What Experience Has Taught Us About Professional Development

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Facilitating Mathematics and Science Reform: Lessons Learned

Created and established by the U.S. Congress, the Eisenhower Regional Consortia and the Eisenhower National Clearinghouse have collaborated with each other and with many state, regional, and national partners to improve mathematics and science education. Since 1992, the 10 consortia and the Eisenhower National Clearinghouse have built an effective national network that has provided valuable, and often unique, services and resources to mathematics and science educators across the nation. To a great extent, this network has been a catalyst for leveraging and brokering partnerships that have improved professional development and classroom practice in mathematics and science.

The consortia have worked diligently to expand and improve mathematics and science education through high quality technical assistance and professional development for teachers and administrators at all levels of the educational system. The major objective of this work is to build the capacity of teachers, professional developers, and school leaders to deliver and support improved and effective curriculum and instructional practices in mathematics and science. Through providing products and services that are built on national and state standards, current knowledge about teaching and learning, and research-tested strategies, the consortia have been able to meet large numbers of requests for shorter-term technical assistance. In many cases, however, intensive site work focused on services designed to directly affect teacher change and student achievement has been undertaken.

Dissemination has been a key network strategy for communicating information to clients about exemplary products and practices. The network has disseminated high quality materials and targeted resources to millions of clients through print, electronic, and in-person media. These resources include information on mathematics and science curricula, instruction, equity, professional development, and assessment. Access to timely and quality information has been a key feature of the network’s success.

*Facilitating Mathematics and Science Reform: Lessons Learned* emerged from the premise that high quality procedural knowledge has been acquired through years of working as a network engaging many thousands of clients in the improvement of mathematics and science education. Though each region has its own unique context and characteristics, core common strategies for our work have yielded significant lessons about how to be effective in facilitating reform.

Two companion publications attempt to capture this hard-won knowledge in lessons learned on the following topics: collaboration and professional development. Each document represents the reflective thinking of professionals who for more than 10 years have been participants and observers of mathematics and science reform. The publications highlight practical knowledge acquired from the systematic use of strategies and tools that facilitated education reform. Moreover, in each document, the writers interpret and/or connect practical experience to research.

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Introduction

This document is intended as a primer on selecting or delivering high-quality professional development. It reflects both the extensive literature base and the cumulative knowledge of the 10 members of the Eisenhower Regional Mathematics and Science Education Consortia program, for whom these lessons are lived experiences.

Since 1992 the regional consortia have been in the forefront in improving the quality of teacher professional development. When the consortia first began their work, the National Council of Teachers of Mathematics standards were in their infancy and the American Association for the Advancement of Science and National Research Council’s benchmarks and standards were just emerging on the education scene. “Less is more” — less shallow coverage of facts and procedures, more in-depth focus on concepts and “minds-on” engagement — was becoming a common refrain, while researchers and policy experts noted the need for teachers themselves to develop more robust understandings of mathematics and science. Within this crucible of challenge and change the regional consortia emerged as leaders, designing and implementing professional development that builds teachers’ deep understanding of subject matter and that models the instructional approaches needed within the classroom.

As the consortia program comes to a close, local school systems are facing new accountability requirements for instructional improvement and for professional development to support that improvement. This report aims to help local educators and service providers to meet their new challenges, by enabling them to draw on the consortia’s experience as well as the research literature on effective professional development.

The network record on professional development

The Eisenhower Network undertakes an annual evaluation of its work during the previous year. The purpose of the evaluation is to describe the services provided, the products disseminated, and the clients who participated in Network-sponsored activities. Additionally, and most importantly, the Eisenhower Network assesses the impact of its products and services on clients’ work.

Highlights of the latest evaluation findings with respect to professional development are as follows:

- The Eisenhower Network provided a wide array of services to over 10,000 clients across the country. Over three-fourths of all Network-sponsored activities focused on professional development and technical assistance.

- The professional development and technical assistance that the Consortia provided had an impact on both teachers and students. Nearly all survey respondents (92%) who received 12 or more hours of service indicated that Consortia-sponsored professional development helped them to improve their teaching. An overwhelming majority of respondents also reported that the intensive training and technical assistance helped improve student engagement (89%) and performance (88%) in mathematics and science.

Each year, the Network evaluation has yielded similarly positive results on the scale of professional development provided and its impact. This experience forms the basis for Network publications on lessons learned.
Over the past two decades there have been significant shifts in the knowledge base about how people learn, including effective models and strategies for professional development (Bransford, Brown, & Cocking, 1999; Loucks-Horsley, Stiles & Hewson, 1996; Hawley & Valli, 1999; Darling-Hammond, 2000; Ball & Cohen, 1999). This knowledge has led to many positive shifts in beliefs and practice.

One significant shift is recognition of the value of a teacher’s knowledge and experience in supporting student learning. Rowan, Correnti and Miller (2002), among others, have documented significant positive effects of teaching experience on student outcomes, with the largest effects seen for students in the later elementary school years. Experienced teachers who know both their content and effective instructional strategies tend to produce higher achievement outcomes among their students. Research suggests that teachers can make the difference for many students, including those who come from disadvantaged backgrounds (Wenglinsky, 2002). Studies have found that children who are taught by several ineffective teachers in a row tend to perform less well than similar students who are taught by several more effective teachers in a row (Sanders & Rivers, 1996). And earlier research suggesting that schooling cannot overcome the effects of students’ background (Coleman et al., 1966) has shown to be fatally flawed (Whitehurst, 2002).

Experienced teachers who know both their content and effective instructional strategies tend to produce higher achievement outcomes among their students.

With the recognition that quality teaching can make a difference in student learning, school systems have paid increasing attention to professional development programs that support teacher learning throughout their careers. Effective induction programs introduce new teachers to curriculum and instructional practices used in the district and provide them with mentors and coaches (Danielson, 1996; Mundry, Spencer, & Loucks-Horsley, 1999). Veteran teachers deepen their experience by reflecting with colleagues, studying what does and does not work in their classrooms, and expanding their content and instructional repertoires through ongoing professional development (Smith, 2001).

We know more about the conditions that help teachers to apply their professional development learning to their practice (Cohen & Hill, 2000; Loucks-Horsley et al, 2003), including direct links to their curriculum, time to practice with colleagues, and ongoing support. We have learned the importance of offering professional development that develops teachers’ content and pedagogical content knowledge and skills (Ball & Cohen, 1999). We have also learned that professional development programs must fit into the context in which they operate and must pay attention to building capacity, including teacher leadership to sustain new practices.

Perhaps the most significant positive change we have witnessed is the shift to believing that the goal of professional development is to enhance learning of challenging content for all students. This has led to increased responsibility and accountability for professional development programs to better equip teachers to teach a rigorous curriculum to all students and to ensure that students meet high standards. We recognize professional development as a tool focused on improving student outcomes as opposed to one for simply meeting administrative mandates (Sparks, 2002).
What constitutes effective professional development

Although the research base is less than definitive (Guskey, 2003; Whitehurst, 2002), there is broad agreement in the field regarding several characteristics that are critical to the effectiveness of professional development initiatives (Elmore, 2002). The consortia’s experience reinforces the importance of these key characteristics. The following paragraphs describe what we have learned regarding the essentials of effective professional development, both from direct experience and from the research literature. Rather than add to the proliferation of lists of characteristics, standards, and benchmarks, we have organized our discussion according to the principles of effective mathematics and science professional development that were compiled by the National Institute for Science Education (Loucks-Horsley, Stiles, & Hewson, 1996). The authors synthesized these seven principles from professional development standards outlined by the National Council of Teachers of Mathematics (1991), the National Staff Development Council (1995), and the National Research Council (1996). The principles were widely disseminated among the regional consortia and helped to crystallize the consortia’s vision as to what characteristics of professional development are more likely to achieve desired outcomes.

The following sections state each of the seven principles, followed by a discussion of the research background and the consortia’s experience. Each section closes with one or two examples of consortia professional development initiatives that illustrate the principle being discussed.

Addressing how people learn and the nature of mathematics and science

Principle 1: Effective professional development experiences reflect a vision for the classroom based on research on how people learn and the nature of science and mathematics. These teacher learning programs reflect a commitment to ensuring learning for all children; emphasize inquiry-based learning, investigations, problem solving, applications of knowledge, and in-depth understanding of core concepts; challenge students to construct new understandings; and provide clear means to measure meaningful achievement.

Science has produced considerable new knowledge about how people learn that is relevant to the environment and strategies for professional development. Meaningful learning involves the development of conceptual understanding as well as procedural knowledge about a subject, and requires experience in applying and transferring knowledge into other contexts (Bransford, Brown, & Cocking, 1999). Learning is complex and involves developing and revising ideas over time. It involves recognizing and modifying misconceptions that block understanding (Driver, Asoko, Leach, Mortimer, & Scott, 1994). We know from cognitive science that learners build knowledge based on what they already know and that they need diverse experiences to add to and challenge what they know.

Drawing on this understanding of learning as an active, sense-making process, the consortia worked to create a learning environment for adults that research describes as necessary for learning (Bransford et al., 1999) — an environment that is:

- learner-centered — designed to build from where the learners are and to support them to construct their understanding;
• **knowledge-centered** — emphasizing the content that is most important to know and understand;

• **assessment-centered** — using ample structures for ongoing assessment of learning and feedback, including means of self-assessment; and

• **community centered** — providing frequent opportunities for interaction with others in the process of learning.

In these environments, teachers have the opportunity to learn mathematics and science content through inquiry and problem solving, processes modeled after the ways in which scientists and mathematicians seek and create new knowledge. Teachers have time and structures to reflect on what they are learning and to make sense of its meaning in the context of their own classroom practice.

Research also demonstrates that students, regardless of race, culture, and gender are capable of learning science and mathematics (Bransford et al., 1999; Loucks-Horsley et al., 2003). Yet when the regional consortia began their work in 1992, in too many schools challenging science and mathematics instruction was still reserved for the “best” students — students who had been guided into the mathematics and science pipeline from an early age. The consortia built a focus on equity into all major activities, and helped teachers develop strategies for making instruction relevant to their students’ daily lives.

**Putting the principle into action: Project REAL (North Central Mathematics and Science Consortium at Learning Point Associates)**

Project REAL (Rural Education Aligned for Learning) was established as an intervention for six troubled school districts. Unless these districts made significant improvements, they risked state takeover or other sanctions from the Ohio Department of Education. A three-year professional development initiative, Project REAL involved intensive summer workshops and follow-up seminars throughout the school year. Activities were designed to promote engaged learning through hands-on, authentic tasks for teachers and, in turn, for classroom students. Consortium staff worked with the schools to identify research-based instructional materials that could help the schools strengthen mathematics and science instruction, and then organized professional development sessions around the implementation of those materials. Teachers reported making substantial changes in their classroom practices, and interviews with students confirmed these changes. The six participating districts showed significant increases in the percentage of students meeting mathematic and science state standards. On average, 38.5 percent more students are meeting these standards than did four years earlier when the project began. The range of improvements ranged from 9.4 percent improvement to 62.7 percent improvement in the grades tested in the six districts. These improvements meant that in the six districts an average of 81 percent of students reached state standards in mathematics and science after four years and two months of Project REAL interventions.

**Putting the principle into action: K-2 Pedagogical Content Knowledge Institutes (Northwest Eisenhower Regional Consortium for Mathematics and Science at Northwest Regional Educational Laboratory)**

Because of the pressure felt by schools to make sure that their students performed successfully on state-wide
assessments, staff development tends to be directed to teachers in the “testing years.” This creates a gap in which K-2 teachers are left out of many staff development efforts. To address this gap, NWERC developed regional pedagogical content knowledge institutes for K-2 teachers focused on algebraic thinking and number sense. The institutes were based on the following research-based principles: (1) teachers at the primary level can benefit from professional development that builds both content and pedagogical content knowledge skills; (2) constructing an in-depth understanding of key mathematics concepts in an atmosphere of inquiry learning will build mathematical proficiency; and (3) professional development that models effective classroom instruction will give teachers a vision that helps them see mathematics through the eyes of their students. The institutes were conducted in the summer over three to five days and then followed-up during the school year with face-to-face or videoconference sessions. The follow-up also incorporated electronic discussions in which the teachers posted descriptions of their efforts to implement the strategies and concepts from the summer sessions and exchanged ideas on lessons. Evaluation data are still being tabulated, but in follow-up surveys conducted six months after the institute, 80 percent of participants reported they were implementing approaches they learned in the professional development sessions.

**Building content and pedagogical content knowledge and skills**

*Principle 2: Effective professional development experiences provide opportunities for teachers to build their content and pedagogical content knowledge and skills and to examine their practice critically.*

They help teachers develop in-depth knowledge of science or mathematics as well as understanding how children learn the content, listening to students’ ideas, posing questions, and recognizing misconceptions; and they provide help in choosing and integrating curriculum and learning experiences.

When the Eisenhower Consortia began, schools were providing staff development workshops on the latest trends in education — cooperative learning, for example, or technology use, or the latest classroom management techniques. These topics often were presented in ways that had little connection to the content that teachers taught. Often little thought was given to tying teacher learning to student needs, or to ensuring that teachers were comfortable in teaching their subject matter. Over time, the consortia have worked to change this pattern. Research suggests that professional development that is closely linked to improved student learning deepens teachers’ understanding of subject matter content and how to teach it (Cohen & Hill, 2000; Wiley & Yoon, 1995; Brown, Smith & Stein, 1996; Kennedy, 1999).

Through their work the regional consortia have demonstrated that effective teaching is complex and involves drawing from a deep knowledge base in the subject matter as well as in instructional strategies for teaching content. Understanding the subject matter is essential. Research studies that examined the relationship between teacher qualifications and background and student achievement in mathematics and science have found high school mathematics and science teachers with a standard certification in their field of instruction (usually indicating coursework in both subject matter and education methods) had higher achieving students than teachers without certification in their subject area (Goldhaber & Brewer, 2000; Darling-Hammond, 2000; Monk, 1994).
Knowledge of content helps teachers to develop an essential ingredient for effective teaching, called pedagogical content knowledge. This is an understanding of what makes the learning of specific topics easy or difficult for learners and knowledge of ways of representing and formulating subject matter to make it comprehensible to learners (Shulman, 1986; Cochran, De Ruiter, & King, 1993; Fernández-Balboa & Stiehl, 1995; Grossman, 1990; van Driel, Verloop, & De Vos, 1998). There have been significant findings related to how teachers develop this specialized knowledge of teaching and content; most studies suggest that teachers’ development of pedagogical content knowledge is contingent on their subject matter knowledge (Clermont, Krajcik, & Borko, 1993; Gordon & Heller, 1995; National Research Council, 1996).

In a review of studies of professional development in mathematics and science that included evidence of student learning, Kennedy (1999) concluded that “programs that focus on subject-matter knowledge and on student learning of particular subject matter are likely to have larger positive effects on student learning than are programs that focus mainly on teaching behaviors” (p. 25). The programs with the greatest effects not only focused on teachers’ subject matter understandings, but also on teaching the subject matter in the context of how students learn it. Similarly, Weiss et al. (2003) found that mathematics and science content knowledge is necessary, but not sufficient, for effective teaching. This study reports that teachers “also must be skilled in helping students develop an understanding of the content, meaning that they need to know how students typically think about particular concepts, how to determine what a particular student or group of students thinks about those ideas, and how to help students deepen their understanding” (p. 28).

*Putting the principle into action: The IMAGES Initiative (Mid-Atlantic Eisenhower Regional Consortium for Mathematics and Science Education at Research for Better Schools)*

IMAGES (Improving Measurement and Geometry in Elementary Schools) was designed to help K-8 teachers develop a deeper understanding of geometry and measurement concepts and to use that understanding to strengthen their classroom instruction. IMAGES includes both resource materials and professional development institutes. The professional development institutes engage teachers in learning activities that mirror those teachers use in the classroom, and tackle content areas that many elementary teachers find difficult. Participants then return to their home schools to implement the content and strategies in their own classrooms and to share the IMAGES resource materials. Results from matched pre- and post-tests showed statistically significant growth in teachers’ content knowledge over the course of the training.

*Putting the principle into action: The Science Case Methods Project (WestEd Eisenhower Regional Consortium for Mathematics and Science Education at WestEd)*

The Science Case Methods Project addresses a critical goal of standards-based reform — to improve the science achievement of K-8 students by building the science content and pedagogical content knowledge of their teachers. Since 1998, the project has provided more than 10,000 hours of professional development for more than 500 San Francisco Bay Area teachers. Professional development is organized into a series of courses that focus on major science concepts in the context of narrative cases drawn from actual classroom episodes involving those concepts. Written by classroom teachers, the case materials contain student work, student-teacher dialogue, instructional context information, and teacher thinking and behaviors. Course sessions also include hands-on science investigations that parallel those done by students described in the cases. Studies with teachers from
four Bay Area districts showed significant gains in participating teachers’ science content knowledge, and significantly higher levels in their students’ achievement than for students in comparable classes. Moreover, low-performing students made the biggest gains.

**Using research-based methods that reflect those needed in the classroom**

*Principle 3: Effective professional development experiences are research-based and use methods that mirror those used in the classroom. They engage teachers as adult learners in the learning approaches they will use with their students, e.g., starting from what teachers understand and building from there, and providing ample time for in-depth investigations, collaborative work, and reflection.*

Years before it was mandated by the No Child Left Behind Act, the consortia recognized the wisdom of using instructional materials and methods that are grounded in the best available evidence regarding teaching and learning. The consortia also found that schools generally lack both time and expertise for selecting such materials and methods without outside support. In cooperation with the Eisenhower National Clearinghouse, the consortia helped to identify instructional programs, curricula, and enrichment materials for which evidence of effectiveness could be documented. The consortia also worked with school staffs, via both professional development and technical assistance consultations, to help them become more discriminating users of educational resources. And consortia staff designed and implemented professional development that not only incorporated many of these resources, but also reflected the research base regarding student and adult learning.

Adult learners need to see the relevance of something before they learn it; they learn most effectively when new knowledge is presented in the real contexts; and they need time to connect new ideas and skills to their already diverse background (Knowles et al., 2000). A national study of Eisenhower-supported professional development programs also found that professional development focused on teachers’ specific instructional practices increases their use of those practices (Desimone, Porter, Garet, Yoon, & Birman, 2002; see also Cohen & Hill, 2000; Supovitz & Christman, 2003).

A major element of the consortia’s professional development approach is the use of activities that model the kinds of instructional strategies that teachers are expected to use with their students. Just as students are more effectively engaged via active inquiry, so are teachers (National Research Council, 1996; NSDC, 1995). In addition, the consortia recognize that teachers need extended time to work with and get to know the new methods and materials they will use in the classroom. One of the many findings of the evaluation of the National Eisenhower Professional Development Program is that professional development that is sustained over time is more closely linked to improved student learning than are short term or one-time experiences (Birman, Desimone, Porter, & Garet, 2000). In another study, teachers with 80 or more hours of professional development reported higher values on inquiry-oriented teaching practice in science, and teachers with at least 40 hours of professional development reported higher values on investigative classroom culture in science (Supovitz &
Cohen and Hill (2000) found that the longer teachers engaged in curriculum-related professional development, the more they reported using the new mathematics practices in their classroom.

**Putting the principle into action: American Samoa Summer School (Pacific Mathematics and Science Regional Consortium at Pacific Resources for Education and Learning)**

In cooperation with the American Samoa Department of Education, the Pacific consortium sponsored a three-week professional development opportunity for teachers from two elementary schools. The initiative included a week of intensive professional development, followed by a two-week summer school for students in which teachers implemented what they had learned during the first week and reflected on their work. Decisions regarding the content of the professional development and related summer school were data-driven, based on analysis of student achievement data. The professional development week was dedicated to strengthening teachers’ content knowledge through hands-on activities, deepening their understanding of effective teaching strategies in a standards-based classroom, and designing instructional lessons for use in the summer school component. Teachers worked in pairs to design lessons, teach the lessons, observe each other, reflect on their observations, and revise the lessons for future use.

For one of the schools, this event was the beginning of a long-term commitment to support professional development in the interest of improved teaching and increased achievement. For the other, it was the capstone of a three-year mathematics and science improvement effort. In the latter school, at the end of the three-year initiative, the number of seventh grade students achieving average or higher scores on the Stanford Achievement Test increased by 55 percent in science and 49 percent in mathematical problem solving. Eighth grade percentages increased by 26 percent and 11 percent respectively. In addition, both observations and discussions indicate that teachers were able to develop and refine lessons that used hands-on activities as the basis for building students’ subject matter understanding.

**Facilitating the development of professional learning communities**

**Principle 4: Effective professional development experiences provide opportunities for teachers to work with colleagues and other experts in professional learning communities to improve their practice. Continuous learning is a part of the school’s norms and culture; teachers are rewarded and encouraged to take risks and to learn together.**

The consortia quickly found that working with only one or two teachers from a single school generally proved less effective in supporting reform-based improvements than did working with teams of teachers who can collaborate to support whole-school change. The consortia have used professional development to help build a school culture characterized by groups of teachers who reflect on practice; discuss research, student work, and classroom experiences; and develop teacher leadership. The consortia found that approaches such as case discussions, lesson study, and examination of student work and data are promising ways of increasing professional culture. The key feature of these strategies is that they bring teaching practice to the center of professional development by using actual artifacts of teaching and learning such as lessons, student work, and teaching cases.
Several studies show a positive impact from these “practice-based” approaches on teacher content and pedagogical content knowledge. For example, a study by Smith et al. (2003) showed that a professional development course that used a set of narrative cases of classroom instruction enhanced middle school teachers’ mathematics knowledge and their understanding of the rationale for making instructional choices. Practice-based approaches are advocated by Ball and Cohen (1999) who call for “using strategic documentation of practice…[such as] copies of students’ work [and] videotapes of classroom lessons” (p. 14) as the basis for “systematic study and analysis of learning and teaching” (p. 16). Stigler and Hiebert (2003), too, emphasize that educators need opportunities to learn through practice; they note that teachers “need theories, empirical research, and alternative images of what implementation looks like” (p. 16). Studies have shown that the types of professional development closely linked to improved student learning are those that provide opportunities for professional dialogue and critical reflection (Weiss, Gellatly, Montgomery, Ridgeway, Templeton, & Whittington, 1999; Cohen & Hill, 1998; Birman, Desimone, Porter, & Garet 2000).

Building a culture of ongoing improvement through thoughtful analysis of the work of teaching and learning, and of the research literature, shows great promise for achieving deep and lasting changes in teachers’ knowledge, skills, and beliefs. Studies indicate that students of teachers who collaborated in examining practice through case discussions of content learning in science showed gains in science test scores, whereas there were no gains among comparable students of non-participating teachers (Daehler & Shinohara, 2001). Case discussions and examination of student work have been shown to develop teachers’ content knowledge and pedagogical reasoning skills and to increase student achievement (Barnett & Tyson, 1999). Mathematics teachers have deepened their pedagogical reasoning and made substantial changes in teaching practice through the examination of cases of teaching and learning. Cases have also been found to increase teachers’ understanding of mathematics concepts (Gordon & Heller, 1995).

The consortium found that approaches such as case discussions, lesson study, and examination of student work and data are promising ways of increasing professional culture.

**Putting the principle into action: Lesson study in Brownsville, Texas (Eisenhower Southwest Consortium for the Improvement of Mathematics and Science Teaching at Southwest Educational Development Laboratory)**

The Southwest Consortium used the lesson study approach as a professional development model for intensive work conducted with teachers from the Brownsville, Texas school district. Lesson study encourages teachers to publicly share and reflect on their teaching experiences, by working together to develop a lesson or series of lessons, conducting and observing a classroom demonstration of the lesson, and critiquing and reflecting on the lesson’s effectiveness. Several iterations usually occur until the lesson leads to higher levels of student learning. For this initiative, the consortium sponsored a summer institute in which teams of teachers, with facilitation from consortium staff, researched and studied mathematical concepts involving algebraic reasoning and then developed a unit of four lessons based on these concepts. During the subsequent school year, teachers implemented the lessons in their classrooms, using the lesson study approach of demonstration, reflection, and revision. Consortium staff also helped to facilitate the implementation of the lesson study approach. Observations and
comments from participating teachers indicated that they were actively engaged in the process. Members of the teacher teams noted a variety of student outcomes, including increased engagement, understanding, and collaboration.

Supporting teacher leadership

Principle 5: Effective professional development experiences support teacher leadership. Teachers become supporters of other teachers, agents of change, and promoters of reform.

Another lesson the consortia learned early on is the importance of facilitating the development of teacher leaders. Schools, like other organizations, need leadership at all levels (Lambert, 1998; Fullan, 2001). This becomes critically important when the school is trying to make changes in its practices and approaches; teacher leaders in particular are needed to support the changes and model effective practice. Crowther et al. (2002) explain that “teacher leadership facilitates principled action to achieve whole school success. It applies the distinctive power of teaching to shape meaning for children, youth, and adults. And it contributes to long-term, enhanced quality of community life” (p. 10).

Teacher leaders are central to the planning of professional development. They serve on committees that set priorities, examine student outcomes to identify areas for improvement and attend conferences to learn about new programs and resources for their school. Some attend facilitator training to develop the capacity to bring new programs back to other teachers in their building or district.

Schools also need teachers who can be credible spokespersons for the profession and for what constitutes quality practice. Teachers are in the best position to share research on learning with parents and other stakeholders to convey the reasons for using certain strategies or materials. When they have a strong command of the research they are able to know what is easy or difficult for students to learn and when (developmentally) students should learn certain concepts. Teacher leaders bring this valuable expertise to deliberations about the district’s curriculum, grade level expectations, and assessments. Schools need structures and supports to enable teacher leadership to flourish. Lambert (1996) notes that the school community must be organized for leadership by creating groups that build teacher leadership responsibility and roles, such as planning the department’s professional development or choosing a new math text. Dialogue, collaboration, and a sense of responsibility, not accountability, further support teacher leadership (Garmston & Wellman, 1999; Lambert, 1998).

The consortia have facilitated the development of teacher leadership in a number of ways, including providing professional development with an explicit focus on leadership (see below); offering opportunities for teachers to make presentations at conferences or workshops; encouraging the development of professional learning communities that build in leadership roles; and working with administrators to help them identify and develop structures and activities to support teacher leadership.

Putting the principle into action: The Maine Governor’s Academy (Eisenhower Regional Alliance for Mathematics and Science Education at TERC)

The Maine Governor’s Academy was a two-year intensive, highly focused professional development initiative for Maine science teachers. The Academy was designed to develop the knowledge and skills that teacher leaders need to initiate, implement, and support teaching and learning. It was also intended to build leadership capacity in schools by elevating the knowledge and skills of teacher leaders and
their administrators in key areas related to implementing standards-based reform. Participants attended a series of institutes, both during the summer and through the school year. Institutes focused explicitly on leadership, facilitation, and collaborative skills, as well as on instructional planning and delivery. Participants maintained informal contact throughout the year via an e-mail list. Survey results and observations indicate that Academy Fellows developed a fuller understanding of science education research and standards-based tools that strengthened their classroom practice and deepened their pedagogical content knowledge. Many emerged as teacher leaders in their schools and districts, initiating curriculum and policy projects, chairing curriculum and assessment committees, developing curriculum, leading study groups, and working with higher education faculty and graduate students.

**Integrating professional development with local and state priorities and systems**

*Principle 6: Effective professional development experiences provide links to other parts of the education system. Professional development is integrated with other district and school initiatives and with district and state curricula, standards, and assessments.*

Because the consortia grew up with the standards movement, their work from the beginning strongly focused on helping to align classroom practice with local, state, and national standards and curricular frameworks. They recognized that effective professional development focuses on building coherence through “systems that link and align standards, curricula, assessment and accountability.” (Whitehurst, 2002, p. 13). Research also supports the need for aligning professional development programs with a particular school district’s curriculum, assessment, and other systems (Garet et al, 1999; Supovitz & Christman, 2003). This strengthens the likelihood that what teachers learn in professional development programs can actually be implemented in the classroom.

A reform initiative’s chances for positive impact are increased when it reduces the number of short-term, unfocused projects, programs, and initiatives and focuses on clear goals for teacher and student learning (Newman et al, 2001). In addition, coherence is increased when professional development programs involve the collective participation of teachers from the same school, department, or grade (Garet et al, 1999).

The consortia found, however, that most local education systems have not established an integrated set of programs for students and staff guided by a common framework for curriculum, instruction, and assessment that are pursued over a sustained period (Newman, Smith, Allensworth, & Bryk, 2001). Consortia staff and partners have worked extensively with school and district teams to focus school improvement plans, professional development, and acquisition of instructional materials on a small number of core educational goals that are tied to a commonly understood instructional framework.

*Putting the principle into action: The Middle School Mathematics Project (Southeast Eisenhower Regional Consortium at SERVE)*

The Middle School Mathematics Project was designed to help build local capacity to implement reform-based mathematics instruction. The consortium worked with school-based leadership teams at each site to develop and implement a professional development action plan designed to align training
and classroom instruction with local and state standards and the district’s school improvement plan. For four years, consortium staff conducted four-day institutes for teams of teachers, followed by on-site workshops, classroom observations, and consultations. Training focused heavily on teachers’ content understandings, and samples of authentic practice — cases, vignettes, and mathematical tasks — were major instructional tools. At the close of the institute and prior to the school year, staff and participants created a professional development plan that was linked to the mathematics goals established for each site’s school improvement plan. This linkage helped to assure that the entire mathematics faculty was working toward the same goal. Although the Middle School Mathematics Project cannot claim exclusive credit, student assessment data show significant increases in most grades in each of the five participating school sites.

**Continuously evaluating effectiveness**

*Principle 7: Effective professional development experiences are based on student learning needs and are continuously evaluated to measure impact on teacher effectiveness, student learning, and/or the school community.*

The consortia’s experience reflects the conclusion by Guskey (2000), who identified evaluation as an essential ingredient in the design and implementation of professional development. Professional developers need data at the planning stage to decide where to focus and what to do, then at the implementation stage to know how things are working and whether changes are needed, and finally at the completion of a program to assess whether outcomes were achieved and to decide what to do next. The changing context of increased accountability for student learning and commitment to results also requires programs to conduct evaluation to assess how well they are meeting their goals.

At the planning stage, evaluation starts with clarifying what the professional development is trying to accomplish. What areas for growth have been identified? What problem in student learning is the focus? This often involves examining student data and setting goals for improvements (Love, 2002; Schmoker, 1999). In the process, professional developers clarify their goals and identify the outcomes they are responsible for supporting teachers to attain. They develop a vision of what they are working toward and then have data to inform them as they move ahead.

Increasingly, professional development includes the opportunity for teachers to assess their own content and pedagogical content knowledge before and after their learning experiences. This type of evaluation provides data about what participants actually learn and critical feedback for the teachers and the professional developers. In addition, at the implementation stage it is important to assess how teachers’ ideas and beliefs are changing and what new practices they are attempting as a result of the experience.
The regional consortia have been instrumental in encouraging a shift toward data-driven professional development that examines results at all of these levels. The consortia also have encouraged the use of ongoing, school-based professional development approaches, such as lesson study and case analysis, that build assessment into the professional development process itself.

*Putting the principle into action: Data-driven instruction (Appalachia Regional Eisenhower Consortium at AEL)*

Through intensive site work with 35 teachers from a single West Virginia middle school, the consortium convened mathematics teachers to work together on using student data to improve instruction and achievement. State assessment data showed uneven student achievement across the middle school mathematics curriculum, and lesson plans reflected uneven coverage of the content standards. Consortium staff worked with teachers over a four-year period. During the first three years, participating teachers analyzed achievement data and selected content strands on which student scores were low. Consortia staff worked with the teachers, providing professional development that would help them design standards-based instructional strategies to address those weaknesses. In the fourth year, the availability of new assessment benchmarking technology enabled the group to convert their data-driven decision making process into an online benchmarking system that predicts success on the annual state assessment. Student performance showed substantial gains in multiple skills areas in all three grades (6, 7, and 8).
Logistical and Planning Issues

While the characteristics described above are critical to success, the consortia’s experiences also reveal logistical and planning issues that can make or break a professional development initiative. Those lessons are highlighted below.

**In recruiting participating schools or districts, work through existing networks that already have established relationships of trust with your intended audiences.** Particularly in the early years when they were virtual strangers to many local educators, the consortia found that their most successful recruitment efforts came through the use of existing professional networks and informal contacts. The consortia could draw on the reserves of trust and confidence that local educators had established with these mutual contacts.

**Establish partnerships wherever possible.** Partnering with other service providers, particularly those who live and work in proximity to the schools involved in professional development, can be invaluable. Partners not only can open doors, as noted above; they can help to leverage resources, and they can help to provide the kinds of sustained support that are key to accomplishing meaningful school improvement.

**Don’t rely on financial incentives alone to obtain local participation. You’ll likely attract a lot of interest, but follow-through is another matter entirely.** The consortia found that financial incentives — funds for teacher stipends, resource materials, or substitute teachers — were often helpful, and sometimes essential, in recruiting participants for the kinds of long-term, in-depth professional development they sought to implement. But unless schools and districts had their own internal incentives for participation as well, they often failed to follow through on the commitments essential to transferring knowledge into the classroom.

**Look for and work with local leaders with strong commitments to school improvement, and a strong rapport with their local constituencies.** The consortia found that identifying and working with local leaders, including teacher leaders, really made a difference in building and sustaining local support for the instructional reform highlighted in consortia-sponsored professional development. Leaders at both the school and district levels could be instrumental in generating teachers’ enthusiasm for the professional development initiative, as well as with the more difficult challenge of maintaining that enthusiasm in the transfer from training sessions to classroom instruction. The consortia found that effective leaders shared two key characteristics: a deep commitment to reform-based improvements in mathematics and science instruction and a rapport with teachers, families, and community members within their local district. The first characteristic was essential to the sustained effort required to achieve meaningful change; the second was essential to knowing just how far and how fast such change could go in a particular setting.

**Provide incentives for principals and curriculum supervisors to participate in professional development sessions along with “their” teachers.** In their role as instructional leaders, principals and curriculum supervisors are key to the potential implementation and sustainability of reform-based curricula and instructional approaches in the classroom. The consortia found that nothing helps more to assure the support of these key figures than their own participation in their teachers’ professional development. Securing principals’ participation can be a challenge, given the many demands on their time. Incentives can help, as can discussions and trainings that help principals to better understand and address their instructional leadership roles.
As much as possible, involve teachers in multi-year professional development activities. One critical learning from all the major reform efforts of recent decades is that it takes a great deal of time and in-depth support to accomplish the kinds of improvements that can positively impact student achievement. Teachers cannot be expected to transform their instructional practice on the basis of a few brief training sessions. Given the demands on school staffs’ time, and the limited resources available to most professional development initiatives, addressing this factor is a major challenge, but it can be done. Involving local partners who can continue their involvement over time is one strategy; another is facilitating the development of ongoing, site-based professional learning communities. Careful scheduling can help a lot as well, such as summer institutes that are well supported by follow-up sessions at strategic points during the school year.

Provide local educators with guidance and incentives to make plans that extend beyond the current school year. As noted above, it takes a great deal of time to accomplish significant school improvements that can help boost student achievement in mathematics and science. However, the consortia found that many schools were not experienced or adept in planning beyond the requirements of the current school year. School staffs need tools and incentives to help them take the long-term view of school improvement and to plan accordingly.

Understand that turnover is a pervasive barrier to effective professional development, and do what you can to accommodate it. Student mobility is commonly recognized as a challenge to educators. But frequent, and sometimes drastic, changes in administrative and teaching staff, particularly in needy schools, also can erode the commitment to long-term participation and change that is so necessary for improvement. The consortia did not find any ready solutions to this pervasive problem. However, they did implement strategies that could help to mitigate the effects of turnover. Those strategies included working to build broad local support for an initiative, so that its fate did not rest with the fortunes of a single administrator; where possible, targeting professional development to schools and school districts rather than to individual educators; and structuring professional development so that new teachers could be brought in at virtually any point.

Involve your target audience in planning professional development activities. The consortia found that teachers tended to be more fully engaged in professional development activities when they had opportunities to provide input into those activities, when the focus of those activities related closely to their work in the classroom, and, in particular, when the activities addressed entrenched obstacles or barriers to change in the classroom.

Provide for activities both during and after professional development sessions that will enable you to assess the extent to which teachers learned what you intended them to learn. The consortia found that it is important to monitor the ways in which teachers interpret the messages and materials used in the professional development activities, rather than to assume that teachers understand its intent and content. Consortia staff assessed teachers’ interpretations frequently, both during training sessions and through follow-up activities.
While the knowledge base on professional development is expanding, many questions still remain about what constitutes effective professional development and what works best under what circumstances. Guskey (2003) calls for gathering more evidence of how professional development relates to improvements in student learning and a better appreciation for the contextual factors that impact on the need for and the effectiveness of the teacher learning programs. The field still needs to develop a greater understanding of what professional development best supports the turnaround needed in under-performing schools and the strategies and mechanisms that close achievement gaps. We need better examples of how schools and districts embed professional development in their daily work and find time for learning.

As we look ahead we also need to know more about how technology can be applied to support teacher learning. Technology tools that facilitate teacher learning, support reflection, create opportunities to learn anytime, and organize teaching and student data can have a profound effect on the future design and provision of professional development. More innovation and research are needed to document how technology can best be applied to enhance teacher learning.

The requirements of the No Child Left Behind Act are likely to have a pervasive influence on the conduct of professional development. Many of the standards that the law sets for professional development are reflected in the recommendations within this document. However, it remains to be seen whether the Act’s mandate will strengthen schools’ approaches to professional development or send them scrambling for the latest “quick fix.”

Finally, there is perhaps the most basic challenge to effective professional development: how to support in-depth, ongoing, practice-based professional development in an educational system where time is as scarce a resource as dollars. The Eisenhower Regional Consortia and Eisenhower National Clearinghouse are proud to have contributed some model approaches toward addressing this task; however, the challenge of scaling up remains to be solved.
What Experience Has Taught Us About Professional Development

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