Rural School-Community Partnerships:
The Case of Science Education[1]

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Partnerships as a strategy for education reform have recently taken on increased national importance. The *No Child Left Behind Act* [NCLB] (2001) promotes an agenda for the development of partnerships with particular emphasis on mathematics and science. A number of federal agencies have responded to the NCLB legislation through the development of grant programs that focus on leveraging resources through school-community partnerships to improve education. For example, the National Science Foundation (NSF) has established the Mathematics and Science Partnership program, which "recommends that partnerships among educational entities, especially [those that bring] together the preK-12 community with scientists, mathematicians, and engineers from institutions of higher education, should ... improve preK-12 teaching and learning in mathematics and science for all children" (National Science Foundation [NSF], 2002, p. 5). Similarly, the U. S. Department of Education (USDOE, 2004) administers a formula grant program to states that is

> intended to increase the academic achievement of students in mathematics and science by enhancing the content knowledge and teaching skills of classroom teachers. Partnerships between high-need school

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> districts and the science, technology, engineering, and mathematics (STEM) faculty in institutions of higher education are at the core of these improvement efforts. (n.p.)

These programs articulate the President's priority of using partnering to close the achievement gap in math and science between majority and minority and/or disadvantaged students in order to keep the United States competitive in international markets. However, in rural communities, the infrastructure for developing these partnerships (i.e., nearby institutions of higher education, stable economic base, human resources) is often not available. In this article we explore how, within the context of a previous national educational reform effort—the National Science Foundation's Rural Systemic Initiative (RSI)—rural communities overcame these obstacles to form viable and meaningful partnerships that strengthened both their schools and communities. This information offers a number of lessons learned about how partnerships are, or are not, formed in the rural community context, which can inform the work of the current Math and Science Partnership efforts.

The Reform Context

The National Center for Education Statistics [NCES] (1997) defines a rural location as "outside urbanized areas in open country, or in communities with less than 2,500 inhabitants, or where the population density is less than 1,000 inhabitants per square mile" (p. 3). As of 1994, 46 percent of the public school districts in the United States were rural, and the poverty rate for rural children ages 5-17 was 20.8 percent (National Center for Education Statistics, 1997). Of the eight geographic location categories used by the U.S. Census Bureau, the poverty rate in rural areas was the third highest, preceded only by large and small inner city rates of 30.5 percent and 22 percent, respectively. These statistics indicate that our rural communities hold a significant number of disadvantaged children, which the NSF directly targeted with its Rural Systemic Initiative (RSI) program.

From 1994 to 2003, the NSF administered the RSI with a focus on science, mathematics, and technology education. This program was designed to ensure that rural districts and schools became a part of the reform efforts underway in the 1990s to improve student achievement. The RSI aimed to promote systemic education reform, namely in economically disadvantaged locales, which, until then, had limited access to services provided by other NSF projects. The rural areas identified by NSF as RSI sites typically served school districts in which greater than

30 percent of the school-aged children lived in poverty (NSF, 2002). The RSIs included diverse geographical areas, often comprising multiple states or consortia of counties within a state. The common thread among all was a history of poverty and, in many cases, a history of oppression, since a number of these communities were populated by Native American tribes, African Americans, and Hispanic Americans (Heenan, St. John, Brown, Howard, & Becerra, 2001). Further, they all shared geographies characterized by physical isolation.

According to the NSF, the RSI was tailored to address policy, leadership, and workforce issues related to education in order to provide a comprehensive and sustainable framework for science, mathematics, and technology education in elementary, secondary, and higher education (NSF, 2002). RSI grants were awarded for anywhere from one to five years and took two forms—planning grants for the development of a larger project design and full grants to support full program implementation. The latter supported curriculum, instruction, and assessment activities as well as teacher or administrator development that lead to improved classroom instruction and student achievement. A major emphasis of many of the RSI grants was community involvement in instructional reform and policy development. The NSF supported several cohorts of RSIs from 1994 to 2002. Each cohort was identified by the particular program solicitation through which they were funded. According to an NSF directory of project directors, there were 31 funded projects throughout the duration of the program. For the study reported here, investigators interviewed staff from all 17 of the final RSI-funded cohort, which constituted 55 percent of the projects across the life of the program (see Table 1 for list of RSI sites that participated in this study).

Study Methods

Forty educators, researchers, and reformers from 17 RSIs (the final funding cohort) were interviewed during the course of this study, specifically 24 RSI project staff (principal investigators (PIs), project directors (PDs), and regional coordinators), 2 project evaluators, and 14 school district and school personnel. Researchers developed a semi-structured, open-ended interview protocol for each of three different groups: RSI staff (PIs/PDs) and evaluators, teachers, and principals. After initial development, researchers refined the protocols as data collection ensued, keeping the questions that appeared to provide useful data, and revising or eliminating questions that did not evoke helpful responses. Researchers also refined protocols for clarity and brevity. The research team reviewed all of the transcripts and, through collaborative conversa-

Table 1.
Participating Rural Systemic Initiative Sites

RSI Name	Location
Alaska Native/Rural Education Consortium for Systemic Integration of Indigenous and Western Scientific Knowledge	AK
Appalachia	KY, WV, NC, VA, TN, OH
Blackfeet Community College	MT
Coastal	GA, NC, SC
Delta	AR, LA, MS
Dull Knife-Northern Cheyenne	MT
Fort Belknap College	MT
Little Big Horn College	MT
Michigan	MI
Navajo Nation	AZ, UT, CO
Northern New Mexico Network	NM
Sisseton-Wahpeton	SD
Sitting Bull College	ND
Texas	TX
United Tribes	ND
UCAN	UT, CO, AZ, NM, Hopi Nation
Wind River	WY

tions, identified themes within which more refined coding categories were identified. Once the coding categories were developed, each transcript was coded. The data within each theme was then consolidated so that patterns could be identified, which constitutes the findings of this study.

The findings, initially reported in a 2003 monograph presented to the National Science Foundation (Education Development Center, Inc., 2003), are captured under three themes: the challenges of conducting educational reform in the rural context, the status of science curriculum and instruction, and professional development challenges and strategies. However, by looking across the findings presented within each of these themes, cross-cutting findings were also generated but not presented in a consolidated manner in the original monograph. The cross-cutting findings about the role that partnerships played in the RSI reform efforts and how the challenges of conducting educational reform in rural contexts influenced these partnerships are the focus of this article. Because this was a small exploratory study, the generalizability of these findings is limited; therefore, the findings should be viewed as provocateurs for new research within the rural context. Although the RSI program addressed the other content areas of mathematics and technology education, the current study focused on only the science aspects of the funded projects.

Findings

The Challenges of Conducting Educational Reform in the Rural Context

There is rural, and then there is really rural. There was a good deal of variability within the RSI districts that participated in this study in terms of students, teachers, and districts served by the RSI staff. However, when compared with urban or suburban settings, there are more similarities than differences among the rural communities represented in this study. One similarity was the diffusion of human capacity due to the geographic distances between schools, and between students and their schools. For example, one principal investigator of an RSI in this study explained that

> in the rural districts, we have to deal with time and distance…we have the largest geographic district east of the Mississippi….We have kids snowmobiling in to get the bus. And you know, the closest other district may be 40, 50 miles away. The closest big town… may be as much as 75, 80 miles away. So again, we are dealing with distances.

The Native American reservations on which several of the RSIs were established have huge geographic regions to which they were expected to deliver professional development. For example, from our interviews we learned that the Sisseton-Wahpeton RSI served the 1,000-square-mile Lake Traverse Reservation; the Wind River RSI served the Wind River Indian Reservation, which is more than 17,000 square miles; and the Navajo Nation RSI, which spanned Arizona, Utah, New Mexico, and Colorado, served an area of about 25,000 square miles. Further, with such large geographic areas, the population density remained low. Fort Belknap RSI in Montana, for example, had about 100 students for a 2,000-square-mile district whereas the United Tribes and UCAN RSIs had about 10 to 13 people per square mile.

The impact of the geographic distance between the schools and districts in rural settings was manifest in the wide-ranging numbers of districts served by the RSIs. For example, Blackfeet Community College RSI in Montana served two districts with 12 K-8 schools and two K-12 schools with a total of 2,400 students, while the Delta RSI served 81 districts, 542 schools and 224,651 students. Of the 11 RSIs that provided district information to us in our interviews, three could be described as small, with an average of 3 districts served; four were midsized, with an average of 19 districts served; and four were large, with an average of 60 districts served. Predictably, the numbers of schools served by the RSIs varied widely as well, ranging from three schools at Dull Knife-Northern

Cheyenne RSI in Montana to 542 schools in the Delta RSI. Further, the average numbers of teachers that the RSIs served ranged from about 50 up to 750 throughout the RSI districts. The numbers of students served varied from 2,350 students in the Sitting Bull College RSI in North Dakota to the 224,651 students in the Delta RSI.

Many of the schools served by the RSIs in our study were small, having few students and teachers compared with their suburban or urban counterparts. It was common to have more than one grade in a classroom, or a single person teaching all the elementary grades, or one person teaching all the sciences in a high school. Of the five RSIs in this study that reported the number of students they had per grade, the average was 17 students per grade. The range was from 9 to 36 students per grade, whereas in suburban or urban settings the number of student per grade is typically three to four-fold larger. Still, the diversity between locales persists when looking at total school populations. A K–12 school in remote Alaska, for example, had only 30 students; a United Tribes school in North Dakota had 200; and a school in the Texas RSI had nearly 1,500 students.

Geographic isolation has social implications for partnerships and networks. The geographic isolation of rural communities often keeps the residents insulated from external influences. In some locales, the low migration (in or out) that accompanies this isolation creates a stable community with a long history of personal relationships. A superintendent of a district participating in an RSI remarked:

> It's a small town—2,000 people in it. So, we go to church together; we see each other at the grocery store. I graduated high school with the high school principal here. I've known her since second grade….There are 59 school districts in our region, and I would dare say I probably know on a personal basis 50 of the 59 superintendents.

Moreover, not only do school personnel identify with their colleagues and counterparts in the communities closest to them, but the students attending the schools and their families also have a strong sense of community, as this RSI principal investigator described: "Fortunately, we're…dealing with communities that are very strong in the family and extended family, and their children tend to be very tied to the community, and tied to the geography and space." And yet, while such closeness is a positive characteristic in any community, in rural settings, the communities' homogeneous natures and closeness can, at times, create an atmosphere of caution toward "outsiders." Education reformers working in these communities, then, need to be aware of the social and cultural history that influences the extent to which local parents and teachers are willing to engage in efforts with "outsiders," and to apply this awareness to appropriate strategies for gaining trust and establishing a collaborative environment. In one RSI serving Native American communities, reformers used the following approach:

> We spent a lot of time… going and working with the tribes; they're very wary of money from the government now. They're tired of being studied. They're tired of being forced to do things they don't want to do. So, it took a good year in some communities to establish enough trust. And the way we did that was we kept coming back with the same consistent message that these are the areas we want to work on; this is how we might be able to help your community…we didn't force anybody to do anything. The people that we worked with, we constantly, physically brought them together. These are people who need to see you: see your face, see your hide, your eyes, and see who you are, and how you interact with people.

To overcome the social and cultural barriers that reform leaders experienced in attempting to form relationships in these isolated and insulated communities, they used a variety of informal mechanisms to develop trust. Without trust and respect, any reform effort will stall and collapse. Thus, establishing trust is a fundamental priority. The "outside" reform leaders established trust by observing local customs in regards to communication style and content as well as social ceremony for appropriate interactions. In certain kinds of communities, these social customs are the very fabric of the community interactions, and anyone attempting to work with these communities should recognize the need for learning these customs and allow for enough time to become accepted. For example, one of the teachers participating in an RSI reform effort in a Native American community explained it this way:

> There's a very interesting contradiction in gaining knowledge from the elders. When you're going to them, you can't just be all gung-ho that I'm teaching this and how can I bring your cultural aspects into this lesson? There's a whole cultural process involved in gaining that knowledge. It's not just going over there and visiting them, being respectful with tobacco, sage, and cedar gifts. But there's a whole other aspect to it too—it's like raising a child, and when they feel you're ready to learn it, when they feel that you're ready to learn and share it, then they'll present it to you. That doesn't happen right away. It's not just a simple act of requesting and then you get it. It's a dance. It's truly a dance.

Additionally, learning about how the community values schooling in general, and subjects such as science specifically, proved to be essential in establishing working relationships among community members, school members, and reform program staff. Within this context of geographic isolation and heightened social mores, the RSI project staff were able to establish a number of successful relationships with community members that improved the status, delivery, and outcomes of science education.

The Role of Partnerships in Rural Reform Efforts

In the context of this study, the term "community partnership" refers specifically to partners *physically* located in the community. There was a range of different types of community partners engaged in the reform work of the 17 RSI sites in this study, which included scientists, industry/business leaders, family members, community leaders or tribal leaders, and faculty at institutions of higher education (local community colleges and tribal colleges).

Partners' involvement in instruction. Scientists (e.g., doctors, natural resource professionals, engineers) most commonly were involved in direct instruction in the classroom. This instruction by science professionals ranged from a one-time presentation on a topic discussed as part of a larger instructional unit to an extended collaboration with the teacher across the entire unit. This kind of activity engaged the larger community in a dialogue about science and mathematics issues and provided students with practical experiences that better prepared them for the kinds of challenges they would face in the work place. For example, in one of the RSI sites, teachers were encouraged by the RSI staff to reach out to the larger community via an "invitation" to think about how they use mathematics and science in their daily lives. Once the community members responded to the invitation, they were asked to collaborate with teachers to design a real-life problem that required math and science skills to solve. In one particular instance, an engineer and a teacher met to plan a unit of study on a particular design problem that the engineer was experiencing at work. The teacher and scientist were equal contributors to this process, since both brought expertise to bear about how to best instruct the students using a real-life practical learning experience.

Other publicly-funded professional scientists that RSI schools used to provide instructional support included staff from the U.S. Fish and Wildlife Service, the state department of fish and game, and state parks in the community. These professionals provided a wide range of content-area expertise that bridged the many scientific domains taught in schools. These professionals had the added benefit of being accustomed to providing public education programs as part of their organizations' outreach missions, so they were comfortable working with teachers and students. However, these professional scientists were not engaged in the majority of the RSI sites interviewed, which indicates an underutilization of potential human resources for a number of sites. In spite of this, there were a few bright spots. As one interviewee put it:

> So, I mean, to me that's really a change in vision of the teachers using their local resources. And that's something that's sustainable, that relationship between the schools and the state parks. And the state parks are starting to change their budgets so that they can fit some money in to do these things with teachers. And the state parks are now aware of the Texas essential knowledge and skills, and how important it is to align the things that are there at the state parks with those Texas essential knowledge and skills.

Industry and businesses within the community or state were another source of partners for the RSI districts. These partners usually provided technology technical assistance support to teachers or other school personnel, and/or resources (e.g., computer components, financial support). One particularly innovative strategy that emerged from this study was the formation of a nonprofit community educational foundation in one RSI site. Upon becoming part of the RSI, the superintendent and school board chairperson in one district formed a nonprofit with 20 charter board members, who each paid a $100 membership fee. This established an initial budget of two thousand dollars, which was used to purchase high-quality reform-based instructional materials for the students and to provide teachers with professional development experiences to support the delivery of these materials. The RSI staff was involved in the foundation to provide guidance on the ways that the assets could best support the reform efforts being conducted at the school. Since the resources, both financial and human, for this partnership resided in the community, this kind of organizational structure may be more likely to be sustained once the RSI was no longer funded to continue fostering school improvement.

Other ways that community members were engaged in the science reform efforts of the RSIs included family night activities, science fairs, and summer camps that focused on science content. In Texas, RSI-family-night learning events involved over 6,500 parents with their children in inquiry-based science learning. This kind of engagement, even on a smaller scale, builds within the community the expectation for learning and the understanding that science is a process of discovery for learning. However, making science a community-wide priority and interest can be more difficult in some communities than others. For example, in Native American communities there is a cultural way of relating to and understanding natural phenomenon that, at times, may be in conflict with a Western scientific way of knowing.

Since a large number of the RSI sites served Native American populations, the issue of culturally relevant science learning repeatedly arose. Within these communities there was a real effort to integrate, whenever possible, local cultural knowledge into lessons so that the Western scientific information could be understood more easily by these students. The most common way this was done was through involving tribal elders in informal instructional situations, such as science camps and summer camps. The tribal elders and other community leaders were engaged, along with teachers, in deciding the curriculum and approach to teaching for the campers. The content of the learning opportunities included culturally significant structures, ideas, or stories to create a whole experience for the students so that they could see that science was all around them, even if it was not labeled as such. A particularly good example of this kind of experience was described by one district RSI program coordinator, who illustrated how a demonstration project, designed by tribal elders and the science teachers, on the construction of a steam house blended the culturally relevant symbol and use of steam houses with fundamental concepts in engineering, physical and life sciences.

> [T]he student explored different styles of construction. Based on structural integrity and the actual effective use of the steam house, it was determined which type of construction would be most effective. In doing so, he explored, obviously, the western concepts of architecture and also the effects of steam in a small area. But he also talked [with the tribal elders] about how the construction of them is very much how they used to be thousands of years ago, as well, and got oral histories from people about the steam house, and the use of it over time, and learned more than just the construction and effectiveness of it, but really why they're so important.

Because elders and science professionals participated in these summer camps, students could see that anyone could engage in scientific exploration and thereby learn both science and culturally relevant life skills. Students were encouraged to identify some practice or activity that they learned from the elders in their region and think of ways that they could test some aspect of the practice in an experimental way, which became local, regional or state-wide science fair projects. Both elders and science teachers were involved in the development and the judging of these projects. One RSI principal investigator explains that the projects are "judged on two sets of criteria. One, their scientific merit, and the other their cultural merit, to what extent they reflect the cultural traditions and values of the region—elders to the latter, science teachers or scientists to the former." This collaborative practice allowed students to experience the "interaction with culture (peers) in the region, and learning from them," while also learning scientific concepts and procedures. These kinds of culturally relevant science experiences often carried over into the fall school semester where students were asked to "follow-up with a culturally relevant or environmentally relevant science project that then is entered into a rural school science fair that honors both the local way of looking at science, the local technologies, as well as western science technologies," thus strengthening the connection between culture and science.

Partnerships help reform educational systems. The RSI program staff also employed more formal structures, such as steering committees, "resource clearinghouses," and leadership institutes to intentionally create community partnerships and networks that would assist with the work of reforming the educational system itself. Steering committees that guided the reform activities intentionally included parents and community leaders (i.e., tribal elders, business people, school board members) as integral and equal decision-making partners. Embedding the decision-making structure into the community established stability in districts where there was high teacher/administrator turnover. This dispersed decision-making structure for school improvement also helped to keep the institutional knowledge of what had and had not worked in the improvement effort in the community, rather than in a few key positions in the school/district/reform program.

Resource clearinghouses were provided by some RSIs as a service to the community. This function involved determining what resources were available within the community and surrounding communities and how these resources could be leveraged to benefit the school efforts. For example, one principal investigator explained what his RSI did:

> What we are really all about is to leverage resources and capacity to change instruction. There are several ways in which we are engaged in doing that. One, of course, is to make sure that our constituent districts understand the resources that are available to them through us. So, what we attempt to do is partner with as many different supportive agencies as we possibly can. We partner very closely with Michigan State. And there we are dealing with administrative and technological aspects. We deal with [Cyrus] State University. And basically, we are talking about teacher education and ongoing teacher education. We deal with McREL Lab out in Chicago. And we have a person that we use, once or twice a month, out of the Math/Science lab. And he helps us in various kinds of things and ways. So, it is how we use and garner the various partners that we have in terms of resources. So, we have to make our people aware that those resources are available to them.

However, often in communities that are short on human capital there is no one person providing this service of locating, vetting, and disseminating information. Yet, in communities that do not have a lot of resources, leveraging them to get the most out of the ones that are present is essential. External funds can be used to initiate this one specific function, and once the networks of human resources are established, they can be sustained by the community network itself.

RSI leadership institutes usually took the form of one-week summer programs that focused on leveraging resources and building capacity to conduct school reform activities. With the intentional focus on partnerships, each invited school district was often required to participate as a team, which included the superintendent, a principal, a mathematics teacher, a science teacher, and one community person (e.g., school board member, business person). This extended, focused dialogue among professionals who did not normally collaborate closely on a regular basis provided unique opportunities to develop meaningful partnerships that could remain in the community beyond the scope of the external reform effort.

Conclusions

There are a number of barriers to capacity that are unique or exacerbated in rural school settings (Heenan, et al., 2001; Education Development Center, Inc., 2003). Many of these barriers have been discussed in this article, but one that is fundamental to conducting educational reform is the severe limitations in human capacity due to low population density in rural settings. For example, a number of interviewees reported that there was a lack of substitute teachers available to release classroom teachers to attend professional development opportunities. Also, it was not uncommon for teachers to have multiple-grade classes, which introduced a challenge for curricular and pedagogical innovation. Severe staff over-extension, so that even basic curriculum components could be provided, was also a common complaint among interviewees. Often there simply were not enough teachers to reach the critical mass necessary to begin professional support networks to aid in reform efforts (Education Development Center, Inc., 2003). However, in spite of these geographically induced constraints on rural education, there were a number of partnership-based school improvement strategies that were implemented in these settings as a result of RSI participation, such as using summer science camps and science fairs to integrate culture and science and to involve all members of the community in the educational endeavor; using local science experts in classes to fill in teachers' content knowledge gaps; developing community nonprofit institutions to financially contribute to the needs of school reform, such as purchasing materials and curricula; and embedding community members in school steering committees and leadership teams to guide reform activities that reflect the values of the community and the integrity of the science education.

These partnerships formed for many reasons. For example, some sought to meld the science knowledge base and wisdom from the local community members with the strengths of science teachers. Others were developed to establish a structure to implement and use funds for curriculum enhancement. And still others worked to build support for science and math improvement in the business community. These and other partnerships formed during districts' RSI involvement and resulted in a range of desired outcomes, including enhanced curricula, increased professional development offerings, increased access to facilities and equipment, and a growing commitment to improving science instruction from the larger community.

Though the rural community context has a number of challenging barriers to educational reform, there are ways that these barriers can be overcome. Rural residents' long history of self-reliance can be an asset if creative approaches to limits on resources and geographic isolation are attempted and solutions are born of the fiber of the community culture. This, of course, can be said of any setting, not just those that are rural. There are many challenges in our public education system, but the strength in numbers that partnerships and networks of colleagues brings to the problem has great potential for improving science learning for all students.

Future Research

Partnerships make a major difference to rural schools and districts embarking on reform efforts, but much is still to be learned in order to identify the critical elements to their success. As new partnerships emerge and others are expanded, it will be important to invest in studying rural partnerships, particularly to determine the commonalities among different types of partnerships that operate in substantially different rural contexts. Of particular interest would be to determine how the dynamic relationship between school and community (i.e., economic viability, cultural context) influences the momentum for science education reform. For example, how do different stakeholders understand, prioritize, and implement the elements of a science reform effort? How do various partners and partnership types affect rural schools' capacity to provide challenging science courses and curricula? How can lessons learned about the power of culturally relevant science curricula inform curricular adaptations in educational contexts with a heterogeneous student population? To date, most research has been done as single case studies. Though this kind of in-depth look adds texture to the "who" and "how" of selected partnerships, it is time to look beyond the individual case for lessons that can be drawn and shared across various contexts—

be they rural, urban, or something in between. Given the tremendous federal investment currently being made in mathematics and science partnerships, more of this comparative-type research is sorely needed.

Note

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