Building Capacity for Continuous Improvement of Math and Science Education in Rural Schools

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Schools in 47 high-poverty school districts located mostly along the Atlantic Coast of North Carolina, South Carolina, and Virginia may have a head start on new requirements of the No Child Left Behind (NCLB) Act of 2001, thanks to a $6 million grant from the National Science Foundation. Begun in April 2000, the five-year Coastal Rural Systemic Initiative (CRSI) is striving to stimulate sustainable systemic improvements in science and mathematics education in school districts with a long history of low student expectations, persistent poverty, low teacher pay, and high administrator turnover. The CRSI capacity-building model is designed to address issues in rural school districts that traditionally limit the capacity for creating sustainable improvements in math and science programs. A critical action step is that each school district must sign a cooperative agreement to establish Continuous Improvement Teams (CITs) at the district and school levels. These CITs represent a fundamental system capacity-building change in how decisions are made at the school and district levels—a change that is also fundamental to creating lasting improvements in math and science education programs.

Thanks to $6 million from the National Science Foundation (NSF), schools in 47 high-poverty school districts located mostly along the Atlantic Coast of North Carolina, South Carolina, and Virginia may have a head start on new requirements of the No Child Left Behind (NCLB) Act of 2001. Begun in April 2000, the five-year Coastal Rural Systemic Initiative (CRSI) is striving to stimulate sustainable systemic improvements in science and mathematics education in school districts with a long history of low student expectations, persistent poverty, low teacher pay, and high administrator turnover.

Almost 70 percent of the eligible districts are comprised of predominately African-American students (50% or more). Eight percent of the students are American Indian. Approximately 77 percent of the schools have 50 percent or more of their student population eligible for free and reduced lunch.

Accountability pressures of NCLB in small rural schools and their communities are stimulating debates in living rooms and court rooms (Lewis, 2003). Declaring all students must pass Algebra seldom serves to motivate students or their parents in rural communities where few opportunities exist to make use of the education. Advocating that higher levels of academic achievement will yield greater prosperity for individual students who consequently leave the local community is a hard sell to local community leaders. Attracting local financial investments and leadership support is difficult if the reform effort appears to only guarantee exportation of the community's best and brightest students.

We have learned from previous efforts that lasting reform in mathematics and science must address the limited capacity issues of rural schools and their communities. Moreover, an intervention model must focus on the needs of students while also stimulating community commitment to sustain reform efforts (Harmon, 2001; Harmon, Henderson, & Royster, 2002; Harmon & Branham, 1999; Harmon & Blanton, 1997).

The CRSI Model

The CRSI capacity-building model is designed to address common issues in rural school districts that traditionally limit the capacity for creating sustainable improvements in math and science programs:

- Small number of district staff with too many job functions and responsibilities
- Lack of district personnel with math/science background
- Inadequate data for making program improvement decisions
- Limited teacher access to professional development opportunities
- Ineffective process of decision making
- Inadequate use of existing school improvement resources
- Turnover in key leadership positions

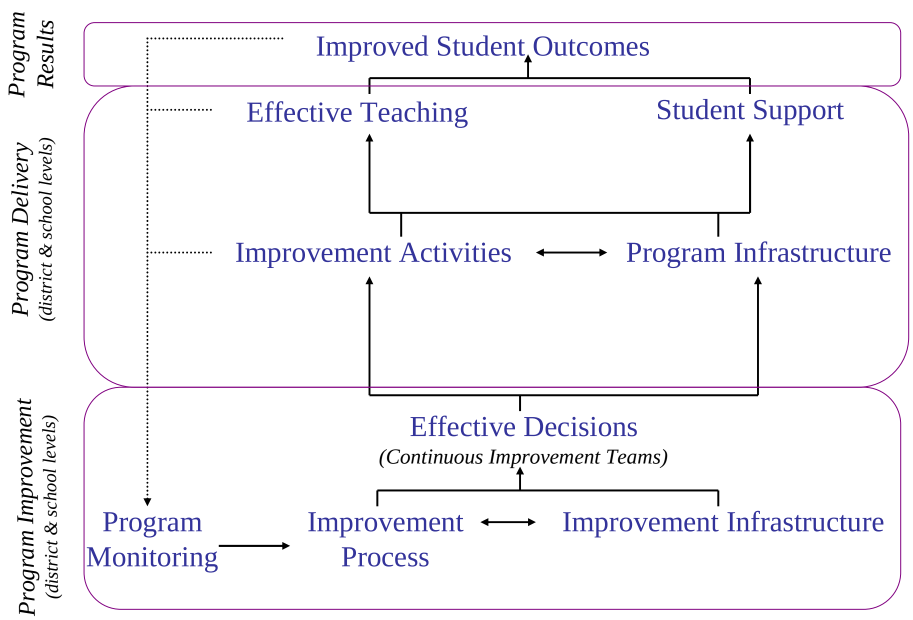
Few rural school districts have mathematics and science specialists in the central office. More often than not, curriculum and instructional reform is led by a person who is a "generalist" with many job functions to perform. While central office staff can usually provide each school with data revealing how students performed on standardized tests and state assessments, little human and fiscal capacity is available for helping schools identify program needs or address the teaching and learning needs of students in mathematics and science. Decisions about all aspects of mathematics and science programs have traditionally been made in isolation by a few teachers, or a select few people, with little or no data to support decisions that reinforce long-term school improvement plans.

Sustainable, high-quality district and school leadership is critical to implementing lasting school improvement initiatives (Lambert, 2003; Lambert, 1998; Love, 2001; Schmoker, 1999). CRSI invests resources provided by the National Science Foundation in school districts where committed administrators and teachers are willing to partner and embrace the CRSI capacity-building model for achieving results in standards-based math and science programs.

Figure 1 shows improving student outcomes is the ultimate program result of the CRSI model. Delivering research-based program interventions (improvement activities) and building appropriate infrastructure at the district and school levels intend to make effective teaching and student achievement in math and science possible. A focus on student achievement guides monitoring of program improvement activities and strongly influences decisions made about the math and science programs.

Figure 1.

CRSI Program Improvement Model



A critical action step of the effective decision-making element of the model is that each school district must sign a cooperative agreement to establish Continuous Improvement Teams (CITs) at the district and school levels. While new teams may be created, the CITs could be integrated into an existing committee with a continuous improvement purpose. Teachers sign the cooperative agreement to become members of school and/or district CITs. These teachers, consequently, commit to participate in activities and professional development designed and implemented by their teams. Every teacher who signs the cooperative agreement has the opportunity to participate in team decisions and to assume leadership roles. These CITs represent a fundamental systemic capacity-building change in how decisions are made at the school and district levels – a change that is also fundamental to creating lasting improvement in math and science education programs.

The districts and schools served by the CRSI are typical rural districts that have limited resources and support personnel to make programmatic decisions in mathematics and science. Less than 5% of the districts/schools we serve have a Principal or Curriculum Supervisor that has a background or experience teaching mathematics or science. Decisions are often made based on speculation or opinions rather than date-based facts.

These districts and schools are also plagued with high turn over of Superintendents, Principals, Supervisors, and certified mathematics and science teachers. The

Combination of traditional decision making roles and high turn over continues to impact the capacity of the administrators and teachers in our schools to make good decisions about mathematics and science programs.

Administrators often create “committees” or “improvement teams” that act in an advisory capacity; however, the transition to a decision making team with the responsibility to implement changes is a fundamental change in role of administrators and teachers. Teams composed of all mathematics and science teachers in a school as well as the Principal an Curriculum Supervisor who have the responsibility and the authority to make program decisions minimizes the impact when an administrator or teacher leaves the team. In addition, making decisions based on a variety of data rather than opinion or recommendations from outside the system, builds the capacity within the schools to make decisions that are appropriate for each school.

A school CIT becomes the sustainable leadership capable of continuous design and implementation of well-planned improvement efforts if teacher and/or administrator turnover occurs. This capacity includes the skill to use program standards, assessments, and other data to prioritize needs and determine use of internal and external resources.

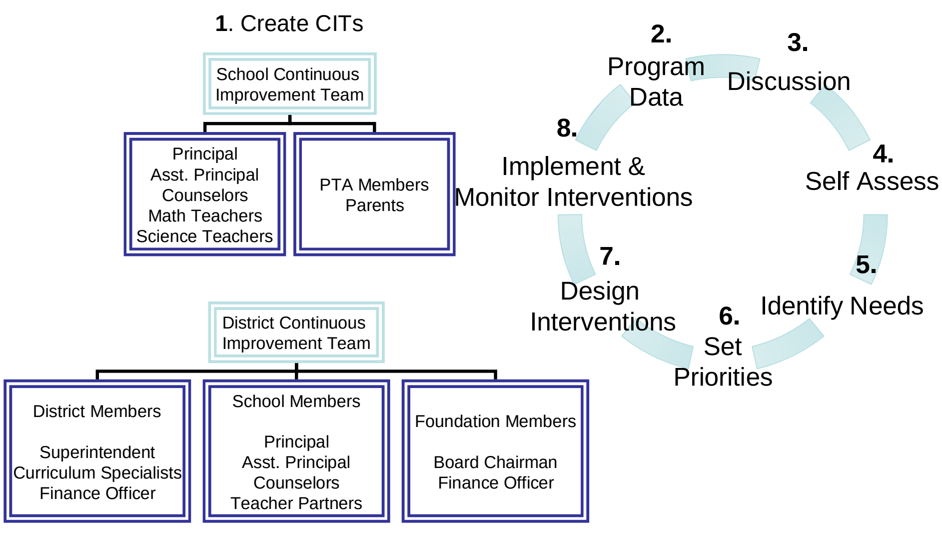
Regional CRSI facilitators provide assistance to the district and school in developing the continuous improvement teams, defining their work, and guiding the overall CRSI assistance (e.g., professional development, data collection and analysis). Facilitators also work with each school’s CIT to ensure teacher input, foster leadership opportunities, and connect the teams to external resource partners and programs. Success (or failure) of the CRSI model depends greatly on each school’s ability to follow a continuous improvement process. Consequently, the most important role of the regional CRSI facilitator is to assist the team in following the CRSI continuous improvement process.

CRSI Continuous Improvement Process

Eight critical steps in the improvement process build capacity for sustainable change in CRSI partner schools. The steps include (1) developing the continuous improvement teams, (2) collecting program data, (3) discussing the data, (4) understanding through self-assessment, (5) identifying school needs, (6) setting priorities, (7) designing intervention strategies, and (8) implementing and monitoring interventions. Requiring each school in the district to follow the eight-step process (see Figure 2) reinforces key elements of systemic reform, particularly ensuring alignment of the district’s K-12 curriculum for mathematics and for science.

Figure 2.

Steps in the CRSI Continuous Improvement Process



Step 1. Developing Continuous Improvement Teams

School leadership that commits to following the process and base decisions on data is essential. Given the limited mathematics and science expertise in the district office and the inevitable turnover of key personnel and teachers in high-poverty rural schools, CRSI assists schools and districts in organizing Continuous Improvement Teams for mathematics and science programs. Emphasis is placed on sharing decision-making responsibilities within Continuous Improvement Teams that include administrators, teachers, and in some cases, counselors and representatives from local educational foundations.

Step 2. Collecting Program Data

CRSI performs two external data collection efforts for a school's CIT. First, CRSI sponsors a Program Improvement Review (PIR). Using a rubric rating guide approach, the PIR presents data on the various elements of a school's mathematics and science programs. Curriculum, instruction, professional development, leadership, resources, climate, and parent/community involvement are reviewed based on standards and indicators drawn from current research on effective programs. During a two-day visit, a team of two or three persons with recognized credibility in mathematics and science that are not employed in the school district collects and reports information back to the CRSI. A formal report is compiled and forwarded to the school's Continuous Improvement Team.

Second, CRSI staff members also collect information through a series of surveys. For example, CRSI analyzed questionnaires completed by approximately 6,000 students and 1,000 teachers in the 2001-2002 school year. Data from these two external efforts are shared with members of the school's Continuous Improvement Team to help them better understand the perceptions about their mathematics and science programs. The data help the school in both focusing efforts on critical improvement needs and in celebrating successes in the teaching and learning of math and science.

Step 3. Discussing the Data

The CRSI Regional Facilitator strives to make the data user-friendly and immediately valuable to the Continuous Improvement Team. Members of the school team review and discuss the data. Team discussion emphasizes an interpretation of the data that will encourage practical decisions for improving the mathematics and science programs at the school. Planning interventions and activities as a result of discussions of the external program improvement review and surveys also exposes the school's team to outside expertise not commonly available to most rural schools.

Data saves precious instructional and planning time for the CITs because discussions are based on objective data. Less time is needed to settle disagreements based previously on opinions.

Step 4. Understanding Through Self-Assessment

Team discussions may also lead to an optional self-assessment. The team searches for examples of school practices that verify or clarify findings or discrepancies in the external data. Those issues or facts that hold the most promise for improving the school's mathematics and science programs are highlighted in the self-assessment. New principals find the self-assessment information especially timely and useful, allowing quick identification of improvements needed without re-inventing the wheel. Periodic self-assessments by the team also answer questions regarding the school's progress toward meeting established benchmarks for school and student performance in math and science education.

Together, the external data and the self-assessment guide decisions for selecting and implementing program delivery interventions consistent with expected results in student achievement and school success. It is this set of data that the school commits to owning as needs for improvement are considered.

Step 5. Identifying School Needs

What defines the work of Continuous Improvement Teams and makes their work unique is that decisions regarding curriculum, instruction, professional development, instructional materials, use of resources, course offerings, policy changes, etc. are based on quantitative and qualitative data rather than on individual opinions. Team members seek to identify needs that, if addressed, will impact student achievement in mathematics and science.

Step 6. Setting Priorities

Not all needs can be met initially. Team members must set priorities for needs that are the most important and feasible to address. Representatives from the school's CIT share relevant data and identified needs at a meeting of the district's CIT. Information from the school CIT helps the district team decide how to best provide equitable instruction, materials and resources to the school. Districts usually concentrate resources where help is most needed, like being sure teachers have access to meaningful professional development opportunities.

How best to leverage district and outside (e.g. CRSI) human and fiscal resources becomes an integral part of the conversation at the district-level meeting. As important, priorities for mathematics and science can be integrated into the overall district improvement plan and influence related policy decisions, personnel actions, and funding practices.

Step 7. Designing Intervention Strategies

District-wide intervention strategies for improving mathematics and science instruction evolve at the district CIT meeting. Representatives who attend the district-level meeting return to the school and share the intervention strategies with other members of the school's Continuous Improvement Team. Information from the district meeting enables the school team to reflect on their intervention strategies, review district-wide strategies, and take leadership action that results in strategies that can be supported with district and school resources. CRSI then strives to invest NSF funds and expertise that leverage the greatest opportunities for the school to deliver a high quality, standards-based program in mathematics and science for all students.

Step 8. Implementing and Monitoring Interventions

Completing the previous seven steps in the process enables the school to develop a learning community culture with the capacity and to lead change from within the school—a culture that can be sustained if key teachers or an administrator leave the school. Key decisions by the CIT position the school to use district and CRSI resources efficiently and to monitor effectiveness of program interventions. Strategic professional development opportunities for teachers can be planned and evaluated based on needs and anticipated outcomes.

Offering after-school and other "extra-help" programs needed in schools with large populations of high poverty students become more feasible. Applications of technology can focus on increasing access to programs or practices that most effectively impact teaching and learning of mathematics and science. Additionally, key interventions for improving mathematics and science programs can be incorporated into the school's or district's other overall improvement plans.

Team leadership using the improvement process also builds capacity among school personnel, thus greatly expanding the potential for implementing lasting change in the school even if the principal or a key teacher leaves the school. Moreover, school district professionals and partners are also in a better position to function as change agents when the superintendent or other key district-level personnel leave the school district.

Early Achievements

CRSI partnering schools are beginning to experience change. In spring of 2003, after two and one-half years of operation, CRSI leadership reported early achievement as part of NSF's midpoint review of the systemic reform initiative. CRSI achievements include:

- Active partnerships with 20 of the 47 eligible districts
- 75% of schools and 86% of teachers are participating in the 20 districts
- 90% of participating schools determined curriculum development and enhancement as a priority need
- 80% of professional development activities for mathematics and science programs were identified and designed through the Continuous Improvement process
- 100% of principals and 76% of math and science teachers participated in the development and enhancement of their local mathematics and science curricula

Data collected during on-site program improvement reviews at schools reveal the following:

- Up-to-date curriculum and instructional materials
- Classroom lessons revised for effective delivery of standards-based instruction
- Vertical alignment of curriculum and instructional materials
- Local math/science curricula aligned to state standards
- Classroom culture with focus on all students
- Lessons contain hands-on activities/use of manipulatives
- Lessons allow for student direction (not completely teacher-directed)
- Program evaluation information includes external data sources
- Students work collaboratively in small groups
- Teachers involved in program decision-making
- Continuous Improvement Teams assume responsibilities rather than individuals
- Continuous Improvement Team members knowledgeable about all available resources (fiscal and other)
- Local foundations being established to support systemic improvements after NSF fiscal resources end in 2005

Conclusion

Districts and schools that are implementing the CRSI model of program improvement are building the capacity to make more effective decisions and use their resources more efficiently. For the first time, some schools are gaining access to key external (and sometimes internal) resources to support math/science programs. Policy changes under consideration include curriculum review cycles, instructional time, teaching assignments, and student placement procedures to help eliminate student "tracking."

These achievements are highly significant in each school's journey to respond to increasing accountability pressures like the federal No Child Left Behind Act. Particularly important for the Coastal RSI and state education leaders, leaving no child behind in mathematics and science becomes more feasible in high-poverty rural schools where the capacity for implementing reform lies primarily within the school. A team-oriented continuous improvement process can be powerful, especially in the hands of skillful teachers, administrators and community partners who are committed to providing high-quality mathematics and science programs in their rural schools.

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