Harmon, H. L., & Smith, K. (2007, June). *A legacy of leadership and lessons learned: Results from the rural systemic initiatives for improving mathematics and science education.* Charleston, WV: Edvantia, Inc.

Abstract:

This report pays tribute to the National Science Foundation's (NSF) Rural Systemic Initiatives (RSIs), an investment of more than $140 million to improve mathematics and science education in some of rural America's most impoverished communities. The report illustrates the impact of NSF's RSI program on a national scale. Each RSI planned a project consistent with the six NSF drivers for mathematics and science reform, and then implemented the project within the context of local rural schools and communities. The report highlights the results and successes experienced by selected RSIs. Information is drawn from material submitted to the authors by leaders of RSI projects. A common theme among the exemplars highlighted in this report is the need to understand contextual circumstances and implement strategies that are considerate of these realities. Major sections include RSI impact on teachers and teaching, impact on students and learning, example RSI intervention strategies (models of change), 22 lessons learned, and concluding thoughts. The examples illustrate the kind of capacity building that is necessary to implement educational improvements in mathematics and science education in high-poverty areas of rural America. The intention is not to claim that all RSIs may have achieved the same successful results, or that only the RSI effort caused the results. The authors strive to demonstrate the impact that is possible when an investment of human and fiscal resources is intensely focused on improving mathematics and science education in rural areas. The RSIs' legacy of leadership and lessons learned gives reason to believe that rural America, even in places with persistent poverty, has the potential to adapt to the educational and economic challenges ahead—if education reformers build on the experiences and leadership capacity for change illustrated in the report. Otherwise, a one-size-fits-all reform approach—inconsiderate of realities in communities and schools in rural America—is unlikely to inspire the leadership, local ownership, and persistence necessary to change the status quo. Moreover, both children and communities in these impoverished rural areas will be left behind. (Contains 11 figures and 15 tables)

A Legacy of Leadership and Lessons Learned

Results From the Rural Systemic Initiatives for Improving Mathematics and Science Education

June 2007

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WHERE DISCOVERIES BEGIN

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The National Science Foundation (NSF) deserves acknowledgement for its contribution to the improvement of mathematics and science programs that are conducted in the K-12 educational systems across this country. Relevant to this particular report, acknowledgement needs to be expressed for the establishment of the Directorate of Education and Human Resources, and the vision and direction that was given to the Rural Systemic Initiatives (RSI) by Dr. Luther S. Williams, who served as the assistant director for education and human resources at the time that the systemic initiatives were established and initially funded. It was Dr. Williams' conceptualization and vision of systemically addressing improvement in mathematics and science education that enabled the State, Urban, and Rural Systemic Initiatives to be developed and nurtured over an adequate period of time to see the results that are reflected in this and other reports. Two additional leaders at NSF who played major roles in the formulation of systemic initiatives were Dr. Peirce Hammond, senior advisor to the director of Education and Human Resources (EHR), and EHR deputy assistant director Dr. Jane Stutsman. Both were key players in designing and developing the concepts and visions that became the RSIs. While the key individuals mentioned above are no longer at NSF, there has been a consistent, knowledgeable, and dedicated RSI Program Director who has served from the inception of the RSIs. This individual is Dr. Jody Chase, and all who have worked with RSIs are indebted to her for the support, guidance, and advocacy she has provided.

On the implementation side of the RSI experience, Dr. Wimberly Royster has played a unique role. He helped to create interest in, and support for, the development of an approach that would address low performance and the need for improvement in mathematics and science education across rural Appalachia and in other parts of the country. As principal investigator for the Appalachian RSI, and through his contacts with NSF and his commitment to improving mathematics and science education in rural places, Dr. Royster has provided leadership for the RSI and served as their spokesperson. His leadership and dedication are recognized not only by NSF, but also by his colleagues across the RSI community.

Last, but not least, the RSI project directors and personnel who have worked diligently to develop proposals, seek funding, implement programs, and do the hard work of making RSIs successful, must be acknowledged. Were it not for their efforts, there would be no need for this report, and the programs and exemplars that provide the substance of this report would never have happened. As a result of what they have done, we know much more about how to build leadership that improves mathematics and science programs in rural places and how to do it in a systemic way that makes a real and lasting impact in places that have historically received minimal service and attention.

Contents

Executive Summary

The Rural Systemic Initiative projects, funded by the National Science Foundation (NSF), represent an investment of over $100 million in the improvement of mathematics and science education in rural America. The Rural Systemic Initiatives, or RSIs, were launched in 1994 and came on the heels of the State Systemic Initiatives and the Urban Systemic Initiatives, which NSF launched in 1990. The last of the RSIs will end in early 2008. From the mountains of Alaska to the Mississippi Delta, from the Indian reservations of the Great Plains to the hollows of Appalachia, the RSIs have served economically disadvantaged and geographically isolated regions that face daunting challenges for education reform.

This report pays tribute to the National Science Foundation's RSIs and their efforts to ensure that students in some of rural America's most impoverished communities are prepared for the 21st century as citizens and workers with a quality education in mathematics and science. Included in this report are numerous tables, figures, and quotes from selected RSIs—projects considered to be exemplars—that highlight the impact of RSIs. Examples of various RSI change models illustrate the complexity and challenge confronted by the RSIs. The report concludes with 22 "lessons learned" by RSI leaders from across the country.

The positive story of results achieved and leadership developed by the RSIs presents to the nation a legacy that can help us meet today's challenges. Accelerating improvements in mathematics and science education looms large on the agenda of federal, tribal, state, and local policymakers. As stated by leaders at The National Summit on Competitiveness:

> The good news is that America is able to meet these challenges from a position of economic strength. We have the resources in people, ideas, and financial strength to invest in a successful future. We will falter only if we are complacent.

Let us hope that what the RSIs have achieved and learned can help prevent the complacency and neglect that has prevailed for decades in too many rural areas of America, particularly in those areas with high concentrations of poor people. Investing in and leveraging the legacy of leadership already established by the National Science Foundation's RSIs would be a prudent path for action.

Preface

On December 6, 2005, more than 55 corporate CEOs, university presidents, and scientists from across the country participated in a daylong summit during which they pressed cabinet secretaries and members of Congress on key issues related to keeping the U.S. economy globally competitive. The report of the national summit was a call to action:

> The National Summit on Competitiveness has one fundamental and urgent message: If trends in U.S. research and education continue, our nation will squander its economic leadership, and the result will be a lower standard of living for the American people.
>
> Global conditions are changing. The competition is getting better at creating and deploying new knowledge. Information technologies are enabling the rapid diffusion of knowledge, know-how, and advanced manufacturing capacity. Talent, technology, and capital are available globally. In this new economic landscape, past performance is no guarantee of future success.
>
> The good news is that America is able to meet these challenges from a position of economic strength. We have the resources in people, ideas, and financial strength to invest in a successful future. We will falter only if we are complacent. (p. 2)

This National Summit on Competitiveness represented the capstone commitment of many business and academic leaders to bring the findings and recommendations of key reports directly to policymakers. Among the reports noted were these:

- *Rising Above the Gathering Storm* (the National Academies, October 2005)
- *Losing the Competitive Advantage*? (AEA [American Electronics Association, now the Alliance for Science & Technology Research in America], February 2005)
- *Tapping America's Potential* (Business Roundtable, July 2005)
- *Innovate America* (Council on Competitiveness, December 2004)
- *The Looming Workforce Crisis* (National Association of Manufacturers, September 2005)

One of the key tasks highlighted at the national summit for action by policymakers was to expand the innovation talent pool in the United States by seeking to double, by 2015, "the number of bachelor's degrees awarded annually to U.S. students in science, math, and engineering, and increase the number of those students who become K-12 science and math teachers" (p. 5).

Congress is taking action to expand our capacity for improving mathematics and education in the United States. In June of 2006, the House Science Committee unanimously passed a competitiveness package that included H.R. 5358, The Science and Mathematics Education for Competitiveness Act. On March 5, 2007, majority and minority leaders and more than 50 cosponsors in the U.S. Senate introduced S. 761, the America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science Act of 2007 (the America Competes Act).

As policymakers and others seek to harness the power of quality mathematics and science education to help rural communities participate in a global economy, this report on the legacy of the RSIs offers ideas and inspiration. A rural economy that represents the "creative class" needed for rural growth, as advocated by McGranahan and Wojan (2007), depends greatly on significant advancements in the education levels of rural citizens.

But why should we care about rural America? After all, as we entered the new millennium, more than 80% of the U.S. population resided in nonrural areas—and slightly more than 50% lived in places with over a million residents. David Brown and Louis Swanson, editors of *Challenges for Rural America in the Twenty-First Century*, offer several reasons:

1. Although rural people make up a minority of the U.S. population, the number of rural residents exceeds the total population of all but 22 of the world's 200 nation-states.

2. Almost three fourths of the counties in the United States are classified as nonmetropolitan (rural), and these counties house most of the nation's natural resources; energy, metals, water, soil, timber, wildlife habitats, open spaces, and attractive viewscapes are all primarily rural resources. Society and natural resources are mutually interrelated, thus America depends on the wise use, preservation, and conservation of these valuable resources in ways that mutually benefit urban and rural locales.

3. Most Americans tend to see the rural population as a repository of almost sacred values, traditions, and a sense of stability during times of rapid change. This view fosters a complex mix of pro-rural and anti-urban attitudes. However, most Americans form their opinions about rural people and their communities from a distance (through literature, art, and music) rather than through direct experience with the conditions and lifeways of rural communities and people.

4. Equity is a final reason. Rural residents still lag behind their urban counterparts on many important quality-of-life indicators. For example, poverty has persisted for more than four decades in some of the most chronically depressed areas of the United States.

Whitener and Parker (2007) point out that research sponsored by the U.S. Department of Agriculture's Economic Research Service has recently documented a direct link between labor force quality and economic development outcomes. Increases in the number of adults with some college education results in higher per capita income and employment growth rates, although less so in non-metro (rural) than metro (urban) counties. Researchers report that efforts to reduce school drop-out rates, increase high school graduation rates, enhance student preparation for college, and increase college attendance are all critical to improving the quality of the local labor force. They recommend strengthening the quality of education by assuring that best-practice models of distance learning are available to remote rural schools. The researchers also note that instructional quality could be improved by promoting effective teacher recruitment and retention efforts in remote and poor rural areas.

This report pays tribute to NSF's Rural Systemic Initiative, an effort to ensure that all students in some of rural America's most impoverished communities are prepared for the 21st century as citizens and workers with a quality education in mathematics and science. An investment of more than $100 million by NSF in the RSIs has bestowed on rural communities a valuable legacy of leadership, providing a foundation for these communities to further develop their human resources in partnership with all key stakeholders—a critical next step for increasing the quality of life for rural residents while also increasing America's competitiveness in the world. Brown and Swanson remind us, however, that

> Rural development is about the interrelationships among the various aspects of rural life; about how population, employment, environment, politics, institutions, and national and international policies affect and are affected by each other.… In reality there is no one rural America. Rural Americans and rural communities are extremely diverse—demographically, economically, environmentally, and culturally. (p. 15)

Introduction

To date, limited information has been available about the impact of the RSIs funded by the National Science Foundation. A few articles about the RSIs have been published in academic journals. Two recent books reveal how one or more RSIs pursued the reform of mathematics and science education: *Building Community: Reforming Math and Science Education in Rural Schools,* by Paul Boyer, and *Telling the Story: Tribal College Rural Systemic Initiative,* edited by Loretta DeLong. Annual reports are available through ERIC and on the Web sites of some RSIs.

This report illustrates the impact of NSF's RSI program on a national scale. Each RSI planned a project consistent with the drivers for mathematics and science reform advocated by NSF, then implemented the project within the context of local rural schools and communities. The set of six NSF systemic reform drivers address the topics of: (1) standards-based curriculum and instructional practices, (2) supportive policies, (3) convergence of resources, (4) partnerships, (5) project and student performance data, and (6) elimination of student achievement gaps.

Provided in this report are exemplars of impact that highlight the results and success experienced by RSIs in various locations. The information presented here is drawn from material submitted by RSIs that responded to solicitations for examples of successful practices and results. Clearly, the intention is not to claim that all RSIs may have achieved the same successful results, or that only the RSI effort caused the results. However, the evidence presented here demonstrates the impact that is possible when an investment of human and fiscal resources is intensely focused on improving mathematics and science education in rural areas.

The RSIs' legacy of leadership and lessons learned gives us reason to believe that rural America, even in places with persistent poverty, has the potential to adapt to the educational and economic challenges ahead—if we can build on the experiences and leadership capacity for change illustrated in this report. Otherwise, a one-size-fits-all reform approach—inconsiderate of realities in communities and schools in rural America—is unlikely to inspire the leadership, local ownership, and persistence necessary to change the status quo. And both children and communities in these rural areas will be left behind.

For example, Table 1 shows a context in rural America—the Delta—that is likely to be different from other rural areas in a few specific ways, and vastly different from urban areas. The Delta RSI included counties in Arkansas, Louisiana, and Mississippi. In the Delta RSI's final report, *Building Educational Bridges Across the Delta,* the contextual circumstance for reform of mathematics and science education is specified.

Table 1. Context of the Delta RSI

High poverty rate	• 74% of Delta students qualify for free or reduced-price meals
Agrarian society	• Little economic diversification • Few employment opportunities • School system often largest employer
Cultural and geographic barriers	• Low population density • Migration to/from rural communities limited • Closed systems somewhat resistant to reform
High teacher and administrator attrition rate	• Employee turnover as high as 60% in some schools • Inadequate pay and lack of amenities • Critical shortage of family housing
Few external resources	• Limited capacity to access resources • Community partnerships minimal
Lack of human resources	• Multiple course responsibilities for math and science teachers • Multiple job responsibilities for district personnel • Few opportunities for professional engagement and growth
Distrust of education systems	• Higher education attainment often results in people leaving the Delta
Dual (segregated) education systems	• Some districts have a total student population that is only 50% African American, yet the African American student population in some schools is as high as 95% • Little interest and tax support for public schools
Lack of parent involvement	• Limited educational attainment by parents • Low expectations • Single-parent families: 36% in Alaska, 33% in Louisiana, and 43% in Mississippi

Table 2 shows the traditional beliefs and practices of the Delta before the reform effort and the transformed beliefs and practices that evolved during the Delta RSI implementation.

Table 2. Evolution of Delta Beliefs and Practices

Before Delta RSI Implementation	After Delta RSI Implementation
• Isolation	• Communication and networking among Delta RSI participants
• Low expectations	• Higher expectations
• Local perspectives	• Regional and national perspectives
• Low student attainment	• Data-driven decision making
• Textbook-driven curriculum	• Standards-based curriculum, instruction, and assessment
• Satisfaction with status quo	• Teachers and administrators as change agents
• Teacher-directed student learning	• Student-centered learning
• Action research and data analysis limited	• Effective use of technology in instruction
• Few opportunities for professional development	• Professional learning communities
	• Needs-based professional development
	• Increased leadership capacities
	• Greater parent involvement

A common theme among the exemplars highlighted in this report is the need to understand contextual circumstances and implement strategies that are considerate of these realities. The many challenges and barriers faced by each RSI make even small gains in teaching practices and student achievement extraordinary, particularly to those working in the trenches to implement the change models. Examples of success follow, along with lessons learned. These examples illustrate the kind of capacity-building that is necessary to sustaining the RSIs' hard-earned educational improvements in mathematics and science education in high-poverty areas of rural America.

The Rural Systemic Initiatives: Impact on Teachers and Teaching

Circumstances made it convenient for teachers in most Ozark RSI (ORSI) schools in 10 Missouri school districts to teach the way they had always taught, rather than to improve professional practice. For rural teachers, the challenge of finding time for professional development is often complicated by the absence of local venues for the delivery of professional development services. A 10-year veteran teacher said, “Driving long distances to attend workshops was a great challenge before ORSI.” A third-grade teacher explained, “I hate to leave the classroom [for professional development], and I don’t want to take more time from my family.”

Prior to ORSI, the workshops available for teachers in the region frequently did not offer content that was appropriate for their teaching assignments. A teacher with 21 years of experience said, “Seldom could I find a workshop that fit my individual teaching needs.” The unavailability of qualified substitutes who meet the educational requirements of NCLB limited the desire of many administrators to release teachers from classrooms. A fifth-grade teacher with 12 years of experience noted, “Before ORSI, professional development wasn’t especially suggested, encouraged, or easy to find.”

ORSI project staff learned that the key challenge is to support teachers in effectively implementing a highly focused curriculum adopted by the school—a curriculum that strongly emphasizes what students must learn to be successful in college, in careers, and as citizens (Harmon, 2006, p. 6). Effective professional development helps teachers gain the knowledge and skills needed to deliver a standards-based curriculum. Delivering such a curriculum often requires teachers to make significant changes (for example, see Table 3). The professional development and related support for delivering this curriculum must represent what teachers really value.

Table 3. Changing Emphasis in Standards-Based K-12 Science Curriculum

Less Emphasis On:	More Emphasis On:
Knowing scientific facts and information	Understanding scientific concepts and developing abilities of inquiry
Studying disciplines (physical, life, earth sciences) for their own sake	Learning subject matter disciplines in the context of inquiry, technology, science in personal and social perspectives, and the history and nature of science
Separating science knowledge and science process	Integrating all aspect of science content
Covering many science topics	Studying a few fundamental science concepts
Implementing inquiry as a set of processes	Implementing inquiry as instructional strategies, abilities, and ideas to be learned
Activities that demonstrate and verify science content	Activities that investigate and analyze science questions

Table 3 continued

Less Emphasis On:	More Emphasis On:
Investigations confined to one class period	Investigations over extended periods of time
Getting an answer	Using evidence and strategies for developing or revising an explanation
Science as exploration and experiment	Science as argument and explanation
Providing answers to questions about science content	Communicating science explanations
Individuals and groups of students analyzing and synthesizing data without defending a conclusion	Groups of students often analyzing and synthesizing data after defending conclusions
Doing few investigations to leave time to cover large amounts of content	Doing more investigations to develop understanding, ability, values of inquiry, and knowledge of science content
Concluding inquiries with the result of the experiment	Applying the results of experiments to scientific arguments and explanations
Management of material and equipment	Management of ideas and information
Private communication of student ideas and conclusions to teacher	Public communication of student ideas and work to classmates
Developing science programs at different grade levels independently of one another	Coordinating the development of a K-12 science program across grade levels
Using assessment unrelated to curriculum and teaching	Aligning curriculum, teaching, and assessment
Maintaining current resources allocations for books	Allocating resources necessary for hands-on inquiry teaching aligned with the National Science Education Standards (NSES)
Textbook and lecture-driven curriculum	Curriculum that supports the NSES and includes field trips and laboratories emphasizing inquiry
Broad coverage of unconnected factual information	Curriculum that includes natural phenomena and science-related social issues that students encounter in everyday life
Treating science as a subject isolated from other school subjects	Connecting science to other school subjects, such as mathematics and social studies
Science learning opportunities that favor group of students	Providing challenging opportunities for all students to learn one science

What Teachers Value

As part of the third-year evaluation activities, lead teachers in the Ozark RSI were asked what they valued most. “Teachers value informative professional development that they can take back and incorporate into their classrooms,” notes a teacher with 13 years of experience. Teachers value being able to network with other professionals to discuss practices that improve student learning. A 25-year veteran teacher of first-grade students explains, “The interaction with other teachers has been helpful. I can see the changes will help students gain a better understanding of math concepts.” Teachers value a convenient way to get information that is truly helpful. Another teacher explains, “ORSI gives me access to hands-on materials, the teaching strategies on advanced content, and an opportunity to work with other teachers on my grade level.”

Teachers also value the administrative support of principals and superintendents who learn about research-based programs that can get results. A fifth-grade teacher with 12 years of experience notes, “Professional development opportunities now are convenient and well-publicized within our school. We are now encouraged to attend professional development.”

As a result, teachers’ roles are changing. A sixth-grade teacher reveals: “With more background knowledge in content and how to help students discover science, I now know how to stand back and let the students go.” She adds, “I use inquiry to help my students learn.” A fifth-grade teacher with 18 years of experience seems to sum up what teachers value in the ORSI effort to improve their professional practice: “I now implement practices that enhance and fine-tune my teaching of *the child* instead of *the class*.”

The Sisseton Wahpeton RSI, which comprises seven local school districts on or near the Lake Traverse Reservation—two tribally controlled, four South Dakota public schools, and one Minnesota public school—sought to emphasize cooperation between the local school systems and the Sisseton Wahpeton College to make quality professional development more available to teachers. Figure 1 shows the increase in professional development opportunities made available.

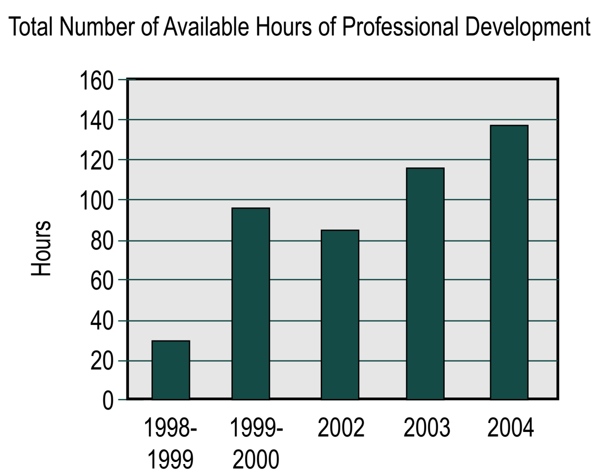


Figure 1. Availability of professional development in the Sisseton Wahpeton RSI.

In addition to developing a 6-credit online course that targeted teacher leadership skills in standards-based curriculum development and reflective inquiry-based learning practices, the Hawaii Networked Learning Community RSI (Hawaii RSI) operationally defined the desired teacher and student outcomes as parallel statements (see Table 4).

Table 4. Hawaii RSI Teacher and Student Expectations

Teachers will . . .	Students will . . .
Transform science and math content standards into measurable learning objectives for their classrooms	Articulate what they are learning and why they are learning it
Devise criteria to assess achievement of these learning objectives and create tools to conduct assessment	Participate in self-assessment and peer-assessment of how well they are learning
Incorporate an inquiry process in classroom projects and units	Engage in a rigorous process of observing/inquiring, questioning, predicting/hypothesizing, planning and conducting investigations/research, interpreting evidence, and communicating findings
Build inquiry around place-based issues and topics involving culture and environment	Investigate environmental issues and topics that are relevant to their neighborhoods and communities
Integrate the use of technology tools for learning	Use technology tools to access and organize data, and compose/create products that reflect their new knowledge

As part of the Hawaii RSI evaluation, a sample of the team leaders for the participating schools was surveyed and interviewed to determine their assessment of the change in curriculum and instruction at their schools. The team leaders were asked to assess the level of impact the Hawaii RSI had on teachers' application of the inquiry process and the use of technology for instruction, on a 4-point scale (1 = *Not at all,* 2 = *Little,* 3 = *Moderately noticeable,* 4 = *Consistently evidenced*).

Table 5 reveals teachers from Cohort 2 are reported to be moderately consistent in their implementation of the principles of teaching and learning emphasized by the Hawaii RSI. They are particularly strong in standards-based instruction (4.0) and the use of research-based pedagogy to design instructional activities. The teachers are fairly consistent in providing real-life learning experiences and more opportunities for all students to learn.

Cohort 3, teachers new to the RSI project, had less experience with the Hawaii RSI professional development in the design of curriculum and place-based learning, which may explain their slightly lower ratings.

Table 5. Team Leader Observed Instructional Change in Hawaii RSI

From your observations, what impact has HRSI had on the teacher application of the inquiry process and the use of technology for instruction?	Interviewee Responses, on a 4-point Scale*					
	All Interviewees		**Cohort 2**		**Cohort 3**	
	Total	Mean	Total	Mean	Total	Mean
1. Teachers expand opportunities for learning to occur for every student.	10	3.2	4	3.5	6	2.9
2. Teachers use research-based pedagogy to design instructional activities.	10	3.4	4	3.8	6	3.1
3. Instruction provides for increased real-life learning experiences.	10	3.4	4	3.5	6	3.3
4. Instruction is more individualized to meet student needs.	10	2.8	4	2.8	6	2.8
5. Assessments are more authentic and directly related to instructional tasks.	10	2.9	4	2.5	6	3.1
6. Student assessments are integral to the learning process and are used to change/ improve instructional strategies.	10	2.7	4	2.5	6	2.8
7. Teachers help students to construct their own projects.	10	2.9	4	2.8	6	3.0
8. Instructional content is based on Hawaii standards and priorities.	10	3.7	4	4.0	6	3.5
9. Teachers increase collaboration and communications with peers on instructional issues.	10	3.3	4	3.3	6	3.3
10. Approaches to teaching to take advantage of technology are often considered.	10	3.1	4	3.0	6	3.1

* 1=*Not at all* 2=*Little* 3=*Moderately noticeable* 4=*Consistently evidenced*

Teacher Leadership Emphasis

The Appalachian RSI (ARSI) has developed a strong network of committed and competent teacher partners in participating districts. The teacher partners have become the primary change agents for individual district reform. In catalyst schools and other schools in their districts, teacher partners help teachers implement standards-based instruction and provide support for curriculum development and selection of resources.

Mark St. John of the California-based Inverness Research Associates has served as the ARSI external evaluator for 10 years. During a presentation at the 2005 ARSI Celebration conference, he commented on the effect of the teacher partner concept:

> Having a high-quality teacher who has release time and the job of sharing her expertise with other teachers—what an idea! This ARSI teacher partner [TP]

model is extraordinary. Many teachers, but more especially students, have benefited from the expertise of TPs in their classrooms. Children have become more excited about math and science because of this. When a TP walks into a classroom and the children cheer, you know that the model has impact.

The primary strategy for change in ARSI schools has been the professional development of mathematics and science teachers. Teachers in area schools now demonstrate attitudes that are consistent with standards-based mathematics and science and more frequently use standards-based practices, inquiry, and problem solving.

No participating school district in the ARSI project had a fully developed *and* aligned science and mathematics curricula at the outset of the project. Consequently, teachers participated in curriculum development workshops, and ARSI curriculum specialists provided on-site technical assistance to participating districts. Ultimately, over 80% of participating districts developed and implemented K-12 science or mathematics curricula aligned with their state's standards for science and/or mathematics.

> *ARSI provided the catalyst for the development of an infrastructure capable of developing and sustaining high-quality instruction. We have seen much growth in teacher content knowledge, the use of research-based instructional strategies and materials, and the effective use of data to make instructional decisions.*
>
> Nancy Wilcher, ARSI District Liaison, Lincoln County, Kentucky

> *College had not prepared me for teaching. I was not teaching my students. I was presenting material . . . . I was blessed with an opportunity to be a teacher partner with ARSI, and science became something we did rather than something we studied. In the end, it was my students and the community in which I teach that benefited.*
>
> Michael J. Slagell, former ARSI teacher partner, Perry County, Kentucky

In the Texas RSI (TRSI), sharing by teacher partners with other teachers was a crucial step in building local leadership and making RSI efforts sustainable. Teacher partners shared best practices, instructional strategies, data-analysis techniques, and assessment models that they learned at TRSI events. TRSI regional specialists helped teacher partners implement the practices at their schools. In the spring of 2004, the TRSI leadership found that 94% of the 433 teacher partners returning a survey indicated that they shared with teachers in their districts, 75% shared with their administrators, and 47% shared with others outside their district. Of teacher partners who reported sharing, 74% indicated they shared at least once a month. Teacher partners reported sharing in the following ways:

- 11% led professional development
- 12% made district-level presentations
- 21% modeled lessons
- 31% made campus-level presentations
- 34% made grade-level presentations
- 50% led demonstrations
- 90% shared TRSI materials with other teachers

Culturally Responsive Curriculum

The Alaska RSI provides another excellent example of how RSIs have influenced curricula and related teaching practices. Supported by the Alaska RSI, Native educators produced the Alaska Standards for Culturally Responsive Schools. These standards, which embody the reform strategy of the Alaska RSI, have been adopted by the state board of education and are having a "ripple effect" in urban as well as rural schools. The standards provide guidelines for teachers, schools, and districts as they develop curricula and instructional strategies that address state and national standards while remaining responsive to the indigenous knowledge systems and ways of knowing in rural/Native communities.

Native educators subsequently developed Guidelines for the Preparation of Culturally Responsive Teachers. These guidelines are used in preservice and in-service teacher education programs around the state. Educators also developed Guidelines for Culturally Responsive School Boards, which have been adopted by the Alaska Association of School Boards.

A curriculum specialist assembled materials collected from across the state and established a popular searchable database of curriculum resources available on the Alaska Native Knowledge Network Web site (www.ankn.uaf.edu). The number of requests for curricular materials listed in the database has grown steadily; during one month, for example, more than 750,000 "hits" from 37,000 different individuals were recorded. The following list of thematic areas in which curriculum units were developed demonstrates the educational potential of linking local knowledge with state cultural standards in areas related to science, mathematics, and technology:

Weather forecasting	Terminology/concepts/place names
Animal behavior	Counting systems/measurement/estimation
Navigation skills	Clothing design/insulation
Observation skills	Tools/technology
Pattern recognition	Building design/construction techniques
Seasonal changes/cycles	Transportation
Edible plants/diet/nutrition	Genealogy
Food preservation/preparation	Waste disposal
Rules of survival/safety	Fire/heating/cooking
Medicinal plants/medical knowledge	Hunting/fishing/trapping
Star knowledge/constellations	Weapons technology

In addition, the Alaska Staff Development Network, under contract with the Alaska RSI, developed two graduate courses for teachers and administrators on creating culturally responsive schools. More than 2,500 teachers and principals have enrolled in these three-credit distance education courses since they became available in 2000.

Creating a culturally responsive curriculum that also impacts teaching practices and the leveraging of available funding may require significant policy change. The experience of the Navajo Nation RSI, however, indicates that such change is possible. The RSI introduced amendments regarding academic achievement, accountability, technology, and cultural infusion; these amendments were made to the tribal education code (i.e., Title 10). The amendments to the code are a tremendous accomplishment for the Navajo Nation and will help them to exercise sovereignty in education. Also, the Navajo Nation has embraced the school leadership development initiatives introduced by the Navajo Nation RSI. In December 2005 the Navajo Nation hosted the first Navajo Nation school leadership conferences, using Indigenous knowledge of leadership and education as the centerpiece of training.

Changing Practices Takes Time

Meaningful changes in teaching practices take time. While serving rural areas in North Carolina, South Carolina, and Virginia, the Coastal RSI achieved considerable success in helping teachers implement standards-based teaching practices. Figure 2 shows a steady increase over the years in the percentage of teachers who have implemented three key practices: written lesson plans, written objectives, and use of a lesson/unit from the local curriculum.

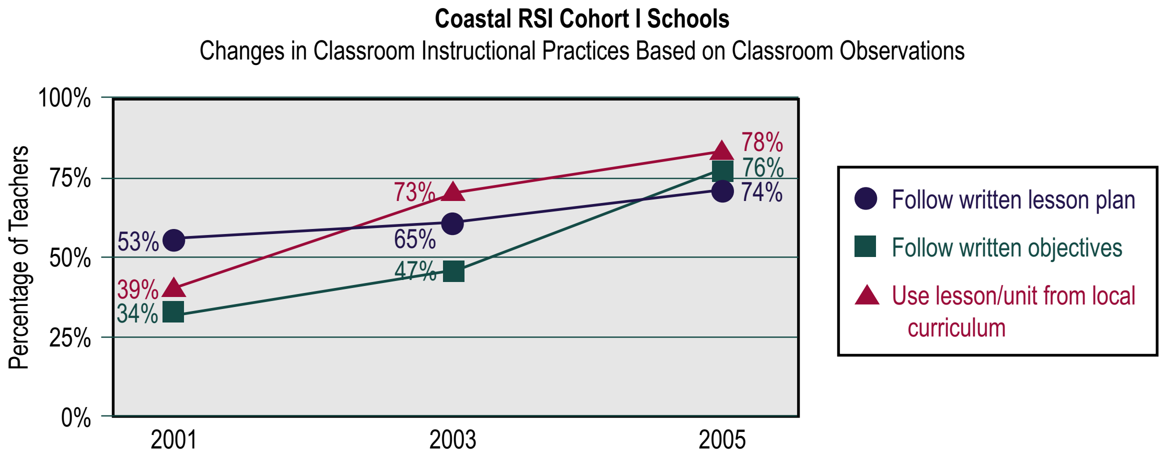


Figure 2. Coastal RSI teachers' increasing implementation of key instructional practices.

The Texas RSI (TRSI) leaders found that implementation of the state's standards-based curriculum framework, Texas Essential Knowledge and Skills (TEKS), created a major challenge for many districts. Many elementary teachers needed assistance with science content, teaching strategies, and selection of curriculum materials. After working with TRSI, districts purchased standards-based science materials for use in elementary science classes, and elementary science labs or outdoor classrooms were added or renovated in 26 of the 58 TRSI districts. Elementary science support positions were also added in 11 districts. Parents in some schools then provided funds to support the purchase of science kits for all the teachers.

TRSI teacher partners used vertical curriculum alignment activities with math and science teachers across grade levels to facilitate a broader understanding of who was responsible for teaching what content, and at which grade levels it should be taught. A Clarendon Elementary teacher partner said, "We have really begun to work together across the grade levels and campuses in both math and science. Each grade level is taking a much closer look at how we can improve the vertical alignment of our curriculum." A Patton Springs campus administrator said of TRSI's efforts: "The need for vertical alignment has been realized, and wonderful activities in alignment have been brought back from TRSI workshops. Our teachers have worked diligently to align math and science, with outstanding results." An online survey in the spring of 2004 revealed that 60 of 65 administrators (92%) reported increased coordination by teachers across multiple grade levels to ensure math and science TEKS are taught at the appropriate time and depth.

An example of TRSI's impact on classroom instructional practices was revealed when teachers were asked to identify the most important instructional change as a result of work with TRSI. A secondary math teacher partner from Clarendon observed, "My students learn more through inquiry now. They also learn from each other. I try to stand up in front of them and teach less and, instead, let them investigate."

In the Spring 2004 online TRSI survey, all 58 districts that were surveyed reported an increase in the use of problem solving, inquiry learning, manipulatives, and hands-on activities due to work with TRSI. Many teachers and administrators provided descriptions of how classroom instruction had changed as a result of work with TRSI. For example, an elementary school teacher partner from the Hereford school district wrote: "I use many more inquiry-based lessons. I allow students time to explore and experiment with manipulatives. I feel more comfortable allowing students to work in groups to complete math and science tasks. I do not feel as threatened when they come up with questions I cannot answer."

It took time for teachers to get comfortable in using new technology. A middle school science teacher partner from the Meyersville school district noted, "I feel more comfortable using graphing calculators in my classroom because of RSI hands-on training and assistance I received from my RSI specialist. The RSI has exposed me to other technologies I can use in my instruction that I previously didn't even know existed."

The TRSI Spring 2004 online survey identified changes in technology use among teachers. Fifty-four of the 57 reporting districts (95%) indicated that their teachers were better prepared to use technology for instruction; 52 districts (91%) reported an increase in the use of various technologies for instruction.

New Leadership Roles

RSIs also experienced success in preparing teachers for new leadership roles that ultimately influenced curriculum and instructional practices in mathematics and science. For example, in the Coalfield RSI (CRSI), two teacher leaders were selected from each of the 18 school districts in the coalfield regions of Virginia and West Virginia. Frequently, these teacher leaders have advanced to school administrative positions. Seven teacher leaders and a former CRSI mathematics content specialist have moved into leadership roles as principals or assistant principals. Another eight teacher leaders were employed by their school districts as mathematics or science coaches. Consequently, the 15 teacher leaders-turned-academic-coaches/principals are now in positions that will allow them to continue using the valuable experiences and leadership skills gained through the Coalfifeld RSI to influence and improve teaching and learning.

The 36 selected teachers gained a wide range of valuable experiences as teacher leaders. CRSI teacher leaders documented their activities annually in teacher leader logs. Table 6 shows that teacher leaders logged over 7,000 hours among the various activities in the 2005-2006 school year. These activities increased local capacity for systemic improvement of mathematics and science programs.

Table 6. Coalfield RSI Teacher Leader Log Summary 2005-2006

Activities	Hours	Percentage of Total Hours
a. Personal training/prof. development	2,239	31
b. Training other professionals	489	7
c. Data collection and analysis	214	3
d. Preparation for training	315	4
e. Mentoring	585	8
f. School district plans	169	2
g. Curriculum	507	7
h. Tutoring	286	4

(continued on next page)

Table 6 continued

i. Community training	75	1
j. Dissemination	186	3
k. Instructional material review	281	4
l. Recruitment	271	4
m. Grant development	204	3
n. Research	14	<1
o. Modeling	29	<1
p. State/regional level work	814	11
q. Unassigned	296	4
r. Study group activity/leadership teams	145	2
Total	**7,119**	**98**

Strengthening Administrator Support

In addition to working with teacher partners to develop their leadership skills, the Appalachian RSI (ARSI) worked with principals, who played a critical role in the professional growth of teachers. A major ARSI principal project was Leadership by Design (LBD): Patterns of Instruction. LBD was a system for monitoring and improving a school's instructional program. Principals were trained to recognize effective instruction and were thus able to support data collection and analysis of classroom practices. Mark Murray, the principal of Rowan County High School in Kentucky, proclaims

> The program provided me, the administrator, with valuable training and tools in the content areas, which in turn helped turn the science and math programs around. The program also helped build a cadre or support system of administrators from other schools. We were able to share lots of ideas and learn better ways to do things in science and math.

Several other RSIs also sought to increase the skills of school administrators in supporting systemic changes in mathematics and science. In Ozark RSI (ORSI) schools, principals, and assistant principals received focused professional development on critical systemic reform elements in mathematics and science, including how to conduct a walkthrough observation of a classroom during the teaching of a mathematics or science concept. The goal was to increase the administrator's ability to consistently recognize and communicate with teachers about key curriculum, instruction, and assessment elements inherent to a standards-based and inquiry-oriented classroom environment. Of the 53 systemic reform practices listed by the ORSI external evaluator in a spring 2004 Web survey, mathematics and science teachers rated principal-related practices highly when asked about the degree to which the reform practices were implemented at their schools (see Tables 7 and 8).

During May 2005 school site visits, principals reflected an understanding of mathematics and science reform practices in an interview with the ORSI external evaluator. For example, an elementary school principal noted:

> I now see teachers going into more depth, not trying to cover everything. Teachers also are using real-life examples in their teaching, and students get to do applications to enhance learning. Teachers are beginning to take more ownership in the new teaching practices.

A high school principal describes the school's adopted curriculum and its impact on a student:

> A science teacher in a class with mixed ability students was going over "half lifes" and the class was doing calculations when a student in the Core Plus Integrated Math showed all the students in the class how to do the problem. The advanced students were really surprised a lower ability student knew how to do the problem.

The Texas RSI also placed a priority on developing proactive principals who support teachers in their implementation of high-quality mathematics and science education for all students. This support included the ability to discuss changes in policies and school improvement plans consistent with a high-quality program of mathematics and science education (e.g., the Texas RSI Attributes). Thus supported by administrators in appropriate ways, the teachers would be more likely to improve student achievement.

Table 7. Top 10 Implemented Practices Based on Ozark RSI Math Teachers' Ratings

Systemic Reform Practice	No. Teachers	Mean Rating*
1. Principal encourages using standards-based instructional strategies	114	8.55
2. Principal encourages using standards-based curriculum	114	8.52
3. Principal encourages using standards-based assessment strategies	114	8.48
4. Students participate in appropriate hands-on activities	115	8.46
5. Principal encourages participation in high-quality professional development aligned with teaching standards-based curriculum	113	8.42
6. Students work in cooperative learning groups	115	8.40
7. School/district policy supports alignment of curriculum, instruction, assessment, and professional development	117	8.28
8. Curriculum taught by most teachers at school	107	8.22
9. Teacher access to in-service opportunities specific for teaching math/science	115	8.18
10. Students engage in inquiry-oriented activities	114	8.16

Table 8. Top 10 Implemented Practices Based on Ozark RSI Science Teachers' Ratings

Systemic Reform Practice	No. Teachers	Mean Rating*
1. Students participate in appropriate hands-on activities	103	8.49
2. Principal encourages using standards-based instructional strategies	100	8.39
3. Principal encourages using standards-based curriculum	100	8.35
4. Principal encourages using standards-based assessment strategies	100	8.35
5. Students work in cooperative learning groups	103	8.31
6. Students engage in inquiry-oriented activities	102	8.16
7. Principal encourages participation in high-quality professional development aligned with teaching standards-based curriculum	97	8.13
8. School/district policy supports alignment of curriculum, instruction, assessment, and professional development	103	8.11
9. Require students to record, represent, and/or analyze data	101	8.01
10. Use informal questioning to assess student understanding	102	7.97

*Rating scale: 0=*Not implemented/low* to 10=*High/fully implemented*

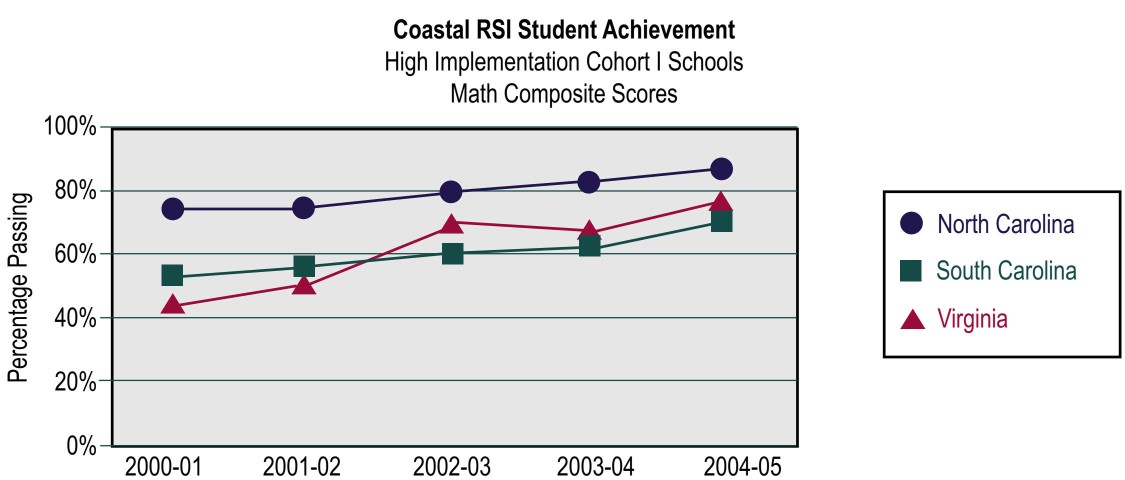
The Rural Systemic Initiatives: Impact on Students and Learning

Improving student achievement was a key outcome in the NSF concept of systemic reform, and all RSIs placed a premium on this outcome. Numerous examples of this emphasis are cited in the annual reports of RSI projects from across the country. The examples provided below include interpretations from the authors of these various reports. The purpose for presenting these examples is not to suggest that any one RSI achieved a better result than another, but to illustrate the hard-earned success achieved by the RSIs—and to reveal the challenge faced by RSI leaders in capturing consistence performance data amidst constant changes in state assessment instruments.

These examples should also encourage the sustained and continued development of NSF's RSI effort across the United States. The RSIs have laid a foundation for significant change in student achievement in mathematics and science—a change that must be accelerated if students and residents in high-poverty rural communities are to enjoy a desirable standard of living in the 21st-century economy.

Student Performance in Mathematics

Figure 3 reveals the positive change that occurred in mathematics achievement in a cohort of high-implementation schools served by the Coastal RSI in Virginia and the Carolinas. Note that the greatest gains in student pass rates were achieved in South Carolina and Virginia, which had the lowest pass rates among the three states in 2001.



	2000-01	2001-02	2002-03	2003-04	2004-05	Change
North Carolina	75%	76%	80%	82%	85%	10%
South Carolina	54%	55%	60%	63%	70%	16%
Virginia	43%	51%	67%	64%	75%	32%

Figure 3. Coastal RSI student achievement in mathematics, 2000-2001 through 2004-2005.

All eight of the Appalachian RSI school districts in Ohio improved student mathematics achievement in either the 4th or 6th grade between 2003 to 2005. The districts also improved on the mathematics assessment at the high school level. Because this assessment was instituted in the 2003-2004 academic year, comparison data for Grade 10 are available only for the last 2 years of the project (see Table 9).

Table 9. Mathematics School District Data from State Proficiency Testing, Appalachia RSI, 2002-2005 Percent Proficient

School District	Grade Level	2002-03	2003-04	2004-05
Adams County	4	44	54	47.4
	6	36.6	70.9	57.9
	10		63.5	81.3
Morgan County	4	49	50.6	48.5
	6	50	68	64.9
	10		72.6	76.7
Eastern Local—Pike County	4	41.5	34.3	50
	6	32.8	47	63
	10		63.8	66
Waverly City Schools Pike County	4	67.4	67.9	56.5
	6	32.9	63.8	44.4
	10		70.6	79.1
Meigs Local School District	4	35.3	42.5	39.4
	6	46.6	65.6	54.9
	10		62.6	75
Eastern Local—Meigs County	4	56.9	51.7	64.5
	6	34.8	51.5	61.4
	10		57.6	90.8
Southern Local—Meigs County	4	17	51.8	59
	6	31.6	45.1	29.5
	10		46.4	59.6
Vinton County	4	35.9	54.9	46.5
	6	31.9	52.2	50.3
	10		50.3	69.1

Table 10 shows that all six Appalachian RSI districts in Tennessee exceeded the state's 3-year average in 2005 and improved the performance for both "all students" and students identified as "economically disadvantaged." Five of the districts reduced the achievement gap between "all students" and "economically disadvantaged" students.

Table 10. Tennessee Grade K-8 Combined the Percent of Mathematics Proficiency (Proficient plus Advanced) Scores, Comparing the Percentage of All Students with Economically Disadvantaged Students

	% 2004 Prof/Adv	%2005 Prof/Adv	%2006 Prof/Adv
Oneida Special	87	96	83
	80*	92	75
Johnson County	77	89	83
	72*	86	75
Fentress County	87	89	83
	82*	86	75
Cocke County	82	86	83
	80*	85	75
Scott County	77	86	83
	76*	85	75
Campbell County	82	85	83
	79*	81	75

* Denotes economically disadvantaged students.

The Alaska RSI also achieved important student performance gains. The most notable feature of the data in Figure 4 is the increase in RSI student performance for Grades 9 and 10 each year between 2000 and 2003. The 10th-grade students in all groups showed a substantial gain in mathematics achievement between 2000 and 2003, but the average performance of all Alaska students declined somewhat in 2004. The overall decline in 2004 is largely attributable to a reset of the cut scores for the test instrument. However, the RSI students posted a lower decline than students in non-RSI rural schools, resulting in a slight reduction in the achievement gap.

Norm-referenced test results are available for ninth-grade students who have been taking the Terra Nova/CAT-6 since 2002 (see Figure 5). Though the differentials for each group between 2002 and 2003 remain small, the RSI students achieved an increase in performance in 2004. The non-RSI students experienced a small decrease in their performance over the 3 years.

RSI leaders have noted the consistent improvement in the academic performance of students in Alaska RSI-affiliated schools over each of the past 7 years. These leaders have concluded that the cumulative effect of utilizing the Alaska Standards for Culturally Responsive Schools to increase the connections between what students experience in school and what they experience outside school appears to have had an important impact on students' academic performance.

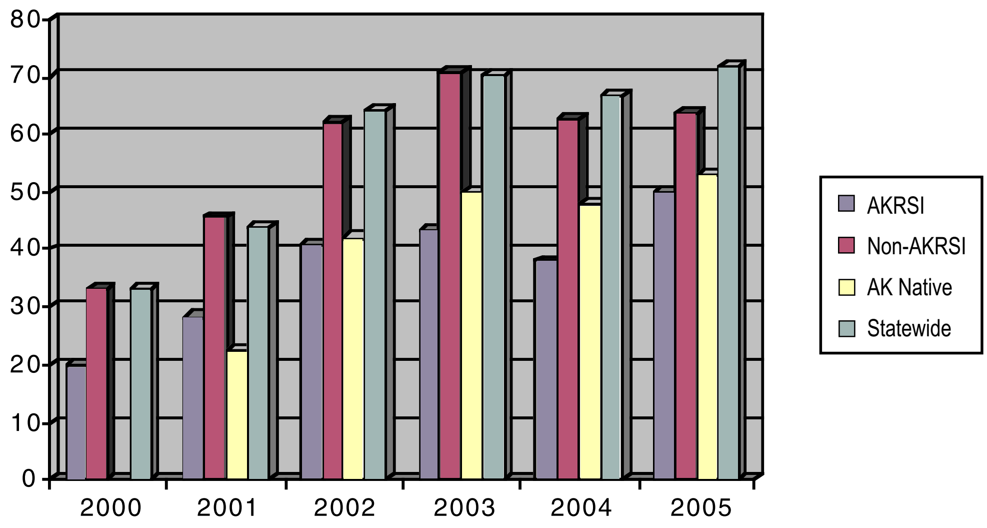


Figure 4. Alaska RSI Grade 10 Mathematics High School Graduation Qualifying Exam, 2000-2005 (percentage of rural students achieving Advanced/Proficient level).

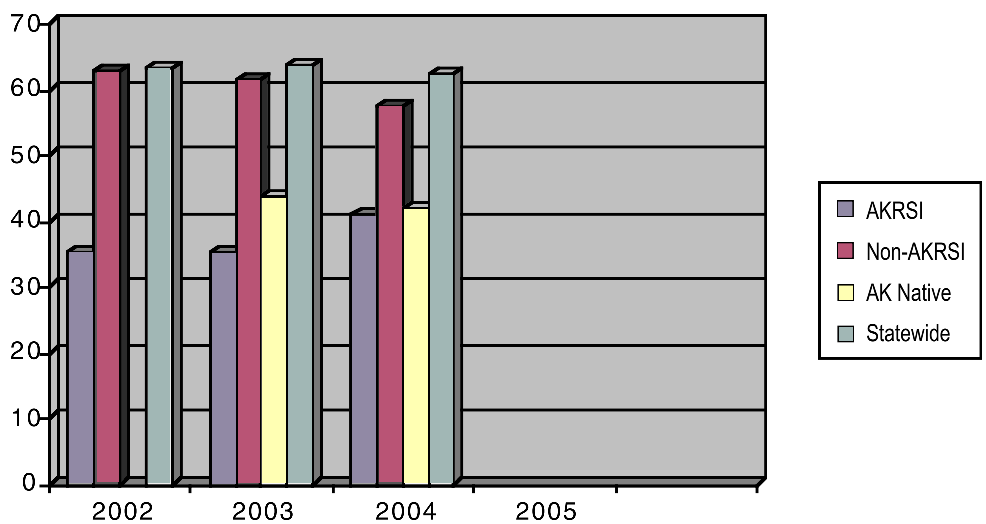


Figure 5. Alaska RSI Grade 9 Mathematics Terra Nova/CAT-6, 2002-2004 (percentage of rural students scoring in the third and fourth quartiles).

Additional examples of student achievement gains in mathematics are revealed in project reports for the Texas RSI (TRSI). Texas Assessment of Academic Skills (TAAS) math tests were administered in Grades 3 through 8 and Grade 10, and passing the Grade 10 TAAS was required for graduation. Math TAAS data are presented in Table 11 for the 1997-1998 TRSI baseline year through the final administration of the TAAS in the 2001-2002 school year. Data are presented for the 60 original districts with which TRSI worked during this time.

Between 1998 and 2002, the overall Math TAAS passing rate (grade-level performance) for all students tested in 60 TRSI districts increased 12 percentage points, from 79% to 91%. The passing rates increased at every grade level tested, with an average grade-level increase of 12 percentage points.

Table 11: Changes in Math TAAS Passing Rates in Texas RSI Districts*

Grade	Percent Passing	1998 Percent Passing	2002 Change in Percent Passing
3	75%	83%	+ 8
4	80%	93%	+13
5	85%	94%	+ 9
6	81%	91%	+10
7	79%	91%	+12
8	79%	92%	+13
10	75%	92%	+17
All Grades Combined	79%	91%	+12

*Average number of students tested per grade level: 4,643 in 1998 and 4,363 in 2002

Longitudinal comparisons also revealed increases in passing rates. The first analysis considered the passing rate of third-grade students in 1998, then followed the progress of this grade-level group through the fourth grade in 1999, and continued each year through seventh grade in 2002. A similar analysis started with fourth-grade passing rates in 1998 and continued each year through eighth grade in 2002. Regression trend analysis showed significant increases in passing rates for the third-grade analysis ($p = 0.09$) and for the fourth-grade analysis ($p = 0.10$).

Difficulty in Tracking Student Performance

The Science Texas Assessment of Academic Skills (TAAS) was administered in the eighth grade. Of the 60 districts participating in TRSI when TAAS was the assessment system, 59 districts included the eighth grade. The average number of eighth graders tested each year was 4,648 students. The percent of students passing the eighth-grade Science TAAS increased by 15 percentage point from 78% in 1998 to 93% in 2002.

From 1998 to 2002, 52 districts had increases in passing rates, and three other districts had 100% passing in both 1998 and 2002. For those 52 districts, the average district passing rate increase was 13 percentage points. Almost 70% of the 52 districts had increases of at least 10 percentage points. The four districts that had decreasing passing rates had small enrollments with small changes in actual numbers of students passing. One district had 15 of 15 students pass in 1998, and 22 of 24 students pass in 2002. Another had all 7 students pass in

1998 and 11 of 13 students pass in 2002. The third district enrolled about 44 students and had a decrease in passing rates from 90% to 88%. The fourth district enrolled about 33 students and had a passing rate decrease from 84% to 82%.

In addition to highly fluctuating test score gains or losses annually in schools with small enrollments, another example of the challenge faced by RSI leaders and evaluators in documenting trend analyses of student performance occurred when the Texas assessment system changed from TAAS to the Texas Assessment of Knowledge and Skills (TAKS) in the fall of 2002. TAKS is completely aligned with TEKS, the state standards-based curriculum framework. To ease the transition to the more rigorous TAKS, four levels of performance were identified as part of a multiyear plan for increasing passing standards:

- Two SEM (standard errors of measurement) below the panel-recommended level
- One SEM below the panel-recommended level
- Panel-recommended level
- Commended level

Math TAKS is administered in Grades 3-11. In 2003, the two-SEM level served as the passing standard for all grades. In 2004, the passing standard for Grades 3-10 was increased to the one-SEM level, and it increased again in 2005 to the panel-recommended level. In 2003, 11th graders were not required to pass the TAKS if they had passed the 10th-grade TAAS. Eleventh graders were required to meet the two-SEM standard for graduation in 2004, the one-SEM standard in 2005, and the panel-recommended standard in 2006. Since the achievement level required to pass the TAKS increased each year, TRSI is reporting TAKS performance data for 2003 at the 2004 passing standard. For example, 2003 student performance is reported in Grades 3-10 at the one-SEM standard, even though students were only required to meet the two-SEM standard in that year.

The percentage of students meeting the 2004 passing standard increased at every grade level tested, ranging from a 3-percentage-point increase in Grade 10 to 19-percentage-point increase in Grade 11. The average grade level increase was 8 percentage points. Table 12 gives the percent meeting the 2004 passing standard for each grade in 2003 and 2004.

Table 12: Math TAKS Percent Meeting 2004 Passing Standards in Texas RSI Districts*

Grade	Percent Passing 2003	Percent Passing 2004	Change in Percent Passing
3	78%	88%	+10
4	74%	82%	+ 8
5	71%	77%	+ 6
6	64%	72%	+ 8
7	55%	66%	+11
8	57%	62%	+ 5
9	50%	55%	+ 5
10	54%	57%	+ 3
11	63%	82%	+19
All Grades Combined	62%	71%	+ 9

* Average number of students tested per grade level: 3,112 in 2003 and 3,076 in 2003.

Student Performance in Science

Texas Assessment of Academic Skills for science was administered only in Grade 8. From 1998 through 2002, 59 of the 60 TRSI districts had eighth-grade TAAS scores (one TRSI district was a K-6 district). The passing rate for economically disadvantaged students increased by 19 percentage points. Data disaggregated by ethnic subpopulation revealed an 18-percentage-point reduction of the gap in passing rates between African American and White students and a 14-percentage-point reduction of the gap between Hispanic and White students. Table 13 provides yearly science TAAS data from 1998 through 2002 that are disaggregated by ethnic subpopulation and economic status.

Table 13: Science TAAS Grade 8 Passing Rates for Ethnic & Economic Subpopulations in TRSI Districts*

Student Group	1998	1999	2000	2001	2002	Change from 1998 to 2002
Economically Disadvantaged	69%	79%	81%	88%	88%	+19 pp
African American	61%	73%	77%	86%	86%	+ 25 pp
Hispanic	69%	80%	80%	87%	90%	+ 21 pp
White	90%	95%	95%	97%	97%	+ 7 pp

* Average number of students tested per year: 2,539 Economically Disadvantaged; 316 African American; 2,276 Hispanic; 1,954 White.

In the Appalachian RSI (ARSI), 13 Kentucky school districts were actively involved during the 1999-2005 school years. All participating school districts increased science achievement scores, which resulted in a significant increase in their science achievement index scores. The science achievement index increase ranged from a low of 3% to a maximum of 48%, with a mean increase of 27% for the 13 districts at the elementary level, 26% at the middle school level, and 20% at the high school level. Table 14 reveals science achievement increases in elementary schools for the 13 ARSI school districts in Kentucky.

Table 14: Science Achievement for Appalachian RSI Districts—Elementary Schools, 1999-2005

ARSI County	1999 Academic Index	2005 Academic Index	1999-2005 Academic Index	% Index Increase
Bath County	67.49	81.75	14.26	21%
Floyd County	61.39	82.07	20.68	34%
Johnson County	74.66	106.10	31.44	42%
Knott County	61.80	72.15	10.35	17%
Lewis County	60.41	82.33	21.92	36%
Lincoln County	65.87	86.41	20.54	31%
Menifee County	77.92	87.65	9.73	12%
Owsley County	64.20	82.18	17.98	28%
Pikeville Independent	75.15	111.59	36.44	48%
Powell County	82.68	94.06	11.38	14%
Rockcastle County	85.96	106.25	20.29	24%
Rowan County	75.19	90.43	15.24	20%
Wolfe County	72.04	91.47	19.43	27%
Averages	71.14	90.34	19.21	**27%**

Note: Index scores are assigned by Kentucky Department of Education with a maximum of 100.

Making Science Relevant

Wind River RSI (WRRSI) is a partnership between the University of Wyoming and five schools on the Wind River Indian Reservation: Arapahoe School, Fort Washakie School, St. Stephens Indian School, Wind River School, and Wyoming Indian School. WRRSI's goal was to increase math and science literacy on the Wind River Indian Reservation in central Wyoming. WRRSI leadership worked aggressively over 10 years to change an infrastructure steeped in outdated philosophies in education to one that included the use of proven research-based methods to increase the achievement of Native students.

WRRSI strived to increase the content knowledge of mathematics and science that was culturally relevant. Professional development activities addressed helping schools transition into using research-based math programs and other programs such as FOSS (Full Option Science System), cultural relevancy, GPS/GIS systems, and Native Ways of Knowing. These programs were regularly provided to teachers for integration into their schools and classrooms.

In teaching science, the FOSS curriculum is used in all the WRRSI schools. It has proven to be an effective way to teach Native American students in a hands-on environment that engages students as they explore the natural world. The RSI provided training on FOSS to all teachers using it across the WRRSI.

Proficiency levels of 11th-grade WRRSI students increased 4.5% between 1999 and 2002 (see Figure 6) based on state test data.

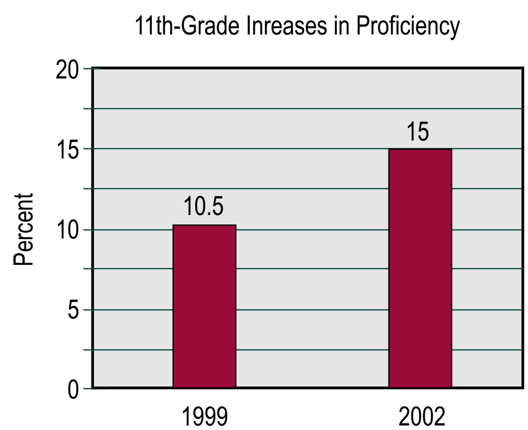


Figure 6. Percentage of Grade 11 Wind River RSI students achieving at the proficient level in science.

During the 2004-2005 school year, Ozark RSI leadership and staff sought to determine if teachers using science kits were getting positive results in student achievement. Thirty classrooms were selected to conduct pre- and posttest analysis. Teachers administered a pre-test to students in their classes during the first month of the school year and again administered the same test to the students as a posttest near the end of the school year. Table 15 shows the results of the Paired *t* test (2-tailed test, P = <.05).

Table 15. Pre- and Posttest Results for Science Kits by Topic and Grade Level, Ozark RSI

Science Kit Topic	Grade	# Classes	# Classes with Mean Score Test Gains	# Classes with Stat. Sig.Gains
1. Animal Studies	3	20	16	11
2. Balancing and Weighing	1	24	23	16
3. Catastrophic Events	6	16	16	16
4. Changes	2	23	23	23
5. Classifying Living Things	5	10	10	10
6. Ecosystems	4	14	14	14
7. Electric Circuits	4	20	20	19
8. Energy, Machines and Motion	7	5	5	5
9. Land and Water	5	10	10	10
10. Life Cycle of Butterfly	2	26	26	25
11. Motion and Design	4	20	19	14
12. Organisms	1	21	21	16
13. Plant Growth and Development	3	16	16	14
14. Soils	2	22	22	21
15. Solids and Liquids	1	8	8	6
16. Sound	3	16	15	13
17. Weather	1	26	25	22
Totals (#)		**297**	**289**	**255**
% of Total Classes		**100**	**97.3**	**85.9**

Teachers taught 17 science kit units to students in classes at the appropriate grade level. Pre- and posttest results (mean scores) were calculated for 297 classes. Of the 297 classes, posttest mean scores increased compared to pre-test mean scores for 289 (97.3%) of the classes. The *t* test results revealed that 255 (85.9%) of the classes experienced a statistically significant gain in mean test scores.

Intervention Strategies (Models of Change)

What models of change or intervention guided the various RSIs funded by NSF? Obviously, the RSIs were breaking new ground. Each reviewed the literature and strived to create a model of intervention that would succeed in its own rural context. Consequently, these research-informed designs might be considered "home-grown" to the extent that no previous systemic rural intervention models existed for reforming mathematics and science education in high-poverty rural areas.

Highlighted here are some examples of the intervention approaches employed by various RSIs. The intent in selecting these examples is not to judge the model or approach used, but to help readers understand program factors that might have influenced the successes profiled in this report. Continuing implementation and perhaps adaptation of the model will play a key role in continuing the Rural Systemic Initiative's legacy of leadership.

The Appalachian RSI (ARSI) model evolved over the 10 years of the project (see Figure 7). The success of this model lies in its regional delivery system and its capacity-building strategies. During the 10 years of its operation, ARSI overcame many of the challenges it faced initially when working with the rural Appalachian school districts in the six states. Keys to ARSI's success include the utilization of the following:

- Teacher partners, selected from the local districts, who build district capacity for improving mathematics and science
- Resource Collaboratives that link to university and other resources to establish a broad-based system which facilitates local planning and decision making
- Leadership teams, consisting of teacher partners, an ARSI district liaison, the superintendent, and a principal, that develop a district plan to support program improvement
- Program Improvement Reviews that help schools assess their current mathematics and science programs and create a plan for improvement
- Resource convergence for student learning through partnerships with state departments of education and other agencies, including the Appalachian Technology & Education Consortium (ATEC), Appalachian Collaborative Center for Learning, Assessment, and Instruction in Mathematics (ACCLAIM), and the Appalachian Mathematics and Science Partnership (AMSP)

ARSI's five Resource Collaboratives, strategically located at area universities, spearheaded ARSI's reform efforts and proved to be the primary locus for program improvement initiatives across the Appalachian region. A coordinator located at each Resource Collaborative served as a "field agent" to facilitate local planning and decision making while coordinating training for teacher partners and direct services to schools in their region. Each coordinator's leadership efforts focused on professional development, technical assistance to schools and districts, planning assistance, and program assessment. Their support helped develop teacher partners as mathematics and science instructional leaders—and served as the cornerstone of ARSI's strategy for accomplishing project goals. Notes Jim Austin, Kentucky Department of Education mathematics consultant:

> I have seen the teacher partners grow in their content knowledge in mathematics and have seen them grow as teacher leaders. I think that this aspect of the ARSI project may pay the greatest dividends in the long run, as these

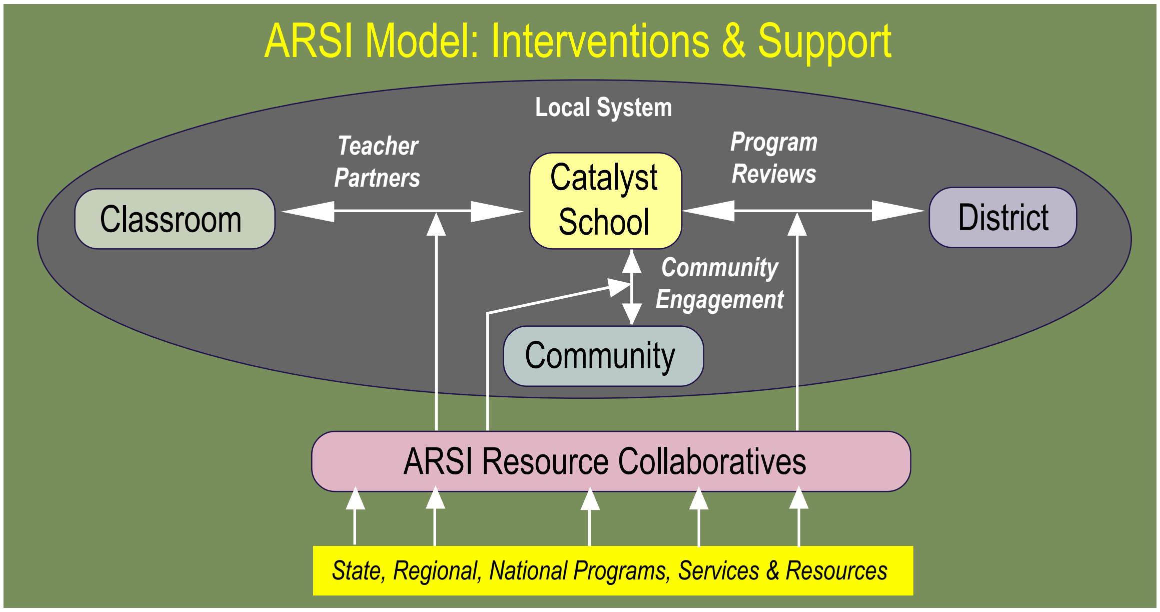


Figure 7. The Appalachian RSI model of change.

> teachers have developed the skills and knowledge necessary to continue to drive improvement in mathematics education in their districts.

Figure 8 shows the Ozark RSI Model of Systemic Instructional Change. In Year 1, schools were assisted in adopting a standards-based curriculum, an action that became the school's most critical decision in ensuring an intense focus on content knowledge and instructional coherence. The need to implement the new curricula served as a catalyst for all teachers to examine their teaching practices. It also allowed all professional development opportunities and assessment strategies—which emphasize using inquiry-based instruction/notebooking to address how students learn—to focus intensively on effectively teaching all students to achieve the higher levels of content and conceptual understanding that are critical elements of the new curricula.

ORSI/Carver Partnership: Curriculum and Focused Professional Development Model (workshops, summer institutes, follow-up with distance learning, online short courses, building-level coaching and mentoring)

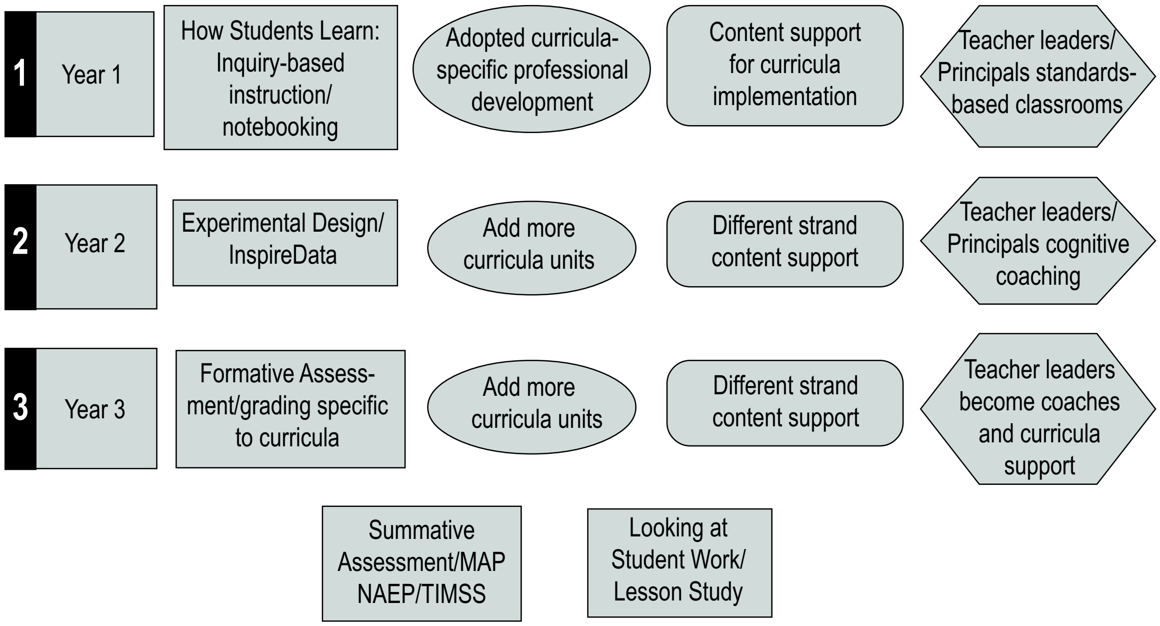


Figure 8. The Ozark RSI model of systemic instructional change.

In Year 2, the curriculum adoption decision continued to serve as a catalyst for ensuring coherence and relevance in elements that support teacher change, such as content-specific professional development, curriculum materials, and learning assessments. Selected teachers as well as school administrators were trained by the Ozark RSI to assist teachers as coaches, with the primary role of supporting teachers in learning and applying instructional techniques that are highly effective in implementing the adopted curriculum.

In Year 3, teachers developed higher-level skills that support implementation of the adopted curriculum, such as formative assessment strategies. Teachers learned how to effectively implement additional units in the curriculum and increase their content knowledge in the subject. Teacher leaders and coaches also provided assistance to teachers needing additional or strategic support in implementing the adopted curriculum and inquiry-based learning environment in their classrooms. Some schools also participated in guided study group activities that enabled teachers to network with other teachers in the region. The study groups provided a unique opportunity for teachers to reflect, learn, and share how best to implement their adopted curriculum, instructional strategies, and assessment practices.

The Coalfield RSI intervention strategy focused primarily on developing additional leadership capacity to improve the teaching and learning of mathematics and science in the participating school systems. Involving local teacher leaders in high-quality training enabled and empowered them to build district capacity. The CRSI built synergy for positive change by emphasizing a data-driven approach to improvement, enhancing the support of district leadership, developing strong parent and community support, and partnering with local higher education institutions and other systemic reform initiatives.

The role of the teacher leaders included modeling inquiry-based instruction, assisting in data analysis, helping with school and district improvement planning, leading staff development, and encouraging students to become mathematics and science teachers. They also served as mentors and helped recruit new math and science teachers. To increase the capacity and effectiveness of school leadership and decision making for mathematics and science programs, the leadership skills of 36 teacher leaders have been enhanced to fill the void that existed in 17 of 18 rural school districts in two states. Before the Coalfield RSI was initiated, these districts had lacked adequate district staff with either the content knowledge in mathematics or science or adequate time to effectively fill the role of district leader for mathematics and/or science.

The Texas RSI (TRSI) intervention model of reform is based on the fundamental belief that sustainable change is accomplished through committed and knowledgeable local stakeholders working together across an entire school district. In order to participate in TRSI, each district's school board signed an agreement committing to a partnership with TRSI. The decision to participate followed a district and community forum conducted by TRSI staff. During the forum, administrators, teachers, parents, and community members indicated interest in working with the RSI. Districts had to agree to focus on systemic reform guided by the state standards-based curriculum framework, known as the Texas Essential Knowledge and Skills (TEKS), and the TRSI Attributes. The Attributes include the following:

1. Successful implementation of the math and science TEKS through
   - Vertical alignment of math and science curriculum K-12
   - Teachers prepared in TEKS implementation, assessment, inquiry-based activities, technology, and the use of available resources
   - Inquiry-based learning for all students
   - Technology tools and training
   - Alignment of professional development

2. District policies supporting math and science TEKS implementation and systemic reform through:
   - Proactive principals supporting teachers in math and science systemic reform efforts
   - Alignment of school improvement plans with TRSI Attributes

3. Alignment of resources to support systemic reform efforts and math and science TEKS implementation through coordination of funding

4. Stakeholders' commitment to systemic reform of math and science education through
   - Districtwide involvement in the reform efforts
   - Parent involvement in the reform efforts
   - Collaboration with other partners

5. All students reaching high standards through:
   - High-quality math and science programs
   - High expectations for all students

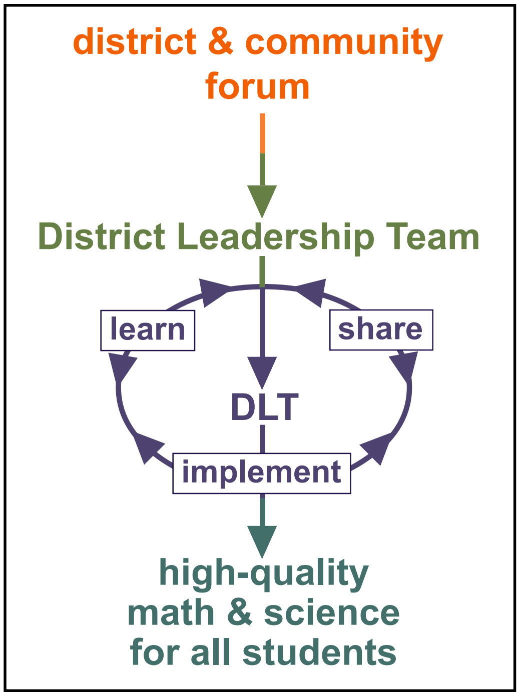


Figure 9. Texas RSI action plan.

Figure 9 shows the action plan for the Texas RSI. Each participating district identified a district leadership team (DLT) consisting of central and campus administrators, math and science teacher leaders from each campus, counselors, and parents and community members to guide the district's work with the RSI.

The TRSI built sustainable leadership capacities of DLTs by providing opportunities for team members to *learn* about TRSI Attributes and about high-quality math and science for all students. TRSI then supported DLT members as they *implemented* what they learned and *shared* their new knowledge and skills with others. This *Learn, Implement, Share* Model formed the basis of the TRSI action plan.

Mathematics and science teachers on the TRSI DLT were called teacher partners. In the TRSI model, teacher partners were the primary catalysts for systemic reform in their districts. TRSI provided leadership development opportunities at teacher partner academies, where presenters modeled learner-centered instructional strategies such as problem solving and inquiry learning.

Through the work of its regional math and science specialists, TRSI supported teacher partners on site in their districts as they implemented the best practices, strategies, techniques, and models learned at teacher partner academies. Specialists were located in regional offices to facilitate work with teacher partners in their districts on a regular basis, usually meeting with each teacher partner at least once every 6 weeks. TRSI regional specialists provided more than 16,600 support sessions. Specialists served as mentors and coaches; provided follow-up to TRSI academies and institutes; modeled and co-taught lessons; and demonstrated technology uses. They also made a wide range of standards-based curriculum materials and resources available for check-out by teacher partners. This arrangement resulted in the district being able to purchase materials that could be used by all teachers.

The Coastal RSI capacity-building program improvement model (see Figure 10) was designed to address common issues in rural school districts that traditionally limit the capacity for creating sustainable improvements in mathematics 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

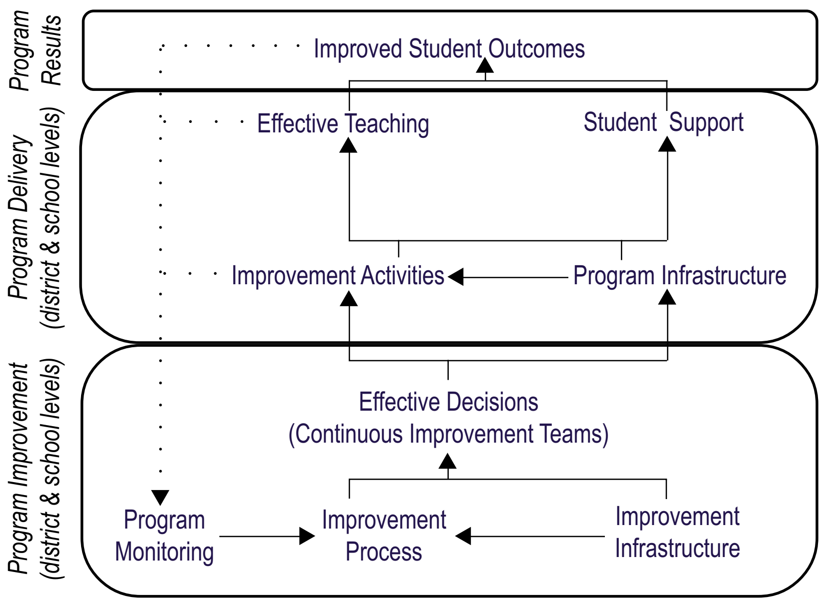


Figure 10. Coastal RSI program improvement model.

Few rural school districts in the Coastal regions of North Carolina, South Carolina, and Virginia had mathematics and science specialists in the central office. More often than not, curriculum and instructional reform was led by a person who was a "generalist" with many job functions to perform. While central office staff could usually provide each school with data revealing how students performed on standardized tests and state assessments, little human and fiscal capacity was 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 were traditionally 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.

Figure 10 shows that improving student outcomes was the ultimate program result of the Coastal RSI model. Delivering research-based program interventions (improvement activities) and building appropriate infrastructure at the district and school levels made effective teaching and student achievement in math and science possible. A focus on student achievement guided the monitoring of program improvement activities and strongly influenced decisions made about the math and science programs.

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 change in how decisions are made at the school and district levels—a systemic change that is essential to creating lasting improvements in math and science education programs.

A school CIT becomes the sustainable leadership capacity that can continue designing and implementing 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.

The Coastal RSI's regional facilitators provided assistance to the districts and schools in developing their CITs, defining their work, and guiding the overall RSI 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 Coastal RSI model depends greatly on each school's ability to follow a continuous improvement process. Consequently, the most important role of the regional RSI facilitator is to assist the team in following the Coastal RSI continuous improvement process.

The Hawaii RSI implementation and evaluation framework follows a "logic model" or "causal model" of project evaluation, whereby the outcomes of the project are assessed against the project "inputs" or interventions. Figure 11 depicts this framework.

Hawaii RSI project goals are influenced by the goals of the Hawaii Department of Education (HDOE) and the No Child Left Behind legislation. These goals take into consideration what knowledge and skills a high school graduate should possess, standards for teaching and learning, and the needs of students and teachers. Project goals are measured by implementation and outcome indicators. These indicators measure the effects of instructional conditions to cause implementation of necessary project intervention strategies, which in turn influence teacher change. Teacher change influences student change.

The logic is that, successfully implemented, all interventions and changes will result in a model of systemic change. Evaluation results inform management decision making (e.g., changes needed in implementation activities to achieve the desired outcomes) and contribute evidence of project success required by NSF and HDOE.

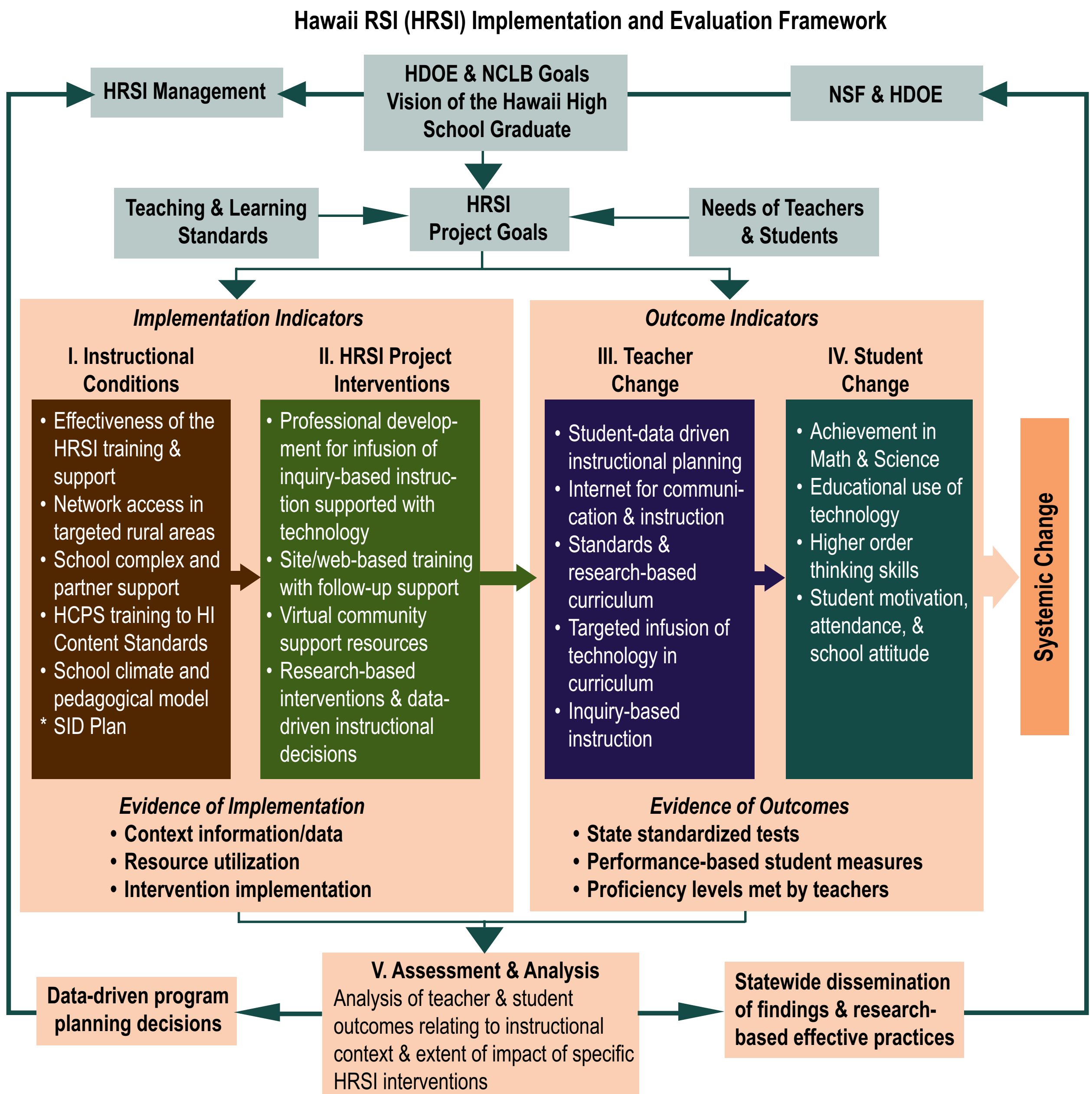


Figure 11. Hawaii RSI logic model for project implementation and evaluation.

Lessons Learned: Continuing the Leadership-Building Legacy

Each RSI learned many valuable lessons as it strived to implement its model for improving mathematics and science education in high-poverty rural areas. The following list was gleaned from the documents reviewed in preparing this report. The purpose here is to provide examples of lessons learned across a variety of exemplary RSIs. It is not implied that each lesson is appropriate to all change/implementation models used by the RSIs.

1. Adopting **a standards-based curriculum** is a critical and difficult decision for schools. Doing so, however, creates a catalyst for all teachers to examine their teaching practices. It also allows all professional development opportunities and assessment strategies to focus intensively on effectively teaching all students to achieve the higher levels of content and conceptual understanding that are critical elements of the new curricula.

2. Math and science **specialists** can help teachers on an individual basis to move from lower levels of implementation (i.e., changing beliefs and the mechanics of using the curriculum) to higher levels (i.e., examining the effect of the curriculum and pedagogy on student learning).

3. School and district **administrators** play a critical role in sustaining the RSI efforts because they control district resource allocations. During the RSI project, administrators devoted funds to purchase standards-based curriculum materials, manipulatives, graphing calculators, and data acquisition devices; to create, renovate, and staff science labs for use by elementary students; and to provide time for teacher partners to share new knowledge with other teachers. Teacher partners reported that administrators provided new opportunities for them to work on budgets devoted to mathematics and science. All of these instances point to changes in administrative, and therefore district, priorities that form the needed foundation for long-term impact.

4. Parents will come to school improvement family events, even in high-poverty rural areas with a history of low parent participation at other kinds of activities. Parents can become proactive in their support for mathematics and science education by helping teachers purchase and/or make materials needed for hands-on and inquiry-based activities, by building equipment such as telescopes, and by creating outdoor classrooms. These kinds of **parent involvement** activities indicate an ongoing and long-term investment in their children's mathematics and science education.

5. Teachers must learn to use the resources in their area, such as state parks, to provide field experiences for their students. Teachers and administrators need to build relationships with university faculty members and informal science providers that will continue after the NSF RSI funding ends. Districts can learn that working with other districts is an effective way to obtain external funding. All of these **partnerships** contribute to reducing the isolation of rural districts; but perhaps the relationships across districts that were facilitated by the RSI will be the most important in combating the isolation that rural teachers experience.

6. A significant problem school and district administrators may face in sustaining the RSI investment is how to fund the continuing instructional material needs of teachers trained

by the RSI. This issue may intensify, as RSI-experienced teachers may be much more assertive about their need for materials and may consistently advocate for administrators to budget and purchase additional **instructional materials**.

7. Without the RSI support, administrators may be equally concerned about how to replace the high-quality **professional development** experiences made available for teachers. This problem is further compounded by the high rates of teacher turnover in high-poverty rural school districts.

8. The "**share**" portion of the learn/implement/share model (in Texas RSI) was less successful than originally anticipated. Mixed results exist on how often and how well what was learned was shared with the teacher partners' colleagues. Teachers commented about how they would return from a workshop and try to explain what they learned to their colleagues, only to be met with blank stares. Something gets lost in translation and it is "hard to bring home the enthusiasm."

9. At the district level, it was common for a junior high mathematics teacher to have never met the high school mathematics teacher before they both became involved with the RSI. This was true even in very small districts. This lack of familiarity made it difficult to align curricula or even to communicate problems. The RSI created a cohort at the district level that facilitated free-flowing **communication** up and down the instructional line.

10. **Teacher cohorts** may be the most fragile of all RSI project artifacts. The rural districts are very likely to return to the isolation forced on them by distance and scarcity of resources.

11. Specialists can be the source of the new ideas, encouragement, and materials for teachers. In many cases, the teachers view the specialists as vital to their growth and are not as confident personally or professionally without the "specialists" relationship. On the other hand, some specialists may be poor matches. Specialists who are mathematicians may not know science well enough to help science teachers (or vice versa). It is important to make good choices in the **specialist selection process.**

12. Teachers view it as "essential" for administrators to engage fully with the new program to understand the needs of the teachers in completing the transformation. Teachers want administrators to demonstrate their support of the RSI initiatives by scheduling **time** for teachers to share/plan with each other.

13. An RSI can meet with school district leaders and help them form district-level leadership teams for the RSI's implementation, but the RSI must also provide immediate tasks to help the team develop a vision for the reform needed and to understand the team's role in leading the reform efforts. Not having an **engaging task** for the district's team to work on right away can greatly diminish the momentum of starting the partnership and delay the district's engagement in true reform efforts.

14. A critical part of teachers' successful implementation of new learning is the **on-site support** provided by RSI regional specialists. A major reason teachers gave for not implementing new strategies and models in their classrooms was the lack of time to prepare and refine the new lessons. Regional specialists make classroom implementation easier for teachers by providing encouragement, clarification, needed materials, and assistance with implementation of valuable technologies.

15. The importance of real **administrative engagement** in the reform process cannot be overemphasized. In the districts where administrators understood the RSI model, teacher partners were encouraged to participate in academies and institutes, time was provided for them to share with other teachers, and funds were allocated to support reform efforts. Astute administrators maximized the impact of visits of regional specialists to teacher partners by finding ways to include other teachers in those meetings. Perhaps most important to administrative engagement was participation with teachers as professionals at RSI events and at district leadership team meetings.

16. **Progress** in reform efforts can be very fragile, especially in small districts where a single teacher is the entire science department or where there are only a few administrators. In those cases, a single person leaving the district can significantly slow the reform process.

17. It is necessary for RSI staff to visit new administrators and teachers early in the school year in order to increase their **understanding of the project** and gain their support and involvement. Frequent nurturing of relationships established with district personnel is critical in guarding against misunderstanding or miscommunication that could hinder reform efforts. Frequent and informative communications with districts must be a high priority for keeping relationships with districts strong and energized.

18. For many Native American educators, **culturally responsive science curriculum** has to do with their passion for making cultural knowledge, language, and values a prominent part of the schooling system. It has to do with presenting science within the whole of cultural knowledge in a way that embodies that culture, demonstrating that science standards can be met in the process. It also has to do with finding the knowledge, strategies, and support needed to carry out this work. For those educators not so linked to the local culture, culturally responsive science curriculum has more to do with connecting what is known about Western science education to what local people know and value.

19. **Moving teachers into the role of being leaders** in the improvement of mathematics and science is a delicate and differentiated process. It requires time and training to build a base of knowledge and expertise and to develop ways to support and enable teachers' change of roles. Most teachers require an extended period of nurturing, while others have just been waiting for the opportunity, but both types need attention and support over time.

20. **Partners** are absolutely essential for systemic change, but it is important to select partners that add value and provide diverse, needed resources. Leaders of change need to know what potential partners bring to the table and what they expect to gain or achieve through their partnering.

21. Time is a major constrainer when it comes to training teacher leaders and improving teacher leader effectiveness in their roles with leadership teams, study groups, and vertical and horizontal planning and alignment of teams. **Training principals** to create common group/team planning and work time may be the most powerful strategic investment for improving mathematics and science programs and student learning.

22. Many teachers can and will step up to leadership roles, given appropriate and adequate professional development, and the **opportunity and encouragement** by their school and/or district administrators.

Concluding Thoughts

The last of the Rural Systemic Initiative (RSI) projects funded by the National Science Foundation (NSF) will come to an end in early 2008. The RSIs came on the heels of the State Systemic Initiatives and the Urban Systemic Initiatives that NSF launched in the early 1990s. Many educators in rural states had raised concerns with NSF about the unique needs that existed in rural places that were typically low income, sparsely populated, and a small school district staff. This combination made it difficult for these systems to deliver high-quality mathematics and science programs, particularly when it became apparent that substantial changes needed to be made in the instructional programs and practices that had been used for many years in their mathematics and science programs.

In 1993, NSF held a conference in Huntington, West Virginia, to present and discuss issues related to improving mathematics and science programs in rural areas. The concerns and issues brought forth by conference participants were heard and heeded by NSF, and in 1994, NSF funded the first rural systemic project. The demographics that described the areas targeted for funding were school systems and districts that were economically disadvantaged and geographically isolated. RSIs were funded in various locations, from the mountains of Alaska to the Mississippi Delta, from Indian reservations on the Great Plains to the hollows of Appalachia.

The challenges to providing high-quality mathematics and science programs were great across all of the RSI projects. Common challenges included underfunding; elevated transportation costs; and facilities that were small, old, and inefficient. Declining populations affected the financing of schools. The capacity of small rural school systems to provide planning, organizational support, monitoring, and staff development was limited. These small districts had to devise ways to cover the responsibilities of the 70 or so jobs that must be done to carry out the work of a typical school system.

The RSIs adopted different pathways and strategies to improve the performance of students in mathematics and science, and to close achievement gaps across ethnic and economic groups. The models and methods used by the RSIs varied from location to location, but they all found ways to be successful in developing leadership capacity; building support for program improvement within the administrative structure of the school system; and leveraging the successes of other systemic initiatives, programs, and materials developed through NSF.

This report is an effort to shine a light on practices and models that may otherwise go unnoticed in the national debate on improving mathematics and science education for all children in rural America. The story of the RSIs is particularly important as the emphasis on mathematics and science education returns to the forefront of federal, tribal, state, and local policymakers, education and business leaders, and others who fund or seek to advance critical education improvement agendas. Consistent with the message of leaders at The National Summit on Competitiveness,

> The good news is that America is able to meet these challenges from a position of economic strength. We have the resources in people, ideas, and financial strength to invest in a successful future. We will falter only if we are complacent.

Let us hope that what the RSIs have achieved and learned can help prevent the complacency and neglect that has prevailed for decades in too many rural areas of America, particularly in those areas with high concentrations of poor people. Investing in and leveraging the legacy of leadership already established by the National Science Foundation's Rural Systemic Initiatives would be a prudent path for action.

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