VI. Summary and Recommendations

A. Summary

Analysis of the core evaluation data collected in the fourth year of the Local Systemic Change Initiative provides valuable insight into the progress and challenges of reforming K-12 science and mathematics education.

The majority of LSC professional development sessions were facilitated by teacher leaders who have used the materials in their classrooms, lending valuable credibility and practicality to the sessions. The use of mathematics and science experts as co-facilitators enabled teachers to grapple with often challenging content in a supportive setting. LSC professional development providers generally modeled effective pedagogical practices; they were less likely to provide time and structure to enable teachers to reflect on how to employ similar strategies in their own teaching.

While there was sometimes resentment over the fact that participation was mandated, most LSC professional development programs were successful in creating a culture conducive to collaboration and learning. In general, teachers felt free to take risks and ask for help as they grappled with understanding new instructional strategies and mathematics/science content, although in some cases they resented the fact that participation was mandated.

The LSC approach of focusing professional development on exemplary instructional materials, and targeting all teachers in a jurisdiction, has proven to be a very promising design. Typically, LSC professional development sessions provided opportunities for teachers to explore the designated materials, work through student activities, and discuss pedagogical and content issues. Most projects also used the instructional materials as a vehicle to work on strengthening teacher content knowledge.

Data collected in Year Four of the LSC indicate how, over time, participating teachers perceived themselves as becoming more knowledgeable and better prepared to teach mathematics and science; were shifting toward the use of exemplary instructional materials; and were changing their instructional techniques accordingly. Treated teachers were more likely to be using the designated materials, and the quality of the lessons taught improved with increased participation in LSC activities. Teachers who adhered closely to the guides accompanying the instructional materials tended to receive higher ratings for their lessons, which may be due to the strong design inherent in many of the materials.

In addition to the focus on exemplary materials and reaching all targeted teachers, a feature that distinguishes the LSC from traditional professional development programs is its year-round nature. Projects typically provided teachers with implementation support during the academic year, often having teacher leaders serve as demonstration teachers, provide peer coaching, and convene groups of teachers to share experiences and insights in using the designated materials. Many projects also provided year-round content support from scientists and mathematicians, who sometimes provided classroom assistance and often served as resources to answer content

questions when they arise. In spite of the success many projects have experienced in continuing professional development throughout the year, when teachers across all projects were asked what additional assistance they needed, they cited both increased support for classroom implementation and easier access to materials for instruction.

LSC projects continue to work through the challenges of time constraints, which are manifested in a variety of ways. Teachers need time to process new ideas and consider how they would apply in the classroom setting. The amount of time teachers were expected to be out of their classrooms (as well as the availability and scheduling of substitute teachers) was often problematic. In addition, many teachers voiced concerns over the "extra" time it takes to implement the instructional materials in their classrooms, which directly affected their comfort level with incorporating the reform strategies into their teaching.

As projects continue to work with fluctuating teacher populations, there are challenges related to participation of targeted teachers. Projects faced with a reduction of state- or district-provided professional development days struggled mightily with finding time to provide professional development during the academic year. Additionally, there was the issue of recruiting teachers who were less than eager to participate in professional development.

In some cases teachers are modifying designated instructional materials, or developing their own instructional materials, and evaluators in those projects often expressed concern about the quality of these products. Sometimes projects encourage teachers to "be creative" in the ways they implement the instructional materials, and to adapt the materials to make them "their own." In other cases, teachers themselves decide to pick and choose activities from the materials due to time constraints. Based on core evaluation findings, these practices may interfere with the intended progression of conceptual understanding. One evaluator summarized the dilemma particularly well:

> *The value of teaching the materials as designed could be more strongly communicated to LSC teachers. In many ways, through the Project, teachers have been empowered to consider and make careful decisions about science teaching. This is clearly beneficial, but issues arise for relatively inexperienced teachers who are in the early stages of implementing the materials…Sending a stronger message about the importance of implementing the materials as designed (at least initially) seems warranted.*

There are a number of factors that projects need to balance when considering teacher needs and contextual issues, which vary considerably from one LSC to the next. Perhaps the most critical one for both professional development and classroom implementation is deciding how much to focus on the content in the instructional materials as opposed to the pedagogy involved in implementing them. Evaluators warned that over-emphasizing the nuts and bolts of materials implementation may result in minimizing the focus on conceptual development.

The diversity of content needs among teachers presents challenges to project staff as they consider depth and breadth elements of the professional development program design. Some teachers reported that they found professional development sessions repetitive and too low-level,

while others within the same project indicated that they needed more help in understanding content; clearly this diversity creates complex planning issues. Some projects responded by providing a menu of choices for teachers to choose from; others asked teachers to specifically identify what they needed and designed activities accordingly.

A number of areas identified by evaluators as needing attention relate to issues of scale-up and sustainability. Inherent in many LSC projects is the challenge of balancing mandated state assessments with LSC goals, and helping teachers find ways to grapple with these demands. There is also a need in many projects for more capacity-building opportunities for teacher leaders. Evaluators suggested that these activities include: strengthening their knowledge of content and pedagogy; increasing their familiarity with the instructional materials; strengthening their presentation, facilitation and group management skills; providing opportunities for them to be mentored by more experienced teacher leaders and, especially, clarifying their roles and expectations.

B. Recommendations

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

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

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

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

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

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

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