The Appalachian Math Science Partnership:

A Multi-State Umbrella Partnership Promoting Local Mathematics And Science Reform

Close-Up Papers

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I. The Regional Program Coordinators:
Making Connections and Developing Local Leadership

II. Baseline Improvement Sites and the Program Improvement Review: Promoting School-wide Involvement in Math and Science Reform

III. The Partnership Enhancement Program:
A Strategy for Supporting Locally Designed Partnerships

IV. Motivating Change in Institutions of Higher Education Through Collaboration with K-12 Partners

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INVERNESS RESEARCH

AMSP CLOSE-UP

I. The Regional Program Coordinators: Making Connections and Developing Local Leadership[1]

Overview

The importance of working within personal relationships is a well-known factor in building improvement communities in Appalachia. Drawing on this knowledge and on the experience and legacy of previous improvement efforts in Appalachia, the AMSP leadership created the role of the Regional Program Coordinator. This was a strategy to make the many connections needed to create working partnerships envisioned by the AMSP. In this paper we describe the role and work of the Regional Program Coordinators and provide examples of how they helped meet the unique needs of counties while working to attain the broader goals of the AMSP. We draw from data collected during site visits to various AMSP counties, interviews with district staff and a series of interviews with the AMSP Regional Program Coordinators.

Background

The work of the AMSP takes place in the Appalachian Mountains, in counties[2] that are predominantly rural and, because of the local geography, isolated.

> *When people come from other places, they have a hard time imagining how we get from one place to the other. It does take longer. And that sets us apart here, the isolation. The Internet and emails haven't been here for so many years, and if you go to a meeting, it is three hours away, no matter how you go.*
>
> *- Regional Program Coordinator*

[1] This "AMSP Close-up" is one of four papers that are intended to accompany a core report about the AMSP entitled "The Appalachian Math Science Partnership: A Multi-State Umbrella Partnership Promoting Local Mathematics And Science Reform." That report is the core document of a set of five and stands alone. The four papers identified as "AMSP Close-ups" are companions to the core document. Each of them focuses on an especially effective strategy or component of the AMSP umbrella partnership.

[2] In this report, the terms county and district are synonymous, with the exception of the few counties where there is more than one school district. For example, Breathitt County has two school districts: the Breathitt County School District and the Jackson Independent School district.

The close-knit communities in the mountains and "hollers" of Appalachia tend, understandably, to be suspicious of strangers coming from the outside "to help." We observed this while studying the work of the Appalachian Rural Systemic Initiative (ARSI), a precursor to the AMSP.[3] Moreover, while the schools in these counties are rich in community connections, they often have limited resources for the support of math and science improvement because of their small size and isolation. The few proficient and experienced leaders of change wear many hats and are pressed into service again and again. These regional characteristics point to a key factor in fostering participation in reform efforts in Appalachia: personal connections are extremely important.

Among the valuable lessons from ARSI on which the AMSP would build was the importance of having point people located at universities throughout the region to provide these important personal connections to the project. The AMSP project leaders' experience with ARSI and their knowledge of Appalachian school districts suggested that having such a point person was essential to the success of the AMSP in all counties. Rather than having the work come through the central office at the University of Kentucky (UK), regional coordinators could be the local eyes, ears and hands of the project and also make AMSP programs and resources accessible to even the most remote counties.

The Role and Work of the Regional Coordinators in the AMSP

The Regional Program Coordinator position was the primary AMSP strategy for personally connecting the 52 counties in the partnership to each other, to the university partners, to the AMSP leadership and to national resources. The role ultimately was a critical means by which the AMSP promoted equitable access and participation across the full range of AMSP counties.

When the AMSP began, three Regional Program Coordinators were designated to provide a personal link between AMSP and the counties. Each was housed at a university, with positions at UK, University of Tennessee (UT) and at the University of Virginia-Wise (UVA-Wise). During the first year, the 52 districts[4] were divided between these three individuals. In the second year, a fourth Regional Program Coordinator was added at Morehead State University (MSU) because the number of counties assigned to the UK Regional Program Coordinator was too great to allow in-person contact with the northeastern Kentucky counties. The involvement of many of the more

[3] For a report on lessons learned from ARSI, and particularly about the importance of "indigenous" leadership development, see the Reports page of the Inverness Research website: www.inverness-research.org.

[4] There are 38 central and eastern Kentucky school districts, nine Tennessee school districts and five Virginia (western) school districts in the AMSP partnership.

remote counties was limited until AMSP added a fourth Regional Program Coordinator.

Brokering connections

The Regional Program Coordinators were expected to broker the connections between the counties and the AMSP by making or leveraging existing connections to the right people in the counties and directing them to opportunities and resources within the AMSP. They visited key educators in their counties, listened to what was needed, and made decisions in the field to determine the next steps for each county while keeping in mind what the AMSP wanted to accomplish. Their role evolved in the interplay between the needs of their counties and the offerings and goals of the larger project. In this role they catalyzed partnerships between county leaders and IHE faculty members, and encouraged counties to participate in the many professional development offerings and other programs associated with the AMSP.

There were a few counties where the Regional Program Coordinator was not necessary because the county already had a person or cadre of people in place that had exemplary leadership skills, connections and commitment to district-wide math and science reform. In these higher-capacity areas the Regional Program Coordinator simply played the role of providing information about AMSP offerings, with the district leaders able to broker the connections, hold the greater vision and move the work forward.

Facilitating local reform efforts

Within each county, the Regional Program Coordinators also worked with designated Baseline Improvement Sites (BIS)[5] to coordinate and analyze their Program Improvement Reviews (PIR) as well as to develop and carry out the improvement plans that resulted from the review process. Over the years, Regional Program Coordinators also led district-based professional development workshops for local educators, helped to coordinate parent-teacher workshops sponsored by Kentucky's Prichard committee, and played pivotal roles in the coordination—and sometimes even facilitation of—the AMSP Summer Institutes. Once the Partnership Enhancement Program (PEP)[6] got underway, the Regional Program Coordinators took an active role with many of their districts in the preparation and planning of their PEP grant proposals. In many cases this involved brokering a partnership with another county or with an institute of higher education.

[5] See the *AMSP Close-up* paper on the Baseline Improvement Sites. These sites are selected by districts for focused participation and data collection. The PIR is a process for identifying reform priorities.

[6] See the *AMSP Close-up* paper on the Partnership Enhancement Program. This program distributes grants of AMSP to local partnerships to carry out well-planned reform efforts.

In many counties served by the AMSP there was not a designated math/science leader, i.e., a person who had the time to step outside of the life of the county, to see the larger context of math and science education reform, and to consistently hold the vision of math and science improvement. In these counties, the Regional Program Coordinator took a more active role in launching the work with AMSP, arranging and facilitating meetings, bringing in outside resources such as curriculum and professional development providers, making sure the county took advantage of the services provided by the AMSP and shepherding the county through phases of reform. One Regional Program Coordinated noted:

> *In every case, it is a matter of facilitating. Facilitating the conversations to make sure that those conversations happen and to make sure that whatever opportunities we offer, whether it be the Summer Institutes or the Leadership Academy, I keep recruiting and making sure that that information is there. I have to be there face to face within their school facilitating those conversations and being a cheerleader and saying 'Okay, this just happened, and okay, that wasn't so great, but what can we do to change this? This looks positive, can we go here?' It takes that person to keep facilitating those relationships.*

In these counties, the Regional Program Coordinators sometimes also provided direct assistance in curriculum alignment and grant writing.

Building the Regional Program Coordinators' capacity to lead

The Regional Program Coordinators met monthly (in person or by teleconference) to discuss upcoming opportunities for school districts and to update each other as to their work within the districts. They supported each other by sharing documents they developed individually in their work with their BIS schools and were also supported by the AMSP leadership when they had questions or concerns. Beyond these meetings, the Coordinators were encouraged to seek additional professional development, either through the AMSP or their resident university, as needed based on areas where they or their districts were seeking growth. For example, one of the Regional Program Coordinators whose background is in secondary mathematics took graduate level classes in elementary math education so she would be better prepared to help elementary schools in this domain.

Profiles From the Field

Our evaluation research for the AMSP suggests that, without the support of the Regional Program Coordinators, many of the counties might never have engaged in meaningful AMSP-supported work. With the consistent and personal guidance and expertise offered by the Regional Program Coordinators, these counties have made significant steps towards the improvement of math and science teaching and learning.

The following profiles demonstrate how the Regional Program Coordinators addressed the unique needs of their counties within the broader framework of the goals of the AMSP and therefore enabled the AMSP to have an impact on a local level. The profiles illustrate a range of strategies Regional Program Coordinators used to facilitate the significant involvement of counties in the AMSP.

1. Shepherding counties through phases of math and science improvement

Clay County, Kentucky

This county's significant and growing commitment to math improvement began with the Regional Program Coordinator's persistent effort to involve the district in the AMSP, and continued by means of her consistent shepherding of the process over time. The first BIS designated in Clay County was the high school. The Regional Program Coordinator made multiple attempts to involve the school, but was not successful. Finally, the Regional Program Coordinator made contact with the district's Supervisor of Instruction, whose discussions with the Regional Program Coordinator opened up new avenues of AMSP participation for the county. The local supervisor reports:

> *[Our Regional Program Coordinator] is wonderful. She is how I found out about AMSP in the first place; she called, came by and explained what it was. We were in the area, and were a part of the grant, but didn't know it. We'd had a few teachers that went to the summer institute, but didn't know until she came and explained it all. That's when I got involved. We knew [one of our elementary schools] was trying to improve their math instruction—so we started with them as a BIS. She met with the teachers about the Program Improvement Review, and went over it with them. She has been a guiding force for us and we love her.*

An elementary school with low test scores was then named the BIS. During our site visit in Spring 2006, the principal told us that they had not known what to do to improve math and science instruction before they met with their Regional Program Coordinator. The Regional Program Coordinator encouraged them to undertake a Program Improvement Review (PIR) and

then worked with instructional teams to help them plan and implement change. The principal said:

> *Whenever we came to a place where we didn't know what to do, [our Regional Program Coordinator] was our guide.*

With the help of the Regional Program Coordinator, the district then partnered with a professor at Eastern Kentucky University and, with strong support from both the Regional Program Coordinator and the Supervisor of Instruction, they wrote a PEP grant to extend math improvement beyond the BIS to all elementary schools in the district. They completed this grant, which was focused on elementary math with an emphasis on technology and science integration. The district then submitted a new PEP proposal focusing on formative assessment in math. The former AMSP Leadership Intern was then released full-time, on district monies, to serve as a math coach, along with another teacher who was hired in 2007 to be a full-time math coach.

2. Catalyzing involvement in multiple AMSP programs and providing technical assistance

Campbell County, Tennessee

In Campbell County schools, the Regional Coordinator linked students, teachers and administrators to a range of AMSP programs and provided direct assistance in helping them secure a PEP grant. In Spring 2006, the Regional Program Coordinator and the current AMSP Leadership Intern visited with all of the principals and guidance counselors in all the schools to encourage them to send their students to the College Reality store. The College Reality store is a one-day event for students (and their parents) in grades 7-11 who are interested in exploring careers in math and science. Its purpose is to help parents and students understand why math and science are important and to help them plan for college. Many students attended the event, including those from one of the more rural schools. The Campbell Leadership Intern said:

> *Last year, our most successful situation came from one of our more rural, mountainous K-8 schools. We had 100% participation from that school with the (7-8th grade) students, and we even had one of the teachers drive the bus and attend with the kids and of course the parents go to that also. That was really a good situation.*

The Regional Program Coordinator also facilitated the development of a working relationship between the AMSP Leadership Intern and a math education professor at UT Knoxville. She made the initial contact with the professor by email, paving the way for the intern to contact the professor to discuss a partnership for a PEP grant. The Regional Program Coordinator

then met with these two individuals to facilitate the discussion of a PEP grant to bring math professional development to the district. At the time of our interview with her in Spring 2007, the intern was currently writing her first grant proposal with the help of the Regional Program Coordinator:

> *We met together and what I had written up at that point, she went over it and we talked about it and then we went over the guidelines and discussed each of those. When I finish this, I am going to submit it to her to read through again before I actually submit it to Lexington.*

3. Persistent contact and professional development tailored to counties' specific needs

Paris Independent District, Kentucky

In the Paris district, the Regional Coordinator's persistence and context-specific supports brought about AMSP involvement where there had originally been no interest, and helped to revive a languishing science program. Making the right connection in this district occurred when the Regional Coordinator persisted through administrative turnover. She says:

> *The first year they started, I went to talk with the principal, at the BIS, and gave him information about what was available. They had received a science review (PIR) the year before I came on and I offered to go through that and basically, that was it. He didn't ever answer emails or anything after that. But then, they switched principals in the summer and so I contacted the new principal the next fall and did the same thing. I went back to tell her that she was a Baseline Site and what that involved, and she saw that there was that science review on the shelf and she didn't know what it was. She arranged a leadership team and I got to go in and go over the science review with them and develop an action plan. They have acted a whole lot on their action plan since then.*

Since the development of their action plan, this school has started their science fair again, reestablished their science lab, and written and received a PEP grant to work on inquiry science teaching. When one of the IHE professors on the grant was not able to help with the professional development workshop, the Regional Program Coordinator was one of the people who took his place.

In 2006 the Regional Program Coordinator worked with the math teachers at the second BIS, the middle school, to help them strengthen areas where students had weak content knowledge by integrating hands-on activities and real life applications into the curriculum. She says:

> *I would bring them materials and they worked together with me there as a facilitator. I think they met for four days. They used their BIS money for that…I think they are very enthusiastic now. That little district right there has been very busy in the last year.*

4. Facilitating cross-county partnerships in very isolated areas

Breathitt County, Kentucky

The relationship of the Breathitt County district to AMSP and to their Regional Program Coordinator has brought new expertise and connections to this isolated district. There are two school districts in this county—the Breathitt County school district and Jackson Independent. Although Jackson Independent is part of the AMSP, their participation has been limited to a few teachers attending summer institutes. The two school districts do not work together. The county school district has one high school, one middle school and three elementary schools, and most of the work on math and science reform in this county is centered at the county high school. This is a typical scenario in AMSP counties—a small island of math and science improvement working in isolation. In this case, the Regional Program Coordinator helped overcome the isolation by facilitating access to a nearby county's expertise and leadership:

> *I remember being up there and talking to the assistant principal of the Breathitt County High School and she wanted to do a math PEP but she didn't know exactly how to go about doing it. I knew that Johnson was working on one and so I asked them to collaborate with each other. Johnson County—several of their administrators grew out of the old ARSI group and so they had some leadership onboard and they have good grant writers. Breathitt County wanted to write PEP proposals, but they just didn't have the experience.*

The county high school is now involved in a PEP focused on Algebra and Geometry 9-12 in partnership with Johnson County. The cadre of teachers from both Johnson and Breathitt take turns meeting in each other's home county. The Regional Program Coordinator has also helped to build connections in the Breathitt district by offering district-wide professional development for math teachers—focused on vertically and horizontally aligning the curriculum. When our evaluation team visited in Spring 2006, the high school principal in Breathitt told us "the partnership wouldn't have happened without AMSP."

A Limitation of the Regional Program Coordinator Role

Frustratingly for the Regional Program Coordinators, there were a few counties with such low capacity for math and science reform that the coordinators could not create a toehold for the AMSP. These tended to be counties that were overstressed with fundamental organizational problems or simply lacked one or two people who were inspired to work with the Regional Program Coordinator to move the science and math teaching in their county forward. One Coordinator says about one such district:

I cannot find the right person. I have made a couple of contacts and I have done a couple of small things, but it just fizzled every single time. I don't know who the right person is. I have read some news stories and heard some things, and then I just see what is happening. Well, there is turmoil within that district. This [AMSP] right now is not important. It is important that they find a director of schools that will stay with them and not leave…They have bigger issues than curriculum, and that is a sad thing sometimes, because it is true. You have to get the organization in place before you can think about the curriculum pieces.

A Final Reflection

Our observations of the role and work of the Regional Coordinators reinforce assumptions about geographic and professional isolation of educational systems in Appalachian counties. The experiences of the counties we visited showed how personal contact with even just the Regional Program Coordinator could significantly reduce isolation. Without the Coordinator, many counties would not be significantly involved in the AMSP. As individuals, Regional Program Coordinators directly supplied resources—from knowledge about the process of reform, to specific professional development opportunities. More broadly, Regional Program Coordinators played the role of linking counties to a vast network of resources, including neighboring counties, institutions of higher education, the AMSP and the national reform community.

Secondly, the Regional Program Coordinators played the pivotal role of shepherding sustained local reform efforts. Without this role, most counties' AMSP involvement would be limited to sending teachers to content institutes. This habit of doing reform by sending teachers out to institutes runs deep in Appalachia, in part because districts often need outside expertise to help them make decisions about what steps to take. The Regional Program Coordinators held the larger vision for these counties and helped each of them take the specific and individualized steps necessary to move further along a pathway of change.

For the majority of the counties in the AMSP, the personal involvement of the Regional Program Coordinator in the work of their counties proved to be a highly successful strategy for connecting them with the AMSP. The Coordinators employed flexibility and persistence to help nearly all of their counties, with the few exceptions noted above, to take steps towards improving math and science teaching. In many cases, they also helped counties begin to develop the leadership capacity and professional connections to sustain the work begun with the AMSP after the grant is completed.

By Year 5, most of the RPCs were able to wean themselves away from the direct intervener role toward the broker role. Each RPC had one or two counties that continued to need this sort of direct support—6-8 districts, or roughly 15% of AMSP K-12 partners.

AMSP CLOSE-UP

II. Baseline Improvement Sites and the Program Improvement Review: Promoting School-wide Involvement in Math and Science Reform[7]

Overview

One of the major goals of the Appalachian Mathematics and Science Project (AMSP) was the school-wide reform of mathematics and science in schools in the AMSP region. Early in the project, the AMSP leaders recognized that if this goal was to be realized, it would be necessary to establish strong connections with individual schools in the region's participating school districts and to provide those schools with support and programs so that they would have the capacity to implement and sustain reform.

To initiate the improvement process in the partner school districts, AMSP asked the districts to designate one school each year as a Baseline Improvement Site (BIS). The AMSP then offered these selected schools access to the Program Improvement Review (PIR), a highly developed and proven tool for program assessment in mathematics and science.

We prepared this *AMSP Close-Up* paper on the Baseline Improvement Sites and the Program Improvement Review because we believe it is an important and educative example of how a very large initiative worked with many isolated, diverse, and often low capacity schools to achieve a seldom accomplished goal—the reform of mathematics and science education programs across all grade levels in these BIS schools. There also were multiple and largely unanticipated side benefits that accrued from this process. In the sections that follow, we will describe the development of this strategy and examine its impact on the teaching and learning of mathematics and science in the participating schools and also on the AMSP work in the region

[7] This "AMSP Close-up" is one of four papers that are intended to accompany a core report about the AMSP entitled "The Appalachian Math Science Partnership: A Multi-State Umbrella Partnership Promoting Local Mathematics And Science Reform." That report is the core document of a set of five and stands alone. The four papers identified as "AMSP Close-ups" are companions to the core document. Each of them focuses on an especially effective strategy or component of the AMSP umbrella partnership.

Background

At the inception of the Appalachian Math Science Partnership (AMSP), baseline data on student achievement from the region indicated that a low percentage of students were achieving proficiency on state assessments. In addition, baseline data from the lead institutions of higher education (IHEs) in the AMSP region established that very low numbers of Appalachian students were pursuing majors in mathematics and mathematics education. However, foundational data specific to the partnership schools around curriculum choices, classroom instruction and administrative leadership for mathematics and science improvement were not available. The AMSP project leaders recognized that reliable data on the needs of schools and school districts were critical to the effort to assist them in the work of reforming mathematics and science. Reliable information also was necessary to guide the work of the AMSP in developing a K-16 mathematics and science infrastructure to raise the level of science and mathematics literacy throughout the AMSP region.

The Baseline Improvement Sites and the Program Improvement Review

By asking each district to designate a school as a Baseline Improvement Site, the AMSP sought to ground the work of improving mathematics and science in the reality of the capacities and needs of the local school districts, and also to establish direct connections to the schools in the region. The AMSP leaders also envisioned these schools as important data sources about the status of mathematics and science learning in the region.

Although many of the BISs recognized the need to improve their mathematics and science programs, many lacked the capacity to accurately access their needs and to collect the data necessary to develop a reform process. To assist these BIS in this effort, the AMSP offered the Program Improvement Review (PIR) to the schools.

The Program Improvement Review was developed and tested in the early years of the Appalachian Rural Systemic Initiative (ARSI) in Kentucky. The PIR instrument allows schools to collect information on their mathematics or science program through classroom observation, interviews, analysis of curriculum, and review of assessment data. The process requires a trained PIR team of knowledgeable and skilled science or mathematics educators to spend a day at a school, observing classes, conducting interviews with the principal, teachers, students and parents, and examining student achievement data. For both the mathematics and science reviews, the data that are gathered on the site visit are organized around selected indicators of quality of mathematics and science instruction.

For example, the ten standards that are used in the mathematics PIR include:

Curriculum	A locally developed curriculum based on national and state standards is in place and used
Instruction	A constructivist approach is the basis of instruction
Equity and Diversity	The learning environment meets diverse learning needs
School Climate	Expectations are high and there is appropriate recognition for achievement
Usefulness	The instruction is related to real life applications and student interest and shows connections to other disciplines
Professional Environment	Teachers, staff and administrators are part of a professional learning collaboration
Community Organization and Leadership	Parents and community are engaged in the education of students The leadership of the school supports and promotes effective instruction
Assessment and Evaluation	Student achievement and program effectiveness are continually evaluated and the results are used to guide improvement
Resources	Adequate financial and material resources support the curriculum

After the site visit, the school receives a comprehensive report and recommendations for improving the opportunities for learning for students in the school. The report is confidential and delivered only to the principal of the participating school. The review and the report supplies the school with the data needed to plan an improvement process.

Impact of the BIS-PIR on the Reform Effort

Although a number of the Baseline Improvement Sites designated in the early years did not stay involved, most BISs remained connected to the AMSP and employed the PIR to guide their reform efforts. Dr. Steve Henderson, an AMSP PI, reported that by 2006, the AMSP had provided support to 65 Baseline Improvement Sites to conduct math PIRs, and to 38 Baseline Improvement sites to conduct science PIRs.[8]

As the Baseline Improvements Sites in the AMSP region increasingly made use of the PIRs to guide and direct their improvement plans, the impact of this strategy was felt not only at the school site, but also in the connections between the AMSP and its partnership school districts, in the spread of the AMSP vision and understanding of the meaning of reform, and in the services and supports the AMSP provided to these districts. In this section,

[8] Personal correspondence, Dr. Steve Henderson, April 2007.

we discuss key findings related to the role of the PIR in the reform effort and also in providing the AMSP with a means of connecting with the partnership schools.

Establishing relationships with local schools

One of the challenges for the AMSP in promoting reform was how to establish connections with the BIS. The responsibility for connecting to the Site fell to the Regional Program Coordinators.[9] The PIR gave the Regional Program Coordinators an entrée into the local schools and districts. The Regional Program Coordinators played a major role in encouraging the Baseline Improvement Sites to engage in the Program Improvement Review process as a first step in improving mathematics and science instruction. As one Regional Program Coordinator noted,

> *The PIR was a motivator for schools that wanted to do something, but did not know what to do. It gives them a more specific view of what it means to reform a school's math or science.*

After a school received its PIR report and recommendations, the Regional Program Coordinators were then able to offer their services to help schools implement the PIR recommendations. They assisted school faculty in reviewing the PIR report and prioritizing PIR recommendations.

The PIR emphasized overall program review and did not single out individual classrooms or teachers; this aspect of the review allowed teachers to feel more comfortable with the process. A Regional Program Coordinator talked about the structure of the PIR, which increased the willingness of teachers to embrace it:

> *The PIR keeps a focus on the positive. Generally teachers are receptive. Partly this is the approach. When the review team meets with the school people for the first time, they emphasize that this is an overall program review, not an assessment of individual teachers. All pieces of data for the entire program are examined and form the basis for the recommendations.*

Focusing the work of the AMSP with partnership schools

Analysis of the recommendations from the PIRs for these Baseline Improvement Sites provided the AMSP with a region-wide needs assessment document to guide the AMSP allocation of resources and tailoring of supports for the schools in the AMSP region. By collecting data from the BIS schools, the AMSP was able to identify

[9] See the *AMSP Close-Up* on the role of the Regional Coordinators. The case of Clay County, especially, illustrates how the Regional Coordinator used PIR results to develop priorities for reform.

the eight highest priority recommendations for mathematics across 27 sites:

- Intentionally incorporating NCTM process standards
- Improving questioning
- Increasing the use of manipulatives to learn math concepts, solve problems and verify reasoning and solutions
- Increasing the use of technology for research, data analysis and problem solving
- Differentiated instruction
- Improving student assessment
- Increasing the problem solving focus of instruction
- Incorporating more opportunities for students to communicate in mathematics

Similarly, the PIR process in 12 schools generated a list of priority findings in science, including the following:

- Assistance for schools/districts in developing goals for science programs, and strategies to address the goals
- Guidance for administrators in evaluating the teaching of science
- Safety training and information for teaching inquiry science
- Technology to advance data collection, analysis and student learning
- Making learning how to learn a priority in every science class
- Need for teachers to participate in ongoing professional development including membership in state and national organizations
- Strong classroom assessment strategies to ensure learning

This compilation of recommendations across the Baseline Improvement Sites provided the AMSP with important insights into the needs of the partnership schools and gave direction to AMSP's work with these schools.

Broadening the understanding of reform

> *The power of the PIR is that it has as its focus an entire school, or an entire discipline in a school, rather than just one classroom. Change occurs over a broader spectrum of the school.*

Rarely does a school attempt whole-school reform in a discipline. Particularly in small isolated schools, reform has tended to be viewed in terms of change within a classroom—modifying instruction, using different content and getting a new textbook. For the schools in the AMSP region,

participating in the Program Improvement Review helped entire schools take a more comprehensive view of reforming their program. The PIR broadened the scope of the reform effort and made reform a collective responsibility in a school.

A Regional Program Coordinator explained it this way:

> *Teachers are often bound by the four walls of the classroom, thinking you own the problem. You may think you know what is causing the problem but you have your own assumptions—"this is the cause of the problem"—but that is not necessarily so. The data tells you what the problem really is… It helps teachers find ways to improve, and gives the outside look. The PIR gives a big overall view of the school's program, and the teachers can find pieces they can identify with.*

Building capacity for reform

Although some schools in the AMSP have the leadership capacity and the experience and expertise to implement the PIR recommendations, many do not. In addition to providing the PIR service to school, the AMSP also has made small grants of $1,500-$2,000 available to the BIS to develop leadership teams to implement the recommendations of the PIR. The Regional Program Coordinators helped schools access these funds and create Leadership Teams within the schools. These Leadership Teams then assumed the responsibility for building the school improvement plan and overseeing its implementation.

For many schools, the impact of the PIR was greater than simply the implementation of the recommendations at the BIS. Schools were able to cite the PIR findings to focus and support their request for other AMSP services, including professional development and Partnership Enhancement Program (PEP) grants.[10] In many districts, PEP grants directly addressed the findings of their PIR.

One Regional Program Coordinator commented on the reform trajectory of the schools that began with the PIR:

> *One of the things that has occurred is that schools that have started with the PIR are moving along to take advantage of other AMSP offerings. They have involved themselves with many other AMSP programs—the Partnership Enhancement Program (PEP) grants to support improvement, teacher institutes, strategies for involving parents and opportunities for kids.*

[10] See the *AMSP Close-Up* describing the Partnership Enhancement Program (PEP) as an effective reform strategy.

The PIR also provided a sound database for schools in pursuing resources outside the AMSP. It gave schools leverage to ask for things even in their own districts. They could cite the evidence from the PIR to support their requests. And schools were also able to use the data from the PIR to develop a statement of need in grant proposals to state and federal agencies.

Finally, a Regional Program Coordinator noted the impact of the AMSP strategies on teacher quality and instruction:

> *The focus has been on using Student Achievement data to answer the question of the impact of the AMSP strategies. But there is another piece that is so important—the number of teachers in the BIS who have taken the summer institutes and the way teachers have incorporated the learning from these institutes into their own teaching.*

The Multiple and Lasting Contributions of the BIS-PIR Strategy

The BIS-PIR strategy was originally envisioned simply as a way to connect with schools and to collect baseline data about the status of mathematics and science education. As it was implemented in the schools, however, it evolved into a process that created multiple benefits at the school sites and also in the AMSP structure.

As the teachers in schools worked with trained AMSP leaders to gather and analyze information about the status of their mathematics and science programs, they were able to broaden their understanding of reform and how to implement it. Their increased understanding of reform as a systemic effort and collective responsibility helped them create the internal capacity to build and implement school improvement plans. The process also promoted the development of leadership at the school level that could tap into both internal and external resources to support the effort. Clearly, the ideal of the PIR outcome was the reform of mathematics or science programs—not just in a single classroom or a department, but rather school-wide, in all the classrooms within in school where math or science was taught. This clearly happened in a number of cases, however it was not the norm in AMSP.

The AMSP, in turn, acquired critical knowledge about the nature of mathematics and science education in the region and the needs that were common among the schools across the region. Using this knowledge, the AMSP was able to build its own capacity as an agent of change and to modify its structure to facilitate reform at that level. It was able to refocus its efforts and direct its resources and investments to support these schools. In short, the BIS-PIR strategy allowed a large and complex entity operating over a vast

area to connect deep within individual schools to build an understanding of the nature of reform and how to support it in rural and isolated schools.

Finally, as the BIS-PIR strategy was implemented in schools across the region, the AMSP project leaders continued to test, revise and proof the PIR process. Over the course of the project, a PIR was modified and tailored for mathematics and likewise one was created specifically for science. The PIR evolved from its humble beginning in Kentucky as a simple tool used between schools, to a pair of widely used and carefully refined instruments suitable for widespread dissemination. Both instruments have now been made available for distribution on a national basis. The math PIR is available in a nationally distributed 2006 publication of the Association for Supervision and Curriculum Development, *The Mathematics Program Review*, authored by Dr. Ron Pelfry. In early 2007 the National Science Teachers Association began conducting SPIR visits and generating reports for schools who pay with a fee-for-service arrangement. While now licensed to NSTA, the process was originally authored by Dr. Steve Henderson and Karen Kidwell, both active in the state science education community in Kentucky.

AMSP CLOSE-UP

III. The Partnership Enhancement Program: A Strategy for Supporting Locally Designed Partnerships[11]

Overview

The Partnership Enhancement Program **(**PEP) is a small-grant program designed to address the locally identified needs of the K-12 partner districts, within the framework of the larger AMSP benchmarks and goals. The PEP was developed in the second year of the AMSP as a strategy for addressing challenges inherent to fostering local work that is meaningful within a very large umbrella involving dozens of institutions. Part of the challenge was to create a structure that would help to build local connections and tailor AMSP-supported work to a wide variety of institutions and contexts. A second part of the challenge was to create a fiscal mechanism that would allow K-12 partners equitable access to grant funds.[12] Assumptions related to the PEP strategy are that local school districts are best positioned to identify their own needs for improving math and science, that access to funds motivates local participation, and that reform work is more meaningful and likely to be sustained if it is designed locally. The PEP turned out to be a very powerful strategy for providing the necessary link between local districts and institutes of higher education, and thus helping to make the AMSP theory a reality.

This paper explains how and why the PEP strategy evolved as it did, describes the local math and science improvement work it fostered, and explores the multiple benefits of the strategy.

[11] This "AMSP Close-up" is one of four papers that are intended to accompany a core report about the AMSP entitled "The Appalachian Math Science Partnership: A Multi-State Umbrella Partnership Promoting Local Mathematics And Science Reform." That report is the core document of a set of five and stands alone. The four papers identified as "AMSP Close-ups" are companions to the core document. Each of them focuses on an especially effective strategy or component of the AMSP umbrella partnership.

[12] The PEP was developed in Year 2, in part in response to concerns among the K-12 partners that the initiative was focused primarily on Institutions of Higher Education; in particular they were concerned that funds were not reaching into the local districts.

The Intention and Initial Design of the PEP

Partnerships that address AMSP goals

The PEP required the development of partnerships among school districts. This was intended to involve more teachers, utilize existing knowledge, and leverage resources, and thus to help broaden the impact of the PEP. Partnering with an IHE was recommended but not required in the first year, and became built into the strategy after that. Linking the districts with an IHE was intended to improve schools' access to resources in the content areas and to forge relationships for future K-16 work. The proposed work needed to align with AMSP objectives, such as increasing the number of students taking additional mathematics and science courses beyond the minimum requirement, reforming math and science curricula to include a more hands-on inquiry-based approach, and increasing student achievement in math and science, as well as reducing the achievement gap.[13]

Significant funding level

The award amounts were $20,000 to $30,000, an amount designed to be "locally significant." A University of Kentucky Outreach Professor commented on the size of the grants:

> *When you tell a teacher that there is $30K available to you to change the way you address a specific problem at your school, that is a huge amount of money. That amount doesn't mean much to IHEs… but to a high school teacher, that is a good thing. Now, when you take the next step and require them to partner with IHE… [you are] now sending a clear message to the school district and the IHE. I think the PEPs have been our best investment.*

Rigorous and systematic development process

An external review committee assessed PEP proposals against explicit criteria, including their potential to help achieve AMSP goals, evidence of a mutually beneficial partnership, the presence of local capacity to carry out the work, an appropriate evaluation plan, and a reasonable budget. In making awards, the AMSP Management Team took into account the external reviewers' recommendations and the potential impact of the proposed idea in relation to AMSP goals; they also sought to ensure that funds would be distributed to institutions that had a history of being under-served by reform efforts.

Part of the initial design was that the process of developing a proposal would be rigorous with very specific requirements. Although people complained, this rigor turned out to have unexpected benefits. Applying for a PEP

[13] See the summary report: "The AMSP: A Multi-State Umbrella Partnership Promoting Local Mathematics And Science Reform" for more detail on AMSP-wide objectives.

provided its own kind of professional development to the grant writer. This was true not only for the writing of the proposal, but also for the implementation of the activities planned for in the PEP. The level of detail of the plan and the record-keeping required gave districts a model to use for professional development activities that they might want to offer in the future. The PEP proposal writer in Powell County, for example, reported to us that because of what she learned, they can now replicate the model for providing future professional development in the district. Although she complained at the time, she found the process was "invaluable" in hindsight.

Supports for context-specific work

The types of activities funded typically fell into two broad categories: 1) providing professional development to teachers, and 2) and reforming mathematics and science curricula. Bringing high-quality professional development to teachers locally was one of the most commonly requested PEPs. Teachers are often unable to travel the large distances required to attend professional development outside of their rural communities. Being able to fund local professional development that focused on a more hands-on, inquiry-based approach gave the AMSP more potential to enhance the content knowledge of teachers in more regions, to support implementation of locally adopted instructional materials while also addressing broad AMSP goals, and to position local districts more strongly to win future grant funding.

Snapshots

Estill County, Kentucky

The PEP grants created opportunities for districts to make improvements that may otherwise not have happened; this was the case in Estill County. Here, an initial PEP grant helped to improve Pre-K-8 math teachers' knowledge of both content and pedagogy. Subsequently, Estill received a Round 3 PEP grant to train teachers in implementing a new standards-based mathematics curriculum in the elementary schools. Estill County then followed up with a Round 4 PEP, to begin a similar course of action to improve mathematics in the middle schools. According to the Instructional Specialist:

> *We wouldn't have been able to change to Investigations without the PEP. We wouldn't be able to offer the high level training for mathematics.*

Rowan County, Kentucky

In Rowan County, Kentucky, the PEP-supported activities focused on developing units around redox chemistry reactions that could be used in physics, earth or life science. Redox reactions, which hadn't previously been taught in the high school, were added to the core content standards. The district felt the teachers would need content training and assistance with developing teaching materials in order to meet the new requirement. Rowan County science leaders had previously worked in collaboration with a professor from Eastern Kentucky University on two summer institute courses for high school chemistry teachers, and when the PEPs were announced, they decided to apply for one in order to develop activities using guided inquiry to use in the science curriculum.

The role of the Regional Coordinator

Partnerships were formed by identifying similar needs in one or more districts, and matching the needs with an appropriate IHE faculty member and/or institution. The AMSP helped facilitate the partnerships with the help of the Regional Program Coordinators, who played an integral role in identifying partners with similar needs. They were able to look across the AMSP region in its entirety and identify the needs of the counties as a whole. This allowed the Regional Coordinators to broker relationships among counties with similar needs, and then to partner them with IHE faculty members who would be well suited to help them meet their goals. In this role they utilized the existing capacity within local areas, and built upon it. One PEP coordinator explained the vital role of the Regional Coordinators:

> *The Regional Coordinators are key to the success of the PEPs. You need somebody the districts can trust. If it hadn't been for the Regional Coordinators some of these PEPs would never have occurred. [The Regional Coordinators] are understanding of*

the schools' needs and never condescending. They also know that you need somebody who knows the district personnel.

These carefully nurtured relationships ensured that the PEP grant strategy—and thus the vision of the AMSP—could come to fruition.

Snapshot

Carter County, Kentucky

Carter County is a rural county about forty minutes from MSU. It has six elementary, two middle, and two high schools that are separated into east and west sides of the county. Before the creation of the Regional Coordinator position at MSU, Carter County had limited participation in the AMSP. Their Regional Coordinator has worked with the leadership of Carter County to develop their grant-writing skills and to connect them with a larger network. This support has allowed Carter County to make significant progress in math and science reform. During our site visit to the county in Spring of 2006, the district leadership described how the Regional Coordinator and the AMSP leadership worked with the county to help them write their first PEP grants:

> *Without the AMSP we wouldn't have the opportunities we have. We are very rural and are cut off—we don't have a tax base or grant writers. AMSP helps to even the playing field. They go beyond the competitive grant and try to understand what non-grant writers are trying to say.*

The county has now successfully implemented three PEPs focused on middle and high school teaching, two in math and one in science. Before the AMSP there was no sharing or collaboration between the east and the west halves of the county. The two math PEPs fostered connections between middle and high school math teachers from both sides of the county, and those teachers are now working together on math reform.

Carter County has two people with AMSP Leadership Intern experience, one currently in the position, and the other from the previous year. These interns both work on the east side of the county, and are in the process of implementing the PEP focused on middle and high school science. They had hoped to partner with science teachers from the west side of the county; however, although partnerships have been formed successfully between east and west side math teachers, this has not happened yet for science. The Regional Coordinator also works with an instructional supervisor in nearby Montgomery County and knew that they were interested in looking at their middle and high school science teaching. She suggested a partnership between the counties, given their similar interests and Carter County's greater experience with writing and implementing PEP grants. The PEP grant was funded and a cadre of middle and high school teachers from these two counties have been working together to enrich their science curricula. Carter County is currently writing another PEP grant proposal for science.

The role and participation of IHEs

Both AMSP Outreach Professors are from the University of Kentucky. They are tenured, full professors, one with a background in mathematics and the other in science. The role of an Outreach Professor is to serve as the liaison between higher education faculty, school partners and the Regional Program Coordinators. These individuals were highly involved as the IHE partner for several PEPs, and they assisted with developing partnerships between other participating IHE faculty and K-12 teachers. One Outreach Professor commented on their quite nuanced role:

> *The PEP grants are fascinating because what we are trying to do is to grow the leadership in the districts and yet have the IHE partner play a role in it so that it is not a watchdog role or leadership role, but someone who has to make sure things are moving forward in a timely manner. The advantage is that there was a real reward in the end… if they did things well, they got money for the district—and did things they wanted to do!*

In addition to helping to bring AMSP resources to the local level, IHE participation in the PEPs also helped to surface important issues facing K-12 districts. One professor spoke about the benefit of this two-way interaction:

> *PEPs have been helpful in that they have introduced higher education faculty to fundamental issues of school districts… I think the higher ed faculty have gotten a better understanding of the complexity of how to solve those problems at a grassroots level, because they have spent more time, [and are] more closely aligned with a particular school district.*

Evolving Features of the PEP

Despite its enormous size and vast reach, the AMSP found ways to respond quickly to the emerging needs in the partnering districts. Nothing about the Partnership Enhancement Program was ever set in stone, and this allowed the leadership to adapt swiftly to feedback from partnering district personnel and IHE faculty. The project used evaluation data and PEP reports as part of this feedback to continually respond to the needs of its partners. The AMSP realized during the first year of the PEP program that they needed to build assistance and flexibility to better serve local contexts and build local capacity, and they addressed this by providing a number of valuable supports.

Technical and grant writing assistance

In an effort to get participation from all of the partnering districts, and recognizing that many districts lacked experienced grant writers, grant writing workshops were offered at regional AMSP meetings called Regional Fall Academies. Through this professional development for local mathematics

and science leadership, the AMSP built capacity within the region that would enhance sustainability.

Planning grants

Not surprisingly, because of the PEP's rigorous requirements, districts with less leadership capacity needed extra support to take on the challenging task of developing and writing a PEP. The AMSP responded to the lack of participation among the more rural and remote districts by offering development grants in amounts of under $5,000. They helped local districts with little or no AMSP involvement to bring together district staff and IHE faculty to plan a PEP that met the specific needs for improving math and science teaching and learning in their counties.

Continuing grants

By design, PEPs are highly focused and of limited duration, one year or less. Initially, there was no mechanism in place for districts and their partners who had successfully completed a PEP to receive additional funding from the AMSP to continue the improvement efforts they had started. The AMSP responded to feedback from districts that wanted to continue to expand their work by creating continuation grants. In Round 2, supplemental support was made available for up to $20,000.

District Needs Assessments

Despite the belief that local districts could best identify their own needs, AMSP leaders soon realized they needed a tool that would yield more systematic understanding of what schools needed most from the AMSP so they could make more targeted micro-investments. They developed a District Needs Assessment, and the PEP Coordinator and others gathered data through field visits with school cluster groups and an online survey available to districts. These data produced a list of the top-5 needs identified by local school districts:

1) *Reduction of academic gaps and subgroups (differentiation issues)*
2) *Implementation of instructional strategies/standards-based practices*
3) *Alignment of curriculum to the standards*
4) *Increase teacher content knowledge of mathematics and science*
5) *Increase teacher knowledge of formative and summative assessment*

AMSP leaders used these to create a "targeted needs" approach for the Round 4 PEPs. For this round, districts had to identify specifically which targeted needs their specific work would address. As a secondary benefit, the District Needs Assessment process also helped the PEP Coordinator, Regional Coordinators and district personnel identify districts with similar needs that could form partnerships and work together on a PEP.

Creation of PEP Coordinator position

Initially, the Regional Program Coordinators were primarily responsible for assisting with the PEPs within their regions, but they were stretched thin by the large distances between the counties and the large numbers of schools within them. While the Regional Coordinators could keep abreast of what was happening in their own regions, it was necessary to create the position of the PEP Coordinator to improve communication and provide increased support across all the AMSP counties.

The PEP Coordinator was given responsibility for overseeing the PEP awards and distributing the funds. The PEP Coordinator also assisted with practical matters concerning PEP development. For example, in Martin County, the activities they were proposing in their PEP were too broad, so the PEP Coordinator helped them narrow their objective and focus their efforts on middle school mathematics where the need was greatest. In other counties, the PEP Coordinator helped district leaders form more realistic expectations of how much they could accomplish with the amount of funding awarded, or helped districts with tools for evaluating the work of the PEPs. The position was thus a welcome addition for the Regional Coordinators, as well as for district personnel, who now had both a Regional Coordinator and the PEP Coordinator to support the designing, writing, planning, implementing and evaluation of their PEP activities.

The Scope and Scale of the PEP Program

A total of four rounds of grants were awarded annually. Each round was funded in the spring and ran for a period of one year. Nine grants were awarded in Round 1, ten in Round 2, and 21 awards were made in Round 3. Round 4 had 18 awards granted in the amount of $15,000 each, with the lead partnering institution contributing a minimum of $7,500 in matching funds. Development grants were not funded in Round 4, although technical assistance was given to six counties where PEPs were not initially funded. As of Spring 2006, PEPs from three of these counties had been re-written and turned in for further consideration. Plans are in place to fund a fifth round during the AMSP's no-cost extension year.

Type of PEP	Round 1	Round 2	Round 3	Round 4	Total
Enhancement (up to $30,000)	9	10	13	9	41
Continuation/Supplemental Support/ Enhancement (up to $20,000)	N/A	N/A	4	9	13
Development/Planning	N/A	N/A	4	N/A	4
TOTAL	**9**	**10**	**21**	**18**	**58**

The Benefits of the PEP Program

The PEP grants turned out to be a major vehicle for implementing the AMSP's partnership vision. The strategy of facilitating local design of reform work and then funding that work produced a number of immediate and long-term benefits.

New relationships

The PEPs required collaboration that yielded short-term partnerships leading to long-term relationships. For example, the PEPs "seeded" **relationships within the counties** that make up the AMSP and enabled them to grow. These relationships have become critical connectors to sustain locally generated work. Further, the PEPs enabled development of **relationships between IHEs and K-12** that didn't previously exist. This has obvious benefits for the districts, but it also benefits the IHEs. One university dean said this about the role of the PEP in broadening university participation and making it sustainable:

> *I think the best thing about the PEP for us is it gave us the opportunity to get some different people involved from our institution in the AMSP. In almost every case, our involvement brought more people into the mix—more faculty. It widened the circle with involvement in outreach. It is also the one component of the AMSP that brought students to campus to take advantage of the labs and the observatory. In all of the other components of the AMSP, we had faculty and administrators, but the PEPs allowed us to get students here and get them involved in hands-on activities that weren't available to them in their school system. As a result we are continuing that process without the money. One of the PEPs we had early on with Lewis County high school and MSU seems to be maintaining some momentum even after they no longer have their PEP funding.*

Another faculty member spoke about the benefits of breaking down traditional barriers between K-12 and IHE:

> *There is a certain amount of respect out there, and it is in both directions. By being involved in these partnerships, we are sharing our expertise and we are learning from other people in public schools, breaking down those walls that keep people from working together.*

Resources for real change

The PEPs allowed the AMSP to build local capacity to change while at the same time strengthening the AMSP's overall capacity to support change on a region-wide scale.

The PEPs have provided **districts with the money, support and guidance to make improvements** in the teaching and learning of mathematics and science at the local level. The PEPs were a catalyst for **prompting changes in pedagogy towards more inquiry based, hands-on teaching**, as well as a vehicle for **professional development in the use of standards-based curricular materials**. The PEP activities provided opportunities for districts to carefully examine and **align the science and mathematics courses** offered in the district.

Greater human capital

The PEP program **strengthened the knowledge and skills of district and IHE leaders** by demanding and supporting an evidence-based, standards-based, outcome-oriented planning and implementation process for local reform. This enhanced leadership capacity is a legacy of the project.

Prospects for ongoing improvement work

These benefits of the PEP program, combined, enhance **the sustainability of AMSP work**. One Outreach Professor put it this way:

> *As resources dwindle and go away, it won't be at the same level as in the past but it won't disappear. We now have established strong partnerships with those school districts, so when additional grant opportunities are available, we will continue to involve those districts when possible.*

Challenges and Lessons Learned

The PEPs continually evolved and shape-shifted in an attempt by the AMSP to better meet the needs of all participating districts, no matter how underserved. Nonetheless, it was always a struggle to reach the most remote counties due to the sheer size and vastness of the region. In many counties the person responsible for math and science improvement played a variety of roles for their district and had limited capacity for writing a rigorous PEP proposal. The large geographic area also made it difficult for some counties to partner with other districts effectively, for example, to create meaningful peer partners for professional development follow-up and for any kind of

scheduling. Also, as in any education system, teachers are busy with many responsibilities and it can be difficult to entice them to attend voluntary professional development, even if there is a stipend.

It is important to note that AMSP recognized the tension between ensuring equitable access to PEP funds, and investing in proposals (typically only a handful of places) that had high likelihood of success because of local capacity. And for the most part, the project was quite proactive in addressing this challenge. Still, the tension remained. Two other challenges specific to the PEPs are worth mentioning. The first was effectively using the PEPs as a link to utilize other resources/services available through the AMSP. The other was to gather adequate and appropriate evaluation data to document the outcomes of the PEPs. In Years 5 and 6, the PEP Coordinator instituted a "common core" set of evaluation instruments for PEPs to build local evaluation capacity, while at the same time providing better data back to AMSP.

The key lessons learned from the PEP strategy are several:

- the need for a large "umbrella" partnership to be continually responsive to the counties being served
- to deliberately engineer connections so that large institutional partnerships can be of relevance and benefit to local contexts
- to let local districts identify their own needs and create their own plan for addressing them
- to draw from and to form personal relationships in making the work happen.

Snapshot

Letcher County, Kentucky

According to a district Math and Science Specialist for Letcher County Schools, what "started as a seed has grown into a garden." This Specialist began his work with the AMSP as a Leadership Intern, and in that role he assisted in the development of the geometry course for the first AMSP Summer Institute. A math professor at UVA-Wise was also part of the course development team. They formed a strong professional relationship during their work together and since that time, Letcher County has partnered with UVA-Wise, as well as other school districts on a Round 2 PEP, as well as a Round 3 continuation grant. The focus of their work has been improving elementary and middle school mathematics. The county Math and Science Specialist explains how the district and county have worked together to improve classroom instruction in a meaningful way:

> *We've been allowed to work where we have common beliefs about content and pedagogy. If we were going to have teachers just take a class, we wouldn't need the AMSP… with AMSP we've taught them pedagogy <u>and</u> what the content is all about, and we've taken that into the classroom as well.*

IV. AMSP CLOSE-UP

Motivating Change in Institutions of Higher Education Through Collaboration with K-12 Partners[14]

Overview

The Appalachian Math Science Partnership (AMSP) was funded by the National Science Foundation (NSF) through its Math Science Partnership (MSP) grants. The MSP grants have as a basic premise that partnerships between institutions of higher education (IHEs), IHE faculty, K-12 school districts and K-12 teachers can greatly enhance the improvement of mathematics and science education, not only at the K-12 level, but also at the level of higher education.

The challenges of creating effective partnerships between IHEs and school districts are many. Often, it has been difficult to find appropriate roles for IHE faculty to play in working with schools and *vice versa*, and there is little structural overlap between IHEs and schools as institutions. Also, historically, the relationship between IHEs and K-12 school districts has been one of client/provider: the IHEs involvement with local schools and districts has been built around the IHEs coming in as the experts, trying to improve the school districts. Collaborative work that might, in turn, influence IHEs has been rare.

These problems are compounded further within Appalachia, and consequently, in the AMSP project. Among many potential IHEs, the AMSP involved nine IHEs and 51 school districts spread out across a large region encompassing three states. The geography of the region makes collaborations extremely difficult because driving times and distances between local schools and IHEs are great. In addition, in Appalachia, traditional roles and responsibilities are not often challenged; for example, it would be unusual for a local schoolteacher and an IHE faculty member to consider themselves as peers or collaborators. Thus the challenge of how to build effective relationships and collaborations between IHEs and school districts was considerable for the AMSP.

[14] This "AMSP Close-up" is one of four papers that are intended to accompany a core report about the AMSP entitled "The Appalachian Math Science Partnership: A Multi-State Umbrella Partnership Promoting Local Mathematics And Science Reform." That report is the core document of a set of five and stands alone. The four papers identified as "AMSP Close-ups" are companions to the core document. Each of them focuses on an especially effective strategy or component of the AMSP umbrella partnership.

The AMSP's Theory of Action with Regard to the IHEs

The MSP initiative set a challenge of creating meaningful partnerships between IHEs and districts, and the AMSP had to respond to that challenge. First of all, the AMSP had to create multiple strands of work and different roles for teachers and individual IHE faculty members within the project that would lead to their professional growth. These roles included the development of preservice courses that would also serve as the core of the summer institutes for inservice teachers, which would be co-facilitated by IHE faculty and teachers, and—later in the project—the Partnership Enhancement Program (PEP) grants, which involved IHEs and districts working in partnership on the specific local needs of the school districts.

In addition to the development of new and different roles for teachers and faculty, another part of the theory involved building broader learning communities—those that involved faculty from various IHEs throughout the region, and also those that involved IHE faculty and local teachers in collaborative work. As faculty and teachers worked together to develop courses and summer institutes, influence could flow from faculty to teachers and *vice versa*, and from one IHE to another.

The theory was that out of this work, individual IHE faculty members would learn more about inquiry-based teaching and learning in science and mathematics, and out of that learning, these faculty members would change their teaching practices. Thus, the AMSP approach was one of focusing on changing one faculty member at a time, trying to build some examples and internal advocates for inquiry-based teaching and learning. The hope for broader change was that these individual changes would percolate up through the departments.

The Strategies

How did the AMSP project make a fundamental shift in the relationships between IHE faculty and districts—away from IHE faculty as expert providers, toward their being co-learners, along with K-12 teachers, about teaching and learning? In turn, to what extent did these faculty members' individual and professional growth lead to broader influences within the participating IHEs?

Collaborations between IHE faculty and K-12 teachers

The collaborative development of preservice courses was the first and main vehicle for effecting change among faculty and IHE programs. The AMSP project created course development teams comprising faculty from the participating IHEs, as well as teachers representing participating school districts in AMSP. In addition, the project set up teams of IHE faculty and

K-12 teachers to collaboratively facilitate the summer institutes for inservice teachers. The development of the courses and the co-facilitation of the summer institutes were the vehicles to introduce IHE faculty to the notion of state and national standards. This led to discussions of what constitutes high-quality instruction according to those standards, and how that is reflected in lesson and unit design, curriculum planning, and materials.

The project set up the course development teams from a fundamental belief that everyone had something to contribute and everyone had something to benefit from their participation. The project invited K-12 teachers into situations with college faculty where historically they would not have been invited. In this case, the project created a structure whereby the higher education faculty and K-12 teachers were on equal footing, with no individual or position owning all the knowledge and expertise. In many cases, the K-12 teachers had more expertise in terms of particular pedagogy and their knowledge of the standards. The IHE faculty tended to have more expertise in particular content. Similarly, with the summer institute, the design was for the IHE faculty to provide the content expertise, while the K-12 teachers provided pedagogical and practical knowledge. The hope was that by involving both in the facilitation of the summer institutes, some of the traditional hierarchy would break down.

One IHE faculty member who participated in course design work through the AMSP project said,

> *These courses were designed and developed in true partnerships across IHEs and with the deep involvement of K-12 school districts and teachers. Higher education faculty sometimes are 'pie in the sky.' The K-12 teachers gave us a good reality check.*

As one local Principal Investigator (PI)[15] said about the collaborations between IHE faculty and K-12 teachers in designing courses:

> *Even if our faculty thought they had the expertise and they were going to go out and impart it, they would get a rude awakening.*

It is important to note that in designing and developing courses, the project did not start from scratch, but rather, began their work with some existing models and high-quality resources. Lillian McDermott and her colleagues at the University of Washington originally created Physics by Inquiry; two faculty members at UK then used those materials to develop an original Physics for Elementary Teachers course at UK as part of the NSF-funded State Systemic Initiative. These precursors were helpful in providing both a

[15] At each of the participating IHEs, the project involved a local Principal Investigator who served as the point person for the project; this person was in the upper administration of the IHE, and helped to facilitate release time for participating faculty, and to leverage the work of the grant.

starting point as well as a model for the courses. Similarly, on the mathematics side, course development teams drew from existing curricular modules, such as *Connected Math* and *Investigations in Data, Number and Space*.

Collaborations across IHEs

Personal relationships play a key role in Appalachia, and the AMSP project used this fact in its efforts to influence IHEs. The AMSP project began by building on existing relationships amongst math and science educators dating from previous improvement efforts in the region, including several NSF-funded projects. These personal relationships allowed the AMSP to have a starting place at the IHEs.

Traditionally, the responsibility for college courses rests with individual faculty, who generally "own" the curriculum they teach. If AMSP had tried to set up a structure whereby administrators told faculty what they were going to teach and how they were going to teach, it would have failed. In addition, just as collaborations between IHE faculty and K-12 teachers have been historically rare, so have opportunities for IHE faculty to collaborate with one another on the design and development of college courses. However, by creating collaborative teams that enabled IHE faculty to learn from one another, AMSP set the stage for faculty to come to change on their own terms, with the support of their peers.

Multiple avenues and levels of participation

The AMSP also started out with an invitation to many IHE faculties to participate, and it naturally turned out that there were various levels of participation. For those who were highly interested, AMSP provided opportunities for rich and deep involvement in the project, from the design of multiple courses, to the facilitation of summer institutes, to taking on leadership roles in PEP grants working with districts. AMSP gave these faculty members a lot of power and resources, and in return, AMSP gained some real champions for the work of the project. Other IHE faculty were involved at different levels—from participating in the design of one course, to working more intensively with students through the project's EXCEL and EXPLORER programs, to learning about the work of the project through attending meetings and seminars. Thus, as the project evolved and developed, it provided multiple strands of work for IHE faculty and allowed for different levels of participation.

The Results

Ultimately, the project's theory that started with personal change at the level of individual faculty—and that used that to set examples and to begin to drive institutional change—played out well at most of the institutions. Many individual faculty members gained significantly from their participation in

AMSP: new courses were added and existing courses revised, and relationships within and across IHEs were strengthened.

Contributions to individual faculty learning and changes in practice

IHE faculty benefited from their participation in AMSP in many ways, from a better understanding of the standards and inquiry-based teaching and learning, to gaining materials to use in their classrooms, to a better understanding of K-16 science and math education. Our interviews with faculty members and local PIs indicate that participating in AMSP contributed to improvements in participating IHE faculty's teaching. This aspect of the project played out for many faculty members just as the project had hoped it would: teachers helped faculty gain a better understanding of the standards and how to teach in a more student-centered way.

There has been some ripple effect as well; with faculty members beginning to incorporate teaching methodologies they learned from their participation in AMSP—especially more student-centered, inquiry-based classroom practices—into other courses they teach. In particular, lab courses at several of the IHEs have been revised.

> *With our involvement with AMSP, and the desire to improve the teacher education programs, I completely re-tooled our entire non-majors physics course to be taught in the inquiry-type fashion, using inquiry materials for both non-science majors and preservice elementary and middle school teachers. This is an inquiry course designed around the standards. I continue to teach that and modify it as needed.*
>
> *—IHE faculty member*

Faculty Vignette

Martin Brock—Discovering Less is More

Martin Brock is a chemistry professor at Eastern Kentucky University. A long-time professor in the traditional vein, he found his views on teaching and learning shifted through his participation in AMSP. One of the first hard lessons for Martin was giving up some of the content. "I realized that students learn more by learning less; that is, they learn better and [they learn] how to approach and solve problems." His chemistry course has moved from a traditional lecture course to a more interactive kind of environment for students. "I would say the overall content, the thematic kinds of things, are still the same, but the way we go about teaching it is 100-percent different. The lectures are out the door. I might lecture two or three times a semester now; the rest of the time, the students are doing inquiry activities in groups, using technology." He is also in the process of changing all of his non-major undergraduate labs to be more inquiry-based, something that will reach hundreds of students. He also became highly involved in working with teachers from local school districts, both through the summer institutes and the PEP grants. "I have developed relationships with teachers all over the place in eastern Kentucky. They have had me come to their schools repeatedly for lots of different things."

Beyond their personal growth and the changes to their teaching, some participating IHE faculty gained a new passion and mission in outreach to K-12 teachers. This played out in different ways at the various IHEs, largely depending on the IHEs' institutional commitment to K-12 outreach. However, mid-way through the project, AMSP provided a much-needed vehicle for professors and K-12 teachers to continue their interactions through the PEP grants, and a number of IHE faculty members have chosen to get involved with schools.

Faculty Vignettes

Carol Wymer—Implementing Inquiry

Carol Wymer is a biology professor at Morehead State University who was involved in developing courses and facilitating summer institutes in the AMSP project. Due to her participation in AMSP, she has, in the words of her dean, "moved away from a pure research situation to one that is more education-oriented." In addition to her interest in working more with K-12 teachers, she has made changes in her courses that reflect the kind of teaching and learning espoused by the AMSP. She teaches a plant science class that is a general education course for non-majors. She revised the course significantly following her involvement with AMSP. She said, "I decided to put as much inquiry in there as I can. I am asking more of my students and they responded better to the class. It's the first time for me to teach inquiry-based science full bore."

Jennifer Wilson—Learning from Teachers

Jennifer Wilson is a mathematics education professor at the University of Virginia at Wise. Working in collaboration with K-12 teachers in facilitating the summer institutes has had an impact on several of the courses she teaches at UVA-Wise. She said, "When I teach pre-service teachers now, I draw from the teachers' experiences, from those that I have worked with through the institutes." She has continued her involvement with teachers by participating extensively in PEP grants, leveraging the AMSP work beyond her own courses and experience with the development team.

New and improved courses at IHEs

AMSP also made contributions to courses at the participating IHEs. Preservice courses created through the AMSP project were placed on the books at several of the IHEs; existing preservice courses were significantly revised at several IHEs; and in some cases, new course requirements were put in place and course sequences were modified. In addition, some participating faculty modified or revised other courses besides the ones directly involved in the preservice track to make them more inquiry-based.

It is important to note the flexibility that AMSP afforded institutions in the implementation of the courses. Once the AMSP courses were developed, the implementation of those courses at the various IHEs was not compulsory. The management team was explicit about the fact that several of these institutions already had fairly good courses on their books; they did not need to adopt the AMSP courses wholesale, but could rather focus on revising their existing courses to be more aligned with the goals of the AMSP project. Thus, each institution took what was developed and incorporated it in the most practical way possible:

> *AMSP was not crammed down anyone's throat. We could choose to participate at whatever level we wanted to.*
>
> *—IHE faculty member*

Even though some of the changes that resulted might not have been as broad or deep as they might have been by adopting what the project developed, an incremental approach was a much more realistic strategy to getting something done at these IHEs.

Some participating faculty chose to use AMSP funds to integrate more technology into their new courses. As one faculty member said:

> *There is a technological component to this as well. The inquiry process is aided dramatically by technology, and through AMSP, we have gotten technology into the hands of our preservice and inservice teachers.*

Institutional Vignettes

Morehead State University

Morehead State University implemented Math for Teachers developed through AMSP, changing its approach to teaching the math course for elementary and middle school teachers and changing the sequence of the courses—all of which has been institutionalized. They also incorporated a new course in earth and space science for elementary teachers into the curriculum. At the secondary preservice level, many of the courses remain the same, but as the PI noted: "We teach them differently."

Kentucky State University

Kentucky State University revised two semesters of math for elementary education, one semester of physical science for elementary education and one semester of biology for elementary education. AMSP also contributed to the development of a problem solving course in mathematics for elementary education, changes in the Development Calculus class, as well as earth science and chemistry courses for teachers. All of these are now "on the books."

Pikeville College

At Pikeville College, a curriculum committee is in the process of re-organizing the developmental and inter-level math curricula, a move influenced by the work of AMSP. As the local PI said, "We might set some new cut-off scores for math courses and refurbish some lower level courses to do things they haven't been doing. That grew out of seeing what kids are coming out of high school with and what teachers are challenged with, and mixing that in with what college teachers are facing—sort of a K-16 look at math and the sequence."

These comments from several participating IHEs further indicate the extent to which AMSP has influenced courses:

> *The department of earth sciences, physics and astronomy has made significant changes in its curriculum and how [the faculty] are teaching that curriculum. Earth sciences completely revised their general education and entry degree courses.*
>
> *—Local Principal Investigator*

> *On the science side, we had a lot of those courses already in place, and those courses got revised. On the math side, that's where we had new courses implemented from AMSP. All these courses are now more or less ingrained in our curriculum and into the education curriculum at the primary and middle grades.*
>
> *—Local Principal Investigator*

> *The changes in our curriculum are a result of faculty members participating to revise these courses and also participating in teaching these courses in the summer institutes.*
>
> *—Local Principal Investigator*

In some cases, the change in courses also stimulated attention to further faculty development. At one IHE, the dean was prompted to look for department members willing to learn the new methods needed to teach their inquiry-based physics course, in case they were needed in place of the AMSP-involved faculty member who precipitated the course change.

New professional relationships

The collaborations between faculty members across different IHEs were particularly important in leading to these changes. In fact, the new professional relationships that formed may well be one of the most long-term remnants of the AMSP. Faculties were greatly enriched by their meaningful interactions with IHE colleagues throughout the region.

As one example, the AMSP typically identified younger faculty members to work on the course development teams alongside faculty already recognized as state or national leaders in mathematics or science education. The interactions provided the younger faculty with valuable professional connections, and fostered their growth as part of the next generation of leaders for the region.

A more specific example of these fruitful collaborations among faculty from various IHEs occurred in the development of the Math for Teachers courses. Mathematics and Mathematics Education faculty from the participating IHEs worked together to map out courses for elementary preservice teachers in mathematics that included rich content and pedagogy. Several of the AMSP faculty involved in the Math for Teachers course development held a weekend-long retreat at Eastern Kentucky University where they invited all

IHE faculty, including some non-AMSP faculty, to come and learn about the new courses.

There are at least some indications that these collaborations will continue after the AMSP funding ends. For example, at one university a faculty member actively involved in AMSP worked with faculty from other universities also involved in AMSP on a grant that encourages minority students to choose math and science careers.

Broader institutional change at IHEs

We saw many individual faculty members becoming advocates for a course and a way of teaching at their IHEs, making changes in more than just the AMSP-influenced courses, and beginning to have an influence on other faculty at their institutions. In addition, the collaborative course design process worked effectively in changing the discourse among some faculty about their work; they began to focus on and discuss issues of teaching, as opposed to merely the content of their specific subjects.

Another set of traditional relationships that were challenged by the project was the divide that often exists between Arts and Sciences and Education faculty on individual campuses. Professors in departments within Arts and Sciences are not often involved in teacher preparation and professional development; in fact, one of the most difficult challenges facing the AMSP project was how to artfully orchestrate productive collaborations between Science and Education faculty. In some cases the AMSP project was able to bridge this gap; in others, the gap remains. In those institutions where such relationships formed, there is a stronger, more campus-wide commitment to preservice education.

> *The collaborations that have taken place between the College of Education and the College of Science and Technology have been good. I think the AMSP has helped us see that preparing a teacher is a campus-wide responsibility. We worked with the College of Education in doing what we needed to do in AMSP, and they have worked better with us.*
>
> *—Local Principal Investigator*

> *The relationships between Arts and Science and Education folks are quite good now. It changed in the content course and has changed the Curriculum and Instruction department.*
>
> *—IHE faculty member*

In addition, one science outreach professor reported that the biology department at his university has agreed to change the way biology majors take their laboratories, moving to a three-hour/one-hour laboratory block that has more inquiry types of activities, a major undertaking in a course that averages more than 600 students a semester.

Institutional Vignettes

Kentucky State University—Arts and Science faculty bridge to Education faculty

At one institution, a biology faculty member from the College of Arts and Science who had been active in AMSP was selected to serve as the liaison to work with the School of Education, who is in charge of biology education in the division of math and sciences. As the local PI said, "He has been tremendously successful working with biology education students."

University of Tennessee—Innovations in distance learning

At the University of Tennessee, a mathematics professor from the College of Arts and Sciences became involved in developing and delivering on-line courses as part of the Master's of Mathematics program at the University, for graduate students and high school and middle school teachers pursuing their degrees through the College of Education.

Moreover, some of the participating IHEs instituted changes in their hiring practices, bringing on new outreach professors and institutionalizing rewards for discipline-based outreach work with local schools and districts.

Reflections on Benefits to IHEs

As noted earlier, the AMSP project had a theory of action for creating change at IHEs that involved IHE faculty participating in different kinds of relationships with other faculty members and with K-12 teachers in specific roles and within specific structures that would lead to IHE faculty members' professional growth. This, in turn, would lead to changes in specific courses, as well as broader institutional changes at the IHEs.

It is inherently difficult to motivate individual faculty within IHEs to change their philosophies and practice, much less to motivate changes in courses and course sequences. The strong norm of academic freedom and the social status that IHE faculty enjoy tend to make them less amenable to change, and in particular, externally-forced change. The AMSP project found a way, however—through building relationships among IHE faculty and between IHE faculty and K-12 teachers—to influence them to change their teaching practices to be more inquiry-based. By challenging the traditional roles and responsibilities between IHE faculty and K-12 teachers, and by setting up a framework within which these two groups could contribute and benefit equally, individual faculty were motivated to alter their teaching practice, their relationships with their colleagues, and their relationships with K-12 teachers. The project honored faculty where they were, respecting their existing beliefs, making suggestions and allowing them to carve out their own path. This approach was inherently respectful, based on the belief that when given

the opportunity, faculty would make choices that enable them to better serve their students.

The project's theory of action thus played out much as the project hoped it would: IHE faculty and K-12 teachers formed meaningful collaborations; IHE faculty from throughout the region forged ongoing relationships; new courses were created and existing ones were revised; and new relationships within IHEs, across IHEs, and between IHEs and local school districts were formed.

Even given these important changes, it remains true that the AMSP's influence on the IHEs at the broader institutional level remains modest. This is due, in part, to reliance on a strategy of individual faculty advocacy, which is vulnerable to turnover. At several institutions, AMSP rested with one or two faculty members in the early stages of this project. When those faculty members left, the impact of AMSP suffered a setback.

Probably the most long-lasting legacy of this work is the respectful faculty-to-faculty relationships that have been forged within and across IHEs, and between IHE faculty and K-12 teachers in the region. These relationships provide a solid foundation upon which to build continuing investments in science and math education in the region.