

**Local Systemic Change
through Teacher Enhancement**

Year Seven Cross-Site Report

By

Iris R. Weiss
Eric R. Banilower
Christina M. Overstreet
Eugene H. Soar

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Horizon Research, Inc.

326 Cloister Court
Chapel Hill, NC 27514

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Appendix Table

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

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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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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 throughout the more than 450 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, and 7 in 2001 for a total of 87 projects in Cohorts 1–7.

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 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, 2000 through August 31, 2001.

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

A. An Overview of LSC Projects in Cohorts 1–7

Project data sheets completed by the PIs and questionnaires completed by the principals of targeted schools provide some basic information about the LSC projects included in Cohorts 1–7.

- As of 2000–2001, the LSC initiative included 38 K–8 science projects, 6 secondary science projects, 17 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-seven of the LSC projects are single-district projects; at the other end of the scale, 4 projects involve more than 20 districts each.
- Sixty-five 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 87 current and completed projects plan to involve a total of approximately 69,000 teachers in nearly 4,000 schools in 466 districts across the United States.
- By the completion of these projects, an estimated 2,110,000 students will receive instruction from LSC-treated teachers each year.

B. Schools Participating in 2000–2001²

As can be seen in Figure 1, nearly half of the schools targeted for the LSC are in urban areas; only 12 percent are in towns or small cities.

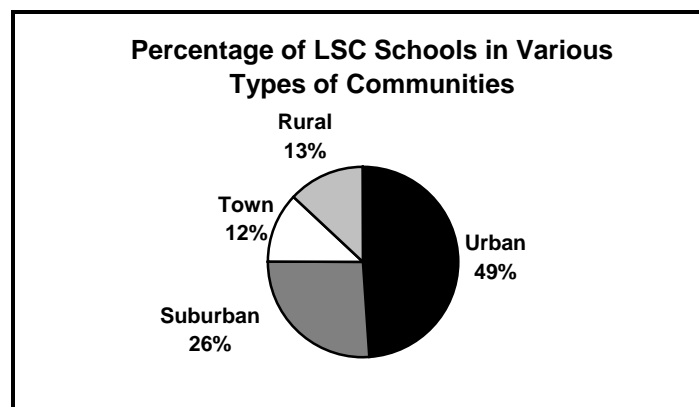


Figure 1

² Three projects completed data collection in 1998, six in 1999, and eight in 2000; these 17 projects are not included in the analyses in this report.

In terms of student demographics, across all schools targeted by the LSCs, 48 percent of students are white, 23 percent African-American, 20 percent Hispanic, 6 percent Asian, 1 percent American Indian or Alaskan Native, 0.7 percent Native Hawaiian or Pacific Islander, and 0.8 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 far greater than the national average of approximately 30 percent.

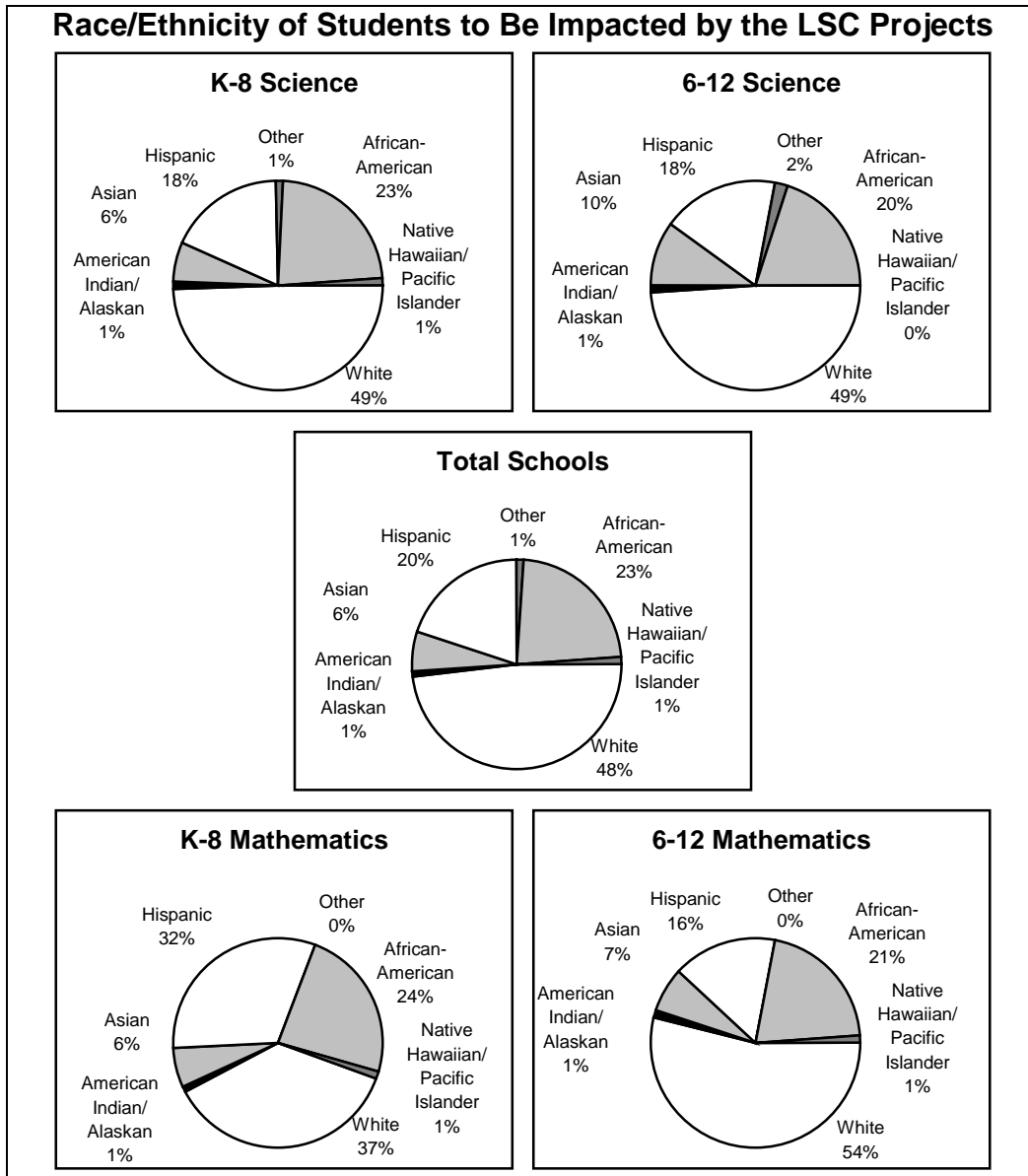


Figure 2

The typical school targeted for K–8 mathematics or science reform by the LSC projects has 498 students, 50 percent of whom qualify for free or reduced-price lunches and 15 percent of whom are of limited English proficiency (LEP). The typical school targeted for 6–12 mathematics or science reform has 790 students, 33 percent of whom are eligible for free or reduced-price lunches and 9 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 and recommendations 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?

Data Collection

Data collection activities for the projects' 2000–2001 Core Evaluation Reports were conducted from September 1, 2000 through August 31, 2001. Cohort 7 projects were collecting baseline data for their first year of funding; this was the second year of data collection for Cohort 6 projects, the third year for Cohort 5 projects, the fourth year for Cohort 4 projects, the fifth year for Cohort 6 projects, and the sixth year for Cohort 2 projects. There were no active Cohort 1 projects in 2000–2001. The Core Evaluation Data Collection schedule was adjusted in 1999–2000 with the goal of transitioning to a longitudinal system. 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 were required to conduct 5–8 observations; baseline projects conducted 2–5 observations. Evaluators were to consult with PIs on what professional development experiences were planned throughout the data collection

year, and select a sample that was representative of the diversity of the project's activities. Program-wide, a total of 366 observations of professional development sessions were conducted. Data were weighted to control for the variable number of observations conducted per project.

2. *Classroom Observations*

Thirty-nine of the 70 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 2001. There was a total of 648 classrooms observed, roughly half 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*

Forty-three 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 85 percent. A total of 11,183 teacher questionnaires was returned to HRI, including 4,154 from K–8 science teachers; 636 from 6–12 science teachers; 4,394 from K–8 mathematics teachers; and 1,999 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 3,162 principal questionnaires were returned, with a median response rate among projects of 97 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 574 interviews were conducted among 58 projects. Seventy-two percent of the interviews were conducted by phone, and 28 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.”³ 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).⁴ 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.⁵ 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.

³ 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.

⁴ In projects targeting both mathematics and science, or both elementary and secondary mathematics, questionnaire, observation, and interview data were collected separately for each “subject.”

⁵ “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 each 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 366 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.⁶ The section concludes with teacher and evaluator judgements 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 typical professional development session observed for the LSC core evaluation included between 11 and 20 participants; only 1 percent of the sessions had more than 100 participants. Of sessions targeting teachers, 15 percent exclusively targeted teacher leaders 78 percent targeted only regular teachers, and 7 percent targeted both lead and regular teachers. A total of 5 percent of the sessions included principals or other administrators.

Presenters/Facilitators

LSC professional development involves presenters/facilitators from a variety of settings. Seventy-five percent of the observed sessions included one or more district personnel as presenters or facilitators, while only 32 percent of the sessions included university faculty as presenters or facilitators. (See Figure 3.) Across all of the observed sessions, roughly three-fourths of the presenters/facilitators were female and one-fourth male. As can be seen in Figure 4, 91 percent of the presenters/facilitators were white and 9 percent members of other race/ethnic groups.

⁶ 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, as well as the core evaluation teacher interview and questionnaire data. All of the available data were to be used in making the summary judgments.

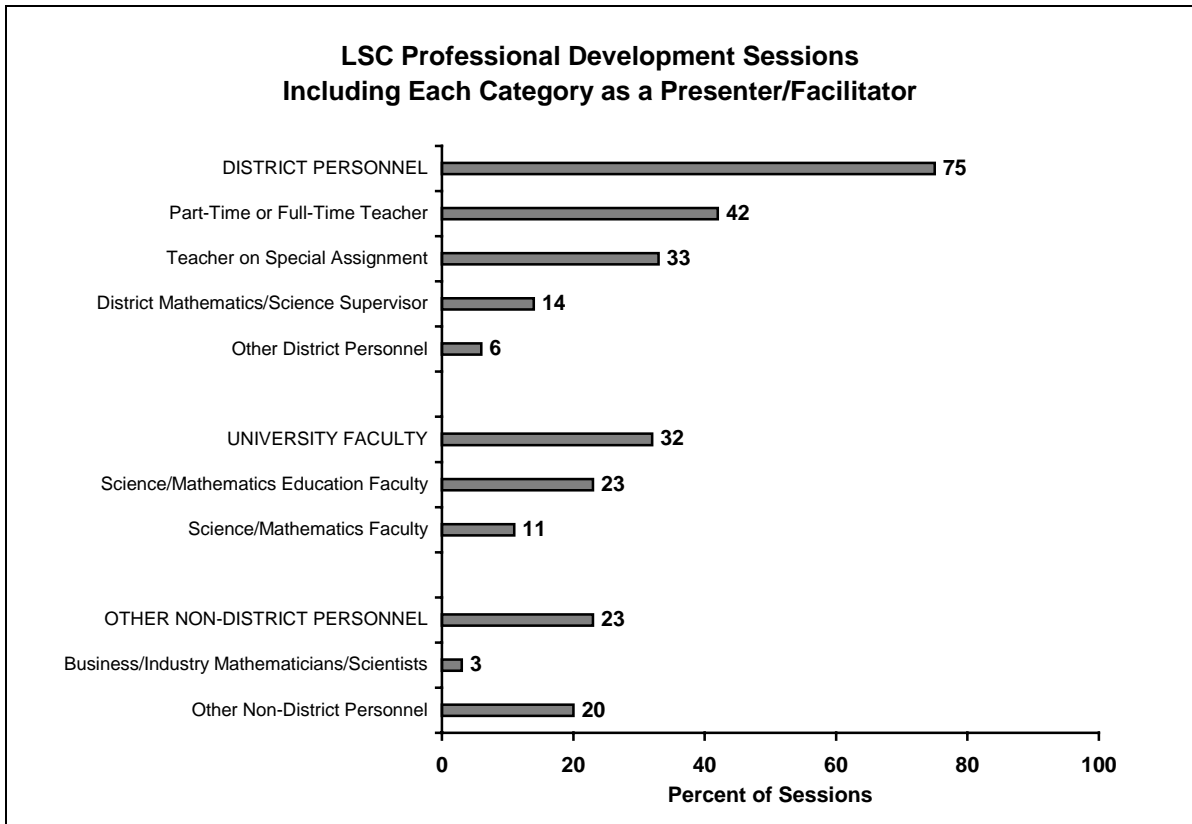


Figure 3

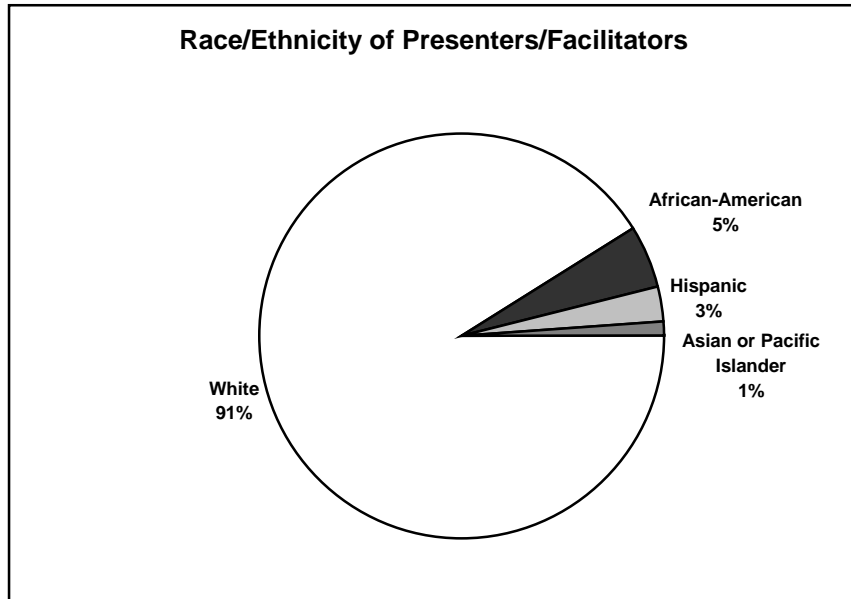


Figure 4

Purposes of the Professional Development Sessions

Evaluators were asked to indicate the major intended purposes of each observed session based on information provided by the session facilitators. The results were nearly identical to those reported in the previous year. As can be seen in Table 1, the most frequently cited purposes were learning how to use specific instructional materials (45 percent), and enhancing teachers’ understanding of mathematics/science concepts (41 percent).

**Table 1
Major 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	45	51	34	39	42
Increasing teacher mathematics/science content knowledge	41	42	38	36	48
Understanding student thinking/learning about mathematics/science content	31	20	44	36	46
Learning pedagogical/classroom management strategies	29	37	28	26	13
Creating a vision of effective mathematics/science instruction	25	25	35	24	23

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 the majority of the sessions with a disciplinary content focus dealt with physical science concepts (55 percent); fewer addressed concepts from earth and space sciences (28 percent), life science (19 percent), or “science as a way of knowing” (16 percent). Only 4 percent of the observed K-8 sessions dealt with measurement, 2 percent emphasized the history of science, and 1 percent focused on engineering concepts. (See Figure 5.)

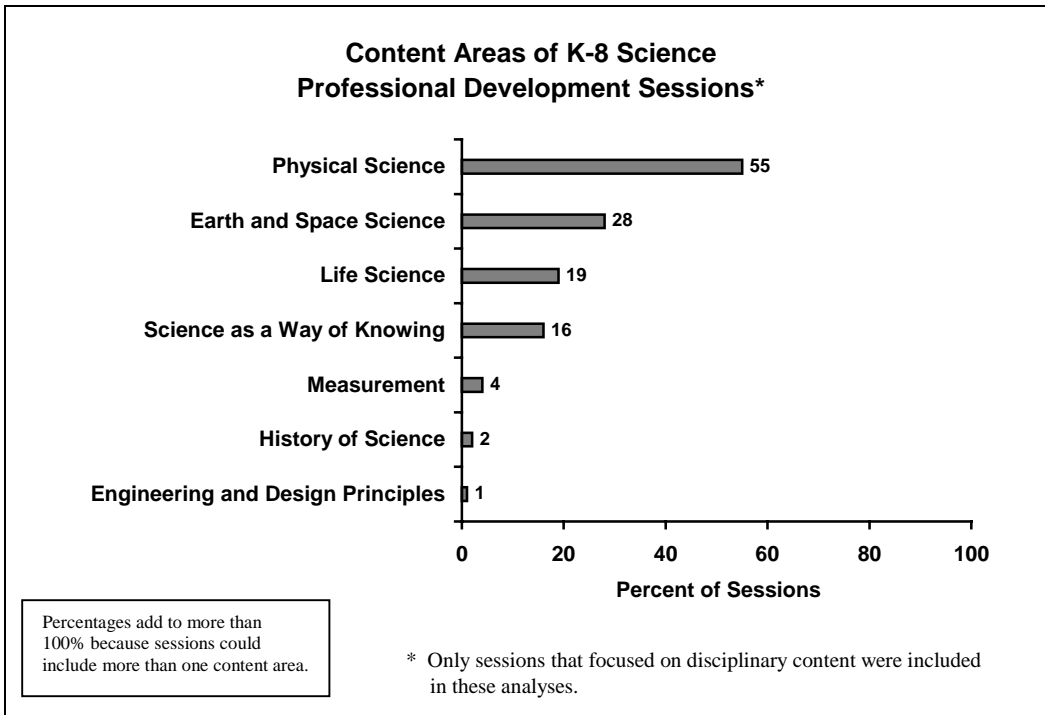


Figure 5

Projects targeting 6–12 science most heavily emphasized physical science (48 percent), as can be seen in Figure 6. Other topics that frequently received emphasis were earth and space science (28 percent), and science as a way of knowing (24 percent).

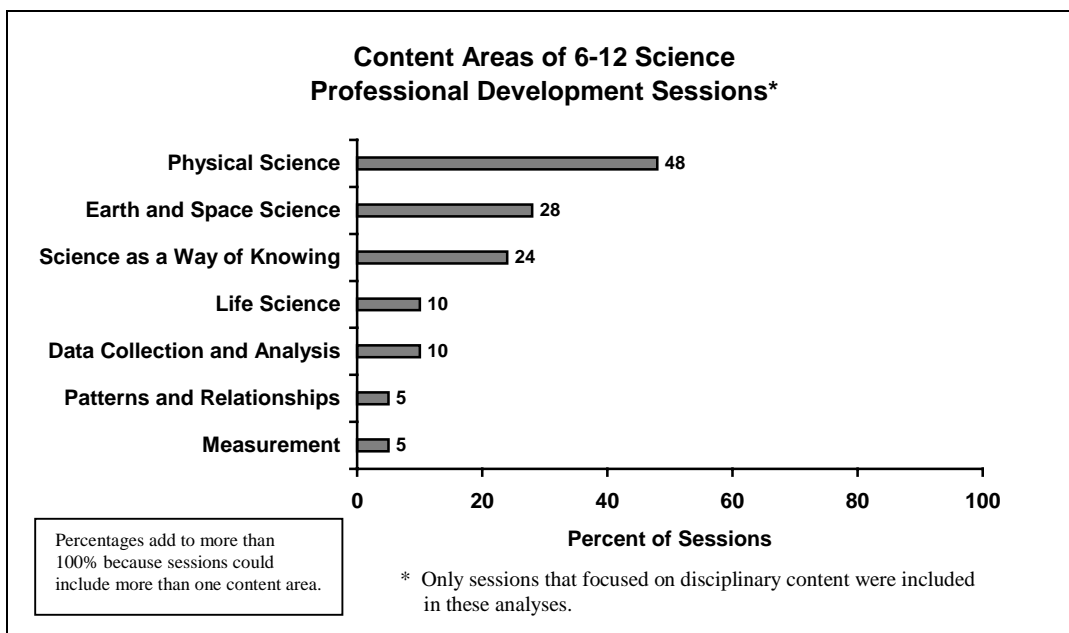


Figure 6

In projects targeting K–8 mathematics (Figure 7), the most heavily emphasized topics were numeration and number theory (38 percent of the sessions that dealt with disciplinary content), computation (19 percent), pre-algebra (19 percent), data collection and analysis (17 percent), and geometry and spatial sense (17 percent).

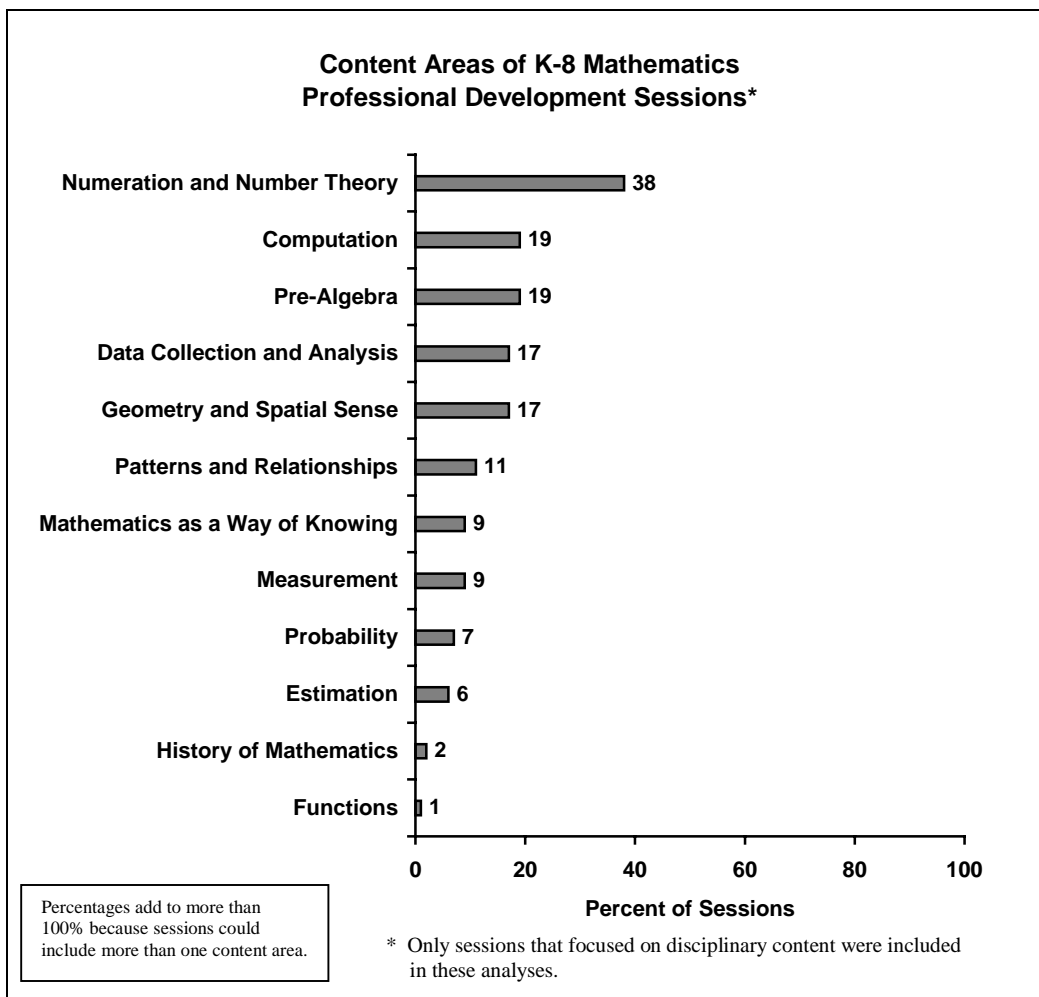


Figure 7

As can be seen in Figure 8, algebra and geometry and spatial sense were the two most commonly emphasized content areas in sessions for 6–12 mathematics teachers, with 33 percent of the sessions that dealt with disciplinary content focusing on each. A number of other areas—discrete mathematics, numeration and number theory, data collection and analysis, statistics, and mathematical functions—were each the focus in 11–18 percent of the 6–12 mathematics content sessions.

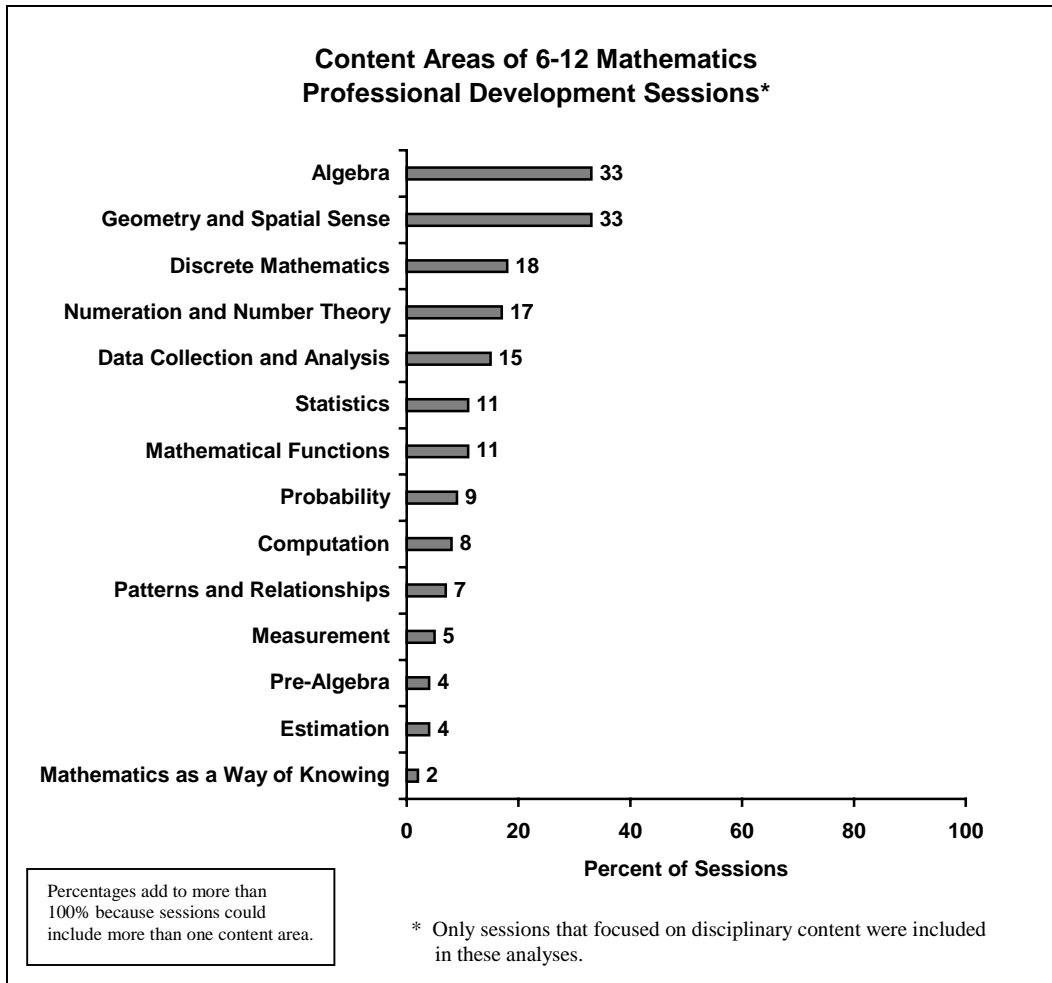


Figure 8

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 (76 percent), about half of the sessions engaged participants in problem-solving or investigation, and about one-third included formal presentations, usually by project staff as opposed to participants. Relatively few of the observed sessions involved participants in reading (6 percent) or writing (2 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
Engaged in discussions/seminars	76	72	87	82	69
Whole group led by facilitator	62	61	68	74	44
Small groups/pairs	36	35	43	37	36
Whole group led by participants	12	11	16	8	19
Engaged in problem-solving/investigation	54	52	91	40	70
Listened to a formal presentation	32	32	45	36	20
By presenter/facilitator	32	32	45	36	20
By participants	1	0	3	1	2
Read about disciplinary content, pedagogy, or reform issues	6	4	6	13	0
Wrote about disciplinary content, pedagogy, or reform issues	2	2	5	2	0

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.⁷ 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:

⁷ 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 (84 percent);
- The extent to which the session design provided opportunities for teachers to consider classroom application of resources, strategies, and techniques (82 percent); and
- The extent to which the session reflected careful planning and organization (81 percent).

Fewer sessions were rated highly on:

- The extent to which the session provided time and structure for the sharing of experiences and insights (70 percent);
- 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 (67 percent);
- Providing adequate time and structure for reflection (60 percent); and
- Providing adequate time and structure for wrap-up/closure (57 percent).

Overall observers found that the designs of the majority of the professional development sessions were quite reflective of best practice. As indicated in Figure 9, 75 percent of the professional development sessions received overall design ratings of 4 or 5.

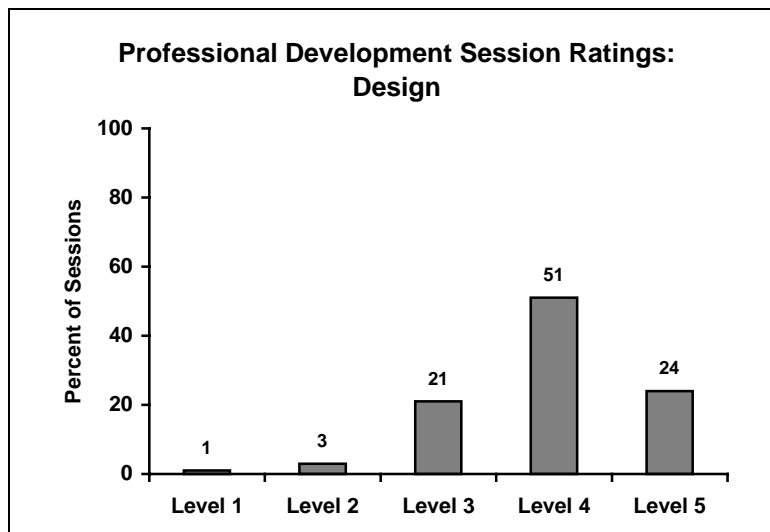


Figure 9

Implementation of Professional Development Sessions

Observers also assessed the quality of implementation of professional development sessions. Indicators most frequently rated 4 and 5 were:

- Extent to which the facilitators' backgrounds and expertise enhanced the quality of the session (81 percent);
- Extent to which formal presentations included in the session were carried out effectively (78 percent); and
- Extent to which the facilitators' contributions during the course of the session enhanced the quality of the session (78 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 (59 percent); and
- The extent to which the session modeled questioning strategies that are likely to enhance the development of conceptual understanding (53 percent).

As indicated in Figure 10, 68 percent of the sessions received overall ratings of 4 or 5 on their quality of implementation.

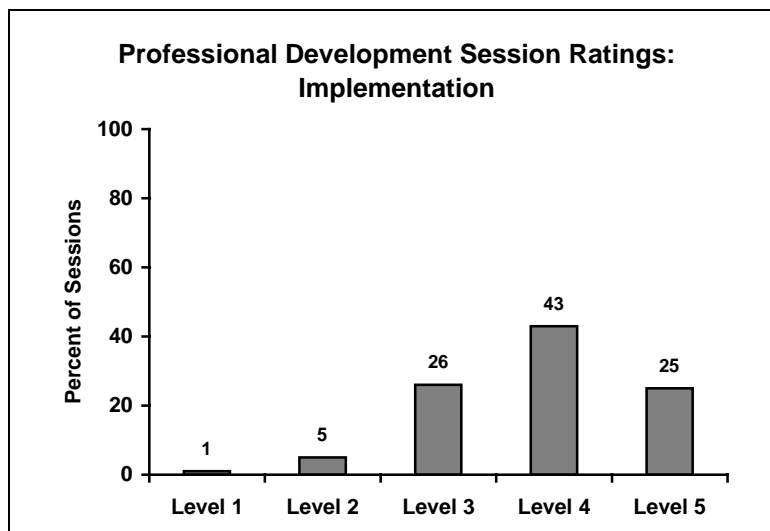


Figure 10

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, 77 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 (87 percent); and
- The extent to which active participation of all was encouraged and valued (86 percent).

Fewer sessions were highly rated on:

- The extent to which intellectual rigor, constructive criticism, and the challenging of ideas were valued (71 percent); and
- The extent to which investigation and risk-taking were valued (53 percent).

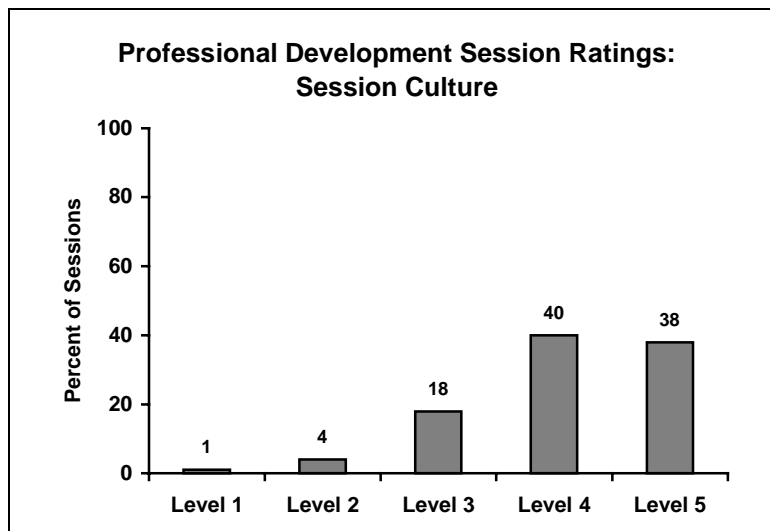


Figure 11

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 234 of the 366 sessions, with 70 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 (84 percent); and

- The extent to which the facilitators displayed an understanding of mathematics/science content (80 percent).

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

- The extent to which the degree of closure or resolution of mathematics/science conceptual understanding was appropriate for the purposes of the session and the needs of adult learners (55 percent).

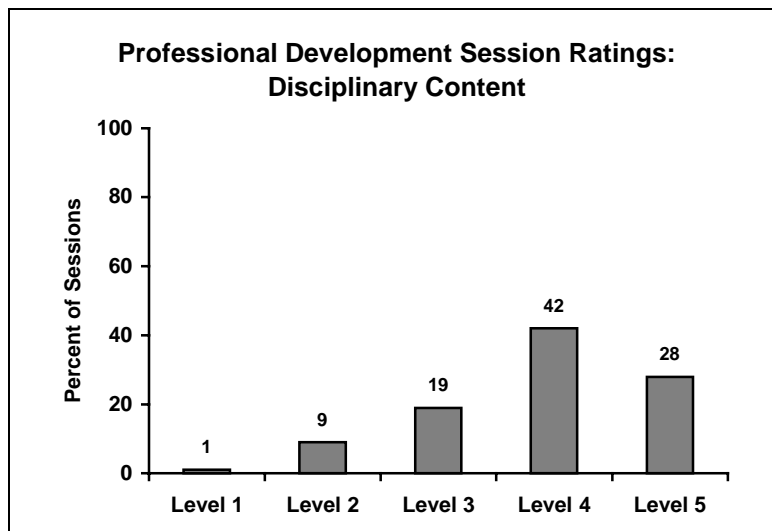


Figure 12

Observers rated 284 of the 366 observed professional development sessions on the quality of their pedagogical content. As can be seen in Figure 13, 71 percent of 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 (82 percent); and
- The depth and breadth of attention to student instructional materials (76 percent).

Fewer sessions received high ratings for:

- Their handling of closure/resolution of understanding of pedagogical concepts (64 percent), an area that was also weak in previous years; and
- The extent to which the depth and breadth of attention to student thinking/learning were appropriate for the purposes of the session and participant needs (63 percent).

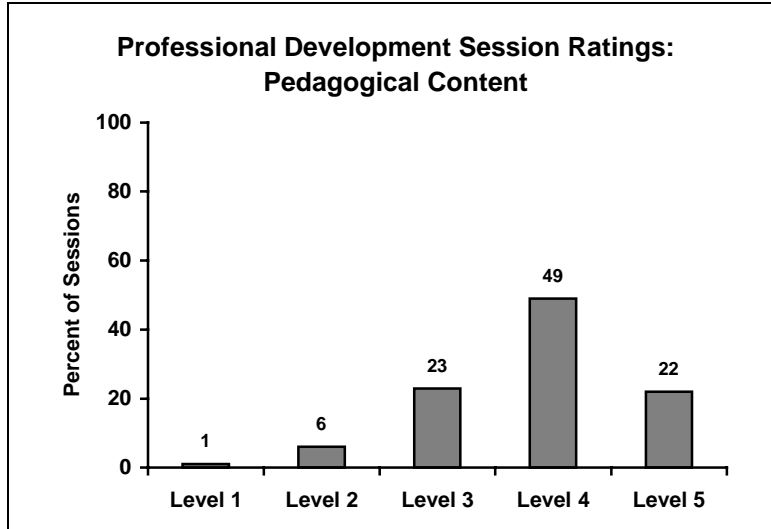


Figure 13

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 observed 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’ ability to: (1) network with other teachers about instruction (79 percent); (2) implement designated instructional materials (79 percent); (3) exhibit self-confidence as mathematics/science instructors (77 percent) and (4) plan and implement high quality classroom instruction (75 percent). Fewer sessions were judged likely to have a positive effect on participants’ understanding of how students learn (64 percent); the same area that was 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 60 of the 366 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, 52 percent of the sessions focusing on leadership content received a high synthesis rating (4

or 5) in this area, lower than in any other area. Leadership sessions were most likely to receive high ratings for:

- The extent to which facilitators demonstrated an understanding of leadership concepts (70 percent);
- The extent to which participants were intellectually engaged with important leadership content (67 percent); and
- How well principles of effective staff development were presented/explored (66 percent).

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

- The extent to which participants were given adequate and appropriate opportunity to consider how the content of the session applies to their leadership role (54 percent); and
- Quality of information on strategies for mentoring/coaching peers (48 percent).

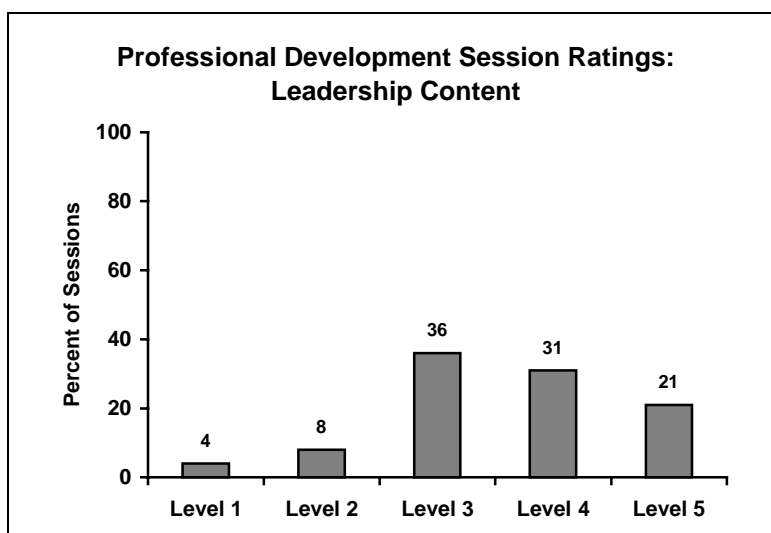


Figure 14

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

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 3 percent were rated at Level 2, having quite limited likelihood of helping participants implement exemplary mathematics/science instruction or be leaders in reform. Overall, 59 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.)

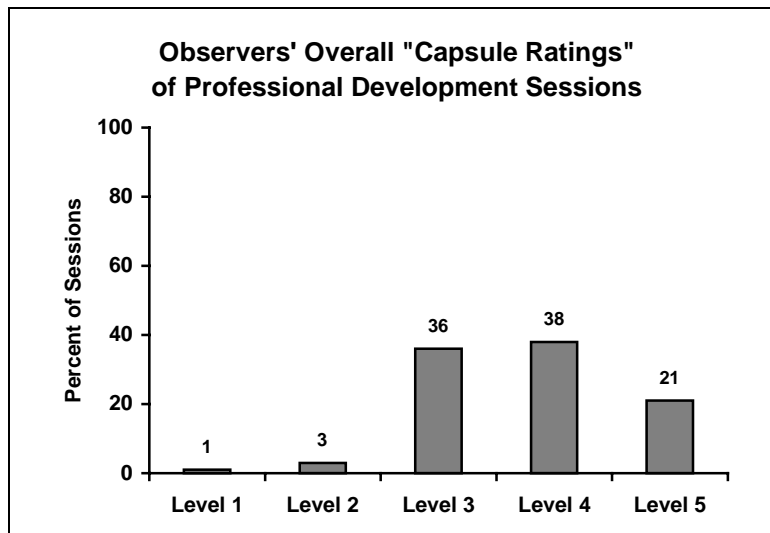


Figure 15

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 2001, 574 teachers who had participated in 20 hours or more of LSC professional development were interviewed by project evaluators. In addition, 7,130 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, only 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
Teacher Responses to Statements
about LSC Professional Development

	Percent of Teachers Assigning High Ratings*				
	All Teachers	Science		Mathematics	
		K-8	6-12	K-8	6-12
I receive support as I try to implement what I've learned.	41	38	47	43	46
I am given time to reflect on what I've learned and how to apply it to the classroom.	25	23	30	28	24
I am given time to work with other teachers as part of my professional development.	24	21	38	26	28

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

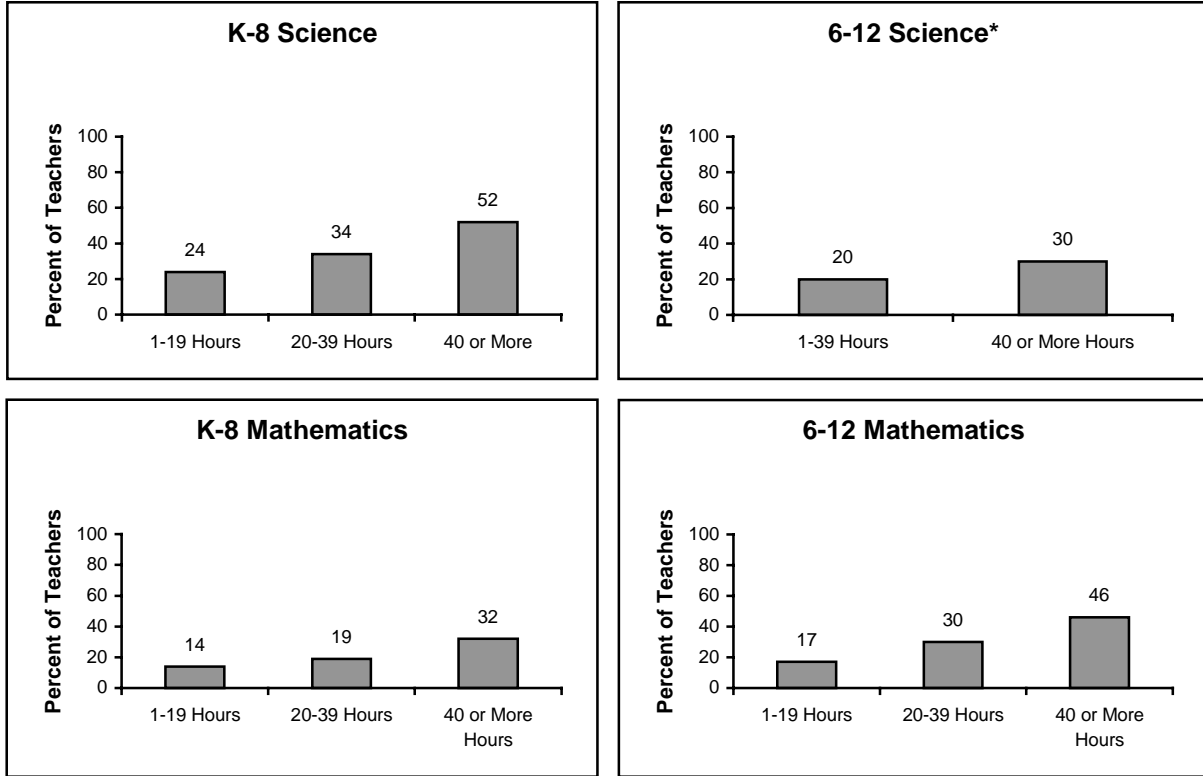
Table 4 shows teacher ratings of LSC professional development programs overall, with 7 percent of teachers rating the professional development programs "poor" or "very poor," 59 percent "fair" or "good," and 34 percent "very good" or "excellent."

Table 4
Teacher Ratings of LSC
Professional Development Programs Overall

	Percent of Teachers					
	Very Poor	Poor	Fair	Good	Very Good	Excellent
K-8 Science	2	5	23	31	26	13
6-12 Science	3	6	26	40	20	5
K-8 Mathematics	2	5	30	36	20	6
6-12 Mathematics	2	5	23	31	30	9
All Teachers	2	5	26	33	24	10

Figure 16 shows the percentage of teachers in each of four subject and grade range combinations who rated LSC professional development "excellent" or "very good" in the 2001 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. Again, the more hours of participation in LSC professional development, the higher the ratings of quality.

**Teachers Rating LSC Professional Development Excellent or Very Good,
by Subject and Extent of Participation**



* Due to the small number of secondary science projects, the number of teachers providing data on the 6–12 science questionnaire does not support disaggregation into four groups (0 hours, 1–19 hours, 20–39 hours, and 40 or more hours). Instead, the 6–12 science questionnaire data are disaggregated into three groups (0 hours, 1–39 hours, and 40 or more hours).

Figure 16

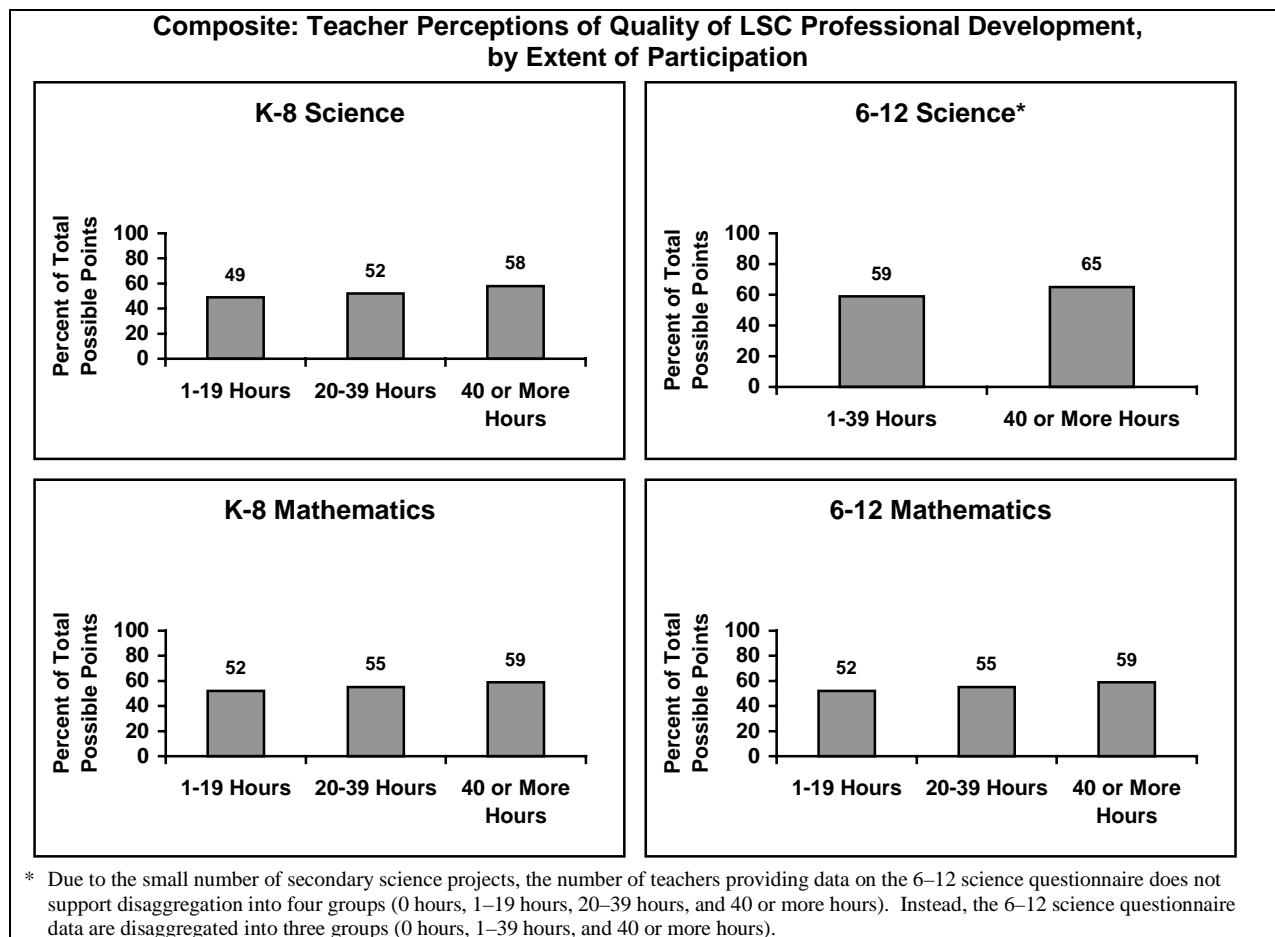


Figure 17

Teacher interviews yield similar findings. Evaluators asked a random sample of teachers who had participated in the LSC professional development for at least 20 hours 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.

When asked about the impact of the LSC, about three-quarters of these teachers talked about how the LSC had enabled them to change their classroom practice, and about 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

It's so much more hands-on now. Children get to manipulate. For example, with Pebbles, Sand, and Silt, they get to handle and sort rocks. That's so much better than just seeing them on a poster. (K–8 Science Teacher)

I'm doing more inquiry...Every time we start a new unit, we start two posters: (1) what we know about it, and (2) what we want to know about it. Then at the end we go back and see if we answered all those questions. (K–8 Science Teacher)

It has changed [my classroom practice] to make it more hands-on and inquiry based, more focused on what the kids need. I've gotten away from the textbook and worksheets and do more inquiry. It engages the kids actively. (6–12 Science Teacher)

I learned to question kids. When I tested them it was more for understanding rather than your basic level one facts, more to see if they had a deeper understanding of math. It's teaching for learning [and evaluation through] ongoing teacher observation with math manipulatives and more hands-on, seeing if they truly understand the concepts. (K–8 Mathematics Teacher)

I look more at how [students] think about math. We are definitely doing more problem-solving in my room and I'm getting a much cleaner picture of their mathematical thinking. (K–8 Mathematics Teacher)

Overall, I teach more hands-on and am giving more real-life problems. When I started [teaching mathematics], it was worksheets, worksheets, worksheets. Now we're really working, we're really doing stuff. (6–12 Mathematics Teacher)

I now focus on problem-solving, real-world applications, and more guiding. I now guide students to discover rather than telling them. (6–12 Mathematics Teacher)

I give students more control in the classroom. They discuss their solutions, show their work, argue, ask questions. I let them take control of the class and be the teachers instead of lecturing to them. (6–12 Mathematics Teacher)

Increased Preparedness

When I first came here two years ago, I was really very frightened of science. Before I got the help, I didn't really teach it at all. The boxes would just come, and I'd leave them in the corner. Sometimes we'd talk about science, but I was afraid to open the boxes. Going to the classes and getting the special help really made the difference for me. Now I think teaching science is fun. It's as much a part of my planning as anything else. I think I'm getting much better at it. (K–8 Science Teacher)

I'm a lot more comfortable with science. I'm not afraid of it. Science was my weakness. It eliminated my fears of even talking with science-oriented people. It clarified a lot of questions about science, raised other questions, and opened other doors. I found out it's okay to have questions and doubts. (6–12 Science Teacher)

Through the training I was able to understand math itself, the content, so much better, I was better equipped to teach it to the kids better. I have a lot more confidence now. It helped me understand math better, because when I went to school it wasn't taught that way. I was always one of those kids who didn't like or "get" math. (K–8 Mathematics Teacher)

When asked about the “most helpful” aspects of the LSC, over 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 less 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 roughly 1 in 4 teachers indicated that everything about the LSC was helpful, others cited one or more concerns. Problems with the designated instructional materials topped the list of “least helpful” aspects of the LSC. In the case of science teachers, the time required to implement the materials and the logistics of materials management were most frequently cited as problematic, while mathematics teachers were more likely to talk about inadequate attention to fundamental mathematics concepts:

The main thing I'm concerned about is the time element. It takes a lot of time for the kids to do hands-on. I know most of us learn better doing hands-on, but it just takes up so much time. I can't seem to get that time element worked into my lessons. Maybe there's too much, and I need to pick-and-choose. (K–8 Science Teacher)

I used the Animals Two by Two [kit], and the animals were a month late in arriving. Then some of them were dead, which is always a problem. But having them arrive late like that meant I had to send the kit back before we were finished with it, and that was a big disappointment. (K–8 Science Teacher)

A lot of our kids are not at grade level and the books don't provide the practice that our kids need. We keep having to supplement. (6–12 Mathematics Teacher)

We think the curriculum doesn't have enough math problems for each lesson, so the teachers have to take time to make up more problems, which takes away from our preparation. (6–12 Mathematics Teacher)

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

For me, much of the training for the 2nd and 3rd kits was repetitive—especially given the summer training and the fact that we'd already had the experience of teaching the first

kit. I just didn't need the structure of going through the kits and taking out all of the stuff with other teachers. So it was sort of a waste of time for me—just not where I am, I guess. (K–8 Science Teacher)

One troublesome aspect of staff development is the time crunch—the need to prepare for a substitute takes lots of time, and if the training is after school you are really rushed. There is no time to ponder and put the ideas learned into practice. I need more time to think about what I have learned and how I can fit it into my curriculum. (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 academic year support, more readily available materials or supplies, and more time for networking with other teachers. Typical comments included:

I need help with classroom management. I like to do hands-on activities, but I have a hard time managing it with kids that don't behave appropriately with the equipment and materials. (K–8 Science Teacher)

I would like to have more time for getting together with other teachers in my grade level. It always helps to have a group of teachers get together and share ideas. Things you haven't thought of, someone else has. (K–8 Science Teacher)

I'd like to have more hands-on professional development facilitated by people who are familiar with the kits and can do demonstration lessons so we can learn how to use the materials. (6–12 Science Teacher)

I would still like to go to other classrooms and see something. Watching other people is helpful for me. I like to take what I see and build on it. (K–8 Mathematics Teacher)

If they would have focused in more on cooperative groups and how to make the groups work. Maybe if they explained how they did it in their own class. (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 and pedagogical content, 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, 83 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.

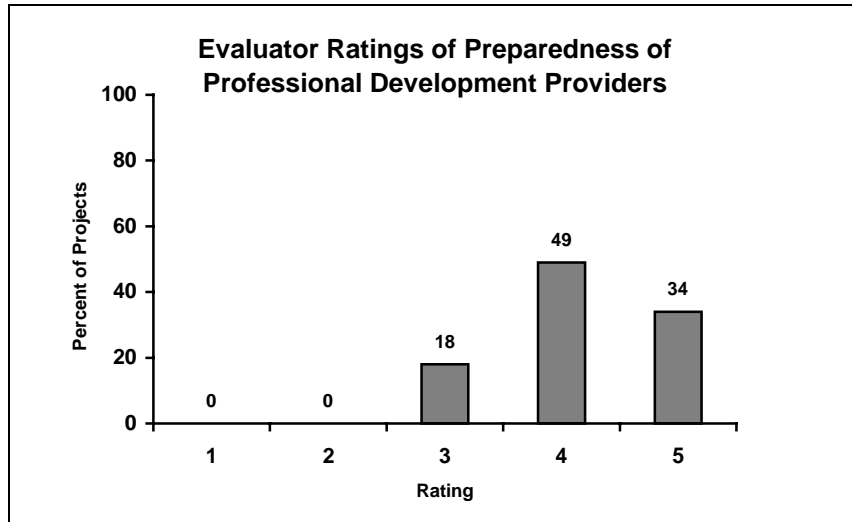


Figure 18

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, 79 percent of projects received ratings of 4 or 5 in this area. (See Figure 19.)

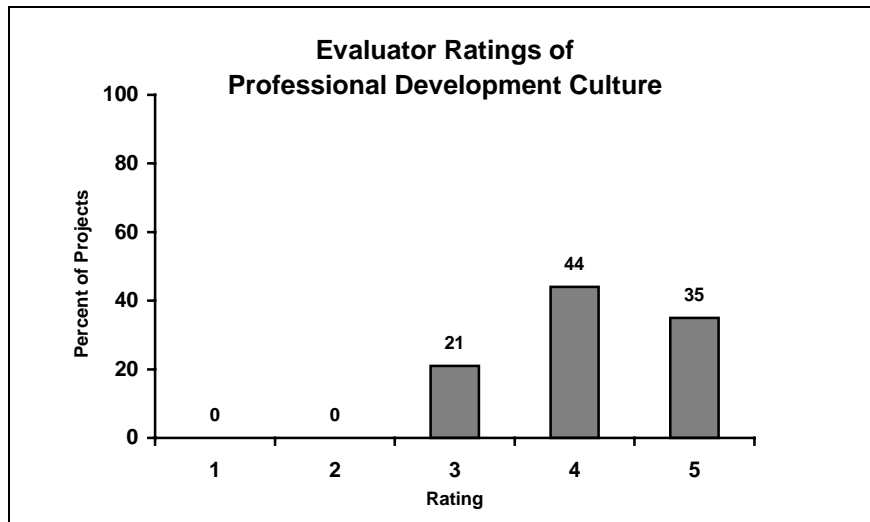


Figure 19

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

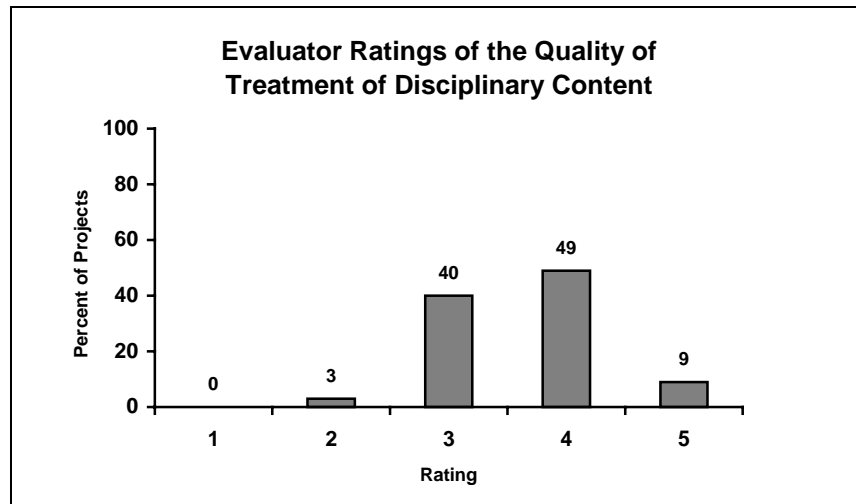


Figure 20

Treatment of Pedagogical Content

In addition to describing the quality of the project’s treatment of pedagogical content, evaluators were asked to provide overall ratings in this area. As can be seen in Figure 21, 88 percent of projects received ratings of 4 or 5 in this area, markedly higher than the 57 percent in developing disciplinary content.

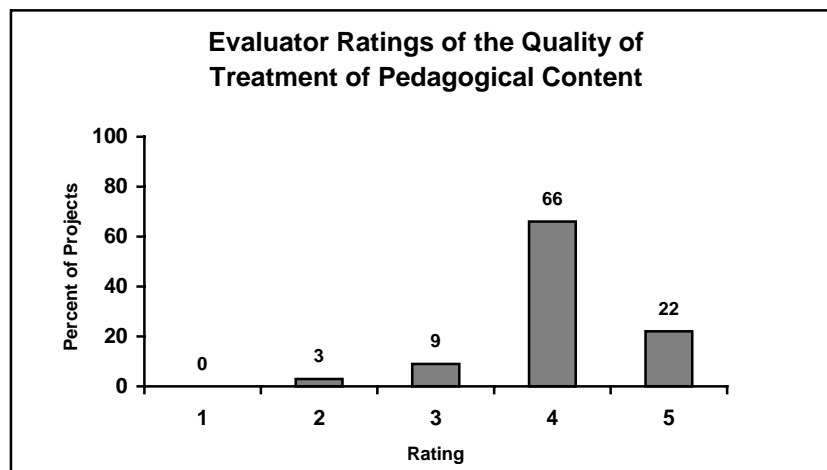


Figure 21

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 54 percent of projects received high ratings in this area; 7 percent received a rating below 3 on a five-point scale.

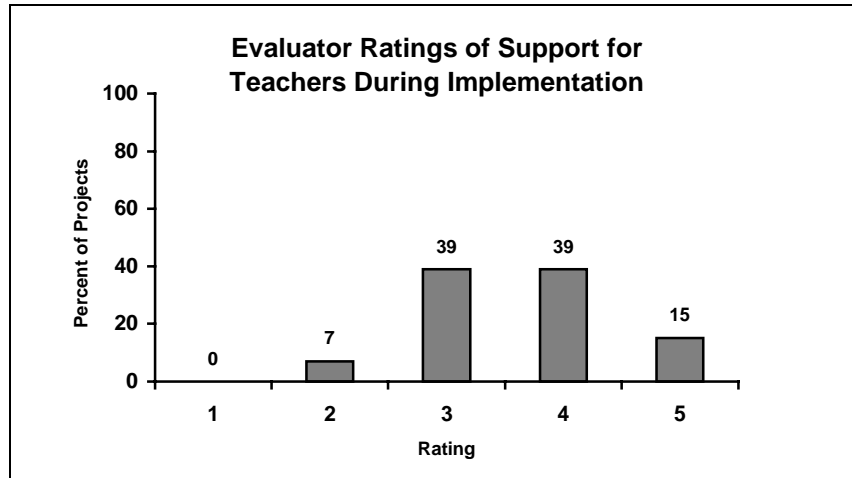


Figure 22

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*				
	All Projects	Science		Mathematics	
		K-8	6-12	K-8	6-12
Level 1: Predominance of Ineffective Professional Development	0	0	0	0	0
Level 2: Exploring Quality Professional Development	0	0	0	0	0
Level 3: Transitioning to Quality Professional Development	46	47	83	44	38
Level 4: Emerging Infrastructure of Well-Designed Professional Development	40	41	17	36	44
Level 5: Predominance of Well-Designed Professional Development	15	13	0	20	19
Mean Continuum Rating Level	3.7	3.7	3.2	3.8	3.8

* 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 science and mathematics, secondary teachers are more likely than their elementary counterparts to favor grouping of students by ability levels, and in some cases (K–8 science and 6–12 mathematics) the support decreases significantly as hours of professional development increase. (See Figure 23.)

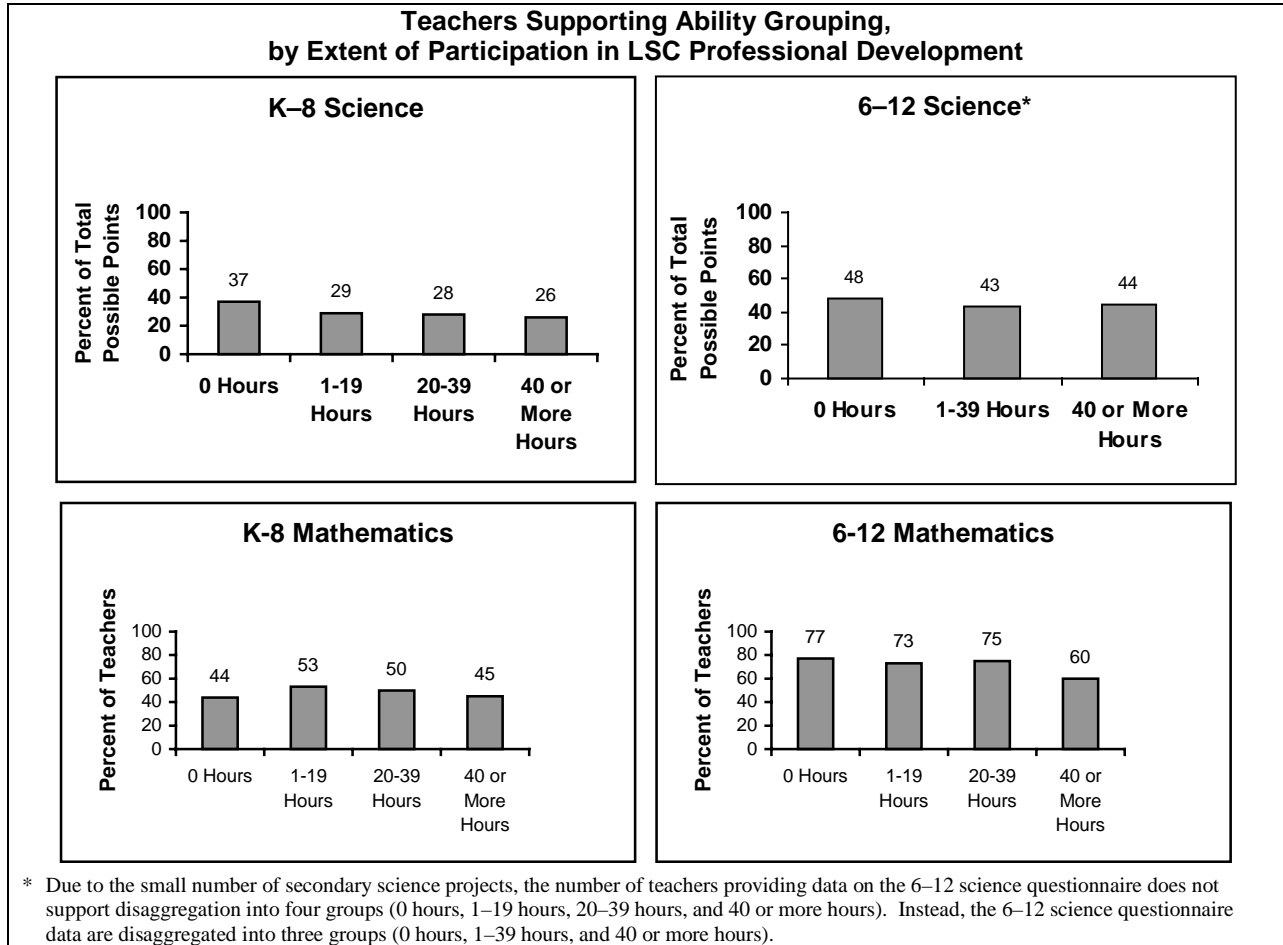


Figure 23

Results on a composite of several items related to teachers' attitudes toward standards-based teaching indicated a small, but significant difference for elementary mathematics teachers, with the most highly-treated group having more reform-oriented attitudes than do untreated teachers.⁸ (See Figure 24.) There were no significant differences in elementary science or secondary teachers' attitudes.

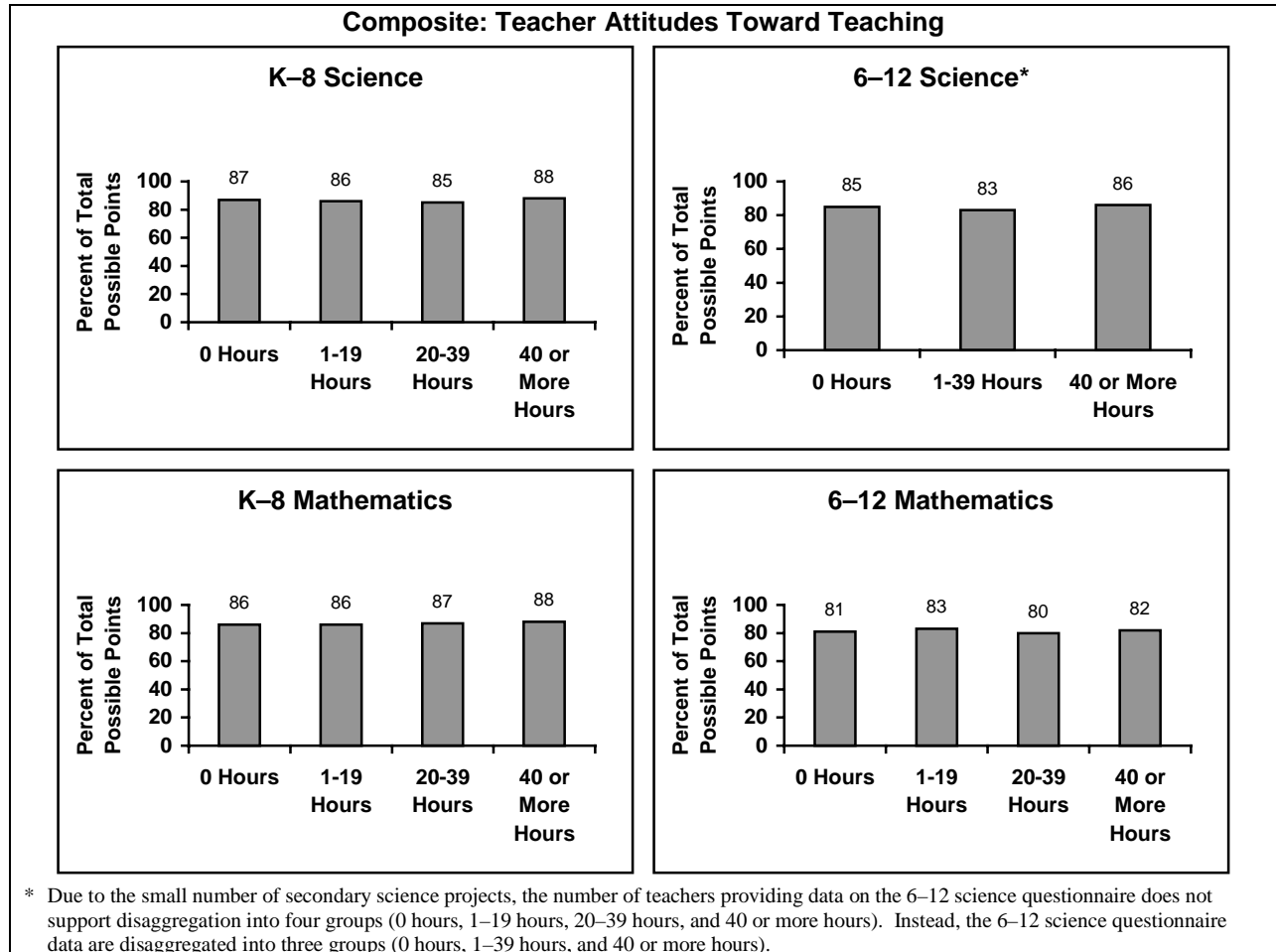


Figure 24

⁸ See Data Analysis in Section I for a description of how composite scores were calculated. Results by treatment level are presented separately for K-8 science, 6-12 science, K-8 mathematics, and 6-12 mathematics teachers. The effect size is calculated as the difference between the “0 hours” and “40 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).

Participating in LSC professional development appears to have had a dramatic impact on elementary teachers' feelings of preparedness. As can be seen in Figure 25, 86 percent of K-8 science teachers who had participated in at least 40 hours of LSC professional development indicated they were at least fairly well prepared to teach science, compared to 68 percent of those who had not yet participated in LSC professional development.

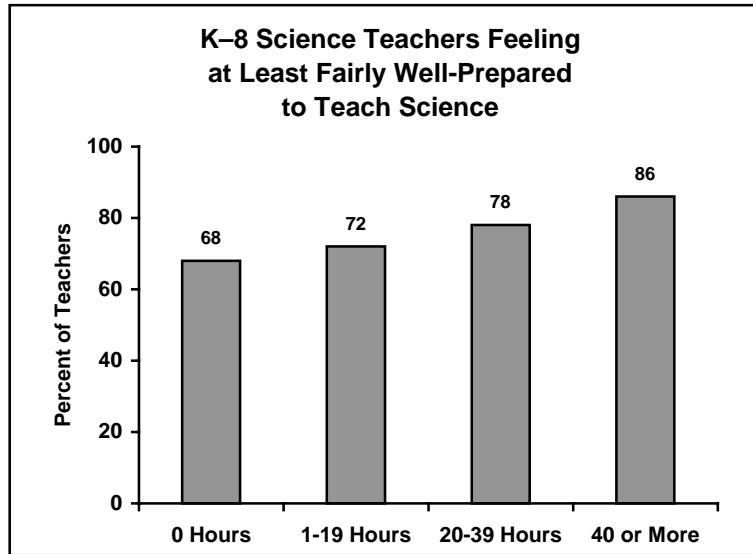


Figure 25

In mathematics, over 80 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, 60 percent of K–8 mathematics teachers who had participated in at least 40 hours of LSC professional development indicated they were very well prepared to teach mathematics, compared to 38 percent of those who had not yet participated in LSC professional development.

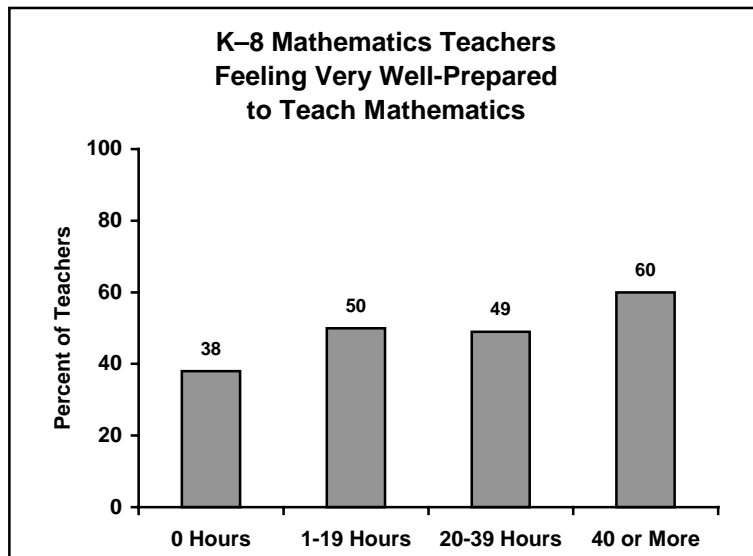


Figure 26

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 10 of the 11 topics listed, with effect sizes⁹ ranging from 0.10 to 0.30. (See Table 6.)

Table 6
Grade K–8 Science Teachers Feeling at Least Fairly
Well-Prepared to Teach Each Topic, by Extent of Involvement in LSC

	Percent of Teachers				Effect Size*
	0 Hours	1–19 Hours	20–39 Hours	40 or More	
The human body	66	65	65	75	0.20
Rocks and soils	52	49	54	62	0.20
Ecology	48	54	52	63	0.30
Forces and motion	45	43	42	50	0.10
Sound	45	48	47	52	0.14
Astronomy	42	46	40	47	0.10
Mixtures and solutions	42	44	42	52	0.20
Machines	42	39	39	48	0.12
Processes of change over time	37	40	35	40	NS
Electricity	36	41	37	46	0.20
Engineering and design principles	22	23	23	30	0.18

* NS = Not significant

⁹ When comparing percents, the effect size is calculated using the difference between the arcsine transformation of the percents of the “0 hours” and “40 or More Hours” groups.

Participation in LSC professional development appears to have somewhat less of an impact on secondary science teachers' perceptions of their content preparedness, with only half of the topics showing significant differences between untreated and highly-treated teachers. This may be partially explained by the fact that the low number of secondary science teachers who were administered the questionnaire reduces the likelihood of finding significant differences.

Table 7
Grade 6–12 Science Teachers Feeling at Least Fairly
Well-Prepared to Teach Each Topic, by Extent of Involvement in LSC*

	Percent of Teachers			
	0 Hours	1–39 Hours	40 or More	Effect Size**
Earth Science				
Earth's features and physical processes	66	68	68	NS
The solar system and the universe	64	55	65	NS
Climate and weather	57	57	61	NS
Biology				
Structure and function of human systems	85	75	74	NS
Interactions of living things/ecology	77	76	85	0.20
Plant biology	70	63	72	NS
Animal behavior	69	68	75	NS
Genetics and evolution	67	66	69	NS
Chemistry				
Properties and states of matter	66	81	86	0.48
Structure of matter and chemical bonding	60	70	73	0.28
Energy and chemical change	56	67	75	0.40
Chemical reactions	52	64	69	0.35
Physics				
Energy	55	57	69	0.29
Forces and motion	54	59	72	0.38
Light and sound	51	58	61	0.20
Electricity and magnetism	47	52	53	NS
Modern physics (e.g., special relativity)	22	29	24	NS
Environmental and Resource Issues				
Population, food supply and production	72	74	76	NS
Pollution, acid rain, global warming	71	76	77	NS
Scientific Methods and Inquiry Skills				
Formulating hypotheses, drawing conclusions, making generalizations	84	88	95	0.37
Describing, graphing, and interpreting data	79	88	93	0.42
Experimental design	70	82	88	0.45

* Due to the small number of secondary science projects, the number of teachers providing data on the 6–12 science questionnaire does not support disaggregation into four groups (0 hours, 1–19 hours, 20–39 hours, and 40 or more hours). Instead, the 6–12 science questionnaire data are disaggregated into three groups (0 hours, 1–39 hours, and 40 or more hours).

** NS = Not significant

In K–8 mathematics, teachers with 40 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 the 11 topics listed, with effect sizes of 0.26 or greater. The largest differences were in geometry and spatial sense and patterns and relationships, with effect sizes of 0.49 and 0.46, respectively. In 6–12 mathematics, there were significant differences between untreated and highly-treated teachers on 11 of the 14 topics listed, with generally smaller effect sizes, ranging from 0.10 to 0.30. (See Table 8.)

Table 8
Mathematics Teachers Feeling at Least Fairly Well-Prepared
to Teach Each Topic, by Grade Range and Extent of Involvement in LSC

	Percent of Teachers									
	K–8 Mathematics					6–12 Mathematics				
	0 Hours	1–19 Hours	20–39 Hours	40 or More	Effect Size	0 Hours	1–19 Hours	20–39 Hours	40 or More	Effect Size*
Computation	91	95	97	97	0.26	—	—	—	—	—
Numeration and number theory	82	90	92	95	0.43	—	—	—	—	—
Estimation	83	89	92	92	0.28	90	92	92	93	0.11
Patterns and relationships	79	93	96	94	0.46	88	86	94	96	0.30
Measurement	78	87	91	93	0.44	89	90	94	95	0.23
Data collection and analysis	68	84	87	85	0.41	81	81	94	90	0.26
Geometry and spatial sense	67	83	87	87	0.49	82	80	85	89	0.20
Pre-algebra	59	72	70	75	0.34	90	84	92	92	NS
Probability	57	69	71	74	0.36	77	73	85	85	0.20
Technology in support of mathematics	50	61	63	63	0.26	55	62	65	62	0.14
Algebra	48	63	64	61	0.26	80	76	82	84	0.10
Functions and pre-calculus concepts	—	—	—	—	—	53	53	59	61	0.16
Statistics	—	—	—	—	—	47	49	58	56	0.18
Topics from discrete mathematics	—	—	—	—	—	31	39	41	40	0.19
Calculus	—	—	—	—	—	25	29	29	26	NS
Mathematics structures	—	—	—	—	—	22	32	33	25	NS

* NS = Not significant

When the various topic areas were combined into a single composite score, K–8 science teacher preparedness ratings ranged from 58 percent of total points possible for teachers with no treatment to 63 percent for those with 40 or more hours LSC professional development, a small effect size¹⁰ (0.24 standard deviations). The difference between 67 percent of total points possible with no treatment and 76 percent with 40 or more hours of K–8 mathematics treatment represents a medium effect (0.52 standard deviations), while the difference between 71 percent of total points possible with no treatment and 75 percent with 40 or more hours of 6–12 mathematics treatment represents a small effect (0.17 standard deviations). (See Figure 27.)

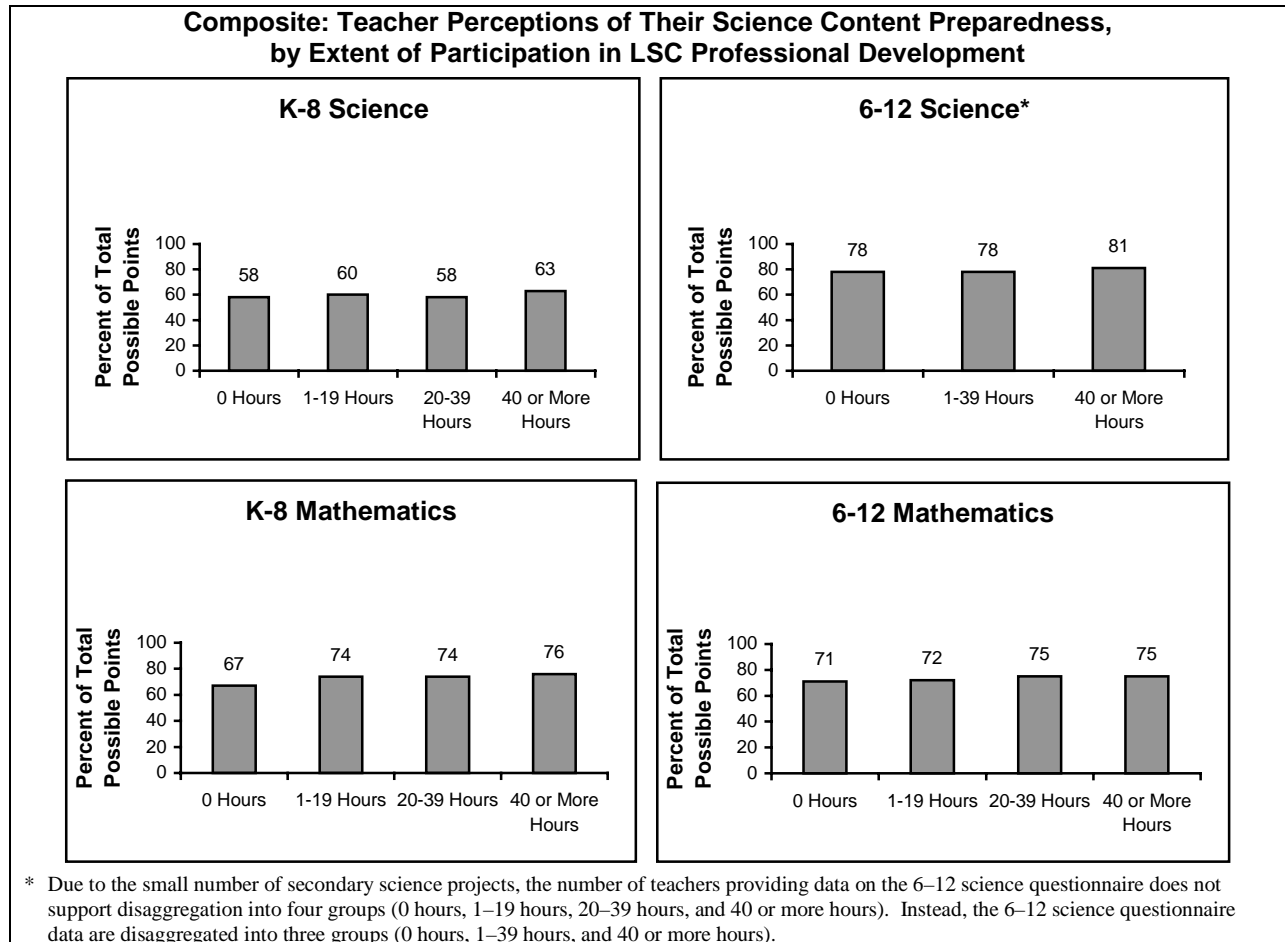


Figure 27

¹⁰ For composites, the effect size is calculated as the difference between the “0 Hours” and “40 or more hours” group means, divided by the standard deviation of the population.

Questionnaire data on individual 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 40 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.)

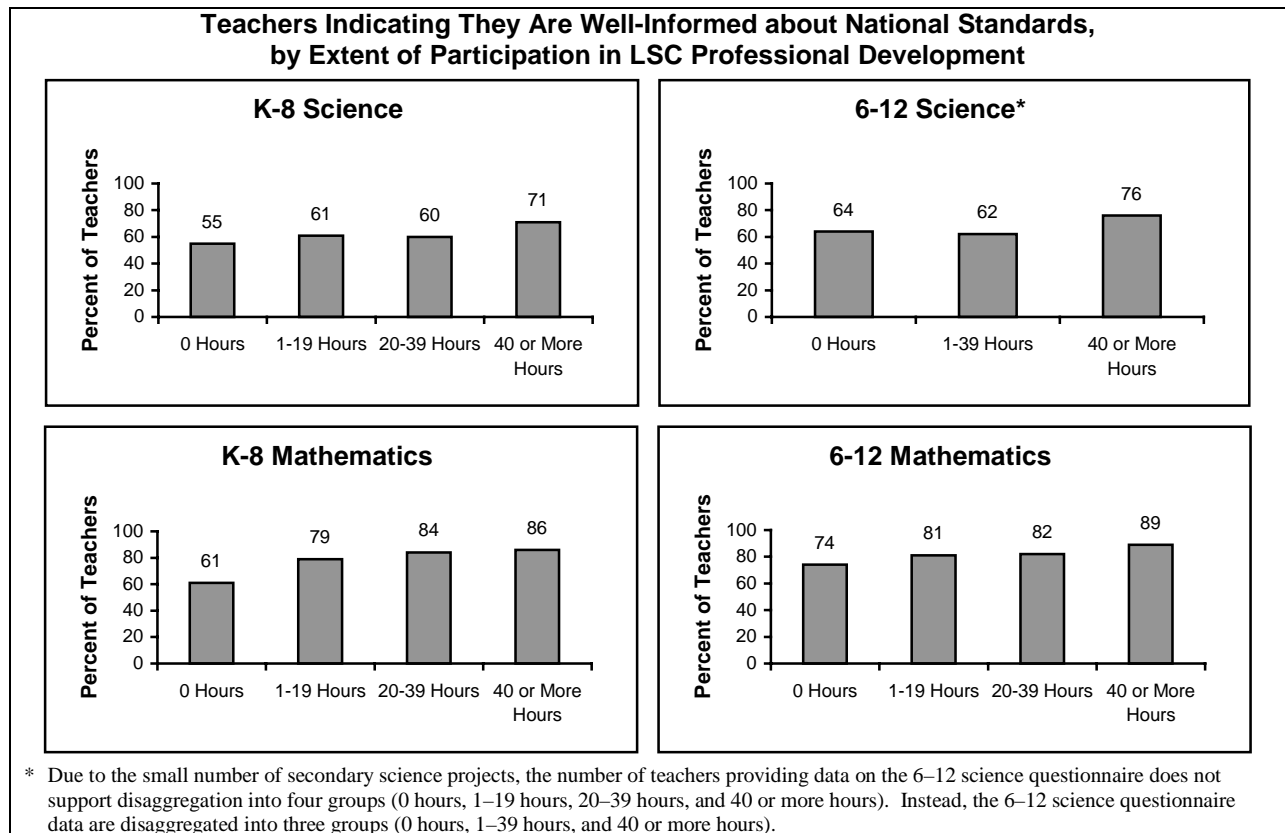
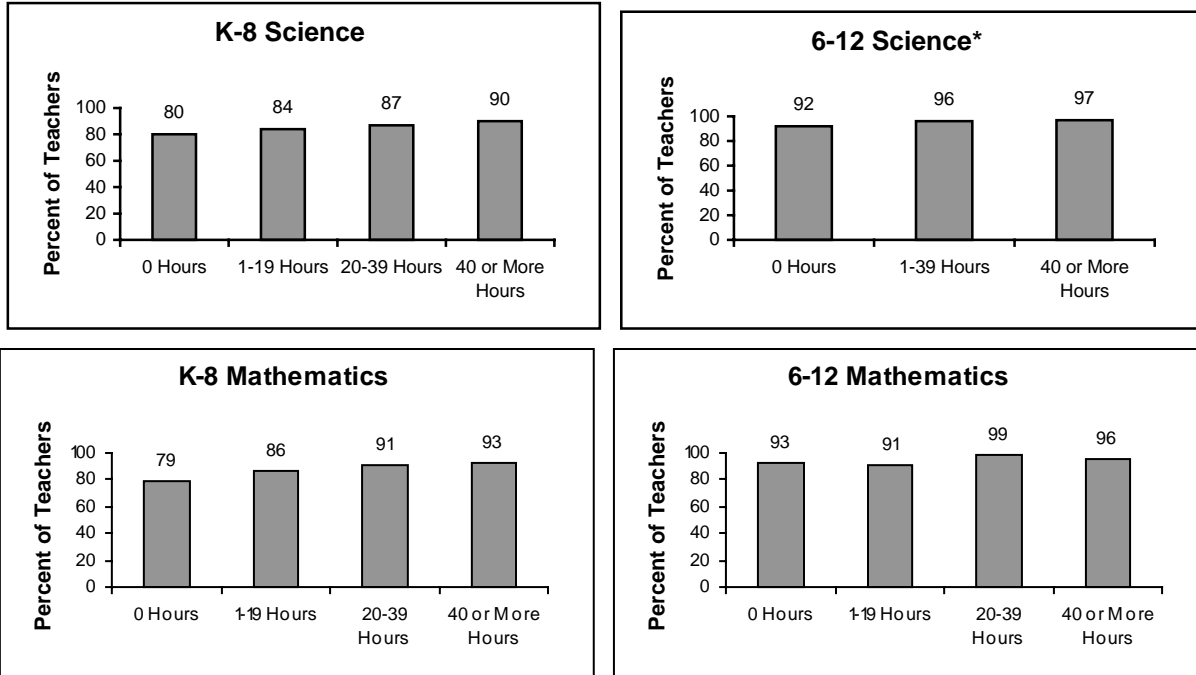


Figure 28

**Teachers Indicating They Enjoy Teaching Mathematics/Science,
by Extent of Participation in LSC Professional Development**



* Due to the small number of secondary science projects, the number of teachers providing data on the 6–12 science questionnaire does not support disaggregation into four groups (0 hours, 1–19 hours, 20–39 hours, and 40 or more hours). Instead, the 6–12 science questionnaire data are disaggregated into three groups (0 hours, 1–39 hours, and 40 or more hours).

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 five percentage points difference between untreated and highly-treated K–8 science teachers constitutes a small effect (0.41 standard deviations), the nine-point difference for K–8 mathematics teachers a medium effect (0.65 standard deviations), and the two-point difference for 6–12 mathematics a small effect (0.20 standard deviations).

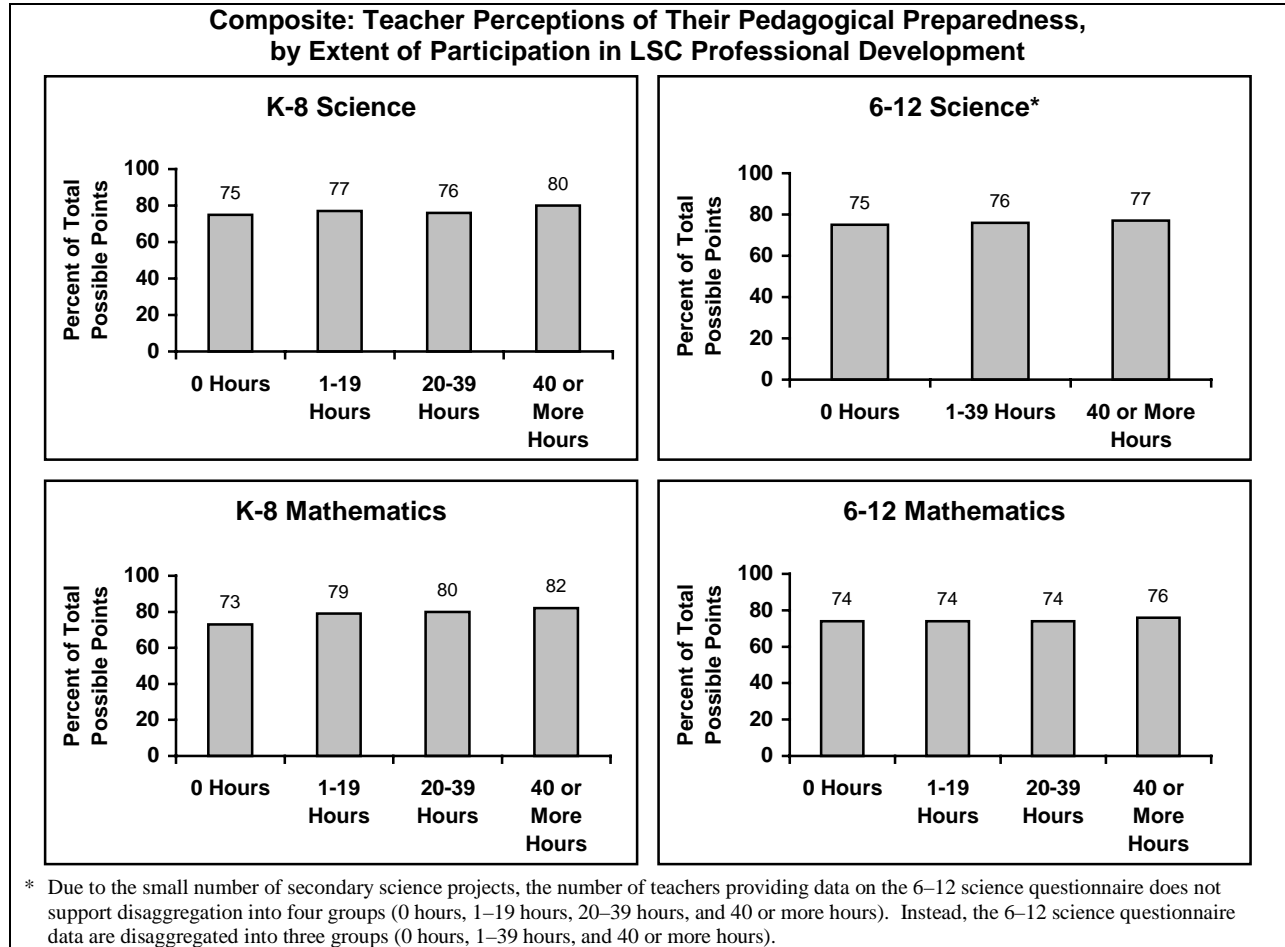


Figure 30

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. In the following sections, 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 major 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 2.5 days among untreated teachers to 3.0 days among teachers with 40 or more hours of LSC professional development.

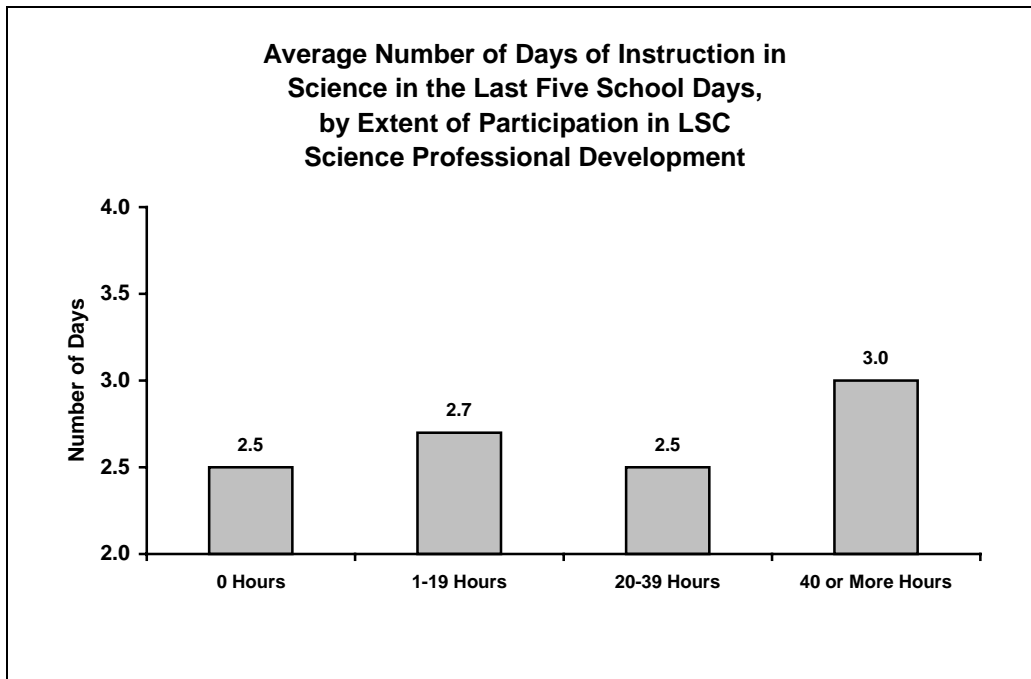


Figure 31

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, 26 percent of teachers who had participated in 40 or more hours of LSC science professional development spent 150 or more minutes on science each week, compared to only 18 percent of untreated teachers.

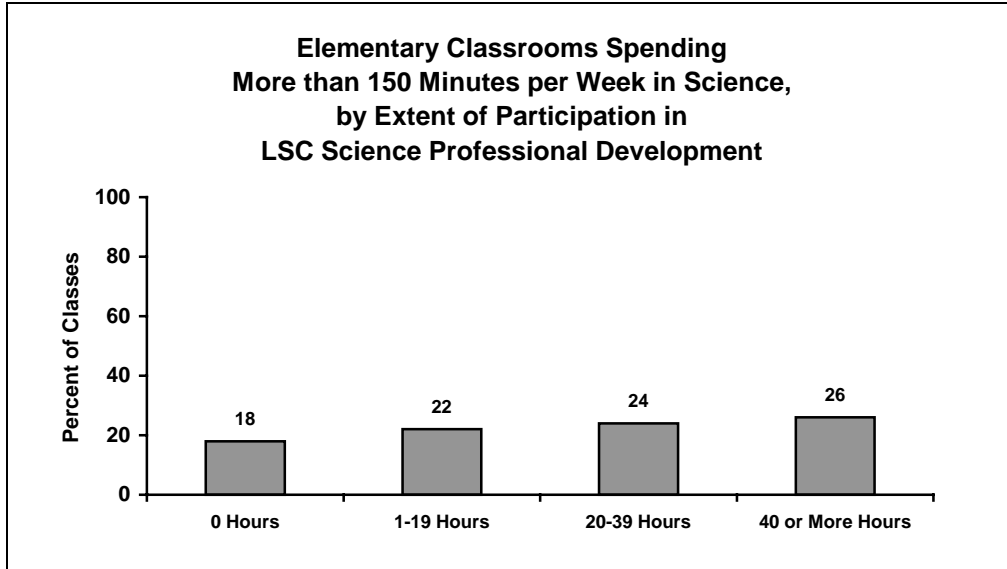


Figure 32

Highly-treated teachers also are more likely to teach six or more science units per year than untreated teachers. (See Figure 33.) As can be seen in Figure 34, the length of units increases with participation in LSC professional development, with 59 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 43 percent of untreated teachers.

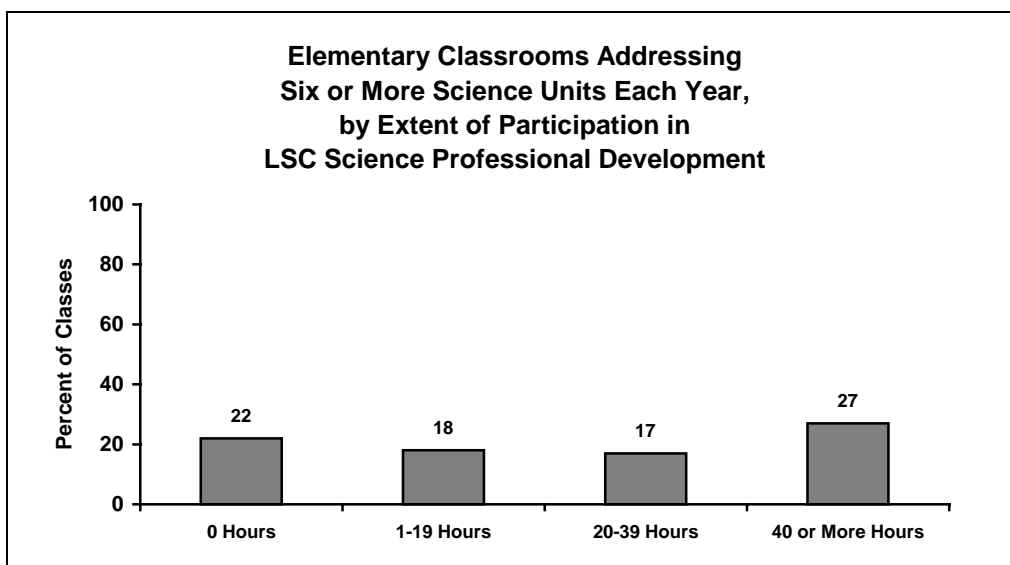


Figure 33

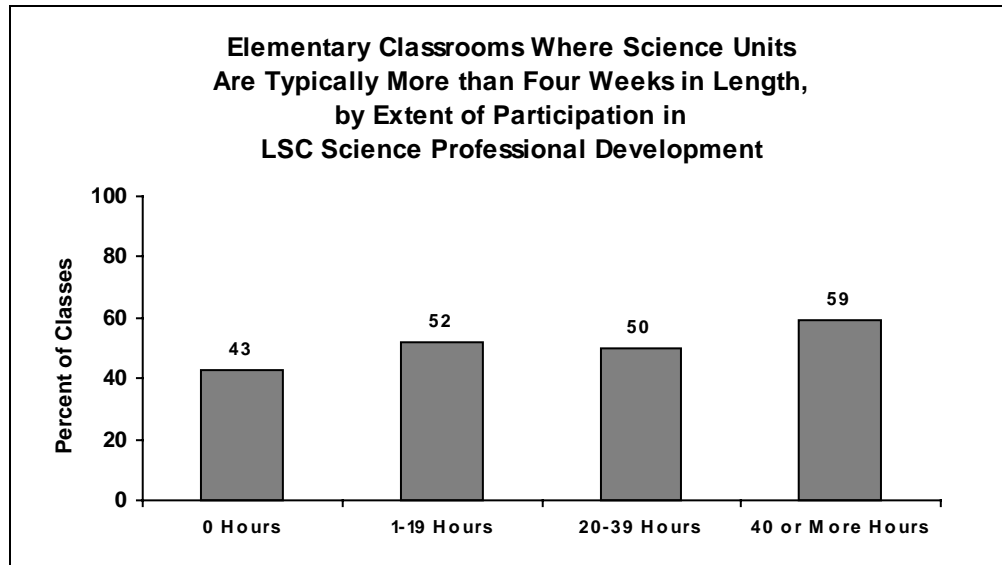


Figure 34

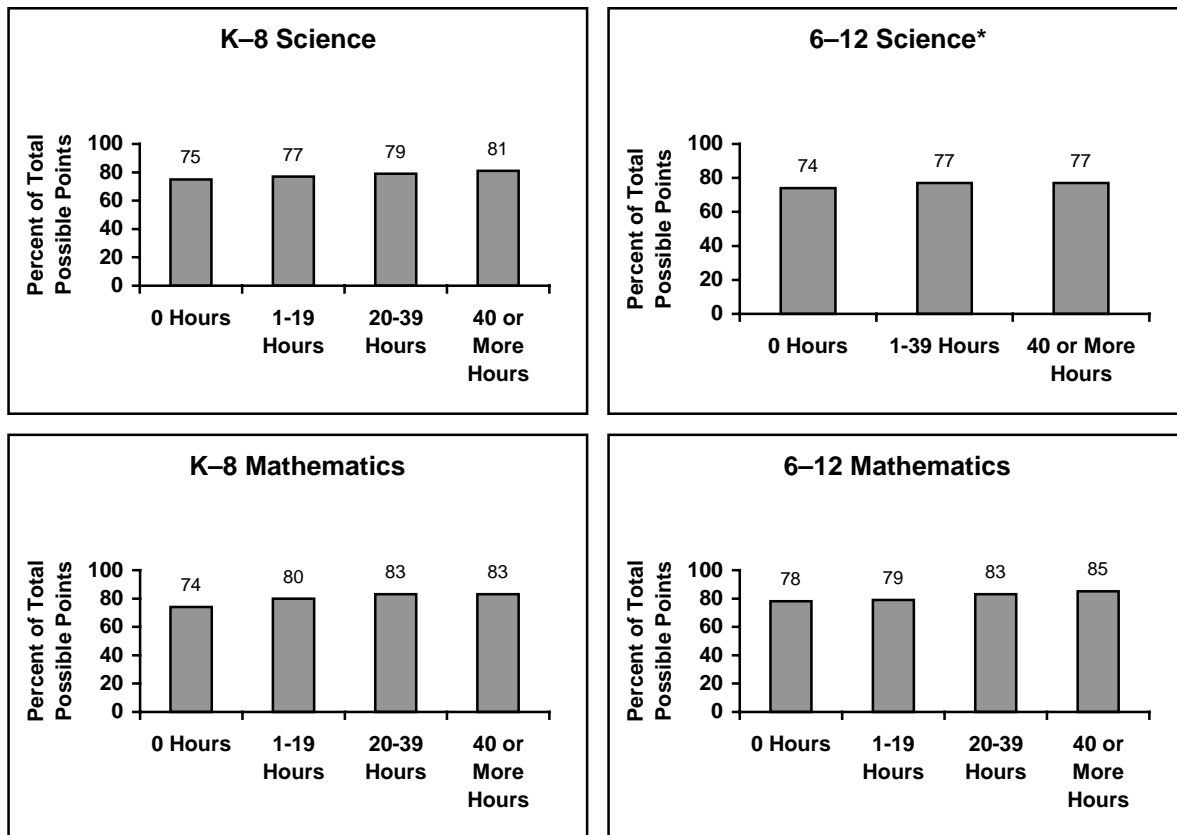
C. Instructional Strategies

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 six-point difference between untreated and highly treated teachers in K–8 science, as well as the three-point difference in 6–12 science, represent small effect sizes (approximately 0.4 and 0.2 standard deviations respectively). The nine-point difference in K–8 mathematics and the eight-point difference in 6–12 mathematics represent medium effect sizes (approximately one-half of a standard deviation in each case).

**Composite: Investigative Culture in Science/Mathematics Classes,
by Extent of Teacher Participation in LSC Professional Development**



* Due to the small number of secondary science projects, the number of teachers providing data on the 6-12 science questionnaire does not support disaggregation into four groups (0 hours, 1-19 hours, 20-39 hours, and 40 or more hours). Instead, the 6-12 science questionnaire data are disaggregated into three groups (0 hours, 1-39 hours, and 40 or more hours).

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 across all subjects, with increasing participation in LSC activities. The five-point difference in K–8 science between untreated and highly-treated teachers (0.36 standard deviations) represents a small effect size, as does the three-point difference in 6–12 science (0.20 standard deviations), the four-point difference in K–8 mathematics (0.26 standard deviations), and the four-point difference in 6–12 mathematics (0.26 standard deviations).

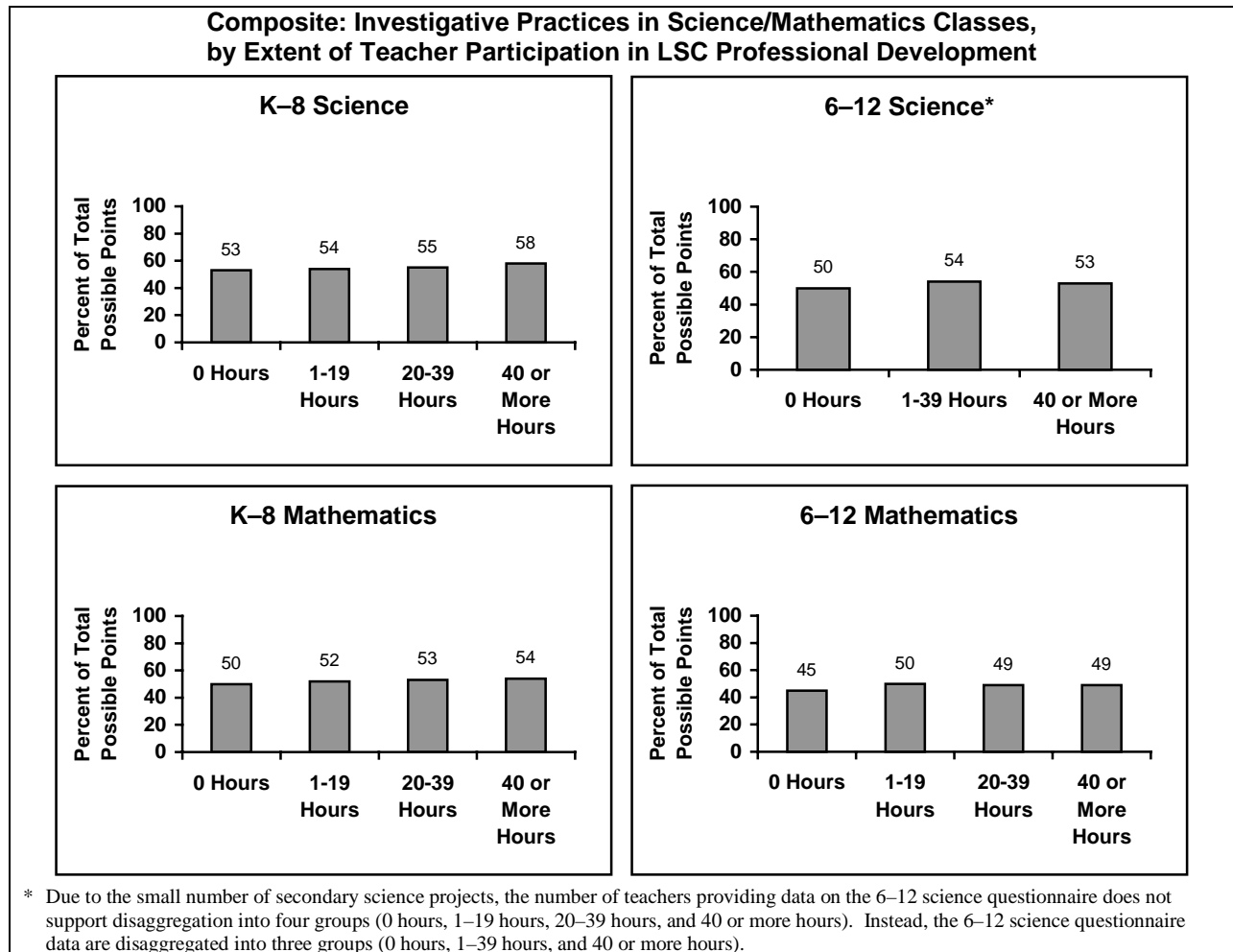


Figure 36

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 on next page.)

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) had considerably higher ratings in each area than those of teachers who had not yet participated.¹¹

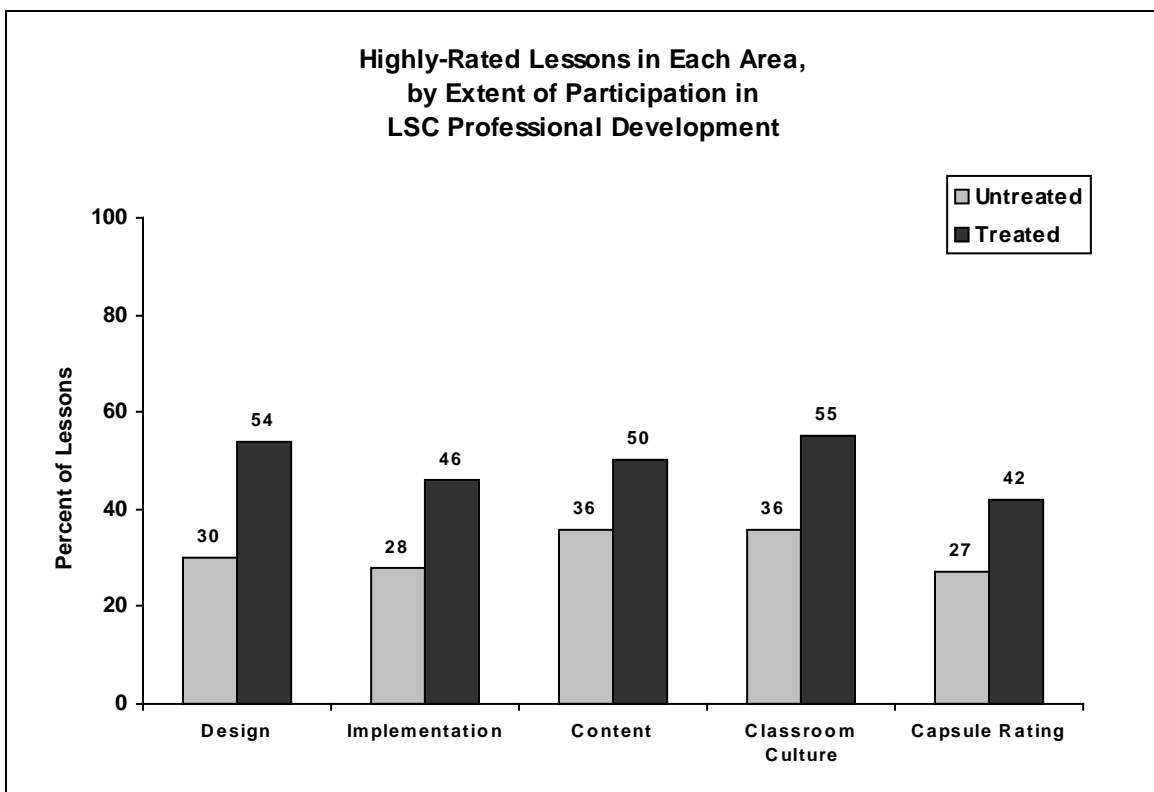


Figure 37

¹¹ While questionnaire results were typically presented for four levels of participation in LSC professional development (0, 1–19, 20–39, and 40 or more hours), the considerably smaller number of classroom observations prevented that extent of disaggregation.

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 session 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 took into account prior knowledge of students.
- 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.
- The 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.
- The 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.

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' view of mathematics/science as a dynamic body of knowledge generated and enriched by investigation, understanding of important mathematics/science concepts, capacity to carry out their own inquiries, self-confidence in doing mathematics/science, and interest in and/or appreciation for mathematics/science.

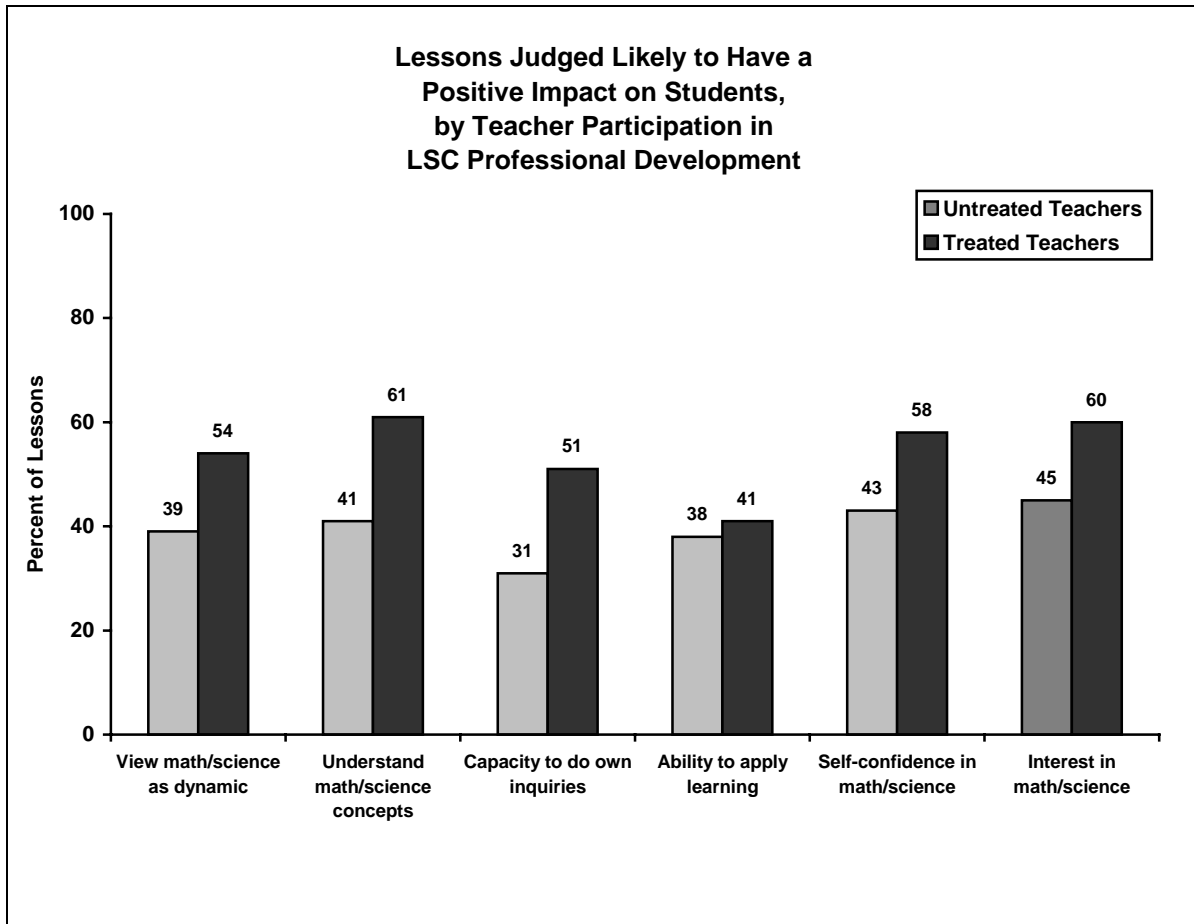


Figure 38

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

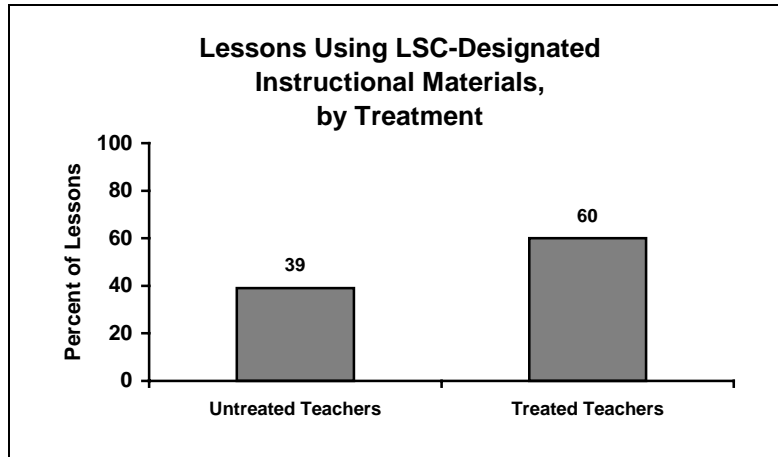


Figure 39

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 22 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 twice as likely to receive high ratings. (See Figure 40.)

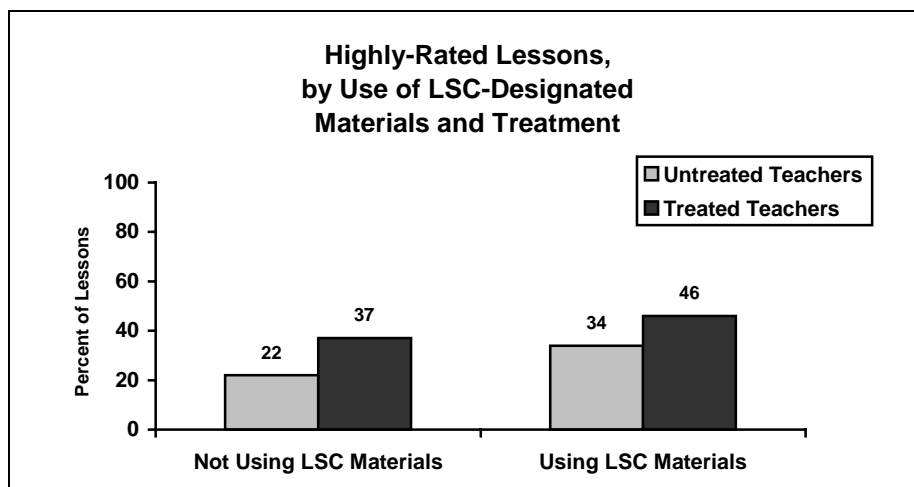


Figure 40

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. Sixty percent of the lessons that adhered closely to the materials were given high ratings (capsule ratings of 4 or 5) compared to only 10 percent of the lessons with low adherence.

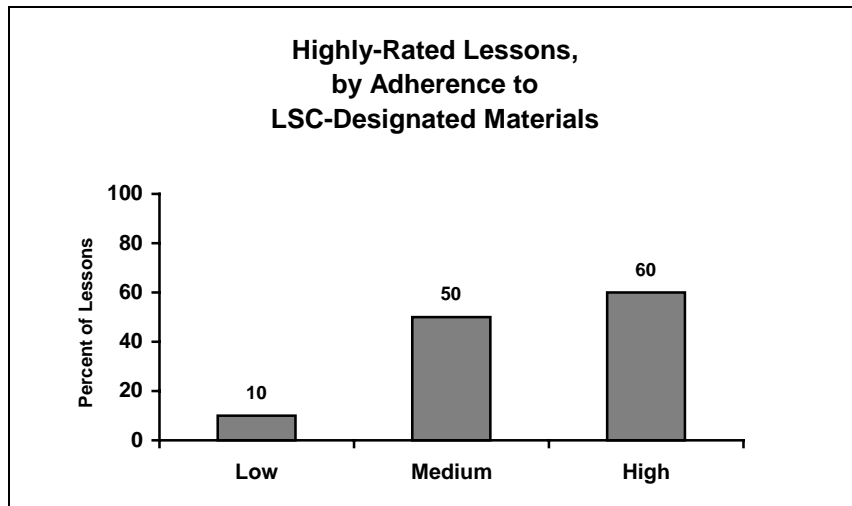


Figure 41

V. Conclusions

Results from the 2000–2001 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 the facilitators' understanding of mathematics/science concepts, the climate of respect for participants, and the fact that active participation was encouraged. The most salient weaknesses in sessions for classroom teachers were in modeling effective assessment strategies, and questioning participants in ways likely to enhance their conceptual understanding.

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, less than 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 33 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. 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 Their Teaching

Questionnaire Composite	Effect Size							
	Science				Mathematics			
	Grades K–8		Grades 6–12		Grades 6–12		Grades K–8	
	Number of SDs*	Effect Size**	Number of SDs*	Effect Size**	Number of SDs*	Effect Size**	Number of SDs*	Effect Size**
Attitudes Toward Teaching	.08	NS	.09	NS	.08	NS	.19	+
Pedagogical Preparedness	.41	+	.14	NS	.20	+	.65	++
Content Preparedness	.24	+	.17	NS	.24	+	.52	++
Investigative Culture	.40	+	.21	+	.55	++	.59	++
Investigative Practices	.36	+	.20	+	.26	+	.26	+
Use of Calculators and Computers	—	—	—	—	.39	+	.30	+

* Number of standard deviations between untreated teachers and teachers with 40 or more hours LSC professional development.

** NS = Not significant; a single “+” indicates a small positive effect; a double “++” indicates a medium positive effect.

Report Available on the Web

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

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