

# **HIGHLIGHTS**

## **OF THE Local Systemic Change through Teacher Enhancement**

### **Year Three Cross-Site Report**

By

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## **Introduction**

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 and 20 more in 1997, for a total of 46 projects in Cohorts 1, 2, and 3.

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 in a K–8 project is to participate in a minimum of 100 hours of professional development; for projects targeting teaching in grades 6–12, the minimum is 130 hours over the course of the project. 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 current 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 a cross-site analysis of the evaluation results.

### ***An Overview of Cohorts 1, 2, and 3***

Project data sheets completed by the principal investigators (PIs) provide some basic information about the 46 LSC projects included in Cohorts 1, 2, and 3.

- In 1996–97, the LSC initiative included 25 K–8 science projects, 5 K–8 mathematics projects, 9 secondary mathematics projects, 4 projects that targeted both elementary mathematics and science, and 3 projects that targeted both elementary and secondary mathematics.

- Nineteen of the 46 LSC projects are single-district projects; at the other end of the scale, 3 projects involve more than 20 districts.
- Thirty-four of the 46 LSC projects are five-year projects, 8 are four-year, and 4 are three-year.
- The 46 LSC projects plan to involve a total of approximately 40,000 teachers in more than 2,000 schools in 263 districts across the United States.
- By the completion of these projects, an estimated 1,356,000 students will receive instruction from LSC-treated teachers each year.

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

HRI has 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 in response to six core evaluation questions.

#### **LSC Core Evaluation Questions**

1. What is the overall quality of the LSC professional development activities?
2. What is the extent of school and teacher involvement in LSC activities?
3. What is the impact of the LSC professional development on teacher preparedness, attitudes, and beliefs about mathematics and science teaching and learning?
4. What is the impact of the LSC professional development on classroom practices in mathematics and science?
5. To what extent are school and district contexts becoming more supportive of the LSC vision for exemplary mathematics and science education?
6. What is the extent of institutionalization of high-quality professional development systems in the LSC districts?

Data collection activities for the projects' 1996–97 Core Evaluation Reports were conducted from September 1, 1996 through August 31, 1997. Cohort 3 projects were collecting baseline data for their first year of funding; this was the second year of data collection for Cohort 2 projects and the third year for Cohort 1 projects. Data collection activities included the following:

#### **1. Observations of professional development activities**

The core evaluation calls for projects to conduct 5–8 observations of professional development sessions each year and record their observations on standardized protocols. Evaluators were to consult with PIs on what professional development experiences were planned throughout the data collection year, and select a sample that was representative of the diversity of the project's activities. Program-wide, a total of 276 observations of professional development sessions were conducted.

## **2. Classroom observations**

HRI provided the lead evaluator of each project with a list of 10 randomly selected teachers for each targeted subject. These teachers were to be observed in the spring of 1997. There was a total of 517 classrooms observed, including 299 classes taught by teachers who had participated in at least 20 hours of LSC professional development, and 218 classes as baseline for Cohort 3 projects.

## **3. Teacher questionnaires**

Each project was asked to administer teacher questionnaires developed for the core evaluation to a sample of 300 teachers per targeted subject; the median response rate was 84 percent. A total of 10,054 teacher questionnaires were returned to HRI, including 6,126 from K–8 science teachers; 2,347 from K–8 mathematics teachers; and 1,581 from 7–12 mathematics teachers.

## **4. Principal questionnaires**

Projects were also 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, with a median response rate of 92 percent; a total of 1,905 principal questionnaires were returned.

## **5. Teacher interviews**

Evaluators of each Cohort 1 and Cohort 2 project 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 249 interviews were conducted among the 26 projects. About two-thirds of the interviews were conducted by phone, and the remaining one-third in person.

Project evaluators were asked to report their findings using guidelines developed for the core evaluation system, including responding to the six core evaluation questions. Evaluators were also asked to provide overall ratings of the quality of professional development activities, the supportiveness of the context, and the sustainability of high-quality professional development systems.

## **Participation in LSC Activities**

LSC projects are responsible for serving all of the teachers who teach the targeted subject and grade range, rather than only those who volunteer to participate. Data on participation in LSC professional development activities come from teacher and principal questionnaires.

Evaluators report that most LSC projects are on schedule for providing in-depth professional development to all teachers in the targeted subjects and grades. To date, the population of elementary teachers participating in LSC professional development activities closely mirrors the overall targeted population in these districts in terms of teacher gender, race/ethnicity, and course

background preparation. In contrast, secondary mathematics projects appear to be starting with relatively less well-prepared teachers in the middle rather than the high school grades.

Based on their responses to core evaluation questionnaires, a substantial proportion of principals is neither involved in nor knowledgeable of LSC activities. However, a number of evaluators pointed out that principals they know to have been involved indicated otherwise on the core evaluation questionnaires, perhaps not associating those activities with the term “LSC program.”

A more serious concern is the fact that a few projects appear to have redefined targeted teacher population to mean those who are *willing* to participate, which is clearly inconsistent with the intent of the LSC initiative.

## **Quality of LSC Professional Development Programs**

Project evaluators were asked to observe 5–8 professional development activities for the core evaluation. Evaluators and PIs were to decide, jointly, which activities would be observed, selecting sessions to represent the diversity of the project’s professional development program and to reflect the extensiveness and importance of the various activities offered.

### ***Description of Observed Sessions***

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

The typical professional development session observed for the LSC core evaluation had between 21 and 50 participants. Some sessions exclusively targeted lead teachers (22 percent); other sessions targeted non-lead teachers (47 percent); and some sessions targeted both lead and non-lead teachers (27 percent). A total of 12 percent of the sessions included principals or other administrators.

LSC professional development involves presenters/facilitators from a variety of settings. Lead teachers served in this capacity in 40 percent of the observed sessions, while only 27 percent of the sessions included university faculty as presenters or facilitators. Two-thirds of the presenters/facilitators were female, 87 percent were white, 8 percent African-American, 3 percent Hispanic, and 2 percent Asian or Pacific Islander.

Evaluators were asked to indicate the major intended purposes of each observed session based on information provided by the session facilitators. As can be seen in Table 1, the most frequently cited purposes were working on classroom pedagogy issues and enhancing teachers’ understanding of science/ mathematics concepts.

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

	Percent of Sessions			
	All Sessions	K-8 Science	K-8 Mathematics	7-12 Mathematics
<b>Working on classroom pedagogy issues*</b>	<b>75</b>	<b>77</b>	<b>69</b>	<b>75</b>
Learning about specific instructional materials	38	37	31	51
Learning pedagogical/classroom management strategies	36	37	39	30
Creating a vision of learning through investigation	35	39	27	30
Designing/scoring student assessments	9	11	6	4
Considering issues of access, equity, and diversity	6	7	4	4
<b>Increasing teacher mathematics/science content knowledge</b>	<b>40</b>	<b>37</b>	<b>39</b>	<b>49</b>
<b>Promoting reflective practice</b>	<b>17</b>	<b>18</b>	<b>10</b>	<b>19</b>
<b>Developing teacher leaders</b>	<b>15</b>	<b>14</b>	<b>15</b>	<b>15</b>
<b>Building professional networks among educators</b>	<b>14</b>	<b>14</b>	<b>12</b>	<b>15</b>
<b>Orientation to the project</b>	<b>14</b>	<b>13</b>	<b>23</b>	<b>11</b>
<b>Developing capacity of participants to use technology</b>	<b>5</b>	<b>5</b>	<b>2</b>	<b>9</b>

\* Percents add to more than total for category because sessions could include more than one purpose.

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 that had a disciplinary content focus dealt with physical science concepts (46 percent), nearly that many with life science content (41 percent), and somewhat fewer with concepts from the earth and environmental sciences (32 percent).

In projects targeting K-8 mathematics, the most heavily emphasized topics were patterns and relationships (32 percent of the sessions that dealt with disciplinary content), numeration and number theory (29 percent), and data collection and analysis (23 percent).

The most commonly emphasized topics in sessions for 7-12 mathematics teachers were patterns and relationships, algebra, and geometry/spatial sense, each the focus of about 30 percent of the sessions that dealt with disciplinary content.

Most of the observed LSC professional development sessions included several different instructional strategies. Most sessions included discussions or seminars (83 percent). Roughly two-thirds of sessions included formal presentations and a similar proportion included investigative/problem solving activities.

***Observer Ratings of LSC Professional Development Sessions***

In order to assess the quality of professional development sessions, observers were asked to rate a number of components for each session they observed.

## **1. Design**

For design of the professional development sessions, the indicators that most often received high ratings were: the extent to which the session design reflected careful planning and organization; how well the session encouraged a collaborative approach to learning and incorporated tasks and interactions consistent with a spirit of investigation; and the appropriateness of strategies used in the session for accomplishing the purposes of the LSC professional development.

## **2. Implementation**

In the area of implementation of professional development activities, indicators most frequently rated high were: whether the facilitator's background and expertise or management style enhanced the quality of the session and the extent to which the session incorporated instructional strategies appropriate for its purposes and the needs of adult learners.

## **3. Content**

Observers 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 176 of the 276 sessions; these 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; the extent to which the facilitators displayed an understanding of mathematics/science content; and the soundness and appropriateness of mathematics/science content.

Observers rated 198 of the 276 observed professional development sessions on the quality of their pedagogical content. As was the case for quality of disciplinary content, these sessions tended to be highly rated for: the appropriateness of the pedagogical content for the purposes of the session and the background of the participants and the extent to which the facilitator displayed an understanding of pedagogical concepts.

## **4. Culture**

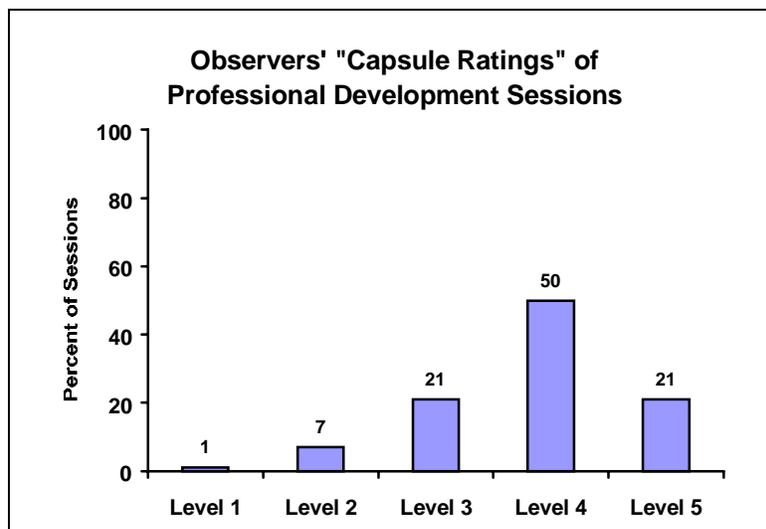
The literature on effective staff development emphasizes the importance of establishing a professional development culture where teachers can explore content and pedagogy in a collegial, risk-free environment, and most observed LSC professional development sessions were successful in this regard. Indicators that were most likely to receive high ratings included: whether active participation of all was encouraged and valued; the extent to which there was a climate of respect for participants' experiences, ideas, and contributions; the extent to which interactions reflected collaborative working relationships among participants and between facilitators and participants; and whether participants were intellectually engaged with important ideas relevant to the focus of the session .

## **5. Leadership**

Most of the LSC projects have chosen to develop teacher leaders as part of their strategy for reaching large numbers of teachers, and 43 of the 276 observed sessions focused specifically on leadership content, such as planning and implementing effective

professional development sessions. These sessions were most likely to receive high ratings for: the extent to which the facilitators displayed an understanding of leadership concepts; whether the leadership content was sound and appropriately presented; and the extent to which the leadership content was appropriate for the purposes of the session and the backgrounds of the participants.

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 7 percent were rated at Level 2, having quite limited likelihood of helping participants implement exemplary mathematics/science instruction or be leaders in reform. Overall, 71 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 1.)



*Figure 1*

### ***Teacher Ratings of LSC Professional Development Programs***

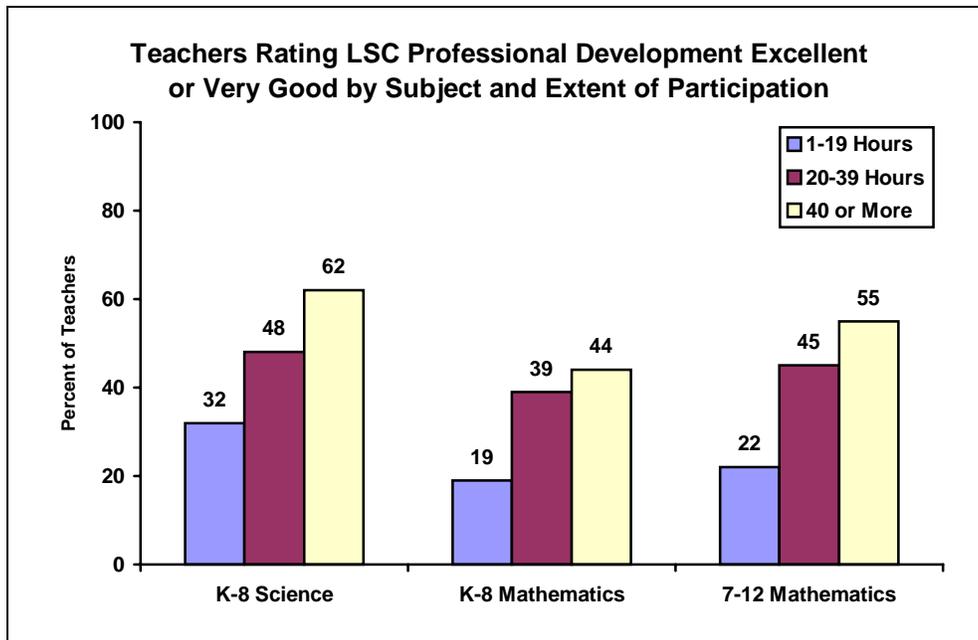
While observations were the main source of information on the quality of LSC professional development, information was also gathered from the participating teachers via questionnaires and interviews. On teacher questionnaires, LSC participants described the extent to which a variety of features characterized the LSC professional development, rating each item on a scale ranging from 1, “not at all” to 5, “to a great extent.” Table 2 shows the percent of teachers rating the LSC professional development high (4 or 5 on the five-point scale), medium (a rating of 3), and low (a rating of 1 or 2) on each of several items. Note that the LSC received highest marks for providing both opportunities for professional development and support for teachers as they implement what they have learned; still only about half of the participating teachers gave the LSC ratings of 4 or 5 on these items.

**Table 2**  
**Teacher Ratings of LSC Professional Development\***

	Percent of Teachers		
	High	Medium	Low
Adequate opportunities are available to me for mathematics/science-related professional development.	54	31	15
I receive support as I try to implement what I've learned.	46	31	23
I am encouraged to develop an individual professional development plan to address my needs and interests related to mathematics/science education.	35	29	36
I am involved in planning my mathematics/science-related professional development.	33	26	41
I am given time to work with other teachers as part of my professional development.	26	27	47
I am given time to reflect on what I've learned and how to apply it to the classroom.	25	30	45

\* Only teachers who had participated in LSC professional development were included in these analyses.

It is interesting to note that the more time teachers had spent in LSC professional development, the more highly they rated it. (See Figure 2.)



*Figure 2*

### ***Evaluators' Overall Ratings of the LSC Professional Development Programs***

Using the observation results, as well as teacher questionnaire and interview data, evaluators then rated the overall quality of the professional development program, noting particular strengths and areas in need of additional attention. Evaluators indicated the following as key strengths in the programs:

- LSC projects are frequently framed around national standards, creating a common vision among participants.
- LSC professional development sessions are typically reflective of best practice, tightly linked to exemplary instructional materials, modeling appropriate instructional strategies, and making explicit connections to classroom practice.
- Most facilitators demonstrate knowledge and skill in implementing the LSC professional development.
- LSC projects typically provide a collegial learning environment and support as teachers implement what they have learned.
- Many LSC projects are enhanced by systemic features that attend to the larger context.

Evaluators also mentioned areas that needed further attention:

- Some projects provided insufficient time for teachers to reflect, discuss, and share ideas with one another.
- Some projects needed to keep more of a focus on key mathematics and science concepts.
- Some projects needed to enhance the “systemic-ness” of project design and implementation.

It is interesting to note that while observers typically gave high ratings to the quality and likely impact of individual leadership development sessions, they were less impressed with the overall quality of the project's handling of leadership content. Only 40 percent of the projects were rated highly (4 or 5 on a five-point scale) with regard to leadership content, compared to more than 70 percent of projects receiving high ratings in each of the other component areas.

Evaluators identified a number of key components that were important for effective professional development for teacher leaders. They included:

- Providing a supportive culture;
- Clearly communicating expectations of teacher leaders;
- Balancing attention to disciplinary, pedagogical, and leadership content;
- Giving teachers opportunities to practice leadership roles;
- Providing teacher leaders with ongoing support;
- Broadening teacher leaders’ professional experience; and
- Fostering administrative support for teacher leaders.

As a culminating task in their analysis, evaluators were asked to place each project on a five-level continuum describing the quality of the professional development program. As can be seen in Table 3, none of the 46 projects was rated at Level 1 (Predominance of Ineffective Professional Development), and only 1 project was considered to be at the Level 2, “Exploring” stage. Nine projects were rated at Level 3 (Transitioning to Quality Professional Development). Twenty-six projects were rated at Level 4 (Emerging Infrastructure of Well-Designed Professional Development), indicating that their professional development plan and activities incorporated many features reflective of current standards-based approaches, that the professional development activities were well-implemented, and that in the evaluator’s judgment they will likely enhance participants’ capacity to provide high quality mathematics/science instruction to their students. The final 10 projects (22 percent) were rated at Level 5, indicating consistently excellent quality.

**Table 3**  
**Continuum Ratings for Quality of LSC Professional Development**

	Percent of Projects*			
	All Projects	K-8 Science	K-8 Mathematics	7-12 Mathematics
<b>Level 1:</b> Predominance of Ineffective Professional Development	0	0	0	0
<b>Level 2:</b> Exploring Quality Professional Development	2	3	0	0
<b>Level 3:</b> Transitioning to Quality Professional Development	20	28	8	0
<b>Level 4:</b> Emerging Infrastructure of Well-Designed Professional Development	57	48	67	75
<b>Level 5:</b> Predominance of Well-Designed Professional Development	22	21	25	25
<b>Mean Continuum Rating Level</b>	4.0	3.9	4.2	4.3

\* Projects that address two subject areas are included in each subject, but counted only once in the total of all projects.

## Current Status of Teachers' Beliefs and Practices

As part of the core evaluation process, considerable data were collected about mathematics and science instruction in the LSC districts. From the teacher questionnaires, teacher interviews, and classroom observations, information was obtained concerning teacher beliefs and practices.

### *Description of Targeted Teachers' Beliefs and Practices*

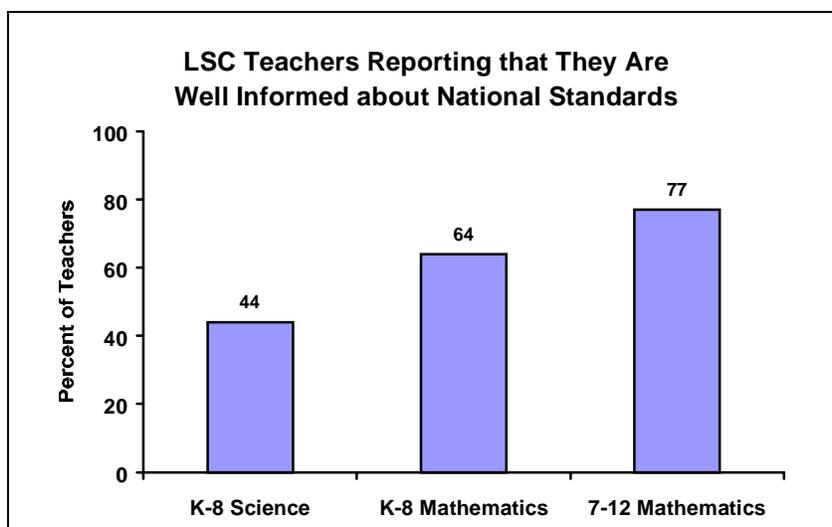
The cross-site data analyzed for this report support many of the findings of the previous year. As can be seen in Table 4, teachers generally report positive attitudes toward teaching mathematics and science, and they feel supported by colleagues to try out new ideas. Although they frequently share materials and ideas with their colleagues, there is little time set aside during the school week to work with peers.

**Table 4**  
**Teacher Opinions about Mathematics/Science Teaching**

	Percent of Teachers Agreeing			
	All Teachers	K-8 Science	K-8 Mathematics	7-12 Mathematics
I enjoy teaching mathematics/science.	88	86	92	96
I feel supported by colleagues to try out new ideas in teaching mathematics/science.	81	80	81	85
Teachers in this school regularly share ideas and materials related to mathematics/science.	63	62	63	68
Teachers in this school have a shared vision of effective mathematics/science instruction.	57	55	59	61
Teachers in this school are well-supplied with materials for investigative mathematics/science instruction.	53	50	61	45
I have time during the regular school week to work with my peers on mathematics/science curriculum and instruction.	16	14	19	18

Figure 3 shows the percentage of teachers in each group indicating that they are “well informed” about the National Science Education Standards/National Council of Teachers of Mathematics (NCTM) Standards. Secondary mathematics teachers were most likely, and elementary science teachers least likely, to report being familiar with national standards.

While they may not be familiar with the standards documents *per se*, most LSC elementary teachers, report attitudes and beliefs that are in fairly close alignment with standards-based instruction. Overall, more than two-thirds of the teachers indicated it was very important for students to participate in hands-on, inquiry-oriented mathematics and science instruction, and to make connections between these and other disciplines. Interestingly, secondary teachers were less likely than elementary teachers to consider these strategies to be of great importance. It is also interesting to note that substantial numbers of teachers do not feel well prepared to implement some of the strategies that they consider important.



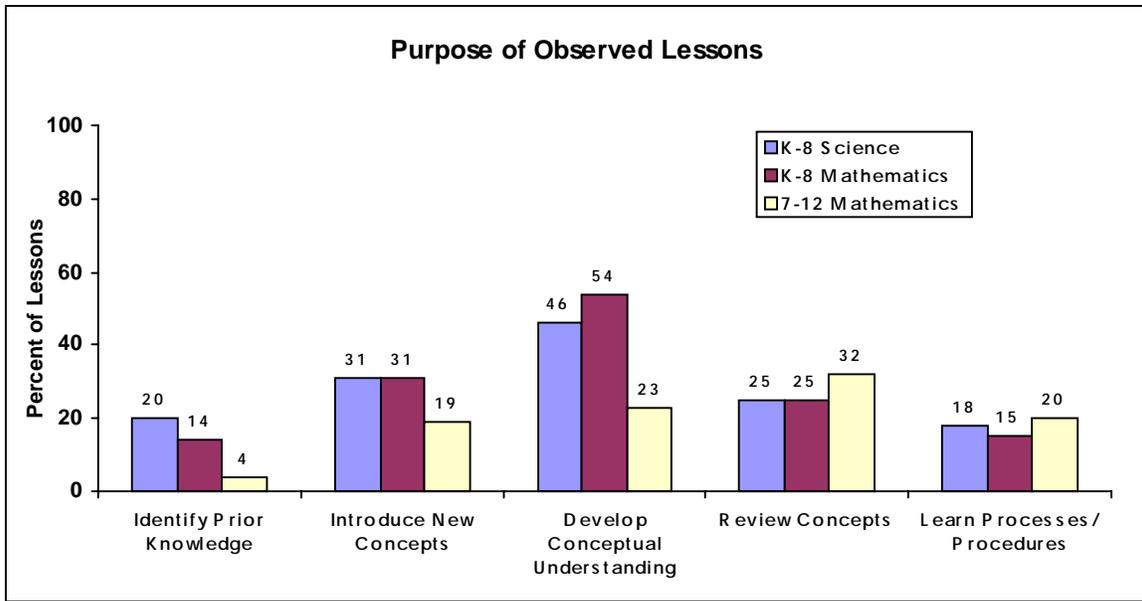
*Figure 3*

Elementary teachers also reported on the number of the last five school days they had taught each of several subjects. Due to the emphasis on reading and mathematics in the elementary curriculum, and perhaps also due in part to teachers' feelings of preparedness, science is taught less frequently than either reading or mathematics. On the average, reading and language arts were taught 4.7 of the 5 most recent days school was in session, while mathematics was taught on an average of 4.6 days, science 2.8 days, and social studies 2.7 days.

***Observers' Descriptions of Classroom Practice***

Trained observers in each project were to observe 10 randomly selected classrooms. For Cohorts 1 and 2, the teachers to be observed had already participated in at least 20 hours of professional development provided by the project. A total of 519 classes were observed, including 292 science classrooms; 198 K–8 mathematics classrooms; and 29 7–12 mathematics classrooms. These observations provided information on student demographics, the physical environment, purposes and disciplinary content of the lessons, class activities, and the quality of the lesson in relation to the LSC vision for exemplary instruction.

The observer talked with the teacher before and after observing each class to find out about both the intended purpose of the lesson and whether these purposes shifted during the lesson for any reason. As can be seen in Figure 4, roughly half of the K–8 mathematics and science teachers, but only 23 percent of the 7–12 mathematics teachers, reported a major focus on developing conceptual understanding.



*Figure 4*

Observers documented the use of instructional materials from a variety of sources, including traditional textbooks or worksheets, materials developed by another school district, or teacher developed materials. However, the majority of the observed lessons made use of LSC-designated materials.

Evaluators were given a checklist of possible class activities and asked to indicate the ones that were included in the observed lesson. Elementary mathematics and science lessons were more likely to include hands-on activities and class discussions than formal presentations by the teachers. In contrast, grade 7–12 mathematics teachers were as likely to use investigative activities as they were to use formal presentations. (See Table 5.)

**Table 5**  
**Instructional Activities in Observed Classes**

	Percent of Lessons		
	K-8 Science	K-8 Mathematics	7-12 Mathematics
<b>Investigative activity</b>	<b>81</b>	<b>88</b>	<b>68</b>
Hands-on	78	54	14
Problem-solving/proof and evidence	17	62	59
<b>Class discussion</b>	<b>61</b>	<b>57</b>	<b>26</b>
<b>Formal presentation by teacher</b>	<b>49</b>	<b>54</b>	<b>76</b>
<b>Reading/writing/reflection</b>	<b>48</b>	<b>37</b>	<b>49</b>

### *Observers' Ratings of Lessons*

For Cohorts 1 and 2, evaluators observed lessons taught by teachers who had already participated in LSC professional development. Many of these lessons were quite strong (ratings of 4 or 5 on a five-point scale) in the extent to which:

- Active student participation was encouraged and valued (74 percent);
- The content was appropriate for the purposes of the lesson and developmental level of the class (68 percent);
- The mathematics/science content was significant and worthwhile (67 percent);
- Teacher-presented information was accurate (67 percent);
- The teacher was confident in his-her ability to teach mathematics/science (67 percent);
- The teacher was cognizant of prior knowledge of students (66 percent); and
- There was a climate of respect for students' ideas, questions, and contributions (65 percent).

In contrast, relatively few of these classes were highly rated for the extent to which:

- Adequate time and structure were provided for reflection (37 percent);
- Appropriate connections were made to other areas of mathematics/science, to other disciplines, and/or to real-world contexts (37 percent);
- Intellectual rigor, constructive criticism, and the challenging of ideas were valued (36 percent);
- The lesson was modified as needed, based on teacher questioning or other student assessments (33 percent);
- The teacher's questioning strategies were likely to enhance the development of student conceptual understanding (31 percent); and
- The degree of closure or resolution of conceptual understanding was appropriate for the developmental levels/needs of the student and the purposes of the lesson (22 percent).

## Impact of LSC Activities

Two of the 6 core evaluation questions address the impact of the LSC on teachers and teaching. One focuses on the impact on teacher preparation, attitudes, and beliefs; and the other on the impact on classroom practices.

### *Impact From the Teachers' Point of View*

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.” Each composite represents an important construct related to one of the key evaluation questions.<sup>1</sup>

Results showed that teachers who had participated in 40 or more hours of LSC professional development were more likely than non-participants to:

- Feel well prepared in both content and pedagogy;
- Establish an investigative culture in the classroom;
- Use investigative instructional strategies; and
- Use calculators and computers in mathematics instruction.

In interviews, teachers indicated that the LSC had had considerable impact, particularly in the areas of curriculum and instruction. Also, the amount of impact generally increased with time spent in LSC activities. (See Table 6.)

**Table 6**  
**Teachers Reporting Extensive Positive Impacts of the LSC in Each Area by Level of Involvement in LSC Professional Development**

	Percent of Teachers		
	All Teachers	Less Than 10 Days	10 Days or More
Instruction	65	63	69
Curriculum	63	60	68
Confidence	58	55	63
Beliefs	53	52	55
Assessment	48	43	52
Leadership	38	20	56

### *Principals' Impressions of Impact*

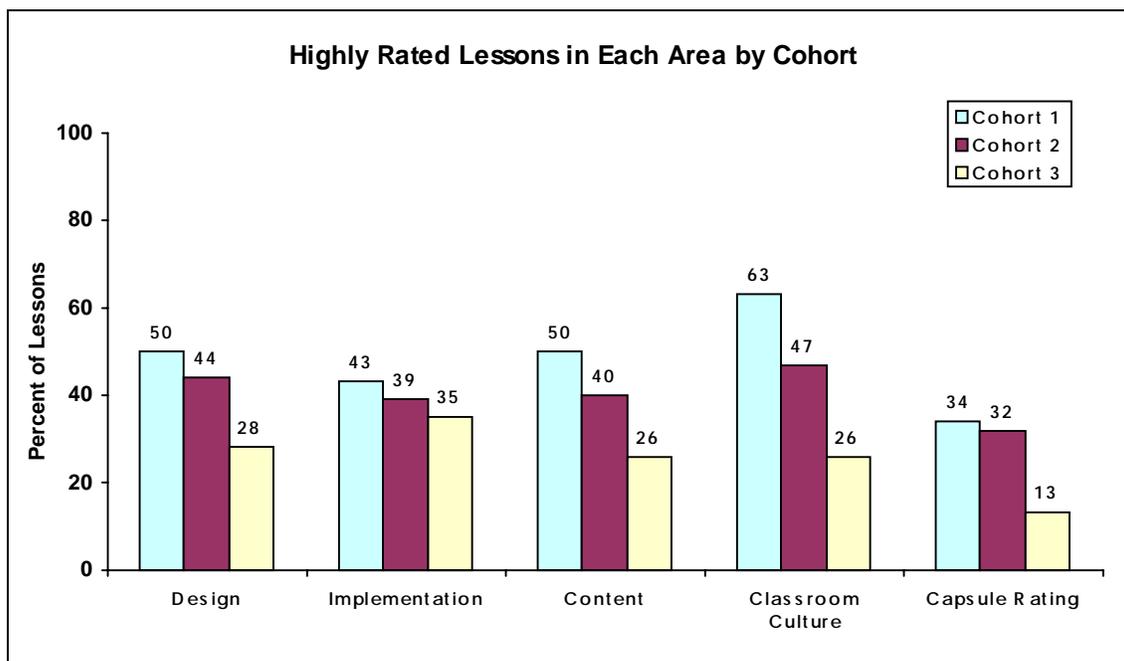
Principals in schools targeted by LSC projects were asked to complete questionnaires. Among other items, they were asked to rate: (1) the level of their school's current involvement in the LSC, (2) the extent to which their teachers were using the LSC-specified instructional materials, and (3) the extent to which teachers were using the LSC-advocated instructional strategies with their students. Fifty-six percent of the principals involved in K–8 science projects in Cohort 1 and

<sup>1</sup> For a full definition of how composites are calculated, see the technical report.

Cohort 2, and 59 percent of those in K–8 mathematics projects felt that their schools were at least “well along in improving” their science education.

***Impact as Measured by LSC Evaluators***

By looking at the synthesis and capsule ratings of the three different cohorts, it is possible to get an indication of impact of the LSC programs. While Cohort 1 and Cohort 2 contained teachers that have received at least 20 hours of LSC professional development, Cohort 3 teachers have not yet received 20 hours of professional development. As can be seen in Figure 5, lessons of teachers in all cohorts were rated similarly for the quality of their implementation. Cohort 1 and Cohort 2 teachers were rated higher in all other aspects than were Cohort 3 teachers.



***Figure 5***

Although teachers enter the LSC projects with a wide range of abilities and knowledge, evaluators frequently commented on participants’ growing self confidence as they engage in LSC activities. Most Cohort 1 and Cohort 2 evaluators also reported that there had been impact on teachers’ classroom practices, pointing out that they noticed frequent use of the designated materials in both mathematics and science.

## **Supportiveness of Context**

Systemic reform theory underlying the LSC initiative calls for aligning policies and practices in support of standards-based mathematics and science education. LSC project evaluators were asked to assess the supportiveness of the policy environment in a number of areas including the curriculum scope and sequence, student assessment, and teacher evaluation policies. They were also asked to gauge the extent of stakeholder support for mathematics/science reform.

### ***Strategies to Increase Stakeholder Support***

Evaluators described some of the mechanisms used by the LSC projects to engender support among key stakeholders. The most common strategy reported by the evaluators was the involvement and active participation of principals (and, to a lesser degree, central office staff) in professional development activities. For the most part, these kinds of professional development activities were designed specifically for administrators, but projects also included principals in teacher professional development activities as a way to increase both their support and their capacity for instructional leadership in mathematics and science.

LSC evaluators also reported a variety of strategies used by projects to increase the support of community stakeholders, such as hosting family mathematics/science nights and involving local organizations and businesses.

When asked to reflect on the impact of LSC activities on stakeholder support for reform, evaluators most frequently identified increased collegiality among LSC participants. As one evaluator put it, the “sheer number of hours teachers spend in professional development in mathematics and science sets the stage for the development of collegial relationships.”

Other evaluators noted that the various ways projects had involved principals and other administrators had led to a better understanding of the support teachers need and a greater willingness to provide them with the necessary resources.

### ***District Policies and Practices***

Teachers, principals, and evaluators were all asked to rate the extent to which specific policies and practices hinder or facilitate mathematics and science reform processes. Areas most frequently reported to facilitate reform included quality of instructional materials, curriculum scope and sequence, systems for purchasing and managing materials and supplies, and the importance placed on mathematics and science education. In contrast, policies for teacher recruitment, teacher evaluation, and student assessment were judged to be impeding reform in quite a few districts.

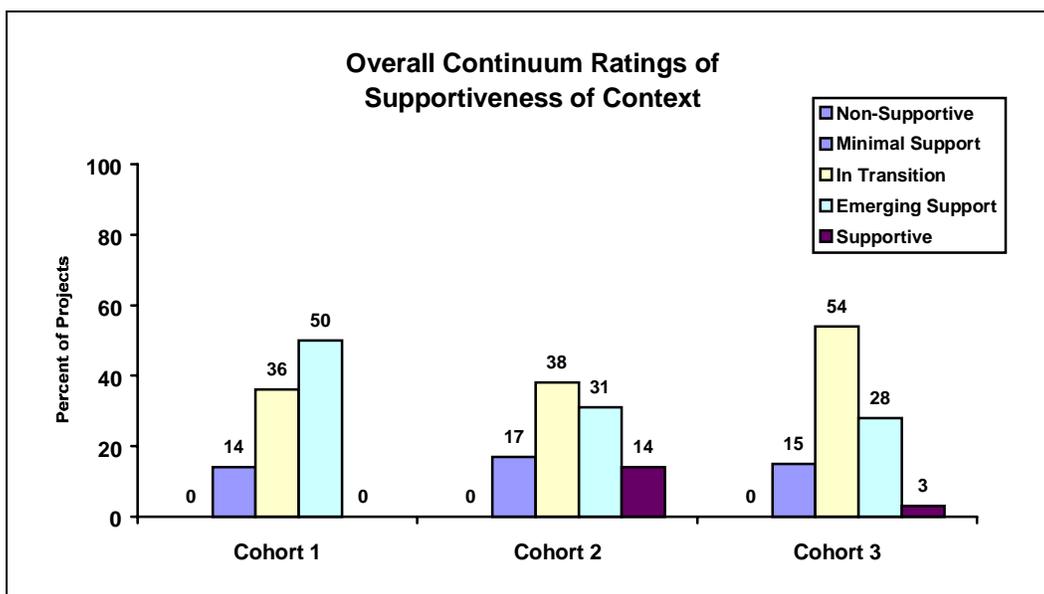
Inadequate time for teachers to plan, both individually and with their colleagues, appears to be particularly problematic. While the precise percentages differ among teachers of the various subjects, and between teachers and principals, all groups agreed that the factors that most impede effective instruction are: time available for teachers to plan and prepare lessons; opportunities for teachers to work with other teachers; and funds for purchasing equipment and supplies.

For example, 44 percent of targeted teachers indicated that the lack of time available for teachers to plan and prepare lessons inhibited effective instruction, roughly twice as many as cited such

factors as inadequate opportunities for professional development, quality of instructional materials, state or district testing policies, or public attitudes toward reform.

### ***Overall Ratings of Supportiveness***

Evaluators were asked to use all of the information available to them to rate the extent to which the district contexts support LSC reform. Figure 6 provides a summary of the district continuum ratings by cohort for 82 districts across the 46 LSC projects. Note that there appears to be a trend toward a supportive context from projects in their earliest stages (Cohort 3) to the most veteran of the LSCs (Cohort 1). The modal rating for Cohort 1 districts is 4, which indicates “emerging support” in terms of policy alignment and commitment of diverse stakeholders. By the same measure, Cohort 3 districts are predominantly “in transition”—modifying policies that hinder effective mathematics/science education and grappling with uneven support among stakeholders. The distribution of ratings for districts in Cohort 2 projects shows them to be shifting from “in transition” to “emerging support.”



***Figure 6***

### **Sustainability of Reform**

The LSC awards are intended to provide support for professional development during the grant period and to develop strategies to ensure that the districts will continue to support reform after the funded period. As a prelude to rating participating LSC districts on the sustainability of mathematics and science reform, evaluators were asked to review their notes of interviews with PIs and district personnel, project documents, observations of professional development activities and district meetings, and district documents. Based on these data, evaluators were asked to reflect on the extent to which the LSC has enhanced both the capacity and will of the districts to provide high-quality mathematics and science professional development.

While evaluators’ information on sustainability was limited, they did note areas that might contribute toward maintaining high-quality professional development programs. Most LSC districts are working to build the capacity of teacher leaders and involving these teachers in facilitating professional development activities. Some districts are changing their policies to increase teacher participation in high-quality professional development. Districts are being encouraged to increase their investments in mathematics and science education.

In addition to noting specific ways in which the districts were, and were not, creating mechanisms to sustain the LSC reform process, evaluators assigned each district a “sustainability rating” on a five-point continuum from 1, “predominately ineffective system” to 5, “institutionalization of a high-quality professional development system.”

Continuum ratings across cohorts once again suggest some trend toward increased sustainability as projects (and district involvement) mature; however, this pattern is less striking for sustainability than it is for supportiveness. (See Figure 7.)

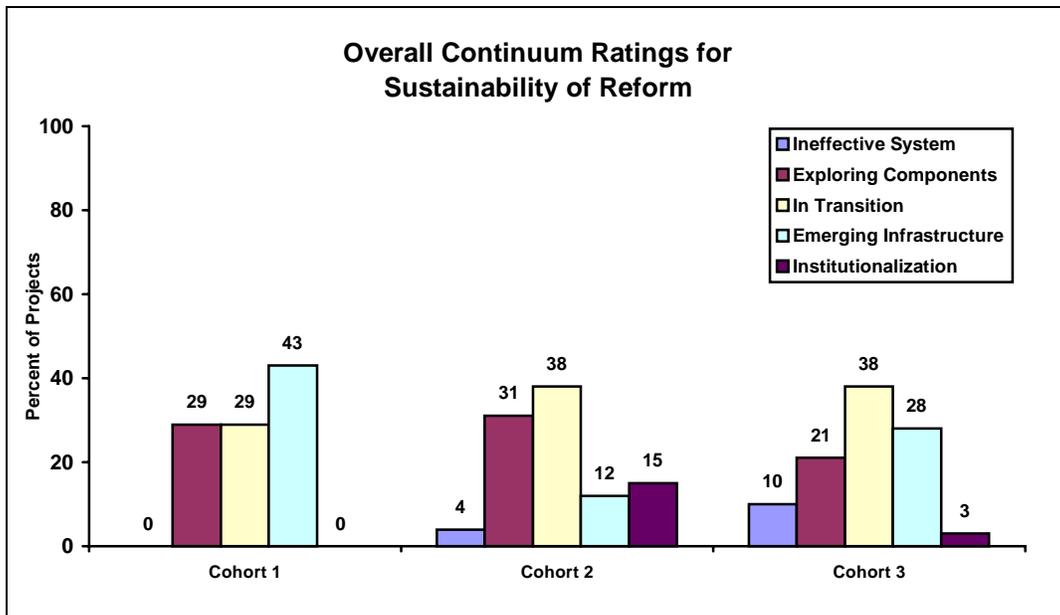


Figure 7

## Summary and Recommendations

In its third year of implementation, the Local Systemic Change Initiative included 46 projects in 263 districts throughout the United States. The 46 LSC projects plan to involve a total of approximately 40,000 teachers in more than 2,000 schools; by the completion of these projects, an estimated 1,356,000 students will receive instruction from LSC-treated teachers each year.

Each targeted K–8 teacher is to participate in a minimum of 100 hours of professional development; at the secondary level, the minimum is 130 hours, over the course of the project. A serious concern is the fact that a few projects appear to have redefined targeted teacher population to mean those who are willing to participate, which is clearly inconsistent with the intent of the LSC initiative. NSF may need to re-emphasize to PIs the requirement of reaching all teachers in the participating districts in order to receive funding under the LSC initiative.

### *Quality of Professional Development*

Evaluators observed a total of 276 professional development sessions during the 1996–97 data collection year. A cross-site analysis provided an overview of the key purposes and activities that characterized most sessions, as well as insight into major strengths and areas in need of further attention.

Sessions were much more likely to be led by teacher leaders and other district personnel than by university faculty or other professionals. Only 13 percent of presenters/facilitators were members of minority groups, which is reflective of neither the targeted teacher population (25 percent minority) nor the targeted student population (51 percent minority). This points out the need for the LSC projects, and NSF, to pay particular attention to increasing the pool of minorities prepared to serve in leadership roles in mathematics and science professional development.

Professional development sessions were most likely to emphasize pedagogy, although quite a few of the observed sessions focused both on increasing teachers' mathematics/science content knowledge and addressing classroom pedagogy issues. A smaller number of observed sessions addressed preparing lead teachers to serve in leadership roles in the LSC.

As was the case in previous years of the core evaluation, evaluators noted a number of key strengths of LSC professional development. Observers found that the majority of LSC sessions provided high-quality professional development experiences that were likely to enhance the capacity of teachers to implement exemplary instruction in their classrooms. Of special note was the collegial and engaging culture established among participants and facilitators. Observers found that most sessions were well-facilitated, and targeted mathematics/science content that was both sound and appropriate for the purposes of the session and background of participants.

Both participating teachers and project evaluators indicated that LSC projects are providing fairly high-quality professional development. Forty percent of participating teachers rated the LSC professional development excellent or very good, with those that had participated for more hours more likely to rate it highly. Teachers were most likely to give LSC professional development programs high marks for providing a wealth of opportunities for mathematics/science related professional development and for providing support as they implement what they have learned. In

each of those areas, teachers rated LSC professional development much higher than professional development prior to the LSC. In contrast, there were only small differences between the LSC and “prior” professional development in the extent to which teachers were given time to work with other teachers, or to reflect on how to apply what they have learned to the classroom.

In addition to its focus on involving all teachers in a targeted district, 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. Linking professional development to exemplary curriculum materials has proven to be an effective way to simultaneously model inquiry-based strategies and address teacher content needs. While links to instructional materials were clearly beneficial in numerous ways, evaluators cautioned that in focusing on the use of module activities, projects risk losing the emphasis on key mathematics and science concepts, pointing out the need to keep the “big picture” in mind.

Areas that observers identified as frequently problematic in professional development sessions were attention to “sense-making” and closure at appropriate points in the sequence, and providing adequate time and structure for teachers to consider how to apply what they were learning to their instruction. LSC project staff may need to pay special attention to addressing these challenges in planning future professional development programs.

LSC projects are confronted with the dilemma that while 100–130 hours of professional development in mathematics/science education over five years is substantially more than most in-service teachers receive, it is still a tremendous challenge to “cover” all the areas in which teachers need assistance. Add to that, the need to address the necessary disciplinary and pedagogical content in a manner that models effective practice, and the magnitude of the challenge becomes clear.

Unfortunately, the theory of effective professional development—and the research base that underlies that theory—is rather thin. While general principles can be derived from the research on adult learners and on in-service education generally, the current knowledge base provides little guidance on how to approach specific content areas. For example, if teachers are expected to use inquiry-based instruction in their classes, is it important that they use such strategies in learning the content addressed in the professional development? As illustrations or all of the time? If the goal is improved classroom practice for multiple units or “kits,” is it more effective to delve into one in great depth, or to distribute the available time more evenly across the kits? Finally, are there differences in optimal time allocations—or instructional strategies—based on the difficulty of the particular content area for teachers and/or students?

As professional development service delivery projects, the LSCs are typically not set up to do the kinds of focused research necessary to answer questions such as these. At the same time, providing PIs and other project staff opportunities to share experiences and lessons learned about these issues and others would enable NSF to capture the “wisdom of practice” that will help move the field forward.

### ***Leadership Development***

Although most LSC projects include a leadership development component in their design, and a substantial portion of professional development sessions were facilitated by and included teacher

leaders as participants, very few of the observed sessions actually targeted leadership content, such as planning and implementing high-quality professional development.

Evaluators identified a number of elements that were important for effective professional development for teacher leaders, including: clear communication of expectations; balancing attention to disciplinary, pedagogical and leadership content; providing opportunities for practice; ongoing administrative and technical support; and broadening their professional experiences.

While leadership content was rated fairly high when it was included in observed professional development sessions, relatively few of the evaluators give leadership content high marks in the overall LSC programs. It appears that this rating was more reflective of the lack of attention to leadership content than the quality of the content when it was addressed. Leadership content is an area of the LSC professional development that clearly needs additional attention, including providing opportunities for PIs to share ideas and discuss strategies with each other.

### ***Impact on Teachers and Teaching***

LSC projects are having a positive impact on both teachers' feelings of competence to teach mathematics/science and their ability to actually do so at the classroom level.

Classroom observations provided insight into areas of strength of LSC teachers and areas of particular difficulty. Lessons taught by teachers who had participated in at least 20 hours of LSC professional development tended to focus on significant content that was at an appropriate level for their students; the teachers seemed to have a good understanding of their students' prior knowledge and teacher-presented information was generally accurate. Moreover, teachers were able to establish a classroom culture of active participation and respect for students' ideas.

Areas that proved to be problematic mirror some of the same ones reported in quite a few of the LSC professional development activities: adequate time and structure for reflection, and providing an appropriate degree of closure. In addition, evaluators found the following areas to be especially challenging for teachers: using questioning strategies that are likely to enhance the development of conceptual understanding; making appropriate connections to real-life applications and to other disciplines; and valuing intellectual rigor and the challenging of ideas. Project PIs and staff may need support in exploring ways to improve these aspects of classroom practice.

### ***Supporting and Sustaining Local Systemic Reform***

In addition to improving classroom instruction through the professional development of teachers, projects are expected to garner support for exemplary mathematics and science educational practices. LSC projects are grappling with ways to not only provide this supportive context, but also to sustain changes that have taken place in the years after NSF funding is terminated.

Evaluators reported a variety of strategies used by the LSC projects to involve key stakeholders, most notably principals, but also central office staff, parents, and other community members. Based on questionnaire data from both teachers and principals, there has in fact been an increase in principal support for mathematics and science education reform. However, evaluators noted

that, as projects struggle with means to move teachers to the next level of expertise, it will be important to continue to include principals in developing a shared vision of exemplary instruction.

Many of the LSC projects have garnered the active support of institutions for higher education, business/industry, museums, and other science-rich institutions. In contrast, evaluators typically reported that parents, non-LSC teachers, and teacher unions were not actively involved in supporting the LSC reforms.

Relatively few evaluators discussed specific strategies developed by projects to influence district policies that would encourage sustainability. The problem may be that project staff, who have expertise in professional development, are not as skilled in strategic planning and systemic reform. Or perhaps evaluators are less attuned to the nuances of policy alignment and therefore less likely to focus on this area in their reports. In any event, NSF should consider providing technical assistance to LSC projects in understanding the importance of the policy domain in systemic reform and in developing strategies to increase alignment of district policy with the LSC vision.

On the other hand, some evaluators did relate a number of ways in which districts are building upon the LSC efforts in order to institutionalize the reform process, including the convergence of resources in support of the LSC vision, the development of incentives for continued professional development, and plans to maintain the involvement of LSC teachers in key leadership positions in the districts.

Most LSC districts are working to build the capacity of teacher leaders in the hopes that the district will continue to support these teachers to work in a leadership capacity after the LSC project. Evaluators noted, however, that in many cases districts appear to be dependent on the LSC grant for planning and delivering high-quality professional development, and there is no system in place for ongoing leadership development after the LSC grant period.

Typically those projects that have been in operation longest are described by evaluators as having “an emerging infrastructure” to sustain reform, while the newer projects are “in transition.” Clearly, institutionalization issues are key to the long-term impact of the LSC projects. Consequently, it would be helpful to provide PIs and other project staff opportunities to learn from each other as well as from external experts about strategies for increasing the likelihood that the LSC reform process will be sustained.