 89.4 89.7
0 20 40 60 80 100 120 140 160 180 200
Hours of Professional Development
Strong
Less Strong

Figure 1

The interaction term of college-level content preparedness with amount of professional development was not significant in any of the models for this outcome. In other words, teachers with strong content preparation tended to have more positive attitudes toward *Standards*-based teaching, but the relationship between the amount of professional development and the outcome did not differ based upon teacher college-level content preparation.

In the analysis across all LSC projects, after controlling for project year, perceptions of principal support, and the other independent variables, teachers with the mean amount of professional development (37 hours) who had strong college-level content preparation scored approximately 0.04 standard deviations higher than teachers with less strong college-level content preparation, equivalent to 0.36 points on this composite.

In the separate analysis of K–8 science projects, teachers with the mean amount of professional development (34 hours) who had strong college-level content preparation scored approximately 0.11 standard deviations higher than teachers with less strong college-level content preparation, equivalent to 1.00 points on this composite. These effects are above and beyond the effects of project year, teacher experience level, and principal support because these factors are controlled in the model.

In the separate analysis of K–8 mathematics projects, teachers with the mean amount of professional development (40 hours) who had strong college-level content preparation scored approximately 0.13 standard deviations higher than teachers with less strong college-level content preparation, equivalent to 1.08 points on this composite. These effects are above and beyond the effects of project year, teacher experience level, and principal support because these factors are controlled in the model.

Relationships between Professional Development, College-Level Content Preparation, and Perceptions of Pedagogical Preparedness

Key results from the analyses on teachers' perceptions of pedagogical preparedness are presented in Figure 2. Both college-level content preparedness and hours of professional development had significant positive relationships with perceptions of pedagogical preparedness in the overall sample, as well as in the separate K–8 science and K–8 mathematics samples. This indicates that teachers who participated in more hours of professional development were more likely to have higher scores on this composite, all other things being equal. In addition, teachers with strong college-level content preparation were more likely to have higher scores on the composite than teachers with less strong college-level content preparation, all other things being equal.

However, the relationships between the variables were not consistent across the three models. In the overall sample, the squared and cubic components of professional development hours were statistically significant, reflecting a leveling off of the relationship between hours of professional development and perceptions of pedagogical preparedness. The interaction between college-level content preparation and hours of professional development was also statistically significant, indicating that the relationship between professional development hours and perceptions of pedagogical preparedness varies by teacher college-level content preparation. The amount of

professional development appears to have a larger effect on perceptions of pedagogical preparedness for teachers with less strong college-level content preparation than for teachers with strong college-level content preparation. Teachers with less strong college-level content preparation who had the mean amount of professional development (37 hours) scored about 0.34 standard deviations higher on perceptions of pedagogical preparedness than untreated teachers, equivalent to 4.60 points on this composite. Teachers with strong college-level content preparation who had the mean amount of professional development scored about 0.21 standard deviations higher on perceptions of pedagogical preparedness than untreated teachers, equivalent to 2.71 points on this composite. Teachers with less strong college-level content preparation who were one standard deviation above the mean on professional development (88 hours) scored about 0.58 standard deviations higher on perceptions of pedagogical preparedness than untreated teachers, equivalent to 7.63 points on this composite. Teachers with strong college-level content preparation who were one standard deviation above the mean on professional development scored about 0.38 standard deviations higher on perceptions of pedagogical preparedness than untreated teachers, equivalent to 4.77 points on this composite.

For K–8 science teachers, the squared and cubic components of professional development hours were also statistically significant. However, the interaction between college-level content preparation and hours of professional development was not statistically significant, indicating that the relationship between professional development hours and perceptions of pedagogical preparedness for K–8 science teachers does not vary significantly based on whether teachers have strong or less strong college-level content preparation. Teachers with the mean amount of professional development (34 hours) who had strong college-level content preparation scored approximately 0.29 standard deviations higher than teachers with less strong college-level content preparation, equivalent to 3.84 points on this composite.

For K–8 mathematics teachers, the squared and cubic components of professional development were not statistically significant, reflecting a linear relationship between amount of professional development and teachers' perceptions of pedagogical preparedness. The interaction between college-level content preparation and hours of professional development was statistically significant. Teachers with less strong college-level content preparation who had the mean amount of professional development (40 hours) scored about 0.15 standard deviations higher on perceptions of pedagogical preparedness than untreated teachers, equivalent to 1.90 points on this composite. Teachers with strong college-level content preparation who had the mean amount of professional development scored about 0.10 standard deviations higher on perceptions of pedagogical preparedness than untreated teachers, equivalent to 1.25 points on this composite. Teachers with less strong college-level content preparation who were at one standard deviation above the mean on professional development (92 hours) scored about 0.34 standard deviations higher on perceptions of pedagogical preparedness than untreated teachers, equivalent to 4.29 points on this composite. Teachers with strong college-level content preparation who were at one standard deviation above the mean on professional development scored about 0.23 standard deviations higher on perceptions of pedagogical preparedness, equivalent to 2.85 points on this composite.

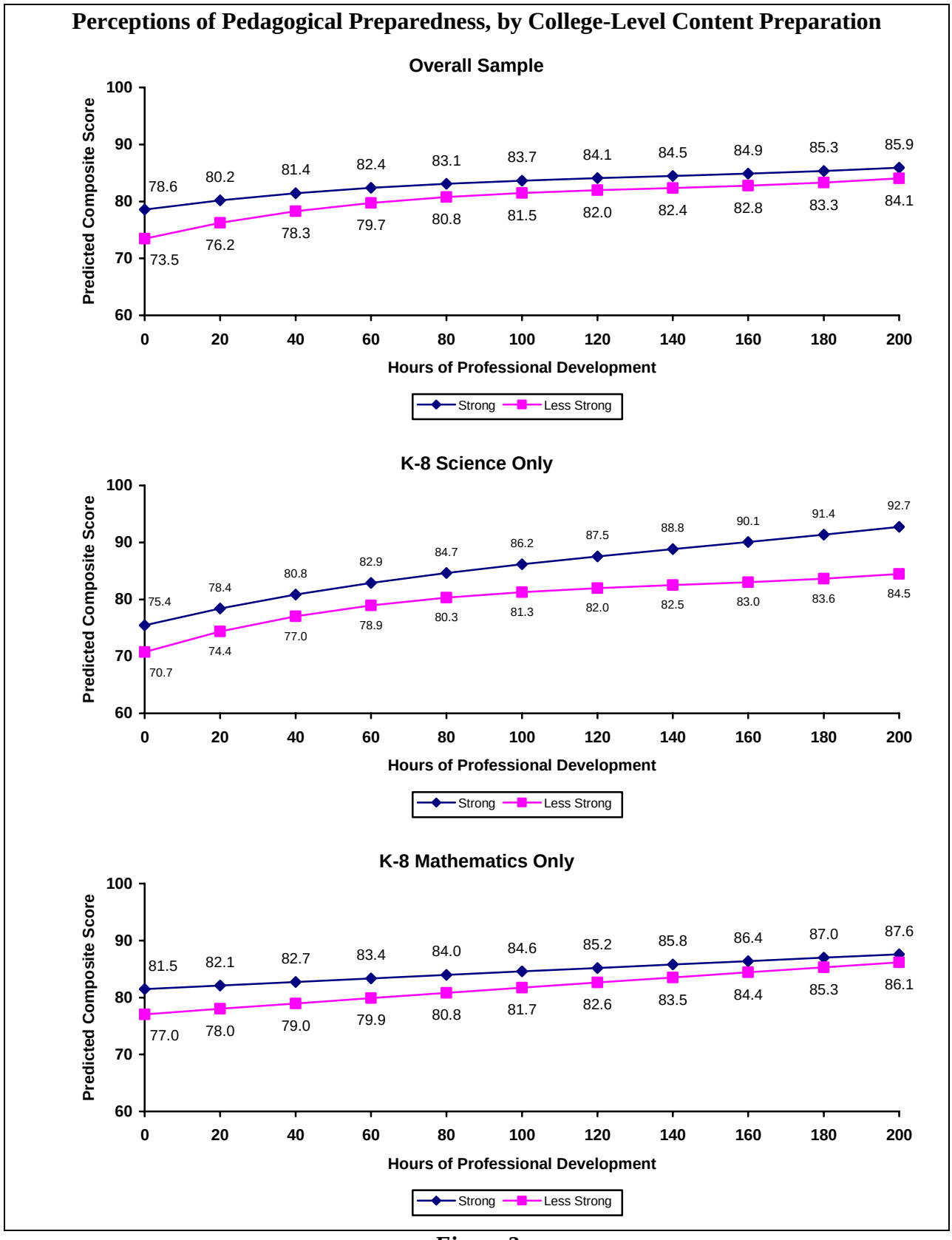
Perceptions of Pedagogical Preparedness, by College-Level Content Preparation
Overall Sample
Predicted Composite Score
100
90
80
70
60
0
20
40
60
80
100
120
140
160
180
200
Hours of Professional Development
78.6
80.2
81.4
82.4
83.1
83.7
84.1
84.5
84.9
85.3
85.9
73.5
76.2
78.3
79.7
80.8
81.5
82.0
82.4
82.8
83.3
84.1
Strong
Less Strong
K-8 Science Only
Predicted Composite Score
Hours of Professional Development
75.4
78.4
80.8
82.9
84.7
86.2
87.5
88.8
90.1
91.4
92.7
70.7
74.4
77.0
78.9
80.3
81.3
82.0
82.5
83.0
83.6
84.5
Strong
Less Strong
K-8 Mathematics Only
Predicted Composite Score
Hours of Professional Development
81.5
82.1
82.7
83.4
84.0
84.6
85.2
85.8
86.4
87.0
87.6
77.0
78.0
79.0
79.9
80.8
81.7
82.6
83.5
84.4
85.3
86.1
Strong
Less Strong

Figure 2

Relationships between Professional Development, College-Level Content Preparation, and Perceptions of Content Preparedness

Key results from the analyses for perceptions of content preparedness are summarized in Figure 3. For all analyses, both professional development hours and college-level content preparation had statistically significant positive relationships with teachers' perceptions of content preparedness. That is, teachers with more professional development were more likely to have higher scores on perceptions of content preparedness, as were teachers with strong college-level content preparation (an effect size of 0.40 standard deviations at the mean value of professional development). In all analyses, the relationship between professional development hours and perceptions of content preparedness appears linear (i.e. the quadratic and cubic components of professional development hours were not statistically significant).

In the overall sample, the interaction between college-level content preparation and professional development hours was statistically significant, indicating that the relationship between the amount of professional development and perceptions of content preparedness differs for teachers with strong versus less strong college-level content preparation. At low levels of professional development, there is a greater discrepancy between teachers with less strong and strong college-level content preparation on this composite than at high levels of professional development. For example, the gap between teachers with less strong and strong college-level content preparation is 7.64 points on this composite for untreated teachers, compared to 7.24 points for teachers at the mean of professional development (37 hours) and 6.70 points for teachers one standard deviation above the mean of professional development (88 hours). This result suggests that professional development may help reduce the gap in perceptions of content preparedness between teachers who received strong content preparation at the college level and those who did not receive such training at the college level.

For K–8 science teachers, the interaction between college-level content preparation and professional development hours was not statistically significant, indicating that the relationship between professional development and perceptions of content preparedness does not vary by teacher college-level content preparation. After controlling for project year, teacher experience level, and all other independent variables, K–8 science teachers with the mean amount of professional development (34 hours) who had strong college-level content preparation scored approximately 0.12 standard deviations higher than teachers with less strong college-level content preparation, equivalent to 6.34 points on this composite.

The interaction between college-level content preparation and professional development hours was also not statistically significant K–8 mathematics teachers. After controlling for project year, teacher experience level, and all other independent variables, K–8 mathematics teachers with the mean amount of professional development (40 hours) who had strong college-level content preparation scored approximately 0.37 standard deviations higher than teachers with less strong college-level content preparation, equivalent to 6.35 points on this composite.

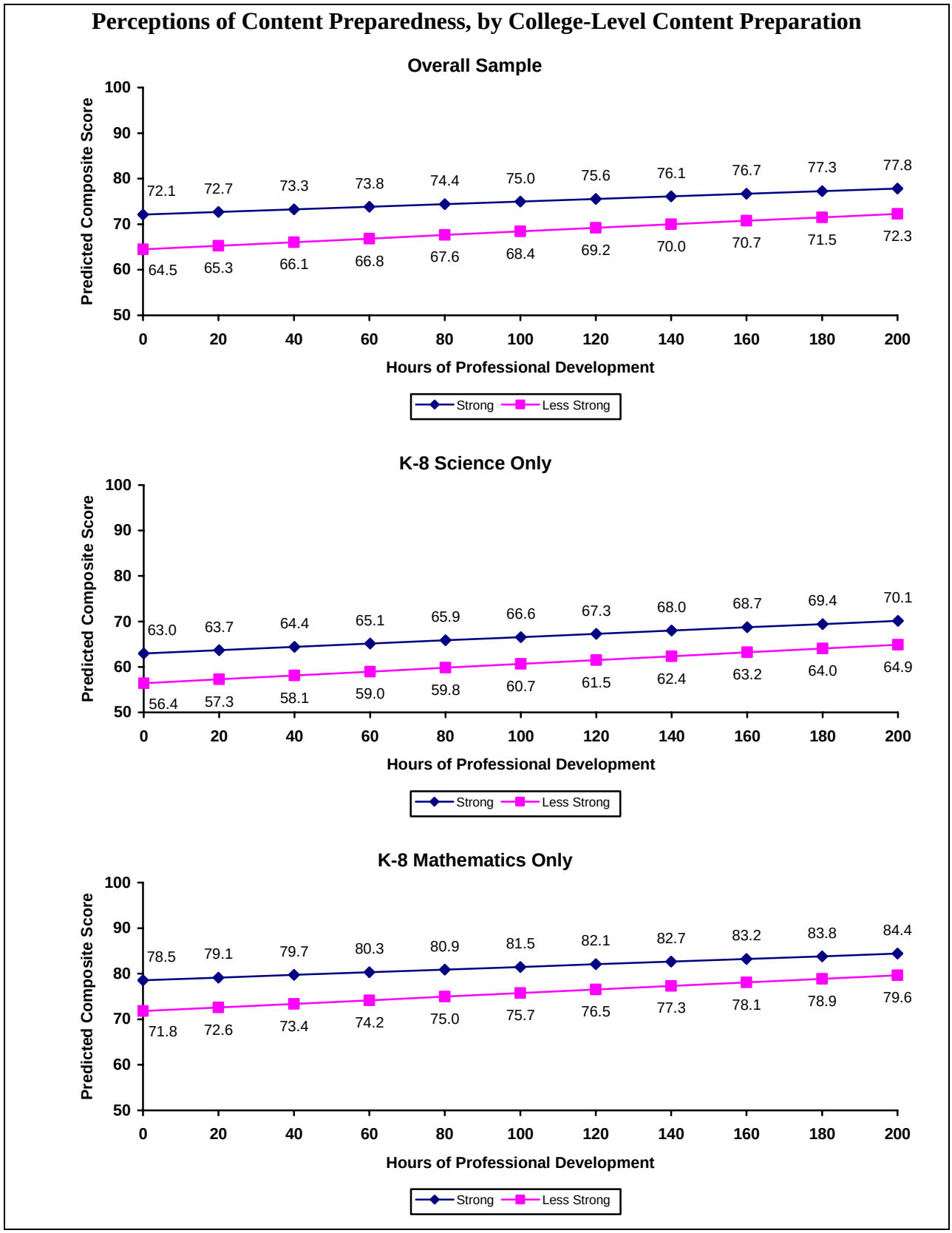
Perceptions of Content Preparedness, by College-Level Content Preparation
Overall Sample
Predicted Composite Score
100
90
80
70
60
50
72.1 72.7 73.3 73.8 74.4 75.0 75.6 76.1 76.7 77.3 77.8
64.5 65.3 66.1 66.8 67.6 68.4 69.2 70.0 70.7 71.5 72.3
0 20 40 60 80 100 120 140 160 180 200
Hours of Professional Development
Strong
Less Strong
K-8 Science Only
Predicted Composite Score
100
90
80
70
60
50
63.0 63.7 64.4 65.1 65.9 66.6 67.3 68.0 68.7 69.4 70.1
56.4 57.3 58.1 59.0 59.8 60.7 61.5 62.4 63.2 64.0 64.9
0 20 40 60 80 100 120 140 160 180 200
Hours of Professional Development
Strong
Less Strong
K-8 Mathematics Only
Predicted Composite Score
100
90
80
70
60
50
78.5 79.1 79.7 80.3 80.9 81.5 82.1 82.7 83.2 83.8 84.4
71.8 72.6 73.4 74.2 75.0 75.7 76.5 77.3 78.1 78.9 79.6
0 20 40 60 80 100 120 140 160 180 200
Hours of Professional Development
Strong
Less Strong

Figure 3

Relationships between Professional Development, College-Level Content Preparation, and Traditional Teaching Practices

Key results from the analyses of the frequency of teachers' use of traditional teaching practices are summarized in Figure 4. Hours of professional development was not related to the frequency of teachers' use of traditional teaching practices in the overall sample, nor in the separate analyses of K–8 science and K–8 mathematics. This result indicates that teachers were equally likely to engage in traditional teaching practices regardless of how many hours of professional development they attended. Teachers with strong college-level content preparation were significantly more likely to engage in traditional practices than teachers with less strong college-level content preparation, for both the overall sample and the separate K–8 science and K–8 mathematics analyses. None of the interactions between hours of professional development and college-level content preparation were significant, indicating that the relationship between professional development and traditional practices did not depend on whether teachers had strong or less strong college-level content preparation.

After controlling for project year, amount of professional development, and all other independent variables in the model, teachers in the overall analysis who had strong college-level content preparation scored approximately 0.10 standard deviations higher than teachers with less strong college-level content preparation, equivalent to 1.91 points on this composite.

In the separate analysis of K–8 science, teachers with strong college-level content preparation scored approximately 0.11 standard deviations higher than teachers with less strong college-level content preparation, equivalent to 2.04 points on this composite. This effect is above and beyond the effects of project year, amount of professional development, and all other independent variables since they are controlled in the model.

In the separate analysis of K–8 mathematics, teachers with strong college-level content preparation scored approximately 0.16 standard deviations higher than teachers with less strong college-level content preparation, equivalent to 2.25 points on this composite. This effect is above and beyond the effects of project year, amount of professional development, and all other independent variables since they are controlled in the model.

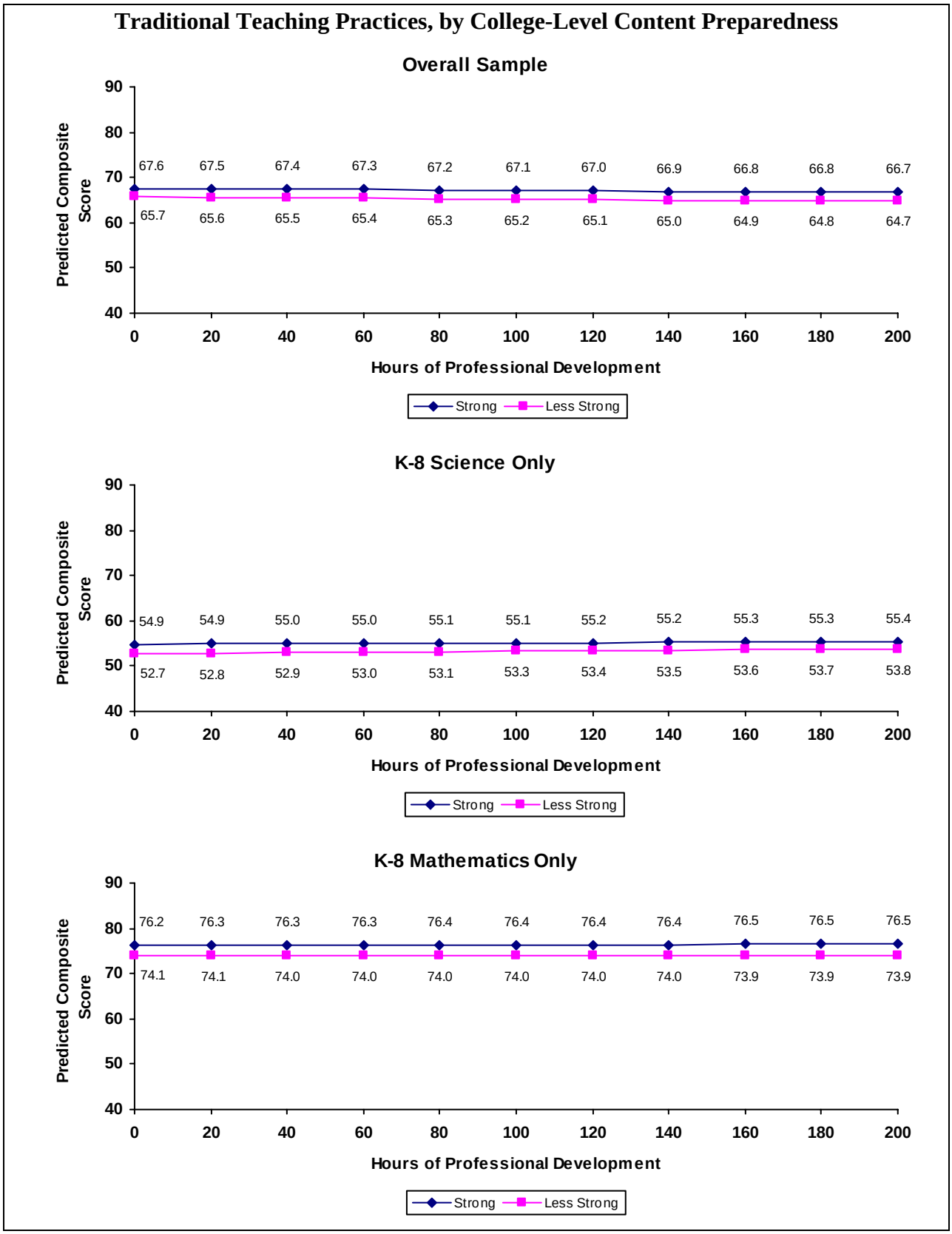
Traditional Teaching Practices, by College-Level Content Preparedness
Overall Sample
Predicted Composite Score
90
80
70
60
50
40
67.6 67.5 67.4 67.3 67.2 67.1 67.0 66.9 66.8 66.8 66.7
65.7 65.6 65.5 65.4 65.3 65.2 65.1 65.0 64.9 64.8 64.7
0 20 40 60 80 100 120 140 160 180 200
Hours of Professional Development
Strong
Less Strong
K-8 Science Only
Predicted Composite Score
90
80
70
60
50
40
54.9 54.9 55.0 55.0 55.1 55.1 55.2 55.2 55.3 55.3 55.4
52.7 52.8 52.9 53.0 53.1 53.3 53.4 53.5 53.6 53.7 53.8
0 20 40 60 80 100 120 140 160 180 200
Hours of Professional Development
Strong
Less Strong
K-8 Mathematics Only
Predicted Composite Score
90
80
70
60
50
40
76.2 76.3 76.3 76.3 76.4 76.4 76.4 76.4 76.5 76.5 76.5
74.1 74.1 74.0 74.0 74.0 74.0 74.0 74.0 73.9 73.9 73.9
0 20 40 60 80 100 120 140 160 180 200
Hours of Professional Development
Strong
Less Strong

Figure 4

Relationships between Professional Development, College-Level Content Preparation, and Investigative Classroom Culture

Key results from the analyses of investigative classroom culture are summarized in Figure 5. The linear, quadratic, and cubic components of professional development hours were statistically significant for the overall sample, as well as for the separate K–8 science and K–8 mathematics analyses. This result indicates that teachers with more hours of professional development tended to score higher on this composite, but that this relationship begins to level off at moderate to high amounts of professional development. College-level content preparation also had a statistically significant positive relationship to investigative classroom culture for all three analyses. Teachers with strong college-level content preparation tended to have higher scores on this composite than teachers with less strong college-level content preparation, after controlling for the other factors in the models. None of the models had a statistical significant interaction between professional development and college-level content preparation, indicating that the relationship between hours of professional development and investigative classroom culture did not change based on whether teachers had strong or less strong college-level content preparation.

After controlling for project year, teacher experience, and all other independent variables in the model, teachers in the overall sample with the mean amount of professional development who had strong college-level content preparation scored about 0.11 standard deviations higher than teachers with less strong college-level content preparation, equivalent to 1.35 points on this composite.

K–8 science teachers with the mean amount of professional development (34 hours) scored who had strong college-level content preparation scored about 0.18 standard deviations higher on investigative culture than teachers with less strong college-level content preparation, equivalent to 2.33 points on this composite. These effects are above and beyond the effects of project year, teacher experience level, and all other independent variables, since these variables are controlled in the model.

K–8 mathematics teachers with the mean amount of professional development (40 hours) who had strong college-level content preparation scored about 0.20 standard deviations higher on investigative culture than teachers with less strong college-level content preparation, equivalent to a 2.20 point increase on this composite. These effects are above and beyond the effects of project year, teacher experience level, and all other independent variables, since these variables are controlled in the model.

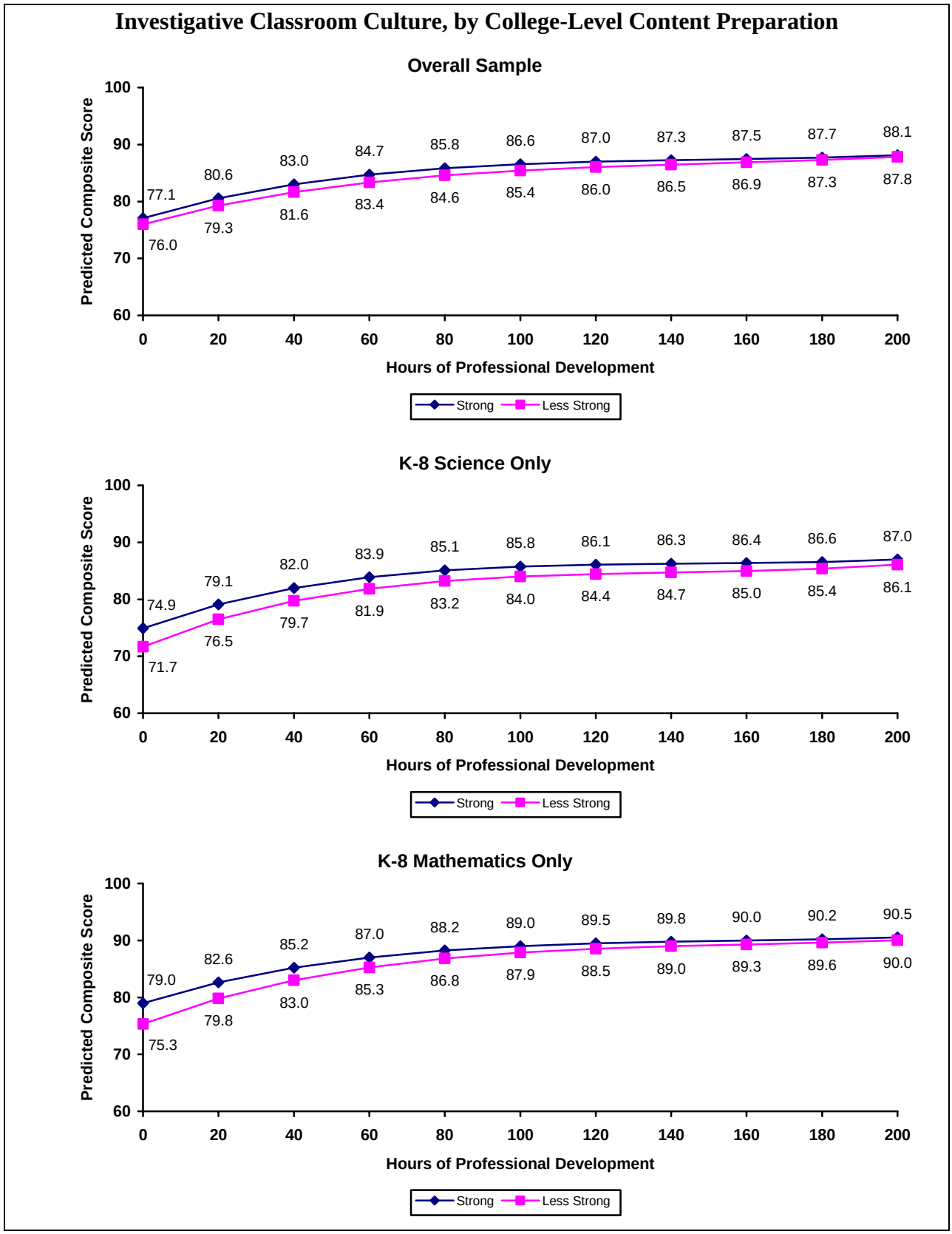
Investigative Classroom Culture, by College-Level Content Preparation
Overall Sample
Predicted Composite Score
100
90
80
70
60
0
20
40
60
80
100
120
140
160
180
200
Hours of Professional Development
77.1
80.6
83.0
84.7
85.8
86.6
87.0
87.3
87.5
87.7
88.1
76.0
79.3
81.6
83.4
84.6
85.4
86.0
86.5
86.9
87.3
87.8
Strong
Less Strong
K-8 Science Only
Predicted Composite Score
Hours of Professional Development
74.9
79.1
82.0
83.9
85.1
85.8
86.1
86.3
86.4
86.6
87.0
71.7
76.5
79.7
81.9
83.2
84.0
84.4
84.7
85.0
85.4
86.1
Strong
Less Strong
K-8 Mathematics Only
Predicted Composite Score
Hours of Professional Development
79.0
82.6
85.2
87.0
88.2
89.0
89.5
89.8
90.0
90.2
90.5
75.3
79.8
83.0
85.3
86.8
87.9
88.5
89.0
89.3
89.6
90.0
Strong
Less Strong

Figure 5

Relationships between Professional Development, College-Level Content Preparation, and Investigative Teaching Practices

Key results from the analyses of teacher's use of investigative teaching practices are summarized in Figure 6. The linear, quadratic, and cubic components of professional development hours were statistically significant for the overall sample, as well as for the separate K–8 science and K–8 mathematics analyses. This result indicates that teachers with more hours of professional development tended to score higher on this composite, but that this relationship began to level off for moderate to high amounts of professional development. College-level content preparation also had a statistically significant positive relationship to investigative practices for all three analyses. Teachers with strong college-level content preparation tended to have higher scores on this composite than teachers with less strong college-level content preparation, after controlling for the other factors in the models. None of the models had a statistical significant interaction between professional development and college-level content preparation.

After controlling for project year, teacher experience level, and all other independent variables, teachers in the overall sample at the mean for hours of professional development (37 hours) who had strong college-level content preparation scored about 0.18 standard deviations higher on investigative practices than teachers with less strong college-level content preparation, equivalent to a 2.63 point increase on the composite.

K–8 science teachers with the mean amount of professional development (34 hours) who had strong college-level content preparation scored about 0.28 standard deviations higher on investigative practices than teachers with less strong college-level content preparation, equivalent to 4.03 points on the composite. These effects are above and beyond the effects of project year, teacher experience level, and all other independent variables, since these variables are controlled in the model.

K–8 mathematics teachers at the mean for hours of professional development (40 hours) who had strong college-level content preparation scored about 0.27 standard deviations higher on investigative practices than teachers with less strong college-level content preparation, equivalent to 3.84 points on the composite. These effects are above and beyond the effects of project year, teacher experience level, and all other independent variables, since these effects are controlled in the model.

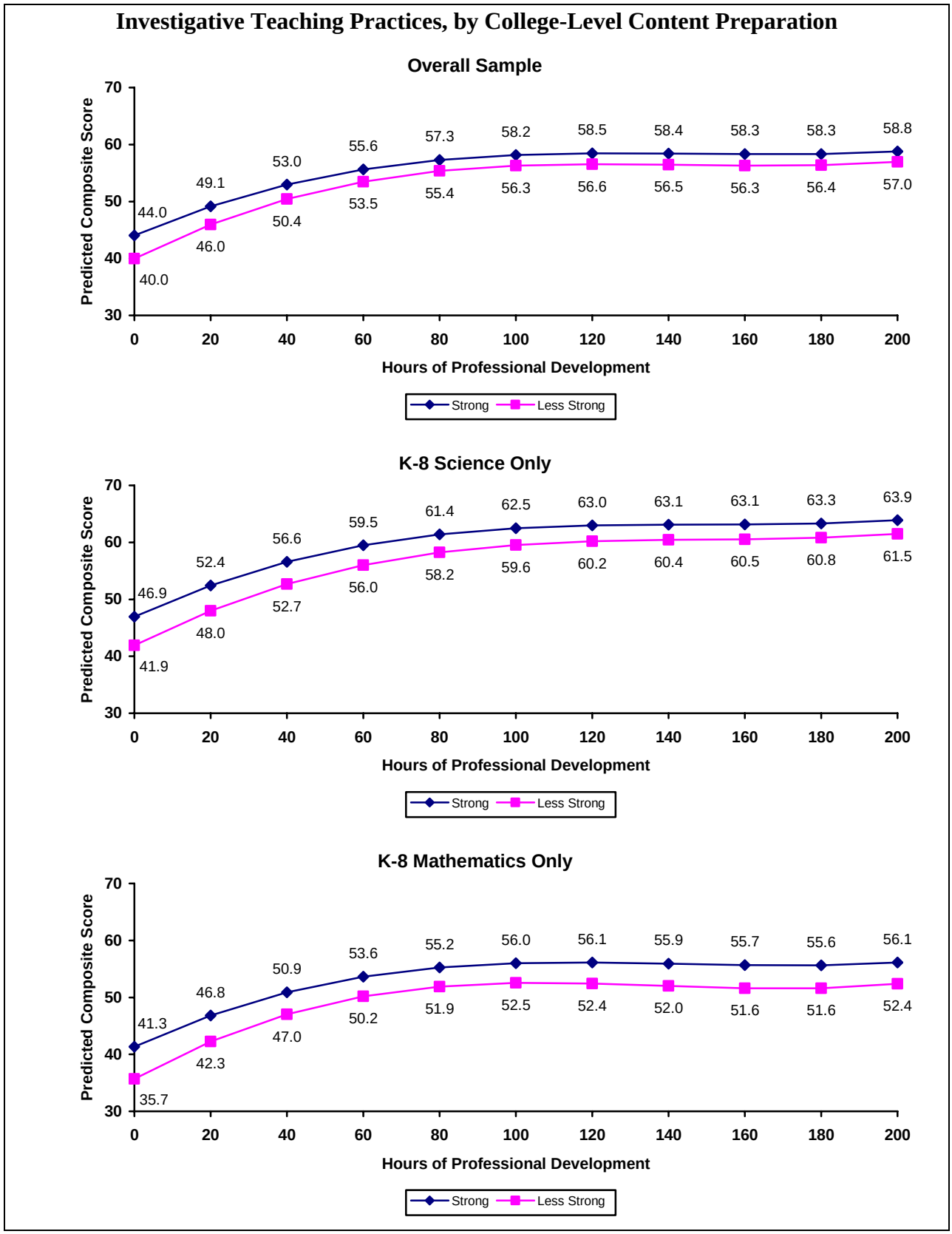
Investigative Teaching Practices, by College-Level Content Preparation
Overall Sample
Predicted Composite Score
70
60
50
40
30
0
20
40
60
80
100
120
140
160
180
200
Hours of Professional Development
44.0
49.1
53.0
55.6
57.3
58.2
58.5
58.4
58.3
58.3
58.8
40.0
46.0
50.4
53.5
55.4
56.3
56.6
56.5
56.3
56.4
57.0
Strong
Less Strong
K-8 Science Only
Predicted Composite Score
Hours of Professional Development
46.9
52.4
56.6
59.5
61.4
62.5
63.0
63.1
63.1
63.3
63.9
41.9
48.0
52.7
56.0
58.2
59.6
60.2
60.4
60.5
60.8
61.5
Strong
Less Strong
K-8 Mathematics Only
Predicted Composite Score
Hours of Professional Development
41.3
46.8
50.9
53.6
55.2
56.0
56.1
55.9
55.7
55.6
56.1
35.7
42.3
47.0
50.2
51.9
52.5
52.4
52.0
51.6
51.6
52.4
Strong
Less Strong

Figure 6

Relationship between Professional Development, College-Level Content Preparation, and Minutes of Instruction Devoted to Science in K–5 Self-Contained Classes

Key results from the analysis of minutes of instruction devoted to science in K–5 self-contained classes are summarized in Figure 7. The linear, quadratic, and cubic components of professional development were all significantly related to the minutes of instruction; teachers with more hours of professional development tended to spend more time teaching science, but the relationship was strongest in the earliest hours of professional development. Teachers with strong college-level content preparation were significantly more likely than teachers with less strong college-level content preparation to spend more time each week teaching science. The relationship between professional development and minutes of instruction did not vary based on whether teachers had strong or less strong college-level content preparation.

After controlling for project year, teacher experience level, and all other independent variables in the model, K–5 teachers with the mean amount of professional development (36 hours) who had strong college-level content preparation scored about 0.17 standard deviations higher than teachers with less strong college-level content preparation, equivalent to 10.69 minutes of additional science instruction per week.

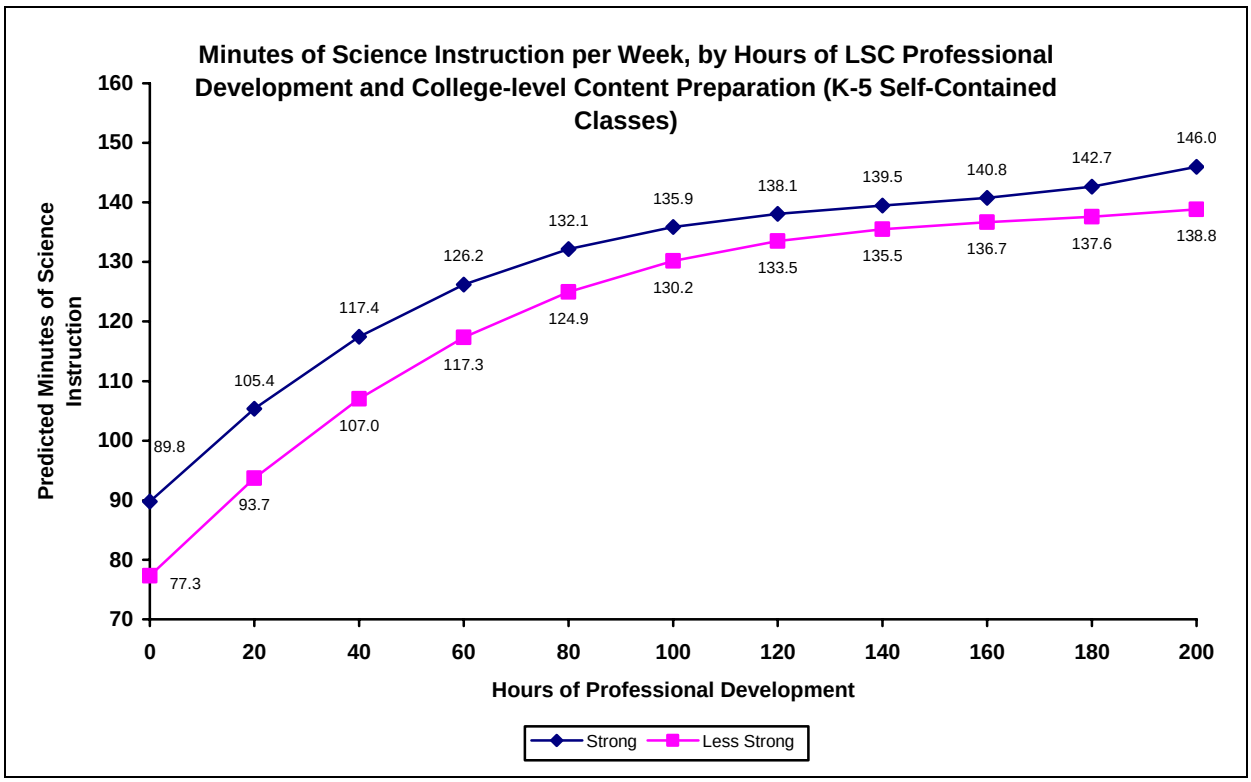

Figure 7

CONCLUSIONS

The goal of this study was to examine how teachers' college-level content preparation moderated the relationship between participation in LSC professional development and several of the intended outcomes of the LSC program. Key findings from these analyses are summarized in Table 16. The study found that teachers with stronger college-level content preparation had significantly higher scores on each of the outcome variables examined, though effect sizes tended to be small.

Table 16
Summary of Findings

	Content Preparation Effect Size (standard deviations)†	Content Preparation x PD Hours Interaction
Attitudes Towards *Standards*-Based Teaching		
Overall	0.04	NS
K–8 Science	0.11	NS
K–8 Mathematics	0.13	NS
Perceptions of Pedagogical Preparedness		
Overall	0.34	Gap narrows with PD
K–8 Science	0.29	NS
K–8 Mathematics	0.15	Gap narrows with PD
Perceptions of Content Preparedness		
Overall	0.40	Gap narrows with PD
K–8 Science	0.12	NS
K–8 Mathematics	0.37	NS
Traditional Teaching Practices		
Overall	0.10	NS
K–8 Science	0.11	NS
K–8 Mathematics	0.16	NS
Investigative Classroom Culture		
Overall	0.11	NS
K–8 Science	0.18	NS
K–8 Mathematics	0.20	NS
Investigative Teaching Practices		
Overall	0.18	NS
K–8 Science	0.28	NS
K–8 Mathematics	0.27	NS
Minutes of Instruction Devoted to Science		
K–5 Self-Contained Classes	0.17	NS

† Effect size is calculated at the mean value of professional development hours.

The study also found that LSC professional development may have helped to close the gap on two of the outcomes between teachers with different college-level content preparation. Across all subjects/grade-ranges targeted by the LSC, the initial differences between teachers with strong and less strong college-level content preparation on the perceptions of pedagogical and mathematics/science content preparedness composites decreased with greater participation in LSC professional development. Although this result was not significant in each subject/grade-level analysis, the results do show a trend in this direction.

It is important to recognize a couple of sources of potential bias in these analyses. First, teacher participation in the LSC program is voluntary, which may result in a sample selection bias (i.e.,

teachers participating in LSC professional development may have been different from those choosing not to participate in important ways). Second, although teachers are randomly sampled to receive questionnaires and projects are required to attain an 80 percent response rate, the potential for non-response bias exists. A previous analysis of project-provided treatment level of teachers indicates that teachers who return a completed questionnaire tend to have slightly higher levels of participation in LSC professional development than teachers who do not return a questionnaire (Heck & Crawford, 2004). Thus, the results of these analyses should be interpreted with some caution.

APPENDICES

Appendix A
Subject Specific Descriptive Statistics

Table A-1
Descriptive Statistics for Composite Variables: K–8 Science

	Minimum	Maximum	Mean	Standard Deviation
Attitudes Toward *Standards*-based Teaching				
Original	25.00	100.00	86.83	9.85
Transformed—Box and Cox	-24.13	0.00	-9.65	5.78
Teachers' Perceptions of Pedagogical Preparedness				
Original	25.00	100.00	75.99	13.94
Transformed—Squared	6.25	100.00	59.69	20.53
Content Preparedness				
Original	25.00	100.00	59.54	17.24
Transformed—Box and Cox	-67.54	0.00	-38.15	15.54
Traditional Practices				
Original	20.00	100.00	51.77	18.29
Transformed—Box and Cox	-53.72	0.00	-37.60	11.43
Investigative Culture				
Original	20.00	100.00	77.87	14.49
Transformed—Square Root	-35.44	0.00	-16.53	8.52
Investigative Practices				
Original	20.00	100.00	54.18	14.24
Transformed—Box and Cox	-100.47	0.00	-51.56	17.95
Perceived Principal Support				
Original	20.00	100.00	74.34	14.90
Transformed—Divided by 100, Squared	0.04	1.00	0.57	0.21

Table A-2
Descriptive Statistics for Composite Variables: K–8 Mathematics

	Minimum	Maximum	Mean	Standard Deviation
Attitudes Toward *Standards*-based Teaching				
Original	25.00	100.00	88.24	9.61
Transformed—Box and Cox	-24.13	0.00	-8.75	5.79
Teachers' Perceptions of Pedagogical Preparedness				
Original	25.00	100.00	79.24	13.36
Transformed—Squared	6.25	100.00	64.57	20.34
Content Preparedness				
Original	25.00	100.00	72.51	17.49
Transformed—Box and Cox	-67.54	0.00	-26.26	16.18
Traditional Practices				
Original	20.00	100.00	74.83	-21.76
Transformed—Box and Cox	-53.72	0.00	15.39	11.42
Investigative Culture				
Original	20.00	100.00	82.73	12.77
Transformed—Square Root	-35.44	0.00	-13.53	8.12
Investigative Practices				
Original	20.00	100.00	54.02	14.73
Transformed—Box and Cox	-100.47	0.00	-51.80	18.43
Perceived Principal Support				
Original	20.00	100.00	78.21	14.41
Transformed—Divided by 100, Squared	0.04	1.00	0.63	0.21

Table A-3
Descriptive Statistics for Time-Point-Level Variables: K–8 Science

	Percent of Questionnaires (N = 27,744)
Extent of Teacher Participation in LSC Professional Development	
0 hours	33
1-9 hours	12
10–19 hours	11
20–39 hours	14
40–59 hours	9
60–79 hours	5
80–99 hours	4
100–129 hours	5
130-159 hours	2
160-199 hours	1
200 or more hours	3
Prior Teaching Experience	
0–5 years	29
6–10 years	18
11 or more years	53
Project Year	
0	10
1	17
2	28
3	15
4	10
5	16
6	3
Content Preparation	
Strong preparation	53
Less strong preparation	47

Table A-4
Descriptive Statistics for Time-Point-Level Variables: K–8 Mathematics

	Percent of Questionnaires (N = 19,377)
Extent of Teacher Participation in LSC Professional Development	
0 hours	34
1-9 hours	11
10–19 hours	8
20–39 hours	11
40–59 hours	9
60–79 hours	7
80–99 hours	6
100–129 hours	7
130-159 hours	3
160-199 hours	1
200 or more hours	3
Prior Teaching Experience	
0–5 years	36
6–10 years	17
11 or more years	47
Project Year	
0	17
1	20
2	28
3	14
4	12
5	7
6	2
Content Preparation	
Strong preparation	71
Less strong preparation	29

Table A-5
Descriptive Statistics for Teacher/School-Level Variables: K–8 Science

	Minimum	Maximum	Mean	Standard Deviation
Number of students in school				
Original	7.00	2290.00	581.79	261.23
Transformed—Box and Cox	2.51	23.67	15.26	2.27
Percent of student body classified as Non-Asian minority				
Original (in hundreds)	0.00	1.00	0.40	0.34
Transformed—Box and Cox	-1.33	0.00	-0.71	0.44
Percent of students in school eligible for free/reduced-price lunch (FRL)				
Original (in hundreds)	0.00	1.00	0.47	0.31
Transformed—Box and Cox	-1.18	0.00	-0.57	0.35
Percent of Students in school classified as limited-English proficient (LEP)				
Original (in hundreds)	0.00	1.00	0.12	0.19
Transformed—Box and Cox	-4.00	0.00	-2.42	1.17

Table A-6
Descriptive Statistics for Teacher/School-Level Variables: K–8 Mathematics

	Minimum	Maximum	Mean	Standard Deviation
Number of students in school				
Original	46.00	2700.00	649.64	277.82
Transformed—Box and Cox	6.42	24.83	15.82	2.27
Percent of student body classified as Non-Asian minority				
Original (in hundreds)	0.00	1.00	0.61	0.34
Transformed—Box and Cox	-1.33	0.00	-0.45	0.41
Percent of students in school eligible for free/reduced-price lunch (FRL)				
Original (in hundreds)	0.00	1.00	0.58	0.31
Transformed—Box and Cox	-1.18	0.00	-0.45	0.35
Percent of Students in school classified as limited-English proficient (LEP)				
Original (in hundreds)	0.00	1.00	0.19	0.25
Transformed—Box and Cox	-4.00	0.00	-2.10	1.25

Table A-7
Descriptive Statistics for Teacher/School-Level Categorical Variables: Community Type

	Percent of Teachers	
	K–8 Science	K–8 Mathematics
Rural	11	9
Town or Small City	17	13
Suburban	29	14
Urban	43	63

Table A-8
Descriptive Statistics for Project-Level Variables: Number of Total Teachers

	Minimum	Maximum	Mean	Standard Deviation
K–8 Science				
Original	276.00	2027.00	1043.43	534.14
Transformed—Square Root	16.61	45.02	31.16	8.61
K–8 Mathematics				
Original	119.00	2052.00	769.69	548.33
Transformed—Square Root	10.91	45.30	26.14	9.45

Appendix B
Exact Statistical Models

Attitudes Towards Reform-Based Teaching: Overall Sample

Level-1 Model

Y = P0 + P1*(NOVTCHR) + P2*(EXPTCHR) + P3*(PROJYR) + P4*(PDMID_DI)
+ P5*(HIQUAL) + P6*(ACN9_T) + P7*(PDHIQUAL) + E

Level-2 Model

P0 = B00 + B01*(NUMST_T) + B02*(NOASN_T) + B03*(FRL_T) + B04*(LEP_T)
+ B05*(RURAL) + B06*(TOWN) + B07*(SUBURB) + R0
P1 = B10
P2 = B20
P3 = B30
P4 = B40 + B41*(NUMST_T) + B42*(NOASN_T) + B43*(FRL_T) + B44*(LEP_T)
+ B45*(RURAL) + B46*(TOWN) + B47*(SUBURB)
P5 = B50 + B51*(NUMST_T) + B52*(NOASN_T) + B53*(FRL_T) + B54*(LEP_T)
+ B55*(RURAL) + B56*(TOWN) + B57*(SUBURB)
P6 = B60 + B61*(NUMST_T) + B62*(NOASN_T) + B63*(FRL_T) + B64*(LEP_T)
+ B65*(RURAL) + B66*(TOWN) + B67*(SUBURB)
P7 = B70 + B71*(NUMST_T) + B72*(NOASN_T) + B73*(FRL_T) + B74*(LEP_T)
+ B75*(RURAL) + B76*(TOWN) + B77*(SUBURB)

Level-3 Model

B00 = G000 + G001(SQRTTARG) + G002(ELEMMATH) + G003(SECMATH) + G004(SECSCI) + U00
B01 = G010 + U01
B02 = G020 + U02
B03 = G030 + U03
B04 = G040 + U04
B05 = G050 + U05
B06 = G060 + U06
B07 = G070 + U07
B10 = G100 + U10
B20 = G200 + U20
B30 = G300 + G301(SQRTTARG) + G302(ELEMMATH) + G303(SECMATH) + G304(SECSCI) + U30
B40 = G400 + G401(SQRTTARG) + G402(ELEMMATH) + G403(SECMATH) + G404(SECSCI) + U40
B41 = G410 + U41
B42 = G420 + U42
B43 = G430 + U43
B44 = G440 + U44
B45 = G450 + U45
B46 = G460 + U46
B47 = G470 + U47
B50 = G500 + G501(SQRTTARG) + G502(ELEMMATH) + G503(SECMATH) + G504(SECSCI)
B51 = G510 + U51
B52 = G520 + U52
B53 = G530 + U53
B54 = G540 + U54
B55 = G550 + U55
B56 = G560 + U56
B57 = G570 + U57

B60 = G600 + U60
B61 = G610 + U61
B62 = G620 + U62
B63 = G630 + U63
B64 = G640 + U64
B65 = G650 + U65
B66 = G660 + U66
B67 = G670 + U67
B70 = G700 + G701(SQRTTARG) + G702(ELEMMATH) + G703(SECMATH) + G704(SECSCI) + U70
B71 = G710 + U71
B72 = G720 + U72
B73 = G730 + U73
B74 = G740 + U74
B75 = G750 + U75
B76 = G760 + U76
B77 = G770 + U77

Attitudes Towards Reform-Based Teaching: K–8 Science

Level-1 Model

Y = P0 + P1*(NOVTCHR) + P2*(EXPTCHR) + P3*(PROJYR) + P4*(PDMID_DI)
+ P5*(HIQUAL) + P6*(ACN9_T) + P7*(PDHIQUAL) + E

Level-2 Model

P0 = B00 + B01*(NUMST_T) + B02*(NOASN_T) + B03*(FRL_T) + B04*(LEP_T)
+ B05*(RURAL) + B06*(TOWN) + B07*(SUBURB) + R0
P1 = B10
P2 = B20
P3 = B30
P4 = B40 + B41*(NUMST_T) + B42*(NOASN_T) + B43*(FRL_T) + B44*(LEP_T)
+ B45*(RURAL) + B46*(TOWN) + B47*(SUBURB)
P5 = B50 + B51*(NUMST_T) + B52*(NOASN_T) + B53*(FRL_T) + B54*(LEP_T)
+ B55*(RURAL) + B56*(TOWN) + B57*(SUBURB)
P6 = B60
P7 = B70 + B71*(NUMST_T) + B72*(NOASN_T) + B73*(FRL_T) + B74*(LEP_T)
+ B75*(RURAL) + B76*(TOWN) + B77*(SUBURB)

Level-3 Model

B00 = G000 + G001(SQRTTARG) + U00
B01 = G010 + U01
B02 = G020 + U02
B03 = G030 + U03
B04 = G040 + U04
B05 = G050 + U05
B06 = G060 + U06
B07 = G070 + U07
B10 = G100 + U10
B20 = G200 + U20
B30 = G300 + G301(SQRTTARG) + U30
B40 = G400 + G401(SQRTTARG) + U40
B41 = G410 + U41
B42 = G420 + U42
B43 = G430 + U43
B44 = G440 + U44
B45 = G450 + U45
B46 = G460 + U46
B47 = G470 + U47
B50 = G500
B51 = G510
B52 = G520
B53 = G530
B54 = G540
B55 = G550
B56 = G560
B57 = G570
B60 = G600 + G601(SQRTTARG) + U60
B70 = G700 + G701(SQRTTARG) + U70
B71 = G710
B72 = G720
B73 = G730
B74 = G740
B75 = G750

B76 = G760
B77 = G770

Attitudes Towards Reform-Based Teaching: K–8 Mathematics

Level-1 Model

Y = P0 + P1*(NOVTCHR) + P2*(EXPTCHR) + P3*(PROJYR) + P4*(PDMID_DI)
+ P5*(HIQUAL) + P6*(ACN9_T) + P7*(PDHIQUAL) + E

Level-2 Model

P0 = B00 + B01*(NUMST_T) + B02*(NOASN_T) + B03*(FRL_T) + B04*(LEP_T)
+ B05*(RURAL) + B06*(TOWN) + B07*(SUBURB) + R0
P1 = B10
P2 = B20
P3 = B30
P4 = B40 + B41*(NUMST_T) + B42*(NOASN_T) + B43*(FRL_T) + B44*(LEP_T)
+ B45*(RURAL) + B46*(TOWN) + B47*(SUBURB)
P5 = B50 + B51*(NUMST_T) + B52*(NOASN_T) + B53*(FRL_T) + B54*(LEP_T)
+ B55*(RURAL) + B56*(TOWN) + B57*(SUBURB)
P6 = B60
P7 = B70

Level-3 Model

B00 = G000 + U00
B01 = G010 + U01
B02 = G020 + U02
B03 = G030 + U03
B04 = G040 + U04
B05 = G050 + U05
B06 = G060 + U06
B07 = G070 + U07
B10 = G100
B20 = G200
B30 = G300
B40 = G400 + U40
B41 = G410
B42 = G420
B43 = G430
B44 = G440
B45 = G450
B46 = G460
B47 = G470
B50 = G500
B51 = G510
B52 = G520
B53 = G530
B54 = G540
B55 = G550
B56 = G560
B57 = G570
B60 = G600 + U60
B70 = G700

Teachers' Perceptions of Pedagogical Preparedness: Overall Sample

Level-1 Model

Y = P0 + P1*(NOVTCHR) + P2*(EXPTCHR) + P3*(PROJYR) + P4*(PDMID_DI)
+ P5*(PDMID_SQ) + P6*(PDMID_CB) + P7*(HIQUAL) + P8*(ACN9_T)
+ P9*(PDHIQUAL) + P10*(PDSQHI) + P11*(PDCBHI) + E

Level-2 Model

P0 = B00 + B01*(NUMST_T) + B02*(NOASN_T) + B03*(FRL_T) + B04*(LEP_T)
+ B05*(RURAL) + B06*(TOWN) + B07*(SUBURB) + R0
P1 = B10
P2 = B20
P3 = B30
P4 = B40 + B41*(NUMST_T) + B42*(NOASN_T) + B43*(FRL_T) + B44*(LEP_T)
+ B45*(RURAL) + B46*(TOWN) + B47*(SUBURB)
P5 = B50
P6 = B60
P7 = B70 + B71*(NUMST_T) + B72*(NOASN_T) + B73*(FRL_T) + B74*(LEP_T)
+ B75*(RURAL) + B76*(TOWN) + B77*(SUBURB)
P8 = B80 + B81*(NUMST_T) + B82*(NOASN_T) + B83*(FRL_T) + B84*(LEP_T)
+ B85*(RURAL) + B86*(TOWN) + B87*(SUBURB)
P9 = B90
P10 = B100
P11 = B110

Level-3 Model

B00 = G000 + G001(SQRTTARG) + G002(ELEMMATH) + G003(SECMATH) + G004(SECSCI) + U00
B01 = G010 + U01
B02 = G020 + U02
B03 = G030 + U03
B04 = G040 + U04
B05 = G050 + U05
B06 = G060 + U06
B07 = G070 + U07
B10 = G100 + U10
B20 = G200 + U20
B30 = G300 + G301(SQRTTARG) + G302(ELEMMATH) + G303(SECMATH) + G304(SECSCI) + U30
B40 = G400 + G401(SQRTTARG) + G402(ELEMMATH) + G403(SECMATH) + G404(SECSCI) + U40
B41 = G410 + U41
B42 = G420 + U42
B43 = G430 + U43
B44 = G440 + U44
B45 = G450 + U45
B46 = G460 + U46
B47 = G470 + U47
B50 = G500 + G501(SQRTTARG) + G502(ELEMMATH) + G503(SECMATH) + G504(SECSCI) + U50
B60 = G600 + G601(SQRTTARG) + G602(ELEMMATH) + G603(SECMATH) + G604(SECSCI) + U60
B70 = G700 + G701(SQRTTARG) + G702(ELEMMATH) + G703(SECMATH) + G704(SECSCI) + U70
B71 = G710 + U71
B72 = G720 + U72
B73 = G730 + U73
B74 = G740 + U74
B75 = G750 + U75
B76 = G760 + U76
B77 = G770 + U77

B80 = G800 + G801(SQRTTARG) + G802(ELEMMATH) + G803(SECMATH) + G804(SECSCI) + U80
B81 = G810 + U81
B82 = G820 + U82
B83 = G830 + U83
B84 = G840 + U84
B85 = G850 + U85
B86 = G860 + U86
B87 = G870 + U87
B90 = G900 + U90
B100 = G1000 + U100
B110 = G1100 + U110

Teachers' Perceptions of Pedagogical Preparedness: K–8 Science

Level-1 Model

Y = P0 + P1*(NOVTCHR) + P2*(EXPTCHR) + P3*(PROJYR) + P4*(PDMID_DI)
+ P5*(PDMID_SQ) + P6*(PDMID_CB) + P7*(HIQUAL) + P8*(ACN9_T)
+ P9*(PDHIQUAL) + P10*(PDSQHI) + P11*(PDCBHI) + E

Level-2 Model

P0 = B00 + B01*(NUMST_T) + B02*(NOASN_T) + B03*(FRL_T) + B04*(LEP_T)
+ B05*(RURAL) + B06*(TOWN) + B07*(SUBURB) + R0
P1 = B10
P2 = B20
P3 = B30
P4 = B40 + B41*(NUMST_T) + B42*(NOASN_T) + B43*(FRL_T) + B44*(LEP_T)
+ B45*(RURAL) + B46*(TOWN) + B47*(SUBURB)
P5 = B50 + B51*(NUMST_T) + B52*(NOASN_T) + B53*(FRL_T) + B54*(LEP_T)
+ B55*(RURAL) + B56*(TOWN) + B57*(SUBURB)
P6 = B60 + B61*(NUMST_T) + B62*(NOASN_T) + B63*(FRL_T) + B64*(LEP_T)
+ B65*(RURAL) + B66*(TOWN) + B67*(SUBURB)
P7 = B70
P8 = B80
P9 = B90
P10 = B100
P11 = B110

Level-3 Model

B00 = G000 + G001(SQRTTARG) + U00
B01 = G010 + U01
B02 = G020 + U02
B03 = G030 + U03
B04 = G040 + U04
B05 = G050 + U05
B06 = G060 + U06
B07 = G070 + U07
B10 = G100
B20 = G200
B30 = G300
B40 = G400 + U40
B41 = G410 + U41
B42 = G420 + U42
B43 = G430 + U43
B44 = G440 + U44
B45 = G450 + U45
B46 = G460 + U46
B47 = G470 + U47
B50 = G500 + U50
B51 = G510 + U51
B52 = G520 + U52
B53 = G530 + U53
B54 = G540 + U54
B55 = G550 + U55
B56 = G560 + U56
B57 = G570 + U57
B60 = G600 + U60

B61 = G610
B62 = G620
B63 = G630
B64 = G640
B65 = G650
B66 = G660
B67 = G670
B70 = G700 + G701(SQRTTARG)
B80 = G800
B90 = G900 + U90
B100 = G1000 + U100
B110 = G1100 + U110

Teachers' Perceptions of Pedagogical Preparedness: K–8 Mathematics

Level-1 Model

Y = P0 + P1*(NOVTCHR) + P2*(EXPTCHR) + P3*(PROJYR) + P4*(PDMID_DI)
+ P5*(HIQUAL) + P6*(ACN9_T) + P7*(PDHIQUAL) + E

Level-2 Model

P0 = B00 + B01*(NUMST_T) + B02*(NOASN_T) + B03*(FRL_T) + B04*(LEP_T)
+ B05*(RURAL) + B06*(TOWN) + B07*(SUBURB) + R0
P1 = B10
P2 = B20
P3 = B30
P4 = B40 + B41*(NUMST_T) + B42*(NOASN_T) + B43*(FRL_T) + B44*(LEP_T)
+ B45*(RURAL) + B46*(TOWN) + B47*(SUBURB)
P5 = B50 + B51*(NUMST_T) + B52*(NOASN_T) + B53*(FRL_T) + B54*(LEP_T)
+ B55*(RURAL) + B56*(TOWN) + B57*(SUBURB)
P6 = B60
P7 = B70

Level-3 Model

B00 = G000 + G001(SQRTTARG) + U00
B01 = G010
B02 = G020
B03 = G030
B04 = G040
B05 = G050
B06 = G060
B07 = G070
B10 = G100
B20 = G200
B30 = G300
B40 = G400 + U40
B41 = G410
B42 = G420
B43 = G430
B44 = G440
B45 = G450
B46 = G460
B47 = G470
B50 = G500
B51 = G510
B52 = G520
B53 = G530
B54 = G540
B55 = G550
B56 = G560
B57 = G570
B60 = G600
B70 = G700

Teachers' Perceptions of Content Preparedness: Overall Sample

Level-1 Model

Y = P0 + P1*(NOVTCHR) + P2*(EXPTCHR) + P3*(PROJYR) + P4*(PDMID_DI)
+ P5*(HIQUAL) + P6*(ACN9_T) + P7*(PDHIQUAL) + E

Level-2 Model

P0 = B00 + B01*(NUMST_T) + B02*(NOASN_T) + B03*(FRL_T) + B04*(LEP_T)
+ B05*(RURAL) + B06*(TOWN) + B07*(SUBURB) + R0
P1 = B10
P2 = B20
P3 = B30
P4 = B40 + B41*(NUMST_T) + B42*(NOASN_T) + B43*(FRL_T) + B44*(LEP_T)
+ B45*(RURAL) + B46*(TOWN) + B47*(SUBURB)
P5 = B50 + B51*(NUMST_T) + B52*(NOASN_T) + B53*(FRL_T) + B54*(LEP_T)
+ B55*(RURAL) + B56*(TOWN) + B57*(SUBURB)
P6 = B60 + B61*(NUMST_T) + B62*(NOASN_T) + B63*(FRL_T) + B64*(LEP_T)
+ B65*(RURAL) + B66*(TOWN) + B67*(SUBURB)
P7 = B70 + B71*(NUMST_T) + B72*(NOASN_T) + B73*(FRL_T) + B74*(LEP_T)
+ B75*(RURAL) + B76*(TOWN) + B77*(SUBURB)

Level-3 Model

B00 = G000 + G001(SQRTTARG) + G002(ELEMMATH) + G003(SECMATH) + G004(SECSCI) + U00
B01 = G010 + U01
B02 = G020 + U02
B03 = G030 + U03
B04 = G040 + U04
B05 = G050 + U05
B06 = G060 + U06
B07 = G070 + U07
B10 = G100 + G101(SQRTTARG) + G102(ELEMMATH) + G103(SECMATH) + G104(SECSCI)
B20 = G200 + G201(SQRTTARG) + G202(ELEMMATH) + G203(SECMATH) + G204(SECSCI)
B30 = G300 + G301(SQRTTARG) + G302(ELEMMATH) + G303(SECMATH) + G304(SECSCI) + U30
B40 = G400 + G401(SQRTTARG) + G402(ELEMMATH) + G403(SECMATH) + G404(SECSCI)
B41 = G410
B42 = G420
B43 = G430
B44 = G440
B45 = G450
B46 = G460
B47 = G470
B50 = G500 + G501(SQRTTARG) + G502(ELEMMATH) + G503(SECMATH) + G504(SECSCI) + U50
B51 = G510
B52 = G520
B53 = G530
B54 = G540
B55 = G550
B56 = G560
B57 = G570
B60 = G600 + G601(SQRTTARG) + G602(ELEMMATH) + G603(SECMATH) + G604(SECSCI)
B61 = G610
B62 = G620
B63 = G630
B64 = G640
B65 = G650

B66 = G660
B67 = G670
B70 = G700 + G701(SQRTTARG) + G702(ELEMMATH) + G703(SECMATH) + G704(SECSCI)
B71 = G710
B72 = G720
B73 = G730
B74 = G740
B75 = G750
B76 = G760
B77 = G770

Teachers' Perceptions of Content Preparedness: K–8 Science

Level-1 Model

Y = P0 + P1*(NOVTCHR) + P2*(EXPTCHR) + P3*(PROJYR) + P4*(PDMID_DI)
+ P5*(HIQUAL) + P6*(ACN9_T) + P7*(PDHIQUAL) + E

Level-2 Model

P0 = B00 + B01*(NUMST_T) + B02*(NOASN_T) + B03*(FRL_T) + B04*(LEP_T)
+ B05*(RURAL) + B06*(TOWN) + B07*(SUBURB) + R0
P1 = B10
P2 = B20
P3 = B30
P4 = B40 + B41*(NUMST_T) + B42*(NOASN_T) + B43*(FRL_T) + B44*(LEP_T)
+ B45*(RURAL) + B46*(TOWN) + B47*(SUBURB)
P5 = B50 + B51*(NUMST_T) + B52*(NOASN_T) + B53*(FRL_T) + B54*(LEP_T)
+ B55*(RURAL) + B56*(TOWN) + B57*(SUBURB)
P6 = B60
P7 = B70 + B71*(NUMST_T) + B72*(NOASN_T) + B73*(FRL_T) + B74*(LEP_T)
+ B75*(RURAL) + B76*(TOWN) + B77*(SUBURB)

Level-3 Model

B00 = G000 + G001(SQRTTARG) + U00
B01 = G010 + U01
B02 = G020 + U02
B03 = G030 + U03
B04 = G040 + U04
B05 = G050 + U05
B06 = G060 + U06
B07 = G070 + U07
B10 = G100 + U10
B20 = G200 + U20
B30 = G300 + G301(SQRTTARG) + U30
B40 = G400 + G401(SQRTTARG) + U40
B41 = G410 + U41
B42 = G420 + U42
B43 = G430 + U43
B44 = G440 + U44
B45 = G450 + U45
B46 = G460 + U46
B47 = G470 + U47
B50 = G500 + G501(SQRTTARG) + U50
B51 = G510 + U51
B52 = G520 + U52
B53 = G530 + U53
B54 = G540 + U54
B55 = G550 + U55
B56 = G560 + U56
B57 = G570 + U57
B60 = G600 + G601(SQRTTARG) + U60
B70 = G700 + U70
B71 = G710
B72 = G720
B73 = G730
B74 = G740
B75 = G750

B76 = G760
B77 = G770

Teachers' Perceptions of Content Preparedness: K–8 Mathematics

Level-1 Model

Y = P0 + P1*(NOVTCHR) + P2*(EXPTCHR) + P3*(PROJYR) + P4*(PDMID_DI)
+ P5*(HIQUAL) + P6*(ACN9_T) + P7*(PDHIQUAL) + E

Level-2 Model

P0 = B00 + B01*(NUMST_T) + B02*(NOASN_T) + B03*(FRL_T) + B04*(LEP_T)
+ B05*(RURAL) + B06*(TOWN) + B07*(SUBURB) + R0
P1 = B10
P2 = B20
P3 = B30
P4 = B40
P5 = B50 + B51*(NUMST_T) + B52*(NOASN_T) + B53*(FRL_T) + B54*(LEP_T)
+ B55*(RURAL) + B56*(TOWN) + B57*(SUBURB)
P6 = B60
P7 = B70

Level-3 Model

B00 = G000 + G001(SQRTTARG) + U00
B01 = G010 + U01
B02 = G020 + U02
B03 = G030 + U03
B04 = G040 + U04
B05 = G050 + U05
B06 = G060 + U06
B07 = G070 + U07
B10 = G100 + U10
B20 = G200 + U20
B30 = G300 + G301(SQRTTARG) + U30
B40 = G400 + G401(SQRTTARG) + U40
B50 = G500
B51 = G510
B52 = G520
B53 = G530
B54 = G540
B55 = G550
B56 = G560
B57 = G570
B60 = G600 + G601(SQRTTARG) + U60
B70 = G700 + G701(SQRTTARG) + U70

Teachers' Use of Traditional Teaching Practices: Overall Sample

Level-1 Model

Y = P0 + P1*(NOVTCHR) + P2*(EXPTCHR) + P3*(PROJYR) + P4*(PDMID_DI)
+ P5*(HIQUAL) + P6*(ACN9_T) + P7*(PDHIQUAL) + E

Level-2 Model

P0 = B00 + B01*(NUMST_T) + B02*(NOASN_T) + B03*(FRL_T) + B04*(LEP_T)
+ B05*(RURAL) + B06*(TOWN) + B07*(SUBURB) + R0
P1 = B10
P2 = B20
P3 = B30
P4 = B40 + B41*(NUMST_T) + B42*(NOASN_T) + B43*(FRL_T) + B44*(LEP_T)
+ B45*(RURAL) + B46*(TOWN) + B47*(SUBURB)
P5 = B50 + B51*(NUMST_T) + B52*(NOASN_T) + B53*(FRL_T) + B54*(LEP_T)
+ B55*(RURAL) + B56*(TOWN) + B57*(SUBURB)
P6 = B60 + B61*(NUMST_T) + B62*(NOASN_T) + B63*(FRL_T) + B64*(LEP_T)
+ B65*(RURAL) + B66*(TOWN) + B67*(SUBURB)
P7 = B70 + B71*(NUMST_T) + B72*(NOASN_T) + B73*(FRL_T) + B74*(LEP_T)
+ B75*(RURAL) + B76*(TOWN) + B77*(SUBURB)

Level-3 Model

B00 = G000 + G001(SQRTTARG) + G002(ELEMMATH) + G003(SECMATH) + G004(SECSCI) + U00
B01 = G010
B02 = G020
B03 = G030
B04 = G040
B05 = G050
B06 = G060
B07 = G070
B10 = G100 + U10
B20 = G200 + U20
B30 = G300 + G301(SQRTTARG) + G302(ELEMMATH) + G303(SECMATH) + G304(SECSCI) + U30
B40 = G400 + G401(SQRTTARG) + G402(ELEMMATH) + G403(SECMATH) + G404(SECSCI) + U40
B41 = G410 + U41
B42 = G420 + U42
B43 = G430 + U43
B44 = G440 + U44
B45 = G450 + U45
B46 = G460 + U46
B47 = G470 + U47
B50 = G500
B51 = G510
B52 = G520
B53 = G530
B54 = G540
B55 = G550
B56 = G560
B57 = G570
B60 = G600 + U60
B61 = G610
B62 = G620
B63 = G630
B64 = G640
B65 = G650

B66 = G660
B67 = G670
B70 = G700 + G701(SQRTTARG) + G702(ELEMMATH) + G703(SECMATH) + G704(SECSCI) + U70
B71 = G710 + U71
B72 = G720 + U72
B73 = G730 + U73
B74 = G740 + U74
B75 = G750 + U75
B76 = G760 + U76
B77 = G770 + U77

Teachers' Use of Traditional Teaching Practices: K–8 Science

Level-1 Model

Y = P0 + P1*(NOVTCHR) + P2*(EXPTCHR) + P3*(PROJYR) + P4*(PDMID_DI)
+ P5*(HIQUAL) + P6*(ACN9_T) + P7*(PDHIQUAL) + E

Level-2 Model

P0 = B00 + B01*(NUMST_T) + B02*(NOASN_T) + B03*(FRL_T) + B04*(LEP_T)
+ B05*(RURAL) + B06*(TOWN) + B07*(SUBURB) + R0
P1 = B10
P2 = B20
P3 = B30
P4 = B40 + B41*(NUMST_T) + B42*(NOASN_T) + B43*(FRL_T) + B44*(LEP_T)
+ B45*(RURAL) + B46*(TOWN) + B47*(SUBURB)
P5 = B50 + B51*(NUMST_T) + B52*(NOASN_T) + B53*(FRL_T) + B54*(LEP_T)
+ B55*(RURAL) + B56*(TOWN) + B57*(SUBURB)
P6 = B60
P7 = B70 + B71*(NUMST_T) + B72*(NOASN_T) + B73*(FRL_T) + B74*(LEP_T)
+ B75*(RURAL) + B76*(TOWN) + B77*(SUBURB)

Level-3 Model

B00 = G000 + G001(SQRTTARG) + U00
B01 = G010 + U01
B02 = G020 + U02
B03 = G030 + U03
B04 = G040 + U04
B05 = G050 + U05
B06 = G060 + U06
B07 = G070 + U07
B10 = G100 + U10
B20 = G200 + U20
B30 = G300 + G301(SQRTTARG) + U30
B40 = G400 + G401(SQRTTARG) + U40
B41 = G410
B42 = G420
B43 = G430
B44 = G440
B45 = G450
B46 = G460
B47 = G470
B50 = G500 + U50
B51 = G510 + U51
B52 = G520 + U52
B53 = G530 + U53
B54 = G540 + U54
B55 = G550 + U55
B56 = G560 + U56
B57 = G570 + U57
B60 = G600 + G601(SQRTTARG) + U60
B70 = G700
B71 = G710 + U71
B72 = G720 + U72
B73 = G730 + U73
B74 = G740 + U74
B75 = G750 + U75

B76 = G760 + U76
B77 = G770 + U77

Teachers' Use of Traditional Teaching Practices: K–8 Mathematics

Level-1 Model

Y = P0 + P1*(NOVTCHR) + P2*(EXPTCHR) + P3*(PROJYR) + P4*(PDMID_DI)
+ P5*(HIQUAL) + P6*(ACN9_T) + P7*(PDHIQUAL) + E

Level-2 Model

P0 = B00 + B01*(NUMST_T) + B02*(NOASN_T) + B03*(FRL_T) + B04*(LEP_T)
+ B05*(RURAL) + B06*(TOWN) + B07*(SUBURB) + R0
P1 = B10
P2 = B20
P3 = B30
P4 = B40 + B41*(NUMST_T) + B42*(NOASN_T) + B43*(FRL_T) + B44*(LEP_T)
+ B45*(RURAL) + B46*(TOWN) + B47*(SUBURB)
P5 = B50 + B51*(NUMST_T) + B52*(NOASN_T) + B53*(FRL_T) + B54*(LEP_T)
+ B55*(RURAL) + B56*(TOWN) + B57*(SUBURB)
P6 = B60
P7 = B70

Level-3 Model

B00 = G000 + G001(SQRTTARG) + U00
B01 = G010
B02 = G020
B03 = G030
B04 = G040
B05 = G050
B06 = G060
B07 = G070
B10 = G100
B20 = G200
B30 = G300 + U30
B40 = G400 + U40
B41 = G410
B42 = G420
B43 = G430
B44 = G440
B45 = G450
B46 = G460
B47 = G470
B50 = G500
B51 = G510
B52 = G520
B53 = G530
B54 = G540
B55 = G550
B56 = G560
B57 = G570
B60 = G600
B70 = G700

Investigative Classroom Culture: Overall Sample

Level-1 Model

Y = P0 + P1*(NOVTCHR) + P2*(EXPTCHR) + P3*(PROJYR) + P4*(PDMID_DI)
+ P5*(PDMID_SQ) + P6*(PDMID_CB) + P7*(HIQUAL) + P8*(ACN9_T)
+ P9*(PDHIQUAL) + P10*(PDSQHI) + P11*(PDCBHI) + E

Level-2 Model

P0 = B00 + B01*(NUMST_T) + B02*(NOASN_T) + B03*(FRL_T) + B04*(LEP_T)
+ B05*(RURAL) + B06*(TOWN) + B07*(SUBURB) + R0
P1 = B10
P2 = B20
P3 = B30
P4 = B40 + B41*(NUMST_T) + B42*(NOASN_T) + B43*(FRL_T) + B44*(LEP_T)
+ B45*(RURAL) + B46*(TOWN) + B47*(SUBURB)
P5 = B50 + B51*(NUMST_T) + B52*(NOASN_T) + B53*(FRL_T) + B54*(LEP_T)
+ B55*(RURAL) + B56*(TOWN) + B57*(SUBURB)
P6 = B60 + B61*(NUMST_T) + B62*(NOASN_T) + B63*(FRL_T) + B64*(LEP_T)
+ B65*(RURAL) + B66*(TOWN) + B67*(SUBURB)
P7 = B70 + B71*(NUMST_T) + B72*(NOASN_T) + B73*(FRL_T) + B74*(LEP_T)
+ B75*(RURAL) + B76*(TOWN) + B77*(SUBURB)
P8 = B80
P9 = B90
P10 = B100
P11 = B110

Level-3 Model

B00 = G000 + G001(SQRTTARG) + G002(ELEMMATH) + G003(SECMATH) + G004(SECSCI) + U00
B01 = G010
B02 = G020
B03 = G030
B04 = G040
B05 = G050
B06 = G060
B07 = G070
B10 = G100 + U10
B20 = G200 + U20
B30 = G300 + G301(SQRTTARG) + G302(ELEMMATH) + G303(SECMATH) + G304(SECSCI) + U30
B40 = G400 + G401(SQRTTARG) + G402(ELEMMATH) + G403(SECMATH) + G404(SECSCI) + U40
B41 = G410 + U41
B42 = G420 + U42
B43 = G430 + U43
B44 = G440 + U44
B45 = G450 + U45
B46 = G460 + U46
B47 = G470 + U47
B50 = G500 + G501(SQRTTARG) + G502(ELEMMATH) + G503(SECMATH) + G504(SECSCI) + U50
B51 = G510 + U51
B52 = G520 + U52
B53 = G530 + U53
B54 = G540 + U54
B55 = G550 + U55
B56 = G560 + U56
B57 = G570 + U57
B60 = G600 + G601(SQRTTARG) + G602(ELEMMATH) + G603(SECMATH) + G604(SECSCI) + U60

B61 = G610 + U61
B62 = G620 + U62
B63 = G630 + U63
B64 = G640 + U64
B65 = G650 + U65
B66 = G660 + U66
B67 = G670 + U67
B70 = G700 + G701(SQRTTARG) + G702(ELEMMATH) + G703(SECMATH) + G704(SECSCI) + U70
B71 = G710 + U71
B72 = G720 + U72
B73 = G730 + U73
B74 = G740 + U74
B75 = G750 + U75
B76 = G760 + U76
B77 = G770 + U77
B80 = G800 + U80
B90 = G900 + U90
B100 = G1000 + U100
B110 = G1100 + U110

Investigative Classroom Culture: K–8 Science

Level-1 Model

Y = P0 + P1*(NOVTCHR) + P2*(EXPTCHR) + P3*(PROJYR) + P4*(PDMID_DI)
+ P5*(PDMID_SQ) + P6*(PDMID_CB) + P7*(HIQUAL) + P8*(ACN9_T)
+ P9*(PDHIQUAL) + P10*(PDSQHI) + P11*(PDCBHI) + E

Level-2 Model

P0 = B00 + B01*(NUMST_T) + B02*(NOASN_T) + B03*(FRL_T) + B04*(LEP_T)
+ B05*(RURAL) + B06*(TOWN) + B07*(SUBURB) + R0
P1 = B10
P2 = B20
P3 = B30
P4 = B40
P5 = B50
P6 = B60
P7 = B70 + B71*(NUMST_T) + B72*(NOASN_T) + B73*(FRL_T) + B74*(LEP_T)
+ B75*(RURAL) + B76*(TOWN) + B77*(SUBURB)
P8 = B80
P9 = B90
P10 = B100
P11 = B110

Level-3 Model

B00 = G000 + G001(SQRTTARG) + U00
B01 = G010 + U01
B02 = G020 + U02
B03 = G030 + U03
B04 = G040 + U04
B05 = G050 + U05
B06 = G060 + U06
B07 = G070 + U07
B10 = G100 + U10
B20 = G200 + U20
B30 = G300 + G301(SQRTTARG) + U30
B40 = G400 + G401(SQRTTARG) + U40
B50 = G500 + G501(SQRTTARG) + U50
B60 = G600 + G601(SQRTTARG) + U60
B70 = G700
B71 = G710
B72 = G720
B73 = G730
B74 = G740
B75 = G750
B76 = G760
B77 = G770
B80 = G800 + G801(SQRTTARG) + U80
B90 = G900 + G901(SQRTTARG)
B100 = G1000 + G1001(SQRTTARG)
B110 = G1100 + G1101(SQRTTARG)

Investigative Classroom Culture: K–8 Mathematics

Level-1 Model

Y = P0 + P1*(NOVTCHR) + P2*(EXPTCHR) + P3*(PROJYR) + P4*(PDMID_DI)
+ P5*(PDMID_SQ) + P6*(PDMID_CB) + P7*(HIQUAL) + P8*(ACN9_T)
+ P9*(PDHIQUAL) + P10*(PDSQHI) + P11*(PDCBHI) + E

Level-2 Model

P0 = B00 + B01*(NUMST_T) + B02*(NOASN_T) + B03*(FRL_T) + B04*(LEP_T)
+ B05*(RURAL) + B06*(TOWN) + B07*(SUBURB) + R0
P1 = B10
P2 = B20
P3 = B30
P4 = B40
P5 = B50
P6 = B60
P7 = B70 + B71*(NUMST_T) + B72*(NOASN_T) + B73*(FRL_T) + B74*(LEP_T)
+ B75*(RURAL) + B76*(TOWN) + B77*(SUBURB)
P8 = B80
P9 = B90
P10 = B100
P11 = B110

Level-3 Model

B00 = G000 + G001(SQRTTARG) + U00
B01 = G010
B02 = G020
B03 = G030
B04 = G040
B05 = G050
B06 = G060
B07 = G070
B10 = G100 + U10
B20 = G200 + U20
B30 = G300 + G301(SQRTTARG)
B40 = G400 + U40
B50 = G500 + U50
B60 = G600 + U60
B70 = G700 + G701(SQRTTARG)
B71 = G710
B72 = G720
B73 = G730
B74 = G740
B75 = G750
B76 = G760
B77 = G770
B80 = G800
B90 = G900
B100 = G1000
B110 = G1100

Teachers' Use of Investigative Teaching Practices: Overall Sample

Level-1 Model

Y = P0 + P1*(NOVTCHR) + P2*(EXPTCHR) + P3*(PROJYR) + P4*(PDMID_DI)
+ P5*(PDMID_SQ) + P6*(PDMID_CB) + P7*(HIQUAL) + P8*(ACN9_T)
+ P9*(PDHIQUAL) + P10*(PDSQHI) + P11*(PDCBHI) + E

Level-2 Model

P0 = B00 + B01*(NUMST_T) + B02*(NOASN_T) + B03*(FRL_T) + B04*(LEP_T)
+ B05*(RURAL) + B06*(TOWN) + B07*(SUBURB) + R0
P1 = B10
P2 = B20
P3 = B30
P4 = B40 + B41*(NUMST_T) + B42*(NOASN_T) + B43*(FRL_T) + B44*(LEP_T)
+ B45*(RURAL) + B46*(TOWN) + B47*(SUBURB)
P5 = B50 + B51*(NUMST_T) + B52*(NOASN_T) + B53*(FRL_T) + B54*(LEP_T)
+ B55*(RURAL) + B56*(TOWN) + B57*(SUBURB)
P6 = B60 + B61*(NUMST_T) + B62*(NOASN_T) + B63*(FRL_T) + B64*(LEP_T)
+ B65*(RURAL) + B66*(TOWN) + B67*(SUBURB)
P7 = B70 + B71*(NUMST_T) + B72*(NOASN_T) + B73*(FRL_T) + B74*(LEP_T)
+ B75*(RURAL) + B76*(TOWN) + B77*(SUBURB)
P8 = B80 + B81*(NUMST_T) + B82*(NOASN_T) + B83*(FRL_T) + B84*(LEP_T)
+ B85*(RURAL) + B86*(TOWN) + B87*(SUBURB)
P9 = B90
P10 = B100
P11 = B110

Level-3 Model

B00 = G000 + G001(SQRTTARG) + G002(ELEMMATH) + G003(SECMATH) + G004(SECSCI) + U00
B01 = G010
B02 = G020
B03 = G030
B04 = G040
B05 = G050
B06 = G060
B07 = G070
B10 = G100 + U10
B20 = G200 + U20
B30 = G300 + G301(SQRTTARG) + G302(ELEMMATH) + G303(SECMATH) + G304(SECSCI) + U30
B40 = G400 + G401(SQRTTARG) + G402(ELEMMATH) + G403(SECMATH) + G404(SECSCI)
B41 = G410
B42 = G420
B43 = G430
B44 = G440
B45 = G450
B46 = G460
B47 = G470
B50 = G500 + G501(SQRTTARG) + G502(ELEMMATH) + G503(SECMATH) + G504(SECSCI)
B51 = G510
B52 = G520
B53 = G530
B54 = G540
B55 = G550
B56 = G560
B57 = G570

B60 = G600 + G601(SQRTTARG) + G602(ELEMMATH) + G603(SECMATH) + G604(SECSCI)
B61 = G610
B62 = G620
B63 = G630
B64 = G640
B65 = G650
B66 = G660
B67 = G670
B70 = G700 + G701(SQRTTARG) + G702(ELEMMATH) + G703(SECMATH) + G704(SECSCI) + U70
B71 = G710
B72 = G720
B73 = G730
B74 = G740
B75 = G750
B76 = G760
B77 = G770
B80 = G800 + G801(SQRTTARG) + G802(ELEMMATH) + G803(SECMATH) + G804(SECSCI) + U80
B81 = G810
B82 = G820
B83 = G830
B84 = G840
B85 = G850
B86 = G860
B87 = G870
B90 = G900
B100 = G1000
B110 = G1100

Teachers' Use of Investigative Teaching Practices: K–8 Science

Level-1 Model

Y = P0 + P1*(NOVTCHR) + P2*(EXPTCHR) + P3*(PROJYR) + P4*(PDMID_DI)
+ P5*(PDMID_SQ) + P6*(PDMID_CB) + P7*(HIQUAL) + P8*(ACN9_T)
+ P9*(PDHIQUAL) + P10*(PDSQHI) + P11*(PDCBHI) + E

Level-2 Model

P0 = B00 + B01*(NUMST_T) + B02*(NOASN_T) + B03*(FRL_T) + B04*(LEP_T)
+ B05*(RURAL) + B06*(TOWN) + B07*(SUBURB) + R0
P1 = B10
P2 = B20
P3 = B30
P4 = B40 + B41*(NUMST_T) + B42*(NOASN_T) + B43*(FRL_T) + B44*(LEP_T)
+ B45*(RURAL) + B46*(TOWN) + B47*(SUBURB)
P5 = B50 + B51*(NUMST_T) + B52*(NOASN_T) + B53*(FRL_T) + B54*(LEP_T)
+ B55*(RURAL) + B56*(TOWN) + B57*(SUBURB)
P6 = B60 + B61*(NUMST_T) + B62*(NOASN_T) + B63*(FRL_T) + B64*(LEP_T)
+ B65*(RURAL) + B66*(TOWN) + B67*(SUBURB)
P7 = B70
P8 = B80
P9 = B90
P10 = B100
P11 = B110

Level-3 Model

B00 = G000 + G001(SQRTTARG) + U00
B01 = G010 + U01
B02 = G020 + U02
B03 = G030 + U03
B04 = G040 + U04
B05 = G050 + U05
B06 = G060 + U06
B07 = G070 + U07
B10 = G100
B20 = G200
B30 = G300 + U30
B40 = G400 + U40
B41 = G410 + U41
B42 = G420 + U42
B43 = G430 + U43
B44 = G440 + U44
B45 = G450 + U45
B46 = G460 + U46
B47 = G470 + U47
B50 = G500 + U50
B51 = G510
B52 = G520
B53 = G530
B54 = G540
B55 = G550
B56 = G560
B57 = G570
B60 = G600 + U60
B61 = G610

B62 = G620
B63 = G630
B64 = G640
B65 = G650
B66 = G660
B67 = G670
B70 = G700 + U70
B80 = G800 + U80
B90 = G900 + U90
B100 = G1000 + U100
B110 = G1100 + U110

Teachers' Use of Investigative Teaching Practices: K–8 Mathematics

Level-1 Model

Y = P0 + P1*(NOVTCHR) + P2*(EXPTCHR) + P3*(PROJYR) + P4*(PDMID_DI)
+ P5*(PDMID_SQ) + P6*(PDMID_CB) + P7*(HIQUAL) + P8*(ACN9_T)
+ P9*(PDHIQUAL) + P10*(PDSQHI) + P11*(PDCBHI) + E

Level-2 Model

P0 = B00 + B01*(NUMST_T) + B02*(NOASN_T) + B03*(FRL_T) + B04*(LEP_T)
+ B05*(RURAL) + B06*(TOWN) + B07*(SUBURB) + R0
P1 = B10
P2 = B20
P3 = B30
P4 = B40
P5 = B50
P6 = B60
P7 = B70 + B71*(NUMST_T) + B72*(NOASN_T) + B73*(FRL_T) + B74*(LEP_T)
+ B75*(RURAL) + B76*(TOWN) + B77*(SUBURB)
P8 = B80
P9 = B90
P10 = B100
P11 = B110

Level-3 Model

B00 = G000 + G001(SQRTTARG) + U00
B01 = G010
B02 = G020
B03 = G030
B04 = G040
B05 = G050
B06 = G060
B07 = G070
B10 = G100
B20 = G200
B30 = G300
B40 = G400 + G401(SQRTTARG)
B50 = G500 + G501(SQRTTARG)
B60 = G600 + G601(SQRTTARG)
B70 = G700
B71 = G710
B72 = G720
B73 = G730
B74 = G740
B75 = G750
B76 = G760
B77 = G770
B80 = G800
B90 = G900
B100 = G1000
B110 = G1100

Minutes of Instruction Devoted to Science: K–5 Science

Level-1 Model

Y = P0 + P1*(NOVTCHR) + P2*(EXPTCHR) + P3*(PROJYR) + P4*(PDMID_DI)
+ P5*(PDMID_SQ) + P6*(PDMID_CB) + P7*(HIQUAL) + P8*(ACN9_T)
+ P9*(PDHIQUAL) + P10*(PDSQHI) + P11*(PDCBHI) + E

Level-2 Model

P0 = B00 + B01*(NUMST_T) + B02*(NOASN_T) + B03*(FRL_T) + B04*(LEP_T)
+ B05*(RURAL) + B06*(TOWN) + B07*(SUBURB) + R0
P1 = B10
P2 = B20
P3 = B30
P4 = B40 + B41*(NUMST_T) + B42*(NOASN_T) + B43*(FRL_T) + B44*(LEP_T)
+ B45*(RURAL) + B46*(TOWN) + B47*(SUBURB)
P5 = B50 + B51*(NUMST_T) + B52*(NOASN_T) + B53*(FRL_T) + B54*(LEP_T)
+ B55*(RURAL) + B56*(TOWN) + B57*(SUBURB)
P6 = B60 + B61*(NUMST_T) + B62*(NOASN_T) + B63*(FRL_T) + B64*(LEP_T)
+ B65*(RURAL) + B66*(TOWN) + B67*(SUBURB)
P7 = B70
P8 = B80
P9 = B90
P10 = B100
P11 = B110

Level-3 Model

B00 = G000 + U00
B01 = G010 + U01
B02 = G020 + U02
B03 = G030 + U03
B04 = G040 + U04
B05 = G050 + U05
B06 = G060 + U06
B07 = G070 + U07
B10 = G100 + U10
B20 = G200 + U20
B30 = G300 + U30
B40 = G400 + U40
B41 = G410 + U41
B42 = G420 + U42
B43 = G430 + U43
B44 = G440 + U44
B45 = G450 + U45
B46 = G460 + U46
B47 = G470 + U47
B50 = G500 + U50
B51 = G510 + U51
B52 = G520 + U52
B53 = G530 + U53
B54 = G540 + U54
B55 = G550 + U55
B56 = G560 + U56
B57 = G570 + U57
B60 = G600 + U60
B61 = G610 + U61

B62 = G620 + U62
B63 = G630 + U63
B64 = G640 + U64
B65 = G650 + U65
B66 = G660 + U66
B67 = G670 + U67
B70 = G700 + U70
B80 = G800 + U80
B90 = G900 + U90
B100 = G1000 + U100
B110 = G1100 + U110