

The Colorado Mathematics Middle School Teacher Enhancement Project

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From 1999 to 2003, a Local Systemic Change (LSC) grant from the National Science Foundation (NSF) supported change in middle school mathematics instruction in 42 Colorado schools across 14 school districts. By offering intensive professional development around standards-based mathematics instructional materials to virtually all middle school mathematics teachers in these districts, the Colorado Mathematics Middle School Teacher Enhancement Project (COMMSTEP) went a long way toward taking mathematics reform to scale.

There were some key challenges along the way, and instructional change did not always reach the depth that project leaders hoped. Still, more than 300 middle school mathematics teachers experienced intensive, sustained professional development in reform mathematics, most attempted implementation of the new programs, and many substantially changed their approach to teaching mathematics. In addition, many of the participating districts continued to implement the mathematics instructional materials and some of the professional development supports after LSC funding ended. In these respects, COMMSTEP helped the districts scale-up mathematics reform. Below, I briefly describe the general contours of the COMMSTEP project, and then offer my thinking on the key components of the project that helped us “go to scale” with mathematics reform. I also share some of the challenges faced by the project.

The Context

It is important to understand that COMMSTEP was not a flash-in-the-pan, but represented a natural progression in Colorado’s efforts to improve mathematics instruction. In the early 1990s, following the adoption of the National Council for Teachers of Mathematics (NCTM) standards, Colorado became involved with the New Standards Project under Governor Roy Romer and a forward-thinking state assessment director. In 1993, the state was funded with a Statewide Systemic Initiative (SSI) grant to improve K–12 mathematics and science. I left the classroom at that time to serve as co-principal investigator on the SSI project. That project had a leadership team that included representatives from the state department of education, institutions of higher education, and the participating school districts. Governor Romer’s office was also linked with the SSI, and it was sometimes difficult to distinguish the SSI work from what was happening at the state department of education. This was a good thing, as the SSI leadership team worked closely with the state of Colorado in developing statewide standards and a statewide assessment program.

Also, underway in Colorado at that time was a National Science Foundation Teacher Enhancement Project specific to implementing high school reform mathematics curriculum. So there was a lot going on at the high school level, but middle school seemed almost like a wasteland. Recognizing this, the SSI leadership team drew together leaders from the high school project as well as others experienced with NSF grants and wrote a proposal for a Local Systemic

Change grant targeted at middle school mathematics teachers. The LSC grant enabled us to work for 4½ years to reform mathematics instruction in the participating school districts. The fact that these districts were under pressure to implement state standards and improve student achievement in mathematics gave us a leg-up in our efforts to take mathematics education reform to scale in those districts.

Overview of the Project

Participating School Districts

It was not difficult to recruit school districts to the COMMSTEP project because of the context described above. Colorado had been moving toward standards-based education for a number of years, and the goals and activities of COMMSTEP were closely aligned with state and district policies and standards for mathematics education. Only 5 of the 19 districts that were approached declined to participate. Those that chose to participate often did so because they had recently adopted or planned to adopt one of the reform mathematics curricula around which our project focused. Districts that chose not to participate were those that were not in the process of choosing mathematics instructional materials or had recently adopted a program our project was not supporting. A few districts declined to participate because the project required that all middle school teachers in the targeted schools be involved, and district officials did not think they could make this happen.

The 14 districts that participated in COMMSTEP represent a small percentage of Colorado's 176 districts. All but one of the districts, however, were located along the north-south Interstate 25 corridor, where 80 percent of Colorado's student population lives. Consequently, the project had potential to impact a large number of students. Eight of the districts were located in the Greater Denver Metro area, two were in Colorado Springs, and another three were small town districts. Only one rural district participated in the project, which meant that the project's impact was felt mostly in urban and suburban areas.

At the time the project began, the districts ranged in size from about 600 to almost 90,000 students. Six districts served over 25,000 students, four served 6000 to 25,000 students, three served 1,200–6,000, and the one rural district served several hundred students. Participating districts included the Adams 14 (Commerce City) school district, which served 82 percent minority and 75 percent free-reduced lunch students. At the opposite end of the spectrum was the Lewis Palmer school district, with 10 percent minority and 4 percent free/reduced lunch students. The project also included the state's two largest school districts, Denver Public Schools and Jefferson County Schools.

Project Components

In keeping with the goals of the LSC grant, the COMMSTEP project centered on providing intensive, sustained professional development and support to teachers as they implemented reform mathematics instructional materials. Key components of the project were three standards-based programs, summer institutes for teachers, school-year workshops, teacher mentors, and training for administrators. Each of these components is discussed in more detail below.

- **Instructional Materials**

Participating districts committed to adopting 1 of 3 standards-based mathematics programs: *Connected Mathematics Project*, *MathScape*, or *Seeing Mathematics in Context*. These programs were chosen to ensure that the instructional materials would be of high quality and aligned with state and national mathematics standards. When the project began, some districts had already adopted one of these programs and others were in the adoption phase, so project leaders wanted to give them some flexibility rather than mandate a curriculum. We envisioned that about one-third of the districts would choose to implement *Connected Mathematics*, one-third would implement *MathScape*, and one-third would implement *Seeing Mathematics in Context*. The plan was to phase in the reform, providing professional development in the chosen program to 6th grade teachers the first year, 7th grade teachers the second year, and 8th grade teachers the third year.

As often happens with these kinds of projects, however, school district realities forced some adaptations to our design. First of all, most districts chose to implement *Connected Mathematics*, and some switched to *Connected Mathematics* later in the project. Second, not all schools were at the beginning point in implementation. Some had been involved in piloting some of the programs, so teachers already had received professional development on the program. Those districts that were further along in implementation wanted to include all of their middle school teachers—not just those in the 6th grade. As a result, the project provided professional development for 6th–8th grade teachers from day one. In that first summer institute in 1999, the first week was for 6th grade teachers, and the second week was for 6th, 7th, and 8th grade teachers, broken out into groups by grade level and program.

These developments caused all sorts of problems for the project as we tried to meet the varied needs of schools and teachers. In retrospect, it might have been better to offer only *Connected Mathematics* from the outset. However, I am not sure all districts would have wanted to choose that program in the early stages. It was only later as districts learned of the success other school districts were having with *Connected Mathematics* that nearly all participating districts chose to use that program.

- **Summer Institutes**

Middle school mathematics teachers participated in a summer institute focused on the district's mathematics program of choice. Because 6th grade teachers were, ostensibly, bringing the program into the school, they were asked to implement all units the first year. Summer institutes for these teachers, then, were for two weeks. Seventh and 8th grade teachers were asked to implement half of the units the first year and all units the second year. These teachers participated in a one-week summer institute the first year, and a second week the following year. New teacher workshops were offered every summer for those who were new to the program.

The intended design of the summer institutes was that morning sessions would focus on a mathematics content strand, and afternoon sessions would focus on in-depth study in curriculum groups (teachers from schools that have selected common materials). Each curriculum group would research how the highlighted strand was developed in its chosen program, and work through activities in that program. Major strands making up the summer institutes were number

concepts; algebraic reasoning; geometry and measurement; and data analysis, statistics, and probability.

In reality, participants in the summer institutes were divided by both grade level and program, so all three curriculum projects were underway at each summer institute. For instance, there might be a 6th grade group focused on *Connected Mathematics*, and another 6th grade group focused on *MathScope*. While the initial plan had been to focus on big ideas (or strands) in the morning, the presenters found that 6th grade teachers had very weak mathematics backgrounds. The presenters believed it would be more effective to spend more time in the student materials to make sure teachers experienced the mathematics the students would experience, and also learned the mathematics content and concepts from the student materials. This approach also seemed an effective way for teachers to see how different people approached problems and how that would play out in the classroom. Seventh and 8th grade teachers, on the other hand, spent significant time in the materials, but not as much time as the sixth-grade teachers. Their sessions focused more on the strands and how their chosen program would cover those strands. These teachers received more of a global picture of the curriculum and how their program fit into that, and they also did some mathematics that was not in the student materials.

The COMMSTEP project required that all middle school mathematics teachers in the targeted schools participate in the professional development, rather than make participation voluntary. While this might have created resentment, teacher resistance did not turn out to be a major issue. This lack of resistance is likely because districts had adopted the mathematics curricula that COMMSTEP focused on, and most teachers wanted to learn more about the curriculum. Almost all participants realized they should participate with their fellow teachers to ensure better implementation. The required participation of all mathematics teachers in the school turned out to be a key strength of the project. This school-wide implementation helped teachers develop both collaboration skills and collegiality.

- **School-Year Workshops**

COMMSTEP also offered school-year, one-day workshops to support teachers as they implemented the new instructional materials. These workshops were held monthly for 6th grade teachers, and quarterly for 7th and 8th grade teachers. The workshops were offered on Wednesdays, with the same workshop repeated on Saturdays to accommodate teachers' schedules and the fact that some districts did not have enough substitute teachers to send their teachers to weekday workshops. The structure of the workshops was to offer a morning session for all participants in one large group around mathematics strands that were not tied to a specific set of materials. In the afternoon, teachers broke out into groups by grade level and curriculum. Because 6th grade teachers met monthly, five of these sessions involved just 6th grade teachers, but four times a year the morning sessions included teachers of all three grade levels.

The school-year workshops were generally perceived by teachers to be less relevant than the summer institutes, probably because they were less focused around the specific instructional materials teachers were using. Sixth-grade teachers tended to find the school-year workshops more useful because they were with their grade-level groups for many of the sessions.

- **Teacher Mentors**

The project design called for teacher mentors to meet monthly with participating teachers. These mentors turned out to be critical to the success of the project. In fact, when project leaders recognized the importance of the mentors early on, we sought and received additional funding from a local foundation to support more teacher mentors than the LSC grant could support.

Initially, the mentors were meant to serve as catalysts for the reform in that they would provide on-site professional development and support to help teachers begin and continue implementation. The mentors were hired by the project, some from outside the districts and two from within their school districts. Mentors were selected based on these criteria: (1) committed to the belief that all children and teachers can learn; (2) understood and practiced quality standards-based mathematics instruction; (3) had experience with the adopted instructional materials; (4) had experience with adult learners; and (5) had strong mathematics content knowledge.

COMMSTEP mentors were trained to be “cognitive coaches” rather than content coaches. The purpose of cognitive coaching is to help teachers become self-directed learners, not to coach them in the teaching of specific subject matter (Costa & Garmston, 1992, 2002). The coaches were called “mentors” because project leaders wanted the teachers to feel the mentor was someone who would work alongside them as they learned new concepts and pedagogical techniques. Training the mentors in cognitive coaching meant they did not do model lessons. Instead, they assisted the teacher in becoming a reflective practitioner, using the cognitive coaching structure of a pre-conference, observation, and post-conference. We wanted to help teachers realize that they could implement the instructional materials as intended, but do it in their own styles. All of the teacher mentors went through the cognitive coaching training together, even though some had been trained before. In this way, camaraderie and a common approach were fostered among the mentors.

In addition to the training as cognitive coaches, mentors were provided with professional development on facilitating collaborative groups, presentation skills, the Concerns-Based Adoption Model (CBAM), how people learn, the Myers-Briggs Inventory, and “best practices” classroom instruction. They met monthly to discuss issues faced at their schools and to prepare for workshops. They also attended mentor retreats each year.

Mentors were assigned to certain schools and to certain instructional materials. Their job was to be a major part of the workshop and summer institute delivery team; they were the presenters in most cases. During the school year, in addition to serving as workshop presenters, they spent time in classrooms coaching teachers. They also met with grade level groups to assist with planning.

The teacher mentor component is important because teachers have experienced summer institutes and summer workshops before. Few, however, have been fortunate enough to have a mentor who knows mathematics, has experience with their adopted instructional materials, has worked with them in the summer institute, and comes to the school to offer professional development and work with them in the classroom. There are different types of coaching models, and different programs use the models that work best for their teachers. For COMMSTEP teachers, project leaders felt it was important that they have a person who could

walk beside them in implementation. This approach went a long way toward taking the reform to scale within individual schools. Indeed, even though teacher mentors were initially thought of primarily as catalysts for reform, over half of the school districts chose to continue with a mentor or mathematics coach after the LSC grant ended.

- **Principal Training.**

Our project included a component for principal training. Every summer, for one day of the institutes, we met with principals—usually on Thursday of the second week. We worked with the principals separately from teachers in the morning, focusing initially on informing them about the project. Later, we used *Lenses on Learning*, a modular course from the Education Development Center, Inc. This course addresses a number of issues of importance to administrators as they seek to support standards-based mathematics instruction in their schools and districts (Grant, Nelson, Davidson, Sassi, Weinberg, Bleiman, 2002). We later used the morning session to look at student assessment data and give principals experience doing the mathematics. In the afternoons, principals had lunch with the teachers and then met with their teachers across grade levels to discuss plans for the upcoming school year. During the school year, principals were invited to attend the same workshops that teachers attended, but only a few did so.

This level of professional development for principals, in retrospect, was inadequate. When we received the LSC award and reviewed the activities we proposed, we focused on teacher professional development and did not devote enough time and resources to meeting with the administrators. Later, we reflected that we should have paid more attention to the principal component. We had 100 percent turnover in superintendents of the districts with which we worked, and anywhere from 75 to 85 percent turnover with principals, so we were constantly trying to bring administrators into understanding about the project.

Going to Scale: Key Components

In attempting to take mathematics reform to scale, some aspects of COMMSTEP and/or the environment facilitated the process, and other factors presented challenges to scaling up. The preceding section highlighted some of the features of the project that contributed to scaling up, but there were other aspects of the work that were important as well. Below is a complete list of the factors that facilitated scaling up:

- Teacher mentors to provide on-site support;
- Use of high-quality, standards-based instructional materials;
- Sustained, intensive, cumulative professional development for *all* teachers;
- Alignment of project goals and activities with national, state, and district standards and policies;
- District commitment to the reform effort; and
- Attention to feedback.

The first three factors were discussed in preceding sections. Below are reflections on alignment, district commitment, and attention to feedback.

Alignment

One thing the COMMSTEP project had going for it from the beginning was that project goals and activities were closely aligned with national, state, and district policies and standards for mathematics education. Colorado had instituted a new system of accreditation in 1998, with the basic purposes of fostering greater accountability from school districts, encouraging excellence by assessing student performance in relation to state standards, helping all schools and districts improve academic achievement, supporting local efforts to reform and restructure education, and developing school-community partnerships. The new accreditation system was a strong motivator for COMMSTEP school districts to implement standards-based instructional materials and to support professional development for teachers.

In this environment—as noted earlier—several districts had already adopted one of the three mathematics programs we had selected for our focus. By participating in COMMSTEP, these districts were able to provide teachers with more professional development on the program than would have been possible otherwise. A second scenario involved districts that were in the process of choosing mathematics instructional materials. Officials in these districts knew that if they chose *Connected Mathematics*, *MathScape* or *Mathematics in Context*, they could participate in COMMSTEP. They knew if they chose another program, they would not receive the kind of professional development we offered. Again, this provided a strong incentive to participate.

District Commitment

COMMSTEP partnered with districts from the beginning, which was key to scale up and sustainability by getting district buy-in. This commitment was tangible in the sense that districts provided important financial support. Each district purchased the mathematics instructional materials, supportive materials, and the needed technology. The districts also provided stipends and/or substitutes for teachers to attend school-year workshops and on-line telecommunications support for participating teachers.

In addition to financial partnering, district administrators and principals attended the Summer Institute Administrators' workshop, which gave them an overview of the project and their role in it. At these institutes, principals developed a facilitation action plan with participating teachers. COMMSTEP project leaders worked closely with district administrators and mathematics chairs throughout the project to ensure they were on board with the vision of reformed mathematics. As a result, when LSC funding ended, most of the participating districts continued to implement the designated mathematics programs. Many of them also provided more time for mathematics instruction and teacher planning than they did before the LSC. In addition, over half of the districts supported their own coaches to provide mentoring as teachers implemented the reform mathematics programs.

Attention to Feedback

The implementation of COMMSTEP was monitored through an external evaluation. The evaluation addressed five issues: (1) the overall quality of professional development; (2) the extent of teacher involvement in LSC activities; (3) the impact of the project on curriculum, instruction, and assessment; (4) the likelihood that the professional development system would

be sustained; and (5) the level of support for teaching. The evaluator also provided specific feedback for project improvements. She attended school-year workshops and summer institute sessions, observed classroom instruction, interviewed teachers, observed mentors meeting with teachers, and interviewed members of the project team. Her feedback—particularly from teacher interviews and classroom observations—helped the project provide the support necessary to ensure high quality implementation.

Evaluation feedback was always taken seriously and used to adjust the program. For instance, feedback that the school-year workshops the first year were not relevant to teacher needs led to adjustments in subsequent years. In addition, in response to teacher feedback, the project offered school-year workshops on student assessment, the use of scoring rubrics, and addressing the needs of diverse learners.

Feedback on school-level implementation was also obtained from teacher mentors. As explained above, the mentor's role was to assist teachers in reflecting on and improving their own practice. The mentors were not evaluators but at the same time, they regularly visited classrooms and knew what was, and was not, being implemented. They knew, for example, if the plastic wrap had been taken off the books and if the manipulatives were in use. They knew what individual teachers were doing to implement the program. Even on days when they were not scheduled to observe particular teachers, the mentors might stop in to say hello and see how things were going. They were not policing teachers, but teachers knew the mentors were there and checking to see how things were going. For example, the project offered a workshop on classroom management after mentors reported that some teachers were struggling to manage behavior when students worked in small groups. This sort of feedback from mentors kept project leaders informed about teacher needs, and enabled the project to offer needed assistance.

Evidence of Scaling Up

The key components of COMMSTEP that contributed to the project's ability to scale-up the reform effort are highlighted above. But what evidence did we have that we had succeeded? Three pieces of evidence suggest that the reform was having a broad and lasting impact: changes in classroom practice, spread of the reform to additional schools and districts, and continuation of aspects of the reform after LSC funding ended.

Changes in Classroom Practice

Classroom change was the goal of COMMSTEP and the focus of all of our professional development. Even with all the time and effort devoted to reaching this goal, COMMSTEP did not reach the depth of implementation envisioned at the outset. Project leaders and mentors perceived, however, that many teachers looked at mathematics differently after participating in COMMSTEP. The summer institutes and the work of mentors assigned to each teacher were instrumental in exposing teachers to new mathematical experiences. The majority of teachers who participated in the training did not have a mathematics background, and the summer institute experience was their first step to learning new mathematics content. The institute instructors chose activities that not only allowed participants to be learners, but reflections after these activities focused on how instructional strategies engaged all participants. Many teachers,

especially those teaching sixth grade, made statements such as, “I wish I had learned math this way. Maybe I would have understood it better.”

The amount of professional development these teachers experienced was substantial compared to what teachers typically receive. NSF required that each secondary teacher receive 130 hours of professional development. Even so, COMMSTEP trainers and mentors would have liked more time with teachers to do more individual follow-up to assess how well implementation was progressing. The professional development was spread over two years, but because the mathematics programs and the requirements for teachers were so new, the depth of implementation might have been greater if the work had been spread over a longer period of time. What did occur, however, was that in a number of districts, teachers began to move along a path that they have continued to follow since the LSC funding ended.

Teachers reported to the project evaluator that they had changed in several ways. They said they were more flexible, more patient with students who needed additional time to learn, and more patient in giving students time to express ideas. They also reported that they were more student-centered, using small groups, focusing on big ideas, using a problem-solving (rather than algorithmic) approach, and doing more hands-on and interactive learning. They said they now reflected more on their teaching, worked more collaboratively in team environments, and networked more frequently with other teachers.

The project evaluator also made classroom observations over the life of the project, and noted similar changes in the classroom: improvement in lesson design, increased use of cooperative learning, more language-appropriate materials, time provided for wrap-up, assessments more consistent with investigative mathematics, more hands-on and investigative strategies, improved lesson pace, improved ability of teachers to “read” their students’ level of understanding, and more and better questioning.

Expansion of Reform to Additional Schools and Districts

In COMMSTEP, the spread of reform implementation and ideas continued throughout the project. Some of the success in spreading the reforms may have been due to the pressure to adopt programs that were aligned with state standards and assessment. When district officials or teachers saw or heard about the positive experience some schools were having in COMMSTEP, they wanted to be part of it. The quality of the program generated a desire to spread the reform throughout the districts. In the Cherry Creek School District, for instance, two middle schools began implementing *Connected Mathematics*. Then another middle school in the district decided to adopt *Connected Mathematics* and those mathematics teachers wanted to join the project. Toward the end of COMMSTEP, a fourth middle school sent teachers to COMMSTEP workshop. By the end of the project, almost all of the middle schools in Cherry Creek were using *Connected Mathematics*.

The same thing happened in the Denver Public Schools, where the project initially worked with only four middle schools. By the end of the LSC, all middle schools in the district were implementing *Connected Mathematics*. At the end of the project, the Denver Public Schools sought (and received) a Math Science Partnership grant from NSF, targeting middle schools,

because they wanted to continue offering the kind of professional development that had been offered by COMMSTEP.

A final example—in Jefferson County, only one school participated initially and was implementing *MathScope*. Then, the district adopted *Connected Mathematics*, and all the middle schools in the district were required to implement it. The growing popularity of *Connected Mathematics* likely occurred because from the beginning, more schools adopted *Connected Mathematics* than the other two programs. When state assessment data then showed that most of the top performing middle schools were using *Connected Mathematics*, many districts decided to adopt the program. (Their decisions appeared to be data-driven; however, there was not comparable data available on the other two programs.)

Challenges to Scaling Up

The COMMSTEP program was successful overall in bringing standards-based mathematics instruction to middle school classrooms, in taking the reform to scale within and across districts, and in ensuring that the reform could be sustained. However, the project faced a number of challenges, some of them serious. Major challenges were meeting the varied needs of teachers, balancing content and pedagogy in professional development, measuring the results of our efforts, teacher turnover, teacher expectations for student learning, and the poor mathematics background of middle school teachers.

Varied Teacher Needs

As noted earlier, offering districts a choice of three mathematics programs created unforeseen challenges for the project. Not only were COMMSTEP presenters and mentors working with teachers using three different programs, but they were also working with teachers from three different grade levels and with varied levels of experience with the instructional materials. This situation created the logistical problem of trying to divide teachers into relevant groups during the summer institutes. In addition, when project leaders tried to make the school-year workshops more general to meet the needs of all groups, teachers complained that the workshops were not relevant to specific programs or grade levels. In hindsight, using only one program might have been a more effective approach, but projects of this type will likely always have to manage a wide range of teacher needs.

Balancing Focus on Content and Curriculum Materials

Although mathematics content was a major focus of COMMSTEP professional development, it proved to be a challenge to focus on “big ideas” in such a way that teachers could see the relevance to the particular program they were using. A case in point was a school-year workshop on patterns and relationships. Teachers in small groups investigated patterns and then were asked to study the program they were using to determine where patterns were used in the learning cycle from grade to grade. The objectives of this workshop did not seem clear to teachers, even though they were to the project team. The provider used *Visual Mathematics* as the vehicle for facilitating these activities, which some teachers perceived as irrelevant to the instructional materials they were using in their classrooms. Contrast this to two later sessions observed by the project evaluator that focused on patterns and relationships, this time linked

directly to the instructional materials teachers were using. The evaluator remarked on those sessions, “The content lacked depth and abstraction. Content was incidental and superficially addressed.” Thus, when the presenters focused on big ideas and concepts, the relevance was sometimes lost on teachers; but when they focused directly on the instructional materials, the content was often superficial. Maintaining an effective balance between content and instructional materials remained a challenge throughout the project.

Teacher Turnover

The LSC requirement that every participating teacher receive 130 hours of professional development was one of the biggest challenges because of teacher turnover. Over the course of the project, a large number of teachers switched grade levels or subject areas (usually within the same school), leaving the project with new teachers to train after having invested considerable resources in the original teachers. At high poverty schools, teacher turnover sometimes resulted in a classroom having as many as three mathematics teachers in one year.

A typical scenario encountered in COMMSTEP went like this: Ms. Jones, the 6th grade mathematics teacher in Room 124, attended the two-week summer institute and monthly workshops during the school year, and received monthly visits from a mentor. By the end of that first year, Ms. Jones had received almost 110 hours of professional development. When a science position opened up in the school, Ms. Jones, who had a science background, took the science position. Ms. Smith replaced Ms. Jones as the 6th grade mathematics teacher, and started COMMSTEP with zero hours. Ms. Smith didn’t start at 110 hours simply because she was teaching in Room 124. Project leaders assumed we would be finished with the teacher in Room 124 in two years, but found we were still working in Room 124 at the end of the project. Teachers might also move to other schools or out of the community, become pregnant and take leave, or leave teaching altogether. COMMSTEP dealt with teacher turnover by offering new teacher workshops every year, and seeking out extra funds from local foundations to support this work. The project was funded by NSF to work with 300 teachers, however, by the end of the project we had worked with 507 teachers.

Teacher Expectations

Another challenge was the attitude of teachers who looked at programs like *Connected Mathematics* or *Mathematics in Context*, and said something like, “This might work for the gifted kids, but this would never work for my kids.” We heard such comments most often from teachers in schools with large enrollments of minority students, or students receiving free or reduced price lunch. Teachers in these schools tended to believe the program was only for the gifted students because their students were struggling to learn the computational skills on which they had been drilled for six years. These teachers seemed to think they needed to do more of the same kind of drill with these students.

COMMSTEP presenters and mentors encouraged these teachers to try some of the non-arithmetic units in the mathematics program to show them that students could actually do this level of work. Another effective strategy for raising teacher expectations was discovered when one of the mentors brought in work from special education students who were mainstreamed into her classes. By sharing student work that exceeded what teachers expected of special needs students, she was able to help teachers think differently about learning mathematics.

Conversely, in suburban schools with 80 percent or more of their students in accelerated mathematics classes, teachers viewed the reform mathematics program as only for the special needs students, or for those who were average or below. To address this issue, one of the summer institute instructors who was a national trainer for *Connected Mathematics* brought in activities she was doing with her gifted students, and the results her students were producing. Again in this case, sharing student work allowed the teachers to re-examine their personal beliefs about how mathematics could be taught, how mathematics was learned, and who could learn mathematics.

Lack of Teacher Mathematics Background

The National Survey of Science and Mathematics Education found that the majority of middle grades mathematics teachers were not well prepared in the discipline, having completed at most 2 of 6 college mathematics courses recommended by the National Council of Teachers of Mathematics for middle grades teachers (Weiss, Banilower, McMahon, & Smith, 2001). We anticipated that the same would be true of the teachers participating in COMMSTEP, which influenced our thinking about what could be done in the summer institutes and school-year workshops. COMMSTEP leaders wanted to stretch the teachers, but at the same time they did not want to reinforce the fact that teachers did not know much mathematics. Many teachers remarked when they came to the summer workshops, “I’m not a math teacher, I didn’t do well in math, but I needed the job, they needed a warm body, and I’m a history teacher and I am here.” The extent of mathematics-phobia was really amazing, especially at the 6th grade level.

Project leaders dealt with this challenge by engaging the teachers in activities that stretched their conceptual understanding of mathematics. In addition, mentors in the schools worked with teachers in advance of teaching the units, from a content perspective as well as from an instructional perspective. Presenters also reviewed district curriculum implementation plans and tried to cover upcoming topics at the school-year workshops. Occasionally, university professors led content-focused sessions from a reformed mathematics perspective. Each year one of the school-year workshops focused on the newest graphing calculator for middle schools. This technology was used to introduce mathematics concepts while showing that the calculator could be a tool for learning. Even so, as noted earlier, it was an ongoing challenge to help teachers deepen their content knowledge in ways that had direct application to the classroom.

Current Status of the Reform

Many of the school districts that participated in COMMSTEP assumed ownership of mathematics reform from the beginning. These districts had already adopted reform mathematics programs; they chose to participate in the project because it provided them with the opportunity to offer their teachers intensive professional development and to provide more support for the mathematics programs they had adopted. Other districts were looking for mathematics programs that were aligned with state standards and assessments, and COMMSTEP helped them find and implement these programs. COMMSTEP, then, did not impose a reform so much as support what districts already felt they needed to do.

When COMMSTEP reached the end of its period as an NSF-funded project, the mathematics programs being supported were still being implemented in most of the districts that participated in the project. Some of these districts have made new reform mathematics adoptions across the entire K–12 spectrum. As a result of COMMSTEP, administrators in these districts are now more aware of the kind of professional development needed to prepare and support teachers in implementing new mathematics curricula and strategies.

Even though the districts are implementing standards-based mathematics programs, few have been able to provide the level of professional development support that was offered when LSC funds were available. Several districts have retained the position of mathematics coach or teacher mentor, but often these people are stretched very thin. At least two districts offer quarterly rather than monthly workshops for teachers and continue to have new teacher workshops during the summer. Again, this shows some recognition of the need to offer training and support for mathematics reform, but more is needed, and districts have not been very successful in finding funding sources to provide more support—an issue addressed in the conclusion.

Conclusion

COMMSTEP was supported by a substantial grant from NSF, but readers should not leap to the conclusion that substantial mathematics reform is impossible without such a grant. In fact, across the country teachers are being asked to implement standards-based reform with or without grants, so a great deal of thought should be put into how to accomplish this effectively.

One issue districts must confront is the amount of money needed to provide professional development to support teachers implementing mathematics reform programs. These funds should be added to the cost of purchasing any new program. Publishers provide a limited amount of professional development, but generally it is not enough to prepare teachers to use reform mathematics curricula effectively. Teachers need high-quality professional development sustained over time. Large amounts of money are spent by districts purchasing mathematics textbooks that are then replaced within a few years because test scores do not improve; the assumption is that the new program is at fault. In many cases, however, the underlying problem is that the needed professional development was not provided. Districts would do well, then, to purchase new instructional materials less frequently and instead invest their resources in substantial, quality professional development.

If districts are willing to focus their professional development resources in support of new mathematics programs, they may be able to provide what is needed. However, if local district resources are not sufficient, there are external organizations interested in supporting improvement in public education. In addition to NSF, COMMSTEP received substantial financial support from a number of Colorado foundations and educational organizations. The project team wanted to expand our original design so we sought additional funding to pursue our work. We defined our goals, made it clear how additional resources would allow the project to have a broader impact, and showed how the funding entity's goals would also be served. Our experiences indicate that money can be obtained to support reforms in mathematics education,

and that funding agencies are looking for effective projects to support. Lack of funding is not a legitimate excuse for failing to provide the professional development teachers need to implement new, standards-based programs. Without this kind of professional development, districts can anticipate substantial problems with implementing new mathematics curricula and consequently, with improving student achievement.

In conclusion, the major lessons learned from the COMMSTEP project about going to scale with mathematics education reform are these:

- Shaping the project around standards-based programs ensures that teachers are using high quality instructional materials that are aligned with state and national standards;
- Teachers need intensive professional development to implement the new curricula effectively. Summer institutes, coupled with follow-up workshops during the school year and support from teacher mentors was a relatively effective approach to professional development for our project;
- The professional development, particularly when aimed at middle school teachers, should anticipate that teachers will have weak backgrounds in mathematics. The training can help build teachers' content knowledge through the use of the actual instructional materials they will be using with students;
- It is critical to enlist district commitment to the reform from the outset, in the form of material and financial support;
- Principals should be involved in the professional development throughout the program;
- Mechanisms to obtain feedback from teachers about their professional development and implementation should be built into reform efforts;
- Teacher turnover and varied teachers needs should be anticipated, and strategies planned to deal with these issues; and
- Funding can be obtained to support substantial mathematics education reform.

Attempting to bring about real change in mathematics instruction is challenging, and scaling up the effort to a large number of schools and districts is a formidable task. Hopefully, the experiences of the COMMSTEP project will illuminate the challenges, but also suggest some pathways that districts and reform organizations can follow to help these kinds of changes occur.

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