

WHAT HAVE WE LEARNED?

Local Systemic Change Initiatives Share Lessons From The Field

I. Introduction

The Local Systemic Change (LSC) program began in 1995, with support from the National Science Foundation (NSF). The goal of the LSC is to improve the teaching of mathematics, science, and technology by focusing on the professional development of teachers within whole schools or school districts, with an emphasis on preparing teachers to implement designated exemplary mathematics and science instructional materials in their classrooms. Starting with 8 projects in 1995, the program expanded to a total of 72 projects by 1999, including projects targeting the elementary or secondary grades, or both; and addressing mathematics, science, or both. Many of the projects chose “kit-based” science programs, with an emphasis on hands-on science inquiry, or module-based mathematics programs that focus on problem-solving in real-world contexts.

In June 2000, NSF sponsored a meeting for Local Systemic Change initiatives engaged in the reform of mathematics and science education. Held in Washington, DC and coordinated by Horizon Research, Inc. (HRI), the “Lessons Learned” conference included representatives from 30 LSC projects. HRI deliberately invited teams of LSC Principal Investigators (PIs) and evaluators to ensure complementary perspectives. PIs responsible for designing and implementing projects brought first-hand knowledge from “the trenches,” while evaluators brought an external, and sometimes multi-site perspective, based on observing one or more LSC projects over time.

Collectively, LSC PIs and evaluators share a wealth of knowledge about how to “do reform.” The June conference, however, asked participants to shift their focus away from specific reform strategies, and dwell on what they had learned from implementing these strategies. Given the opportunity, what would LSCs tell the mathematics and science education communities about designing professional development? about preparing professional development providers? about supporting implementation of instruction materials? about engaging administrators? about sustaining reform? What barriers might new LSCs anticipate? What could more experienced projects tell others about overcoming or circumventing these barriers? In answering these questions, LSC conference participants had the chance to consider some of their own decisions, and reflect on how they might have altered their design, based on what they have learned. Our goal was to capture these discussions to benefit both current and future projects.

To help frame the Lessons Learned conference, HRI conducted interviews during the spring of 2000 with the PIs of 12 LSC initiatives whose NSF funding was just ending; nine of these were K–8 science projects. We expected that, over time, these projects had learned some key lessons about systemic reform in mathematics and science education. Interview questions about professional development providers, professional development strategies, and sustaining reform were designed to identify issues that an expanded LSC audience could explore further in conference sessions.

Not surprisingly, the predominant lesson learned from both the conference and the interviews was that there are no easy answers in designing and implementing systemic reform. Given limited resources, LSCs must engage in a balancing act, deciding how, where, and when to build on or forego particular reform strategies. These decisions, based on needs versus assets, result in a cycle of tensions and trade-offs. This report highlights some of these dilemmas, and provides LSCs and NSF with an opportunity to consider some design strategies that appear to be critical to the success of systemic reform in mathematics and science education.

The substance of this report reflects the contributions of both PIs and evaluators who attended the LSC conference.¹ Their experiences enabled them to speak knowledgeably about systemic reform at the local level, and we present their advice as a set of preliminary, empirically-driven “lessons learned.” We would add, however, that while LSCs face similar challenges, they also vary in design, context, targeted grade levels and subject, and experience with reform. All of these factors are likely to influence the salient lessons learned from a particular project. In short, we recommend that the reader view the content of this report as practical advice from reform-experienced colleagues, and consider the pieces that make sense within the context of their own LSC. It is also important to recognize that many of the conference participants were representing elementary science projects reflecting the composition of the initial cohorts of LSCs; some of the “lessons” may not be as applicable to mathematics projects or to those serving secondary science teachers.

One final caveat: this report is not intended to be a comprehensive discussion of all of the elements critical to local systemic reform. HRI intentionally focused on preparing and deploying professional development providers; trade-offs in professional development design; involving administrators and ensuring sustainability; since these were issues that most often emerged in LSC evaluators’ reports.

II. Professional Development Providers: Purveyors of vision, knowledge, and skills

LSCs rely on a diverse set of professional development providers: Teachers on Special Assignment (TOSAs) who are released from their classroom responsibilities, classroom teachers, district personnel, university faculty, scientists, museum staff, and others. In part, an LSC’s success lies with these persons and their capacity to convey a vision of teaching that is a “novelty” for the majority of teachers. Professional development providers must help teachers feel comfortable using manipulatives and hands-on instructional materials, inquiry-based practices, and new assessment strategies—all in the service of helping students learn important mathematics and science concepts. Because of the central roles played by professional development providers, finding effective ways to select, prepare, deploy, and support them is critical to all LSCs. In fact, the majority of conference participants reported that they had under-anticipated the level of effort required in their work with professional development providers.

¹ We did not distinguish between PIs and evaluators in recording their comments at the conference.

While HRI sought lessons learned across a variety of types of professional development providers (e.g., teachers, scientists), conference participants' discussions remained firmly centered on teacher leaders—both TOSAs and classroom teachers. As a result, much of the discussion below focuses on these particular groups, although LSCs might apply a number of these lessons across all professional development providers.

A. Identifying Professional Development Providers

➤ Define the task, and select leaders accordingly.

Professional development providers can assume a myriad of responsibilities: workshop facilitation, materials review, one-on-one coaching and mentoring, materials management, parent and community outreach, and advocacy. Identifying providers requires that LSC staff first and foremost identify the tasks expected of them, differentiating responsibilities and expectations, and making these criteria as specific as possible. What tasks will be assigned to teacher leaders? What will district-level work involve as opposed to school-based work? What “nuts-and-bolts” activities are needed to support implementation? Who can best accomplish the various tasks? The process is tricky, though, and choices may not be obvious. For example, even with intensive professional development, exemplary classroom teachers may not be ready or willing to take on training or leadership roles.

The challenge of identifying teacher leaders

“Some teachers I had worked with for 15 years. I thought if I opened the door and extended the opportunity and said—‘How would you like to be a leader? You can go here, and learn about this and become an expert’—that I’d get some takers. But hardly anyone would do it. I expected a lot more to emerge than did.”

—PI Interview

➤ Consider a range of skills and expertise in selecting teacher leaders.

LSCs noted that those selected to be teacher leaders must have prior experience with the instructional materials to have credibility with teachers. Some decisions were easy; the “no-brainer” decisions included the selection of high profile teachers with previous experience in reform-based activities. Other criteria should also play into the selection of leaders, however. For example, projects noted that, for the sake of credibility, LSCs also need to include teacher leaders who are less well-prepared—those who are not necessarily the most knowledgeable in content or the best at teaching, but who have the respect of their peers. Said one PI: “If you don’t win those people over, you’re dead in the water.” While prior experience as professional development providers or with reform were “natural choices,” some LSCs found less experienced teachers to be among their strongest teacher leaders; the key was to cultivate commitment and build their reform vision by involving them in professional development planning and design from the outset.

➤ **Plan for multiple levels of leadership.**

LSCs cited the need for multiple levels of teacher leadership. Teachers on Special Assignment (TOSAs) can play key roles in professional development, acting as facilitators, mentors, and coaches, while site-based lead teachers can provide more visibility for reform at the building level. LSCs noted that both levels of teacher leadership are critical to the success of reform, but they also described some of the pitfalls associated with using each group. Figure 1 summarizes some of the strengths and challenges LSCs will likely encounter in identifying and using TOSAs, and some strategies suggested by LSCs for dealing with these dilemmas.

Figure 1
Using Full-Time Teachers on Special Assignment (TOSAs):
What LSCs Should Know

| Advantages | Disadvantages | Advice |
|---|--|---|
| TOSAs are more likely to have a biased view, provide a more consistent message, and ensure quality control. | TOSAs require intensive, long-term capacity building opportunities to grasp the vision and feel comfortable in leadership roles. | Provide formal and informal opportunities for practice, reflection, and feedback; involve in project planning and design. |
| Having a small cadre of TOSAs helps streamline professional development planning and the feedback process. | TOSAs get stretched thin and worn out; turnover has dramatic impact on small cadre, creates gaps in the distribution of support. | Delineate responsibilities to reduce burn-out; provide incentives and rewards to sustain involvement. |
| TOSAs, being outside the schools, can have a more objective view—one not vested in current relationships or ways of doing things. | TOSAs may feel ill-at-ease as “outsiders,” and with new roles as vision-builder, mentor, coach, and advocate. | Provide explicit strategies TOSAs can use in schools with peers and with principals. |
| District-level TOSAs can contribute to sustainability, particularly if turnover of other district-level administrators is high. | District may commit to full-time LSC TOSAs, but then reassign them, give them responsibilities beyond the LSC, or decrease the level of resources. | Work with administrators to ensure that they understand the significance of the TOSA model and TOSA roles. |

As with TOSAs, conference participants extolled the use of school-based teacher leaders, but also discussed some of the liabilities that projects may encounter in selecting classroom teachers for leadership roles. Figure 2 summarizes some of these challenges, as well as some advice suggested by LSCs.

Figure 2
Using School-Based Teacher Leaders:
What LSCs Should Know

| Advantages | Disadvantages | Advice |
|---|---|--|
| Credibility is high; site-based teacher leaders know the school context, can identify with teachers, and engage in sharing and problem-solving. | Dynamics of faculty interactions can hamper their work. Are they respected by other teachers, or in competition with the department chair or other perceived leaders? | Pay attention to school context; broaden reform message; clarify roles of leaders; recruit leaders from other disciplines to participate on school team. |
| Site-based teacher leaders provide visibility for reform in each school. | Greater numbers of teacher leaders increases the likelihood of role confusion; decreases consistency in professional development. | Provide replicable tools and training materials. Build in “quality assurance” feedback mechanisms for teacher leaders. |
| On-site teacher leaders are available to meet regularly with teachers. | Teaching and other responsibilities already burden teacher leaders; without incentives or supports, they may be unable to fulfill LSC roles. | Embed professional development and team-building opportunities into school structures. |
| School-level leadership contributes to the likelihood that reform will be sustained. | School-based teacher leaders may not see themselves as leaders, or see the “big picture” of reform. | Plan on-going capacity building opportunities to build vision and leadership skills. |
| School-based teacher leaders provide a link between the flow of information from the district level to the school level. | Lack of administrative support may render school-based leaders ineffective. | Work with principals; create school teams that engage teacher leaders, teachers, and administrators. |

➤ **Carefully consider the use of existing channels and administrators in selecting teacher leaders.**

Given the barriers that prevent teachers from assuming leadership roles, some LSCs suggested identifying leaders through existing channels, such as district science or mathematics committees. Still others asked principals to recommend teachers who might qualify as potential leaders. But LSCs must consider both the advantages and the disadvantages of these strategies. For example, leaders chosen through existing channels may have competing agendas; school or district administrators may have different criteria for selecting teacher leaders. Said one PI who had initially asked principals to identify teacher leaders in each of their schools: “There was no consistency of what the expectations were for those teachers.” If LSCs choose to use administrators in the recruitment process, they must ensure that they are “on the same page” as the project, providing principals with explicit criteria for identifying teacher leaders, based on a sound description of roles and expectations for those leaders.

➤ **Look for emergent leaders who demonstrate talent and commitment, and nurture them for more demanding leadership roles.**

Some of the suggestions described earlier presume a model based on the selection of teacher leaders in advance for specific roles. To be sure, this strategy gives projects visibility and a tangible set of individuals to work with; further, it allows LSCs to launch their professional

development plans with some expediency. But LSCs also need to remain vigilant for leaders who may emerge through a grass-roots process of identification, and to provide deliberate opportunities for this to occur. School-based learning communities were a compelling choice among some LSCs. Nurtured and supported by project staff, these groups were “a tremendous asset” for letting “regular” teachers emerge as leaders. Leadership seminars and other formal professional development opportunities also provided avenues for cultivating emergent leaders. Said one conference participant: “Those leaders that emerge are more likely to be appropriate.”

- **Plan for turnover and have a deliberate process for bringing new leaders into the fold.**

Teacher leaders are key to implementation and sustainability, and conference participants advised including them in planning and design from the outset. But LSCs were also pessimistically clear about what projects should anticipate in their efforts to identify teacher leaders: expect teacher reluctance to take on leadership roles; expect that there will not be as many teacher leaders as you need; and expect burn-out, mobility, and attrition. The lesson in these messages was implicit: build strategies into your model to address these “givens.”

B. Preparing Professional Development Providers

- **Ensure that teacher leaders fully embrace the tenets of reform.**

The strongest professional development providers have a clear understanding of the project vision and goals. While this may be stating the obvious, LSCs have found that they have sometimes assumed too much in the area of vision, when they should have “assumed nothing.” Projects must be proactive and explicit in communicating vision, and have a formal process for doing so—with core staff, TOSAs, school-based teacher leaders, and outside content experts. Participation in high quality professional development—both local and national—and co-planning with core staff can help reinforce reform goals with teacher leaders.

Two pieces of the vision have been particularly thorny for LSCs: the effective use of inquiry in elementary science projects and ensuring high expectations for all students. LSCs can benefit from revisiting these issues in explicit ways over time, both to reinforce teacher leaders’ evolving views and to ensure that they embrace these goals. Lead teachers have to be advocates and “sales people” to convince others of the value of reform. To do so, they must have a firm grasp of the vision and goals for the project.

- **Clarify teacher leaders’ roles and where they fit in the “big picture.”**

Having defined the tasks of professional development providers, LSCs need to define the skills required for the designated role. What expertise do potential leaders bring to the LSC and how do their skills fit with others on the LSC team? LSCs must ask these questions deliberately and answer them as explicitly as possible, with preparation tailored to meet both immediate and emerging needs. Regardless of their level or role, teacher leaders must understand both what they bring to reform and how they fit into the plan—within the context of their district and

school. LSCs must also recognize that roles may evolve over time as the context and system change, as turnover takes its toll, and as expertise and levels of readiness increase among teacher leaders.

- **Provide time and a range of leadership opportunities for teacher leaders to gain skills and confidence.**

Teacher leaders vary in their talents and background. Typically, as LSCs attempt to reach all of the targeted teachers, they struggle with pressing teacher leaders into roles before they are sufficiently prepared. Apprehension and burnout are particularly relevant for school-based teacher leaders who maintain full-time teaching assignments, and who may feel ill-prepared to lead professional development or advocate for reform with faculty, administrators, and parents. LSCs should expect that it will take participation in high quality professional development over a period of years for teacher leaders to become fully adept at their roles. Some advised working with teacher leaders as long as possible before using them as professional development providers, involving them in planning, reviewing instructional materials, and the development of new assessment instruments.

Easing teacher leaders into their roles

“Start teacher leaders off easy, don’t overwhelm them with the magnitude of the chore, feed them small bits of responsibility at a rate comfortable for them.”

—PI Interview

- **Develop a broad awareness of content.**

LSCs can safely assume that content needs for elementary and middle school teacher leaders are huge. Beyond understanding the content included in the student instructional materials, professional development providers must have an understanding of, and be able to articulate, the “big content picture;” that is, how the content in the instructional materials fits into the curriculum as a whole. This was the “really challenging piece” according to PIs—working with teacher leaders on developing awareness of content strands over the course of grades K–12. Reform leaders noted that LSC professional development for teacher leaders typically enhanced their understanding of module-related content and improved their classroom instruction, but it was less likely to convey the larger conceptual picture or link content across units. LSCs found the latter to be critical—yet elusive—pieces.

Some LSCs talked of the merits of formal coursework for TOSAs and school-based teacher leaders conducted by university professors who understand vision, inquiry, and content. Said one PI: “It’s the only thing that can lead to teacher leaders’ understanding of the larger conceptual picture.” In the absence of these opportunities, LSCs must be explicit in addressing broader content knowledge in their own professional development courses through the use of standards, concept webs, and assessment tools. As one PI put it, how do LSCs reach teacher leaders “who don’t know they don’t know content?” LSCs suggested one-on-one coaching as a key strategy, but also recommended building a community of learners—allowing teacher leaders

time and opportunity for discourse and reflection, for example, in small groups looking at student work. According to LSCs, that process best enables teacher leaders to realize where their needs are.

- **Provide multiple formats and opportunities for practice and reflection for teacher leaders to gain expertise in pedagogy.**

Teacher leaders need time to learn and practice inquiry-based instructional strategies before they can effectively help others use these methods in the classroom. As with content, LSCs suggested formal and informal learning opportunities, including one-on-one coaching by core staff and small group discussion among teacher leaders. The design must allow teacher leaders to engage in the inquiry process themselves—asking questions and struggling with applications. One PI described a model that includes a series of stages to groom leaders and help them grasp new practices: teacher leaders first attend “basic” workshops, then observe and script workshop sessions, participate in planning and leadership sessions, and finally, join the core team to design and present sessions. Within these formats, modeling of pedagogy by LSC staff was key, along with structured debriefing time afterwards. In addition to these local experiences, several national workshops (e.g., The Exploratorium) came highly recommended for providing in-depth experiences in pedagogy for teacher leaders.

Modeling and debriefing with teacher leaders

“Teacher leaders can replicate an activity without understanding what you’re trying to achieve. You lose quality when that happens. Discussing it explicitly was really important.”

—PI Interview

- **Provide opportunities for teacher leaders to acquire skills and expertise beyond content and pedagogy.**

Teacher leaders must be well-grounded in content and pedagogy. But LSCs are quick to assert that teacher leaders need an array of skills. Facilitation skills, the ability to work with adult learners, and knowledge of the change process are fundamental, as well. Reform leaders discovered that teacher leaders were typically far more adept at handling the pedagogy and even the content than they were at working with their peers. LSCs should expect this to be a key challenge, and work with teacher leaders on how to tap into what the adult learner brings to the professional development situation. Core staff must lead by example, providing interactive sessions where teacher leaders can safely participate as learners.

Teacher Leader Preparation: Beyond content and pedagogy

“The challenge is in training the TOSAs. They are supposed to be the movers within the schools—motivators, mentors, facilitators, not the traditional professional development provider....Their [preparation] needs are much broader than instruction. They need political acumen: how to go into a school and pick up clues as to what’s important; how to nurture it toward a successful science school. How do you build consensus? How do you solve logistical problems? What is the balance between a specific teacher lesson or content versus school-based team building or system building? And how can TOSAs access the principal community?”

—Conference Participant

“Professional development providers need to know about the change process—the school culture, how you help a school assess where they are, where they want to go, and develop a road map for getting there. Some will say this is not the role of professional development providers—changing the school culture—but there is a huge gap in the focus of earlier NSF teacher enhancement grants and the LSCs. We’re expected to address the system, to create mechanisms for change at the school site. Professional development providers need facilitation skills, how to focus the discussion, about the nature of dialogue and teacher decisionmaking, how to help teachers figure out how to take the next step in their teaching. You can do lots of centralized professional development, but if you don’t have the follow-up, you don’t get a lot of impact. You have to develop professional development provider skills to do that.”

—PI Interview

➤ Attend to philosophical differences among professional development providers.

LSCs indicated that identifying and preparing outside content experts as professional development providers was well worth the effort, despite some of the logistical headaches of using them for school-based professional development. But LSCs must be vigilant about philosophical differences among the professional development providers, especially between teacher leaders and content experts. Even projects that were “primed and ready” for the LSC—with a long history of working with university faculty on teacher enhancement projects—were not immune to these difficulties. When preparing content experts, as with teacher leaders, LSCs must attend to vision; be explicit about roles; involve them in professional development planning from the outset; and prepare them well on pedagogy, using the designated instructional materials, and working with adult learners.

Preparing Content Experts

One PI described the project’s strong collaborative culture among professional development providers. Core staff basically told faculty to “check their credentials at the door.” Still, there was tension between TOSAs and university faculty over the design of content courses. TOSAs felt that teachers should learn it the way they were expected to teach it, and that content courses should be designed to be “accessible for adult learners.” To resolve this tension, the LSC teamed content experts with a TOSA and another classroom teacher to co-plan the content courses, incorporating concepts from the student instructional materials and fundamentals from the appropriate science domain.

In another LSC, university faculty worked intensively with school-based teacher leaders, both centrally and on-site. Despite their past experience as professional development providers, the faculty had never worked with a population who typically lacked an undergraduate degree in science. The LSC provided sessions for faculty to “get them smarter” about working with elementary teachers: getting scientists familiar with the instructional materials; identifying K–6 content relevant to their discipline; discussing the AAAS Benchmarks; familiarizing them with grade-level appropriate pedagogy; and having them visit classrooms.

C. Deploying and Supporting Professional Development Providers

- **Team professional development providers of varying backgrounds to get the best match of skills and expertise.**

Given the breadth and diversity of roles required of LSC professional development providers, teaming was the recommended strategy. Said one PI: “Teaming has been key—telling teacher leaders that they’re not expected to have all the skills.” Using veteran professional development providers with less experienced ones helps launch reform activities while building capacity for the future, and helps ensure quality control. Other LSCs noted that teaming university faculty or other content experts with TOSAs and teacher leaders can ensure a range of perspectives and a better integration of content and pedagogy; this teaming approach can also increase the likelihood that university faculty—sometimes “unrealistic about teacher needs”—will work effectively with teachers who have limited backgrounds in mathematics or science.

The benefits of teaming professional development providers

“Our project staff consists of people with a whole range of skills: university math and science professors, district reps, classroom teachers, college of education faculty, grad students from several departments, and other staff from other universities. Of course, some aspects of the [professional development design] ‘solutions’ depend on the skills of the professional development producers. But more than the individual skills, the ability of the producers to act as a team that addresses content, pedagogy, and leadership is the biggest asset in arriving at a balanced professional development program.”

—Conference Participant

➤ **Create learning communities among the professional development providers.**

LSCs must balance the need for formal, high quality professional development experiences for teacher leaders with interim opportunities for shared reflection, problem-solving, and mutual support. Regularly scheduled meetings of TOSAs with core staff provide these kinds of opportunities, and LSCs noted that they were critical to the professional growth of TOSAs. Similarly, school-based teacher leaders need their own learning communities—through both formal, project-provided sessions, and informal strategies instigated by TOSAs (e.g., potluck suppers). LSCs recommended teams of several teacher leaders in schools to foster collaboration. “More than one [teacher leader] was definitely better” for providing mutual support and sustaining a community of learners. How can LSCs help sustain these learning communities? Providing resources, materials, and information, and creating an awareness of how teachers can access these resources on their own, were among the ideas shared by PIs.

➤ **Build in quality assurance and feedback mechanisms.**

Reform leaders recognized the benefits and need for site-based professional development but lamented the drawbacks: greater inconsistency, lower quality overall, and limited resources for monitoring. LSCs have learned that school-based teacher leaders’ “...background and skills are fragile. Regression will occur if you’re not attentive. You have to keep them focused on the model you’re using.” To ensure quality, projects must build in mechanisms for consultation, improvement, and replacement of teacher leaders, if necessary. One-on-one work with school-based teacher leaders is key for building in quality: a design that includes frequent communication, observation, coaching, and formative feedback by TOSAs is optimal. Where TOSAs are spread thin over a number of schools, projects cited the need for convening monthly meetings with site-based teacher leaders for discussion and feedback on implementation issues.

D. Tensions and Trade-offs

Throughout this report, at the end of each section, we have included a summary chart to recap the dilemmas described by LSCs. These “Weighing the Options” charts are not intended to provide either/or scenarios for LSC designs. More than likely, LSC strategies will fluctuate in response to context, need, and resources. Some strategies will make more sense at the beginning of implementation, as opposed to 4–5 years down the road. Multiple strategies may be required at any given time. Our purpose is to alert LSCs to some of the strengths and pitfalls associated with particular decisions, and to help them be more deliberate in the choices they make. The following chart summarizes some of the dilemmas LSCs can expect to encounter in their work with professional development providers.

Figure 3
Summary Chart
Professional Development Providers: Weighing The Options

| ON THE ONE HAND... | ON THE OTHER HAND... |
|--|---|
| Using designated teacher leaders gives the project visibility and a tangible set of key individuals with whom to work. | A team or learning community model is more sustainable with turnover and changing system dynamics. |
| Using existing leaders as providers allows the project to get up and running faster. | Using existing leaders hampers efforts to build the system’s capacity by expanding the leadership cadre. |
| Clarifying explicit tasks and roles for teacher leaders helps LSCs in the selection and preparation of leaders. | Roles may prove unreasonable, as leaders are easily over-taxed or system may get in their way; selection criteria may become obsolete as roles evolve or as system or context change. |
| Multiple levels of teacher leadership allow LSCs to extend the work of core staff at the district and school levels. | More teacher leaders can result in differences in role perceptions and inconsistency in professional development. |
| Projects should take the time to develop a strong cadre of leaders who can do all that is expected of them. | Time spent developing leaders limits time available to provide professional development to targeted classroom teachers. |
| Preparation of teacher leaders should focus on content and pedagogy—the primary areas in which teacher leaders work with others. | Teacher leaders need skills beyond content and pedagogy, e.g., working with adult learners, small group facilitation. |
| Outside experts can provide needed content expertise. | Content experts may have little experience in working with adult learners. |

III. Professional Development Design: Reaching Teachers, Meeting Needs

In this section, we shift the focus from preparing teacher leaders to professional development for targeted teachers. LSCs face enormous challenges in designing professional development for classroom teachers: the diversity of needs, as well as teachers’ will and readiness to participate; varying implementation schedules; different instructional materials across districts; different grade levels; entrenched attitudes about who can learn mathematics and science; and often a culture that inhibits collaboration. Working within these constraints, LSCs must balance attention to content, pedagogy, and instructional materials, while ensuring that professional development meets teachers’ real and perceived needs. Reform leaders must also find ways to structure professional development to encourage broad participation, creating the “maximum number of opportunities for teachers to decide” to attend. At the same time, LSCs must attend to equity issues in the design, and create a professional development culture in which continuous learning and improvement are valued.

A. Structuring Professional Development Activities

➤ **Be deliberate in choosing professional development approaches.**

LSCs run the risk of limiting their professional development design to what they know best. That is, many begin their project with prior experiences in teacher enhancement—primarily workshops and institutes offered centrally. Armed with this expertise, reform leaders look to these same formats for LSC professional development. Clearly, a centralized approach facilitates quality control. Project leaders also noted that summer and school-year institutes are an efficient way to reach large numbers of teachers, and that the “immersion” experience over a period of days helps create an “intense support system” and learning community. However, centralized venues can present challenges in providing opportunities for extended discussion and reflection, or in offering experiences that move participants beyond an “awareness level” on content, pedagogy, and instructional materials. Other formats, such as school-based meetings, grade-level study groups, and coaching may be more appropriate for these purposes. LSCs need to reflect on the strengths and limitations of different professional development approaches, consider a range of options, and make design choices based on teacher needs and program goals, rather than primarily on the background of project staff.

LSCs also need to consider how best to “roll out” the professional development. Some projects choose to involve all of the teachers from the beginning, with the idea of providing both formal professional development and opportunities for practice over the duration of the project. Others have found it more feasible to start with a subset of the teachers, either working “a school at a time” or starting with one or two grade levels throughout the project and expanding to other grades in subsequent years.

Evolving views on the balance and sequence of professional development

Some PIs noted an evolution in their thinking about the balance and sequence of centralized professional development and school-based follow-up activities. In hindsight, one PI noted that the project should have started out with grade-level professional development both within and across schools, rather than the centralized focus that was initially chosen. LSCs found that school-based professional development was more effective in achieving teacher ownership and in ensuring that the push for reform came from within the school building.

A conference participant concurred about a shift in the balance and sequence of professional development activities, although for different reasons: “While we front-loaded professional development before the initial implementation with an eight-day institute, we are beginning to believe that more follow-up and less introductory professional development might be a more effective balance. Teachers bring deeper, less mechanistic questions—about both content and pedagogy—after attempted implementation.”

➤ **Have a plan, but be responsive to feedback and changing context.**

While LSCs need to be deliberate in designing their professional development, they also need to be responsive and flexible. Said one PI: “People saw that we were listening to them and trying

to give them what they wanted. That encouraged them to come back.” LSCs must also be aware of the ever-changing district context in designing professional development. Projects that had anticipated neither high levels of teacher turnover and mobility, nor the influx of beginning teachers to the project, had to quickly devise a plan for dealing with these realities. Required to shift focus, they found their resources for more advanced workshops substantially reduced, due to the need for additional introductory sessions to meet the needs of newcomers. The lesson was implicit: expect turnover, and build a strategy for new teachers into the design from the beginning.

**The best laid plans...
responding to changing contexts**

One LSC initially required all teachers in cohorts of schools to complete 100 hours of professional development over two years: 24 university-based hours during the summer and the remainder after school during the school year. A year into the project, the district extended the school day until 5:00 p.m., and added summer school so that teachers had only one week off. The result of these policies? Teachers couldn't come to after-school LSC meetings, they wouldn't come on Saturday, and they couldn't come during the summer. The LSC had to shift its design to a classroom-based approach, and use release days in the fall and spring to reach the targeted teachers.

➤ **Take professional development into the schools.**

LSCs asserted that site-based professional development is an essential element of successful reform. Echoing the comments of several PIs, one person noted: “School is where change occurs—that’s the arena for achieving critical mass.” Like teacher leaders, “regular” classroom teachers need time and multiple formats to learn, practice, and reflect on content and pedagogy. School-based professional development can provide these kinds of opportunities, allowing LSCs to tailor activities to the needs of each school and enabling schools to be partners in the process. On-site small group sessions can help teachers to articulate, synthesize, and explore what they are learning about content and pedagogy. Further, school-based professional development takes teachers out of isolation, and promotes dialogue over time with a cross-section of teachers—“typical,” resistant, beginning, and teachers of other subjects. And in schools with particularly needy or unreceptive teachers, school-based professional development can provide a means for core staff to cultivate supportive relationships with teachers.

Taking teachers out of isolation

“Thinking about the summer professional development versus the school-year follow-up, it seems like teachers had more growth in the follow-up. It helped them to take ownership of their own improvement. I don’t care what you call it—action research, study groups, or critical friends group, but the focus is on teacher ownership, teacher collegiality, and looking at continuous improvement, using data, looking at student work, and trying to teach differently. There just has to be that year-long piece. But you have to have a facilitator, there has to be an agenda, you can’t just say, ‘We’re going to meet. What do you want to talk about?’ You have to have specific goals and someone to facilitate.”

—PI Interview

“Teachers generally feel isolated and kit clubs really helped. It’s important for there to be an agenda for the meeting facilitated by a kit specialist, and the agenda must be responsive to users’ needs. But it’s also important to provide opportunities for free discussion.”

—Conference Participant

➤ **Provide tools to boost the quality of site-based professional development.**

Even under the best of circumstances, accountability and quality control remain huge challenges in site-based professional development. Tools that promote high quality, replicable professional development can help ensure consistency and quality. Some LSCs recommended creating documents that clarify reform vision, goals, standards, and instructional materials. Scripts or protocols help ensure that site-based discussions remain firmly centered on content and pedagogy, and less on mechanics and logistics. In one project, core staff kept detailed descriptions of professional development plans and activities, and from these, created a notebook describing the goals and rationale behind professional development. These kinds of tools have proven valuable for those charged with facilitating and monitoring site-based professional development.

LSC suggestions for boosting the quality of site-based professional development

- Provide guidelines to help teachers frame discussions and share information.
- Encourage teachers to present solutions to common problems.
- Provide videos or cases for teacher discussions to eliminate personal vulnerability.
- Encourage teachers to ask designated questions of students to elicit their understanding; use student responses as a springboard for in discussions about teaching and learning.
- Encourage the use of cross-discipline activities to help bring in teachers from other content areas.

B. The Dimensions of Professional Development

➤ **Balance attention to content, pedagogy, and instructional materials.**

The most effective professional development design achieves a balanced integration of content, pedagogy, and instructional materials. LSCs agreed, however, that this is no easy task. In the best case scenario, teacher leaders model pedagogy and provide explicit clarification of

approaches, while content experts address the conceptual underpinnings, both module-specific and beyond. Said one PI: “It’s not like Monday is content day, and Tuesday is pedagogy. You tell teachers what you’re doing, and you’re intentional, and you use curriculum materials to convey the content.”

The challenge of integrating content and pedagogy

In one LSC, the professional development model initially focused one third of the professional development hours on content, one third on pedagogy, and one third on leadership development. In the original design, these three dimensions were completely separate, and there was a “huge tension between content and pedagogy.” By the end of the project, content and pedagogy were well-integrated, with content experts and teacher leaders working collaboratively.

LSCs suggested that professional development providers bridge content, pedagogy, and instructional materials with standards, student work, and assessment. The latter two provided effective, non-threatening ways for getting at teachers’ weaker content areas, for making professional development relevant to teachers’ concerns about classroom instruction, and for developing a deeper understanding of both content and pedagogy.

Still, challenges abound as LSCs try to achieve a balance. One PI echoed the sentiments of others in working with teachers from the elementary and middle grades, commenting that “it’s a constant struggle to get teachers excited by the content, and sometimes the pedagogy just overwhelms the content.” Those working at the high school level encountered different challenges, noting the need for greater emphasis on pedagogy and in making connections between concepts and across disciplines.

- **Expect to shift the focus of professional development, depending on the needs and concerns of targeted teachers.**

The relative balance on content versus practice will likely vary with the needs of a particular group of teachers. While the initial professional development experience should be rich with content and pedagogy, PIs noted that “coming to know the teachers,” and understanding their needs and what they care about is a “critical first step.” Teachers who consider themselves content experts may resist the idea that they need to deepen their understanding of mathematics/science and those who recognize their needs in this area may nonetheless consider it more important to get assistance in using new instructional materials in their classroom “tomorrow.”

For some LSCs, focusing on the instructional materials was a “safe” and a “real” place to start—a strategy for making the content “appealing” to teachers and a first step in moving them through a series of “readiness” stages. Introductory “core” courses for all participating teachers on the use of student modules can help generate interest; as teachers become more comfortable using the materials and as specific needs become evident, LSCs must provide a range of opportunities to meet pedagogical needs (e.g., inquiry, questioning strategies, and assessment), and to shore up teachers’ conceptual knowledge (e.g., by revisiting the modules a second time

with a heavier focus on content). In short, LSCs can expect the three dimensions of content, pedagogy, and instructional materials to take background and foreground roles at various points in the professional development, depending on teacher needs. Within this shifting focus, LSCs must also keep in mind building district reform capacity, as well as classroom capacity, injecting leadership skills into the mix of content, pedagogy, and instructional materials when appropriate.

The evolving focus of professional development

“It makes sense then that the relative emphasis on instructional materials, content, and pedagogy will change significantly as teachers move through the process and adapt, implement, and refine their use of the materials. Concerns with management and logistical issues will precede concerns about the more substantive matters of content and pedagogy. This requires that professional development activities be a balancing act, coordinating components that deal with management/logistics and content and pedagogy....In our experience, basically all of the teachers have a very similar lack of knowledge of pedagogy and the content in the instructional materials initially. Teachers who have had a year of work with the kids have different levels of concern than those who are new to kit use. So as the project proceeds, the variety of professional development expands.”

—Conference Participant

➤ **Take content beyond the materials.**

LSCs concurred that teachers’ content needs are huge. There was far less agreement on how best to meet these needs. LSCs typically maintained that projects are hard-pressed to get teachers to enroll in specific content courses—that content *has* to be embedded in the instructional materials. Said one PI: “You have to be as efficient as possible to couple the content and the curriculum. There are not enough hours to do content training beyond the curriculum.” Still, LSCs agreed that adult learners require broader applications. To meet these needs, LSC professional development must “take it deeper” and go beyond the content in the student materials. Some projects, particularly multi-district LSCs that are using different instructional materials, found it useful to focus on standards, benchmarks, or state proficiency outcomes to keep the content applicable across modules. Others asked teachers to bring their own instructional materials to workshops, and used professional development to address concepts across units.

Making content meaningful

One conference participant described LSC efforts to encourage teachers to ask content-related questions in both initial and subsequent professional development sessions. The project then brought in content experts to address those questions. The result was that teachers got “more than a canned course”—they got their own questions answered. The strategy helped teachers “want” to learn content beyond the module.

➤ **Modeling pedagogy is necessary but not sufficient.**

PIs noted that modeling by professional development providers is critical for communicating a vision of effective classroom instruction. Seeing exemplary teaching helped teachers use the

materials “richly” rather than “rotely,” and moved them beyond just “walking through an activity.” Said one PI: “Principals and teachers don’t see enough examples of good teaching.” The more important message, however, was that modeling alone is not enough. Professional development providers must be explicit in their modeling—identifying particular strategies they are using, clarifying why they are asking specific questions, suggesting classroom applications of content and pedagogy, illustrating how and why these strategies work, and exploring these issues further with individual teachers or in small groups.

Providing the proof through modeling

“Teachers have to see that the pedagogy works, that it’s research-based, but also there has to be in-person modeling so they can see how kids react. That’s had the biggest impact. When we first started, we showed videos, and the teachers gave excuses about why it wouldn’t work in their class, and we knew right away that we had to get in there and show them that these kids could do this.”

—PI Interview

C. Reaching the Targeted Teachers

- **Keep the door open to resisters, but focus on those who are willing and ready for change.**

Conference participants advised that LSCs concentrate early efforts on those who are receptive to change, and not expend energy on resistant teachers. Using this approach, projects can “work out the kinks,” use existence proofs to gain credibility, develop a base of support among faculty and administrators, and build a source of reform-minded teachers to serve as advocates, role models, and mentors to resisters.

The first wave as advocates

“It would be nice if everyone could be involved immediately but that’s not the way the change process works. You get your top ten percent motivated people getting involved, and you get it off the ground, while the others remain skeptical, and then they realize that the materials are good and it’s here to stay. There was peer pressure to participate. They began to realize they were odd person out. The first wave became the advocates.”

— PI Interview

But ignoring resisters also poses dilemmas for LSCs. By concentrating on those eager to participate, LSCs may shortchange others who are most in need of professional development; coming later into the project, resisters may receive neither the breadth nor the depth in their professional growth experience. Further, LSCs that target the high school grades may encounter large numbers of resisters, making it impossible for them to ignore these teachers.

Keeping the door open to resisters

- Conduct interviews with a sample of teachers to determine reasons for resistance.
- Listen to and respond to resisters' concerns.
- Prepare professional development providers for resisters' questions and charges.
- Provide resisters with opportunities to visit successful classrooms.
- Assign mentors to work one-on-one with resisters.
- Keep inviting the resisters.

But even with teachers who are ready and willing to change, how do LSCs ensure participation? In short, they must expect to do whatever it takes. Wide dissemination of information about professional development opportunities requires a solid communication structure—through meetings, mailings, phone trees, and e-mail. Coordinating professional development with school and district calendars to avoid conflicts is also key. Beyond these logistical issues, LSCs recommended using well-respected teachers to recruit others for professional development, and providing incentives and support (e.g., stipends, college credit, credentialing, materials). One PI noted that stipend checks were put in the mail within the week after professional development sessions: “It was a little thing, but incredibly important to the teachers.”

➤ **Make it real.**

Getting the buy-in of “typical” teachers requires that LSCs make professional development relevant to their world. Conference participants suggested using program activities to address issues that matter to teachers, and relating professional development explicitly to what teachers do in the classroom. Focusing on assessment-related issues was a particularly useful strategy for making professional development relevant. LSCs recommended working with teachers on increasing expectations for student achievement, giving teachers formative assessment tools for gauging student understanding, demonstrating how the instructional materials support what is tested, and clarifying how project work can help improve other tested subjects.

Using assessment to move teachers in new directions

In one LSC, project staff developed pre-assessment instruments which teachers administered to students before the units—both to help them assess current levels of understanding and to think about appropriate content for the grade level. Teachers then brought the results of these pre-assessments to an in-school meeting. The instruments gave teachers a useful analytical tool for teaching, and for examining student work. In addition to the pre-assessments, core staff developed embedded and post-assessment instruments, and worked with teachers on ways for students to demonstrate understanding. LSC staff felt that teachers needed much more time on this aspect, but the instruments were a valuable way to focus teachers' thinking in new ways.

Using student work as a focal point for discussions also helped relate reform ideas to classroom practice. One project took this a step further by involving students in summer workshops to give teachers a chance to use the instructional materials under classroom-like conditions; with “team work and solid staff support,” the strategy helped “break down classroom walls. Teachers were willing to take risks and try new things.”

Linking professional development to classroom practice

“Focus professional development around school priorities. The closer you get to the classroom with the professional development, the better.”

—PI Interview

“To create the most teacher change and student growth, you have to integrate professional development into classroom practice.”

—PI Interview

➤ Make it easy for teachers to participate.

In addition to making professional development relevant, LSCs have to make it easy for teachers to participate—both substantively and logistically. Reform leaders must deliver on promises, providing the tools, resources, and support that teachers need to implement the instructional materials. Effective strategies for materials management are critical: where the system worked well, there was solid district commitment, adequate and well-trained staff to deal with logistics, responsiveness to teachers’ needs, and an efficient communication structure.

Logistically, LSCs must provide a range of options “so that teachers have no excuses for not participating.” Giving teachers a choice of formats (e.g., summer institutes, study groups, mini-series) for fulfilling LSC professional development requirements helped to promote participation. LSCs must also encourage schools to look for creative ways to make time available for site-based professional development. Said one PI: “You have to do [professional development] during the school day. I didn’t believe that when I started this project. It’s the only way to get full participation.” Finally, LSCs must ensure that professional development supports school and district goals so that teachers do not feel pulled in conflicting directions.

D. Redefining the Professional Development Culture

➤ Create an awareness of need.

LSCs have the potential to enhance teachers’ identity as professionals, but to do so, they must dispel the notion of professional development as “something that is done to teachers.” They must build a culture where teachers and administrators value professional growth—where teachers see themselves as participants, not recipients. Said one PI: “Often teachers get the message that they’re doing it wrong. You have to talk about it in terms of, ‘This is how we were all taught.’” Teachers may also have misguided ideas about their needs: they may think their content knowledge is adequate, or their interest in pedagogy may interfere with deepening content knowledge, or they may harbor beliefs about who can learn mathematics and science. To prevail over these misconceptions, LSCs must increase teachers’ capacity to recognize their limitations, and create experiences where they can explore these weaknesses and safely feel “puzzled or inadequate.” In sum, LSCs must bring participants to the level of saying, “I’ve got to find out more,” and then provide for their needs.

Developing teachers' awareness of professional development needs

“Professional development has to be congruent with need, but one can develop teachers’ awareness of the need. Student work is very powerful for this. Whenever you can link what you’re doing in professional development to what kids can do, you raise the teachers’ level of consciousness of that need.”

—Conference Participant

“At the beginning of a project or during the pre-project period, very few teachers have perceived needs relative to elementary science. So you have to create an awareness of the needs. We have usually spent time during the pre-project year doing preview professional development, focusing on good elementary science teaching.”

—Conference Participant

“LSCs have to distinguish between what teachers WANT versus what they NEED. [You have to] develop the need....and have professional development that develops a vision and a need for school reform, not curriculum-specific professional development.”

—Conference Participant

In reality, LSCs have struggled with providing teachers with choices, while ensuring that they enroll in the workshops they need most. Requiring teacher participation flies in the face of autonomy. Some LSCs advised putting the responsibility on teachers to develop their own professional development plan and to self-select courses, within the context of standards or the instructional materials. Said one PI: “You have to give teachers options, but [it’s also important to] limit the options. To achieve critical mass, you have to get them to see it as a sequence.” LSCs must convey the message that professional development providers are there to support teachers, not to evaluate them, and that there is value in seeking support from colleagues through discussion and collaboration. Finally, reform leaders can show teachers how to access local and national professional development activities that address specific needs in content and pedagogy.

➤ Embed equity in the professional development design and culture.

Equity should permeate LSCs, cutting across how reform leaders engage students, teachers, and the community. Conference participants emphatically noted that equity is not a one-topic workshop, nor is it an “add-on.” Rather, LSCs advised attending to equity in creative, explicit, and on-going ways, embedding it in the project design from the outset and using an “equity lens” in selecting teacher leaders and in targeting teachers for treatment.

Projects should expect to encounter difficulties in convincing teachers that they *can* make mathematics and science accessible for all children. Some PIs advised using data with teachers and parents to look at student enrollment in specific courses; others focused on teacher content knowledge, noting that “teacher limitations are often perceived as student limitations.” Still others cited the importance of working on teachers’ belief systems, insisting that you “can’t avoid equity issues because you are afraid to make teachers uncomfortable.”

Projects targeting the high school grades were particularly challenged in building teacher appreciation for mathematics and science for non-college bound students. To address these barriers, LSCs suggested meeting regularly with mathematics and science departments, taking

LSC activities into the schools, and developing solid existence proofs to use with secondary teachers. Conference participants also recommended the use of rubrics to look at equity in instruction at all grade levels, and the need to seek out tools and expertise from other equity-focused projects. LSC-Net—the website for Local Systemic Change projects—was seen as a prime vehicle for helping LSCs link with existing resources so that projects do not expend large amounts of time seeking out or developing their own equity materials.

➤ **Empower teachers through participation in networks and learning communities.**

While many of the LSCs indicated that schools are the unit of change, they also noted that reform leaders cannot work with schools in isolation. Conference participants saw teacher empowerment—a “combination of knowledge and staying power”—as vital to reform, and teacher networks as a key strategy for empowering teachers. Teacher networks can help build a professional development culture that promotes on-going learning. Further, teacher networks can create “positive subcultures” that can sustain “small pockets of reform.” As one project drew to an end, it encouraged teachers at schools with less supportive department chairpersons or principals to transfer to other schools where support is strong to increase the likelihood of institutionalization. Innovative instructional materials can provide the focus for teacher networks—the “fiber that holds them together.”

Empowering teachers

“Teacher empowerment both to participate in a new mathematics culture and to become motivated to create that experience for their students is the foundation on which any successful institutionalization of mathematics reform will rest.”

—Conference Participant

Some projects recommended structuring professional development sessions so that all grade-level teachers in the same school can attend together to promote school-based learning communities. Others recommended structuring time for cross-grade seminars, study groups across schools, grade-level meetings in school clusters, and other similar strategies to help broaden teachers’ views. Cross-grade discussions put content into the “big picture;” grade-level discussions helped with more specific content needs in the context of the materials. Both formats were highly valued, particularly in LSCs dealing with multiple grade levels or different instructional materials across districts. But LSCs have to build time into the design for these kinds of activities. They must also encourage schools to build in time and opportunities for meeting, and advised working toward allocated in-service time to support networks across schools and districts.

The benefits of cross-grade networks

One LSC project sponsored “seminars”—interactive, reflective groups of about 25–30 elementary, middle and high school teachers. The strategy was designed as a way to “get a conversation going” about content across grades, and as a way to reinforce the entire K–12 scope and sequence. It was a huge challenge for the project to create mathematical problems suitable for cross-grade discussions, but it led to quality interaction among teachers, elegant ways to solve problems in progressively more complex ways, and a better understanding of the rationale for doing a set of exercises. Keeping high school teachers involved, and keeping the groups thinking and working together was also a major challenge: group members initially looked at high school representatives—those with more content background—and said, “You work this out.” To overcome these barriers, LSCs have to provide training on cooperative learning, give groups an operating philosophy, and provide time for brainstorming and processing.

E. Tensions and Trade-offs

The previous section has covered much ground: what to consider in structuring professional development, the shifting balance and focus of professional development activities, and altering the professional development culture to one that promotes a more equitable and collegial approach to learning. Again, to help LSCs as they grapple with these decisions, we have summarized some of the challenges and dilemmas associated with these topics.

**Figure 4
Summary Chart**

Designing Professional Development: Weighing The Options

| ON THE ONE HAND... | ON THE OTHER HAND... |
|---|---|
| Centralized professional development facilitates quality control, can reach large numbers of teachers, and can provide valuable “immersion” experiences for participants. | Providing opportunities for in-depth discussion and reflection, and getting teachers beyond an awareness level may prove more challenging in a centralized professional development format. |
| Focusing initially on small cohorts of enthusiastic teachers/schools helps work the kinks out, and provides existence proofs to apply pressure for buy-in. | Involving all teachers and schools from the beginning is better for reaching critical mass in a short period of time, with less chance for sabotage. |
| Change happens “one teacher at a time.” | LSCs must reach critical numbers of teachers for reform to take hold. |
| School-based professional development promotes in-depth discussion of content and pedagogy, develops teacher leadership, and builds learning communities. | Core staff and teacher leaders are spread thin providing site-based support; quality control is an inherent difficulty. |
| Content must be linked to the instructional materials in order to engage teachers. | Teachers need broader applications; courses focused solely on the student materials may not convey the “big picture.” |
| Giving teachers choices in course selection promotes professionalism and autonomy. | Teachers may not choose the courses that are most critical for improved classroom instruction. |
| Giving individual districts choices in instructional materials selection promotes autonomy and buy-in. | Multiple sets of instructional materials increases the design challenges for LSCs. |

IV. Building and Sustaining Support for Reform

Developing teacher capacity is a major goal of LSCs. So also is the broader mission of building systemic support for mathematics and science education reform. Without this support, reform efforts are likely to stall. The mission of LSCs must necessarily include developing supportive infrastructure at various levels of the system—district, school, classroom, and community. The task requires that reform leaders look beyond teachers to administrators and other constituents who can help reform to thrive and survive; that LSCs “make reform part of doing district business;” and that they view data and accountability as allies in communicating the value of reform.

A. Building Political Support for Reform

1. Enlisting the Support of Administrators

- **Engage principals and department heads early and often.**

LSCs typically focus their work on teachers and underestimate the importance of working with those who directly support teachers—the principals, and at the secondary level, mathematics and science department chairpersons. Few projects expected or planned for the level of effort

required for this task. Yet, over time, reform leaders discovered that principals were key for enabling teacher leaders to do their work, for promoting teacher participation, and for “setting the tone” for reform in the school. They found that administrators can be a solid ally—working around barriers that detract from reform—or they can “destroy a successful program.” Enlisting principal support was typically cited by PIs as the most influential factor in determining teacher participation in professional development, and in building a supportive context for reform.

Reform leaders found, however, that principals have many demands, with limited time to devote to any one project. Some LSCs acknowledged that they had harbored unrealistic expectations on how much of principals' time they could capture. The solution was to figure out how to engage administrators in ways that matter to them. The most successful strategies were those that helped principals fulfill existing school and/or district responsibilities (e.g., improving literacy, raising test scores). LSCs must look for pertinent issues at a school, find the common ground, and communicate to principals how they can address these issues through mathematics and science education reform.

What LSCs said about involving principals

“[LSCs must] work with principals and develop a relationship with them and start that conversation early. You can’t wait until the last year.”

—PI Interview

“It should have been the first thing we did. Principals control the information. If we had understood the school as the point of change, we would have started with principals.”

—PI Interview

“We would have involved principals earlier, made them commit funds earlier than the fourth year. From day one, we [should have been asking] for their concrete commitment, saying, ‘What are we going to do when the NSF grant is over?’”

—PI Interview

➤ **Develop awareness at the highest levels of administration.**

Building professional development for principals into the system can help ensure sustainability, but it also requires the sanction of superintendents and other central office administrators who hold principals accountable. Speaking about the importance of the superintendent, one PI said: “I wasn’t aware of that until we were well into the grant, as to how the district context would be so critical.” LSCs must understand the locus of control and chain of command. Conference participants noted that if the superintendent backs the LSC vision and goals, the project will likely have more leverage in getting principals and teachers to participate. LSCs advised using superintendents to deliver the reform message to the media, school boards, universities, and others. LSCs can increase the weight of the message by linking professional development and instructional materials implementation to what matters to district administrators, for example, teacher evaluation, certification renewals, and school performance. Getting the message to school boards was key as well; LSCs advised disseminating annual reports to board members, and having students, staff, and evaluators make presentations to help keep attention focused on mathematics and science.

The importance of involving district administrators

“The process of changing the approach to teaching and learning mathematics in urban classrooms is a complex situation with multiple variables. Each variable is in constant motion, responding to the climate of instability and high political pressure that characterizes the contemporary urban high school. The combination of these factors means that all programs, even successful ones, are always vulnerable to criticism, attack, and potential elimination. The ongoing education and involvement of policy makers throughout the district is an important safeguard to minimize such vulnerability.”

—Conference Participant

➤ **Have a systematic plan for communicating the vision to administrators.**

Projects need a systematic professional development plan for engaging administrators from the start. With principals, LSCs must provide tools to guide them in their efforts to improve mathematics and science instruction, and educate them about effective instruction and materials. Conference participants suggested a range of professional development strategies—some apparently contradictory. For example, some LSCs stressed the importance of involving administrators in teacher professional development, while others highlighted the necessity of working directly with administrators apart from teachers. Some participants emphasized the effectiveness of working with principals one-on-one in their own schools, while others underscored the need to provide time away from schools for administrators to convene. As a single strategy, inviting principals to observe teacher professional development was rarely sufficient for building expertise and securing commitment.

Recommendations for engaging principals

- Have a systematic professional development plan for principals, with formal workshops and agreements.
- Don't depend on voluntary participation.
- Be explicit about what good mathematics and science teaching looks like.
- Provide intentional opportunities for principal-teacher interaction.
- Build principal networks and learning communities.
- Infiltrate principal meeting agendas.

As with principals, PIs recommended both formal and informal mechanisms for engaging district administrators, and assigning “staff with the most credibility” to do one-on-one outreach with superintendents. Convening a meeting with high-level administrators soon after the grant is awarded can help clarify expectations and reconfirm commitments. Reform leaders noted the advantages of working through existing channels to engage administrators; using regularly scheduled, mandated meetings for principals and district administrators helps convey the message that the LSC vision matters. Some projects invited superintendents to annual LSC meetings, credited them for their role in reform, and presented them with awards. Said one PI: “You have to tend to those kinds of things.” Even if LSCs have the sanction of administrators, however, rarely is that support assured over time. Competing priorities will divert attention.

Turnover will occur. With both school and district administrators, LSCs need a systematic plan for conveying the message over and over and over.

➤ **Be explicit about roles and expectations for principals, counselors, and department chairpersons.**

Expectations for administrative support should be made clear from the outset. LSCs noted that getting a general commitment—without specific assurances for involvement and action—was insufficient. With district administrators, LSCs must have a well-defined understanding of what this commitment will look like and get *explicit* district commitment—through materials adoption; funding for materials management systems, Teachers on Special Assignment, and substitutes; district contract days earmarked for LSC professional development; and release time for classroom teachers.

With principals, LSCs should expect (at a minimum) attendance at professional development sessions designed to educate them about project goals, materials, pedagogy, and specific ways in which they can support reform. Ideally, expectations for this support should be at a more fundamental level that just “giving teachers permission to participate.” For example, principals can facilitate building-level collaboration by making time for teachers to meet; they can provide resources for professional development and space to store materials and supplies; they can reduce other responsibilities assigned to school-based teacher leaders to enable them to engage in reform activities; they can work with resistant teachers; and they can provide good “press” for the LSC by communicating the reform vision to parents and the media. Some LSCs further expanded the roles and visibility of principals through “purposeful interaction” with teachers on school teams, by creating teams of principals who assumed leadership roles in the LSC, or by creating principals-in-residence who functioned like TOSAs, supporting their colleagues in reform.

The importance of active principal support

“Too many principals think that just saying yes is support. LSCs need to get them beyond that...Principals need to be in the classroom. They need to say to teachers, ‘I saw you do this in the classroom, and the kids responded well. Tell me why you did that. What was going on?’ Support has to be more than just giving them books and letting them go to seminars.”

—PI interview

➤ **Build vertical and horizontal networks.**

LSCs pointed to the need for creating deliberate opportunities for collegial discourse among administrators. Principal networks were a strong incentive for participation and commitment in some LSCs, and a valuable strategy for engaging new administrators. Multi-district projects reported using “horizontal” teams or consortia across districts. While these groups varied in their effectiveness, they nonetheless provided a vehicle for keeping administrators informed, and for generating responsibility and ownership. Others spoke of the need for creating “vertical” teams consisting of various levels of administrators: superintendents, assistant superintendents,

curriculum directors, principals, assistant principals, and others. In the face of mobility among school and district administrators, both of these strategies provided a vehicle for sustaining awareness and keeping newcomers apprised of reform activities and commitments.

Increasing accountability through communities of superintendents

One PI talked of the “inherent difficulties” of maintaining quality control in a multi-district project. The LSC used cross-district communication structures—monthly superintendent meetings and co-directors’ meetings—to discuss these issues and help districts assume greater accountability roles. LSC staff played a facilitation and dissemination role, communicating what professional development strategies had worked well in other districts in the project. Said the PI: “When you’re dealing with a loose federation, you have to tread lightly... You don’t have quality control from a view point of direct responsibility, but you do have good, effective communication to stimulate that.”

2. Building Partnerships and Community Support

➤ Tap the science and mathematics community.

LSCs advised building heavily on existing partnerships and establishing new ones. Partnerships with universities, businesses, museums, and other institutions can help LSCs keep reform afloat. Informal science centers provide expertise in linking with the community. Universities and museums can provide a professional development setting conducive to reform—taking teachers out of the school culture, helping them to “think out of the box,” and providing them with an additional resource to use during the school year. LSCs that lack ready access to museums or universities must identify the range of community resources that exist and tap into them appropriately; for example, LSCs in more rural areas might link with agricultural extension offices, state/regional conservation agencies, county parks and health departments, and small businesses with mathematics/science connections.

Beyond the roles they play as professional development providers, scientists and mathematicians who represent these agencies and institutions provide credibility and visibility. They can help keep these disciplines on the radar screen, can act as potent messengers of reform to school boards and other constituents, and can be a source of funding. Over the course of the LSC, one PI noted “more and more...I have to step away from the day to day operations” to address stakeholders, attend board and community meetings, and deal with partnering institutions.

Institutional relationships that promote collaboration and resource-sharing add to a supportive infrastructure, but they come with their own set of challenges. Each partner brings an agenda and specific needs to reform. Said one PI: “It’s like negotiating with schools. You have to find a mechanism that works. You have to get everybody to have the same vision. It has to be a deliberate process.” LSCs advised that projects continually look for ways to expand the pool of supportive individuals and institutions outside the school community. Persistent one-on-one outreach by LSCs is crucial, but so also is a formal structure and a deliberate process for communicating vision, goals, roles, and expectations. However, unless LSCs have designated, paid staff to do outreach, the task will likely fall to the bottom of the list.

➤ **Meet with parents early and often.**

Parents can demand that their children be assigned to LSC-prepared teachers, thus applying pressure toward change and sustainability. Yet few PIs reported having a coherent, systematic plan for stimulating parent and community support. In fact, most reported “not doing enough.” LSCs advised including parent involvement strategies in professional development for lead teachers, and developing strategies early on for communicating to parents both the vision and substance of new mathematics and science programs. Formal, broad-based advisory groups comprised of parents, teachers, administrators, counselors, union members, and others helped build community awareness and support. LSCs also advised using the media heavily to inform parents and the community, suggesting that reform leaders maintain close ties with media staff charged with covering education issues.

Recommendations for engaging parents and the community

- Create parent expectations that students will participate in the program.
- Trust the value of your work and invite scrutiny by parents and the community.
- Develop a sense of inevitability—this isn’t going away.

LSCs must also build the capacity of schools for enlisting the support of parents. Projects used Family Math and Science Nights toward multiple ends: kicking off the program each year, demonstrating and celebrating success, and introducing parents to content and materials. Some LSCs used teacher leaders to convey strategies for formatting activities and running activity stations for parents and children. Said one PI: “You need to show parents the curriculum up front. But you want it to be fun, not anxious.” Other LSCs identified parent leaders and schooled them through courses and workshops, facilitated by teachers on leave from the classroom.

B. Building Fiscal Support

➤ **Embed reform in district and school priorities.**

Without a mandated state or district assessment, the LSC agenda becomes an “add-on.” Science LSCs are particularly prone to this perception, given that mathematics is more often tested and therefore more likely to be a district priority. Competing initiatives may in fact lurk behind principals’ and teachers’ lack of support, requiring LSCs to ask up-front about existing programs to determine if they conflict with reform goals. Where priorities lie with other areas, such as literacy, LSCs must make science and/or mathematics “philosophically compatible,” forge connections with other subject matter leaders, and communicate explicitly how LSC goals and objectives can help students achieve in other subjects. For example, reading directors must be educated about the importance of buying books that support content areas. Similarly, reform leaders can educate administrators on how the LSC can help meet equity goals. Said one PI: “It all has to fit together. I’m not sure I knew that when I started.”

Synchronizing reform with other priorities requires formal mechanisms for working with other departments (e.g., bilingual, special education) and in-service education providers. LSCs must also attend to the “tug-of-war” between the district’s business and instructional divisions. Working committees (as opposed to informal, one-on-one efforts) that involve key players from multiple departments can best promote resource coordination. Several issues were particularly challenging for LSCs as they looked for ways to advance reform within existing constraints: promoting district policies that support common teacher planning time; including special education teachers and students in the reform process; and broadening the notion of reform through the use of inquiry across subjects.

Using inquiry as the common thread

As one LSC that targeted science was getting started, a district mandate required that all district-supported professional development focus on mathematics. LSC staff had to figure out a strategy for coordinating their efforts in science. They worked with leaders of subject matter committees to take inquiry across the board. Said the PI: “It was the only way we could survive it.” Creating opportunities for interaction among site-based teacher leaders was also key to survival, with discussions focusing on ways to keep science on the radar screen, and to be synergistic, not competitive.

➤ Make reform part of doing business.

Districts must be made aware of the need for fiscal commitment from the outset. That commitment can be small at first, but LSCs found it vital to have a line item in the budget. Initially, reform leaders can make it economical for districts to buy in, using NSF funds to subsidize LSC activities heavily at first. Over time, projects can decrease the NSF proportion and gradually increase requirements for local support. For example, one LSC used project funds for two years to support a person in each school to handle materials management, alerting schools from the beginning that they would have to pay for the position thereafter. But LSCs found they must “tread lightly” with their requests, making districts mindful of the need for reform, demonstrating the benefits and successes, and easing districts into fiscal commitment over a period of years—until support becomes “part of doing business.”

The task of embedding reform in district business can be tricky, however, depending on who “owns” the LSC. District-driven projects, as opposed to those that are managed from the outside, for example, by a university or nonprofit agency, may define “building support”—administrative, fiscal, and otherwise—quite differently. “Outsiders” run the risk of paying less attention to the institutionalization of reform-based practices in the district, if it means a reduced role for their institution or agency in the future.

Easing the district into commitment

“We eased into asking for district in-kind contribution. We didn’t want to hit them with a big bill all of a sudden. We kept adding to the professional development bill every year as we added more teachers. So they began to expect it and it was part of doing business. They needed the incentive of NSF funding to make it happen, and the credibility. But they took their responsibility seriously.”

—PI Interview

➤ **Look for funds everywhere, but concentrate on fostering district commitment.**

Numerous PIs noted that sustaining reform ultimately comes down to money. LSCs recommended seeking other national or state funds, particularly if reform leaders can link their efforts to high-priority initiatives. Other sources of support, while worth exploring, require LSCs to weigh both the benefits and disadvantages. For example, “soft money” from private foundations, corporations, and industry can boost reform efforts but, like NSF support, are finite in duration. External agencies charged with managing multi-district LSCs face different challenges: they must balance their interest in maintaining their income stream against building local districts’ capacity and commitment to support reform. Given these cautions, LSCs recommended that reform leaders look for funds everywhere, but to sustain their efforts, fostering district commitment should take priority. LSCs must find ways to leverage district funds, and look for support in new places within the district budget. Some LSCs noted that “dollars follow the vision.” District administrators who understand and embrace the vision are more likely to find the necessary resources. Without this support, the prospects of increasing district financial support beyond a minimal level are shaky.

Marketing mathematics and science education reform

“It’s nice to say all this, but resources and time are limited. You just work to get the most you can. It’s a matter of looking at what’s important, what’s working, and doing whatever you need to do to keep that going. I thought I was going into science education, but it’s more like marketing and public affairs.”

—PI Interview

C. Providing Evidence to Support Reform

➤ **Value accountability at all levels.**

Before LSCs can get major financial commitments—from districts, foundations or others—projects must get peoples’ attention. They must demonstrate success. LSCs urged reform leaders to “be prepared with data” to enhance levels of awareness among funders and constituents. While some LSCs asserted that resources follow the vision, others argued that “resources follow the test.” The apparent dichotomy between these views illustrates the challenges LSCs face in sustaining a vision that is not test-driven. Still, reform leaders found it critical to have some kind of evidence to show improvement, and to use whatever mechanisms are available. If, for example, mathematics or science is not tested, LSCs must link instruction in

these subjects with others that are tested. Some tied LSC goals and professional development to state proficiency standards; said one PI, “If our scores had gone down, the project would have been in trouble.” In the absence of state or district assessments, projects can use LSC evaluation data to show how reform is meeting broader instructional goals and objectives. Finally, LSCs must push districts toward developing assessment policies aligned with their reform vision, and involve core staff and teacher leaders on committees to create new classroom and district assessment instruments.

Aside from using externally imposed measures to enhance reform efforts, LSCs advised pushing for accountability internally and at all levels of the system. Some worked toward building teacher and administrator capacity to monitor reform activities, while others created district- and school-based structures for this purpose. Finally, at the project level, recurring feedback from constituents, evaluators, and other “critical friends” was essential in helping LSCs stay the course or alter the path when necessary.

➤ **Address teachers’ assessment concerns.**

High stakes assessments: are they a barrier or an opportunity? On the positive side, they demand that mathematics and/or science be taught. Those projects with misaligned district or state assessments still felt “blessed” because the tests made mathematics and science instructional priorities. Yet high stakes assessment can also divert teachers from using LSC-advocated practices. LSCs advised addressing concerns outright to reduce teacher conflict: develop tools that link the instructional materials to state or local performance standards; model ways to balance teaching facts with teaching for understanding; help teachers interpret test results; and use these results to bolster content knowledge. Said one PI: “You can’t ignore it. Teachers are concerned... But give them strategies to work with, and encourage them to trust that the content and pedagogy will prevail in the test score.”

D. Tensions and Trade-offs

Building an infrastructure to support reform will surely challenge LSCs. The context and players will change, requiring a relentless process of capacity building and outreach, as well as review, reflection, and revision of strategies. Typically, LSCs wished they had spent more time earlier on thinking about sustainability and building a supportive context for reform. Below are some of the dilemmas that challenged them in their efforts to do so.

**Figure 5
Summary Chart**

Building A Supportive Context For Reform: Weighing The Options

| ON THE ONE HAND... | ON THE OTHER HAND... |
|--|---|
| The superintendent is key to sustaining efforts. | Turnover will likely occur. LSCs cannot rest the success of the LSC entirely on the superintendent. |
| Principals are instrumental in promoting site-based professional development and reform. | Time and resources to devote to principals are severely limited by the need for working with teachers; principals have many demands. |
| Department chairpersons can be influential in establishing a supportive context. | Sometimes department heads are the most resistant to reform. |
| Getting the support of partners and parents can help keep pressure on schools and districts to support reform. | LSCs have limited expertise in building partnerships, and little time for doing so; partners may have agendas that conflict with LSC goals. |
| LSCs can help sustain their efforts by embedding reform in other school and/or district priorities. | Science and/or mathematics may get lost as LSCs try to coordinate with literacy/other priorities. |
| LSCs must get explicit district fiscal commitment. | LSCs have to tread lightly, and are typically not in a position to demand support. |
| High stakes tests can ensure that reform subjects are taught. | Pressures of high stakes tests can result in teacher conflict; they may abandon reform-advocated strategies. |

V. Summary

In this report, we have tried to capture key lessons shared by LSC PIs and evaluators, based on their experiences in designing and implementing professional development, and in building a supportive context for mathematics and science education reform. We have also tried to capture some of the tensions and trade-offs described by LSCs as they have planned and implemented their reform efforts.

Clearly, if LSCs had unlimited resources, staff, and time, these tensions would not be so troublesome. But project staff must temper decisions at every turn with the resources available to them. They must balance the need for preparing and supporting teacher leaders with the need for providing professional development for targeted teachers. They must build capacity to meet current obligations, while simultaneously meeting the growing demands for professional development among targeted teachers and teacher leaders. They must balance the resources dedicated to building the capacity of administrators—key players in supporting reform—with resources dedicated to teachers—the targeted audience. And they must find the time and resources to build partnerships and community support to help sustain reform.

In dealing with these issues, several messages reoccurred throughout this report. They are worth repeating here in summary.

➤ **Communicate vision and goals.**

Perhaps the single most important thing LSCs can do is communicate the vision repeatedly across broad audiences—teachers, teacher leaders, administrators, content experts, project partners, parents, and others. Doing so can help ensure consistency and higher quality in professional development, and a deeper understanding among constituents of how reform reinforces district goals and enhances learning for all children.

➤ **Be proactive, deliberate, and explicit.**

These qualities should permeate the design. It requires that LSCs know their context well, and work within constraints while also seeking to remove them. LSCs must assume nothing, anticipate roadblocks, be attuned to opportunities, clarify roles, have a strategy, and leave nothing to chance—at all levels of the system. It’s a daunting undertaking. Reform leaders should expect that it will take longer than five years to achieve reform goals, and they should begin laying the groundwork for sustainability from the outset.

➤ **Be flexible and responsive.**

LSCs must be deliberate, but they must also respond to context and emerging need. They must have mechanisms for communication, feedback, and quality control, and be prepared to replace ineffective staff or strategies. Feedback from constituents and evaluators is critical to these decisions. LSCs must also adapt tools and opportunities to meet evolving needs, and balance expectations for buy-in and support with the reality of other demands. They must respond to district mandates that render their design ineffective, and be ready to devise alternative plans. Finally, they must be alert to, and prepared to shift their focus in response to, changing NSF requirements.

➤ **Build capacity and networks.**

LSC staff cannot do it alone. They must build the capacity of a broad range of persons to support reform and keep it from “backsliding”—from the district to the classroom. Ongoing training and support after the initial preparation helps build expertise, capitalizes on experiences with reform, and deepens understanding of vision and goals. Networks within and across schools and districts can be a prime vehicle for capacity-building. They can reduce the isolation of reform, create incentives for participation, and engender deeper and potentially longer-lived opportunities for professional growth than the LSC can provide. In short, creating networks among constituents during the LSC can help ensure a continuing dialogue around reform after NSF funding ends.

Aside from these “lessons learned” for LSCs, several messages also emerged for NSF. We have summarized these below.

➤ **Clarify the breadth and depth of systemic reform.**

LSCs were typically unprepared for the demands of systemic reform, as opposed to “mere” teacher enhancement. Few anticipated the level of effort required for attending to the various elements of systemic reform: preparing teacher leaders sufficiently; engaging principals; getting the sanction of district administrators; working at multiple levels of the system; and building partnerships and community support. NSF can help by clarifying the demands of systemic reform, and communicating a clearer picture of the issues and dilemmas that projects will likely

encounter. Prospective LSCs can then begin their efforts with a better grasp of what to expect in balancing the notion of teacher enhancement with the broader mission of building systemic support for reform.

➤ **Provide ready access to knowledge, tools, and resources needed by LSCs.**

Like the teachers they work with, LSCs initially may not know what they don't know. As projects evolve and new challenges emerge, PIs "keep learning, and keep having new questions." NSF must remain vigilant regarding these needs, and provide access to tools and resources to help LSCs, particularly in dealing with areas that have proven troublesome: strategies for conveying content and inquiry, reckoning with high stakes assessment, and promoting equity in professional development and in the classroom.