Local Systemic Change through Teacher Enhancement

2003–06 Cross-Site Report

By

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Acknowledgments

The core evaluation of the Local Systemic Change Initiative requires the energy, efforts, and insights of a very large number of people.

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I. Introduction to the Local Systemic Change Initiative

In the spring and summer of 1995, the National Science Foundation (NSF) funded the first cohort of eight projects in a new initiative, the Local Systemic Change through Teacher Enhancement (LSC) program. Eighteen additional projects were funded in 1996, 20 in 1997, 12 in 1998, 13 in 1999, 9 in 2000, 7 in 2001, and 1 in 2002 for a total of 88 projects in Cohorts 1–8. No additional LSC projects were funded since 2002.

The goal of the LSC program is to improve the teaching of science, mathematics, and technology by focusing on the professional development of teachers within whole schools or school districts. Each targeted teacher is to participate in a minimum of 130 hours of professional development over the course of the project.[1] In addition to its focus on involving all teachers in a jurisdiction, the LSC initiative is distinguished from previous teacher enhancement efforts by its emphasis on preparing teachers to implement designated exemplary mathematics and science instructional materials in their classrooms.

LSC projects are expected to align policy and practice within the targeted district(s) and to include:

- A shared comprehensive vision of science, mathematics, and technology education;
- Active partnerships and commitments among stakeholders;
- A detailed self-study that provides a realistic assessment of the system's strengths and needs;
- Strategic planning that incorporates mechanisms for engaging each teacher in intensive professional development activities over the course of the project; and
- A set of clearly defined, measurable outcomes for teaching, and an evaluation plan that provides ongoing feedback to the project.

The LSC solicitation indicated NSF's plan to "provide a framework for data collection (including a set of instruments and procedures) that will allow the Foundation to evaluate individual projects, aggregate data and information across projects, and produce a cross-project analysis" (NSF 94-73). NSF contracted with Horizon Research, Inc. (HRI) of Chapel Hill, NC to design the data collection framework, provide technical assistance in its implementation, and analyze cross-site evaluation results.

This section provides an overview of the LSC projects and a description of core evaluation data collection activities. Subsequent sections present the findings from the core evaluation activities conducted from September 1, 2003 through May 1, 2006.

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

A. An Overview of LSC Projects in Cohorts 1–8

Data provided by the PIs and questionnaires completed by the principals of targeted schools provide some basic information about the LSC projects included in Cohorts 1–8.

- The LSC initiative has funded 38 K–8 science projects, 6 secondary science projects, 18 K–8 mathematics projects, 14 secondary mathematics projects, 6 projects that targeted both elementary mathematics and science, 1 project that targeted both elementary and secondary science, and 5 projects that targeted both elementary and secondary mathematics.

- Thirty-eight of the LSC projects were single-district projects; at the other end of the scale, 4 projects involved more than 20 districts each.

- Sixty-six of the projects were funded as five-year projects, 14 as four-year, and 8 as three-year; although a number of projects have been granted no-cost extensions.

- The 88 current and completed projects plan to involve a total of approximately 70,000 teachers in roughly 4,000 schools in 467 districts across the United States.

- By the completion of these projects, an estimated 2,142,000 students will receive instruction from LSC-treated teachers each year.

Twenty-two LSCs were still active for at least one of the data collection years included in this report (see Table 1).[2] Most projects targeted a single subject (e.g., K–8 mathematics); four projects targeted multiple subject/grade-ranges (i.e., K–12 mathematics, K–12 science, K–8 mathematics/ science).

Table 1
Active LSCs, by Targeted Subject†

	Number of Projects
Mathematics	
K–8	6
6–12	0
K–12	1
Science	
K–8	8
6–12	4
K–12	1
Mathematics and Science	
K–8	2

† Three LSC projects targeted middle school only; 1 is categorized as 6–12 mathematics, 2 are categorized as 6–12 science.

[2] Three projects completed data collection in 1998, 6 in 1999, 8 in 2000, 19 in 2001, 13 in 2002, and 17 in 2003; these 66 projects are not included in the analyses in this report.

B. Schools Participating Between 2003 and 2006

As can be seen in Figure 1, 36 percent of the schools targeted in the LSCs included in this report are in urban areas, 21 percent are in suburban areas, 26 percent are in rural areas, and 17 percent are in towns or small cities.

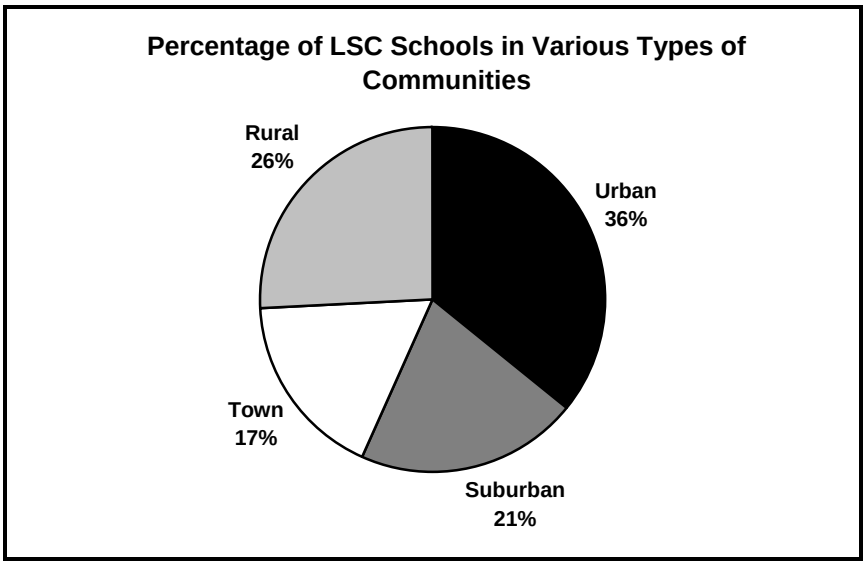

Figure 1

In terms of student demographics, across all schools targeted by these LSCs, 48 percent of students are white, 24 percent Hispanic, 22 percent African-American, 5 percent Asian, 1 percent American Indian or Alaskan Native, 0.1 percent Native Hawaiian or Pacific Islander, and 0.6 percent from another background. As can be seen in Figure 2, projects targeting K–8 mathematics serve the largest proportion of minority students, but in each subject/grade range the representation of minority students is about as large as, if not larger than, the national average of approximately 40 percent.

The typical school targeted for K–8 mathematics or science reform by these LSC projects has 478 students, 57 percent of whom qualify for free or reduced-price lunches and 13 percent of whom are of limited English proficiency (LEP). The typical school targeted for 6–12 mathematics or science reform has 633 students, 71 percent of whom are eligible for free or reduced-price lunches and 11 percent of whom are classified as LEP.

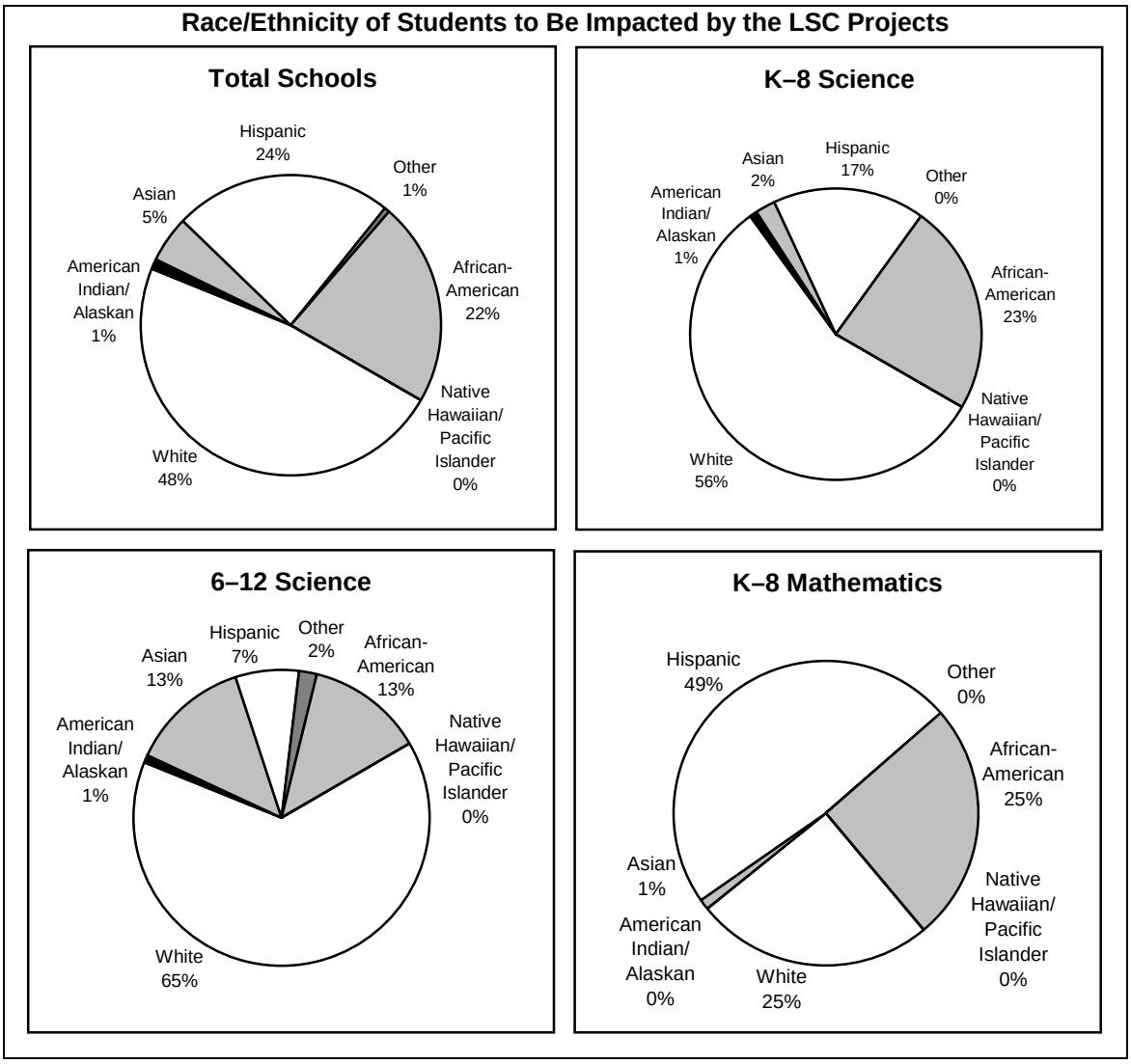
Race/Ethnicity of Students to Be Impacted by the LSC Projects
Total Schools
Hispanic 24%
Other 1%
Asian 5%
African-American 22%
American Indian/ Alaskan 1%
Native Hawaiian/ Pacific Islander 0%
White 48%
K–8 Science
Asian 2%
Hispanic 17%
Other 0%
American Indian/ Alaskan 1%
African-American 23%
Native Hawaiian/ Pacific Islander 0%
White 56%
6–12 Science
Hispanic 7%
Other 2%
Asian 13%
African-American 13%
American Indian/ Alaskan 1%
Native Hawaiian/ Pacific Islander 0%
White 65%
K–8 Mathematics
Hispanic 49%
Other 0%
African-American 25%
Asian 1%
Native Hawaiian/ Pacific Islander 0%
American Indian/ Alaskan 0%
White 25%

Figure 2

C. Description of Core Evaluation Data Collection and Analysis

HRI worked with the National Science Foundation and PIs and evaluators of the early LSC projects on the design and implementation of a core evaluation system to allow the aggregation of information across projects. This section describes the data collection activities associated with the core evaluation. Subsequent sections of the report present results for the three core evaluation questions listed below, followed by a summary section.

LSC Core Evaluation Questions

- What is the overall quality of the LSC professional development activities?
- What is the impact of the LSC professional development on teacher preparedness, attitudes, and beliefs about mathematics and science teaching and learning?
- What is the impact of the LSC professional development on classroom practices in mathematics and science?

Data Collection

This report spans three data collection years, in which each project included in this report collected core evaluation data at least once. For most data collection activities, only the most recent data collected were used in these analyses.[3] Data collection activities included the following:

1. ***Observations of Professional Development Activities***
   The core evaluation calls for projects to conduct 5–8 observations of professional development sessions each year and record their observations on standardized protocols. Evaluators were to consult with PIs on what professional development experiences were planned throughout the data collection year, and to select a sample that was representative of the diversity of the project's activities. Program-wide, a total of 283 observations of professional development sessions were conducted in the period from September 1, 2003 through May 1, 2006. Data were weighted to control for the variable number of observations conducted per project.

[3] Data from all professional development observations conducted over these three years were included in the analyses described in this report.

2. *Classroom Observations*

All 22 active projects conducted classroom observations of randomly selected teachers (or their backups), with the number of observations ranging from 10 to 24 per project.[4] A total of 366 classrooms were observed, roughly three-fourths of which were taught by teachers who had participated in at least 20 hours of LSC professional development. In all cases, the data were weighted to represent the total population of eligible teachers in the project.

3. *Teacher Questionnaires*

Twenty-one projects administered teacher questionnaires developed for the core evaluation to a random sample of teachers for each targeted subject; the median response rate among projects was 86 percent.[5] A total of 4,952 teacher questionnaires were returned to HRI, including 2,247 from K–8 science teachers, 638 from 6–12 science teachers, 1,999 from K–8 mathematics teachers, and 68 from 6–12 mathematics teachers. Weights were added to the data file to reflect the probability of each teacher's selection into the sample, adjusted for any non-response in that project.

4. *Principal Questionnaires*

Each of the 22 projects administered questionnaires to the entire population of principals of targeted schools. Return rates on the principal questionnaire were generally higher than for the teacher questionnaire; a total of 720 principal questionnaires were returned, with a median response rate among projects of 94 percent.

5. *Teacher Interviews*

Each year after the baseline year, evaluators were asked to interview a random sample of 10 teachers who had participated in at least 20 hours of professional development activities in that project. A total of 231 interviews were conducted among the 22 projects. Eighty-four percent of the interviews were conducted by phone, and 16 percent were conducted in person. Evaluators reported the interview data by completing an interview summary form with both ratings and direct quotations from the participating teachers. Interview data from each project were weighted to reflect the total number of teachers who had participated in LSC professional development in that project.

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[4] Projects targeting a single subject/grade-range were required to conduct 16 classroom observations in their baseline, second, and final years. Projects targeting multiple subjects/grade-ranges were required to conduct 12 classroom observations per subject/grade-range in those years. All but 4 of the 22 projects included in this report completed the required number of observations.

[5] Although all 22 projects were responsible for submitting teacher questionnaires during the time period examined in this report, one project failed to do so.

Table 2 provides a summary of the number of projects participating in each data collection activity, by targeted subject.[6]

Table 2
Projects Participating in Each Core Evaluation Component, by Targeted Subject

	Number of Projects			
	Science		Mathematics	
	K–8	6–12	K–8	6–12
Professional Development Observations	11	5	9	1
Classroom Observations	11	5	9	1
Teacher Questionnaires	10	5	9	1
Principal Questionnaires	11	5	9	1
Teacher Interviews	11	5	9	1

Data Analysis

To facilitate the reporting of large amounts of survey data, and because individual questionnaire items are potentially unreliable, HRI used factor analysis to identify survey questions that could be combined into "composites."[7] Each composite represents an important construct related to one of the core evaluation questions. For example, there is a composite on the quality of LSC professional development, and several on teacher attitudes, preparedness, and classroom practice.[8]

Once the questionnaire items associated with each composite were identified, composite scores were created. The composites are calculated as percentages of total points possible. An individual teacher's composite score is calculated by summing his/her responses to the items in that composite and then dividing by the total points possible. For example, if a composite is based on six survey questions asked on a five-point scale of "strongly disagree" to "strongly agree," that composite has 30 total possible points. If a teacher's raw composite score on these six items adds to 24 points, the percentage score is 80 (computed as $24 \div 30 \times 100$). A project's mean composite score is computed by averaging the scores of the individual teachers in that project.

In the results presented in this report, teachers, schools, and projects are sometimes categorized by targeted subject/grade-range (K–8 science, 6–12 science, or K–8 mathematics; results for 6–12 mathematics are not presented separately due to the small number of participants in this

[6] In projects targeting both mathematics and science, or both elementary and secondary mathematics, questionnaire, observation, and interview data were collected separately for each subject/grade-range combination. Thus, the sum of projects is greater than the total number of active projects.

[7] See "Technical Report: Analysis of the Psychometric Structure of the LSC Surveys" (12/07/98) by David B. Flora and A.T. Panter, L.L. Thurstone Psychometric Lab, University of North Carolina at Chapel Hill, NC for a detailed description of the factor analysis procedure.

[8] See http://www.horizon-research.com/LSC/news/composites/composites.pdf for definitions of the composite variables.

subject/grade-range during the period covered by this report). Analyses of the impact of the LSC initiative on teachers and their teaching are typically reported by extent of teacher involvement in LSC professional development activities.[9] Differences in proportions were tested using Chi-square procedures. Analysis of variance and t-tests were used to test the significance of differences in means of continuous variables, using the Holm-Bonferroni adjustment to compensate for the fact that multiple comparisons were performed. Differences noted in this report are statistically significant at the 0.05 level.

[9] "Teacher leaders" are likely not representative of the typical teacher targeted by the LSCs and were omitted from these analyses.

II. Quality of LSC Professional Development

A. Introduction

For the core evaluation, project evaluators were asked to observe 5–8 professional development activities in each ongoing project. Evaluators and PIs were to decide jointly which activities would be observed, selecting sessions to represent the diversity of the project's professional development offerings and to reflect the extensiveness and importance of the various kinds of activities. A total of 283 professional development sessions was observed during the period covered by this report.

This section of the report presents a summary of data collected from observations of individual sessions across the 22 LSC projects active during the data collection period, including both descriptive information about the observed sessions and evaluators' assessments of their quality. The section concludes with teacher and evaluator judgments of the overall quality of the LSC professional development programs.[10]

B. Description of LSC Professional Development Sessions

Evaluators documented a number of features of each professional development session, providing information about targeted participants, presenters/facilitators, purposes and content focus, and the major types of activities that characterized the sessions.

Participants
The majority of professional development sessions observed for the LSC core evaluation included between 11 and 50 participants. Of sessions targeting teachers, 10 percent exclusively targeted teacher leaders, 85 percent targeted only regular teachers, and 5 percent targeted both lead and regular teachers. A total of 6 percent of the sessions included principals or other administrators.

Presenters/Facilitators
LSC professional development involved presenters/facilitators from a variety of settings. Seventy-two percent of the observed sessions included one or more district personnel as presenters or facilitators, while only 17 percent of the sessions included university faculty as presenters or facilitators. (See Figure 3.) Across all of the observed sessions, 71 percent of the presenters/facilitators were female and 29 percent were male. And as can be seen in Figure 4, 87 percent of the presenters/facilitators were white and 13 percent were members of other race/ethnic groups.

[10] In addition to the core evaluation data collection, evaluators sometimes observed additional professional development activities without completing core evaluation protocols, and interviewed teachers about their professional development experiences, using project-specific protocols. All of the available data were to be used in making the summary judgments.

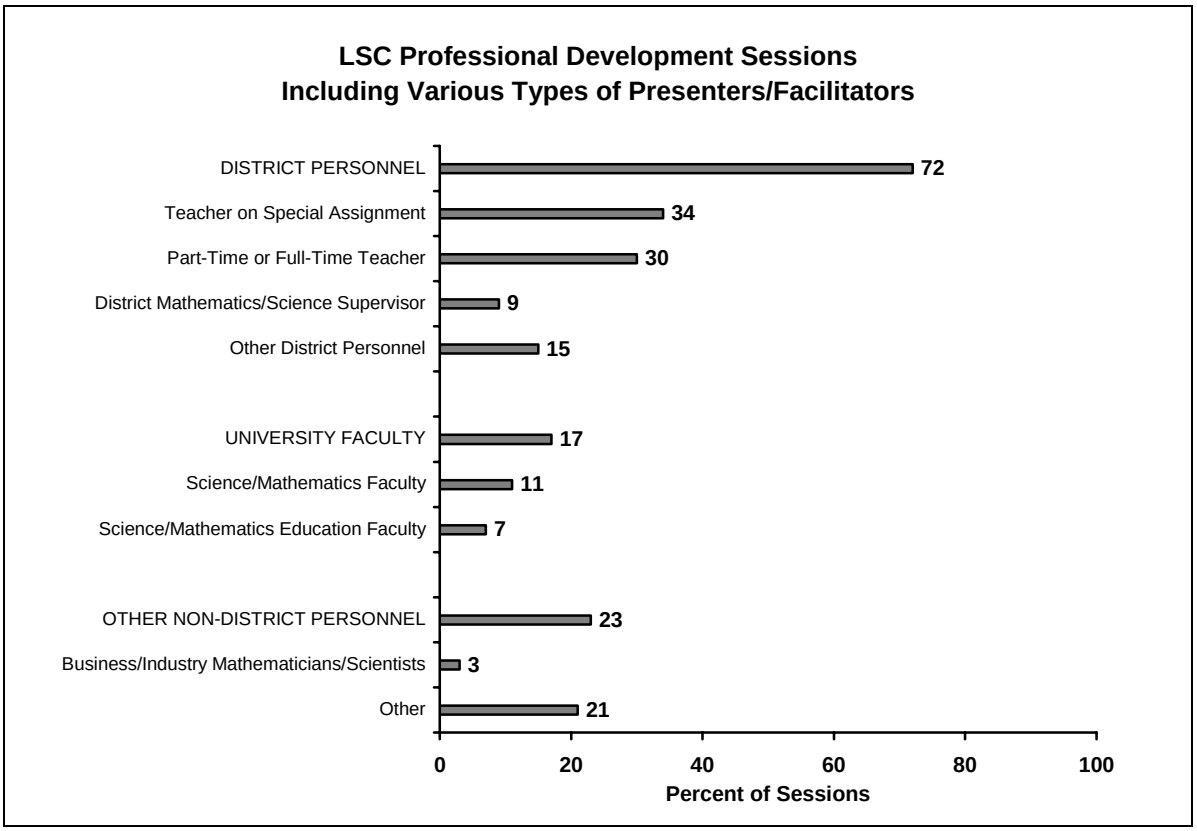

Figure 3

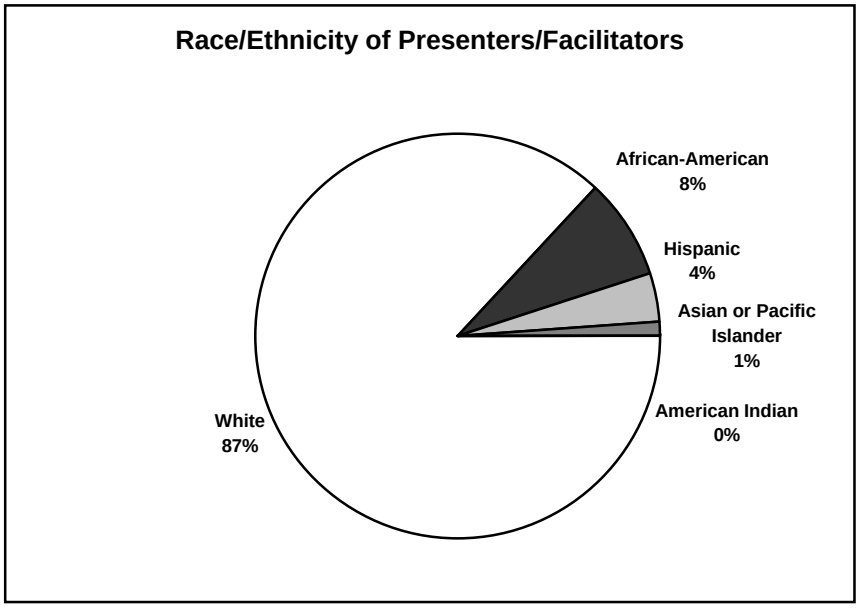

Figure 4

Purposes of the Professional Development Sessions

Evaluators were asked to indicate the primary intended purposes of each observed session based on information provided by the session facilitators. The vast majority of the observed sessions dealt with classroom practice, either pedagogy or the implementation of designated instructional materials. As can be seen in Table 3, 78 percent of the sessions included attention to issues of classroom pedagogy or use of the designated instructional materials, and 36 percent of the sessions included a focus on teacher content knowledge.

Table 3
Primary Intended Purposes of LSC Professional Development Sessions

	Percent of Sessions[†]			
	All	Science		Mathematics
	Sessions	K–8	6–12	K–8
Explicit attention to classroom pedagogy/designated instructional materials	**78**	**76**	**69**	**83**
Learning how to use specific instructional materials in the classroom	42	45	42	39
Understanding student thinking/learning about mathematics/science content	35	24	31	49
Learning pedagogical/classroom management strategies	32	26	34	36
Creating a vision of effective mathematics/science instruction	25	27	21	24
Considering issues of scope and sequence (e.g., K–12 curricular frameworks)	11	8	8	16
Designing or scoring student assessments	9	8	8	10
Considering issues of access, equity, and diversity	4	0	3	8
Learning how to use technology in the classroom	4	3	13	1
Increasing mathematics/science content knowledge of participants	**36**	**40**	**47**	**30**
Explicit attention to strategies/issues/roles of teacher leaders, principals, or others in leadership positions	**11**	**13**	**9**	**11**
Other major purposes	**32**	**20**	**38**	**41**
Promoting/exploring reflective practice	19	15	20	22
Building professional networks among educators	12	7	24	15
Orientation to the project	2	1	2	4
Developing the capacity of participants to use technology	6	2	21	4
Assessing participants' knowledge/skills	3	1	3	6
Involving administrators and/or other school/district personnel in the reform process	3	2	0	4

[†] Percents add to more than 100 as sessions could have multiple purposes.

Content Focus of Professional Development Sessions

When sessions focused on one or more disciplinary content areas, evaluators were asked to categorize that content. In K–8 science projects, evaluators reported that slightly more than one-third of the sessions with a disciplinary content focus dealt with physical science concepts (38 percent). Other content areas representing at least one-quarter of the sessions were life science (33 percent) and earth and space sciences (26 percent). Few of the observed K–8 science sessions dealt with "science as a way of knowing," data collection or analysis, or engineering and design principles. (See Figure 5.)

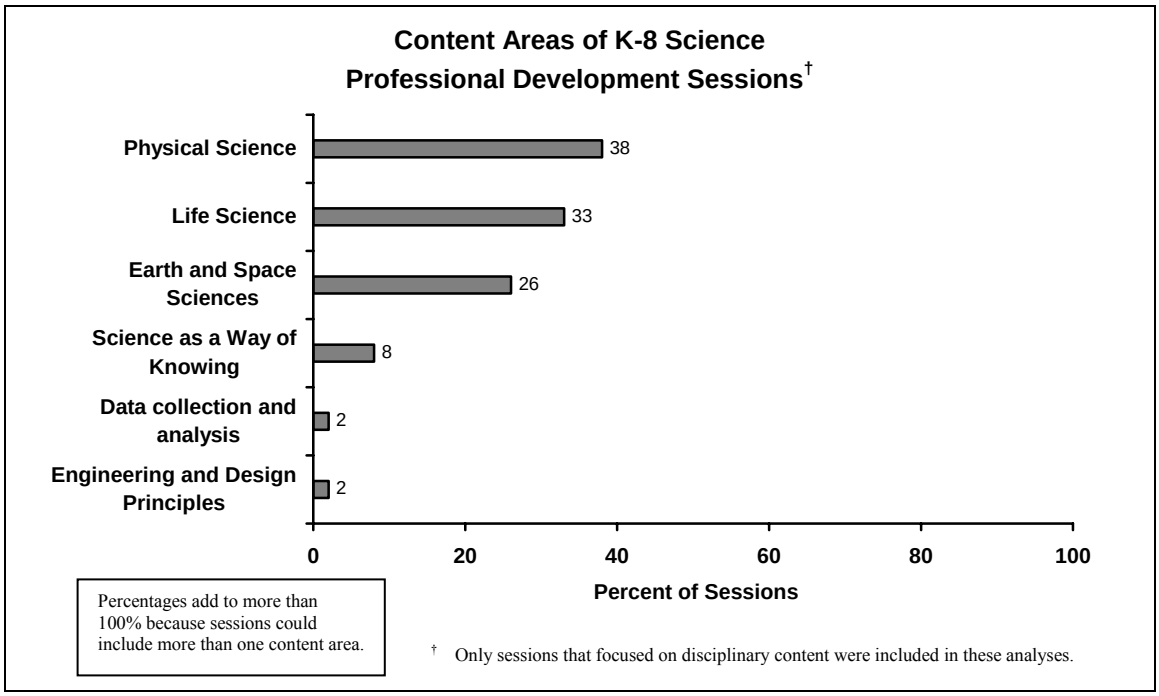

Figure 5

Projects targeting grade 6–12 science emphasized physical science in 52 percent of their sessions. (See Figure 6.) Other topics that were emphasized in more than 10 percent of the sessions were earth/space sciences (41 percent), life science (20 percent), and "science as a way of knowing" (14 percent).

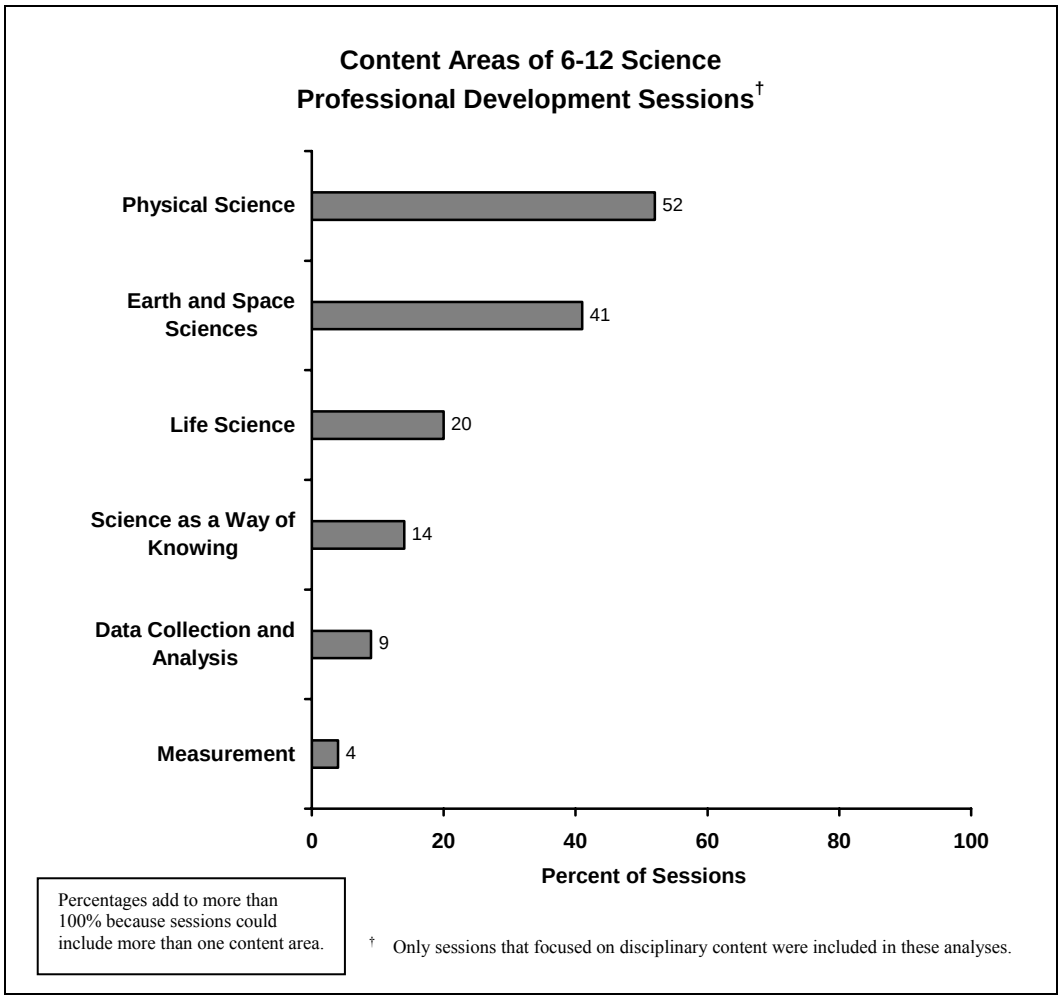

Figure 6

In projects targeting K–8 mathematics (see Figure 7), heavily emphasized topics included numeration and number theory (37 percent of the sessions that dealt with disciplinary content), computation (31 percent), and patterns and relationships (24 percent). Fewer than 20 percent of the disciplinary content sessions focused on measurement, geometry and spatial sense, data collection and analysis, estimation, or probability, and fewer than 10 percent addressed concepts in "mathematics as a way of knowing," algebra, pre-algebra, functions, history of mathematics, or statistics.

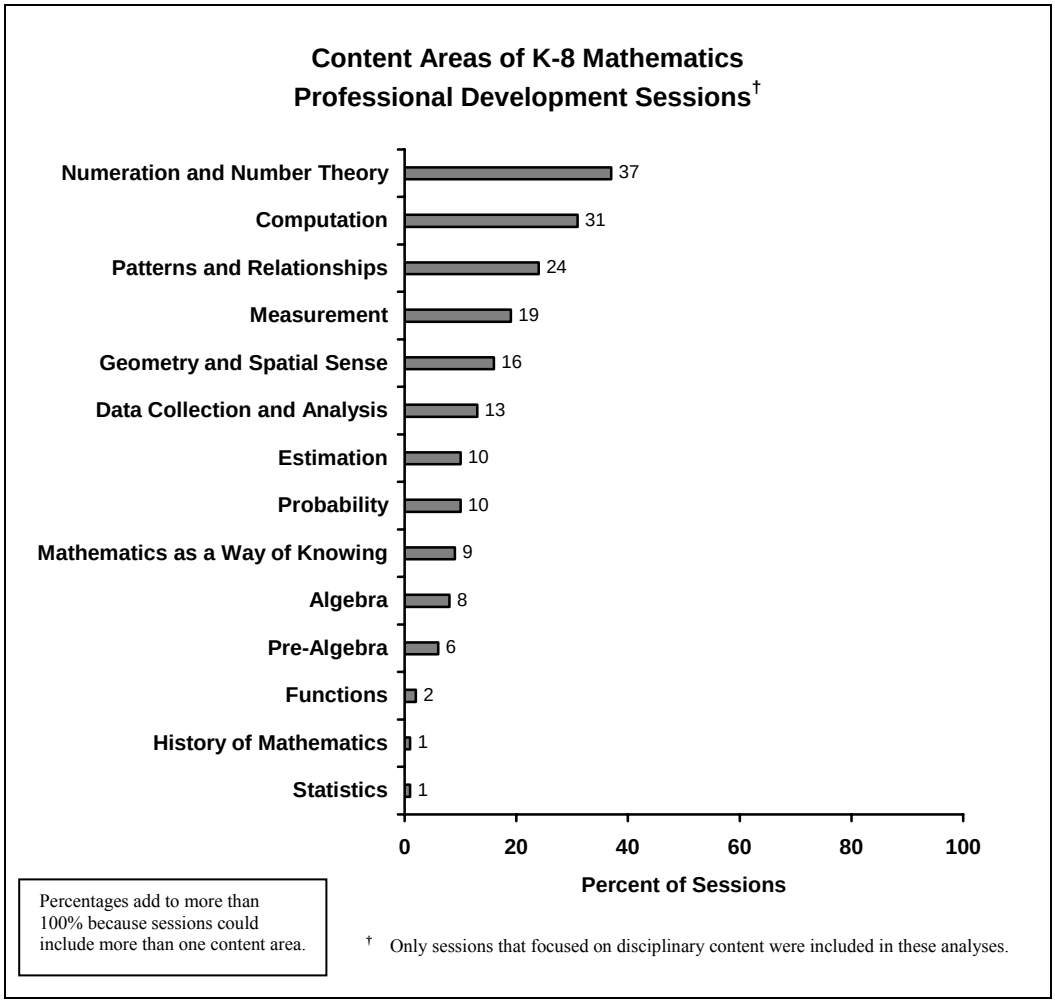

Figure 7

Session Activities

The typical professional development session observed as part of the LSC core evaluation included several different types of activities. As can be seen in Table 4, most sessions included discussions or seminars (76 percent) and about half engaged participants in problem-solving or investigation. Thirty-eight percent of the sessions included formal presentations, usually by project staff as opposed to participants. Very few of the observed sessions involved participants

in reading (2 percent) or writing (3 percent) about disciplinary content, pedagogy or reform issues.

Table 4
Major Activities of LSC Professional Development Sessions

	Percent of Sessions			
	All Sessions	Science		Mathematics
		K–8	6–12	K–8
Engaged in discussions/seminars	**76**	**72**	**74**	**83**
Whole group led by facilitator	62	63	51	68
Small groups/pairs	13	10	5	19
Whole group led by participants	22	17	38	19
Engaged in problem-solving/investigation	**51**	**58**	**56**	**43**
Listened to a formal presentation	**38**	**42**	**54**	**32**
By presenter/facilitator	37	41	51	30
By participants	2	2	3	2
Read about disciplinary content, pedagogy, or reform issues	**2**	**2**	**5**	**2**
Wrote about disciplinary content, pedagogy, or reform issues	**3**	**4**	**8**	**0**

† Percents add to more than 100 as sessions could include multiple activities.

C. Quality of LSC Professional Development Sessions

As part of assessing the quality of professional development sessions, evaluators were asked to rate a number of components for each session they observed, including the:

- Design of the session;
- Implementation of the professional development activities;
- Quality of the disciplinary, pedagogical, and/or leadership content; and
- Culture of the session.

For each component area, observers first rated a series of individual indicators of best practice in professional development for standards-based mathematics/science education. These indicators were rated on a scale ranging from 1, "not at all" to 5, "to a great extent" to document the extent to which that feature characterized the observed professional development session.

Considering those indicators, observers then assessed the overall quality of each component area. The lowest rating for component areas (Level l) indicated that the session was not at all reflective of best practice. The highest rating (Level 5) indicated that the particular component of the session was extremely reflective of best practices for standards-based mathematics and science education.[11] Evaluators' ratings of the component areas are presented in the following sections.

[11] Copies of the Professional Development Observation Protocol may be found in the Data Collection Manual section of the HRI web site: http://www.horizon-research.com/LSC.

Design of Professional Development Sessions
As noted above, observers assessed the design of professional development sessions by rating a series of individual indicators based on current understandings of best practice. Several of these indicators received high ratings (4 or 5 on a five-point scale) in many of the observed sessions. Those indicators that were often highly rated included:

- The extent to which the session reflected careful planning and organization (78 percent);
- The extent to which the session design provided opportunities for teachers to consider classroom applications of resources, strategies, and techniques (78 percent); and
- The extent to which the session encouraged a collaborative approach to learning (75 percent).

Fewer sessions were rated highly on:

- The extent to which the session provided adequate time and structure for "sense-making" (61 percent); and
- The extent to which the session provided adequate time and structure for wrap-up (58 percent).

Overall observers found that the designs of the majority of the professional development sessions were generally reflective of best practice. As shown in Figure 8, 68 percent of the professional development sessions received overall design ratings of 4 or 5.

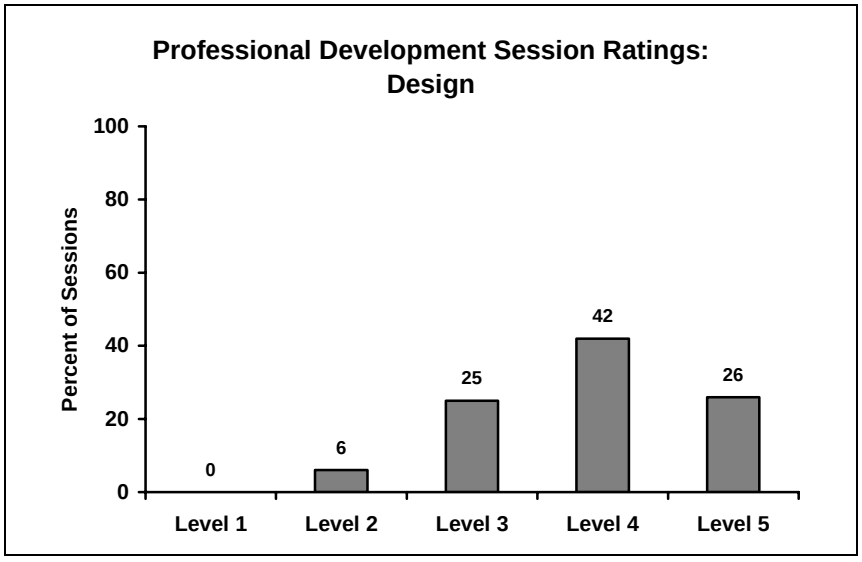

Figure 8

Implementation of Professional Development Sessions
Observers also assessed the quality of implementation of professional development sessions. Indicators frequently receiving high ratings included:

- The extent to which formal presentation(s) included in the session were carried out effectively (80 percent); and

- The extent to which the facilitator(s)' background, experience, and/or expertise enhanced the quality of the session (77 percent).

As has been the case in previous years, fewer LSC professional development sessions were rated highly on such indicators as:

- The extent to which the session modeled effective assessment strategies (66 percent); and

- The extent to which the facilitators modeled questioning strategies that are likely to enhance the development of conceptual understanding (56 percent).

As shown in Figure 9, 66 percent of the sessions received overall ratings of 4 or 5 on their quality of implementation.

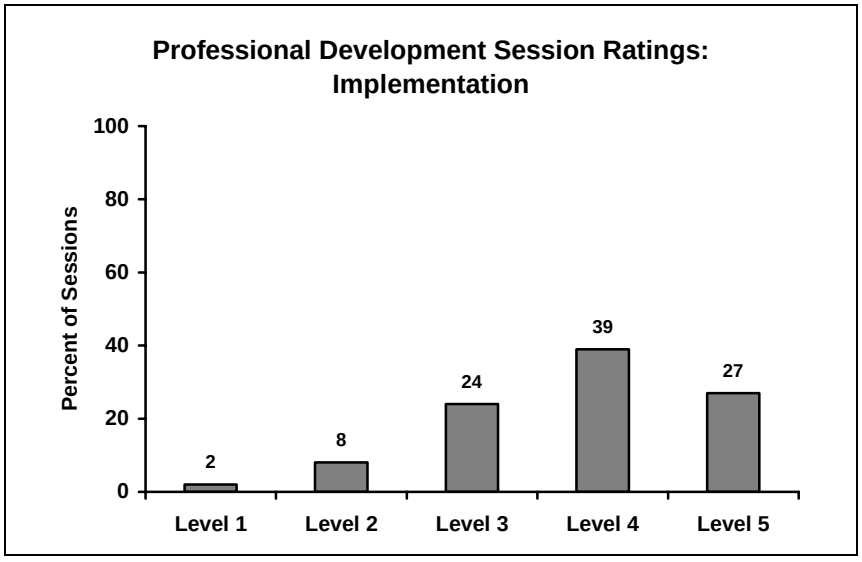

Figure 9

Culture of Professional Development Sessions

The literature on effective staff development emphasizes the importance of establishing a professional development culture where teachers can explore content and pedagogy in a collegial, risk-free environment. As can be seen in Figure 10, 73 percent of the sessions received synthesis ratings of 4 or 5 in this area. Indicators that were very likely to receive high ratings included:

- The extent to which there was a climate of respect for participants' experiences, ideas, and contributions (84 percent); and
- The extent to which active participation of all was encouraged and valued (84 percent).

Fewer sessions were rated highly on:

- The extent to which participants were encouraged to generate ideas, questions, conjectures, and propositions (66 percent);
- The extent to which intellectual rigor, constructive criticism, and the challenging of ideas were evident (66 percent); and
- The extent to which participants demonstrated a willingness to share ideas and take intellectual risks (50 percent).

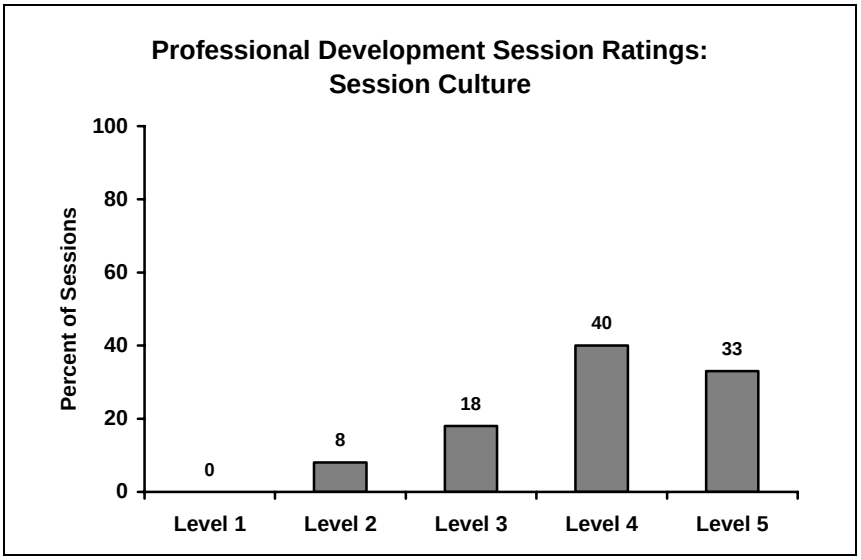

Figure 10

Disciplinary and Pedagogical Content of Professional Development Sessions
Evaluators were asked to rate either the quality of the disciplinary content of the observed session, its pedagogical content, or both, depending on the focus of the session. Disciplinary content was rated in 201 of the 283 sessions, with 64 percent of these sessions receiving overall ratings of 4 or 5 in this area. (See Figure 11.) Indicators for disciplinary content that typically received high ratings included:

- The extent to which the facilitators displayed an understanding of mathematics/science content (81 percent); and

- The appropriateness of the disciplinary content for the purposes of the session and the backgrounds of the participants (80 percent).

Fewer sessions received high ratings on:

- The extent to which "sense-making" of mathematics/science content was appropriate for the purposes of the session (62 percent); and

- The extent to which mathematics/science was portrayed as a dynamic body of knowledge continually enriched by conjecture, investigation, analysis, and/or proof/justification (58 percent).

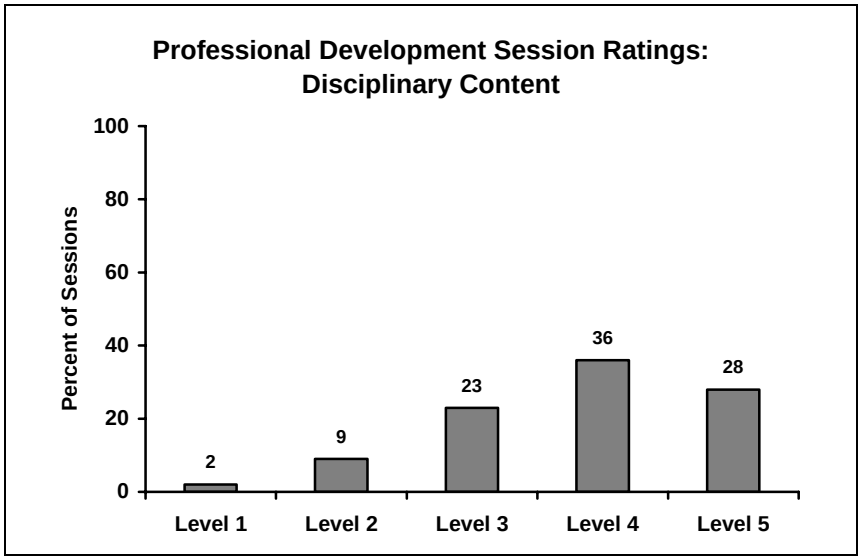

Figure 11

Observers rated 238 of the 283 observed professional development sessions on the quality of their pedagogical content. As can be seen in Figure 12, 64 percent of those professional development sessions received ratings of 4 or 5 for overall pedagogical content.

Within the area of pedagogical content, sessions tended to be rated highly for:

- The extent to which the depth and breadth of attention to instructional materials intended for classroom use were appropriate for the purposes of the session and participants' needs (79 percent); and

- The extent to which the facilitators displayed an understanding of pedagogical concepts (76 percent).

Similarly to previous years, fewer sessions received high ratings for:

- The extent to which depth and breadth of attention to student thinking/learning were appropriate for the purposes of the session and participants' needs (64 percent); and

- The extent to which "sense-making" about classroom practice was appropriate for the purpose of the session and the needs of adult learners (64 percent).

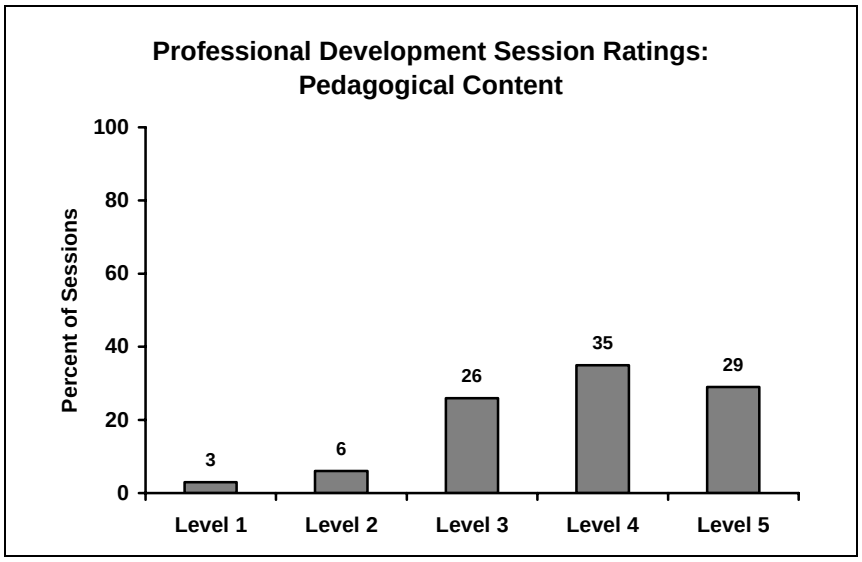

Figure 12

Overall Assessment of Observed Professional Development Sessions

In addition to rating the quality of individual components of the professional development session, observers were asked to assess the overall quality of each session. First, they considered the likely impact of the session on participants' capacity for exemplary mathematics/science instruction, or the likely impact on leadership capacity when leadership development was a focus of the session instruction. They then assigned a "capsule rating" to characterize the overall

quality of the professional development session. Ratings on a five-point scale ranged from "ineffective professional development" (Level 1) to "exemplary professional development" (Level 5).

Impact on Participants' Capacity for Exemplary Mathematics/Science Instruction

Observers rated the likely impact of each session on teachers' capacity for exemplary mathematics/science instruction. According to these observers, LSC professional development sessions often had a positive effect on participants' abilities to network with other teachers about instruction (73 percent), use the designated instructional materials to develop students' conceptual understanding (73 percent), and plan/provide high quality mathematics/science classroom instruction (73 percent). Sessions were also judged likely to have a positive effect on teachers' self-confidence as mathematics/science instructors (69 percent), ability to identify and understand important ideas of mathematics/science (66 percent), understanding of how students learn (65 percent), and understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation (58 percent).

Quality of Leadership Development Sessions

Many LSC projects incorporate the use of teacher leaders in their professional development strategies. When evaluators observed professional development sessions that focused on the preparation of teacher leaders, as did 32 of the 283 observed sessions, they were asked to rate a number of applicable key indicators in the area of leadership content. As can be seen in Figure 13, 67 percent of the sessions focusing on leadership content received a high synthesis rating (4 or 5) in this area.

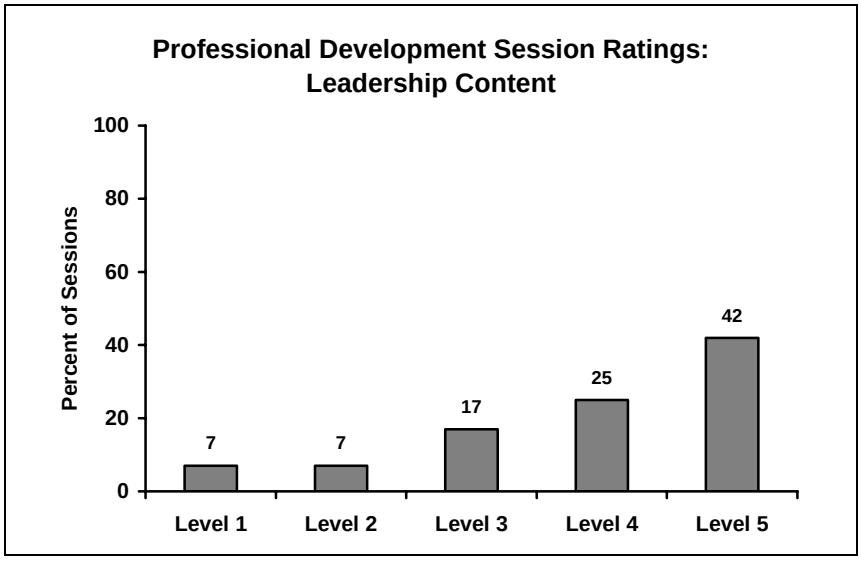

Figure 13

When asked about the likely impact of the sessions on participants' leadership capacity, each of the following areas was rated as likely to have a positive impact in 70 percent or more of the sessions: leaders' knowledge and understanding of effective classroom practice; leaders' understanding of important strategies for reform of mathematics/science education; leaders' knowledge and understanding of mathematics/science; leaders' ability to convey to others a vision of effective mathematics/science classrooms; leaders' ability to plan/implement exemplary professional development; and professional networking among participants with regard to leadership roles.

Capsule Ratings of Observed Professional Development Sessions

As would be expected given the high ratings assigned by evaluators for the various components, overall ratings for individual professional development sessions were quite favorable. Only 2 percent of observed LSC sessions were rated as ineffective professional development (Level 1), and 7 percent were rated at Level 2, having quite limited likelihood of helping participants implement exemplary mathematics/science instruction or be leaders in reform. Overall, 60 percent of the observed professional development sessions received ratings of 4 or 5, indicating that those sessions were skillfully facilitated, engaging participants in purposeful work that would likely lead to enhanced capacity to implement exemplary instruction. (See Figure 14.)

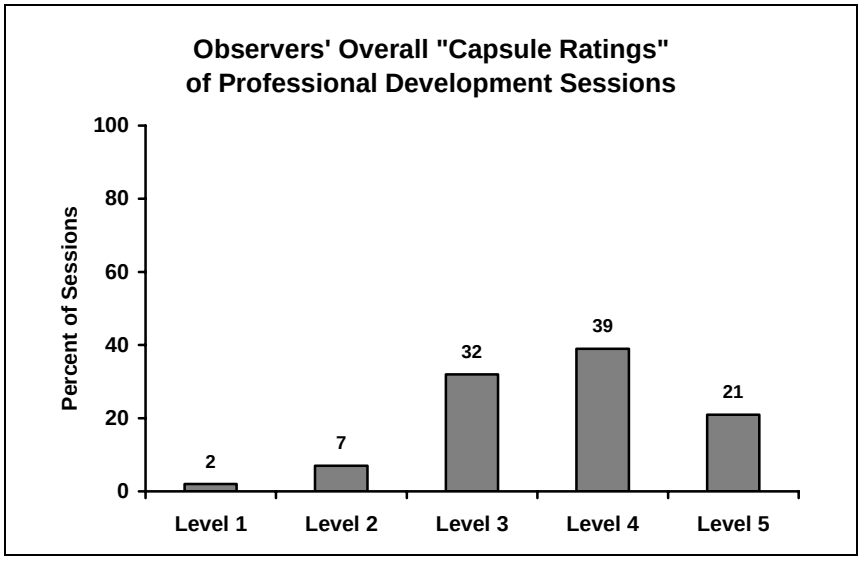

Figure 14

D. Teacher Perceptions of the Overall Quality of LSC Professional Development Programs

As part of the core evaluation, each year a sample of teachers is asked about the overall quality of the LSC professional development. A total of 221 teachers who had participated in 20 hours or more of LSC professional development were interviewed by project evaluators during the three years covered in this report. In addition, 3,998 teachers who had participated in LSC professional development answered survey questions about the quality of those experiences.

Teachers who indicated they had participated in LSC professional development were asked to respond to a series of statements about those experiences. Table 5 shows that roughly one-third of the teachers who had participated in the LSC indicated that they were given considerable time to work with other teachers and to reflect on how to apply what they were learning to their classrooms. Forty-six percent of teachers indicated that they received considerable support for implementation.

Table 5
Teachers Agreeing† to Statements about LSC Professional Development

	Percent of Teachers			
	All Teachers	Science		Mathematics
		K–8	6–12	K–8
I receive support as I try to implement what I've learned.	46	40	43	49
I am encouraged to develop an individual professional development plan to address my needs and interests related to mathematics/science education.	37	27	42	41
I am given time to work with other teachers as part of my professional development.	34	27	32	39
I am given time to reflect on what I've learned and how to apply it to the classroom.	32	26	28	37
I am involved in planning my mathematics/science-related professional development.	30	22	39	28

† Includes teachers indicating 4 or 5 on a five-point scale ranging from 1 "not at all" to 5 "to a great extent."

Table 6 shows teacher ratings of LSC professional development programs overall, with 6 percent of teachers rating the professional development programs "poor" or "very poor," 55 percent "fair" or "good," and 39 percent "very good" or "excellent."

Table 6
Teacher Ratings of LSC Professional Development Programs Overall

	Percent of Teachers			
	All Teachers	Science		Mathematics
		K–8	6–12	K–8
Very Poor	1	1	1	1
Poor	5	4	4	5
Fair	22	21	22	23
Good	33	34	29	33
Very Good	28	28	29	27
Excellent	11	11	16	10

Figure 15 shows the percentage of non-lead teachers in each of the subject and grade-range combinations who rated LSC professional development "excellent" or "very good" in the questionnaires, analyzed by level of treatment. Note that the greater the level of participation, the higher the ratings. Similarly, Figure 16 shows the results on a composite variable on quality of the LSC professional development created from teachers' responses to several items on the questionnaire.[12] For all three subject/grade-range groups, a larger number of hours of participation in LSC professional development is associated with higher composite scores. It is not possible to tell from these data whether teachers appreciate the professional development to a greater extent after having experienced more of it, or if the teachers who consider the professional development of high quality are more likely to participate in multiple professional development activities.

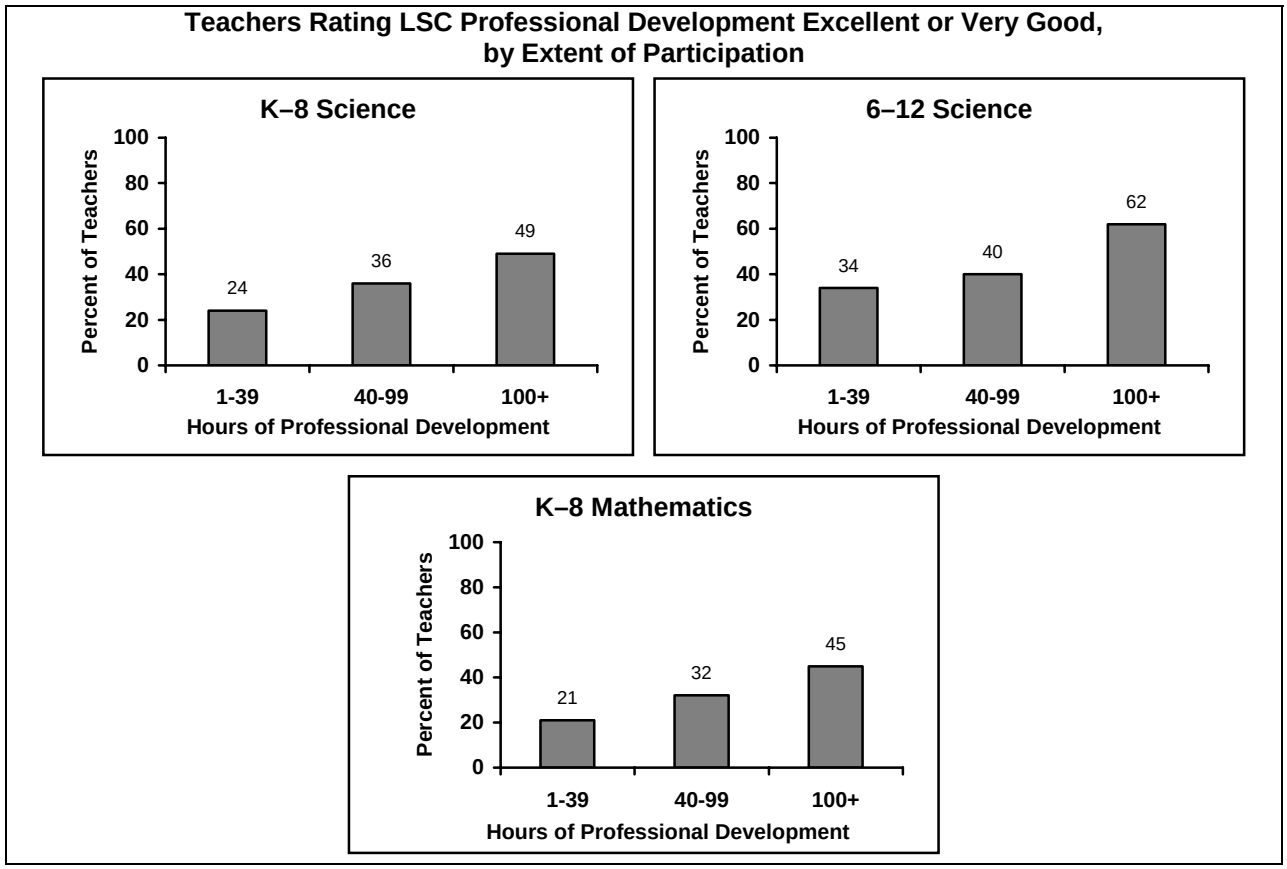

Figure 15

[12] See Data Analysis in Section I for a description of how composite scores were calculated.

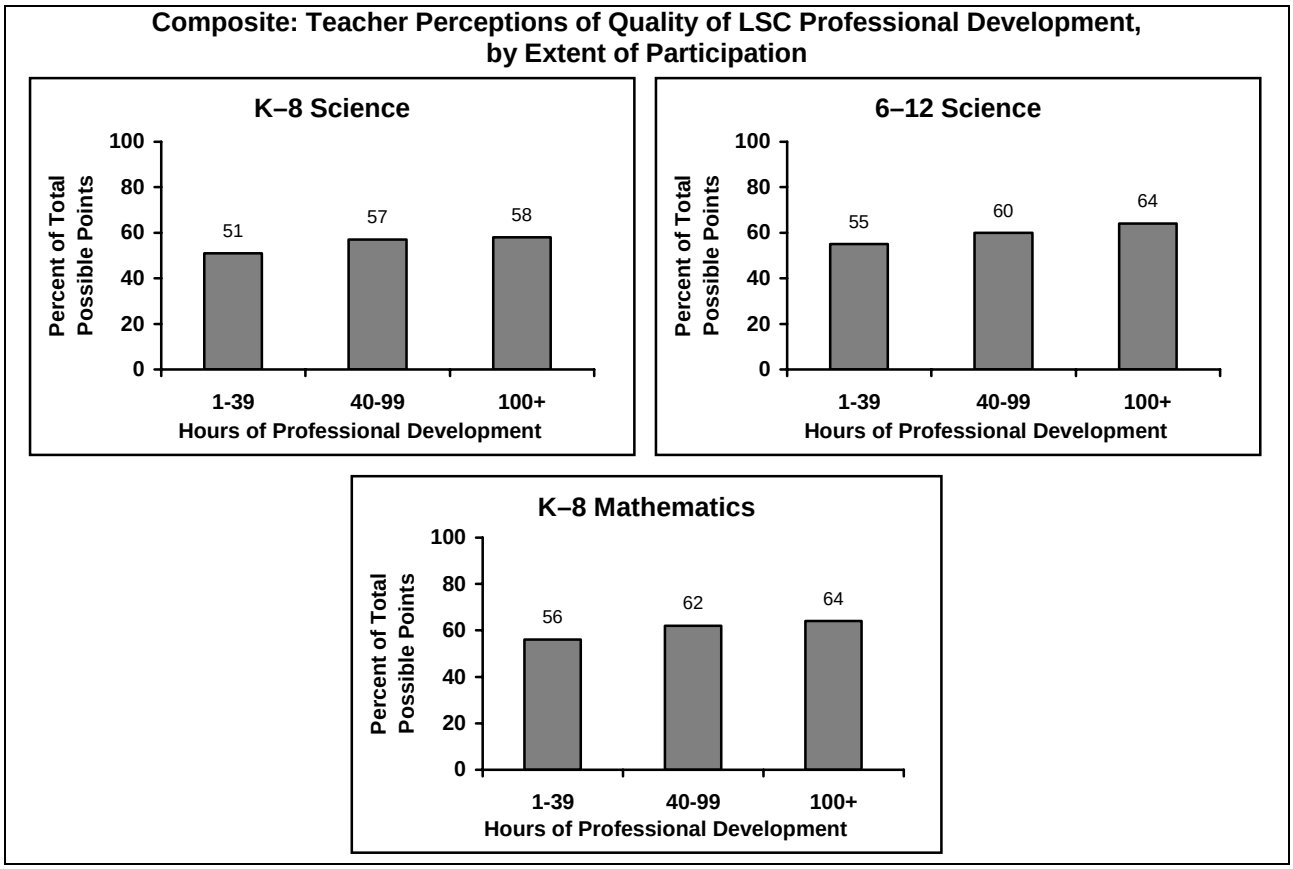

Figure 16

Teacher interviews yielded similar findings. Evaluators asked a random sample of teachers who had participated in at least 20 hours of LSC professional development to talk about their experiences in the program and used these responses to characterize each teacher's opinions on a five-point scale from very negative to very positive. Overall, 57 percent of teachers who had participated in LSC professional development had highly positive opinions of the LSC program and less than one percent had highly negative opinions.

When asked about the impact of the LSC, about two-thirds of teachers talked about how the LSC had enabled them to change their classroom practice, specifically their instructional strategies, and half spoke about how the LSC had made them better prepared for mathematics/science teaching. Interestingly, more teachers cited improvements in relation to their instructional strategies than cited improvements related to content, either their own content knowledge or the content of their classroom instruction. Typical comments concerning changed classroom practice and increased preparedness follow.

Changed Classroom Practice

I disliked science and felt I wasn't good at it. Having the classes [professional development] and being able to do it hands-on alleviated the stress. It strengthened my teaching and the science notebooking is something I use across other subjects now. I was burned out on texts, videos, and taking tests; I was turned off by that. I love the kits; it makes it fun for me and the students. (K–8 Science Teacher)

I implemented the journaling. I have the students use their science notebook for every class kit. They have to show everything involved in the assignment like the procedures, set-up, etc. I have them do this in such detail so they can take their journal home every night and the parents know exactly what their child did in science for the day. (K–8 Science Teacher)

I do more inquiry. I have changed my focus from my being at center stage and now I redirect more responsibility on the shoulders of my students. I no longer teach the way I was trained. I lay the foundation, but I use less formal lecture and more questions…I ask a lot of questions. (6–12 Science Teacher)

It has provided me with the resources needed to conduct meaningful experiments. Instead of spending so much time locating items for experiments, I am able to spend time in preparation and planning. I can now focus more time on my students and the actual lesson. (6–12 Science Teacher)

I think it has made me a better teacher. I am more familiar with the program and this helps me get more out of the students—using inquiry-based concepts—and get it to work best for the students. I am learning how to do the program and see how to break it down and how to focus. It has been really beneficial. I am more comfortable with math and definitely the hands-on approach. (K–8 Mathematics Teacher)

I see myself as a facilitator…I do not have to be teaching all the time. They [students] do the work and the thinking. And the students like that too. They are not threatened or anything. They work individually and in groups. I did not do this as much before [project name] professional development. (K–8 Mathematics Teacher)

It helped me grow professionally: new teaching ideas for lessons, making them more interesting, being able to talk with colleagues about what worked and didn't work, further developing those lessons to keep improving them. (6–12 Mathematics Teacher)

Increased Preparedness

It has made me more confident in my ability to teach science. And having the kits ready to use is wonderful. I really feel like I can do a good job of teaching science now. (K–8 Science Teacher)

Well, my understanding of content definitely improved and I felt much more confident about the material I was working with. (6–12 Science Teacher)

I feel that it has benefited my teaching to a great extent. I felt I was a fairly good teacher to start with, but learning to use the [instructional] materials opened up a whole new world. It really helped me become an excellent teacher. I can see how things fit together. (K–8 Mathematics Teacher)

When asked about the "most helpful" aspects of the LSC, 43 percent of the teachers identified the high quality of professional development, 40 percent of teachers mentioned getting materials needed for instruction, and 34 percent cited the opportunity to deepen their knowledge. About one-fifth of the teachers talked about the opportunities to deepen their knowledge of pedagogy and how to use the designated instructional materials. Science teachers were more likely than mathematics teachers to talk about the utility of the LSC in helping them understand content and providing them with materials needed for instruction.

Teachers were also asked whether school and district policies and practices would help them maintain or expand the changes they have made in their teaching. The selection and provision of instructional materials, and the availability of high quality professional development were each mentioned by about one-third of the teachers as factors that would facilitate on-going reform. Science teachers were also likely to mention the more readily available equipment and supplies as a practice that would sustain the LSCs' efforts. Typical comments included:

The school and district continue to furnish our equipment and supplies. Now, we're all using the same materials and there in continuity between the grades and staff. (K–8 Science Teacher)

The professional development and training and the equipment and supplies provided are the things, I believe, helped me the most in adopting this program in our district. (6–12 Science Teacher)

Our superintendent sent out a letter to all teachers saying that [name of instructional materials] is here to stay and it's expected to be taught in the classroom. (K–8 Mathematics Teacher)

All of the materials I would ever need in math have been ordered and I have received them. I've never been denied something that I needed. (6–12 Mathematics Teacher)

When asked about needs for additional help in improving instruction, many teachers indicated no additional support was necessary or were unable to identify specific needs. When teachers did specify a need, they typically requested "more" of what they were already getting: more readily available materials or supplies, more professional development in pedagogy and in the use of the designated materials, more professional development in mathematics/science content, and more time for networking with other teachers. Typical comments included:

Now that I teach first grade, I would like to start my 100 hours over again…I would like to focus on what I am actually teaching. (K–8 Science Teacher)

I need more classes that help me learn about the content. (6–12 Science Teacher)

I would like to see it [professional development] throughout the semester. You know, try it, go back, look at results, go back and follow-up, and then come back together and see, "Are these the results we wanted?" (K–8 Mathematics Teacher)

Teachers also indicated that high-stakes testing had limited the impacts of the LSCs, or would make the reforms difficult to sustain. Nineteen percent of interviewed mathematics teachers indicated that student grading or testing policies have hindered progress, with the lack of alignment of assessments with the designated instructional materials and the number of topics they need to cover to prepare students for the test being the main concerns. Science instruction has also been affected by high-stakes testing; 28 percent of interviewed science teachers indicated that science instruction was suffering because of the priority given to other disciplines. Typical comments included:

As a sixth grade teacher, I had to get my students ready to take the [state test]. That means that I can't take as much time for science as I would like to. (K–8 Science Teacher)

School reform focused on reading and mathematics. We used to have an emphasis on science, science festival, family science, and kids would do hands-on science experiments. Now, there is so much emphasis on test scores. To be honest, I focus on math a lot. (6–12 Science Teacher)

We don't always go deep with the curriculum because of pressures from the tests and covering the standards. (K–8 Mathematics Teacher)

E. Evaluator Ratings of the Quality of LSC Professional Development Programs

Based on the results of their observations, as well as feedback from participating teachers, evaluators rated the overall quality of the LSC professional development in a number of areas, including preparing project staff to carry out their roles in providing professional development to targeted teachers; the quality of the professional development culture; the project's overall treatment of disciplinary content; instructional materials and pedagogy; and the nature and extent of support provided to teachers during implementation.

Preparedness of Professional Development Providers

As can be seen in Figure 17, overall, 86 percent of LSC projects received high ratings (4 or 5 on a five-point scale ranging from 1 "inhibited effective professional development" to 5 "facilitated effective professional development") for the quality of their efforts in preparing professional development providers.

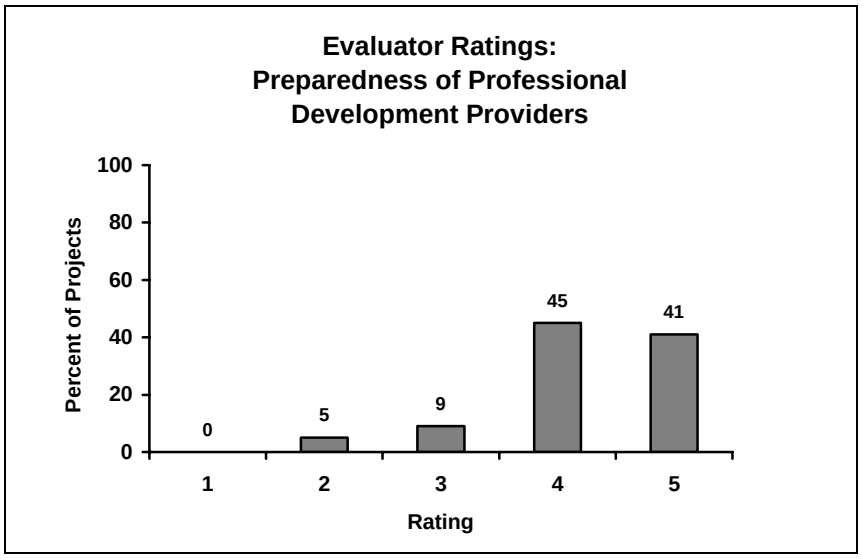

Figure 17

Professional Development Culture

Using all of the information available to them, including teacher comments and their own observations, evaluators rated the overall success of each project in creating a climate conducive to teacher learning. Overall, 91 percent of projects received ratings of 4 or 5 in this area, suggesting that the professional development culture is a major strength of these projects. (See Figure 18.)

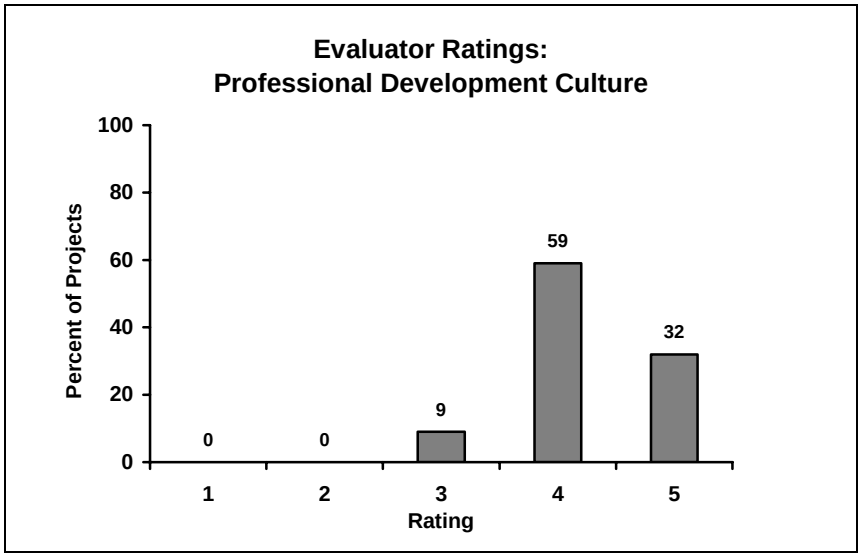

Figure 18

Treatment of Disciplinary Content

When they prepared their annual reports, evaluators considered the data they had from observations, interviews, and questionnaires and came up with an overall rating of the quality of the project's treatment of disciplinary content. As can be seen in Figure 19, only 58 percent of projects received high ratings (4 or 5 on a five-point scale ranging from 1 "poor" to 5 "excellent") in this area.

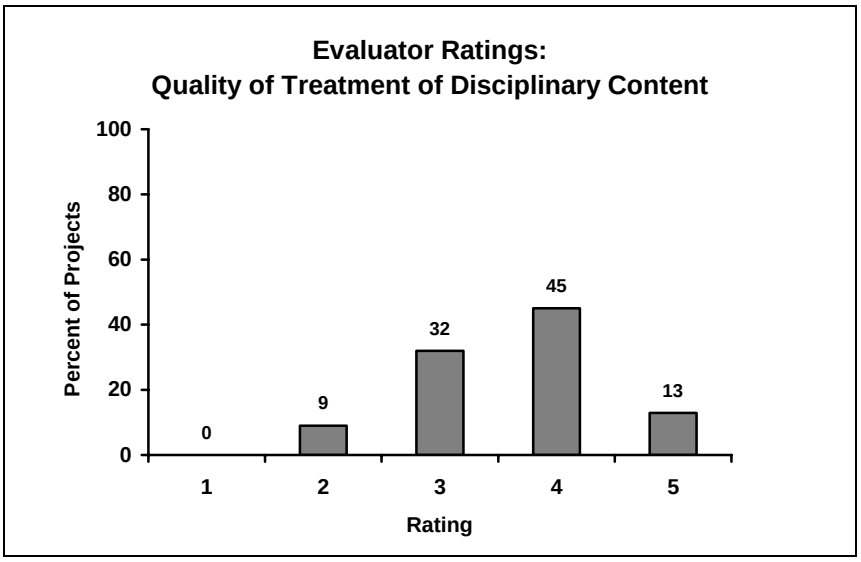

Figure 19

Treatment of Instructional Materials and Pedagogy

In addition to describing the quality of the project's treatment of the designated instructional materials and pedagogy, evaluators were asked to provide overall ratings in this area. As can be seen in Figure 20, 86 percent of projects received ratings of 4 or 5 in this area, markedly higher than the 58 percent in developing disciplinary content.

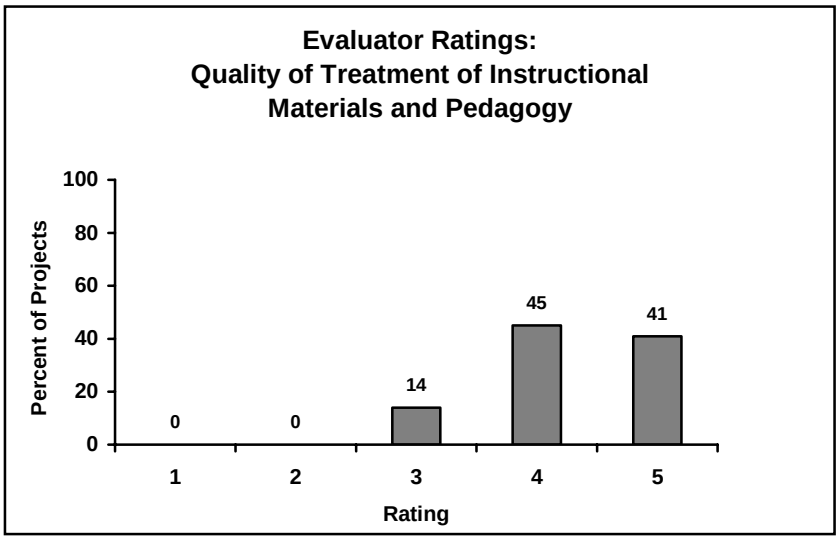

Figure 20

Support for Teachers During Implementation

Based on interview, observation, and questionnaire data, evaluators provided an overall rating of the quality of the support provided to teachers as they implemented the instructional materials in their classrooms. As can be seen in Figure 21, overall, 72 percent of projects received high ratings in this area; 9 percent received a rating below 3 on a five-point scale.

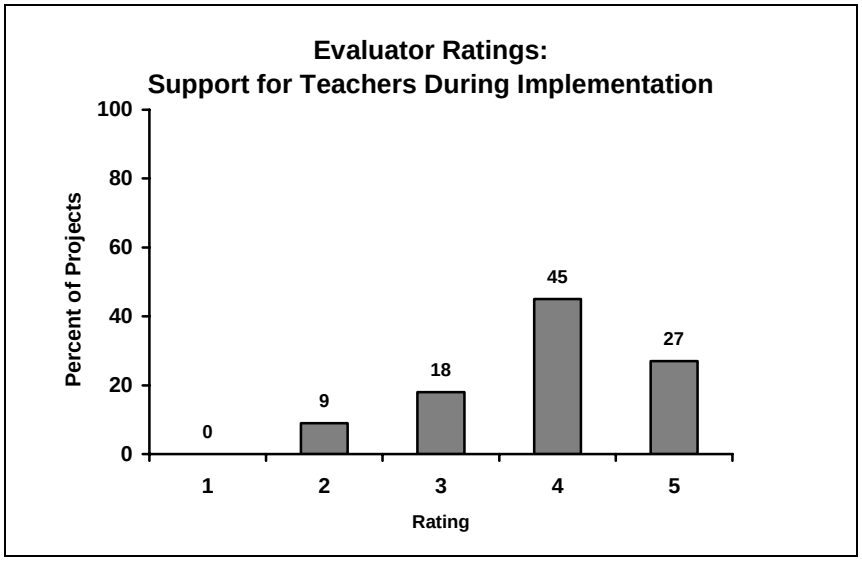

Figure 21

Continuum Ratings

At the close of the data collection year, evaluators were asked to use all of the information available to them to place the project on a continuum, from predominance of ineffective professional development, through various stages of improvement, to a system of predominantly well-designed professional development**.** As can be seen in Table 7, nearly three-quarters of the LSC projects were rated as having an emerging infrastructure or a predominance of well-designed professional development; none were rated at the lowest level.

Table 7
Continuum Ratings for Quality of LSC Professional Development

	Percent of Projects
Level 1: Predominance of Ineffective Professional Development	0
Level 2: Exploring Quality Professional Development	5
Level 3: Transitioning to Quality Professional Development	23
Level 4: Emerging Infrastructure of Well-Designed Professional Development	41
Level 5: Predominance of Well-Designed Professional Development	32
Mean Continuum Rating Level	4.0

III. Impact of the LSC on Teacher Preparedness, Attitudes, and Beliefs

The theory of action underlying the Local Systemic Change initiative argues that providing teachers with well-designed opportunities to appreciate standards-based reform and deepen their content and pedagogical knowledge in the context of high-quality instructional materials will result in better prepared teachers. When these teachers are also given support in using these instructional materials, the theory predicts, they will be both inclined to change their teaching in ways advocated by national standards, and have the capability of doing so. Improved instruction, in turn, will lead to higher student achievement.

Participating in LSC professional development impacted teachers' beliefs about mathematics/ science education in a variety of ways, prompting them to re-evaluate their own practice as well as their perceptions about mathematics and science teaching.[13] The reflection time built into high-quality professional development sessions gave teachers the opportunity to process what they had learned about content and pedagogy, and to examine their evolving beliefs about teaching and learning. Still, many teachers continue to feel under-prepared in these areas.

As can be seen in Figure 22, results on a composite of several items related to teachers' attitudes toward standards-based teaching indicated that most teachers, regardless of treatment level, had positive attitudes. (Effect sizes, and the data used to calculate them, for all comparisons on the composites are included in the Appendix.[14]) There were no significant differences between highly treated teachers and untreated teachers on this composite for any of the subject/grade-range combinations.

[13] As mentioned previously, teacher leaders were excluded from all analyses examining the impact of the LSC on teachers.

[14] The effect size for composites, Cohen's d, is calculated as the difference between the "0 hours" and "100 or more hours" group means, divided by the pooled standard deviation. Following standard conventions, effect sizes of 0.2 are considered small effects, 0.5 medium effects, and 0.8 large effects (Jacob Cohen, *Statistical Power Analysis for the Behavior Sciences,* Hillsdale, NJ: Lawrence Erlbaum Associates, 1988).

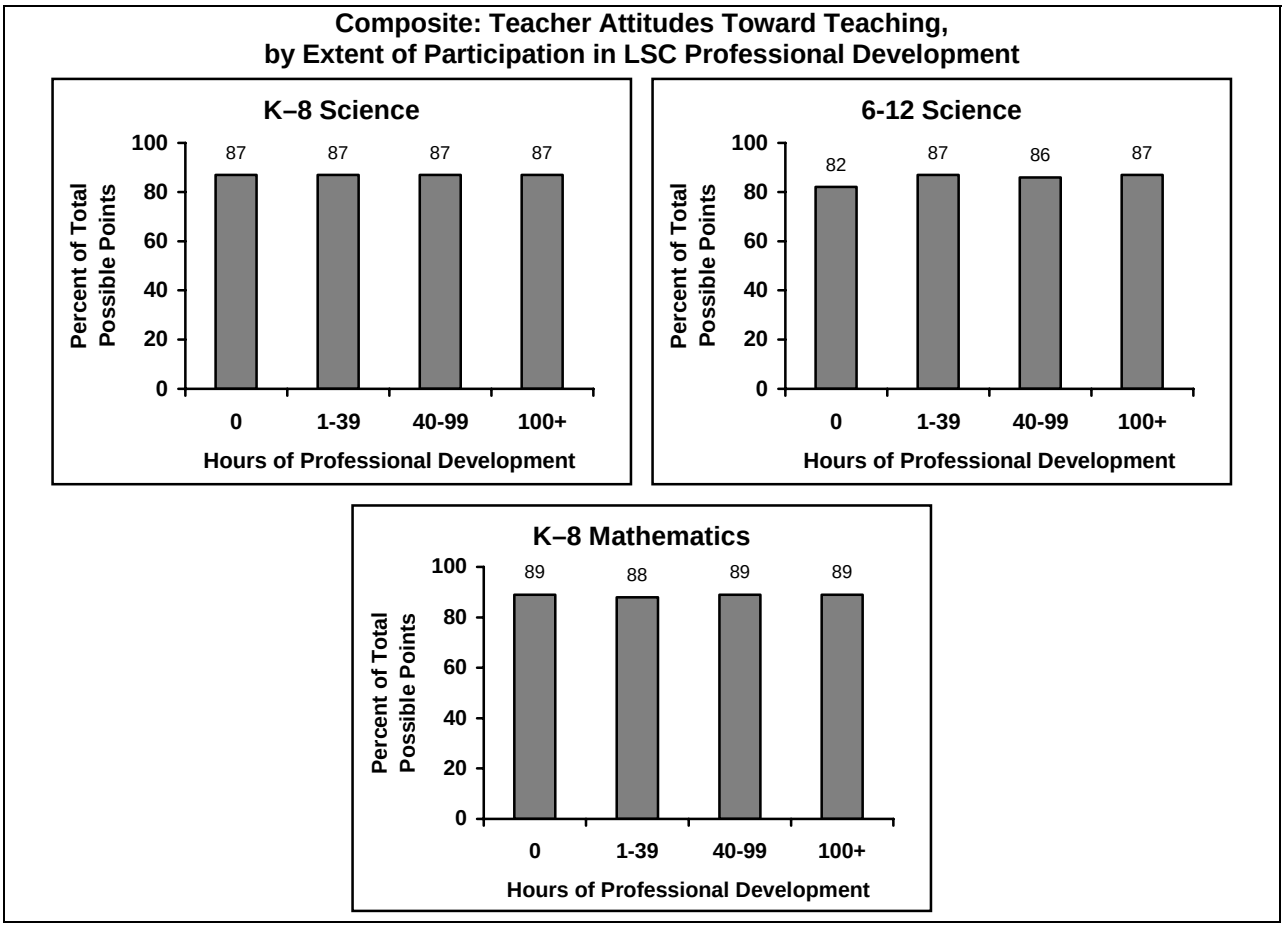

Figure 22

Participating in LSC professional development appears to have had a substantial impact on elementary teachers' feelings of preparedness to teach science. As can be seen in Figure 23, 88 percent of K–8 science teachers who had participated in at least 100 hours of LSC professional development indicated they were at least fairly well prepared to teach science, compared to 72 percent of those who had not yet participated in LSC professional development (an effect size[15] of 0.41).

[15] When comparing percents, the effect size, h, is calculated using the difference between the arcsine transformation of the percents of the "0 hours" and "100 or more hours" groups. Specifically, $h = \varphi_1 - \varphi_2$, where $\varphi = 2*\arcsin(P^{½})$, and P is the proportion of cases in a category.

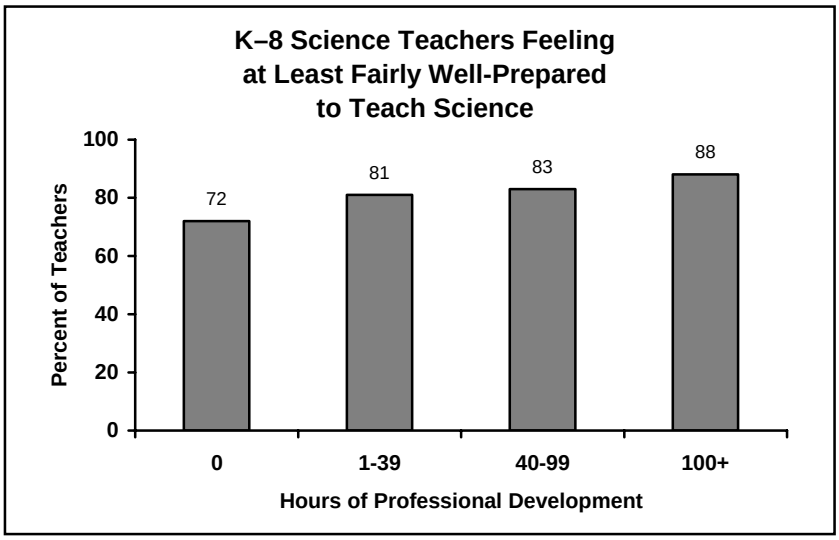

Figure 23

In mathematics, the vast majority (87 percent) of teachers in K–8 projects who had not yet received LSC professional development indicated they were at least fairly well prepared to teach mathematics, so the comparison was made for very well prepared. As can be seen in Figure 24, 71 percent of K–8 mathematics teachers who had participated in at least 100 hours of LSC professional development indicated they were very well prepared to teach mathematics, compared to 50 percent of those who had not yet participated in LSC professional development (an effect size of 0.43).

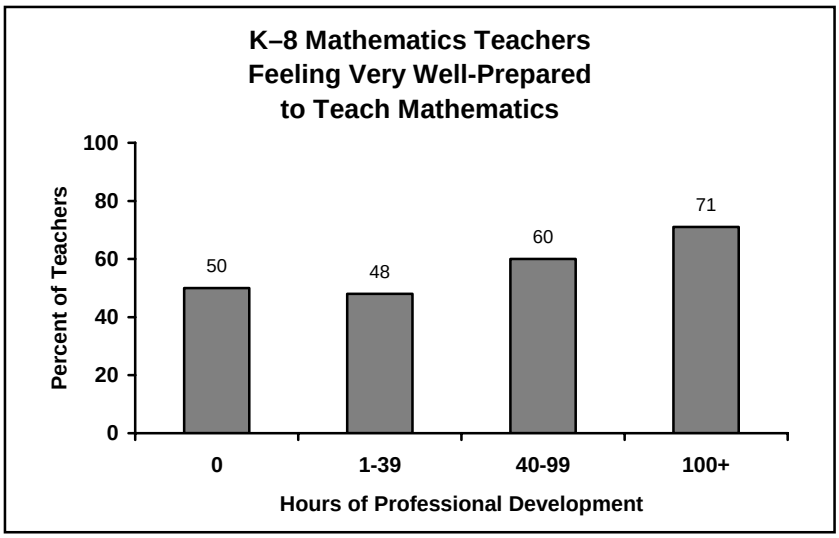

Figure 24

A similar pattern can be seen when teachers were asked about their preparedness to teach specific science and mathematics topics. In K–8 science, there were significant differences between untreated and highly-treated teachers on 3 of the 11 topics listed, with effect sizes ranging from 0.20 to 0.37. (See Table 8.)

Table 8
K–8 Science Teachers Feeling at Least Fairly Well-Prepared† to Teach Each Topic, by Extent of Participation in LSC Professional Development

	Percent of Teachers				
	0 Hours (N = 417)	1–39 Hours (N = 576)	40–99 Hours (N = 361)	100 or More Hours (N = 582)	Effect Size (h)
The human body	67	65	69	68	0.02
Ecology	55	58	60	65	0.20*
Rocks and soils	51	62	63	69	0.37*
Astronomy	46	48	49	51	0.10
Processes of change over time	42	45	47	47	0.10
Mixtures and solutions	44	53	59	56	0.24*
Electricity	43	48	50	52	0.18
Sound	48	49	57	55	0.14
Forces and motion	54	55	61	61	0.14
Machines	47	47	52	50	0.06
Engineering and design principles	28	29	33	30	0.04

† Includes teachers indicating 3 or 4 on a four-point scale ranging from 1 "not adequately prepared" to 4 "very well prepared."
* $p < 0.05$; (proportion of teachers feeling at least fairly well-prepared in the 100 or more hours group significantly different than in the 0 hours group, RS3-adjusted chi-square, WesVar 4.2).

Participation in LSC professional development also appears to have had an impact on secondary science teachers' perceptions of their content preparedness, with significant differences between untreated and highly-treated teachers in 9 of the 22 topics, including all four of the chemistry topics listed on the questionnaire. (See Table 9.)

Table 9
6–12 Science Teachers Feeling at Least Fairly Well-Prepared† to Teach Each Topic, by Extent of Participation in LSC Professional Development

	Percent of Teachers				
	0 Hours (N = 72)	1–39 Hours (N = 152)	40–99 Hours (N = 142)	100 or More Hours (N = 166)	Effect Size (h)
Earth Science					
The solar system and the universe	53	69	65	73	0.42
Earth's features and physical processes	51	81	72	85	0.76*
Climate and weather	54	67	65	67	0.27
Biology					
Animal behavior	58	63	68	71	0.27
Genetics and evolution	63	60	65	72	0.19
Interactions of living things/ecology	70	76	82	87	0.42
Plant biology	57	63	67	69	0.25
Structure and functions of human systems	72	71	77	79	0.16
Chemistry					
Properties and states of matter	56	68	76	85	0.66*
Structure of matter and chemical bonding	46	55	62	67	0.43*
Chemical reactions	44	55	66	68	0.49*
Energy and chemical change	44	58	67	73	0.60*
Physics					
Forces and motion	53	63	66	78	0.53*
Electricity and magnetism	41	48	49	60	0.38
Energy	50	59	64	75	0.52*
Light and sound	49	54	59	67	0.37
Modern physics (e.g., special relativity)	29	28	28	31	0.04
Environmental and Resource Issues					
Pollution, acid rain, global warming	63	68	73	78	0.33*
Population, food supply and production	66	63	75	83	0.40
Scientific Methods and Inquiry Skills					
Describing, graphing, and interpreting data	82	89	92	94	0.38
Formulating hypotheses, drawing conclusions, making generalizations	74	91	91	94	0.58*
Experimental design	65	80	84	86	0.50*

† Includes teachers indicating 3 or 4 on a four-point scale ranging from 1 "not adequately prepared" to 4 "very well prepared."

* $p < 0.05$; (proportion of teachers feeling at least fairly well-prepared in the 100 or more hours group significantly different than in the 0 hours group, RS3-adjusted chi-square, WesVar 4.2).

In K–8 mathematics, teachers with 100 or more hours of LSC professional development were significantly more likely than untreated teachers to indicate that they were at least fairly well-prepared to teach 2 of the 11 topics listed. (See Table 10.)

Table 10
K–8 Mathematics Teachers Feeling at Least Fairly Well-Prepared† to Teach Each Topic, by Extent of Participation in LSC Professional Development

	Percent of Teachers				
	0 Hours (N = 231)	1–39 Hours (N = 438)	40–99 Hours (N = 553)	100 or More Hours (N = 554)	Effect Size (h)
Computation	96	97	98	99	0.20
Numeration and number theory	92	93	95	97	0.23
Estimation	91	93	94	95	0.16
Measurement	91	89	94	95	0.16
Pre-algebra	75	76	81	85	0.25
Algebra	64	67	71	74	0.22
Patterns and relationships	89	93	94	98	0.39*
Geometry and spatial sense	78	85	86	90	0.33
Data collection and analysis	80	85	90	92	0.35*
Probability	75	74	79	81	0.15
Technology in support of mathematics	66	65	70	66	0.00

† Includes teachers indicating 3 or 4 on a four-point scale ranging from 1 "not adequately prepared" to 4 "very well prepared."

* $p < 0.05$; (proportion of teachers feeling at least fairly well-prepared in the 100 or more hours group significantly different than in the 0 hours group, RS3-adjusted chi-square, WesVar 4.2).

When the various topic areas were combined into a single composite score for content preparedness, a significant difference was found between teachers with no treatment and those with 100 or more hours of LSC professional development in 6–12 science (effect size of 0.62 standard deviations). (See Figure 25.) No significant differences were found for K–8 mathematics or science.

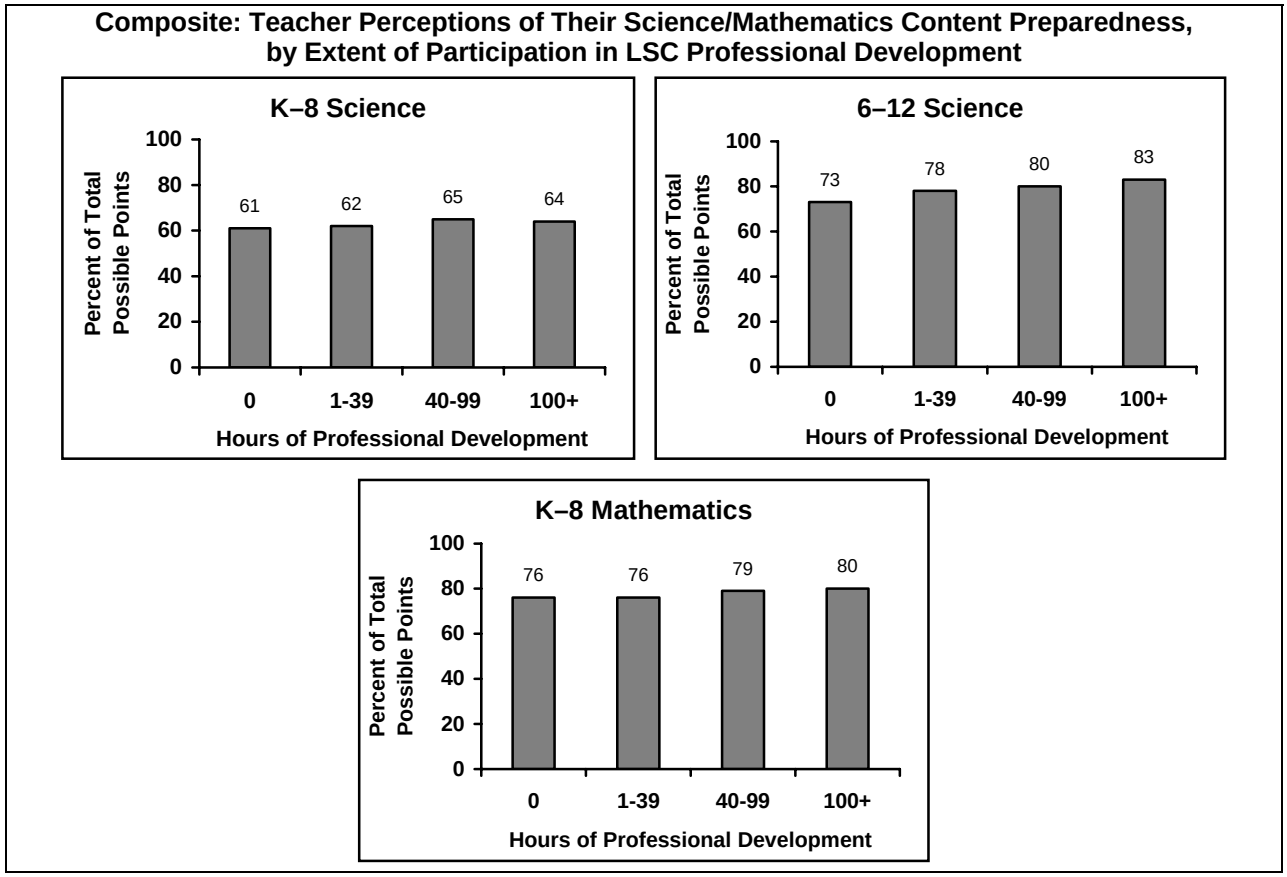

Figure 25

Questionnaire data on other items provide support for the impact of the LSC on teacher self-confidence. For example, the larger the number of hours of LSC professional development, the more likely teachers were to indicate that they are well-informed about national mathematics/science standards. (See Figure 26.)

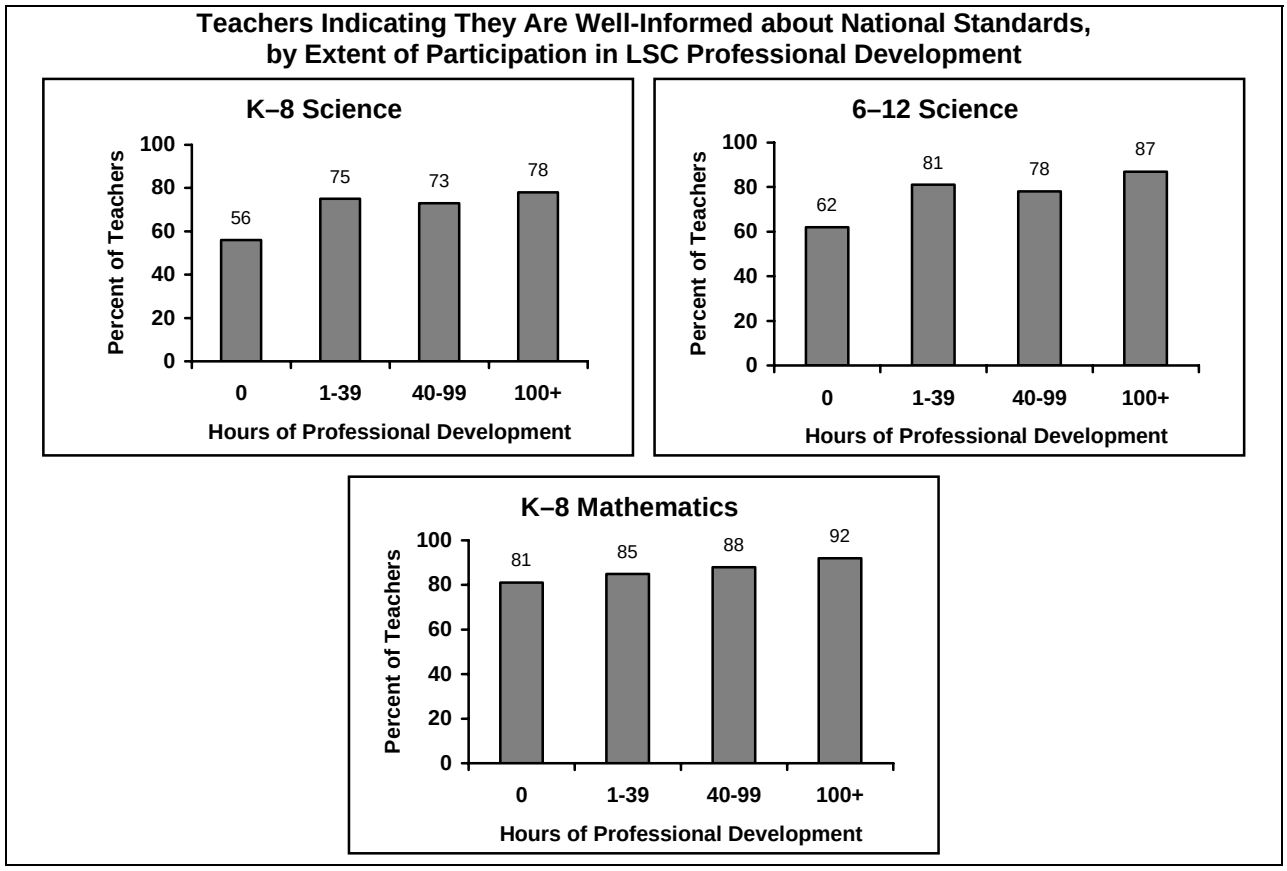

Figure 26

Figure 27 shows the results on a composite of items about teacher preparedness to use a variety of instructional strategies in their mathematics/science instruction, including taking students' prior understanding into account when planning curriculum and instruction, having students work in cooperative learning groups, and using informal questioning to assess student understanding. The ten percentage point difference between untreated and highly-treated 6–12 science teachers constitutes a large effect (0.78 standard deviations). For K–8 mathematics, the four point difference between untreated and highly treated teachers represents a small effect (0.33 standard deviations). There was no significant difference on this composite for K–8 science teachers.

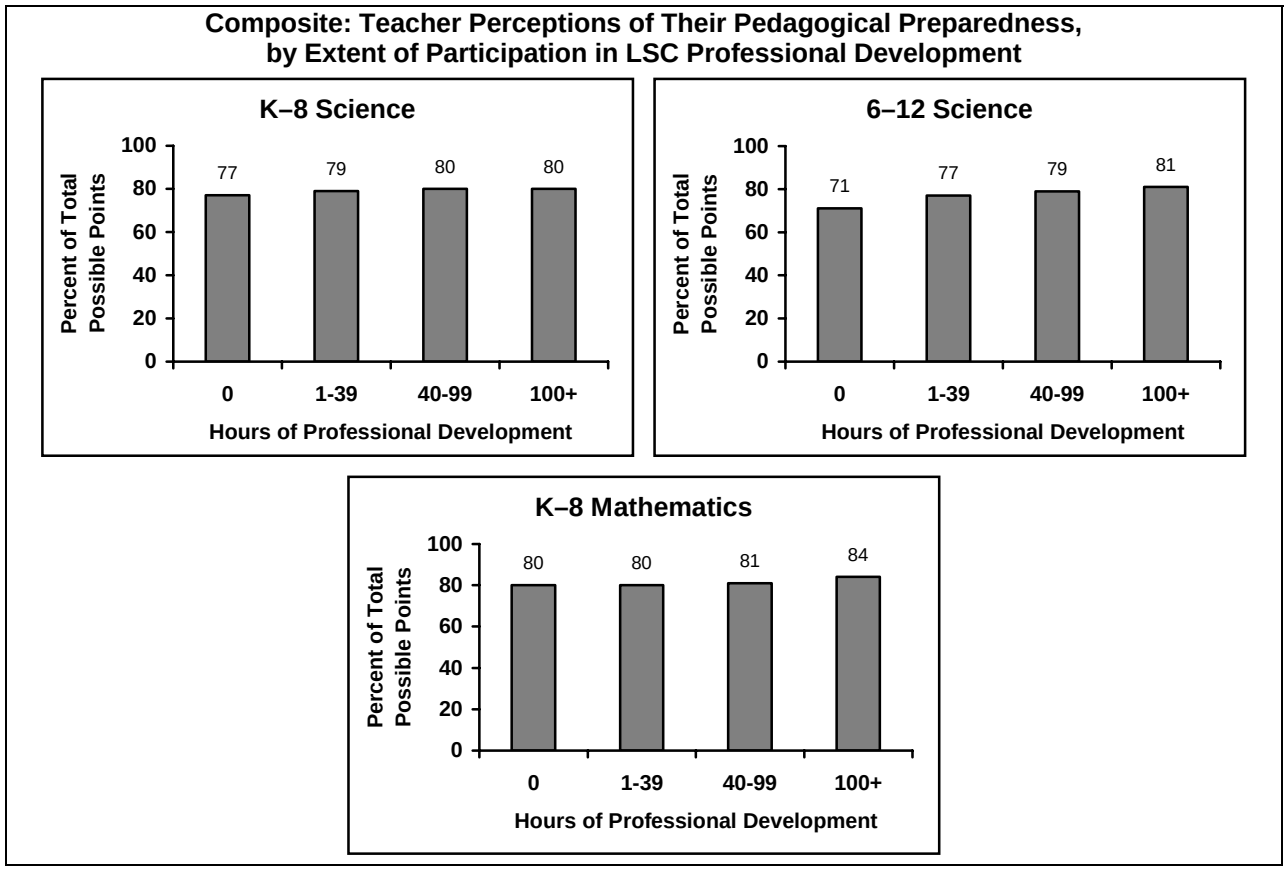

Figure 27

IV. Impact of the LSC on Classroom Practice

A. Introduction

The core evaluation focuses a great deal of attention on the impact of the LSC projects on classroom instruction. Data come from several sources: classroom observations, teacher interviews, and teacher questionnaires. As was the case with impact on teachers, the impact of the LSC on classroom practice was assessed by comparing results for teachers with varying extents of participation in LSC professional development.

B. Time Spent on Elementary Science Instruction

Over the years, one of the impacts of the LSC has been increased attention to science instruction in the elementary grades. However, as can be seen in Figures 28–31, there are no significant differences in this area for the elementary science data included in this report. Based on teacher interview data, the increased attention to mathematics and literacy in the face of high-stakes accountability may help explain this finding.

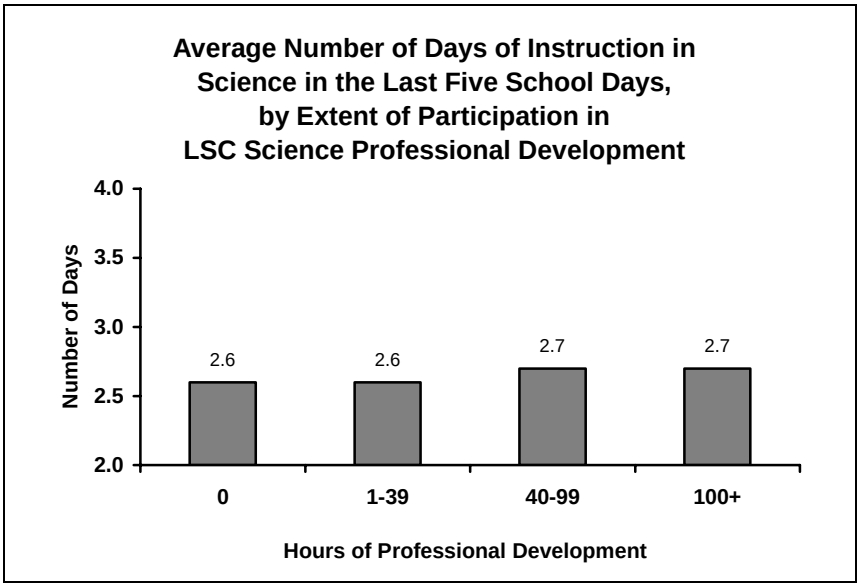

Figure 28

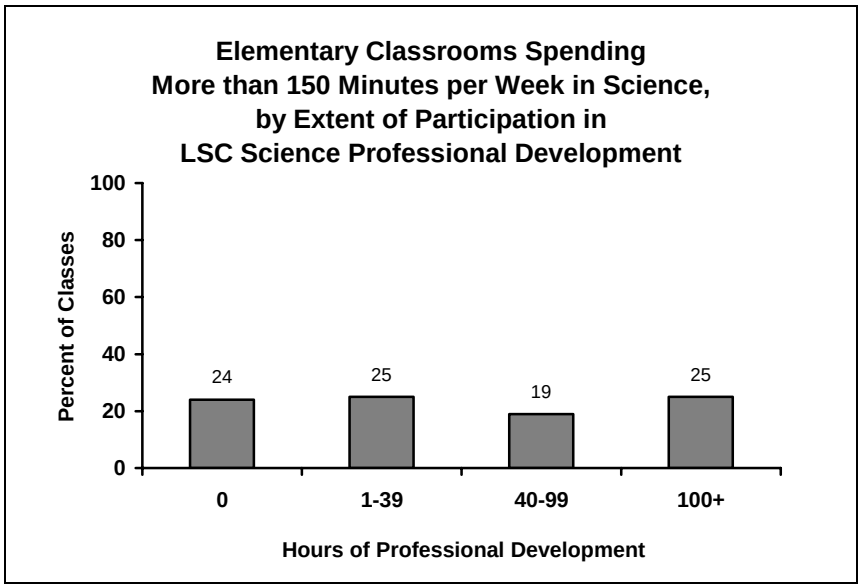

Figure 29

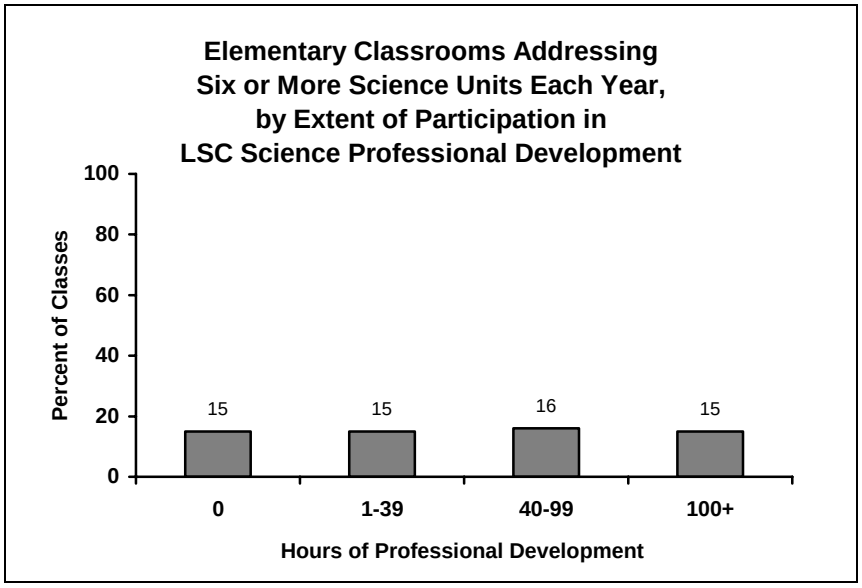

Figure 30

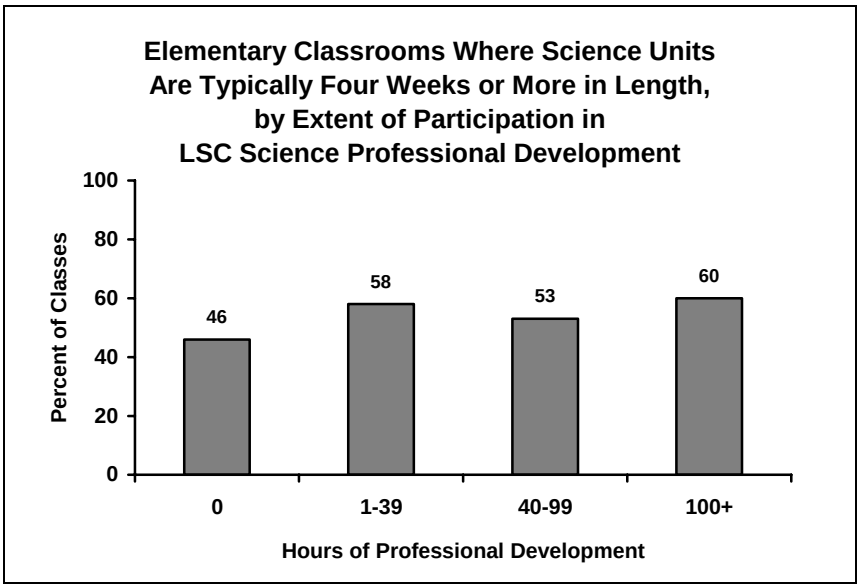

Figure 31

C. Instructional Strategies

One indication of the impact of LSC activities on classroom practice comes from composites created from questionnaire data. The investigative culture composite includes strategies used by teachers to facilitate exploration and investigation by students. It includes such practices as:

- Arranging seating to facilitate student discussion;
- Using open ended questions;
- Requiring students to supply evidence to support their claims; and
- Encouraging students to consider alternative explanations.

There was a significant increase in scores on this composite with increasing participation in LSC activities for all three targeted subject/grade-level combinations. (See Figure 32.) The nine-point difference between untreated and highly treated teachers in 6–12 science represents a large effect size (0.79 standard deviations). The seven-point difference in K–8 mathematics represents a medium effect size (0.54 standard deviations), and the six-point difference in K–8 science represents a small effect size (0.43 standard deviations).

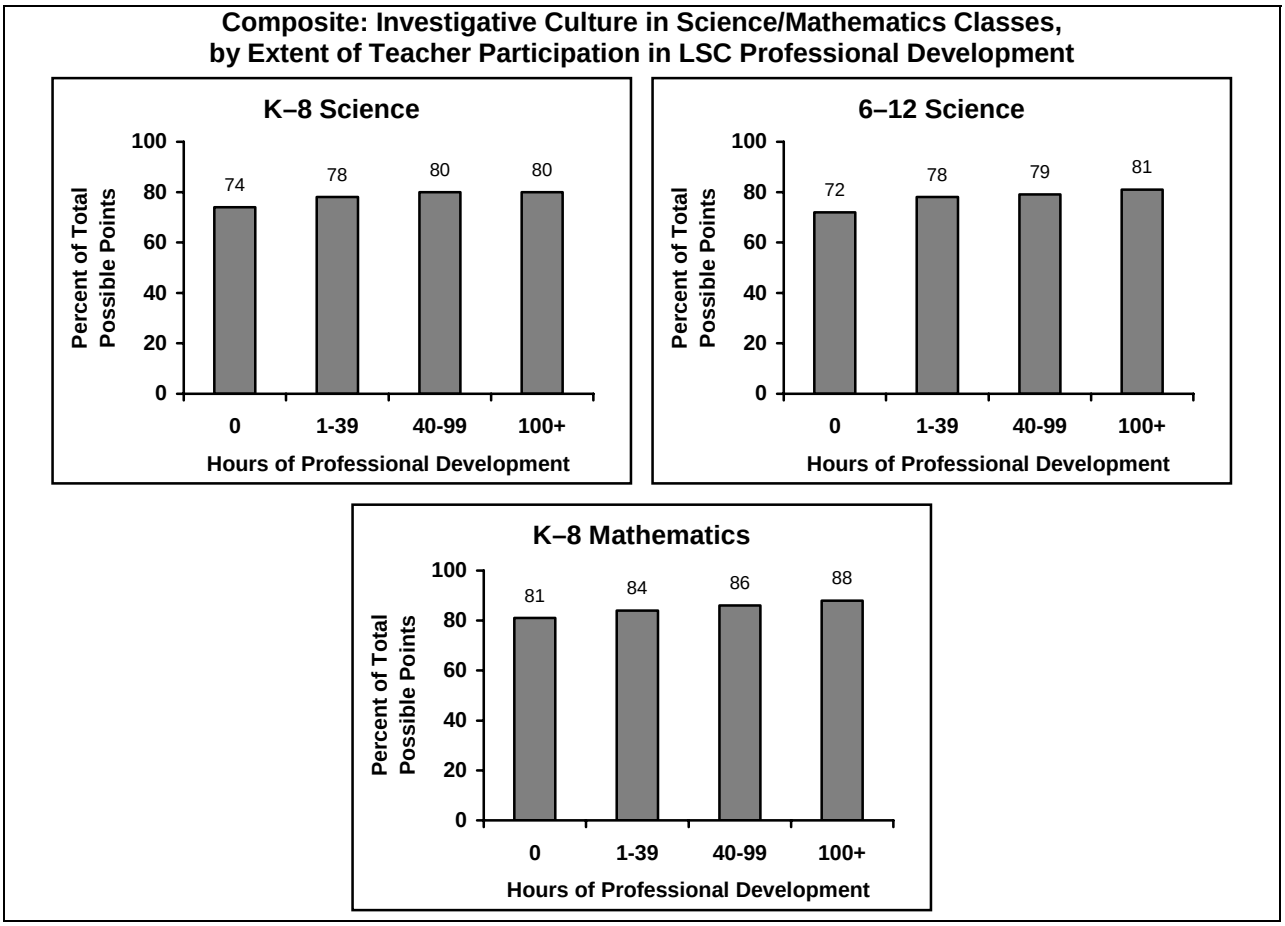

Figure 32

The investigative practices composite is tied to what students actually do in the classroom. It includes such instructional strategies as having students:

- Engage in hands-on mathematics/science activities;
- Work on models or simulations;
- Work on extended investigations; and
- Write reflections in a notebook or journal.

As shown in Figure 33, there was an increase in composite scores for both science and mathematics teachers with increasing participation in LSC activities. The differences between untreated and highly-treated teachers represent a medium effect size for 6–12 science (0.56 standard deviations), and small effect sizes for K–8 science and mathematics (0.39 and 0.37 standard deviations, respectively).

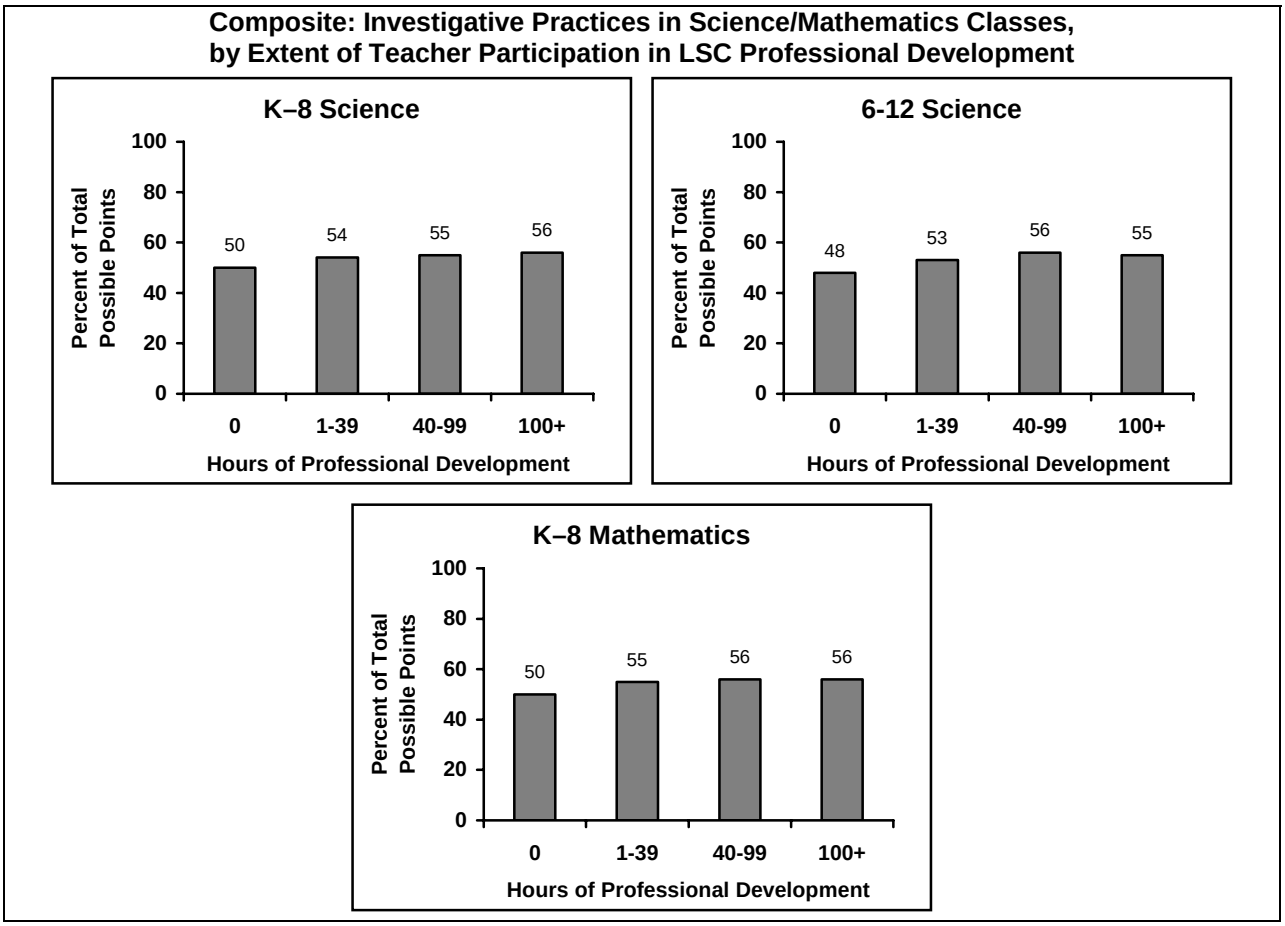
Composite: Investigative Practices in Science/Mathematics Classes, by Extent of Teacher Participation in LSC Professional Development
K–8 Science
Percent of Total Possible Points
100
80
60
40
20
0
50
54
55
56
0
1-39
40-99
100+
Hours of Professional Development
6-12 Science
Percent of Total Possible Points
100
80
60
40
20
0
48
53
56
55
0
1-39
40-99
100+
Hours of Professional Development
K–8 Mathematics
Percent of Total Possible Points
100
80
60
40
20
0
50
55
56
56
0
1-39
40-99
100+
Hours of Professional Development

Figure 33

D. Quality of Observed Lessons

Trained observers visited classrooms of teachers who had already participated in LSC professional development and others who had not yet participated and assessed the quality of the lessons using a variety of indicators. (See box.)

Sample Indicators for Classroom Observations

Design

- The design of the lesson incorporated tasks, roles, and interactions consistent with investigative mathematics/science.
- The design of the lesson reflected careful planning and organization.
- The instructional strategies and activities used in this lesson reflected attention to students' experience, preparedness, and/or learning styles.
- The resources available in this lesson contributed to accomplishing the purposes of the instruction.
- The design of the lesson encouraged a collaborative approach to learning.
- Adequate time and structure were provided for "sense-making."
- Adequate time and structure were provided for wrap-up.

Implementation

- The instruction was consistent with the underlying approach of the instructional materials designated for use by the LSC.
- The teacher's classroom management style/strategies enhanced the quality of the lesson.
- The pace of the lesson was appropriate for the developmental levels/needs of the students and the purposes of the lesson.
- The teacher was able to "read" the students' level of understanding and adjust instruction accordingly.
- The teacher's questioning strategies were likely to enhance the development of student conceptual understanding/problem solving (e.g., emphasized higher order questions, appropriately used "wait time," identified prior conceptions and misconceptions).

Mathematics/Science Content

- The mathematics/science content was significant and worthwhile.
- The mathematics/science content was appropriate for the developmental levels of the students in this class.
- Students were intellectually engaged with important ideas relevant to the focus of the lesson.
- Teacher-provided content information was accurate.
- Appropriate connections were made to other areas of mathematics/science, to other disciplines, and/or to real-world contexts.

Classroom Culture

- Active participation of all was encouraged and valued.
- There was a climate of respect for students' ideas, questions, and contributions.
- Interactions reflected collegial working relationships among students (e.g., students worked together, talked with each other about the lesson).
- The climate of the lesson encouraged students to generate ideas, questions, conjectures, and/or propositions.

Observers then rated the quality of each lesson's design and implementation, the science/ mathematics content, and the classroom culture. Lessons of treated teachers (those who had participated in 20 or more hours of LSC professional development) were not significantly different in the quality of their design, implementation, content, and classroom culture than lessons of teachers who had not yet participated (see Figure 34).[16,17]

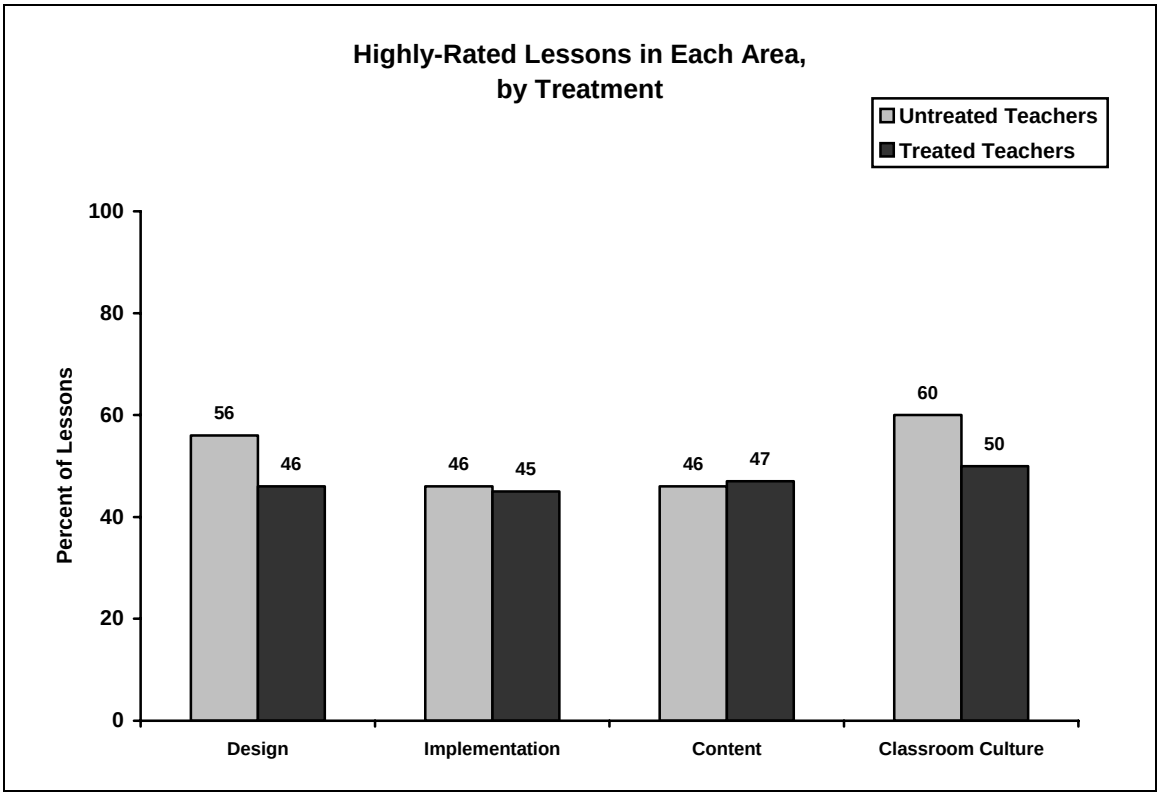

Figure 34

[16] While questionnaire results were typically presented for four levels of participation in LSC professional development (0, 1–39, 40–99, and 100 or more hours), the considerably smaller number of classroom observations prevented that extent of disaggregation.

[17] Although 366 classroom observations were submitted during the time frame covered by this report, only 257 were included in these analyses. Data from the 47 lessons taught by teacher leaders were excluded as were the 48 lessons taught by teachers that did not return a completed teacher questionnaire (by which the treatment information is gathered). An additional 14 lessons were excluded as the observed teachers completed a questionnaire, but did not respond to the item asking about the extent of their participation in LSC professional development. Of the 257 lessons analyzed, 59 were taught by untreated teachers and 198 were taught by treated teachers.

Classroom observers also considered the potential for student impact as they observed lessons. Areas of likely student impact are compared for treated and untreated teachers in Figure 35. Lessons of treated and untreated teachers were not statistically different in any of these areas.

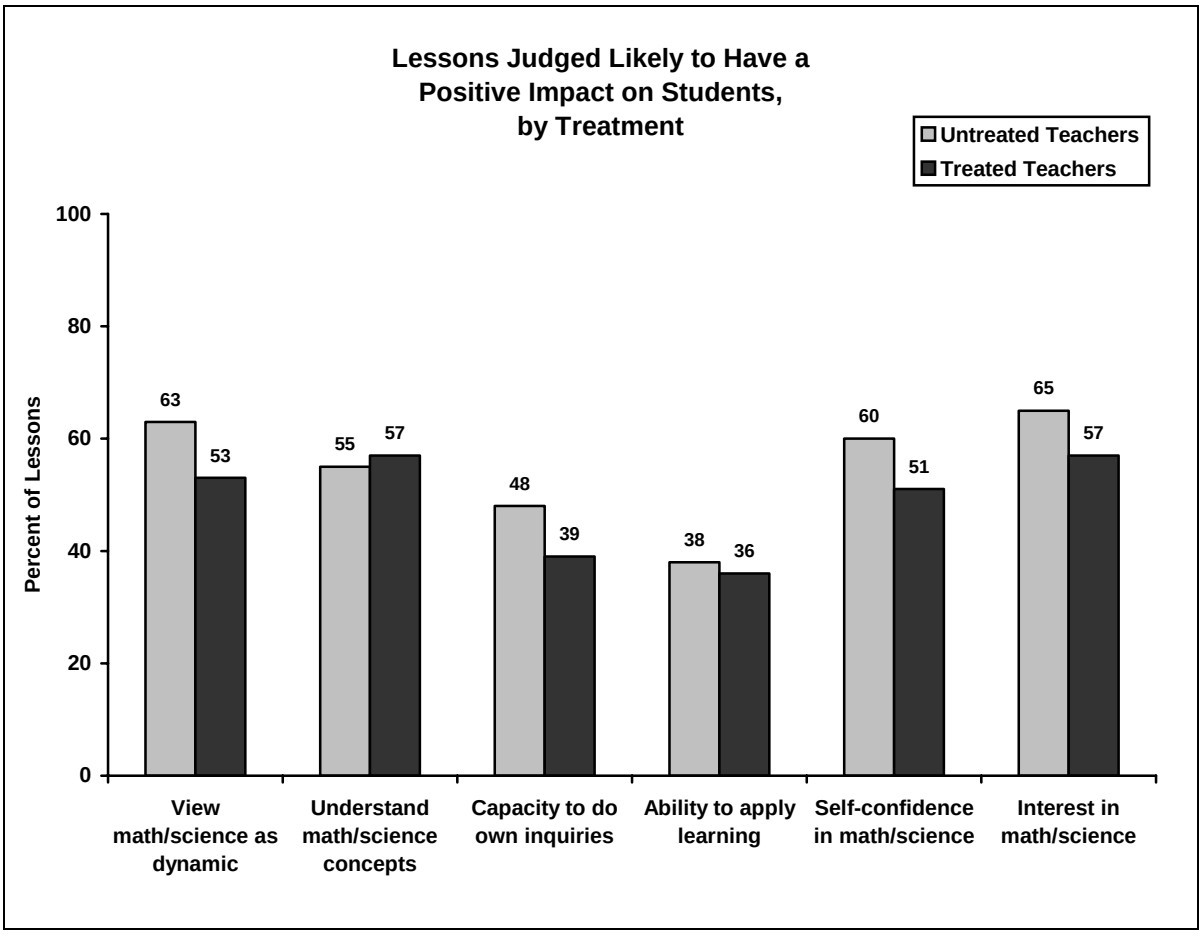

Figure 35

In addition, each lesson was given an overall capsule rating. Overall quality ratings for lessons of treated and untreated teachers were not significantly different. (See Figure 36.)

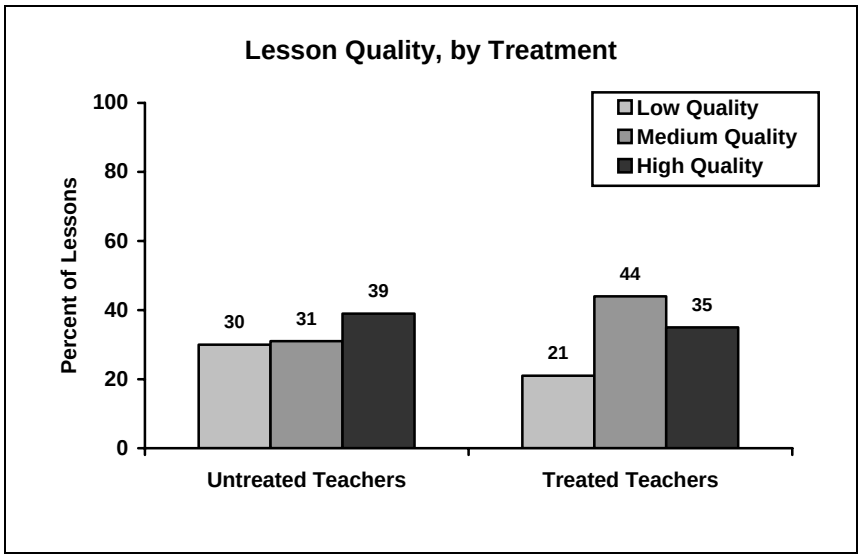

Figure 36

Since a specific goal of the LSC program is to increase the use of exemplary instructional materials, classroom observers were asked to note whether or not these materials were being used and to comment on the quality of their use. As can be seen in Figure 37, the majority of observed lessons were based on the designated instructional materials, regardless of whether the teacher had participated in LSC professional development. The widespread use of the designated instructional materials may be responsible for the lack of difference in lesson quality between treated and untreated teachers.

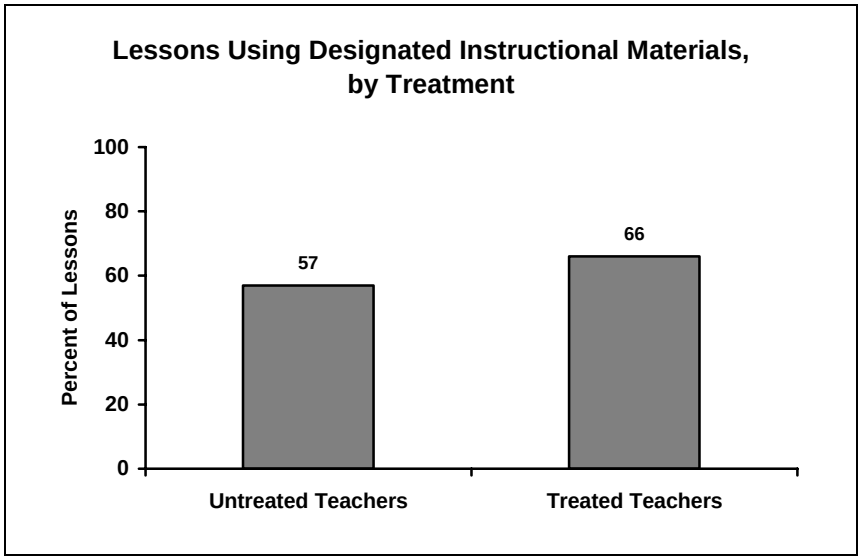

Figure 37

However, lesson quality is related to teachers' use of the designated instructional materials, reinforcing the LSC program's emphasis on having teachers implement the designated instructional materials as designed by their developers. As can be seen in Figure 38, 50 percent of the lessons that adhered closely to the materials were given high ratings (capsule ratings of 4 or 5), significantly more than the 23 percent of lessons not using the designated instructional materials.

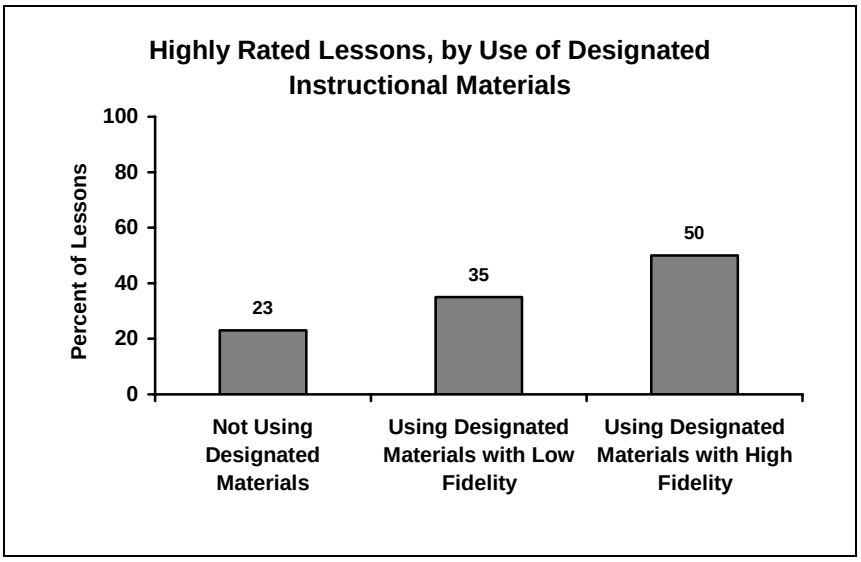

Figure 38

V. Conclusions

Results from the Local Systemic Change core evaluation between 2003 and 2006 continue to show areas of both strength and weakness in the design and implementation of the professional development and the impact of those interventions on teachers and their teaching.

Evaluators were asked to observe a representative sample of professional development sessions and rate each in relation to its particular purposes. Sessions were very likely to receive high ratings for providing a climate of respect, encouraging active participation, and fostering a collaborative approach to learning, as well as addressing appropriate mathematics/science content. The most salient weaknesses in sessions for classroom teachers were in questioning participants in ways likely to enhance their conceptual understanding, creating a culture that encouraged participants to share ideas and take intellectual risks, providing adequate time and structure for wrap-up, portraying mathematics/science as a dynamic body of knowledge, and the appropriateness of "sense-making" about classroom practice.

Interestingly, the majority of the observed sessions were facilitated by district personnel, most often full- or part-time teacher leaders. Fewer than 1 in 6 sessions included scientists or mathematicians as professional development providers, and fewer than 2 in 5 had a major focus on increasing teacher content knowledge, raising the concern that the LSC professional development does not emphasize adequately the need to deepen teacher disciplinary content knowledge. Similarly, just over one-third of the observed sessions included a focus on helping teachers understand student thinking/learning about mathematics or science content, an area that is increasingly being identified as important in teacher development.

While only 39 percent of the teachers rated the LSC professional development excellent or very good, the more hours of participation in LSC professional development, the higher the ratings of quality. In interviews, teachers indicated that having the opportunity to deepen their content and pedagogical knowledge, receiving materials needed for instruction, the high quality of LSC professional development, and the opportunities to collaborate with other teachers were particularly helpful aspects of the LSC.

Questionnaire data collected from targeted teachers suggest that LSC professional development has had a significant impact on teachers' perceptions of their pedagogical preparedness. Impact on teachers' perceptions of content preparedness was mixed, with significant differences found only for 6–12 science projects. In addition, participants reported making greater use of strategies that facilitate student exploration and investigation by students than did teachers who had not participated in LSC professional development, such as using open ended questions and requiring students to supply evidence to support their claims. Participants were also more likely than other teachers to use reform-oriented teaching practices such as having students engage in hands-on activities, work on extended investigations, and write reflections in notebooks or journals.

For the time period covered in this report, the quality of observed lessons was no different for teachers who had and had not participated in LSC professional development. This finding could indicate that LSC professional development was not as effective as desired. The data also

indicate that lessons that adhered closely to the designated materials were more than twice as likely to be rated highly than lessons not based on the designated materials. Thus, the impact of LSC professional development may be masked by the widespread use, in both treated and untreated teachers' classrooms, of the designated instructional materials.

Appendix Tables

Summary of the Impact of LSC Professional Development on Teacher Perceptions of Their Preparedness and on Their Teaching

K–8 Science

Questionnaire Composite	Mean: 0 Hours (N = 418)	Mean: 100 or More Hours (N = 583)	Pooled Standard Deviation	Effect Size (d)
Attitudes Toward Teaching	86.68	86.68	8.95	0.00
Pedagogical Preparedness	76.71	79.93	12.16	0.26
Content Preparedness	61.27	64.07	17.16	0.16
Investigative Culture	73.66	79.92	14.61	0.43*
Investigative Practices	50.38	55.89	14.08	0.39*

* $p < 0.05$; (composite score for the 100 or more hours group significantly greater than for the 0 hours group, 1-tailed independent samples t-test – WesVar 4.2)

6–12 Science

Questionnaire Composite	Mean: 0 Hours (N = 73)	Mean: 100 or More Hours (N = 166)	Pooled Standard Deviation	Effect Size (d)
Attitudes Toward Teaching	82.24	86.60	9.15	0.48
Pedagogical Preparedness	70.56	80.65	12.92	0.78*
Content Preparedness	73.43	83.23	15.78	0.62*
Investigative Culture	71.63	81.10	11.99	0.79*
Investigative Practices	48.41	55.30	12.34	0.56*

* $p < 0.05$; (composite score for the 100 or more hours group significantly greater than for the 0 hours group, 1-tailed independent samples t-test – WesVar 4.2)

K–8 Mathematics

Questionnaire Composite	Mean: 0 Hours (N = 231)	Mean: 100 or More Hours (N = 554)	Pooled Standard Deviation	Effect Size (d)
Attitudes Toward Teaching	88.79	89.23	9.35	0.05
Pedagogical Preparedness	79.97	84.25	12.92	0.33*
Content Preparedness	76.09	79.79	15.98	0.23
Investigative Culture	81.41	88.27	12.70	0.54*
Investigative Practices	50.03	56.22	16.67	0.37*
Use of Calculators and Computers	54.37	57.08	22.16	0.12

* $p < 0.05$; (composite score for the 100 or more hours group significantly greater than for the 0 hours group, 1-tailed independent samples t-test – WesVar 4.2)

Report Available on the Web

This report is available on Horizon Research, Inc.'s web site:

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