EXECUTIVE SUMMARY

OF THE

Local Systemic Change through Teacher Enhancement

Year Four Cross-Site Report

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Executive Summary

Background

The Local Systemic Change through Teacher Enhancement (LSC) program was initiated by the National Science Foundation (NSF) in 1995. The goal of the 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 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.[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 districts 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.

Starting with a first cohort of 8 projects in 1995, the program grew to include 59 projects in its fourth year of implementation. These 59 projects plan to involve approximately 53,000 teachers in nearly 3,000 schools in 327 districts throughout the United States.

The Core Evaluation

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

[1] As of 1999, NSF requires 130 hours of all projects.

to design the data collection framework, provide technical assistance in its implementation, and prepare a cross-site analysis of the evaluation results.

The core evaluation system includes teacher and principal questionnaires, teacher interviews, and observations of both classroom and professional development sessions. Each project is responsible for selecting a lead evaluator, and in some cases a team of evaluators, who must be approved by NSF, participate in training conducted by HRI, and demonstrate proficiency in use of the core evaluation instruments. This report is based on data collected using the core evaluation instruments, as well as interpretations of those data by the project evaluators.

Quality of Professional Development

As part of the core evaluation, a total of 402 professional development sessions were observed during the 1997–98 data collection year. A cross-site analysis provided an overview of the major purposes and activities included in these sessions, as well as insight into the successes and challenges projects are encountering in their efforts.

Evaluators rated each session on a number of indicators within the general areas of quality of design, implementation, disciplinary and pedagogical content, and professional development culture. They then assigned a "capsule rating," from Level 1 (ineffective professional development) to Level 5 (exemplary professional development). Overall, 59 percent of the observed sessions received ratings of 4 or 5, indicating that they engaged participants in purposeful work that would likely lead to enhanced capacity to implement exemplary instruction.[2]

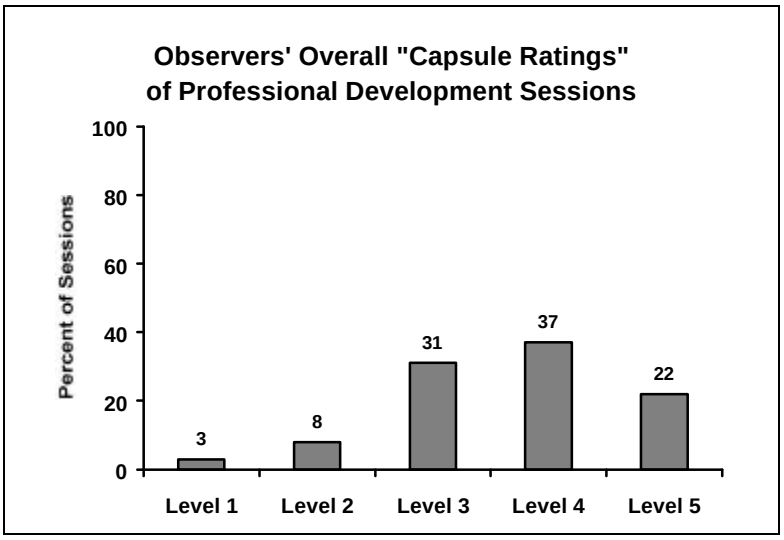

Figure 1

[2] It is interesting to note that the percentage of observed sessions receiving high ratings decreased from Year Three (71 percent). This decrease is likely in response to discussions at lead evaluator meetings focused specifically on more stringent criteria for these ratings.

Professional Development Providers
The quality of professional development providers is a major strength of many of the LSC projects. In describing effective professional development providers, teachers and evaluators alike talked about their in-depth knowledge of content; their experience in using LSC-designated instructional materials; their ability to model and discuss sound pedagogical strategies; and their responsiveness to participants' needs.

At the same time, about 1 out of 4 projects were judged to have fairly substantial weaknesses in the area of preparedness of professional development providers. In some cases, the concerns had to do with scientists/mathematicians having difficulty relating to the needs of classroom teachers. More often the concerns focused on the need to better prepare (and provide time for) teacher leaders to fulfill the increasing responsibilities assigned to them, including both facilitating professional development sessions and providing support to teachers during implementation.

Professional Development "Culture"
One of the key enablers of a high-quality professional development program is the establishment of a culture conducive to collaboration and learning. Evaluators reported that most LSC projects were successful in creating a collegial environment where teachers felt free to take risks and ask for help as they grappled with understanding new instructional strategies and mathematics/ science content. Teachers appreciated the opportunity to share experiences and insights with their peers, and especially, to learn about the designated instructional materials from teacher leaders and others who had actually used them.

Difficulties within the area of professional development culture typically fell into one of two categories. In a few cases, teachers resented the fact that LSC professional development is mandated, making it difficult for project staff to create the kind of collegial atmosphere they intended. In other cases, the culture was collegial but fairly superficial, with participants working through activities and sharing ideas for their use without the intellectual engagement that comes from grappling with challenging ideas.

Deepening Teacher Mathematics and Science Content Knowledge
Based on evaluator reports, there is a trend toward an increased emphasis on mathematics and science content in LSC professional development. Most projects involve content experts from higher education, and in many cases from industry and museums, as well. Sometimes scientists and mathematicians serve as PIs or co-PIs; they often help plan and implement content-based professional development activities and serve as resources in sessions focusing on instructional materials implementation. In addition, scientists and mathematicians often team up with teacher leaders in providing professional development both during workshops in the summer and in sessions held throughout the academic year.

Even with active participation of content experts, only about half of the projects received high ratings for the quality of treatment of disciplinary content. There were large differences by subject and grade range, with 87 percent of 6–12 mathematics projects compared to only 39 percent of K–8 science projects receiving high ratings for their treatment of disciplinary content.

The problems in K–8 science seemed generally to stem not from the quality of the professional development providers, but from a combination of factors.

First, content needs are much greater for elementary teachers than secondary teachers, and especially great in elementary science. Second, evaluators in K–8 science projects frequently noted the need for projects to be "more deliberate about the disciplinary content being taught" and the importance of balancing the learning of the "mechanics of the kits" with helping teachers understand the underlying conceptual framework. Others suggested "going deeper" to give teachers a more comprehensive perspective, even if it meant sacrificing breadth in content coverage.

Preparing Teachers to Implement Exemplary Instructional Materials

The overriding goal of the LSC initiative is to improve the teaching of mathematics/science through the use of exemplary instructional materials in classrooms. All other project activities are intended to support that goal, whether they are aimed specifically at deepening teacher content knowledge, providing a mechanism for materials distribution and management, and/or ensuring that school and district policies and practices are aligned with the LSC vision of effective mathematics and science education.

In most cases, the project proposals specified the instructional materials to be used as the basis for the LSC, and have geared their professional development toward preparing teachers to implement those materials. Some projects listed several materials that individual districts, schools, or teachers might choose, often because they did not have the authority to designate a particular set of materials across the entire project. While not consistent with the intent of the LSC program, a couple of projects view themselves as professional development efforts to increase teachers' knowledge and skills, but not in relation to a particular set of instructional materials.

Providing teachers with opportunities to become conversant with the designated materials and to deepen their understanding of the underlying pedagogy has been a strength of many of the LSC projects. When projects have experienced difficulties, they have typically been in the following areas:

- Devoting much of the available time to choosing materials, leaving little time for teachers to study the selected materials in depth;
- Assuming that modeling effective pedagogy is sufficient and not giving teachers an opportunity to focus explicit attention on these areas; and
- Having teachers revise the designated materials, or pick and choose bits and pieces of activities and units, with the intellectual coherence of the materials suffering as a result.

Support for Teachers as They Implement the Instructional Materials

One of the characteristics that distinguishes LSC programs from traditional professional development offerings is their year-round structure. In addition to providing intensive

professional development in the summer when teachers can devote full time to these activities for one or more weeks, LSC projects typically provide professional development activities during the academic year. Across the projects, these activities include project-wide workshops; school-based workshops and study groups; demonstration lessons; and mentoring/peer coaching. A typical project incorporates several of these approaches in order to provide ongoing support for teachers as they implement the instructional materials in their classrooms. As can be seen in Figure 2, teachers are more than twice as likely to receive "considerable support" for implementation as part of the LSC compared to their previous professional development opportunities.

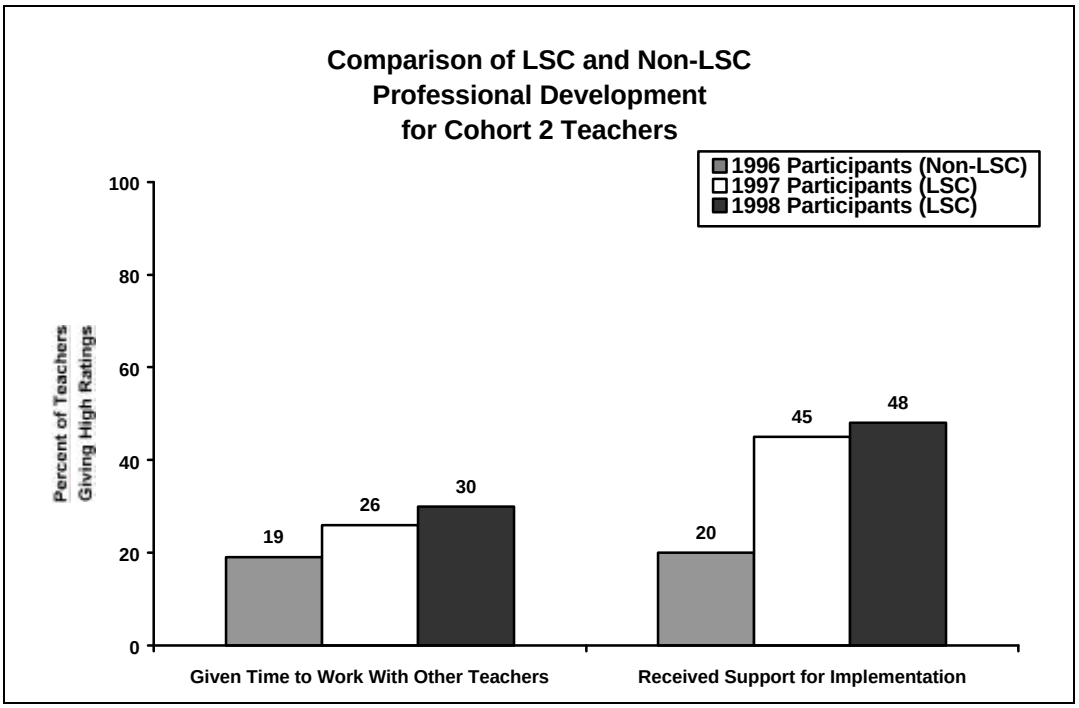

Figure 2

Teachers were overall highly appreciative of the help they received, both in sharing with other teachers and especially when they had the opportunity to get coaching or other in-class assistance. They were delighted when the project made sure they received all of the materials they needed for instruction, and correspondingly annoyed when the materials arrived late or in poor condition. Overall, evaluators gave high marks to 70 percent of the LSC projects for their support for teachers during implementation. Nevertheless, across all projects many teachers expressed concerns about having the time to do it all—being out of the classroom to attend workshops or study groups, and dealing with the extra demands of teaching using the LSC materials and approach. Elementary teachers also worried that the emphasis on the LSC subjects was taking too much time away from other subjects.

Overall Ratings of the Quality of LSC Professional Development

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. More than half of the LSC professional development programs in each subject were rated at "Level 4: Emerging Infrastructure of Well-Designed Professional Development," with another one-fifth considered to have a predominance of well-designed professional development. Ratings for K–8 science projects were significantly lower than those for either K–8 or 6–12 mathematics projects.

Impact of the LSC on Teachers and Teaching

The theory of action underlying the LSC argues that providing teachers with well-designed opportunities to 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. While the core evaluation does not include measures of student achievement, in large part because of the diversity of content areas and grade levels addressed, it does assess teacher attitudes, beliefs and preparedness, as well as the quality of classroom practice.

Teacher Attitudes, Beliefs, and Preparedness

Teacher interview data contained many references to how participation in LSC professional development changed the ways teachers thought about how students learn, which in turn impacted the ways they viewed their instruction. Teachers' comments reflected a heightened awareness of differences among students in both extent of prior knowledge and learning styles. In addition, a number of teachers mentioned changing their ideas about how much time students need to make sense of unfamiliar mathematics and science concepts.

Based on teacher questionnaire as well as interview data, teachers feel better prepared in both content and pedagogy as a result of participating in LSC professional development. Differences tended to be larger and more pervasive for elementary science; when teachers were asked about their preparedness to teach specific science and mathematics topics, there were significant differences between untreated and highly treated teachers on all 11 topics listed. In elementary mathematics, there were significant differences in 9 of 11 topics, and in secondary mathematics in only 5 of 16 topics listed.

While large percentages of teachers reported being in favor of the vision of mathematics and science teaching embodied in current national standards, and many see the designated instructional materials as a great improvement over previous materials, other teachers are not convinced that using these materials is in the best interest of their students. Some elementary teachers expressed concerns about the developmental appropriateness of some of the instructional materials. Others indicated a need to have students do more reading about science

and to focus on "basic skills" in mathematics, especially if state and district assessments emphasized vocabulary and computation.

Classroom Practice

The core evaluation focuses a great deal of attention on the impact of LSC projects on classroom instruction, including having trained observers visit a random sample of science and mathematics classrooms, as well as self-report results from teachers interviews and questionnaires.

Teachers participating in K–8 science projects report spending more time teaching science, typically by going into more depth on individual units rather than increasing the number of science units taught. In both science and mathematics, the use of the designated materials has led to a broader range of topic coverage—more physical and earth science content in elementary science classes and more probability and data collection/analysis in elementary mathematics classes.

Evaluators noted a positive climate in many classrooms, where students were encouraged to generate questions and express their ideas. Similarly, a recognition of the importance of listening to student talk was frequently mentioned when teachers were asked about the impact of their LSC project. Teachers reported being less dependent on the textbook, stepping back to "let the kids discover," and looking more at how students arrived at and justified their answers.

At the conclusion of each classroom observation, evaluators rated the lesson on a number of indicators related to the quality of design, implementation, mathematics/science content, and classroom culture. For example, observers were asked to note the extent to which the lesson incorporated tasks, roles, and interactions consistent with investigative mathematics/science; the mathematics/science content was significant and worthwhile; the pace of the lesson was appropriate for the developmental levels/needs of the students and the purposes of the lesson; and active participation of all students was encouraged and valued. Across all projects, lessons of teachers who had participated in LSC activities had considerably higher ratings than those of teachers who had not yet participated.

It is interesting to note that the combination of LSC professional development and use of exemplary instructional materials appears to have the greatest positive impact on the quality of classroom instruction. Approximately half of the lessons conducted by treated teachers using the LSC instructional materials received high ratings, twice as many as those where the teacher was either untreated or treated, but not using the designated materials.

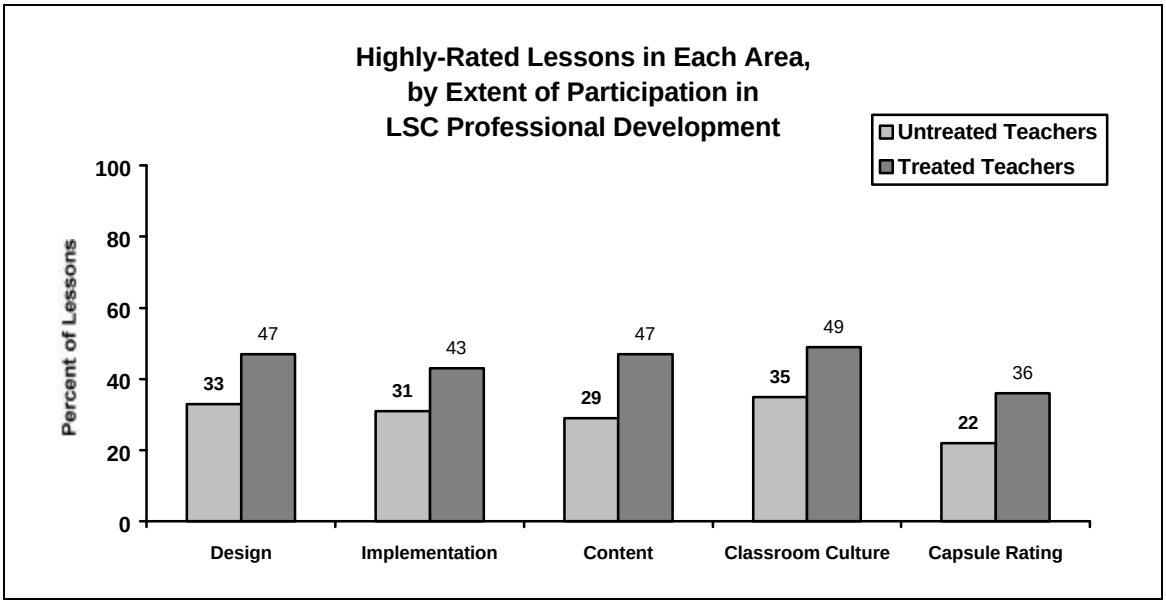

Figure 3

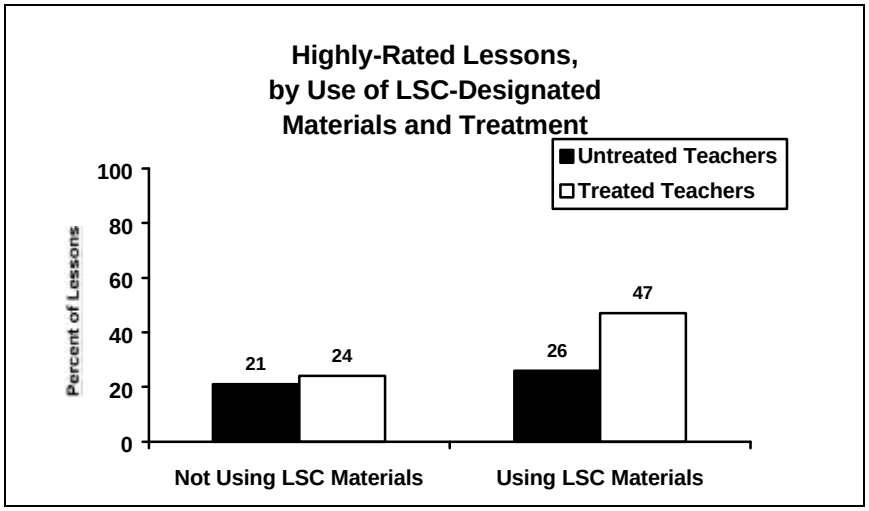

Figure 4

In cases where treated teachers are using the LSC materials less successfully, the problem often appeared to be that the materials were not being implemented as intended, with observers indicating that the deviations from the plan outlined in the materials lessened their potential impact on student learning. Evaluators noted that some teachers were skipping over activities in the modules, teaching lessons out of sequence, or otherwise modifying the materials in ways that undermined the development of students' conceptual understanding. While many projects are concerned about getting teachers beyond "mechanical use" of the designated materials, core evaluation results suggest that they may do better to focus more attention initially on using the materials as designed.

Recommendations

Findings from the Year Four core evaluation suggest a number of refinements to the LSC design.

1. Projects need to put even more emphasis on the important mathematics/science concepts that are being developed in the instructional materials, both at the activity and at the unit/module level, and help teachers understand the progress of ideas inherent in the materials.

2. LSC projects need to ensure that professional development providers explicitly discuss effective pedagogy, in addition to modeling it.

3. Projects should review their designs periodically to make sure they are providing teachers with adequate: (a) opportunities to learn about implementing the instructional materials from experienced users of those materials; (b) time to reflect on what they are learning and how to apply it to the classroom; (c) follow-up support during the academic year; and (d) materials needed for classroom implementation.

4. Ideally, projects would deploy teacher leaders who already have deep content knowledge and leadership expertise and are experienced users of the instructional materials, as well as content specialists with expertise in working with teachers. However, since people who meet those criteria are in short supply, LSC projects need to increase the training opportunities and support for professional development providers in order to effectively reach the targeted teacher population.

5. LSC projects that are able to accommodate only a subset of targeted teachers at a time should consider alternatives to working solely with "volunteers." Projects need to make sure that their designs facilitate reaching critical mass at the school level, and help ensure that recalcitrant teachers will be "won over" by the enthusiasm of their peers.

6. NSF needs to reemphasize to projects the importance of adhering to the conceptual flow underlying the instructional materials. While addressing the needs and interests of a particular group of students is certainly important, selecting pieces out of carefully sequenced units, or otherwise modifying the instructional materials, may inadvertently limit their effectiveness. This issue is particularly important at the elementary level, where teachers are unlikely to have the in-depth background in mathematics or science needed to modify the materials while ensuring their conceptual integrity.