

**Local Systemic Change  
through Teacher Enhancement  
Year Eight Cross-Site Report**

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### **Appendix Table**

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

## **Acknowledgments**

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

Conrad Katzenmeyer in the National Science Foundation's (NSF) Division of Research, Evaluation, and Communication; Joyce Evans, Susan Snyder, and Diane Spresser formerly of NSF's Division of Elementary, Secondary, and Informal Education (ESIE); and Joy Frechtling of Westat, Inc. were instrumental in the design of the core evaluation system. Numerous other NSF/ESIE program officers have provided valuable assistance throughout the process, as well.

Within HRI, in addition to the authors of this report, Alison Bowes, Scott Hanrath, Susan Hudson, Kristen Malzahn, and Joan Pasley were responsible for various tasks essential to the production of this report, from instrument design, to data processing and analysis, to report production.

This report would not have been possible without the efforts of the LSC project evaluators, whose work formed the basis for the analyses presented here. Special thanks are due to the thousands of teachers in the participating districts who took time from their busy schedules to provide information about their mathematics and science teaching.

## 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.

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.<sup>1</sup> 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 prepare an annual cross-site analysis of the 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, 2001 through August 31, 2002.

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<sup>1</sup> Prior to 1999, the requirement for K–8 projects was 100 hours.



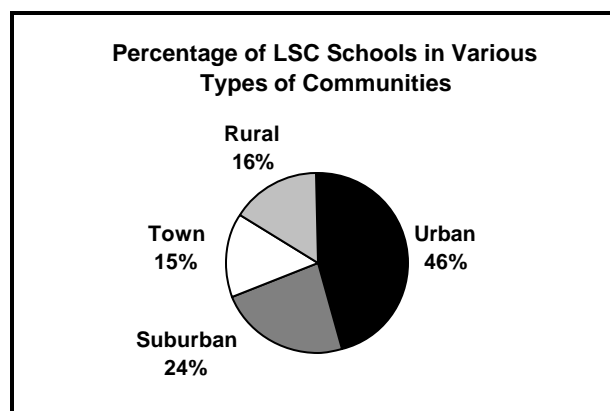
## A. An Overview of LSC Projects in Cohorts 1–8

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.

- From 1995 to 2002, the LSC initiative included 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.

## B. Schools Participating in 2001–2002<sup>2</sup>

As can be seen in Figure 1, nearly half of the schools targeted for the LSC are in urban areas; only 15 percent are in towns or small cities.



*Figure 1*

<sup>2</sup> Three projects completed data collection in 1998, 6 in 1999, 8 in 2000, and 19 in 2001; these 36 projects are not included in the analyses in this report.

In terms of student demographics, across all schools targeted by the LSCs, 50 percent of students are white, 21 percent African-American, 21 percent Hispanic, 6 percent Asian, 0.9 percent American Indian or Alaskan Native, 0.1 percent Native Hawaiian or Pacific Islander, and 0.6 percent are 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 the representation of minority students is at least as large as the national average of approximately 40 percent.

The typical school targeted for K–8 mathematics or science reform by the LSC projects has 491 students, 49 percent of whom qualify for free or reduced-price lunches and 16 percent of whom are of limited English proficiency (LEP). The typical school targeted for 6–12 mathematics or science reform has 750 students, 27 percent of whom are eligible for free or reduced-price lunches and 6 percent of whom are LEP.

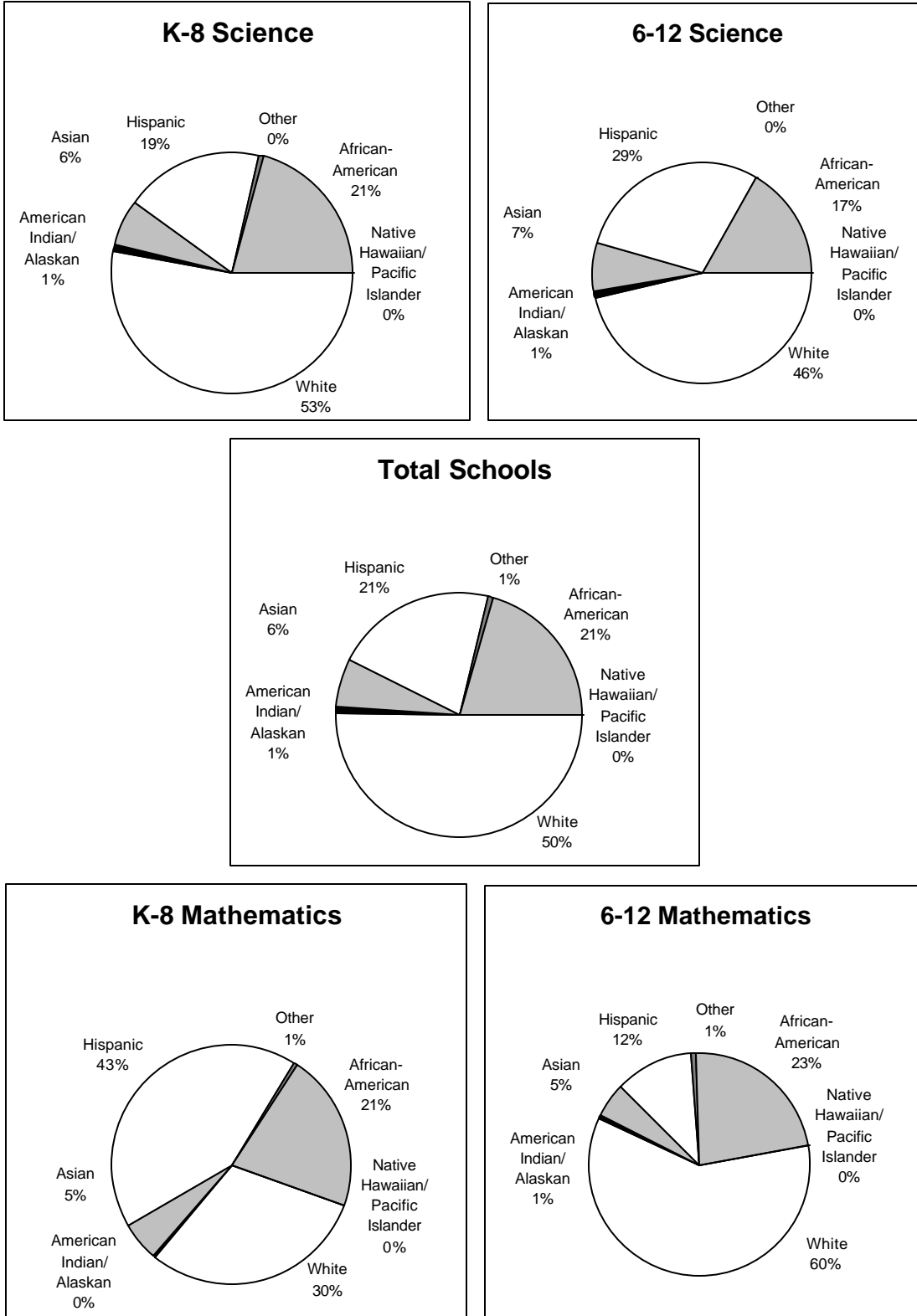
### **C. Description of Core Evaluation Data Collection and Analysis**

HRI worked with the National Science Foundation and PIs and evaluators of the LSC projects on the design and implementation of a core evaluation system to allow aggregating information across projects. This section describes the data collection activities associated with the core evaluation. Subsequent sections of the report present results for the four 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 extent of school and teacher involvement in LSC 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?

**Race/Ethnicity of Students to Be Impacted by the LSC Projects**



**Figure 2**

## **Data Collection**

Data collection activities for the projects' 2001–2002 Core Evaluation Reports were conducted from September 1, 2001 through August 31, 2002. The single Cohort 8 project was collecting baseline data for their first year of funding; at the other end of the spectrum, this was the seventh year of data collection for cohort 2 projects. There were no active Cohort 1 projects in 2001–2002. The Core Evaluation Data Collection schedule was adjusted in 1999–2000 with the goal of transitioning to a longitudinal system. As a result, some projects conducted less-extensive evaluation activities than in previous years, resulting in an overall smaller pool of data for some analyses.

Data collection activities included the following:

### **1. *Observations of Professional Development Activities***

The core evaluation called for projects to conduct observations of professional development sessions and record their observations on standardized protocols. Established projects are required to conduct 5–8 observations; baseline projects are required to conduct 2–5 observations. 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 350 observations of professional development sessions were conducted. Data were weighted to control for the variable number of observations conducted per project.

### **2. *Classroom Observations***

Twenty-seven of the 52 active projects were scheduled to conduct classroom observations, with the number of observations ranging from 12 to 16. These randomly selected teachers, or their back-ups, were to be observed in the spring of 2002. There was a total of 382 classrooms 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-seven 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 82 percent. A total of 7,722 teacher questionnaires was returned to HRI, including 4,002 from K–8 science teachers; 79 from 6–12 science teachers; 3,222 from K–8 mathematics teachers; and 419 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***

All projects were asked to administer 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 2,209 principal

questionnaires were returned, with a median response rate among projects of 95 percent.

### **5. *Teacher Interviews***

Evaluators were asked to interview a sample of 10 teachers who had participated in at least 20 hours of professional development activities in that project. A total of 515 interviews were conducted among 51 projects. Seventy-nine percent of the interviews were conducted by phone, and 21 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.

### **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.”<sup>3</sup> 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.

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 associated with 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 (K–8 science, 6–12 science, K–8 mathematics, or 6–12 mathematics).<sup>4</sup> 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.<sup>5</sup> 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 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.

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<sup>3</sup> 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.

<sup>4</sup> In projects targeting both mathematics and science, or both elementary and secondary mathematics, questionnaire, observation, and interview data were collected separately for each “subject.” Teacher questionnaire data from the two secondary mathematics projects and the one secondary science project are included in the overall results for “all teachers,” but they are not reported separately because of the small sample sizes.

<sup>5</sup> “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 and at least two in the project that had just begun its professional development. 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 350 professional development sessions was observed.

This section of the report presents a summary of data collected from observations of individual sessions across all LSC projects, including descriptive information about the observed sessions and evaluators’ assessments of their quality.<sup>6</sup> The section concludes with teacher and evaluator judgments of the overall quality of the LSC professional development programs.

### B. Description of LSC Professional Development Sessions

Evaluators documented a number of descriptive 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

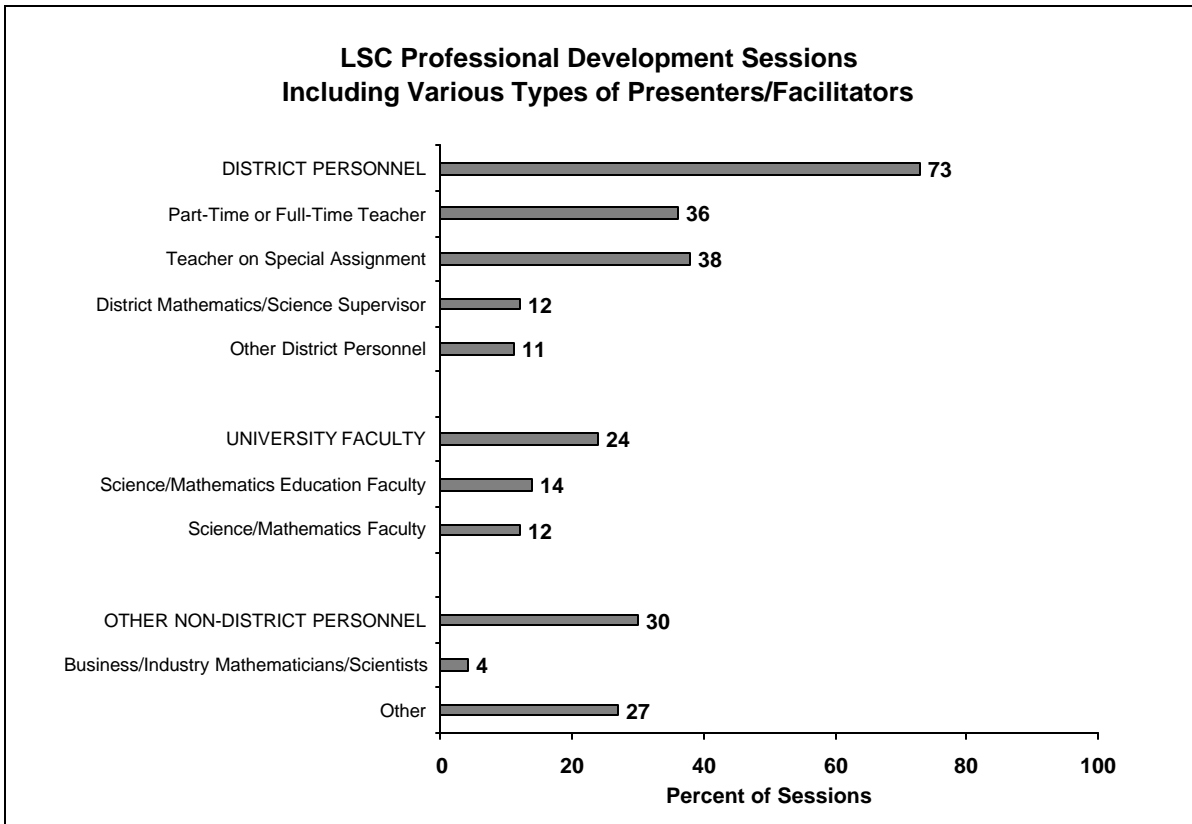
The majority of professional development sessions observed for the LSC core evaluation included between 11 and 50 participants; only 1 percent of the sessions had more than 100 participants. Of sessions targeting teachers, 11 percent exclusively targeted teacher leaders, 79 percent targeted only regular teachers, and 10 percent targeted both lead and regular teachers. A total of 6 percent of the sessions included principals or other administrators.

#### Presenters/Facilitators

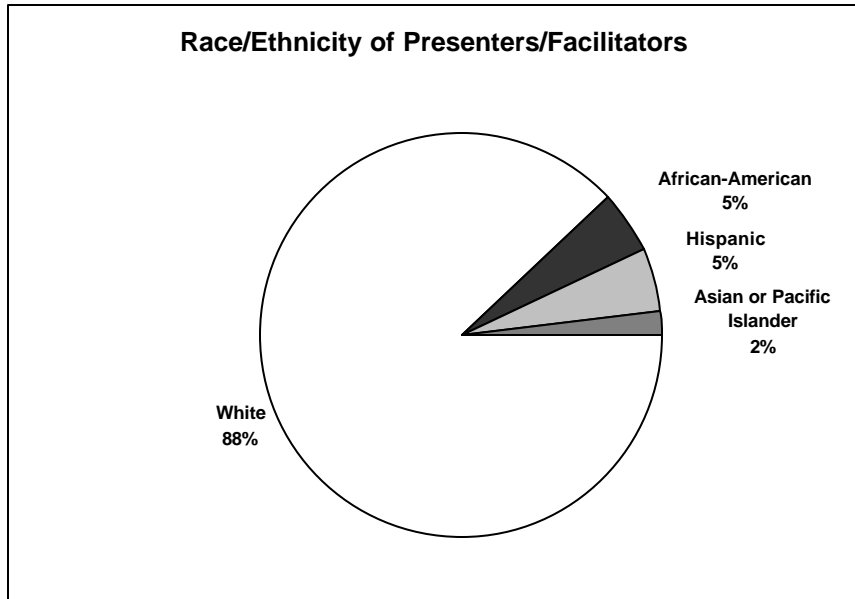
LSC professional development involves presenters/facilitators from a variety of settings. Seventy-three percent of the observed sessions included one or more district personnel as presenters or facilitators, while only 24 percent of the sessions included university faculty as presenters or facilitators. (See Figure 3.) Across all of the observed sessions, 71 percent of the presenters/facilitators were female and 29 percent were male. As can be seen in Figure 4, 88 percent of the presenters/facilitators were white and 12 percent were members of other race/ethnic groups.

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<sup>6</sup> In addition to the core evaluation data collection, evaluators observed all or parts of 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

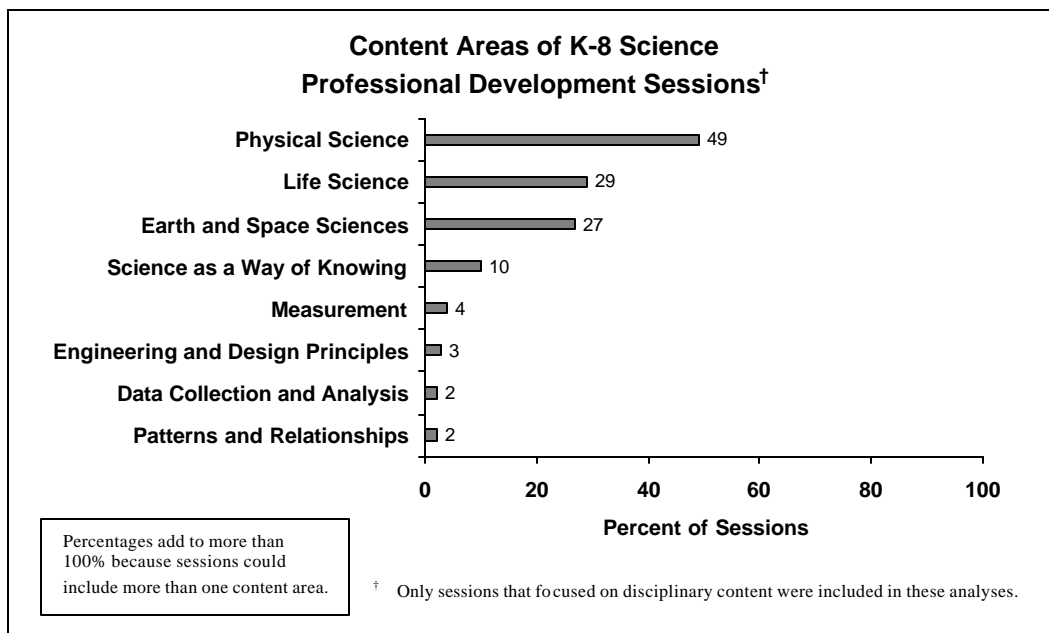
Evaluators were asked to indicate the primary intended purposes of each observed session based on information provided by the session facilitators. The vast majority of the observed sessions dealt with classroom practice, either pedagogy or the implementation of designated instructional materials. As can be seen in Table 1, 39 percent of the sessions included a focus on teacher content knowledge.

**Table 1**  
**Primary Intended Purposes of LSC Professional Development Sessions**

	Percent of Sessions				
	All Sessions	Science		Mathematics	
		K-8	6-12	K-8	6-12
Learning how to use specific instructional materials in the classroom	44	44	45	42	48
Increasing mathematics/science content knowledge of participants	39	39	45	39	37
Understanding student thinking/learning about mathematics/science content	35	25	40	46	41
Learning pedagogical/classroom management strategies	34	40	34	26	30

### Content Focus of Professional Development Sessions

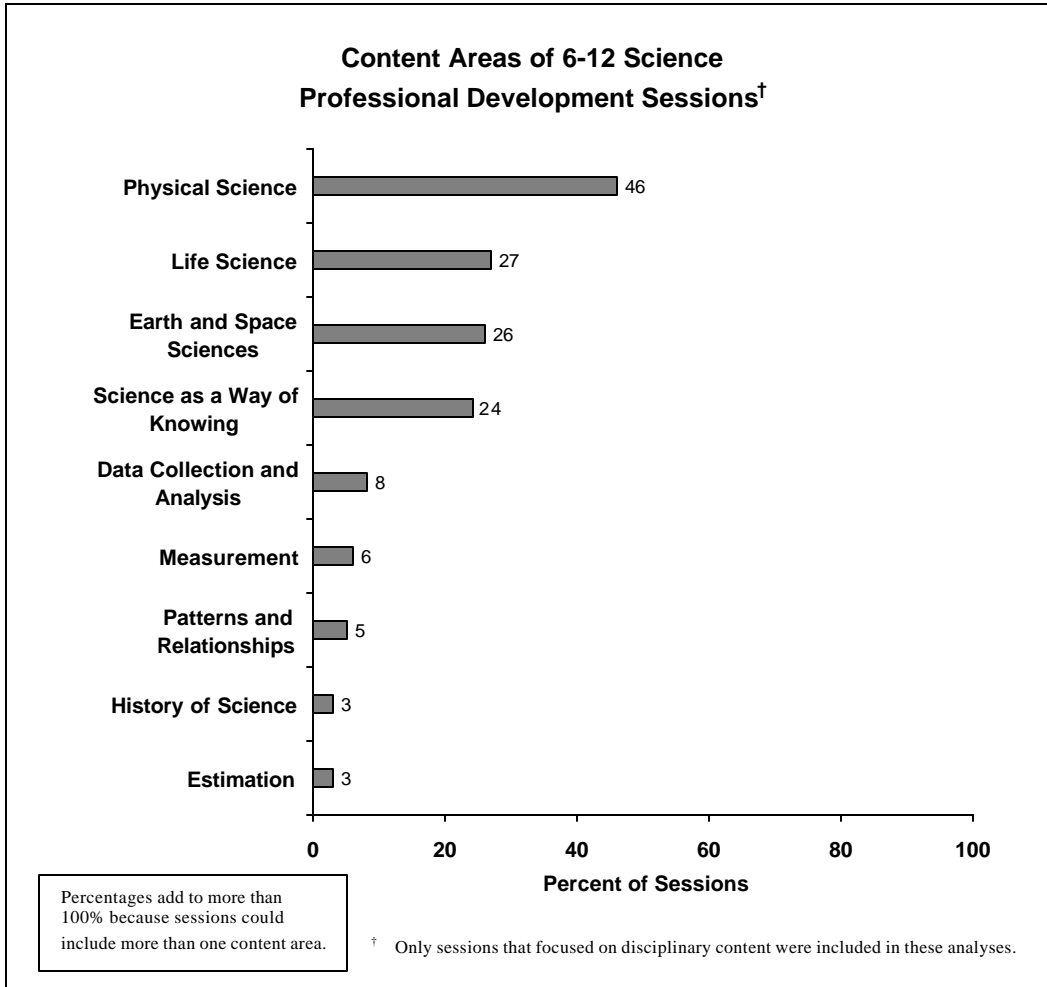
When sessions focused on one or more disciplinary content areas, evaluators were asked to categorize that content. In K-8 science projects, evaluators reported that nearly half of the sessions with a disciplinary content focus dealt with physical science concepts (49 percent); fewer addressed concepts from life science (29 percent), earth and space sciences (27 percent), or “science as a way of knowing” (10 percent). Fewer than five percent of the observed K-8 science sessions dealt with measurement, engineering and design principles, patterns and relationships or data collection and analysis. (See Figure 5.)



**Figure 5**

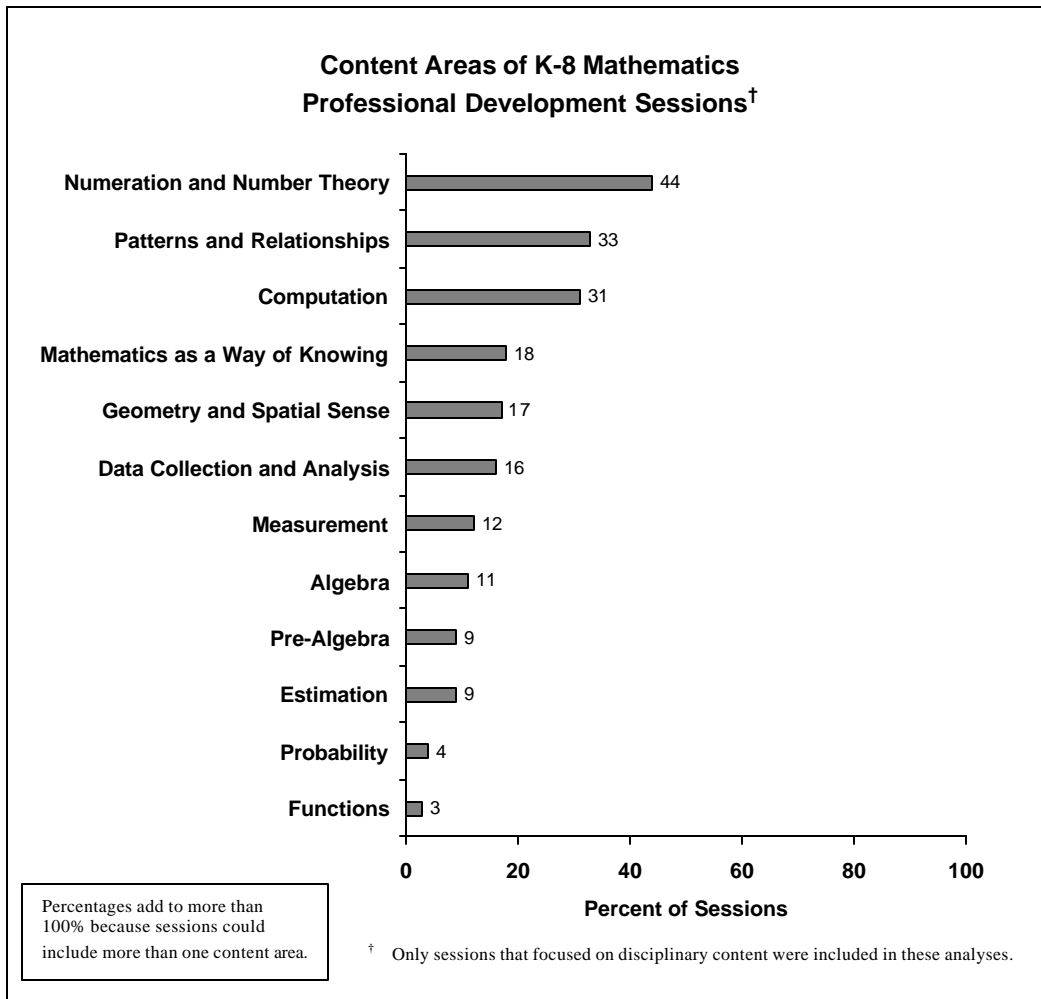


Projects targeting grade 6–12 science most heavily emphasized physical science (46 percent), as can be seen in Figure 6. Other topics that frequently received emphasis were life science (27 percent), earth and space science (26 percent), and science as a way of knowing (24 percent).



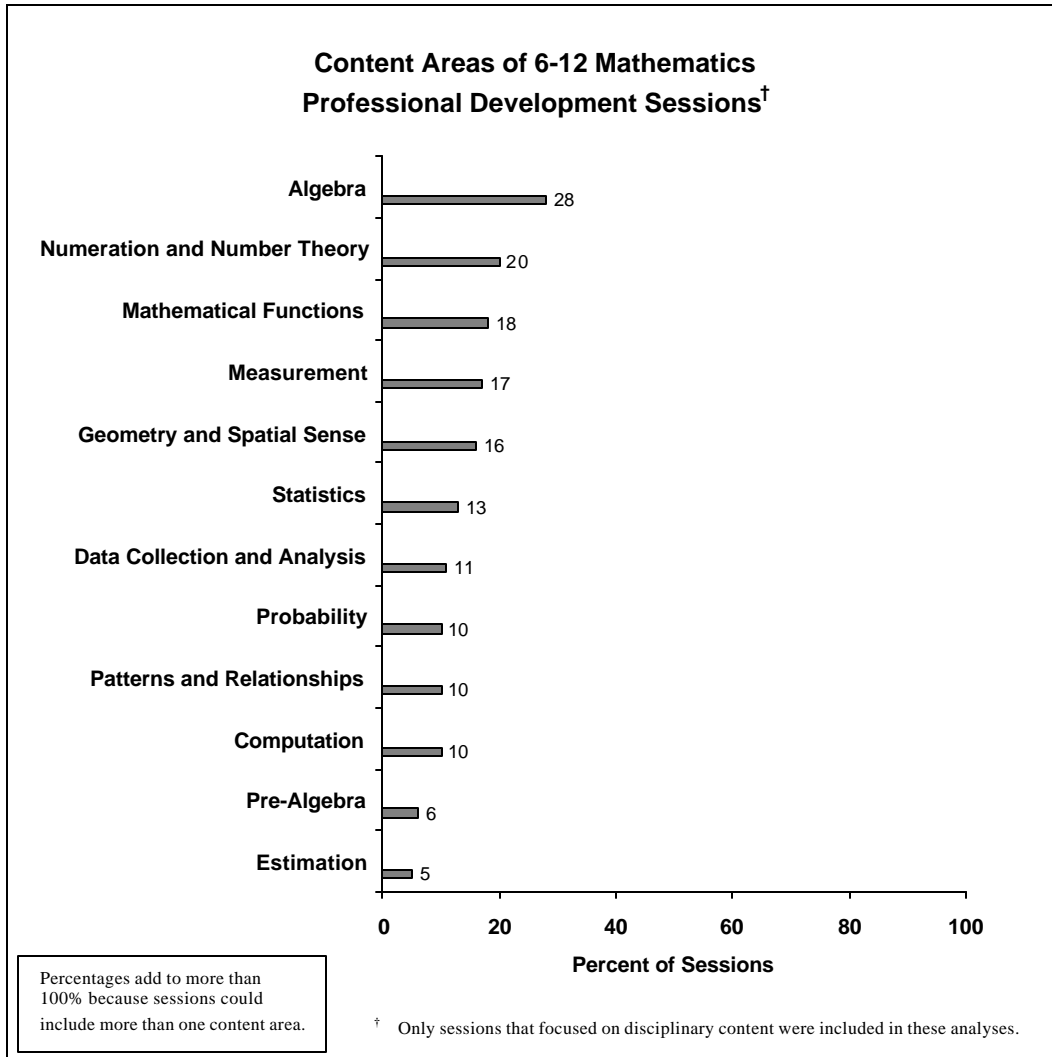
*Figure 6*

In projects targeting K–8 mathematics (Figure 7), the most heavily emphasized topics were numeration and number theory (44 percent of the sessions that dealt with disciplinary content), patterns and relationships (33 percent), and computation (31 percent). From 16 to 18 percent of the disciplinary content sessions focused on data collection and analysis, geometry and spatial sense, and mathematics as a way of knowing.



*Figure 7*

As can be seen in Figure 8, 28 percent of the disciplinary content-focused sessions for 6–12 mathematics teachers dealt with algebra. A number of other areas—numeration and number theory, functions, measurement, geometry and spatial sense, statistics, data collection and analysis, probability, patterns and relationships, and computation—were each the focus in 10–20 percent of the 6–12 mathematics content sessions.



**Figure 8**

### 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 2, most sessions included discussions or seminars (77 percent) and engaged participants in problem-solving or investigation (59 percent). Almost half of the sessions included formal presentations, usually by project staff as opposed to participants. Relatively few of the observed sessions involved participants in reading (9 percent) or writing (3 percent) about disciplinary content, pedagogy or reform issues.

**Table 2**  
**Major Activities of LSC Professional Development Sessions**

	Percent of Sessions				
	All Sessions	Science		Mathematics	
		K-8	6-12	K-8	6-12
<b>Engaged in discussions/seminars</b>	<b>77</b>	<b>72</b>	<b>78</b>	<b>83</b>	<b>79</b>
Whole group led by facilitator	61	53	72	71	56
Small groups/pairs	41	38	49	45	38
Whole group led by participants	8	6	17	6	9
<b>Engaged in problem-solving/investigation</b>	<b>59</b>	<b>61</b>	<b>50</b>	<b>58</b>	<b>61</b>
<b>Listened to a formal presentation</b>	<b>46</b>	<b>49</b>	<b>59</b>	<b>41</b>	<b>33</b>
By presenter/facilitator	44	46	57	39	33
By participants	5	6	8	4	0
<b>Read about disciplinary content, pedagogy, or reform issues</b>	<b>9</b>	<b>8</b>	<b>18</b>	<b>10</b>	<b>5</b>
<b>Wrote about disciplinary content, pedagogy, or reform issues</b>	<b>3</b>	<b>5</b>	<b>5</b>	<b>2</b>	<b>0</b>

### C. Quality of LSC Professional Development Sessions

In order to assess 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 “on-ramp” indicators, observers then assessed the overall quality of each component area. The lowest rating for component areas (Level 1) 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.<sup>7</sup> Evaluators’ ratings of the component areas are presented in the following sections.

#### 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 most often highly rated included:

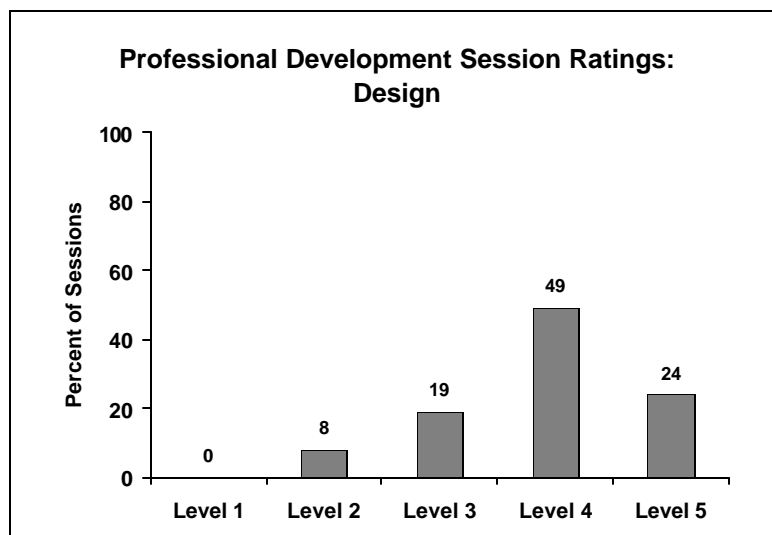
<sup>7</sup> Copies of the Professional Development Observation Protocol may be found in the Data Collection Manual section of the HRI web site: <http://www.horizon-research.com/LSC>.

- The extent to which the session encouraged a collaborative approach to learning (77 percent);
- The extent to which session design reflected careful planning and organization (76 percent); and
- The extent to which session design incorporated tasks, roles, and interactions consistent with the spirit of investigation (75 percent);

Fewer sessions were rated highly on:

- The extent to which the session included “framing” the activity to help participants understand the purpose of the session and where it fits into the larger professional development picture (65 percent);
- The extent to which the session provided adequate time and structure for “sense-making,” including reflection about concepts, strategies, issues, etc. (63 percent); and
- The extent to which the session provided adequate time and structure for wrap-up (53 percent).

Overall observers found that the designs of the majority of the professional development sessions were generally reflective of best practice. As indicated in Figure 9, 73 percent of the professional development sessions received overall design ratings of 4 or 5.



*Figure 9*

### Implementation of Professional Development Sessions

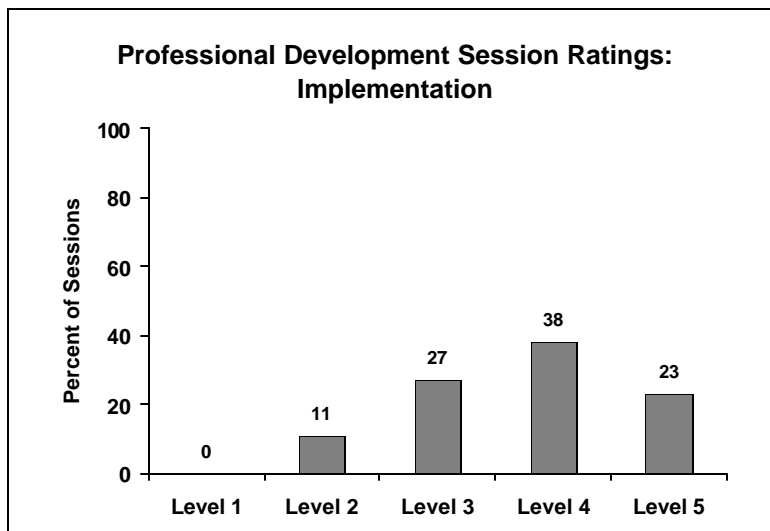
Observers also assessed the quality of implementation of professional development sessions. Indicators most frequently receiving high ratings were:

- The extent to which the facilitators' backgrounds and/or expertise enhanced the quality of the session (76 percent);
- The extent to which the facilitators' contributions during the course of the session enhanced the quality of the session (73 percent); and
- The extent to which formal presentations included in the session were carried out effectively (71 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 (56 percent); and
- The extent to which the facilitators modeled questioning strategies that are likely to enhance the development of conceptual understanding (49 percent).

As indicated in Figure 10, 61 percent of the sessions received overall ratings of 4 or 5 on their quality of implementation.



*Figure 10*

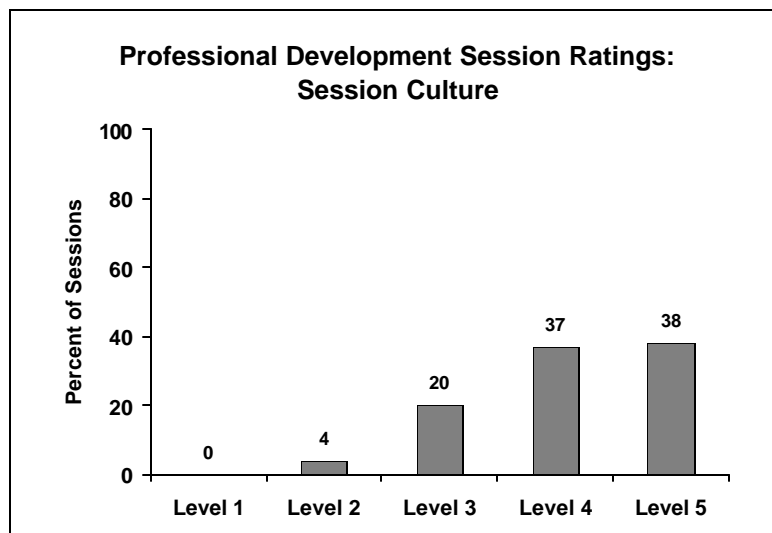
### Culture of Professional Development Sessions

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 11, 75 percent of the sessions received synthesis ratings of 4 or 5 in this area. Indicators that were most likely to receive high ratings included:

- The extent to which there was a climate of respect for participants' experiences, ideas, and contributions (86 percent);
- The extent to which interactions reflected collegial working relationships among participants (83 percent); and
- The extent to which active participation of all was encouraged and valued (80 percent).

Fewer sessions were highly rated on:

- The extent to which intellectual rigor, constructive criticism, and the challenging of ideas were evident (69 percent); and
- The extent to which participants demonstrated a willingness to share ideas and take intellectual risks (54 percent).



*Figure 11*

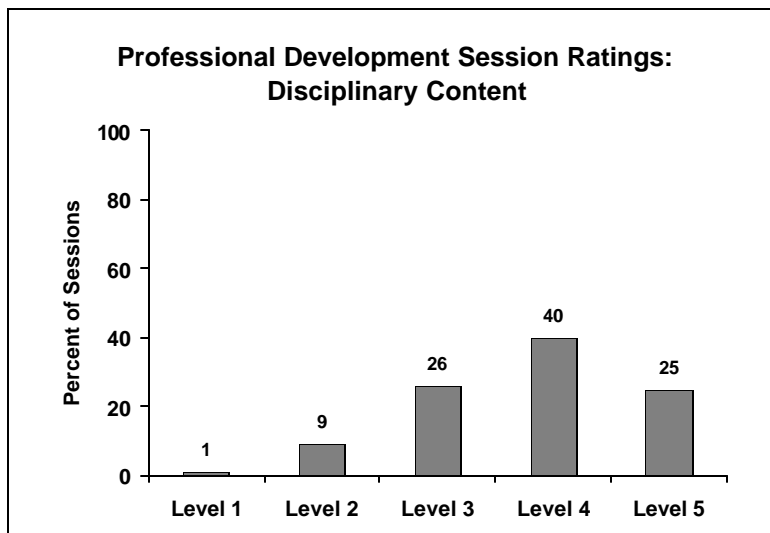
### **Disciplinary and Pedagogical Content of Professional Development Sessions**

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 246 of the 350 sessions, with 65 percent of these sessions receiving overall ratings of 4 or 5 in this area. (See Figure 12.) Disciplinary content sessions were most likely to receive high ratings for:

- The appropriateness of the disciplinary content for the purposes of the session and the background of the participants (83 percent); and
- The extent to which the facilitators displayed an understanding of mathematics/science content (79 percent).

As has been the case in previous years, fewer sessions received high ratings on:

- The extent to which the depth and breadth of attention to mathematics/science content was appropriate for the purposes of the session and participants' needs (64 percent); and
- The extent to which “sense-making” of mathematics/science content was appropriate for the purposes of the session and the needs of adult learners (61 percent).



*Figure 12*



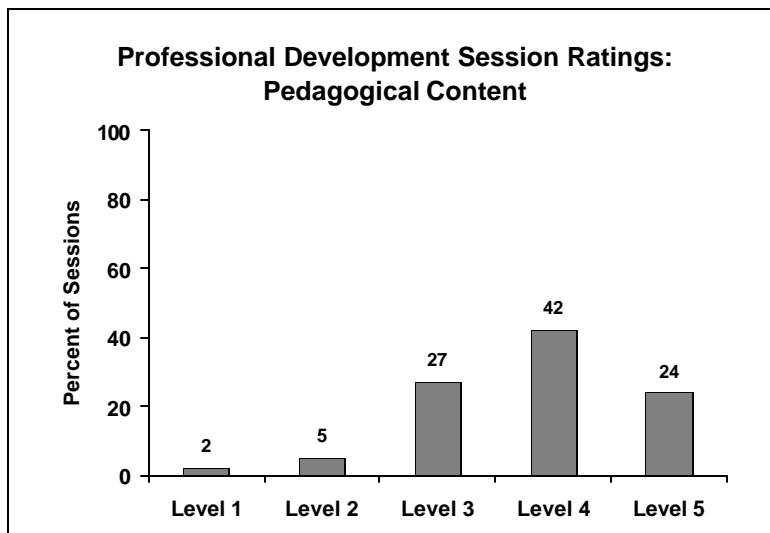
Observers rated 292 of the 350 observed professional development sessions on the quality of their pedagogical content. As can be seen in Figure 13, 66 percent of those professional development sessions received ratings of 4 or 5 for overall pedagogical content.

Within the area of pedagogical content, sessions were rated most highly for:

- The extent to which the facilitators displayed an understanding of pedagogical concepts (77 percent); and
- 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 (75 percent).

Fewer sessions received high ratings for:

- The extent to which the depth and breadth of attention to student thinking/learning were appropriate for the purposes of the sessions and participants' needs (66 percent); and
- The extent to which "sense-making" about classroom practice was appropriate for the purposes of the session and the needs of adult learners (57 percent).



*Figure 13*

## **Overall Assessment of Observed Professional Development Sessions**

In addition to rating the quality of the professional development session in terms of its components, 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 were most likely to have a positive effect on participants' abilities to network with other teachers about instruction (77 percent), and to plan/provide high-quality mathematics/science classroom instruction (76 percent). Fewer sessions were judged likely to have a positive effect on participants' ability to use the designated instructional materials to develop students' conceptual understanding (64 percent), and understanding of how students learn (64 percent). This latter area also has been rated least highly in previous years.

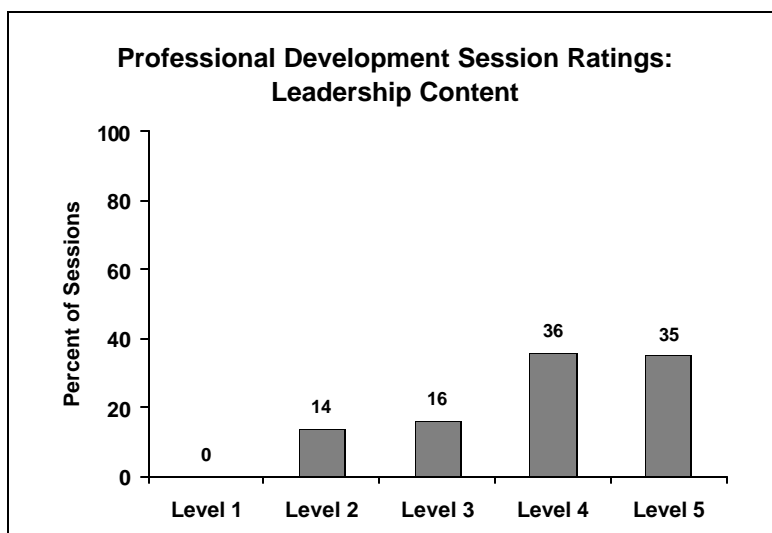
### ***Quality of Leadership Development Sessions***

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 50 of the 350 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 14, 71 percent of the sessions focusing on leadership content received a high synthesis rating (4 or 5) in this area. Leadership sessions were most likely to receive high ratings for:

- The extent to which participants were intellectually engaged with important ideas relevant to the focus of the session (82 percent);
- The extent to which facilitator(s) displayed an understanding of leadership concepts (e.g., in their dialogue with participants) (78 percent); and
- The extent to which participants were given adequate and appropriate opportunity to consider how the content of the session applies to their particular leadership roles (75 percent).

Sessions focusing on leadership concepts were less likely to receive high ratings for:

- The extent to which information on strategies for mentoring/coaching peers was sound and appropriately presented/explored (55 percent); and
- The extent to which information on how to be a reform advocate at the school/district level was sound and appropriately presented/explored (53 percent).



*Figure 14*

When asked about the likely impact of the sessions on participants' leadership capacity, evaluators were most likely to cite leaders' knowledge and understanding of effective classroom practice; ability to convey to others a vision of effective mathematics/science classrooms; professional networking among teacher leaders; and knowledge and understanding of mathematics/science, with roughly three-quarters of sessions deemed to have had a positive impact in each of these areas. In contrast, fewer than two-thirds of leadership sessions were judged likely to have a positive effect on teacher leaders' understanding of the reform process; understanding of teachers' prior knowledge; or on their understanding of adult learners.

***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 1 percent of observed LSC sessions were rated as ineffective professional development (Level 1), and 6 percent were rated at Level 2, having quite limited likelihood of helping participants implement exemplary mathematics/science instruction or be leaders in reform. Overall, 58 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 15.)

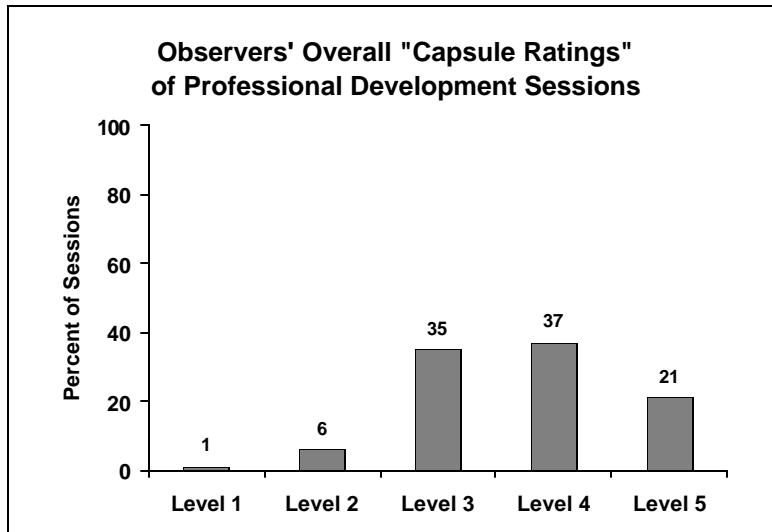


Figure 15

### 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. In the spring of 2002, 515 teachers who had participated in 20 hours or more of LSC professional development were interviewed by project evaluators. In addition, 5,791 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 3 shows that overall, fewer than a quarter of the teachers who have 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 are learning to their classrooms. Teachers were more likely to indicate that they receive considerable support for implementation, with 41 percent doing so.

**Table 3**  
**Teachers Agreeing<sup>†</sup> to Statements about LSC Professional Development**

	Percent of Teachers		
	All Teachers	K-8 Science	K-8 Mathematics
I receive support as I try to implement what I've learned.	41	38	46
I am given time to reflect on what I've learned and how to apply it to the classroom.	22	20	25
I am given time to work with other teachers as part of my professional development.	22	19	27

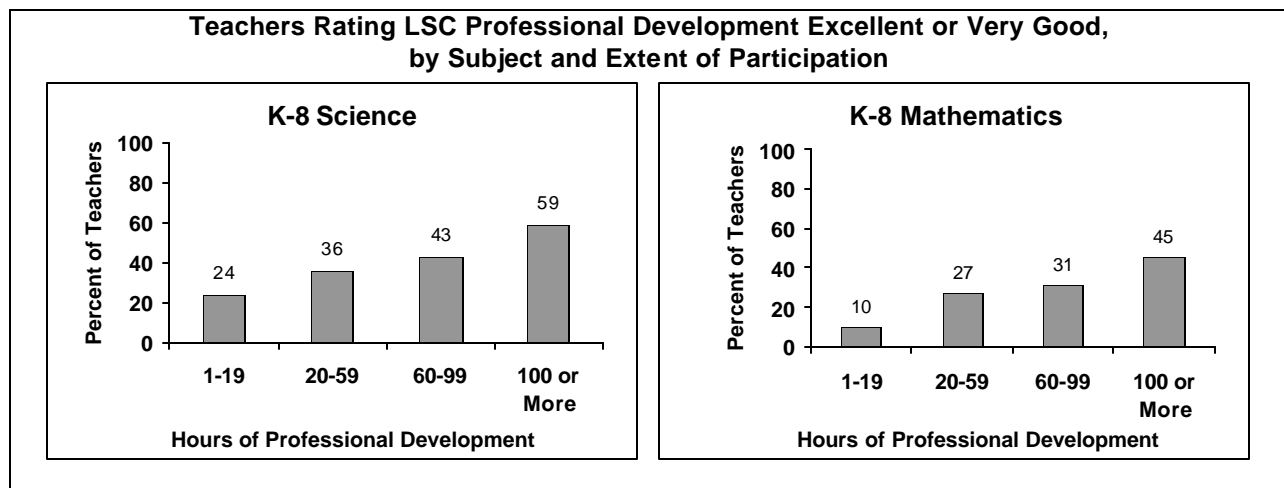
<sup>†</sup> Includes teachers indicating 4 or 5 on a five-point scale ranging from 1 "not at all" to 5 "to a great extent."

Table 4 shows teacher ratings of LSC professional development programs overall, with 6 percent of teachers rating the professional development programs “poor” or “very poor,” 58 percent “fair” or “good,” and 35 percent “very good” or “excellent.”

**Table 4**  
**Teacher Ratings of LSC Professional Development Programs Overall**

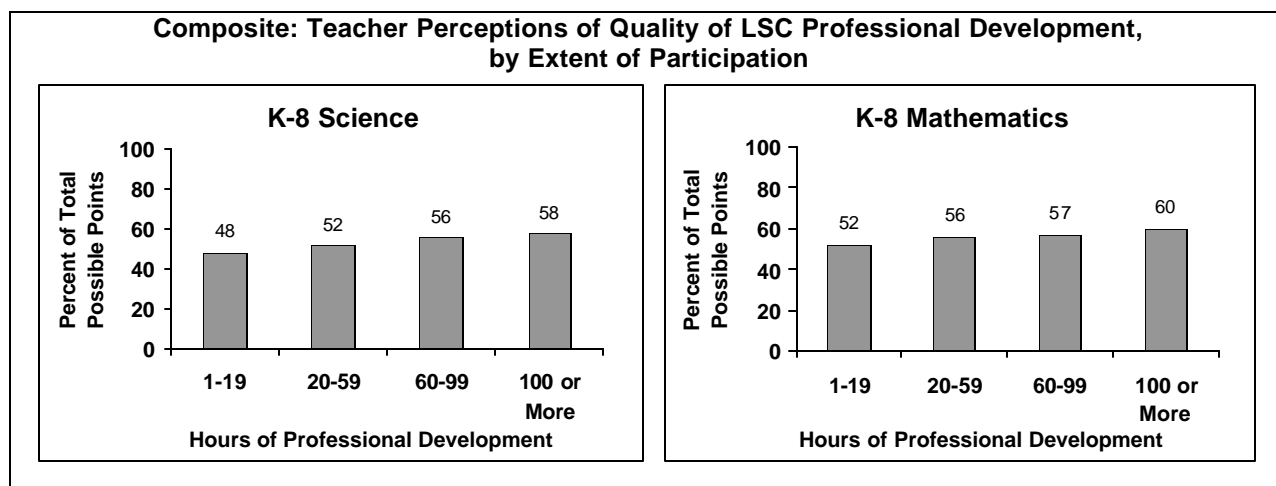
	Percent of Teachers		
	All Teachers	K-8 Science	K-8 Mathematics
Very Poor	1	1	2
Poor	5	3	7
Fair	25	23	28
Good	33	34	32
Very Good	25	27	23
Excellent	10	12	9

Figure 16 shows the percentage of teachers in each of two subject and grade range combinations who rated LSC professional development “excellent” or “very good” in the 2002 questionnaire, analyzed by level of treatment. Note that the greater the level of participation, the higher the ratings. Similarly, Figure 17 shows the results on a composite variable on quality of the LSC professional development created from teachers’ responses to several items on the questionnaire.<sup>8</sup> Again, the more hours of participation in LSC professional development, the higher the ratings of quality.



*Figure 16*

<sup>8</sup> See Data Analysis in Section I for a description of how composite scores were calculated.



*Figure 17*

Teacher interviews yield 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, 54 percent of teachers who had participated in LSC professional development had highly positive opinions of the LSC program.

When asked about the impact of the LSC, more than three-quarters of teachers talked about how the LSC had enabled them to change their classroom practice, and over 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 and use of the designated materials 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 am actually doing something in the classroom. Before, science was textbook work for me. The kits make things happen. And science comes alive. I am now doing more hands-on and now I have the resources to make that happen. Before I just had to make up stuff, and without much background I had a hard time. (K–8 Science Teacher)*

*It has been helping me with the questioning, the questions I need to pose to the kids. You can set up the experiment or what processes you’re doing and they can run through it. But if you are not questioning their heads while they are doing it, then they are not thinking about what they are doing. (K–8 Science Teacher)*

*It helped me to stand back in the classroom and let science happen, let kids do it, struggle on their own. It allows me not to be the center of the world in the classroom, and allows kids to hypothesize and come up with their own answers. I ask more questions of the kids than I did in the beginning. Now I give a question back or show kids where to find the answers instead of giving them the answers. (6–12 Science Teacher)*

*I was very teacher directed. I was concerned with the correct answer. But now I'm asking, "Why?" I'm more interested in "How do you know?" We're opening up more choices for the kids to realize that there is more than one way to solve a problem. (K-8 Mathematics Teacher)*

*[I'm] really thinking about how children think and learn and process things. [I do] a lot of assessment by observation to really get at the heart of what children know, rather than just get a right answers. [The LSC professional development] has opened my eyes to how kids learn, [and I'm] thinking really hard about misconceptions children have. (K-8 Mathematics Teacher)*

*It made me look at instruction from a different point of view. It has made me more flexible with learning styles. Before, I was very traditional. Instead of me showing the students how to do a problem and then the students doing what I did, the students solve problems on their own and with my guidance. (6-12 Mathematics Teacher)*

*It definitely helped me to teach all kinds of kids. I am able to address auditory, visual, kinesthetic learns much better than with the traditional book. [It] also helped me to know my students' skills much better than with "talk and chalk." The kids are busier so it allows me to assess their learning every day, every minute. [I] also use a lot more projects which allows some kids to shine when they wouldn't on a test. Since kids are more successful, I'm more successful. (6-12 Mathematics Teacher)*

### **Increased Preparedness**

*It's made me more confident and comfortable. Science used to be kind of a scary subject to me. I didn't know that much about it, hadn't spent that much time on it and a lot of what we did even at the lower grade level was just read it out of a textbook. It's given me access to more background knowledge as well as access to the kits and to the materials, to use it and all of that. Now we can do more with science and make it more hands-on rather than just book learning. The kids are really enjoying it! We moved from just book learning to hands-on and hopefully to minds-on. (K-8 Science Teacher)*

*I think it has made me more conscious of what I have to do in the class. Knowing how to do it and having all of the theory is one thing, but I think what happened with [LSC PD] is that they have given me more or less the impetus to try even more of those things [hands-on, inquiry science] with these big groups. (6-12 Science Teacher)*

*I think it has made me more aware of different strategies. I was taught one way with one answer. This teaches me other strategies. It is effective with different students. I think more logically about how to get answers, to see patterns, and to use common sense. (K-8 Mathematics Teacher)*

*It gives me confidence to understand how to do a problem and how to solve it in different kinds of ways. I can look at a problem and see what's the first thing that has to be done.*

*I have more confidence knowing I can show kids different ways to solve a problem. (6–12 Mathematics Teacher)*

When asked about the “most helpful” aspects of the LSC, about one-half of the teachers mentioned the opportunity to deepen their knowledge and about 40 percent identified getting materials needed for instruction. Slightly more than one-third of the teachers cited the high quality of the LSC professional development, and slightly fewer than one-third talked about the opportunities to collaborate with other teachers and to deepen their knowledge of how to use the designated instructional materials. Science teachers were much more likely than mathematics teachers to talk about the utility of the LSC in helping them understand pedagogy, content, and how to use designated instructional materials, while mathematics teachers were more likely to cite collaborating/networking with other teachers as the “most helpful” aspect of the LSC.

While 1 in 3 teachers indicated that everything about the LSC was helpful, others cited one or more concerns. Problems with the designated instructional materials, mentioned by 1 in 5 teachers, topped the list of “least helpful” aspects of the LSC, particularly the time required to implement the materials and the logistics of materials management:

*The one thing is the amount of time it takes for some of the kits on preparation and clean up. We have one called Land and Water, the kids have a container of soil and pour water in it to look at erosion and those kids of things. The amount of time for clean up and preparation time is sometimes a lot. I don't know if there's anything that can be done; it's pretty time consuming. Another kit where we have lots of animals in the classroom is pretty time consuming, maintaining the animals. That's the biggest negative, the amount of time involved. (K–8 Science Teacher)*

*A teacher has to be really prepared before she does a lesson. The lessons themselves are extremely time-consuming. Acclimating the children to the manipulatives needs more time. (K–8 Mathematics Teacher)*

*The downside is that it is hard to get into the good stuff. In the 10<sup>th</sup> grade there is too much material to cover and it is harder to connect things together... We just don't have the time to get through every thing we are supposed. (6–12 Science Teacher)*

Others expressed concern about the quality or applicability of the professional development and the time commitment required:

*There was one on reading that was good, but the rest were either over our heads, inappropriate to our age kids, or poorly presented. Anytime you have an hour of asking every site to contribute whether they want to or not, (every single time), it's not going to be a good use of an hour. (K–8 Science Teacher)*

*The added demands. At first I had to work an extra 30 hours a week to learn the new topics and to prepare the materials. (6–12 Science Teacher)*



*Being pulled out of class for the half day staff development sessions has not been helpful. It is frustrating to give up a half day for training when it does not help me directly in the classroom. (K–8 Mathematics Teacher)*

When asked about needs for additional help in improving instruction, teachers typically requested “more” of what they were already getting: more professional development in pedagogy, and in the use of the designated materials, more readily available materials or supplies, and more time for networking with other teachers. Typical comments included:

*I think maybe too what might be helpful is for teachers to see how one kit carries over for the next year, how the concepts build on themselves. I don’t think a lot of teachers understand that. (K–8 Science Teacher)*

*Teachers need a lot more help in seeing how to do formative assessment in nontraditional ways. We need more professional development that can help teachers use the materials in a more student-centered way that is more minds-on. Teachers need help understanding how students construct understanding. There needs to be more on effective ways to get students to work together. Need continued time to think about how and why we are doing things and more time to reflect on practices. (6–12 Science Teacher)*

*Now that I realize importance of questioning in my lessons, I would like more training in how to do it better. And how I can use questioning to get at student thinking. (K–8 Mathematics Teacher)*

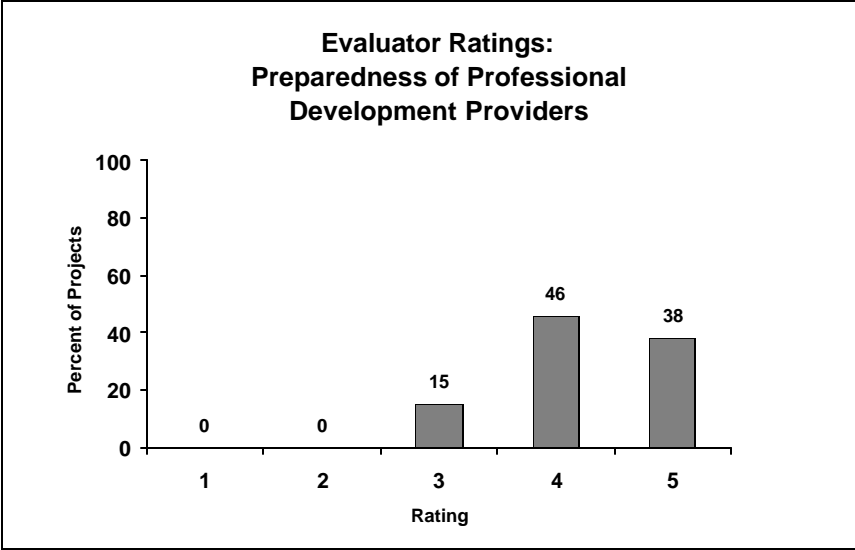
*I’d like to be able to go watch master teachers, watch them teach and then get together with other teachers to talk about the lesson, to reflect on what she did. (6–12 Mathematics Teacher)*

## **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**

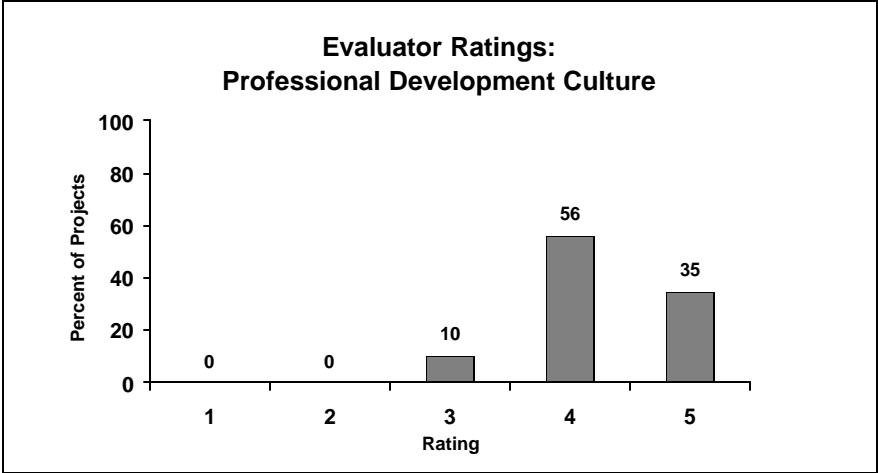
As can be seen in Figure 18, overall, 84 percent of LSC projects received high ratings (4 or 5 on a five-point scale ranging from 1 “inhibited effective professional development” to 5 “facilitated effective professional development”) for the quality of their efforts in preparing professional development providers.



*Figure 18*

**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. (See Figure 19.)



*Figure 19*

### 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 20, only 53 percent of projects received high ratings (4 or 5 on a five-point scale ranging from 1 “poor” to 5 “excellent”) in this area.

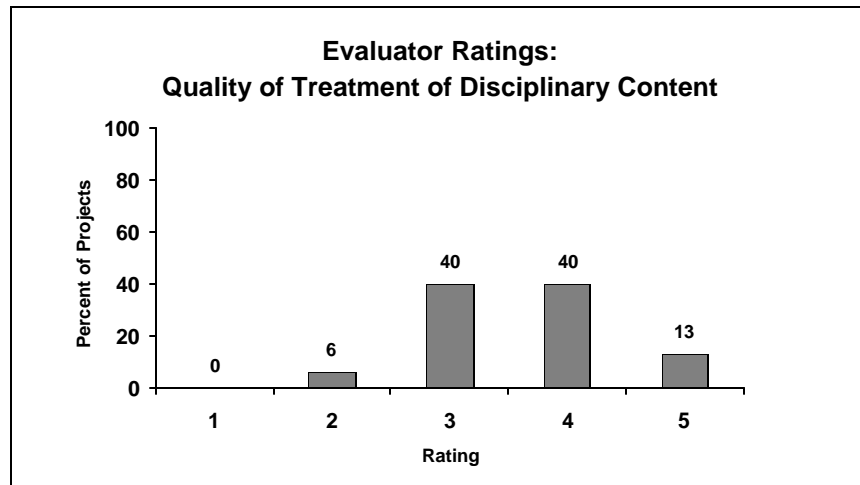


Figure 20

### 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 21, 77 percent of projects received ratings of 4 or 5 in this area, markedly higher than the 53 percent in developing disciplinary content.

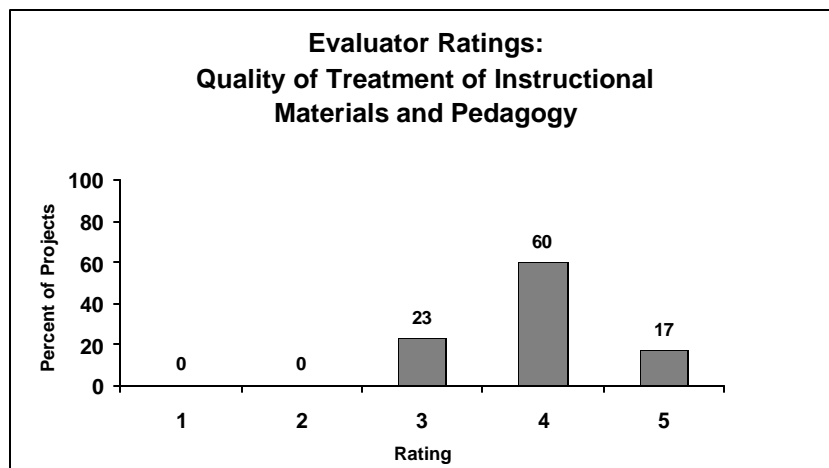


Figure 21

### 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 22, overall, only 57 percent of projects received high ratings in this area; 8 percent received a rating below 3 on a five-point scale.

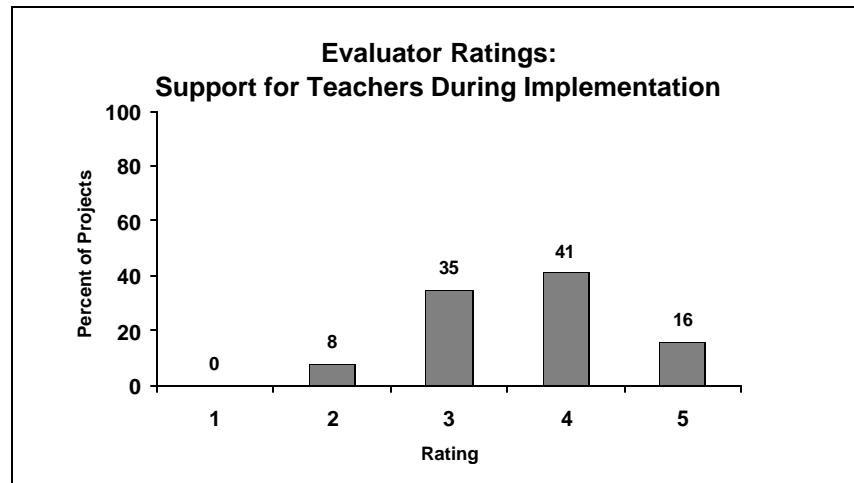


Figure 22

### 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 5, most LSC projects were rated as either transitioning to quality professional development or having an emerging infrastructure of well-designed professional development; none were rated at the two lowest levels.

**Table 5**  
**Continuum Ratings for Quality of LSC Professional Development**

	Percent of Projects <sup>†</sup>				
	All Projects	Science		Mathematics	
		K-8	6-12	K-8	6-12
<b>Level 1:</b> Predominance of Ineffective Professional Development	0	0	0	0	0
<b>Level 2:</b> Exploring Quality Professional Development	0	0	0	0	0
<b>Level 3:</b> Transitioning to Quality Professional Development	42	38	86	44	22
<b>Level 4:</b> Emerging Infrastructure of Well-Designed Professional Development	48	58	14	39	67
<b>Level 5:</b> Predominance of Well-Designed Professional Development	10	4	0	17	11
<b>Mean Continuum Rating Level</b>	3.7	3.7	3.1	3.7	3.9

<sup>†</sup> Projects that address two subject areas are included in each subject, but counted only once in the total of all projects.



### 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’ attitudes and 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. 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.

Teacher questionnaire data indicate that in both K–8 science and mathematics, teachers with 100 or more hours of professional development are less likely to support ability grouping than those who had not yet participated. (See Figure 23.)

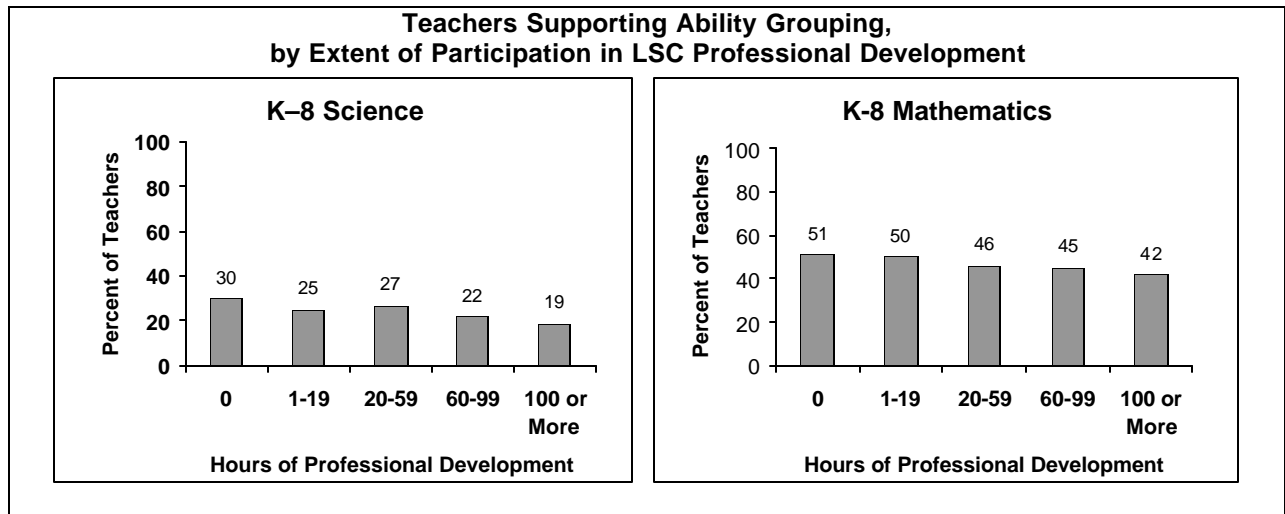
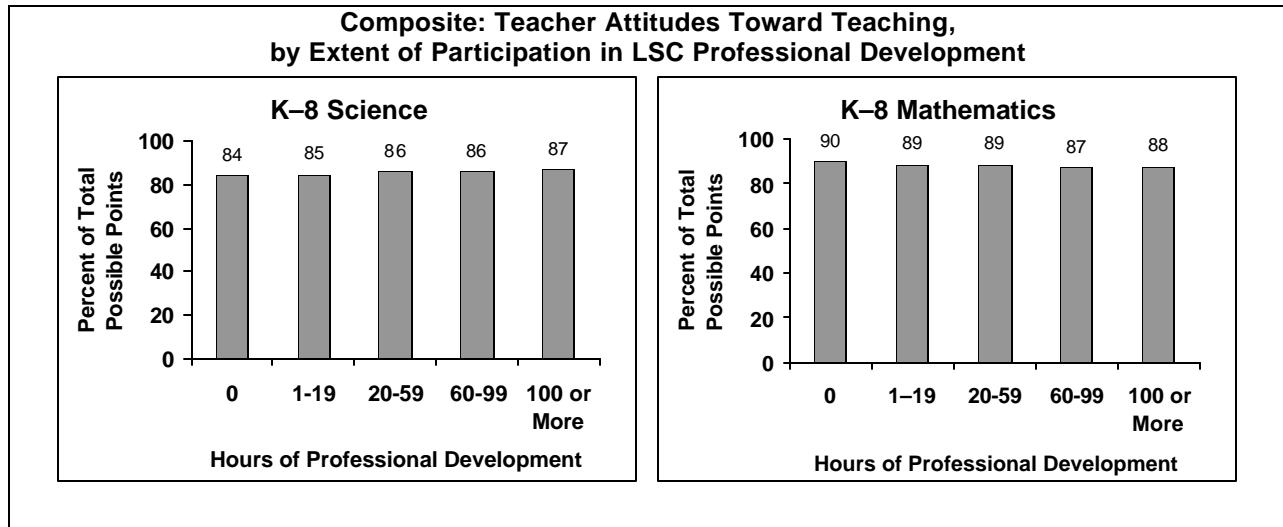


Figure 23

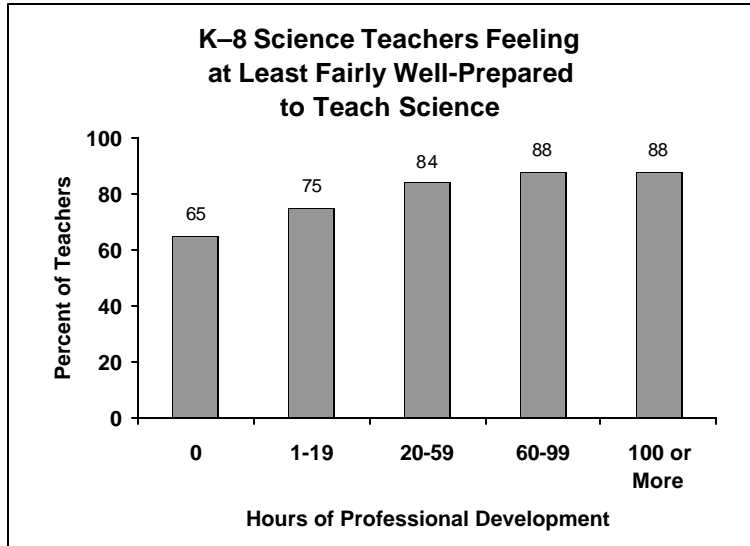
Results on a composite of several items related to teachers' attitudes toward standards-based teaching indicated a small positive, but significant difference for elementary science teachers, with the most highly-treated group having more reform-oriented attitudes than do untreated teachers.<sup>9</sup> (See Figure 24.) For elementary mathematics, highly-treated teachers have slightly less reform-oriented attitudes than do untreated teachers.



*Figure 24*

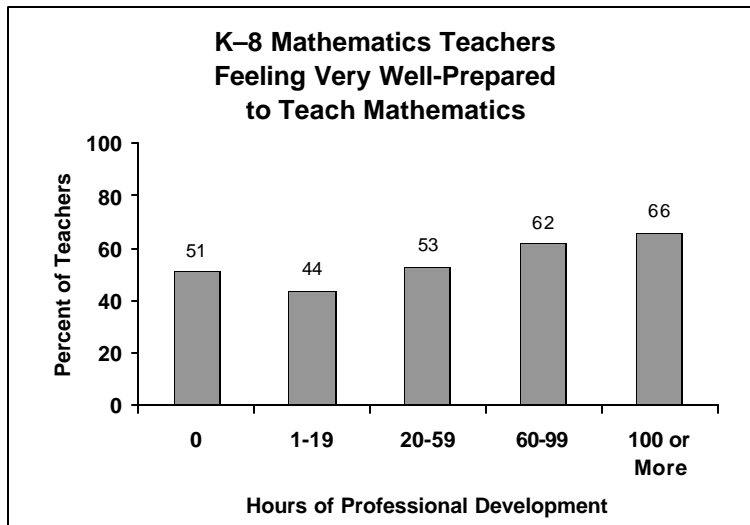
Participating in LSC professional development appears to have had a substantial impact on elementary teachers' feelings of preparedness. As can be seen in Figure 25, 88 percent of K-8 science teachers who had participated in at least 100 hours of LSC professional development indicated they were at least fairly well prepared to teach science, compared to 65 percent of those who had not yet participated in LSC professional development.

<sup>9</sup> The effect size is calculated as the difference between the "0 hours" and "100 or more hours" group means, divided by the standard deviation of the population. 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). The effect sizes for all comparisons on the composites are included in the Appendix.



*Figure 25*

In mathematics, over 90 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 26, 66 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 51 percent of those who had not yet participated in LSC professional development.



*Figure 26*



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 9 of the 11 topics listed, with effect sizes<sup>10</sup> ranging from 0.11 to 0.32. (See Table 6.)

**Table 6**  
**K–8 Science Teachers Feeling at Least Fairly Well-Prepared<sup>†</sup> to**  
**Teach Each Topic, by Extent of Participation in LSC Professional Development**

	Percent of Teachers					Effect Size <sup>§</sup>
	0 Hours	1–19 Hours	20–59 Hours	60–99 Hours	100 or More	
Ecology	48	52	57	59	64	0.32
Rocks and soils	46	51	57	59	62	0.32
Mixtures and solutions	36	42	48	43	50	0.28
Forces and motion	40	39	44	50	52	0.24
Electricity	35	38	44	42	45	0.20
Sound	40	35	38	39	48	0.16
Machines	34	34	38	41	41	0.14
Engineering and design principles	21	22	25	26	27	0.14
Processes of change over time	31	35	39	37	36	0.11
The human body	62	63	67	67	65	NS
Astronomy	39	38	43	39	42	NS

<sup>†</sup> Includes teachers indicating 3 or 4 on a four-point scale ranging from 1 “not adequately prepared” to 4 “very well prepared.”

<sup>§</sup> NS = Not significant

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 each of 5 of the 11 topics listed, with effect sizes of 0.13 or greater. The largest difference was in geometry and spatial sense, with an effect size of 0.21. (See Table 7.)

<sup>10</sup> When comparing percents, the effect size is calculated using the difference between the arcsine transformation of the percents of the “0 hours” and “100 or More Hours” groups.

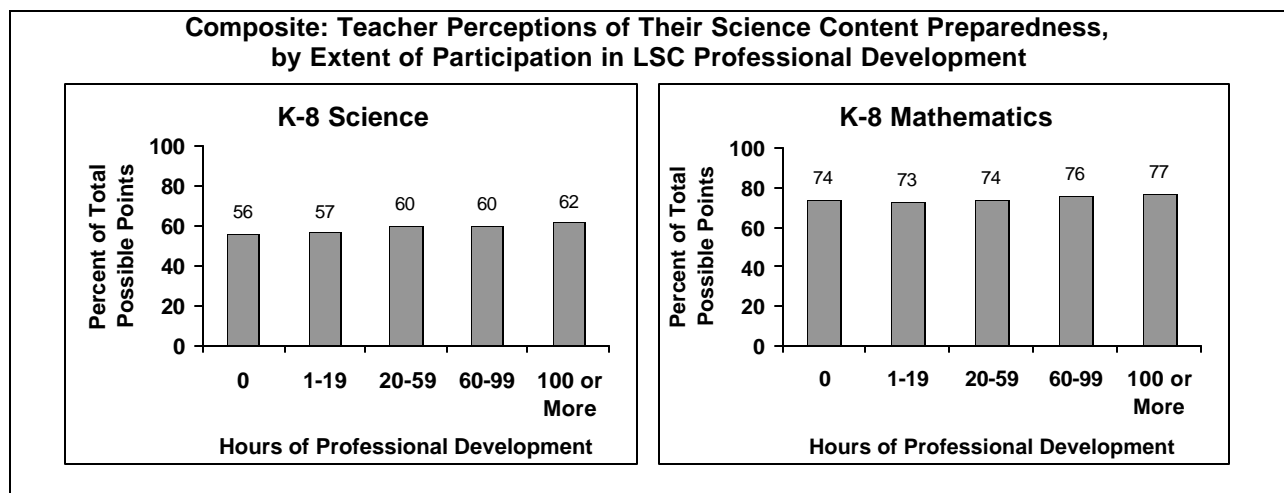
**Table 7**  
**K–8 Mathematics Teachers Feeling at Least Fairly Well-Prepared<sup>†</sup> to**  
**Teach Each Topic, by Extent of Participation in LSC Professional Development**

	Percent of Teachers					Effect Size <sup>§</sup>
	0 Hours	1–19 Hours	20–59 Hours	60–99 Hours	100 or More	
Geometry and spatial sense	79	85	86	85	87	0.21
Computation	95	94	96	97	98	0.17
Patterns and relationships	91	95	94	95	95	0.16
Data collection and analysis	84	90	85	88	89	0.15
Technology in support of mathematics	63	59	59	63	69	0.13
Numeration and number theory	91	90	90	94	93	NS
Estimation	91	92	87	93	91	NS
Measurement	89	88	86	92	91	NS
Probability	73	73	71	75	75	NS
Pre-algebra	70	64	69	74	75	NS
Algebra	60	52	57	60	63	NS

<sup>†</sup> Includes teachers indicating 3 or 4 on a four-point scale ranging from 1 “not adequately prepared” to 4 “very well prepared.”

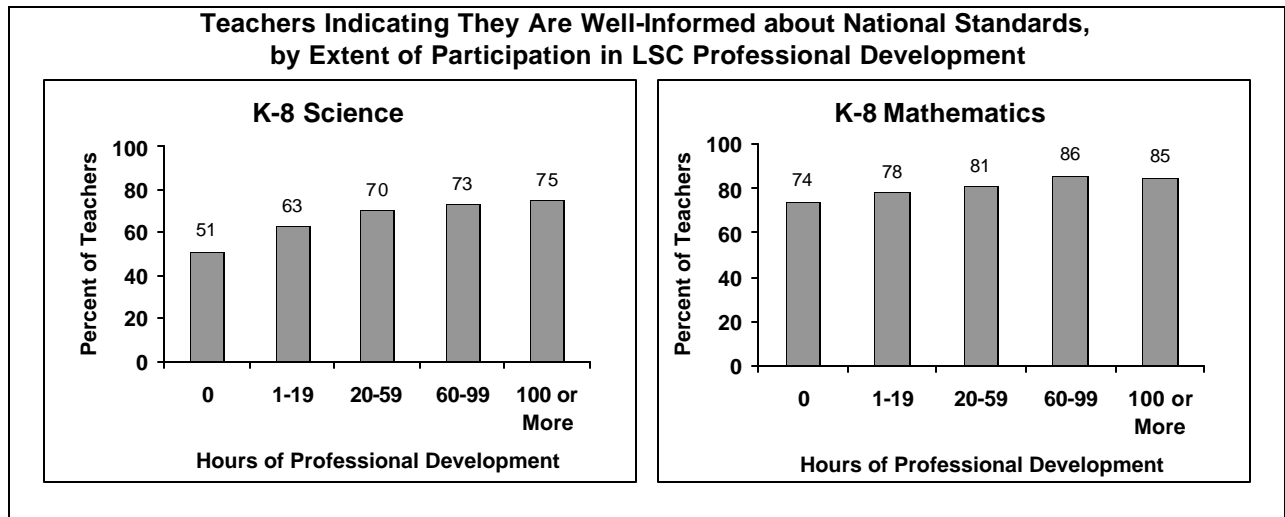
<sup>§</sup> NS = Not significant

When the various topic areas were combined into a single composite score, K–8 science teacher preparedness ratings ranged from 56 percent of total points possible for teachers with no treatment to 62 percent for those with 100 or more hours LSC professional development, a small effect size (0.31 standard deviations). (See Figure 27.)

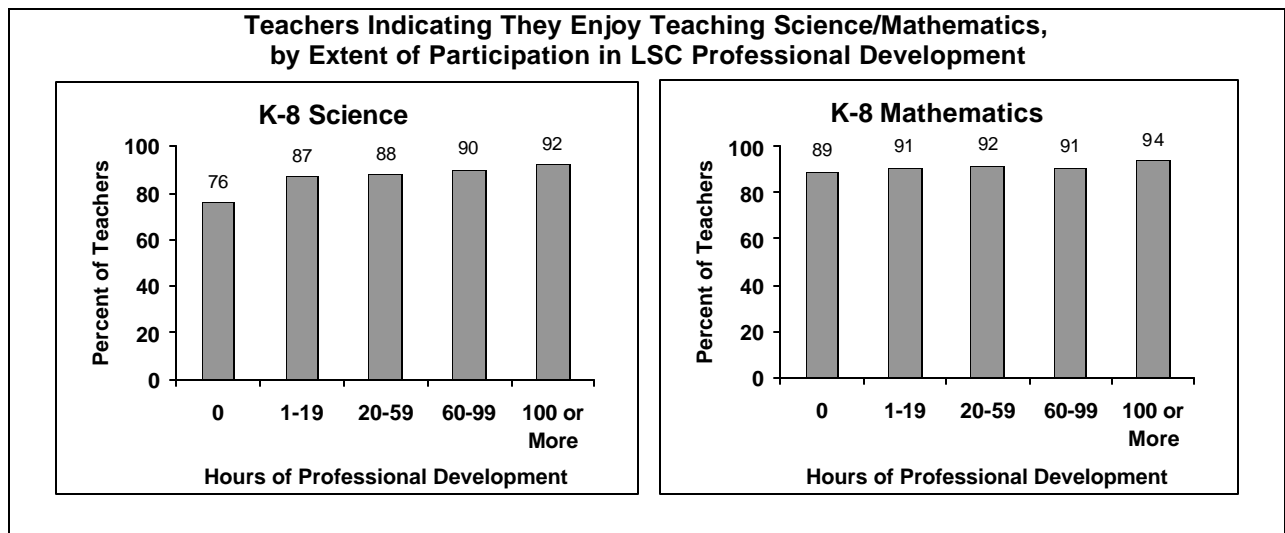


*Figure 27*

Questionnaire data on other items provide additional 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 28.) Similarly, teachers who had participated in 100 or more hours of LSC professional development were more likely than their untreated peers to indicate that they enjoy teaching mathematics/science. (See Figure 29.)

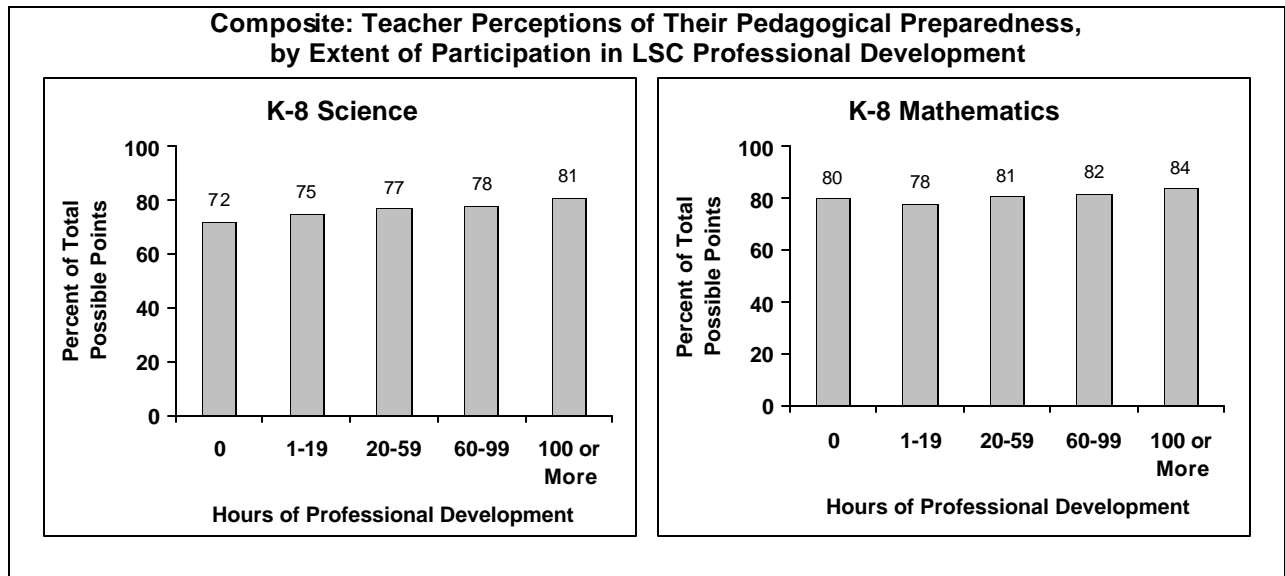


*Figure 28*



*Figure 29*

Figure 30 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 nine percentage points difference between untreated and highly-treated K-8 science teachers constitutes a medium effect (0.67 standard deviations), the four-point difference for K-8 mathematics teachers a small effect (0.28 standard deviations).



*Figure 30*



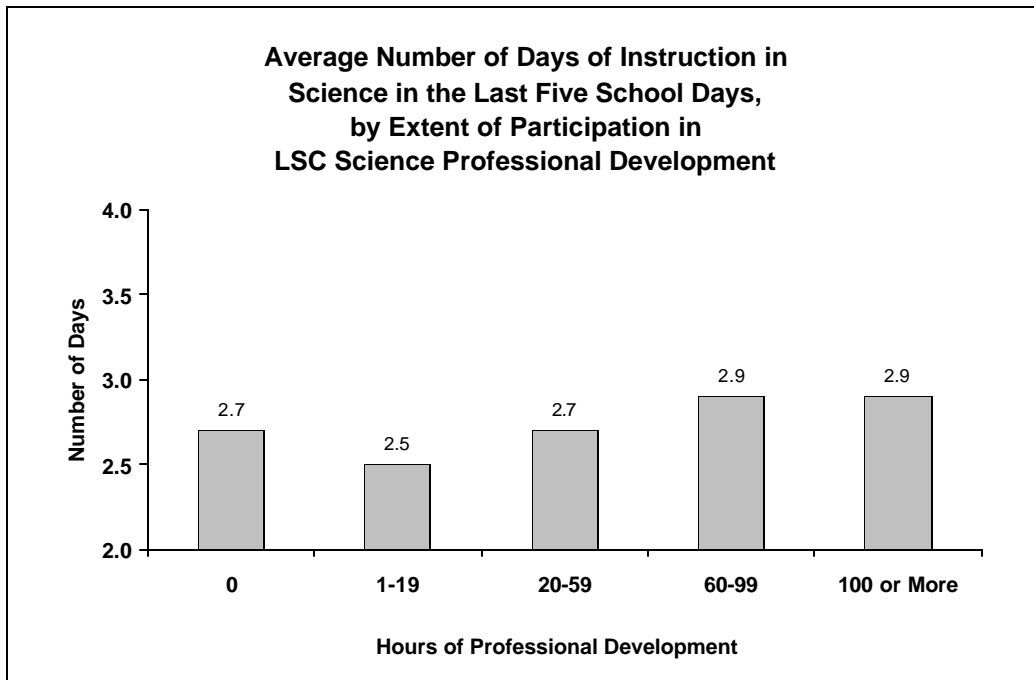
## IV. Impact of the LSC on Classroom Practice

### 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 is assessed by comparing results for teachers with varying extents of participation in LSC professional development.

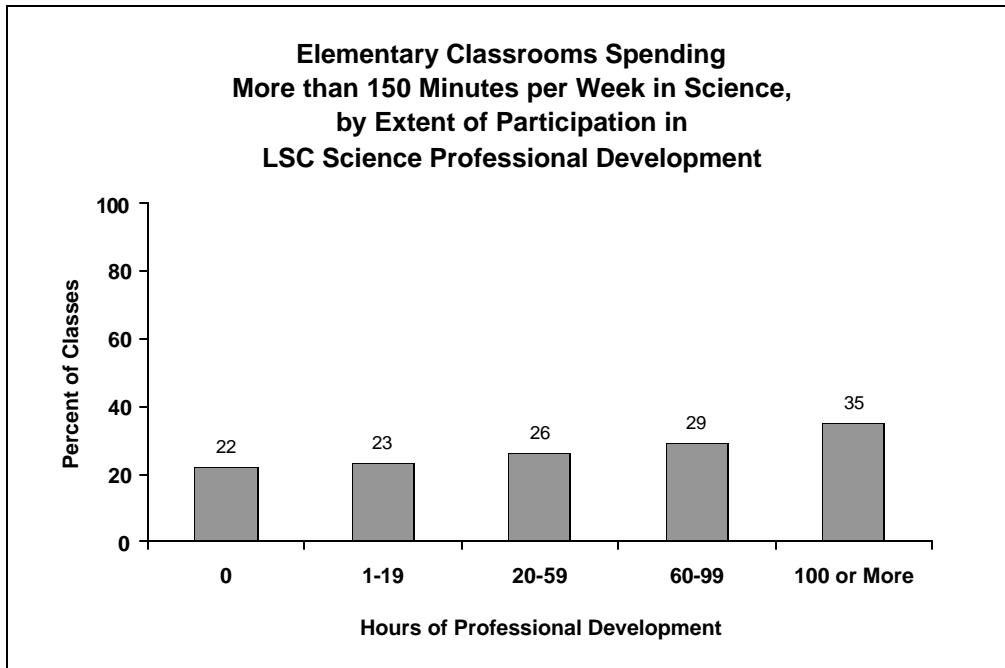
### B. Time Spent on Elementary Science Instruction

One of the impacts of the LSC has been increased attention to science instruction in the elementary grades. As can be seen in Figure 31, the average number of days per week in which science is taught increases from 2.7 days among untreated teachers to 2.9 days among teachers with 100 or more hours of LSC professional development. It is important to note that the increase in frequency of science instruction only occurred in science projects, not in mathematics projects, supporting the hypothesis that the increased emphasis on science is attributable to LSC activities.



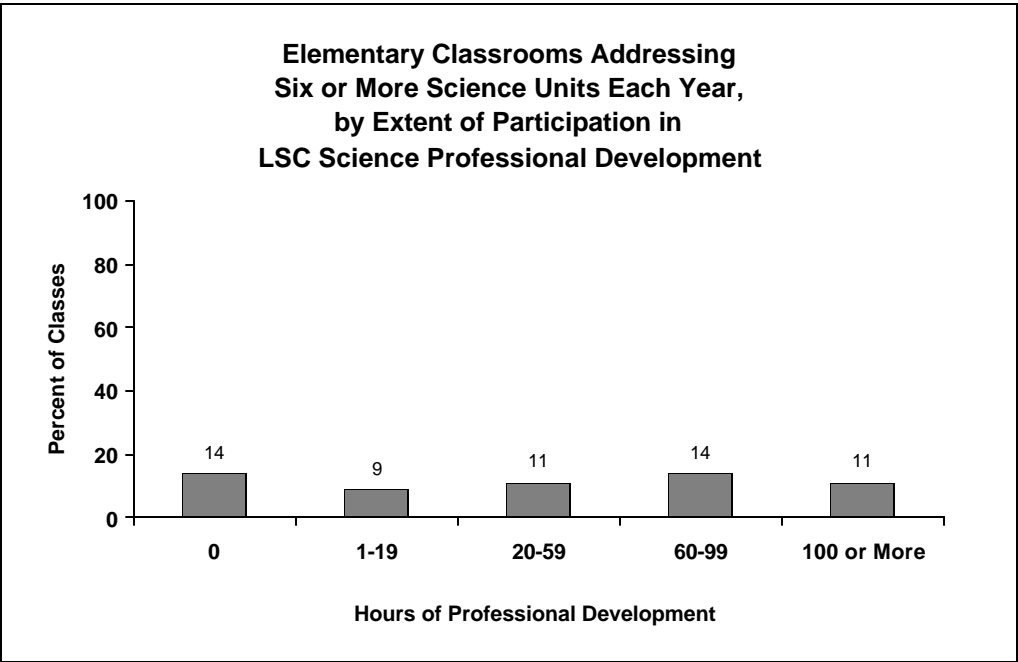
*Figure 31*

As would be expected, the increased frequency of science instruction results in a greater amount of time devoted to the subject. As can be seen in Figure 32, 35 percent of teachers who had participated in 100 or more hours of LSC science professional development spent 150 or more minutes on science each week, compared to only 22 percent of untreated teachers.

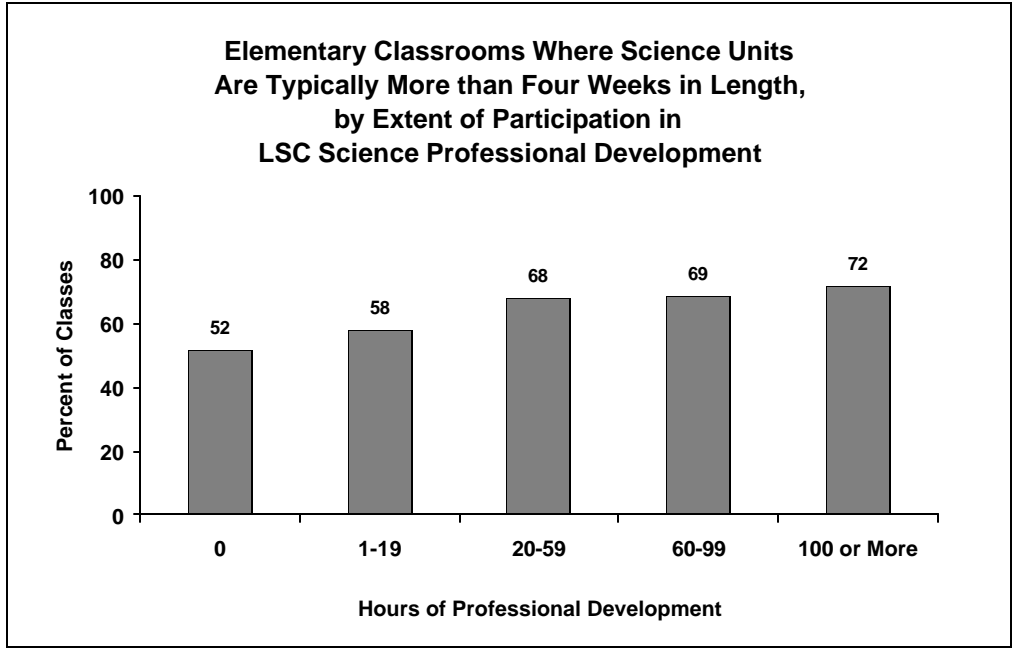


*Figure 32*

Overall, few elementary science teachers implement six or more science units per year. (See Figure 33.) However, as can be seen in Figure 34, the length of units increases with participation in LSC professional development, with 72 percent of the teachers who have participated most heavily in the LSC report spending more than four weeks on a typical science unit, compared to only 52 percent of untreated teachers.



*Figure 33*



*Figure 34*

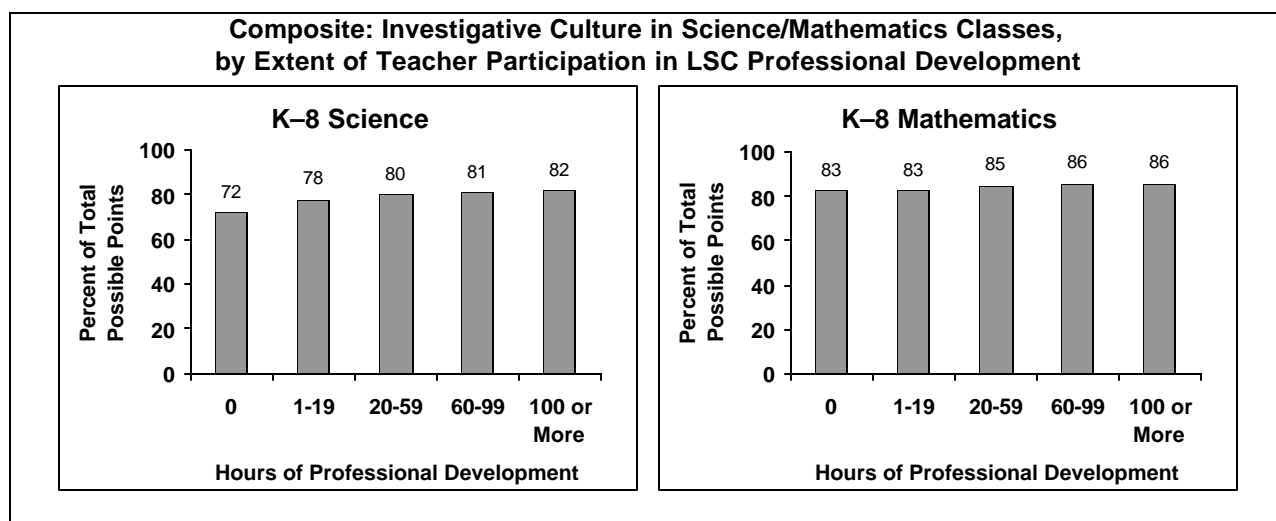


## C. Instructional Strategies

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 is a significant increase in composite scores with increasing participation in LSC activities. (See Figure 35.) The ten-point difference between untreated and highly treated teachers in K–8 science represents a medium effect size (0.66 standard deviations). The three-point difference in K–8 mathematics represents a small effect size (0.22 standard deviations).

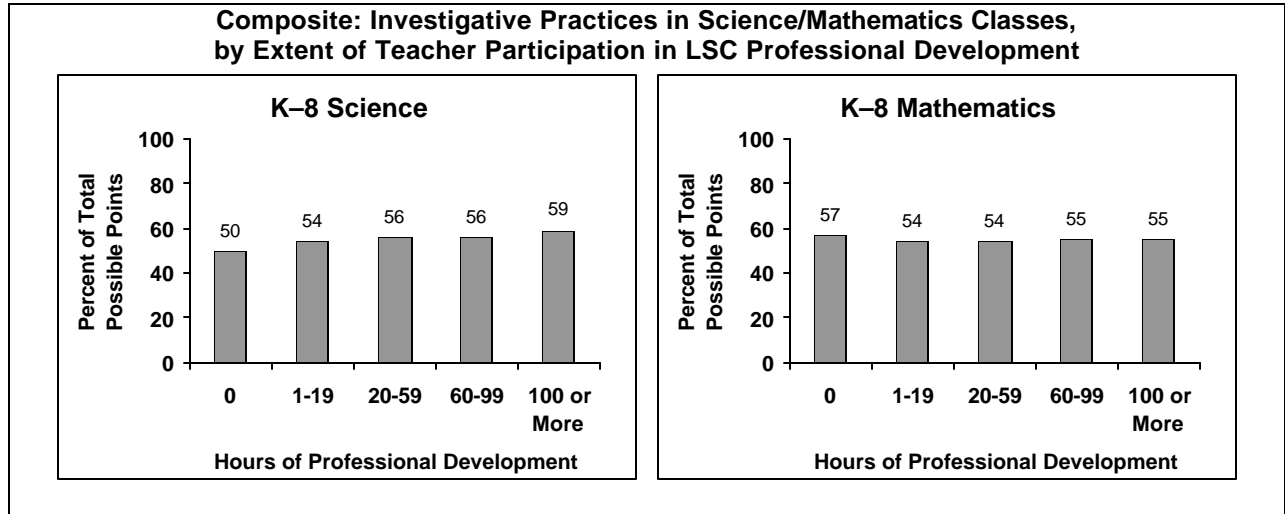


*Figure 35*

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.

Again, as shown in Figure 36, there is an increase in composite scores for K–8 science teachers with increasing participation in LSC activities. The nine-point difference between untreated and highly-treated teachers (0.71 standard deviations) represents a medium effect size. There is no significant difference for K–8 mathematics classes.



*Figure 36*

### **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).

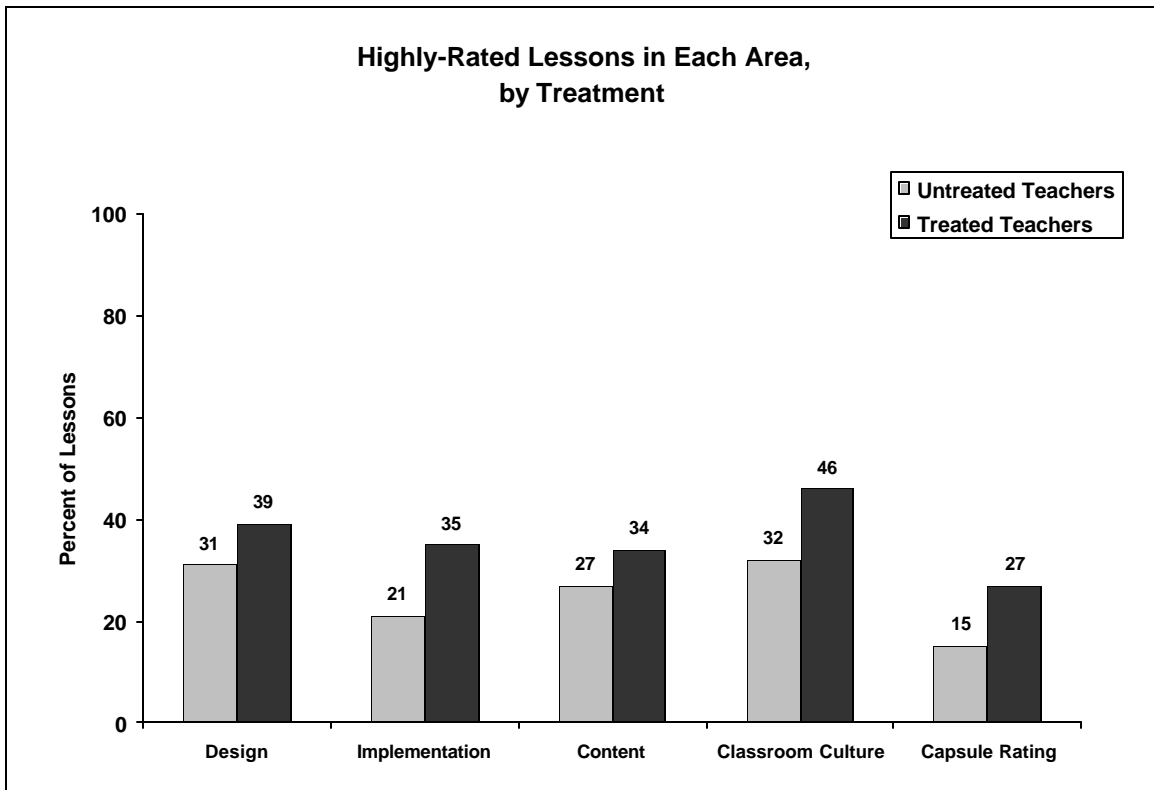
### **Mathematics/Science Content**

- 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.

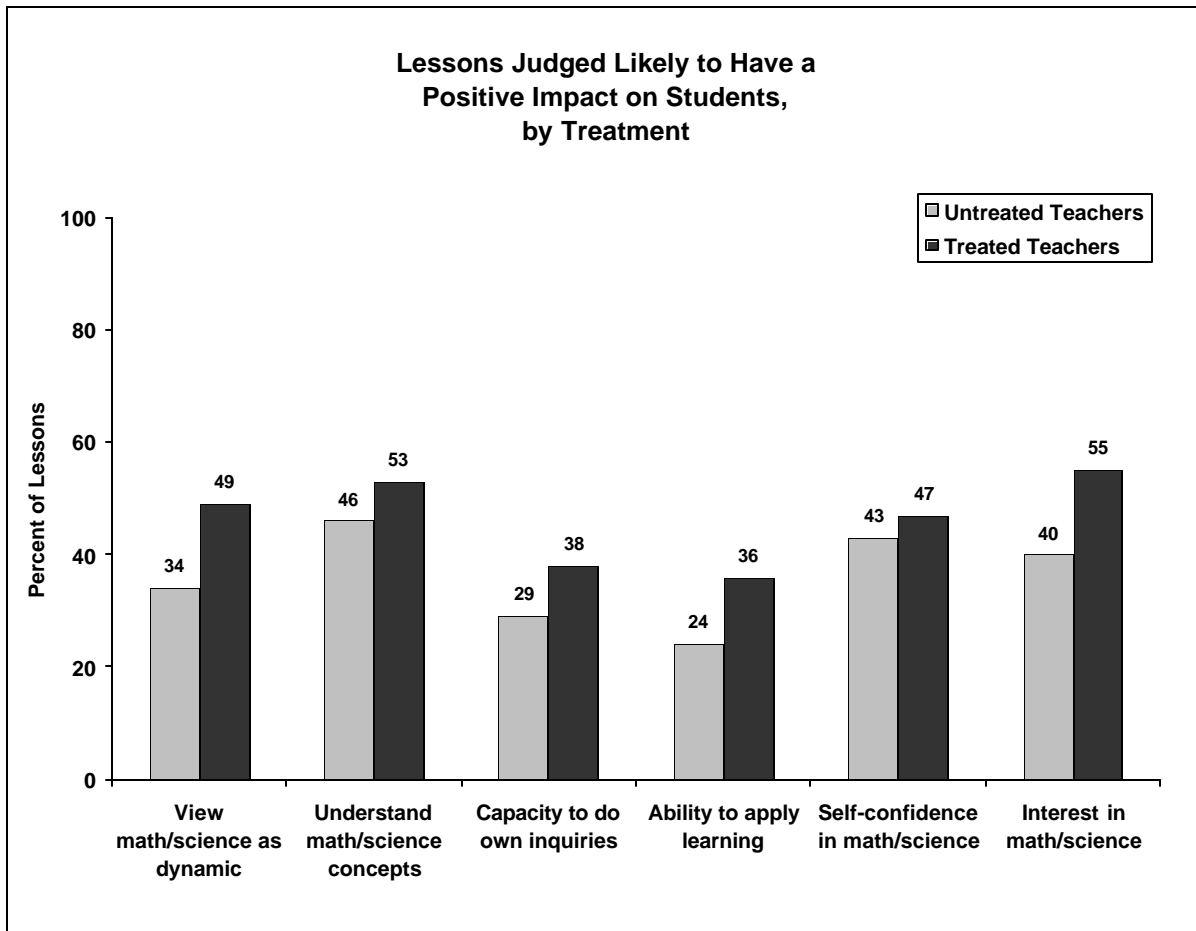
Observers then rated the quality of each lesson’s design and implementation, the science/ mathematics content, and the classroom culture. In addition, each lesson received an overall capsule rating. As can be seen in Figure 37, lessons of treated teachers (those who had participated in 20 or more hours of LSC professional development) were more likely to receive higher implementation, classroom culture, and capsule ratings than those of teachers who had not yet participated.<sup>11</sup>



*Figure 37*

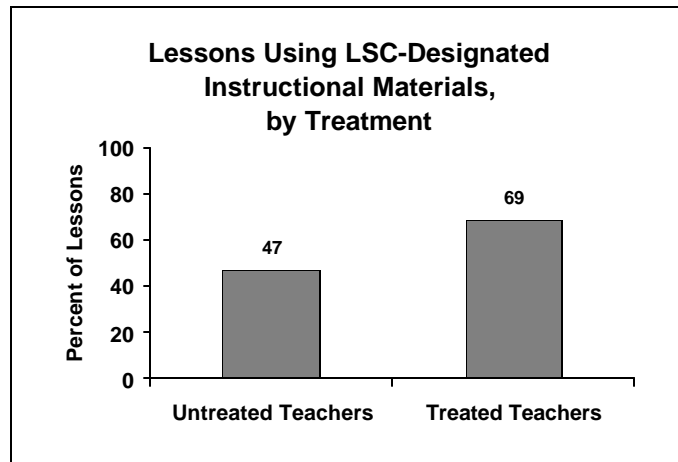
<sup>11</sup> While questionnaire results were typically presented for four levels of participation in LSC professional development (0, 1–19, 20–59, 60–99, and 100 or more hours), the considerably smaller number of classroom observations prevented that extent of disaggregation.

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 38. Lessons taught by teachers who had participated in 20 or more hours of LSC professional development were judged to be more likely than others to have a positive impact on students' viewing of mathematics/science as a dynamic body of knowledge generated and enriched by investigation, ability to apply learning, and interest in and/or appreciation for mathematics/science.



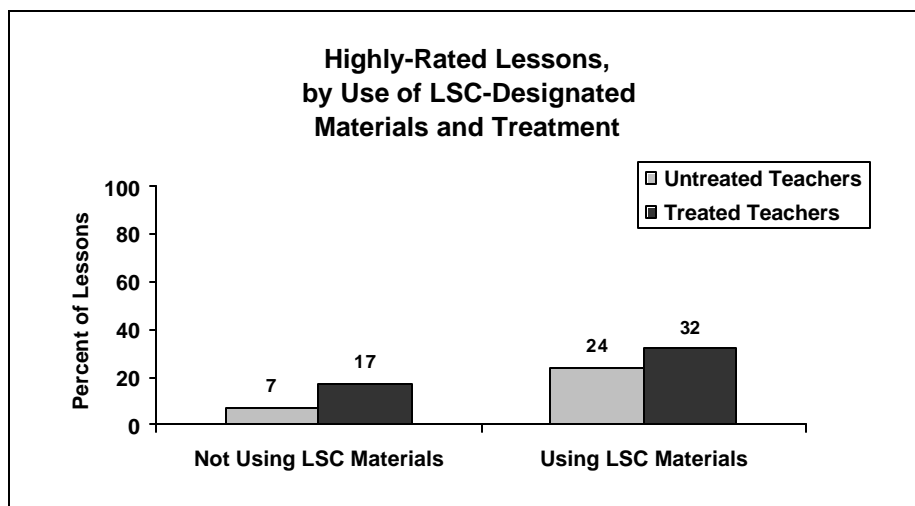
*Figure 38*

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 39, 69 percent of the treated teachers were using the designated instructional materials when observed, compared to 47 percent of the untreated teachers.



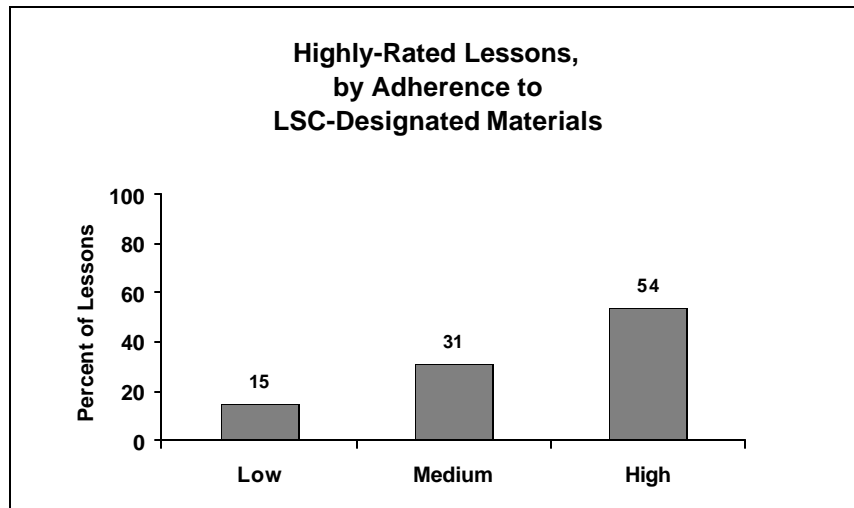
*Figure 39*

It appears that the combination of LSC-designated materials and LSC professional development is having a positive impact on the quality of classroom instruction. Only 7 percent of lessons taught by teachers who had not participated in LSC professional development and were not using the designated materials received high ratings. Lessons taught by teachers who had participated in at least 20 hours of LSC professional development and were using the designated materials were more than four times as likely to receive high ratings. (See Figure 40.)



*Figure 40*

Other findings from the core evaluation also reinforce the LSC program’s emphasis on having teachers implement the designated instructional materials as designed by their developers. Figure 41 shows that the more closely the lesson adhered to the instructions provided in the teacher’s manual, the more likely it was to be rated effective. Fifty-four percent of the lessons that adhered closely to the materials were given high ratings (capsule ratings of 4 or 5) compared to only 15 percent of the lessons with low adherence.



*Figure 41*

## V. Conclusions

Results from the 2001–2002 Local Systemic Change core evaluation 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 most likely to receive high ratings for appropriateness of the mathematics/science content, the climate of respect for and collegial interactions among participants, and the fact that active participation was encouraged. The most salient weaknesses in sessions for classroom teachers were in questioning participants in ways likely to enhance their conceptual understanding and in providing adequate time and structure for wrap-up.

Interestingly, the majority of the observed sessions were facilitated by district personnel, most often full- or part-time teacher leaders. Fewer than 1 in 5 sessions included scientists or mathematicians as professional development providers, and only 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 35 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 networking with other teachers, 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. Concerns focused on the amount of time required to attend professional development; in some cases, the quality of the professional development; and especially, problems teachers experience in implementing the instructional materials in their classrooms.

Questionnaire data collected from targeted teachers suggest that LSC professional development has had a significant impact on teachers' attitudes and beliefs about mathematics/science education. In addition, participants were becoming more confident in their knowledge of mathematics and science content, and more likely to use standards-based instructional strategies.

Both mathematics and science participants reported making greater use of strategies that facilitate exploration and investigation by students, such as using open ended questions and requiring students to supply evidence to support their claims. Science 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.



Classroom observations show that teachers who participated in LSC professional development were more likely to be using the designated instructional materials, and that the quality of the lessons taught improved with increased participation in LSC activities. Furthermore, lessons taught by teachers who had participated in at least 20 hours of LSC professional development and were using the designated materials were more likely to receive high ratings for their lessons, lending support to the program's focus on professional development aimed at implementing exemplary instructional materials.

## Appendix Table

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

Questionnaire Composite	Effect Size			
	K-8 Science		K-8 Mathematics	
	Number of SDs <sup>†</sup>	Effect Size <sup>‡</sup>	Number of SDs <sup>†</sup>	Effect Size <sup>‡</sup>
Attitudes Toward Teaching	.29	+	-.26	-
Pedagogical Preparedness	.67	++	.28	+
Content Preparedness	.31	+	.16	NS
Investigative Culture	.66	++	.22	+
Investigative Practices	.71	++	-.12	NS
Use of Calculators and Computers	—	—	-.06	NS

<sup>†</sup> Number of standard deviations between untreated teachers and teachers with 100 or more hours LSC professional development.

<sup>‡</sup> NS = Not significant; a single “+” indicates a small positive effect; a double “++” indicates a medium positive effect; a single “-” indicates a small negative effect.