

Appalachian Mathematics Science Partnership (AMSP)

2003-2004 Evaluation Report

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Appalachian Mathematics Science Partnership (AMSP) 2003-2004 Evaluation Report

EXECUTIVE SUMMARY

The Appalachian Math Science Partnership (AMSP) represents the investment of National Science Foundation funds in the improvement of mathematics and science education in some of the nation's most rural and high poverty communities. The AMSP faces the challenge of working in three different states, with 51 school districts and nine institutions of higher education, and across four grade bands – elementary, middle level, high school, and post-secondary. In addition, the project must contend with a regional culture that historically distrusts outsiders, honors traditional hierarchy, displays ambivalence towards schooling, and has very little capacity for sustained educational improvement.

Inverness Research Associates serves as the external evaluator for the AMSP, and to date has pursued a range of activities that study both the theory and the realities of this large-scale initiative. The current evaluation report is written primarily for NSF program officers and their colleagues participating in the AMSP's Phase I site visit. Our goal is to further the productivity of their review through our independent evaluation of the AMSP design and implementation efforts.

The report begins with an articulation of the evolving conceptual model that underlies the AMSP design. Within this model, we see the AMSP serving as an “umbrella partnership” – a generative structure that develops and supports the work of many local partnerships. We see the AMSP pursuing an approach similar to micro-financing in that it simultaneously pursues multiple strands of investment that enable money to flow to smaller projects that would not be able to attract independent funding. Each strand of investment involves working partnerships engaged in collaborative tasks that 1) meet local needs, 2) contribute to the broader AMSP goals, and 3) build local capacity. The current strands of AMSP investment include:

- ◆ **Course Development**

- pre-service and in-service courses collaboratively designed by teams consisting of university faculty with the help of K-12 teachers

- ◆ **Student Opportunities**

- programs that allow undergraduate and high school students to participate in the teaching of mathematics to their younger peers

- ◆ **Teacher Enhancement & Learning**

- multiple opportunities for teacher participation in professional development

- ◆ **Leadership Development**

- positions, programs, and activities that all contribute to building the expertise needed to sustain ongoing improvement in the region

♦ School Improvement & Program Enhancement

support for local efforts in which schools and/or districts engage in self-study and data-driven self-improvement

♦ Regional Identity & Connections

structures and activities that contribute to region-wide vision, relationships, and shared work around the improvement of math and science education in Appalachia

In this report, we discuss the rationale for each strand, the work completed to date, the return on the AMSP investment, and any emerging issues. Our evidence from the field indicates that the AMSP has made significant progress in designing and delivering new courses, providing opportunities for students in grades 9-16 to explore teaching as a career, and contributing to the professional growth of teachers currently in the field. The AMSP has also accomplished much in the areas of leadership development, school improvement, and establishing a regional identity – however, these strands will be more fully implemented as the project proceeds.

Meanwhile, AMSP leaders continue to refine the project's conceptual model, management and communication structures, and investment strands. As they approach the end of the initiative's second year of work, all 60 partner institutions are actively on board, many aspects of the AMSP are running quite smoothly, and it is time to more strategically confront some of the project's ongoing challenges. From the standpoint of the evaluation team, these are as follows:

- articulating and operating within their own vision of the AMSP partnership and the conceptual model
- articulating, studying and refining the strands of investment that the AMSP pursues
- cultivating mid-level leadership
- strengthening management and communications strategies and methods
 - fully establishing a research strand that can inform, document, and disseminate the work of the AMSP

Each of these issues is discussed in detail in the final section of the report. Given all that the AMSP has accomplished since the Fall of 2002, we believe the initiative is well-positioned to work through these challenges and continue on its positive trajectory – addressing local needs, meeting project goals, and building local capacity – and thereby achieving considerable success as the remaining years of the partnership unfold.

Introduction

OVERVIEW

Inverness Research Associates has been contracted to serve as the external evaluators for the Appalachian Math Science Partnership (AMSP). Since the partnership first received its funding, we have worked closely with the AMSP leaders and staff to document the design of the initiative, to study the field-based realities of the work, and to report our findings to the project leadership. Although we anticipate the external evaluation playing multiple roles over the course of the AMSP, to date, ours has been largely formative. We have met regularly with AMSP leaders to provide oral debriefs of site visits and to engage in collaborative planning for the project as well as the evaluation. Our written feedback has consisted primarily of internal memos addressed to members of the project's Executive Committee and Management Team.

During the past decade, Inverness Research Associates has interacted with a number of NSF-funded projects seeking to improve mathematics and science education in the Appalachian region.¹ Our growing experience in Appalachia as well as other rural areas in the United States has informed and shaped our thinking about and design for the external evaluation of the AMSP. (Please note that our detailed evaluation plan has been submitted to NSF as part of the AMSP proposal and strategic planning processes.)

THIS REPORT

The current report is designed primarily to communicate the work and findings of the external evaluation to members of the NSF team who will be conducting the Phase I site visit in July 2004. In order to better understand and use this report, it is important to remind reviewers of the following information:

- The evaluation work conducted to date has placed considerable focus on clarifying the AMSP's theory of action, more deeply understanding its design, and assessing the nature and quality of early implementation efforts.
- Inverness Research is not solely responsible for the study, documentation and evaluation of this MSP. As result, we have purposely emphasized the partnership structure and management, as well as the project design and implementation, in carrying out our work. The AMSP's internal data collection and evaluation team is charged with gathering baseline data from the participating partners and conducting formative evaluation of local activities.
- This report, then, is not written simply as a presentation of data and findings. Instead, it is intended as more of a narrative that is explanatory and illuminative in nature. Through the report, we wish to share with outside reviewers our conceptualization of the AMSP project and our assessment of the initiative's progress as it approaches the end of its second year. In what follows we discuss in detail the design of the AMSP, the milestones achieved along

¹ Staff from Inverness Research Associates has been involved in studying the Appalachian Rural Systemic Initiative; Project CATS; ACCLAIM Center for Learning and Teaching; Coalfields Rural Systemic Initiative; and MERIT.

multiple lines of work, as well as emerging issues and ongoing challenges. In doing so, we hope to contribute to the clarity, efficiency and productivity of the upcoming NSF review.

We divide the report into four major sections:

- ◆ Section 1: A Framework for Evaluating the AMSP
- ◆ Section 2: Progress Claims
- ◆ Section 3: Alignment with MSP Key Features
- ◆ Section 4: Overarching Challenges

Section 1 carefully communicates how we at Inverness Research Associates view the AMSP – essentially as an “umbrella partnership” – one larger partnership that generates smaller partnerships through a process of targeted and exploratory investments that very much parallels that of a micro-financing approach. Section 2 delineates what we see as the AMSP’s most significant accomplishments during the initial implementation phase as it pursues six major strands of investment; we also note challenges that warrant attention within each of the investment strands. Section 3 provides a brief summary of how the AMSP’s successes and issues align with each of the key features designated for all NSF-funded MSP initiatives. Finally, Section 4 points to some project-wide challenges that are now emerging and that the AMSP will want to address in continuing its work.

SECTION 1: A Framework for Evaluating the AMSP

INVESTING IN THE IMPROVEMENT OF RURAL EDUCATION

Recently, there has been a great deal of attention given to the evaluation of the MSP projects as well as the overall initiative. The Inspector General has issued a memo (audit of NSF's Math and Science Partnership Program OIG Report No. 04-02-003) that outlines an assessment of the sufficiency of current MSP evaluations. NSF has, in turn, responded to the document. While there is much debate and differing opinions about evaluation approaches that would be appropriate for MSPs, there are several areas of consensus. In particular, it is clear that the evaluation should focus on and be designed around the "conceptual model" of the project – a theory of action as to how the investment will yield benefits to the intended audiences. We quote the first evaluation criteria from the Inspector General's letter:

The award recipient has a conceptual model for the project. Every project should start with a conceptual model to ensure that a common understanding about the project's structure, connections and expected outcomes exists. Also, the conceptual model assists in focusing the evaluation design on the most critical program elements. The conceptual model should include project inputs, activities, short-term outcomes and long-term outcomes.

Our evaluation approach aims to adhere to this principle. In particular, we think it is very important for external evaluators to help MSP project leaders elicit and articulate the key elements that comprise a shared conceptual model. Thus, before presenting what we have learned about the outcomes of the AMSP work, we want to frame our conceptual model of this particular partnership in a way that will help others understand the nature of and rationale for its design and strategy.

It is first essential to understand that this project is working in a very large rural and impoverished region that has known economic hardship for generations. As an example, the 1990 Census listed the national poverty rate as 12.8 percent, but the poverty rate for Central Appalachia was 19 percent. Kentucky and West Virginia had the highest rates of poverty in their Appalachian counties, with 28 and 20 percent respectively. Many institutions and agencies play a role in the AMSP: the partnership operates in three different states and formally involves nine institutions of higher education and 51 school districts; however, a number of other organizations and individuals are connected to the work. In addition, significant challenges and critical shortages persist in terms of the capacity and performance of the educational "system" in the region.

While there is clearly a real need for improving both educational opportunity and academic achievement in Appalachia, how best to do so remains quite unclear. "Outside" funders such as NSF must contend with a number of critical issues when seeking to invest their funds in the improvement of education in Appalachia (and other similar rural areas):

- NSF seeks to bring about fundamental reforms in an educational enterprise that is deeply rooted in long-standing traditions of rural schooling and local control.
- NSF and others wishing to fund the improvement of American education face a system that is not actually a system per se, but a loosely coupled set of governance units that range from states, to counties, to districts, to schools, to departments, to the individual teachers. The distribution and localization of control is particularly characteristic of the Appalachian region.
- Compared to the scale of the system they are trying to improve, the AMSP has limited resources to invest. (We estimate the relative scale of AMSP resources to be about ten cents for every hundred dollars spent on education in the region.)
- NSF is ambitious in its goals. It seeks to invest its resources so that education is improved in Appalachia – teaching is of higher quality and student learning increases – *and* to accomplish this on a large scale, not just locally in isolated instances. In addition, they desire that the changes resulting from their funded work be sustained and institutionalized, not just temporary improvements.
- Perhaps the most important challenge of working in Appalachia is that the local school systems in Appalachia have very little improvement infrastructure² of their own. Over 99% of all resources go to the operation of the system with almost no resources, structures, or expertise devoted solely to the improvement of the system.

In summary, funders such as the National Science Foundation embark on a difficult path in making investments in education, targeting local school systems which themselves have limited expertise, experience, or structures for doing the work of improvement. In Appalachia the “system” of education consists mostly of small districts; often individual schools themselves are the operating local “system.” Because of isolation, both cultural and geographical, such schools have practically no improvement infrastructure of their own, and little access to regional and/or state resources. Combine this with strong local control, traditional values, and distrust of outsiders who want to “fix” the system, and it becomes very difficult to find ways for external agents such as NSF to influence or invest in local educational improvement.

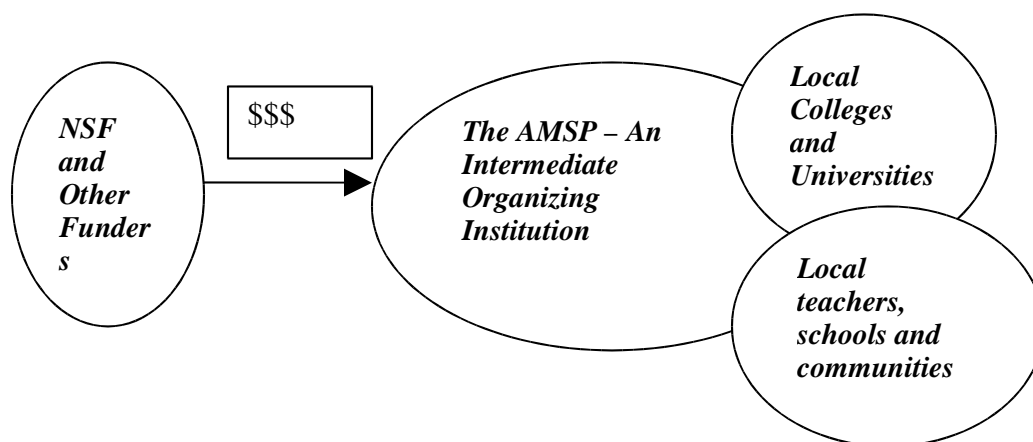
Making any good investment requires two things. One is the capital needed to make the investment. NSF is able to provide this, in a relatively small but still significant amount. The second thing needed is the investment opportunity itself. While NSF can provide the capital for the work of reform, questions about who will do the work and who to invest in loom large. What is needed are highly talented improvers – people skilled in professional development, curriculum implementation, assessment reform, school restructuring, etc. Currently, a severe shortage of such candidates exists within the schools and colleges of Appalachia; individual rural districts and schools are simply not well-equipped to use outside capital to design, initiate and sustain their own improvement processes. This fact creates a great dilemma for the outside funder: the

² To learn more about the concept of improvement infrastructure see <http://sustainability2002.terc.edu/invoke.cfm/page/123>

system that needs improving is not fully capable of receiving and utilizing the capital targeted for that very purpose.

One solution to this dilemma is to have external organizations (such as universities, labs, and museums) operate as “improvement institutions.”³ However, although these organizations are often local and possess some of the necessary capacities, they are not considered part of the system that is earmarked for improvement. As a result, the danger is that even though these institutions can use the investments to carry out improvement activities, the activities remain external and marginal to the Appalachian school systems they are trying to serve. In a worst, but not unusual case, the improvement strategies and activities conducted by the “outsiders” will run counter to or be in conflict with the needs and interests of local Appalachian schools and teachers.

Hence, the general problem of investing in educational improvement in Appalachia consists of finding a way to bridge the gap between the large-scale distant funder (NSF) and the small scale and very local system (be it a school, district, or college). It is not easy for the outside agents to fund local schools directly because there is limited capacity for using such funds to carry out high-quality improvement activities. And to fund outsiders runs the risk of having little lasting connection impact. We see the AMSP – both in its design and its method of working – directly addressing this dilemma.



³ Rowan, B. The ecology of school improvement: Notes on the school improvement industry in the United States. *Journal of Educational Change*, 2002, 3, 283-314.

THE ROLE OF THE AMSP

The AMSP is an example of what we have come to call intermediate organizing institutions (IOIs).

At best these organizations provide the interface between the funder and the very small and widely distributed local schools and colleges that are the intended beneficiaries of the funding.

There are several design characteristics that are important in making an intermediate organization a successful interface between funder and local beneficiaries. First and foremost, the intermediate organization must not be random in its work, but principled. From our observations and interviews we are able to infer that the principles that define the AMSP as IOI include the following:

- ◆ The work done by the AMSP is based upon and grounded in research findings and national standards. The leaders of the AMSP are well connected at the national level and very cognizant of the latest research and vision for high-quality math and science education. Thus, one principle that helps determine the nature and type of work that gets done centers around the degree to which that work promotes movement toward this national vision.
- ◆ The work done by the AMSP is intended to be respectful of and responsive to the interests, values, and wisdom of local communities. While the work of the AMSP must be mindful of national standards, it also must be seen as addressing local concerns and issues.
- ◆ The work must involve and build the capacity of local schools and colleges. It is not enough to fund services and activities that help individual teachers and their students. The AMSP is striving to structure all of its work so that it not only provides service but also creates enduring capacity. For example, as the AMSP funds course development efforts, those efforts must not only develop good courses, but they must also develop future course developers. Thus, the work sponsored by the AMSP must leave behind a legacy of increased capacity for doing future improvement work.

Following these principles, the AMSP can serve as an IOI for the entire Appalachian region, providing the interface between NSF and the effective investment of its resources in local educational improvement efforts.

The Partnership as a Generative Structure

This conceptual model of the AMSP centers on partnership; but to think of it as a simple dyadic relationship between the participating institutions would be a mistake. Targeted MSPs generally consist of one university and its surrounding school districts, sometimes only a single district. That is not the case with this comprehensive initiative. Rather we have come to view the AMSP as an “umbrella partnership” – one that is generative of numerous smaller working partnerships. Within this umbrella, there are the 60 formally designated partners – nine IHEs and 51 school

districts. However, the AMSP umbrella also takes into account other surrounding districts, other colleges, and other NSF (and other) reform efforts that have informal but important connections to the goals of the initiative. Thus, the AMSP is designed 1) to be inclusive of the region, and 2) to be a partnership that generates more partnerships.

To foster and cultivate meaningful working partnerships the AMSP pursues multiple strands of investment. Designing multiple strands of investment is a way of allocating the AMSP resources. But more than that, it is a way of building local and regional partnerships to focus on specific needs and areas of work.

Strands of Investment

One approach to investing that parallels the AMSP work is known as “micro financing.” There are two key characteristics to this approach to investing in local improvements. One is that the funder pursues small grants to local individuals and small groups with the goal of empowering local people to develop their own capacity. The other key characteristic is that the organization that supplies and monitors the flow of funds is providing a structure and guiding set of principles for the investment.

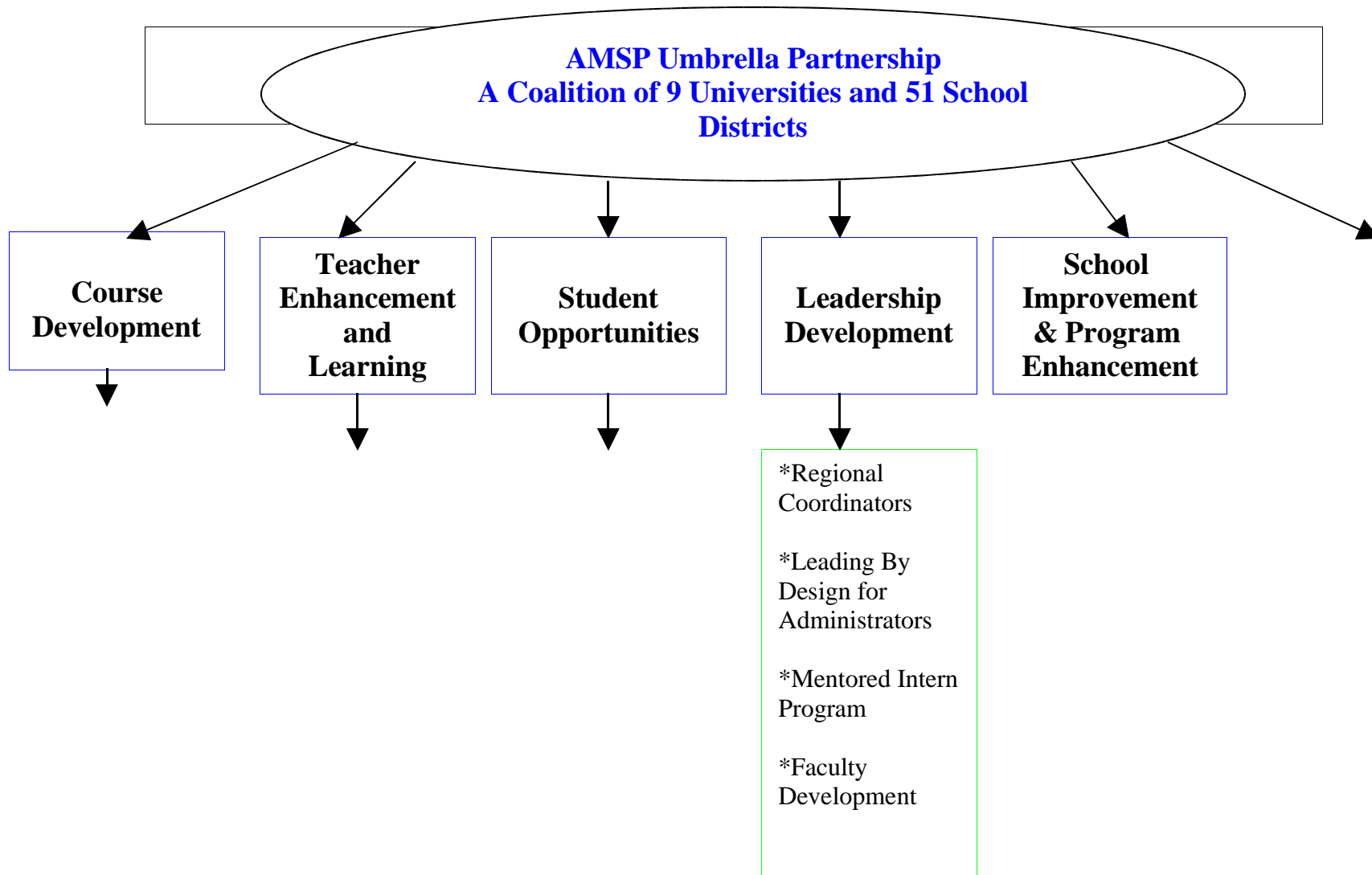
In a similar way the AMSP has developed a way to invest in local work in Appalachia that is empowering, meets national standards, and addresses local needs. While the AMSP does not give small grants to individuals, it does seek creative ways to distribute funds to local groups (partnerships) so that they can be part of larger AMSP guided initiatives. The AMSP develops multiple strands of investment, which to date, have included work centering around the following:

- ◆ Course Development
- ◆ Student Opportunities
- ◆ Teacher Enhancement & Learning
- ◆ Leadership Development
- ◆ School Improvement & Program Enhancement
- ◆ Regional Identity & Connections

For each of these investment strands, the AMSP is shepherding a process of local partnership development (e.g., workshops and courses are developed by teams comprised of university faculty and school teachers). Each strand of work is focused on issues and areas that address local needs and interest local leaders (e.g., courses are focused on the content knowledge of local teachers that is critically important to leaders worried about meeting the NCLB requirements). The AMSP provides a wide set of supports so that the work of the local partnerships is likely to be successful both in local terms but also with respect to meeting the higher level goals of the AMSP (e.g., course development teams are given resources, release time, travel money, and

evaluation feedback).

Each strand of investment is comprised of multiple programs and activities. For example, the Student Opportunities strand includes the Excel program and the Explorer program. The current work of the AMSP, in terms of the investment strands and their components, is exhibited in the diagram on the following page.



***MATH**
Geometry
Probability &
Statistics

Communicating
Mathematics/
Technology

Mathematics for
Elementary
Teachers

***SCIENCE**
Physical Science

Earth/Space
Science

Biology

Chemistry

***Summer
Institutes**

***Site-Based
Follow-Up**

***Materials
Support**

***EXCEL for
high school
students**

***EXPLORERS
for college
students**

***Using Data,
Getting Results**

***Success for
Seniors**

**Regional
Identity
and
Connections**

***Glade Springs
Conference**

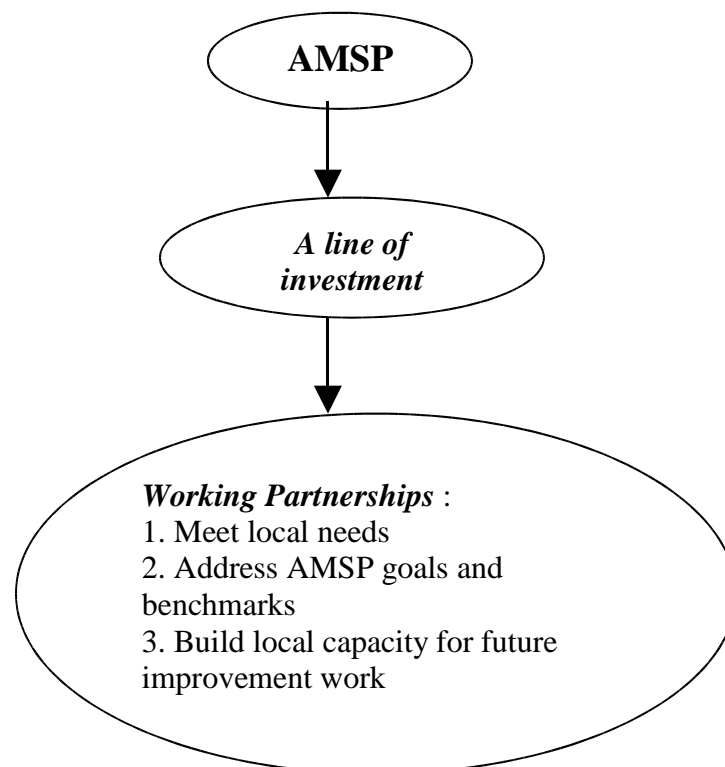
***Collaborating
with other reform
efforts in the
region – ARSI,
CRSI,
ACCLAIM,
MERIT**

***Partnership
Enhancement
Project mini-
grants (PEPs)**

SUMMER ACADEMY

These strands of investment are not fixed or pre-ordained. They represent the most current thinking about the AMSP conceptual model. The AMSP not only supports these lines of investment, it also intends to test and refine each strand. If a set of partnerships or a program within a specific line of investment does not work out, then the AMSP can either modify that investment or shift resources away from it. And new strands are always possible.

The AMSP is thus a research project where the key research challenge is to pursue the most profitable strands of investment. Serving as an IOI, the AMSP is designing work that generates working partnerships that organize themselves to pursue these strands of investment. And, again, we want note that each the work generated within each strand a) meets local needs,⁴ b) meets AMSP goals, and c) builds long-term local capacity.



⁴ We need to stress how very important it is that the AMSP work speaks to locals. In Appalachia it is often said that not only is all work local, it is also always personal. (There may well be no institutional relationships, only personal ones). Local schools and districts are not interested per se in pursuing NSF's goals – a lesson very clearly learned in the first year of the project. The local schools and districts are interested in pursuing their own needs and solving their own problems. The work of the AMSP must address those needs and problems if it is to attract and involve local participation.

Evaluating the AMSP - Identifying Key Questions

The conceptual model for the AMSP as we have described it provides the focal point for designing our evaluation plan. If one sees the AMSP as an umbrella partnership pursuing multiple strands of investment that serve multiple goals, then there are real implications for the evaluation of the project.

The evaluation questions that become central within this perspective include the following:

- Does the AMSP effectively serve as an umbrella partnership and as an IOI for the region?
- Does the AMSP design and successfully implement multiple strands of investment?
- Do these strands create authentic effective working partnerships that engage key people in IHEs and the schools in authentic and appropriate ways?
- Do these partnerships engage in work that:
 - is of high quality?
 - meets local needs and addresses local concerns?
 - contributes to the building of local capacity for future work?
- Given the limited resources available to the AMSP, are the partnerships strategic in targeting appropriate local or regional leverage points for maximal return on investment?
- What is the AMSP doing to learn from its multiple lines of investment to guide subsequent investments?
- What lessons can be learned from the AMSP that might inform initiatives in other rural regions facing similar challenges?

These questions are central as we continue to re-design our own evaluation efforts. It is critical that our evaluation questions and activities align closely with the conceptual model of the AMSP – a point of view strongly supported in the recent Inspector General report. The questions above guide us as we use our resources to efficiently pursue evaluation activities that will be most beneficial to the project. We are now in the process of realigning our activities to focus on these questions in a way that is most congruent with and supportive of the emerging AMSP conceptual model.

SECTION 2: Lines of Investment – Rationale, Progress and Issues

LINES OF INVESTMENT

According to the emerging conceptual model, the AMSP can be viewed as having six primary lines of investment. For each of these strands, we discuss the rationale for the investment, the work completed to date (both on the part of the AMSP and the evaluation team), the return on the investment, and any next steps or immediate challenges to be addressed.

Course Development

Rationale

The AMSP has chosen to invest in course development for a variety of reasons. First, there is a great need in the region for new and improved content-based pre-service and in-service courses in math and science. Second, there is concern that many higher education faculty responsible for teaching these courses have been doing so in isolation. They rarely have opportunities to collaborate with their colleagues at other institutions or with local master teachers. Many have only limited knowledge of the state and national standards that determine much of what is taught in today's K-12 classrooms. And finally, there is a desire to cultivate a common vision about what high-quality math and science education looks like from kindergarten through college, and to create a set of common experiences with respect to pre-service and in-service courses that will help make that vision a reality.

Work to Date

The AMSP has successfully created more than a dozen course development teams charged with designing math and science courses for pre-service teachers that can also be offered in an in-service format during Summer Institutes. These are collaborative teams, comprised primarily of university faculty but also including K-12 teacher representatives. They involve faculty members from multiple institutions, most of whom report never having worked with such a group prior to the AMSP. As such, the development teams are good examples of what we call "working partnerships;" they bring both people and ideas together in a collaborative effort to create higher quality offerings and greater consistency in pre-service math and science courses across the region.

Over the course of the external evaluation, the team from Inverness Research Associates has interviewed a sample of leaders and participants from nearly all of the development teams. We have observed several examples of the *Physics for Elementary Teachers*, *Mathematics for Elementary Teachers*, and *Math Explorers* courses. According to what we have seen and heard, this collaborative approach to course development and delivery continues to be one of the greatest strengths of the AMSP. The courses produced have been of very high quality. Some course development groups have stayed together and are now completing their second year of

work. (For more details about the participants' experiences in the courses, see the section on Teacher Enhancement & Learning below.)

Return on Investment

Faculty members participating in the development teams greatly appreciate the opportunity to collaborate with their colleagues both within and across institutions. They tell us this is something they rarely, if ever, did in the past. Particularly younger professors see the teams as an unprecedented and highly valuable professional development experience. As one member of the *Math for Elementary Teachers* group told us:

I've been here four years and this is the first time I've had a chance to meet, let alone work with, the faculty at Morehead and some of the other colleges. And without something like the AMSP, I just don't think it would happen. You just can't make the time.

Higher education members also appreciate the presence of practicing classroom teachers on their teams. As one science professor explained: "They're our reality check – and they're not afraid to rein us back in when we getting trotting down some crazy path." In turn, K-12 teachers feel that they function as active and respected members of their teams. One teacher told us:

Everything was based on Kentucky Core Content and the Kentucky Course of Study. The professors were not really familiar with the state standards that teachers are assessed by. One of my major roles was to help them understand what standards we're held accountable to. The professors were surprised at what [how much] had to be taught – they were surprised because they hadn't had the experience. But there was no resistance [from them].

Overall, we note the following as significant returns related to this strand of the AMSP investment.

- The collaboration that is at the heart of the work in course development teams leads to stronger relationships among math and science faculty both within participating institutions and across the region.
- The course development process also affords opportunities for K-12 teachers and university faculty to learn from each other as members of the same design team – a rare experience for faculty as well as teachers.
- Development teams feel obligated to disseminate their work throughout the AMSP and beyond, via written correspondence as well as workshops for university faculty, increasing the likelihood that these courses will be replicated elsewhere.
- The effort to create greater continuity across institutions contributes to a common vision for what high-quality math and science education should look like across the grade level bands, from elementary school through college.

- As the AMSP approaches the end of its second year, the first courses are now being offered at multiple institutions and in multiple forms – in-service as well as pre-service – a new set of courses is being offered for the first time this summer as professional development institutes for in-service teachers.

Next Steps/Challenges

As the AMSP continues to pursue this line of investment, a number of issues remain with respect to course development.

- Each team works differently based on its leadership and composition – faculty members serving on multiple teams report that some have been more productive and worthwhile than others. There may be both a need and opportunity for greater connection, networking, and sharing across course development teams.
- Not every IHE is represented on each development team, meaning the team faces the challenge of not only effectively communicating its work to colleagues at other institutions, but also convincing their colleagues that the course is worth implementing as designed.
- Courses like “Mathematics for Elementary Teachers” and “Physics for Elementary Teachers” clearly promote a more student-centered and inquiry-based approach to instruction that many higher education faculty members have not yet embraced. However, most courses focus explicitly on content with the pedagogy remaining implicit and at times rather traditional.

Student Opportunities

Rationale

Across the United States, schools and districts are confronting the realities of hiring and retaining qualified mathematics and science teachers in the midst of a nationwide shortage. Rural districts, because of their geographic isolation and generally lower salaries, often find it difficult to compete with their urban and suburban counterparts. In Appalachia, it has become common knowledge among educators that the number of math and science teachers due to retire over the next decade far exceeds the number of people in the pipeline eligible to replace them. For this reason, recruiting new teachers within Appalachia who will stay and work in the region is a critically important goal of the AMSP.

Work to Date

Two programs, Explorers at the college level and Excel at the high school level, aim to provide strong math students with an early exposure to teaching in hopes of influencing their future career choices.

Explorers

In the Explorers program, undergraduate students assist a designated math professor during class sessions and participate in a weekly seminar that focuses on teaching issues and strategies. (Note: University of Tennessee has also launched a science-based Explorers program; other IHEs have expressed interest in doing the same.) The Explorers Seminar has been designed as part of the AMSP course development process and is generally taught by faculty who have participated as part of the design team. Most Explorers seminars are also co-facilitated by a local K-12 teacher who serves as a mentor to the participating students and often arranges opportunities for observing and/or teaching in nearby schools. Explorers also lead review or recitation sessions outside of the regular class period. Coordinators for the program are quite explicit about Explorers not being asked to serve merely as graders. During the 2003-04 academic year, all nine IHEs supported an Explorers program.

Excel

In the Excel program older high school students serve as instructional assistants in 9th and 10th grade courses for a semester with the goal of teaching a full lesson on their own by the end of the term. Students receive a stipend of \$250 from the AMSP and a semester of elective or math credit depending on the high school. Two accomplished high school teachers designed the Excel program and each participating school has essentially made it their own, given a few basic parameters. For example, Excel participants are expected to work directly with students rather than assisting with paperwork. During the 2003-04 academic year, 15 high schools in 15 different school districts had Excel programs. The number of programs is expected to increase for 2004-05.

Evaluation Activities

Since beginning our work, the Inverness Research team has interacted with nearly all of the Explorers programs and just over half of the Excel programs. Researcher have completed the following evaluation activities:

- conducted interviews with members of the Explorers Seminar development teams
- conducted interviews with faculty members teaching Explorers Seminars
- observed Explorers Seminars at five IHEs
- conducted interviews and/or focus groups with students enrolled in Explorers Seminars
- interviewed Excel coordinators
- observed Algebra courses with Excel students assisting
- conducted interviews and/or focus groups with students participating in Excel

programs

Return on Investment

According to our observations and interviews, overall, both the Explorers and Excel programs have been quite successful with respect to their implementation and participant satisfaction.

As undergraduates, we just never get this kind of experience, you know working so closely with a professor. Mostly, that's for graduate students. I think it's a really worthwhile program.

- Explorers participant

We were in the classroom with freshman the whole semester and we did different things. Some days the teacher will sit back and let you teach the class. I loved it.

- Excel student

Simply because of the age of the students, the Explorer program tends to attract students who have already considered teaching as a career. The Excel program, on the other hand, targets strong high school math students who may or may not have expressed an interest in teaching. At the site level, according to our interviews with program coordinators, the Explorer program confirms students' interest in teaching while the Excel program encourages students to reconsider their career paths. The Excel coordinators estimate that about 10% of the students who participated in Excel during the 2003-04 academic year have since demonstrated a strong commitment to pursuing teaching as a career. Below is an example of an Excel "success story" that we encountered in the field.

EXCEL IN MADISON COUNTY

Due to the structure of block scheduling, Chris Stunson completed all of the mathematics courses he needed for high school graduation during his sophomore year. He took no math his junior year. However, with college on the horizon, he enrolled in math again, Algebra III, in the fall of his senior year. His teacher, Melanie Scott, who had taught Chris as a freshman would not let him stop there. She signed him up to take Pre-Calculus in the spring and asked him to join the Excel program as an instructional assistant for her Algebra II course. Chris proved to be a natural. Without being asked, he began taking attendance, organizing student assignments, and circulating about the room providing students with support. When his teacher attended a conference later in the semester, Chris stepped in to teach the course and did so with ease and grace. The students found him much better than most of the math substitutes they had experienced at the high school and Chris, in turn, had a terrific time. Until then he had given little thought to a college major, engineering maybe? Now, Chris Stunson plans to attend Union College as an education major in the fall and already knows about the Explorer program. As he puts it, "Every kid in Kentucky should get a chance to do this program. It can change your life."⁵

In both the Explorers and Excel programs, younger students benefit from the presence of knowledgeable peers who can answer questions and provide additional classroom support. Students at the high school level are particularly vocal about the value of this assistance. Excel coordinators reported additional benefits at their individual sites. Examples they cite include increased ACT scores on the part of Excel participants and higher averages in Algebra sections with Excel students compared to those without.

Next Steps/Challenges

In terms of the AMSP's return on its investment, we have no doubts that both Excel and Explorers have yielded positive results. However, we also encountered some issues that AMSP leaders will want to consider in the months ahead.

- There is considerable variability across the different Explorers programs, more so than with the Excel programs. While participating faculty members have met as a course development team and have some shared vision for what the program should be, there does not appear to be a common curriculum for the seminars or agreed upon expectations for the experiences that all Explorers will have. We see a need and opportunity for greater networking and communication across the program.

⁵ The actual names of the student, teacher, school, and district have been used here with permission.

- The Excel program seems more loosely organized and supervised on the part of the AMSP – site-based coordinators express confusion about who they should contact when questions or problems arise.
- The Excel programs appear to be attracting young people to the teaching profession with success equal to or greater than that of the Explorers programs, but at a much lower cost. In terms of the career pipeline, the Explorers are much closer to becoming certified teachers, while the Excel students still have many years to go. The AMSP will need to continue to refine its vision, design and support for each program to maximize the return on investment made in the student opportunities strand.

Teacher Enhancement & Learning

Rationale

The requirements of No Child Left Behind have placed mounting pressures on teachers, schools, and districts with respect to professional development and adequate teacher preparation, especially when it comes to math and science content. Exacerbating the situation, in some of the more remote counties of Appalachia, teachers are hours away from the nearest research university and have difficulty finding high-quality professional development that is within driving distance of their homes. The AMSP wants K-12 teachers through the region to have easier access to rich professional experiences and high-quality in-service offerings that will help improve their mathematics and science instruction. The project also wants teachers to have more opportunities to network with one another so that they can better support each other in their work throughout the year.

Work to Date

While there are a variety of ways for teachers to interact with the AMSP, two structures provide the greatest formal opportunities for teacher learning and enhancement: the Summer Academy and the Summer Institutes. The Summer Academy takes place each July and offers a diverse menu of workshops aimed at a wide range of AMSP participants – from elementary school to college, from teachers to superintendents. As the figure on page 11 indicates, it is a program that cuts across many investment strands. (For more details, see the discussion of the **Regional Identity & Making Connections** investment strand that appears later in this report).

Summer Institutes

By design, most of the new AMSP pre-service courses are offered as Summer Institutes, either during the piloting stage or after the course has been offered and revised at the college level. Summer Institutes are designed to be rigorous, academically intensive, multi-week programs that promote deeper understanding of adult-level math and science content relevant to the work of K-12 teachers. Through these Summer Institutes, the AMSP makes available to teachers multiple, regionally based professional development offerings in both math and science. For example, this

summer's *Physics for Teachers* will be offered in four different locations.

Academic Year Follow-Up & Materials Support

For all Summer Institute participants, the AMSP has also provides follow-up through designated mentors or “mentored interns,” who visit individual classrooms twice during the school year. There are six mentored interns and 15 mentors – each was assigned 12 to 18 teachers to follow. (For more details, see the section on **Leadership Development**.) Upon completion of the Institute, teachers also receive a materials package that contains a set of supplies related to their course of study. These additional supports are designed to encourage teachers to make use of what they have learned in Summer Institute when they return to their regular classrooms.

Inverness Research Associates has conducted a variety of activities aimed at better understanding the AMSP's investment in teacher enhancement and learning:

- attended Summer Academy 2003
- observed a sample of 2003 Summer Institute sessions
- observed newly designed pre-service courses that provide the basis for Summer Institutes or vice versa
- interviewed teacher participants in both Summer Institutes and pre-service courses
- interviewed facilitators of Summer Institutes and faculty teaching pre-service courses
- conducted district site visits in counties where teachers attended 2003 Summer Institutes; some visits included classroom observations

Return on Investment

Our observations and interviews indicate to us that the courses designed to date are: 1) rich in math and science content, 2) high in quality 3) valued by the teachers who enroll in them, and 3) reflective of national standards in terms of cultivating a learner-centered classroom environment. From both the teacher and district perspective, there is great appreciation for and interest in these professional development opportunities. The teachers who attend are generally pleased with their experience and rate these offerings to be of very high quality. In addition, teachers claim that they are not only taking what they have learned back to their own classroom, but they are also sharing it with their colleagues. Below are some of the things we heard from participating teachers during our interviews.

I've been out of school for a while and I haven't had the chance to use the materials before. I wasn't taught in the inquiry way as a college student. The workshop really helped me see how important the inquiry-based process is.

It's great and I think they have very good ideas about teachers needing to change their teaching practices of how students learn math and science. There's going to be a change in teaching.

I've shared some of the things I've learned with other teachers who are scared to teach science. I've helped lots of other teachers.

The professors were very respectful and supportive. They were wonderful. At no time did any of us feel like we were being talked down to. They made us work hard, and they'd question the teachers and force us to think.

One phenomenon that we encountered this spring was pre-service teachers in the piloted version of the *Mathematics for Elementary Teachers* who had taken their first semester in the traditional or unimproved course. All of these teachers were quite pointed in their comments. They described the AMSP version as more rigorous, more relevant, and simply more worthwhile.

Next Steps/Challenges

According to our interviews and district site visits, despite their overall success, there are also a number of concerns connected to the Summer Institutes. First, only a limited number of spaces are available for each offering and at this point, demand exceeds supply, especially in certain counties. Second, some groups of teachers are frustrated that there have not been more offerings related to their discipline and grade level band – high school mathematics being the most frequently cited example. A third challenge relates to communication. Teachers continue to have questions about what offerings are now available and what they can anticipate in the future. Although this information is generally available via the AMSP website, users sometimes find it difficult to access. Finally, the AMSP needs to review the mentor follow-up that teachers receive to ensure that participants are truly getting the support that they need to make the desired changes in their classrooms.

Leadership Development

Rationale

The AMSP wants to develop indigenous leadership in both math and science education that will shepherd, strengthen, and sustain the improvement effort for many years to come. This means identifying people with leadership potential and providing opportunities for them to develop and deepen those skills. In Appalachia, as in most rural areas, there is a need for growing such leadership capacity at all levels of the system.

Work to Date

Regional Coordinators

The three AMSP Regional Coordinators presently serve as the field-based project leaders and critical points of contact for the 51 partner school districts in the AMSP. The Regional Coordinator for the Eastern Region is housed at the University of Virginia at Wise – she works with 14 districts; the Regional Coordinator for the Southern Region is housed at the University of Tennessee – she works with 12 districts; and the Regional Coordinator for the Northern Region is housed at the University of Kentucky – she works with 25 districts. All three are

accomplished, hardworking math and/or science educators, with long histories in the region. And all have pursued a rigorous path of bettering their leadership skills and forging connections over the past year.

Since the beginning of the school year, the Regional Coordinators have focused their efforts on establishing a solid working relationship with each district, gaining an understanding of the local math and science needs and goals, and helping district leaders see how they can best benefit from and contribute to the partnership. At times, the work can be thankless and overwhelming, but these three have clearly persevered. The Regional Coordinators have held multiple meetings in nearly every one of their districts and have facilitated some sort of professional development for more than half. These AMSP-supported leaders now have the know-how to provide many important functions vis-à-vis the strengthening of the regional improvement infrastructure: connecting IHEs and schools, connecting districts with common interests and goals, steering schools and districts in the direction of AMSP program improvement opportunities, acting as a liaison between AMSP project leaders and partners, and so on.

"Leading by Design"

Enhancing the leadership skills of K-12 principals is one of the goals of "Leading by Design," an ongoing series of leadership development sessions in which school administrators are learning to use a PDA-based classroom observation instrument. Despite some initial frustrations with the technology, participants are very enthusiastic about this new tool and its potential for looking at instructional trends in their school. Many have tested pilot versions of the observation instrument and have successfully uploaded their classroom data to the AMSP website. In addition to learning to use the new technology, principals are given the opportunity to more carefully consider issues of classroom practice and teacher evaluation. This offering also affords an opportunity for networking among regional principals at the elementary, middle, and high school levels that did not exist prior to the AMSP.

Mentored Interns

In addition to following up with teachers who have participated in the Summer Institutes, the six designated "mentored interns" were also given time and support during the 2003-04 academic year for pursuing their own professional development opportunities. Some chose to enroll in college courses aimed at completing an advanced degree. Others chose to pursue other avenues for bolstering their educational leadership skills such as National Board certification.

Evaluation Activities

In studying the AMSP's Leadership Development strand, the Inverness team has focused not only on the activities available and services offered, but also on the capacity building that takes place within and through them. While this area has not been a primary focus of our work, the following evaluation activities have been conducted in conjunction with the Leadership Development strand:

- multiple, in-depth interviews with the three Regional Coordinators

- interviews with principals participating in the “Leading by Design” group
- interviews with Mentored Interns

Return on Investment

- The three Regional Coordinators are now well established in their positions and have been very successful in establishing connections with all of the AMSP partners in their individual regions. They provide an important layer of mid-level leadership that is critical to the productive functioning of the AMSP’s overarching “umbrella” partnership.
- Principals are learning to use new technology that supports their observing in classrooms with greater frequency and regularity. They are collecting classroom-based data, sharing it with AMSP leaders, and discussing it with their peers.
- Mentored Interns have honed their skills as classroom observers and pursued individually designed courses of leadership development.

Next Steps/Challenges

- While the Regional Coordinators have succeeded in meeting most of their goals for the year, all admit that they are simply spread too thin and cannot continue indefinitely at the pace they have maintained throughout the past year.
- In future years, the AMSP leaders need to strategically articulate the Regional Coordinator job description (what the position is and is not) and provide some sort of additional field-based support.
- We understand that the distribution of counties among the Regional Coordinators has much to do with geography. However, we simply do not see how one person can adequately support 25 districts. Another concern is that current configuration puts those districts that take the initiative to request help at a distinct advantage, leaving very little time or space for Regional Coordinators to reach out to their needier or more hesitant districts.
- Regarding the Leading by Design group, our evaluation team has some questions about how principals are going to make use of the PDA tool. Is it indeed for studying trends in instructional practice? Or will it play a more evaluative role? The instrument is currently titled “Classroom Assessment Instrument,” which we think may send the wrong message to both principals and teachers.
- Questions also remain for the evaluation team with respect to the Mentored Intern strategy and the extent to which the resources dedicated to this component of the Leadership Development strand are truly achieving AMSP goals.

School Improvement & Program Enhancement

Rationale

The AMSP wants to provide opportunities and mechanisms for schools and districts to collaborate in new ways that will lead to overall increased capacity for improvement in math and science and ultimately, to increased students achievement. Many districts and schools are already participating in other projects and reform efforts that involve their own school and program improvement efforts. The AMSP is seeking ways to assist schools in their local program improvement efforts so that they are locally relevant but also reflect research and national standards. Part of this work involves learning how to engage in self-examination; in most counties, teachers and administrators have limited experience analyzing trends in student achievement data or course-taking patterns. This strand of the AMSP work involves helping schools and teachers use high-quality resources to strengthen their own program improvement efforts.

Work to Date

"Using Data, Getting Results"

For districts that want to begin making more data-based decisions and can organize a team of interested educators, teachers as well as administrators, the AMSP provides a series of district-based or school-focused sessions designed around materials produced by Nancy Love. Two of the AMSP Regional Coordinators began this work with ARSI and have since received the necessary training to be certified facilitators. Following some general offerings to clusters of counties, they now go to schools and districts by request – a service that has become increasingly popular over the past year. The sessions clearly fill a need by helping teachers and administrators analyze their data more effectively and use it to make more informed decisions. Not surprisingly, participants in these workshops have responded quite positively.

"Success for Seniors"

The "Success for Seniors" offering grew out of a series of meetings with high school counselors earlier this year that examined a variety of issues related to student achievement in math and science. The feeling was that more people needed to be brought together to discuss the issues – i.e., principals, teachers, and representatives from higher education. The resulting "Success for Seniors" workshops present an opportunity for conversations among educators at the secondary and post-secondary levels. The sessions are also facilitated by Regional Coordinators. Those who have experienced them say that they prove very valuable.

Evaluation Activities

The evaluation team has encountered this strand of the AMSP investment in our evaluation activities, especially during our spring site visits to schools and districts. However, to date, it has not been a major area of focus.

Return on Investment

- Educators who have participated in the “Using Data, Getting Results” or “Success for Seniors” workshops are quite positive about their experience. What they appreciate most is the opportunity to collaborate with other educators around common issues, to learn to use student data as the basis for educational decisions, and to consider new strategies for improving student achievement.
- Both offerings, especially with the “Success for Seniors” workshops, provide opportunities for collaboration that has not occurred in the past: between counselors and teachers, between high school math and science departments and university math and science departments, between administrators and college faculty, and so on.

Next Steps/Challenges

- Participants and facilitators of the School Improvement & Program Enhancement offerings need to view them as launching points rather than ending points. Going forward, participants will need opportunities to build on their initial experiences and deepen their understandings. Otherwise, the analysis will not be as rich as it could be. And in some cases, inaccurate inferences could result.
- Another issue that surfaced relates more specifically to the “Success for Seniors” and has to do with carefully selecting the representative from higher education that participates in such a workshop. This person has unmatched authority in the group. Therefore, it is critical that the faculty member understands and be able to effectively articulate the AMSP vision for science and math educational improvement in the region.

Regional Identity & Making Connections

Rationale

The AMSP is well positioned to assume a leadership role in creating a regional perspective on the improvement of math and science in Appalachia. Given the NSF’s long-term, multi-project investment in the region, many schools and districts served by the AMSP have had prior opportunities to participate in a range of programs aimed at improving the math and science teaching and learning in their area. Many AMSP districts are presently targeted by multiple

initiatives. The AMSP recognizes the unique opportunity afforded by this situation and wants to take the lead in ensuring that eligible counties in Appalachia use it to the full advantage of their teachers and students. By building connections and relationships across the region the AMSP can help build what we call an “Appalachian Improvement Infrastructure” that includes many different people, institutions and resources.

Work to Date

Annual Summer Academy

The 2nd AMSP/ARSI Annual Summer Academy entitled “Creating New Learning Opportunities through Partnerships,” will take place July 8-9, 2004. As the name suggests, it is supported by both projects so as to serve schools and districts participating in either one of the initiatives or both. The Academy offers two full days of concurrent plenary sessions designed to appeal to a broad range of math and science educators: teachers, principals, counselors, curriculum supervisors, district-level administrators, and higher education faculty.

Glade Springs Conference

In October 2004, the AMSP supported and Inverness Research Associates hosted a two-day conference in late October in Daniels, West Virginia for key representatives of all NSF-funded initiatives working in Appalachia and other leaders for math and science education in the region. The projects invited participate along with the AMSP were: CATS, ARSI, West Virginia – Handle on Science, MERIT, ASSET, ACCLAIM, South Fork LSC, and the Coalfield RSI.

Each project leader was asked to put together a team of that included PIs as well key mid-level leaders – those people who are in the field, doing and organizing the difficult work of math and science reform. They included people working both in the field and at the level of strategy and leadership – such as regional directors, key university faculty, key school administrators, and teacher partners. All came together to learn about each other’s work and discover potential avenues for working together.

Partnership Enhancement Project

In order to foster and strengthen sustainable partnerships among its cooperating school districts and higher education institutions, the AMSP has created the Partnership Enhancement Project (PEP). This is a small-grant program in which participants propose collaborative projects aimed at addressing program benchmarks. Interested parties submit a pre-proposal and work with AMSP to refine their ideas prior to making a final submission. Two specific types of partnering to address the project goals and benchmarks are the focus for Year Two support:

- Two or more school district partners
- One or more school districts and one or more IHE partners

Evaluation Activities

The Inverness Research team has been integrally involved in advising project leaders regarding this strand of the AMSP investment. We have observed, participated in, and helped plan the first Summer Academy. We facilitated the Glades Springs Conference and analyzed all of the data that resulted. We helped AMSP leaders think through the model for the PEP and reviewed some of the initial proposals. In the field, we query everyone we interview to see how they perceive the AMSP Regional Identity and what connections they have made to other institutions and reform efforts.

Return on Investment

Over the course of the evaluation work this spring, we have encountered a number of examples of instances when the AMSP enhanced or benefited from work begun by another project. We list a few of these examples below:

- AMSP Regional Collaborators share office space with ARSI staff and in doing so have an opportunity to make stronger initial connections with their districts.
- Members of AMSP – a Regional Coordinator, a professor of math education, and a handful of teachers – attended the ACCLAIM Leadership Institute during July 2003 and received grants to provide local professional development.
- Former and current ARSI Teacher Partners are established math and science leaders in their communities who now refer local teachers to AMSP professional development opportunities. Some also serve as AMSP Mentored Interns, supporting the work of the Teacher Enhancement investment strand.
- Multiple districts are now implementing or considering implementing NSF-funded mathematics curricula, due to a series of experiences connected to ARSI, ACCLAIM, and AMSP.
- As a result of the Glade Springs conference, a group representing multiple improvement initiatives agreed to explore the concept of joint data collection so that schools and districts would not be burdened by reporting overlapping or duplicate data for various projects.

In addition, throughout our site visits involving schools, districts, and IHEs, educators and administrators tell us that the AMSP is providing many opportunities to collaborate within and between schools and districts, within and between IHEs, and between IHEs and districts.

IMPLEMENTING NEW CURRICULUM IN POWELL COUNTY

In September 2004, Powell County will begin its district-wide implementation of the Math Trailblazers program. It will be the first time in 30 years that all three elementary schools in the county have used the same set of curriculum materials. The way this all came about is indicative of how the AMSP partnership is operating in Appalachia. First, a recently-hired Regional Coordinator was sent to the ACCLAIM Leadership Institute last summer. There she met staff from EDC who were looking for someone to host one their Regional Collaborators "Choosing Curriculum" seminars. The Regional Coordinator and an AMSP Math Education faculty member volunteered. They used their AMSP connections to publicize the seminar - twice the number of people expressed interest than they had space for. In Powell County, a former ARSI Teacher Partner heard about the offering and realized it was just what her district needed. She acted quickly and put together a team to attend. The team returned convinced that Trailblazers was the direction they wanted to take. Others followed their lead. Powell County now plans to partner with a neighboring county that is also implementing NSF-funded math materials at the elementary level to design a PEP.

Next Steps/Challenges

- The opportunities are seemingly endless with this line of investment. Therefore, there is a danger of the effort becoming too disperse and fragmented.
- The AMSP must continue to communicate what the partnership is and does using a variety of media.
- In forging connections with other projects, the AMSP needs to determine the appropriate relationship according to their shared purpose – connections should not be made in a one-size-fits-all fashion.

SECTION 3: Alignment with MSP Key Features

In this section we provide a brief, complementary perspective and assessment of the AMSP work to date. Rather than describe the work in terms of the strands of investment, in this section we look at the work in terms of the NSF-defined “key features” that should pertain to all MSP projects. We hope that this summary view will help the reader gain additional perspective on the work and progress of the AMSP to date, as well as the challenges it continues to face.

PARTNERSHIP DRIVEN

The AMSP is very much “partnership driven.” However, we caution that the way we construe partnership is more complex than a single, large partnership. Rather it is in terms of the conceptual model described in Section 1. More specifically, we can make the summary statements about the AMSP partnership to date:

- ◆ The AMSP serves as an umbrella structure providing opportunities for entities throughout the system to establish relationships, identify relevant work, and to forge partnerships to accomplish that work.
- ◆ Various strands of investment and their components optimize opportunities for working groups to become partnerships – examples include: Course Development Teams, Success for Seniors, PEP grants.
- ◆ Good partnerships involve authentic and equitable relationships. The UK has proceeded with caution and gone thoughtfully about its work with the other AMSP partners, trying to avoid a situation of “big brother.” Our interviews indicated that K-12 and higher education partners see the AMSP work as collaborative rather than top-down.

EXAMPLE: A school counselor who is the unofficial Math Resource person for her district also serves on the Math For Teachers Course Development Team. She describes the work of the AMSP as follows: “We are trying to build a bridge from higher ed to the elementary schools and back again.”

Overall, the AMSP has made strong progress in terms of cultivated good partnerships. However, this work is ongoing and much remains to be done. The next challenges for the AMSP partnerships include the following:

- The K-12 partners need additional direct access to participation in the AMSP. The PEP grants are one opportunity for schools and districts to design and initiate activities that fit within the current strands of investment. Other avenues are needed, and this will require further creativity on the part of the AMSP leadership.
- The AMSP must continue to find ways of connecting with other NSF projects in the

Appalachian region. In particular, being more strategic about building relationships with ARSI, ACCLAIM and the Coalfields Rural Systemic Initiative is essential to its overall effectiveness. The AMSP is currently making connections with EPSCOR – an example of a relationship that can serve both partners well.

TEACHER QUALITY, QUANTITY & DIVERSITY

The MSP is addressing the issue of teacher quality, quantity and diversity in multiple ways. We report here our reflections based on the work of the external evaluation.

- ◆ The quality of teachers working in Appalachia depends upon the quality of the people who enter the teaching force, the preparation they have for that job, and the support they receive while working as teachers. The student opportunity programs may well have a long-term impact on who enters the teaching force. The courses that are being developed and implemented in the colleges will contribute to the knowledge base of new teachers who enter the system. Evidence from the first two years strongly suggests that the Summer Institutes and other AMSP professional development supports are contributing to a system that will provide ongoing learning opportunities for teachers in the field.
- ◆ In terms of the quantity of teachers, the student programs at both the high school and college level show early signs of significant success in attracting prospective teachers to the profession. Additionally, the AMSP is disseminating information about state policies and student loan forgiveness plans might steer the career choices of eligible young people toward education.
- ◆ The issue of diversity is not straightforward in Appalachia. The percentage of ethnic minorities in the overall population of the targeted counties is quite low – considerably lower than in other parts of Kentucky, Tennessee, and Virginia. Issues of diversity and adequate representation tend to center more around economics, geography, and gender. For example, on the one hand, male teachers continue to outnumber female teachers in secondary math and science; on the other hand, more females are successfully graduating from high school and going on to college than males. According to our observations and interviews, students from a variety of demographic backgrounds are participating in both the Excel and Explorers programs. The participation of Kentucky State University, with its history of serving African American students, provides the additional possibility of diversifying the pool of future teachers.

The issues emerging for the AMSP in this area include the following:

- While the AMSP is offering high-quality learning opportunities for a number of teachers, the question now arising is how to “scale up” their offerings so that they can meet the current demand and, potentially, a much larger future demand for professional

development.

- The issue of diversity needs to be more central and deliberately addressed. The AMSP will need to find ways to engage their whole community in taking this issue more seriously and defining it locally.
- The issue of teacher supply is most critical at the high school level. Many teachers who graduate from Appalachian colleges go to jobs out of state where the pay is higher. A special and creative response will be needed if the AMSP is to truly impact the number and quality of teachers at the secondary level in math and science.

CHALLENGING COURSES AND CURRICULUM

The MSPs seek to help local schools and districts increase the quality of the math and science curricula they offer students, both at the K-12 and higher education levels. The AMSP has responded to this challenge in the following ways:

- ◆ The pre-service courses and Summer Institutes that have been offered to date incorporate a variety of curricular materials developed with NSF funds. Examples include: *Investigations in Data, Number, and Space*; *Connected Math*; and *Physics by Inquiry*.
- ◆ The work of Regional Coordinators and PEPs can help support districts interested in learning about, identifying and implementing challenging curricula.
- ◆ “Using Data, Getting Results” helps schools and districts examine their data to better understand the student achievement issues and course-taking patterns, and how to address them. Curriculum improvement is one obvious solution to this issue.
- ◆ “Success for Seniors” is educating those at the high school level about under-achieving math and science course-taking patterns that can inadvertently accompany block scheduling.

The challenges faced by the AMSP in this area include the following:

- Given the current financial struggles of most states and districts, the AMSP will want to carefully track state and district curriculum adoption cycles in order to provide guidance and leadership as they invest in new materials.
- Challenging curricula place more demands upon teachers and students. In many Appalachian districts and schools it is not clear that they are willing to take on these additional demands.
- The lowest achieving Appalachian schools are facing sanctions under the state

administration of the NCLB law. These schools are pressured to raise scores on state tests. It is not clear to them what kind of “challenging curriculum” will best suit their needs, and there may well be a conflict between “reform curricula” and more standard textbooks. Additionally, community norms may argue for more traditional curricula and teaching practices.

- The identification, adoption and implementation of challenging curricula requires curricular leadership, professional development, and extra resources. Capitalizing on the foundation laid by ARSI in many of its partnering K-12 districts, the AMSP is continuing to contribute to these domains, but the capacity for true curricular reform can take years to develop.

The implications of all of this is that the AMSP must take a long-term view in terms of building the capacity within districts and colleges so that they have both the propensity and ability to choose and implement higher-quality and more challenging curriculum.

EVIDENCE-BASED DESIGN & OUTCOMES

All MSPs are intended to have designs that are grounded in research that can accommodate change according to feedback along the way. The AMSP continues to improve its capacity to seek out, generate, and make use of relevant research. Below we cite some examples of this progress:

- ◆ From the outset, the AMSP has dedicated substantial resources to the development and maintenance of its comprehensive information management system, demonstrating an overall orientation towards collecting data and desiring evidence.
- ◆ The AMSP Research Advisory Council has met to develop a carefully considered research agenda.
- ◆ The Science Courses have all committed to a model of pre- and post-testing all teacher participants with respect to content knowledge.
- ◆ The design of the external evaluation aims to bring field-based information to the project in a timely fashion. To date, project leaders have taken a proactive stance to such data, demonstrating a willingness to respond to recommendations and make necessary mid-course corrections. Examples include:
 - reworking the schedule of how science offerings would roll out over the course of the initiative
 - initiating the “Success for Seniors” strand and trying to place a greater focus on the high school
 - developing field-initiated PEPs

- ◆ The development of the courses draws on research about teaching and learning as well as a process of piloting and revising in order to strengthen the quality of the courses that result.

As we have stated earlier, we believe it is essential that the AMSP systematically and deliberately continue to develop its own “research” strand that focuses on learning about and from its own work.

INSTITUTIONAL CHANGE & SUSTAINABILITY

The work of MSPs should not be completely ephemeral and marginal to the institutions that participate. The goal is to change the perspective, policies, priorities and modes of working of K-12 as well as higher education institutions so that they are better positioned to continue the improvements accomplished with support of the NSF grant. For the AMSP we highlight the following:

- ◆ In Appalachia, institutional change is closely related to personal change. The involvement and commitment of individuals is a sine qua non for influencing the behavior of schools and colleges. Hence, the involvement created through the work generated by the AMSP programs and components is key to the long-term change in policies and practices of schools and colleges.
- ◆ The AMSP is pursuing a subtle and customized strategy of infusing changes into schools and districts. The AMSP is sponsoring multiple components that allow for and support institutions examining their own policies and practices. The whole strand of **School Improvement & Program Enhancement** emphasizes self-examination, as does the work of the PEP grants. By creating new programs and supporting individuals as well as institutions, the AMSP is building the vision and grassroots foundations that will ultimately influence the policies and practices of the system. Often in large urban settings this approach fails, as it turns out that institutional policies have longer life spans than the tenure of some of the reformers who work in them. In Appalachia there is more hope for a grassroots strategy because the scale of the systems is small, the decision-making processes are highly local and personal, and rates of transience and staff turnover are low.
- ◆ Finally, the establishment of new courses at the higher ed level and new programs, like Excel at the K-12 level, especially because they are responding to a local need, ultimately lead to buy-in and, therefore, change. These programs are designed to be institutionalized – some courses, for example, are often a reworking of prior or existing courses, as opposed to entirely new entities that would be more difficult to get into a college catalogue.

The AMSP thus has a grassroots and customized strategy for “institutionalization.” While this

approach makes sense, it is nonetheless true that the AMSP will need to continue:

- Working with the Deans and Administrators at the IHEs to ensure top-down support for the grassroots reforms happening through the work of the AMSP;
- Working directly with Superintendents to make sure that they understand and come to support the kinds of changes infused into their schools through AMSP collaboration;
- Identifying and ultimately influencing the key policies and conditions that most influence the nature and quality of instruction occurring in Appalachian colleges and schools.

SECTION 4: Overarching Challenges

The AMSP is continuing to refine its conceptual model, management and communication structures, and investment strands. After nearly a year, with all 60 designated K-12 and higher education partners now actively engaged in the work, the AMSP now faces the following major challenges and issues:

♦ **articulating and operating within their own vision of their partnership and the conceptual model**

The AMSP, we believe, is pursuing a different model for its partnership. Serving as an umbrella organization, the AMSP has an approach that resembles the micro-finance strategy, organized around multiple strands of investment. We believe this is a good conceptual model and one that has great promise for this project as well as others. The AMSP has created a web-based management system that reflects this model and can help to facilitate and organize all of the different programs and components involved in the AMSP work. While this represents good progress, it remains unclear that the management structure is best set up for pursuing multiple strands of work. (The project is currently structured around three major components – science, math and implementation.) The initiative faces the challenge of using this structure, or creating an alternative, in order to operate within the conceptual model and to organize work that is complicated and diverse. Equally important, the project needs to create a shared vision of its conceptual model and use that vision to help everyone involved see how the AMSP's work is coherent and sensibly organized. Otherwise, the project runs the risk of being viewed as, and indeed operating as, many unrelated pieces.

♦ **articulating, studying and refining the strands of investment that the AMSP pursues**

As we have described in this report, the AMSP is supporting partnerships that 1) meet local needs, 2) build local capacity, and 3) support the achievement of the broader AMSP goals. To date the work of the AMSP has been organized according to program and component. We believe that using the concept of investment strands, and being explicit about each strand as to its goals, principles, and intended outcomes, could help clarify the work of the AMSP. Then, it will also be possible to study and refine the strands pursued and the work undertaken by each strand.

We have noted earlier in this report that the design of the programs and components within each strand need ongoing study, refinement, and assessment. For example, we recommend carefully considering the relationship between the Explorers and Excel programs. We have also noted the need for greater connection and networking within strands – e.g., promoting stronger connections between course develop teams.

♦ **cultivating mid-level leadership**

The AMSP needs leadership at two key levels in order to function successfully. One is the leadership of the project itself – and here, we judge the program to be strong as it has very experienced people involved in the key leadership positions. In addition, the project needs effective and plentiful leadership at the “mid-level” – people who can oversee the programs and components that are essential parts of the investment strands pursued. The Regional Coordinators are a good example of such leadership, but it is clear that they are not enough. For example, the AMSP needs leaders for the Excel program, the “Leading by Design” program, and the PEP effort that are not already serving as leaders in other areas. Simply put, more people are needed to do the work, and not just oversee it. But more deeply, it is important that the AMSP more deliberately foster leadership in the region, and it is important that each strand of investment and key components and programs be guided by good leaders. We recognize that doing so without incurring large administrative costs will be difficult, but we are not convinced that simply having Co-PIs serve as leaders of the math, science, and implementation divisions of the AMSP work is adequate, especially given the complexities of the initiative.

♦ **strengthening management and communications strategies and methods**

The AMSP is a complex initiative and ultimately involves thousands of people. The way in which the program is managed, and the ways in which it communicates with the world, are closely related. Both are key to its success. We encountered repeated instances of people wanting better communication from the AMSP and more access to the AMSP. The web-based management system is a powerful and promising tool but it is not sufficient unto itself. Multiple modes and channels of communication are needed. Many people cannot or will not use the web as a primary source of information. Multiple redundant lines of communication need to exist.

♦ **fully establishing a research strand that is able to inform, document, and disseminate the work of the AMSP**

The MSPs aim to serve multiple purposes. They are charged with improving math and science teaching at a local level; toward that end they are meant to have measurable local impacts. They also aim to develop leadership, build connections and relations, create programs, and improve policies; toward that end they are capacity building projects. In addition, MSPs are meant to generate broader knowledge (in this case about improving education in rural regions); toward that end they are research initiatives. The AMSP has initiated multiple efforts toward studying its work and the issues it faces. It has an internal data gathering system for assessing the impact of its work at the local level, and it has established a Research Advisory Council – both under the direction of a Mathematics Outreach Professor hired last year. While the external evaluation can help contribute to the overall AMSP research effort to date, the various areas of AMSP-based research need to be better coordinated and focused. Perhaps what is needed is a “research

strand” – a line of investment that is similar to other AMSP lines of investment. The research emphasis for the MSPs has increased of late, and the AMSP might respond by directing more structure and attention toward its own research efforts.

Closing Thoughts

The AMSP is now nearing the end of its second year of work. The project has put in place a complex management structure and initiated work on six strands of investment: The project has successfully launched collaborative work that has developed courses and created student programs. It has also initiated work in the area of professional development and local school program improvements. Finally, it has begun the foundational work for leadership development and research that will contribute to the long-term capacity of the region for ongoing improvement in math and science education.

Of equal importance, the AMSP is re-conceptualizing its role and its work. It is developing a more sophisticated and useful notion of “partnership” – serving as “umbrella partnership,” a new institution and generative structure – that is capable of initiating and supporting multiple strands of investment. And within each strand of investment, the AMSP is developing local programs and components that both develop and draw upon local working partnerships. To date, there has been strong involvement of higher education faculty, school administrators, and teachers – and more importantly, the relationships have proven mutually beneficial and respectful. In addition to fostering collaboration within each strand of investment, the AMSP is designed to generate work that addresses local needs, that builds local capacity, and that directs progress toward project goals and benchmarks.

The AMSP is now well-positioned to proceed according to this vision. The external evaluation will continue to track both the evolving conceptual model that underlies the design of the AMSP initiative, and the quality and impact of the work that results. No doubt, the AMSP leaders will need to be creative, tenacious and very hard working to realize the goals they have set. However, from our position as outside evaluators we believe the AMSP is on a positive trajectory towards actualizing its benchmarks. The future looks promising.