Arkansas Math and Science Partnership Project Evaluation for 2011-2012

Project Conducted by the Arkansas Department of Education

Ms. Judy Trowell, Director

Evaluation Produced by the National Office for Research on Measurement and Evaluation Systems

University of Arkansas

Dr. Sandra Bowman
Dr. Charles Stegman
Dr. Jam Khojasteh

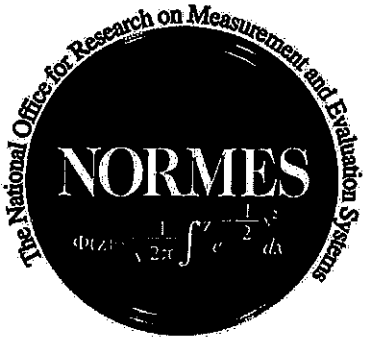


Table of Contents

Tables

Figures

Executive Summary

Our nation's students are underachieving in mathematics and science compared to students in other industrialized nations. Research suggests that increased teacher content knowledge and teaching skills lead to improved student achievement (Hill, Rowan & Ball, 2005; Goe, 2007; Krauss, Baumert, & Blum, 2008).The purpose of the Arkansas Mathematics and Science Partnership (MSP) program is to improve student learning in mathematics and science through intensive, high-quality professional development activities that focus on enhancing teachers' content and pedagogical knowledge.

The MSP program is a formula grant program to the states, with the size of individual state awards based on counts of students living in poverty. With these funds, each state administers a grant competition, in which awards are made to partnerships to improve teacher knowledge and skills in mathematics and science.

Since 2004, the National Science Foundation's (NSF) Math and Science Partnership (MSP) program has awarded Arkansas over $18,300,000 to fund 47 partnerships. The partnerships between institutions of higher education, high need school systems, and other qualifying partners design, deliver, and evaluate professional activities intended to increase teacher content skills.

NSF awarded Arkansas over $1,600,000 during the 2011-2012 funding period to fund eight partnerships in Cohort 6--the focus of this evaluation.

Characteristics of MSP Projects and Participants

Thirty-four faculty members from institutions of higher education including 28 from STEM areas were involved with the MSP projects in PP12, with an average of 4.25 IHE faculty members per project. MSP projects reporting in 2012 had an average of 14 partner organizations and eight school districts. The number of partners ranged from three to 26. The number of school districts ranged from one to 21.

The number of participants involved in MSP professional development across all projects in 2011-2012 was 336. The number of each project's participants ranged from 25 to 85. Expenditures per participant ranged from $3,016 to $5,994 with the average expenditure being $4,388.

The target population for Cohort 6 MSP professional development is classroom teachers in grades 3-8. MSP participants are distributed across school levels as follows: 25 percent at the elementary level, 74 percent at the middle school level, and one percent at the high school level. Across all projects, 19,510 students benefited from the MSP.

Teacher Content Knowledge Gains

Increasing teacher content knowledge is important to achieving changes in teacher practices. Six projects reported significant gains in teacher content knowledge. The percent of teachers with significant gains ranged from 52 to 75 percent. For 2011-2012 a meta-analysis is also provided. The individual effect sizes (Fisher z-transformation) range from .07 to .30 which are considered small. In education, if it could be shown that making a small change would raise academic achievement by an effect size of even as little as 0.1, then this could be a very significant improvement, particularly if the effect were cumulative over time (Coe, 2002).

Professional Development Content and Models

In recent decades, school reform efforts have recognized teacher professional development as a key component of change and as an important link between the standards movement and student achievement. Many research studies have identified components of in-service teacher professional development programs that have an effect on practice and student learning. The first component is the substantial time that needs to be invested in the professional development experience for it to have an effect on practice and ultimately student learning.

The professional development activities offered by MSP projects focus on increasing teachers' content knowledge in mathematics and enhancing their pedagogical skills. All projects offered summer institutes with school-year follow-up activities. Projects reported offering from 70 to 112 hours of professional development with the average being 88 hours. An equal number of projects reported delivering professional development on-site and off-site. Eighty-eight percent of the projects used Reformed Teaching Observation Protocol (RTOP) to assess classroom practice.

Most MSP projects addressed multiple content areas and topics. Across schools, numbers and operations and algebra were the most frequently addressed content areas with five (63%) projects offering professional development in these areas. Geometry and other-rational number concepts were the least frequently addressed content area with only one project concentrating on these areas.

Respondents were generally positive about their perceptions of local MSP progress toward objectives. Some partners noted changes in teacher knowledge and attitudes for their project.

Project Evaluation Design

The Math and Science Partnership program represents a significant investment by the NSF. Accordingly, project-level evaluations are critical to helping the NSF understand and assess the value of its investment. MSP projects reported the primary designs they used to assess program outcomes. All projects reported using a quasi-experimental design with 25 percent

using a matched comparison group design and 75 percent using a non-matched comparison group. All projects reported using a pre-test and post-test to assess the content knowledge gains of the teachers severed by MSP.

The most frequently reported assessments of teacher content knowledge in mathematics were national normed/standardized tests (63 percent of projects.) Projects that did not use nationally normed or standardized content assessments developed their own assessments.

All projects shared common goals: improving teacher content knowledge and teaching methods. And for all eight projects the primary target was individual teachers as opposed to whole school reform.

Conclusions

The first year of the project was focused on establishing infrastructure, which required rather rigid adherence to MSP policies. Teachers participating in the MSP professional development receive intensive and sustained content-rich professional development form college and university faculty partners. Although it is too early to see achievement of long-term outcomes, examples of short-term and mid-term outcomes are becoming evident, such as increased awareness of research-based instructional practices and materials, increase in teacher content knowledge, increased collaboration among different partners and alignment of curriculum with professional development and State Common Core Standards.

Section 1: Introduction

Our nation's students are underachieving in mathematics and science compared to students in other industrialized nations. On international tests of science and mathematics such as Trends in International Mathematics and Science Study (TIMSS) and Program for International Student Assessment (PISA) American students ranked 23rd in math and 31st in science when compared with 65 other top industrial countries. Only 26 percent of our nation's high school seniors perform at proficient levels or above in mathematics and only 21 percent of our nation's high school seniors perform at proficient levels or above in science (Provasnik, 2012).

The Science and Engineering Readiness Index (SERI) measures how high school students are performing in physics and calculus--based on publicly available data. The SERI score given to each state is based on a scale from 1 to 5 and reflects how well states perform. Arkansas was one of 21 states to earn a ranking of "below average" or "far below average" with a score of 2.14 (41 out of 50). The national average is 2.82. State scores range from 1.11 to 4.82 (Blue, 2011). Clearly there is much room for improvement in science and mathematics education in Arkansas.

Research suggests that increased teacher content knowledge and teaching skills lead to improved student achievement (Hill, Rowan & Ball, 2005; Goe, 2007; Krauss, Baumert, & Blum, 2008). Therefore, education improvement efforts increasingly focus on the teachers as the most powerful approach to increase student learning.

Overview of the Mathematics and Science Partnership Program

In January 2002, the No Child Left Behind Act of 2011 (NCLB) became law (Public Law 107-110). Title II, Part B of this legislation authorized the MSP competitive grant program. The MSP is intended to increase the academic achievement of students in mathematics and science by enhancing the subject matter knowledge and teaching skills of classroom teachers. Partnerships between high-need school districts and the science, technology, engineering, and mathematics (STEM) faculty in institutions of higher education (IHE) are at the core of these improvements efforts. STEM faculty's substantial intellectual engagement in these projects is one of the attributes that distinguishes the MSP program from other programs seeking to improve K-12 student outcomes in mathematics and science.

The MSP program is a formula grant program to the states, with the size of individual state awards based on counts of students living in poverty. With these funds, each state administers a grant competition, in which awards are made to partnerships to improve teacher knowledge and skills in mathematics and science.

Figure1 shows how federal support for the MSP program in Arkansas increased substantially from the program's inception in FY 2004 ($1,025,320). Funding has remained above $1,600,000 since FY 2005 reaching a high in FY 2010 of $2,137,830.

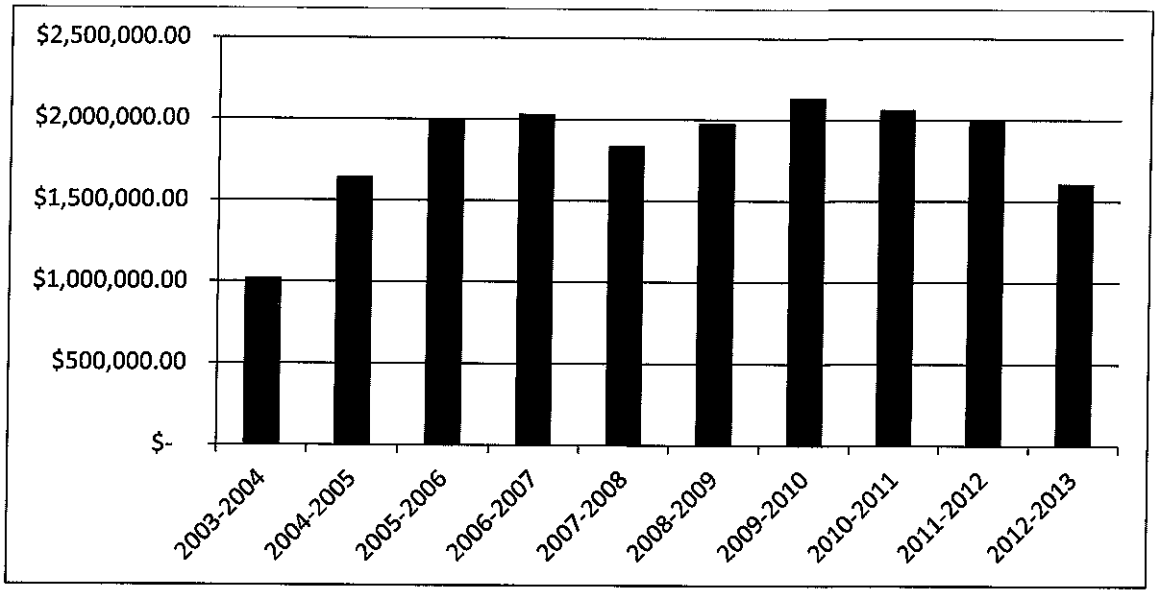
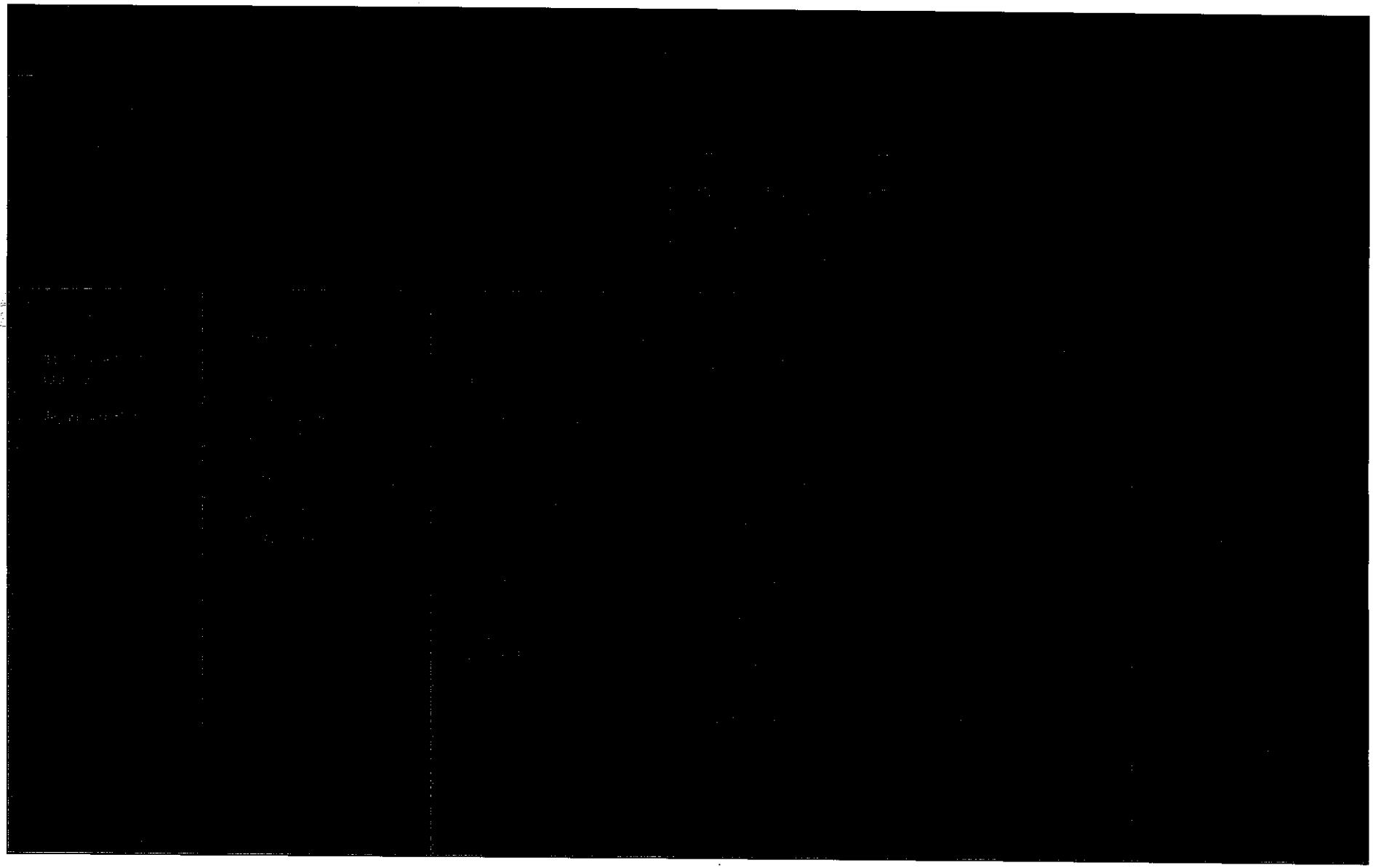


Figure 1: MSP Program Funding, Fiscal Years 2004-2012

The Arkansas Department of Education (ADE) is responsible for the administration of this program. Funds available for the MSP program were awarded by the ADE to support successful proposals submitted by Arkansas institutions of higher education (IHEs), school districts, or nonprofit organizations (NPOs) that have formed partnerships focused on the improvement of mathematics and/or science instruction in grades K-12. Each partnership formed was based on its own regional needs and history of partnering; therefore partnerships varied in terms of number of districts and IHEs included. Partnerships included, at a minimum, a high-need district and a department of mathematics, science, or engineering in an IHE. For the purposes of the Arkansas MSP program, ADE defines a high-need district as one that has 25 percent or more of the students on free or reduced lunch *and* has one or more schools designated as a school in improvement. In the state of Arkansas, there are eight funded projects in Cohort 6. The number of school districts included in the partnerships ranges from one to 21.

The MSP professional development model recognizes that curricular and pedagogical reform is at the heart of sustainable change in mathematics and science education. Arkansas' MSP programs are designed to provide a challenging curriculum for every student by providing rigorous professional development opportunities to teachers that focus on continuously upgrading teachers' knowledge and skills. The MSP conceptual logic model on the following page illustrates the interrelationships among the MSP program's goals, activities, and structure.

Logic models are commonly used in evaluation, and offer visual representations of a program's path to achieving intended outcomes.



Inputs: Inputs are the resources that support or guide the MSP activities. The NSF provides the funding to support the MSP activities. MSP staff including the MSP director and project coordinators facilitates many activities through coordinating and maintaining contact with the different partners. Partnerships are the core of the program.

Activities: The inputs support the activities necessary to bring about outputs. Professional development is the major impetus for bringing about change. Continuous, long term professional development that includes content and pedagogical knowledge workshops is the primary avenue that may lead to student achievement.

Outputs: Outputs are the direct and tangible products of the MSP activities. There are five major outputs from the MSP activities: 1) individuals' exposure to skills and knowledge-enriching activities; 2) Common Core Curriculum and planning materials; 3) refined math curriculum frameworks; 4) materials/tools that can be accessed and utilized for courses, curriculum and district planning; and 5) opportunities for interactions and networking.

Outcomes: The next three columns list the expected outcomes that develop from these outputs. Short term outcomes are defined as increase in knowledge, skills, and awareness. Many short term outcomes describe the kinds of increases in knowledge, skills, and awareness that are expected for the instructional leaders. For example, we expect to see evidence of increases in awareness and knowledge of research-based practices and materials, teacher content knowledge, and leadership skills, and an increase in STEM faculty involvement. Mid-term outcomes are the changes in behavior or practice that occur presumably as a result of the increases in knowledge, skills, and awareness. Together, the changes outlined in the mid-term outcomes should lead to achievement of the project goals which are defined as the long-term outcomes.

Theory of Action: The theory of action that undergirds the MSP logic model is based on the view that student achievement in mathematics and science can be improved by classroom teachers who are willing to become learners and deepen their own conceptual understanding of mathematics and science. This theory of action argues that providing teachers with opportunities to deepen their content and pedagogical knowledge in the context of high-quality instructional materials will result in better prepared teachers. Improved instruction will, in turn, lead to higher student achievement.

Both the MSP logic model and research evaluation questions provide a framework to guide the evaluation.

Overview of the MSP Evaluation

Every MSP project is required to design and implement an evaluation and accountability plan locally that allows for an assessment of its effectiveness. Projects are required to report annually on two aspects of their evaluation findings: 1) gains in teacher content knowledge based on pre- and post-testing; and 2) proficiency levels on state-level assessments of students of teachers who received professional development. In addition to each partnership's own local evaluation, the National Office of Measurement and Evaluation Systems (NORMES) at the University of Arkansas have contracted with the Arkansas Department of Education since 2006 to assist with yearly statewide evaluations of the MSP projects.

Based on the goals of the MSP program, the questions guiding these evaluations include the following:

1. Did Arkansas' MSP projects provide professional development with significant and meaningful content that models the instructional strategies that will enable teachers to teach in a manner that will improve student achievement in mathematics and/or science?

2. Did Arkansas' MSP projects improve and upgrade the status and stature of mathematics and/or science teaching by encouraging IHEs to assume greater responsibility for improving mathematics and/or science teacher education through the establishment of a comprehensive, integrated system of professional development that continuously stimulates teachers' intellectual growth and upgrades teachers' knowledge and skills?

3. Did Arkansas' MSP projects provide opportunities to focus on ways to deepen teachers' subject matter knowledge, increase teachers' knowledge of how students learn particular subject matter, provide opportunities for engaging learning, and establish coherence in teachers' professional development experiences?

4. Did Arkansas' MSP projects bring mathematics and/or science teachers in elementary schools and secondary schools together with scientists, mathematicians, and engineers to increase the subject matter knowledge of mathematics and/or science teachers and improve such teachers' teaching skills?

5. Did Arkansas' MSP projects develop more concise and rigorous instructional resources that are precisely aligned to state and local academic content standards and with the standards expected for preparation of students for postsecondary study in engineering, mathematics, and science?

6. Did Arkansas' MSP projects provide opportunities to improve and expand training of mathematics and/or science teachers, including training such teachers in the effective integration of technology into curricula and instruction?

Purpose of this Report

This report is the first in a series of three annual evaluation reports that details the evolution of the MSP Cohort 6. The primary purpose of this report is to provide formative assessment of activities to date. This report presents a summary of the data for projects in their first year of funding for Performance Period 2012. The findings presented in this report are primarily based on annual performance report (APR) data submitted by all MSP projects by September 30, 2012.

Organization of this Report

The remainder of this report is organized into six sections and the appendix, as follows:

Section 2: Characteristics of MSP Projects and Participants

Section 3: Teacher Content Knowledge Gains

Section 4: Professional Development Content, Models, and Activities

Section 5: Project Evaluation Designs

Section 6: Conclusions and Recommendations

References

Appendix: Project Summaries

Section 2:
Characteristics of MSP Projects and Participants

This section describes the MSP program and the general characteristics of the MSP projects. It provides information on the amounts of funding awarded to MSP projects, the types and number of partners involved in MSP projects, and the number of teachers and students served by MSP projects.

Program Description

The MSP program is a major research and development effort that supports innovative partnerships to improve K-12 student achievement in mathematics and science. MSP projects are expected to both raise the achievement levels of all students and significantly reduce achievement gaps in the mathematics and science performance of diverse student populations by enhancing the content knowledge and teaching skills of classroom teachers. Successful projects serve as models that can be widely replicated in educational practice to improve the mathematics and science achievement of all the nation's students (NSF, 2003).

Partnerships between high-need school districts and the science, technology, engineering, and mathematics (STEM) faculty in institutions of higher education are at the core of these improvement efforts. Other partners may include state education agencies, public charter schools or other public schools, businesses, and nonprofit or for-profit organizations concerned with mathematics and science education.

Consistent with the objectives of the overall MSP program, the primary goals of this partnership are to increase K-12 students' knowledge of mathematics and science thereby preparing them to be successful in advanced math and science courses; enhance the quality, quantity and diversity of the K-12 mathematics and science teacher workforce; create sustainable partnerships with IHEs; and improve the mathematics and science learning experiences for all undergraduates.

These goals will be accomplished through three intervention strategies:

- Professional development for content and pedagogy is accomplished through workshops and seminars for K-12 educators led by university faculty and experts in the field.

- Curriculum alignment and pedagogical and course enhancement is accomplished at the K-12 level through the use of curriculum frameworks.

- Support for and dissemination of research based resources and tools is primarily accomplished through the state MSP office and networks of educators using research-based curricula.

The first strategy is designed to create teachers who are knowledgeable and confident in using research-based teaching strategies in teaching mathematics with the end result being improved student performance in mathematics. The second strategy of curriculum alignment and pedagogical and course refinement is accomplished through the use of math and science curriculum frameworks for the State Common Core Standards at the K-12 level. Finally, the third strategy of disseminating and supporting the use of research-based resources and tools is achieved in part through network connections, individual MSP partnership websites, and the state MSP office.

Amount of Funding

The MSP program is a formula grant program to the states, with the size of individual state awards based on student population and poverty rates. With these funds, each state is responsible for administering a grant competition, in which grants are made to partnerships to improve teacher knowledge in mathematics and science. All projects in Cohort 6 received their initial award on August 5, 2011. The amount of funding for individual projects ranged from $128,171 to the $283,515 with an average funding level of $161,546. All projects in Cohort 6 completed their first year of implementation. Table 2.1 lists award amounts for each project.

Table 2.1

MSP Project Titles and Key Identifiers

MSP Project Title	Project Director	Lead Organization	Award Amount
Common Core Boot Camp	Julie Grady	Arkansas State University	$146,244
Thinking Mathematically for Common Core State Standards in Grades 3-5	Beth Neel	Dawson ESC	$134,986
6th-8th grade Algebra Common Core Initiative	Angelia Carlton	Northeast ESC	$149,750
The South Arkansas Mathematics Standards Project	Roger Guevara	South Central ESC	$167,807
University of Arkansas Engineering and Mathematics Partnership	Bryan Hill	University of Arkansas	$283,515
Getting to the Core: Grades 3-5 Mathematics Partnership	Shannon Dingman	University of Arkansas	$135,666
Math Core Team	Uma Garimella	University of Central Arkansas	$128,171
6th-8th Grade Common Core Geometry Project	Tony Finley	Wilbur D. Mills ESC	$149,750

Organization and Partnerships

The MSP program requires partnerships to include institutions of higher education (IHE) or eligible nonprofit organization (or consortium of such institutions or organizations) and one or more local education agencies (LEAs) that may also include a state educational agency or one or more businesses. Successful partnership building requires a significant amount of time, money, and effort—all of which may be considered valuable resources.

Partnerships between IHEs and school districts offer mutual benefits of respect and professionalism. Sustainability of the partnerships depends, in large part, on the IHEs recognizing the benefits of participating in the MSP. Most STEM faculty members do not receive any formal training in teaching. Consequently they tend to teach the way they have been taught, which is typically using a lecture-based format. As a result of MSP participation, faculty members have been exposed to different teaching strategies. Through participation in MSP activities and workshops, IHE faculty members have numerous opportunities to learn and reflect on the same inquiry-based and hands-on teaching practices as K-12 teachers. The impact of the

MSP on IHE teaching strategies can be significant. The openness and willingness to embrace different modes of practice represents a crucial element in changing the pipeline of teaching practices from K-16. The impact this will have on teaching strategies remains to be seen. One participant commented that it would be helpful if the presenter used the same strategies he/she was recommending.

The partnering school districts are high-need school districts that serve children from families where more than 25 percent of the students are on free or reduced lunch. Additionally, many participating school districts are rural, isolated school districts with at least one building in school improvement. In the partnership schools, the percentages of students who are economically disadvantaged (as measured by percent of students on Free or Reduced Lunch) range from 27 percent to 100 percent. The percentages of students who are minority populations vary widely from less than one percent to over 84 percent. Similarly, there is wide variation in student achievement levels across the state MSP projects. A substantial portion of MSP schools are not making adequate yearly progress under NCLB.

Each MSP grant has a designated fiscal agent that serves as the lead organization for the project. The fiscal agent is primarily responsible for distributing MSP funds, but often organizes and manages project activities as well. The lead organization is typically an education service cooperative or an IHE but it can also be a local school district.

Table 2.2 describes the number of projects based on lead organization type as well as the mean number of IHE faculty participants by lead organization type. As can be seen in Table 2.2, half of the projects were headed by education service cooperatives and half were headed by institutions of higher education. For all projects, the mean number of IHE faculty participants is 4.25 with a range of 3-7.

Table 2.2

2011-2012 MSP Project Lead Organization Type and Mean Faculty Participants

Type of Organization	Number and Percentage of Projects	Mean Faculty Participants	Range of Faculty Participants
Education Service Cooperative	4 (50.0)	4.25	3-5
Institute of Higher Education	4 (50.0)	4.25	3-7

Note: percentages are in ( ).

The participating IHE faculty was also examined by department. These results can be found in Table 2.3.

Table 2.3

IHE Faculty Participants by Department

Department	Number IHE Faculty
Education	6 (17%)
Mathematics	20 (59%)
Science	2 (6%)
Engineering	2 (6%)
Other	4 (12%)

n = 34

The MSP program establishes local partnerships that include: 1) a science, technology, engineering and/or mathematics department of an institution of higher education and 2) a high-need school district. However, MSP projects may incorporate other types of partners such as: education departments from IHEs; additional local education agencies including public charter schools, public or private elementary or secondary schools; and business and non-profit or for-profit organizations. MSP projects reporting in 2012 had an average of 14 partner organizations and eight school districts. As can be seen in Table 2.4, the number of partners ranged from three to 26. The number of school districts ranged from one to 21.

Table 2.4

Number of Participating Partners and Districts

Project Name	Number of Partners	Number of Districts
Common Core Boot Camp	3	1
Getting to the Core	9	7
South Arkansas Mathematics Standards Partnership	15	11
University of Arkansas Engineering & Mathematics Partnership	26	21
6th-8th Grade Algebra Common Core Interactive Initiative	15	13
Math Core Team (MCT)	5	3
6th-8th Grade Geometry Common Core Interactive Project	19	16
Thinking Mathematically for Common Core State Standards in Grades 3-5	17	11

The number of participants involved in MSP professional development across all projects in 2011-2012 was 336. The number of each project's participants ranged from 25 to 85. Expenditures per participant ranged from $3,016 to $5,994 with the average expenditure being $4,388. These results can be seen in Table 2.5.

Table 2.5

Number of Participants and Expenditure per Participants

Project Name	Number of Participants n=336	Expenditure per Participant
Common Core Boot Camp	25	$5,718
Getting to the Core	40	$3,444
South Arkansas Mathematics Standards Partnership	37	$4,671
University of Arkansas Engineering & Mathematics Partnership	85	$5,994
6th-8th Grade Algebra Common Core Interactive Initiative	42	$3,559
Math Core Team (MCT)	30	$4,320
6th-8th Grade Geometry Common Core Interactive Project	48	$3,016
Thinking Mathematically for Common Core State Standards in Grades 3-5	29	$4,382

Table 2.6 reveals the target population and number of students served by each project. The target population for Cohort 6 MSP professional development is classroom teachers in grades 3-8. MSP participants are distributed across school levels in PP12 as follows: 25 percent at the elementary level, 74 percent at the middle school level, and one percent at the high school level. Across all projects, 19,510 students benefited from the MSP.

Table 2.6

Targeted Population and Number of Students Served

Project Name	Targeted Population	Number Elementary Students n=4,962	Number Middle Students n=14,548
Common Core Boot Camp	Grades 3-7	117	861
Getting to the Core	Grades 3-5	1167	166
South Arkansas Mathematics Standards Partnership	Grades 3-8	660	120 127HS
University of Arkansas Engineering & Mathematics Partnership	Grades 6-8	0	8400
6th-8th Grade Algebra Common Core Interactive Initiative	Grades 6-8	0	2090
Math Core Team (MCT)	Grades 4-6	1518	0
6th-8th Grade Geometry Common Core Interactive Project	Grades 6-8	0	2784
Thinking Mathematically for Common Core State Standards in Grades 3-5	Grades 3-6	1500	0

Even though all eight projects in Cohort 6 are in their first year of implementation, they are at different stages of implementation. MSP projects classified their stage of implementation into one of three stages: (1) new, defined as conducting start-up tasks such as planning activities, formalizing partnerships, and implementing the professional development model for the first time; (2) developing, defined as revising, enhancing, or continuing to develop their professional development model; and (3) fully developed, defined as all components of a project's planned model were fully operational. Table 2.5 shows the number of projects in each stage of development.

Table 2.7

Stage of Implementation

Stage of Implementation	Number of Projects	Percent of Projects
Stage 1: New	4	50%
Stage 2: Developing	2	25%
Stage 3: Fully Developed	2	25%

N = 8

As you can see in Table 2.7, 50 percent of the projects are still in stage 1; 25 percent in stage 2; and 25 percent in stage 3.

Section 3:

Teacher Content Knowledge Gains

Research shows that increased teacher content knowledge and pedagogy knowledge lead to improved student achievement (Hill, Rowan, and Ball, 2005; Kilpatrick, et.al., 2001; Ball and Bass, 2000, 2003; Grossman, 2008; Goe, 2007; Krauss, Baumert, and Blum, 2008; Fennema and Carpenter, 1996). This section will utilize meta-analysis techniques to evaluate teacher content knowledge gains. Measuring gains in teachers' content knowledge is an important component of federal funding for MSP projects. These gains are expected to be used in the evaluation of the MSP grants. Different numbers of MSP projects have been supported each year in Arkansas. Utilizing individual program effect sizes and meta-analysis techniques provides statistical information to help evaluate the effectiveness of the MSP program in Arkansas.

Increasing Teacher Content Knowledge

As outlined in the MSP theory of action, increasing teacher content knowledge is important to achieving changes in teacher practices. Increased content knowledge makes teachers more comfortable with using many of the strategies advocated by the MSP. Evaluation summaries of the content knowledge seminars were generally positive. Some participants responded that as a result of the summer workshops they feel much more comfortable with being able to teach the Common Core Curriculum. Others responded that they can see much more clearly the progression of mathematics from 4th through 8th grades. Participants considered the workshops valuable in furthering their understanding of the importance of concepts that need to be covered in the Common Core Curriculum.

Project directors provided pre- and post-test scores for teachers that were assessed during PP12. Only projects that utilized existing, validated measures and that supplied raw data to the researchers were included in this analysis. The meta-analysis in this report was conducted using Biostat's Comprehensive Meta-Analysis Version 2 software.

Results

In 2011-2012 there were eight mathematics projects. Only projects that utilized existing, validated measures were included in this analysis. Two projects did not use validated tests, one project did not supply raw data, and one project was not able to give the post-test until after the deadline for reporting. Therefore, four projects were analyzed using meta-analysis. The individual effect sizes (Fisher z-transformation) range from .07 to .30, which is considered small, can be seen in Table 3.1 and Figure 3.1. The weighted value of z across the projects is .12 and

the 95% confidence level is .08 to .16. The test for homogeneity was statistically significant (Q = 14.78, df = 3, p = .002).

The effect size is a simple way of quantifying the difference between two groups. Effect size emphasis the size of the difference rather than confounding this with sample size and promotes a more scientific approach to the accumulation of knowledge. Caution should be used when interpreting effect size. Glass et al. (1981) argue that the effectiveness of a particular intervention can only be interpreted in relation to other interventions that seek to produce the same effect. In education, if it could be shown that making a small change would raise academic achievement by an effect size of even as little as 0.1, then this could be a very significant improvement, particularly if the effect were cumulative over time. One advantage of using effect size is that when a particular experiment has been replicated the different effect size estimates from each study can easily be combined to give an overall best estimate of the size of the effect (Coe, 2002).

Table 3.1

Meta Analysis of Cohort 6

	Statistics for Each Study						
Study Name	Fisher's Z	Standard Error	Variance	Lower Limit	Upper Limit	z	p
6-8 Grade Geometry	0.297	0.072	0.005	0.156	0.438	4.120	0.000
6-8 Grade Algebra	0.227	0.053	0.003	0.124	0.330	4.313	0.000
UA Engineering and Math Partnership	0.066	0.025	0.001	0.018	0.115	2.667	0.008
Math Core	0.133	0.061	0.004	0.013	0.252	2.174	0.030
Combined	0.116	0.020	0.000	0.076	0.155	5.713	0.000

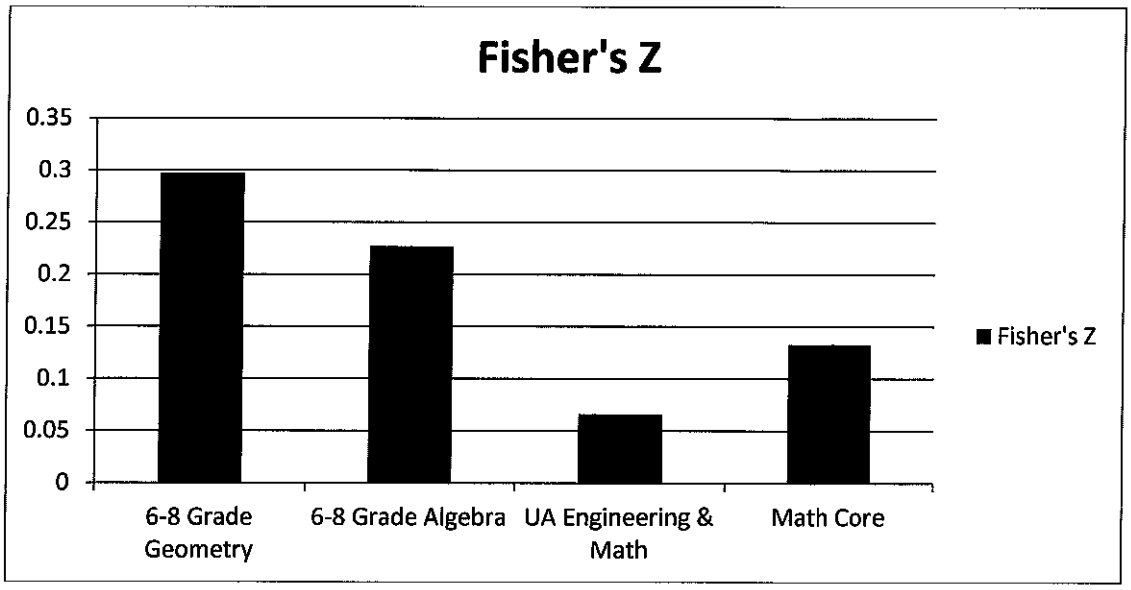


Figure 3.1: Meta Analysis

In the MSP, the professional development activities are essential to ensuring that teachers not only understand how to change instructional practices, but why such changes are important. Awareness of the larger purpose behind these changes is a critical component of sustainability, as it provides teachers with a foundation that should last beyond the funding period of MSP. Six projects reported statistics on teachers with significant gains in content knowledge. As detailed in Table 3.2 and Figure 3.2, percent of teachers with significant gains ranged from 52 percent to 75 percent.

Table 3.2

Percent of Teachers with Gains in Content Knowledge

Project	Total Number of Teachers Served	Number of teachers with content assessments	Percent of Assessed Teachers with Significant Gains
6th-8th Grade Algebra Common Core Interactive Initiative	42	37 (88%)	26 (70%)
6th-8th Grade Geometry Common Core Interactive Project	48	42 (88%)	22 (52%)
Common Core Boot Camp	25	19 (76%)	14 (74%)
Getting to the Core	40	40 (100%)	30 (75%)
Math Core Team (MCT)	30	27 (90%)	14 (52%)
South Arkansas Mathematics Standards Partnership	37	31 (84%)	17 (55%)
Thinking Mathematically for Common Core State Standards in Grades 3-5	29	No post test	NA
University of Arkansas Engineering & Mathematics Partnership	85	75 (88%)	Did Not Report

Across the six projects, who reported results, 62.8% of the teachers exhibited significant gains from pre-test to post-test.

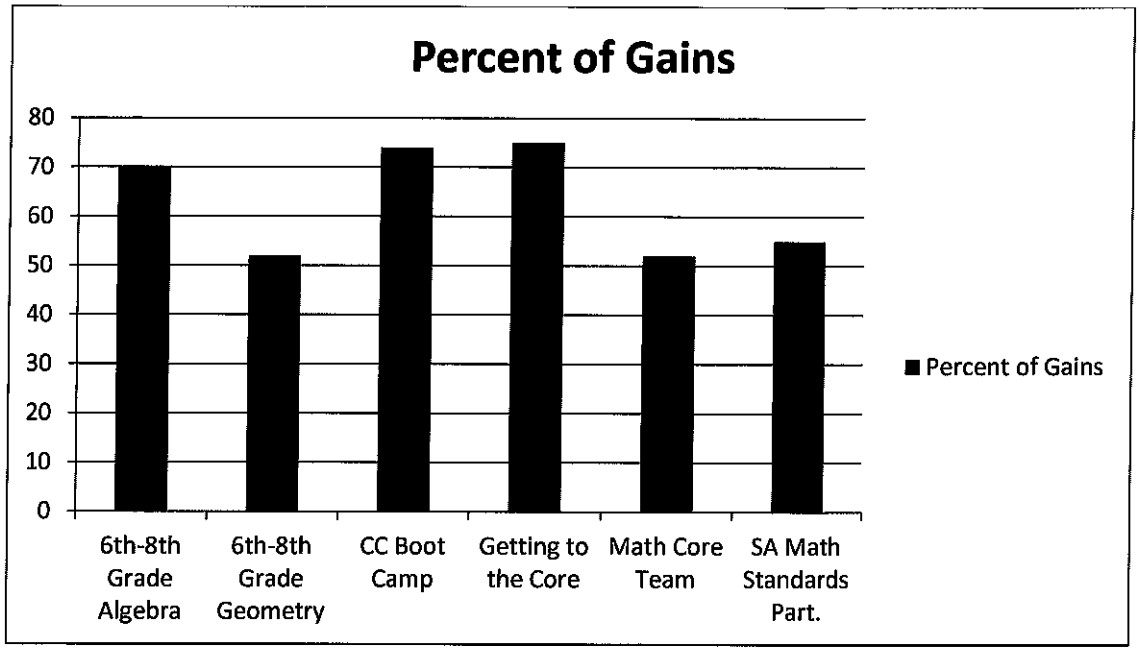


Figure 3.2: Percent of Teachers with Significant Gains

Section 4:

Professional Development Content and Models

In recent decades, school reform efforts have recognized teacher professional development as a key component of change and as an important link between the standards movement and student achievement. Many research studies have identified components of in-service teacher professional development programs that have an effect on practice and student learning. The first component is the substantial time that needs to be invested in the professional development experience for it to have an effect on practice and ultimately student learning. A review (Yoon, et al., 2007) of research studies with rigorous evaluation designs found that teachers who received an average of 49 hours of professional development, spread over 6-12 months, boosted their students' achievement by approximately 21 percentile points on standardized achievement tests. Conversely, professional development that offered 5 to 14 hours had no significant effect on student achievement.

The method in which professional development hours are distributed across time is also important. Having a concentrated learning opportunity through either workshops or institutes (typically held during the summer), with follow-up sessions to reinforce the learning from the intensive experiences, has been shown to be particularly supportive of teacher learning (Saxe, Gearheart, & Nasir, 2001). Research also suggests that professional development is most effective when teachers engage actively in instructional inquiry in the context of collaborative professional communities, focused on instructional improvement and student achievement (Wei, et al., 2009).

A prerequisite for change is developing a capacity for change. Thus, a major component of the MSP is to build the capacity for change through professional development for K-12 teachers and administrators, as well as through the involvement of IHE faculty in math, science, and education. Each project held one week to two week long immersion seminars during the summer months with follow up activities throughout the school year. Each seminar focused on content and pedagogy appropriate to specific school levels (elementary and middle).

Professional development affects student achievement through three steps. First, professional development enhances teacher knowledge and skills. Second, better knowledge and skills improve classroom teaching. Third, improved teaching raises student achievement. All links must be present for student learning to take place (REL, 2001). No Child Left Behind sets five criteria for professional development to be successful:

1. It is sustained, intensive, and content-focused.
2. It is aligned with and directly related to state academic content standards, student achievement standards, and assessments.
3. It improves and increases teachers' knowledge of the subjects they teach.

4. It advances teachers' understanding of effective instructional strategies founded on scientifically based research.
5. It is regularly evaluated to determine the impact on increased teacher effectiveness and student achievement (Birman, et al., 2007).

Arkansas MSP professional models were based on the No Child Left Behind standards. This section will summarize professional development activities for Cohort 6 during the 2011-2012 project year. First, it describes the specific mathematics content of the MSP professional development. Next it describes the models of professional development offered, as well as the specific learning activities within those professional models.

Changes in Instructional Practices

Changes in instructional practices, particularly sustainable ones, depend on many factors. The logic model highlights some important short- and mid-term outcomes that contribute to teachers' ability to engage in classroom practices that enhance K-12 students' knowledge of mathematics and science. Some of these outcomes should be evident at the classroom level, such as increased awareness and knowledge of research-based instructional practices and materials, increased teacher content knowledge, and increased principals' leadership skills, which enables them to serve as instructional leaders. Other outcomes are targeted at the school and/or district level, including changes in policies and practices and alignment of curriculum with professional development and state standards, all of which can contribute to and support teachers' efforts to change instructional practices.

Although it is still too early in the project to fully evaluate whether the MSP has fostered changes in instructional practices, some trends are noted. Year 1 included intensive content knowledge instruction and the unpacking process. These processes are critical elements of the project. They will lead to deeper understanding and development of interactive lessons for the Common Core in Year 2 (2012-2013).

Content of MSP Projects

In their annual reports, projects provided the content of their professional development and identified the major topics within their discipline. Also included in their annual reports were the grade level and number of teachers involved in professional development activities. Since the focus of all projects in Cohort 6 was mathematics, only mathematical processes were covered in professional development activities. Refer to Table 4.1 for the number of projects offering professional development in each mathematical process and number of teachers at each level involved in the professional development.

\

Almost all MSP projects offered professional development in more than one content area, often focusing on topics relevant to the grade level of the participating teachers. Across MSP projects these areas included: number and operations, algebra, measurement, problem solving, geometry, probability and statistics, reasoning and proof, technology, and other--rational number concepts. Since multiple topics were covered by different projects, teachers are counted each time they received professional development in a given area. For example, five projects covered numbers and operations and a total of 197 teachers received professional development in this area.

Table 4.1
Professional Development in Mathematical Processes Provided by School Level

Mathematics Content and Processes	Number Projects Providing PD	Number Elementary School Teacher	Number Middle School Teacher	Number High School Teachers	Total Number Teachers
Number and Operations	5	102	95		197
Algebra	5	191	120		311
Measurement	4	59	126	4	189
Problem Solving	4	59	90		149
Geometry	1		48		48
Technology	4	30	165		195
Probability and Statistics	2	30	78	4	112
Reasoning and Proof	2	37	78		115
Other - Rational Number Concepts	1	30			30

Recall that there were 336 reported participants. Looking at Table 4.1, it is clear that almost all of the teachers received information dealing with Algebra (311/336=92.6%). Over half of the teachers had instruction about Numbers and Operations (58.6%), Technology (58.0%), and Measurement (56.3%). Geometry and Other-Rational Number Concepts were the least frequently addressed content areas with only one project covering these areas.

At the elementary school level, the content area with the most participants was Algebra. The content areas with the least number of participants were Probability and Statistics,

Technology, and Other--Rational Number Concepts. At the middle school level, the content area with the most participants was Technology followed by Measurement and Algebra.

All projects focused on mathematics for grade levels ranging from 3-8. However, one project had four high school teachers take part in professional development activities. The content areas in which the four high school teachers were involved included measurement and probability and statistics.

Professional Development Models

The professional development activities offered by MSP projects focus on increasing teachers' content knowledge in mathematics, specifically content knowledge related to the new Common Core State Standards. All Cohort 6 MSP partnerships focused their professional development activities around a summer institute which provided multiple, intensive learning experiences in mathematical content and pedagogical practices. Teachers then applied the content knowledge and pedagogical practices in their classroom during the school year. Teachers will come together each of the next two summers to receive additional intensive training in content knowledge and discuss successes and areas needing improvement in a non-threatening environment.

In addition to providing intensive summer institutes, MSP projects offered a range of other professional development activities to participating teachers. The activities were offered as a follow-up to summer institutes to supplement material and concepts learned in those institutes. Half of the projects offered on-site professional development activities and half offered off-site professional development activities. Eighty-eight percent of the projects used Reformed Teaching Observation Protocol (RTOP) to assess baseline classroom practice. RTOP results for year two should provide information about actual classroom practices after initial professional development received during the first year.

Table 4.2

Methods of Professional Development and Contact Hours by Project

Project Name	Summer Institute	On-Site PD	Off-Site PD	Total # of PD Hours	RTOP
6th-8th Grade Algebra Common Core Interactive Initiative	X		X	84	
6th-8th Grade Geometry Common Core Interactive Project	X		X	84	X
Common Core Boot Camp	X	X		112	X
Getting to the Core	X	X		105	X
Math Core Team (MCT)	X	X		75	X
South Arkansas Mathematics Standards Partnership	X		X	96	X
Thinking Mathematically for Common Core State Standards in Grades 3-5	X	X		70	X
University of Arkansas Engineering & Mathematics Partnership	X		X	80	X

As shown in Table 4.2 all of the projects conducted summer institutes with school-year follow-up activities. Projects reported the total number of contact hours for their project. The average number of contact hours reported by the projects for 2011-2012 was 88 hours. Contact hours ranged from a minimum of 70 to a maximum of 112.

Unlike many professional development activities in which teachers are involved, MSP professional development provides intensive and sustained content-rich professional development from college and university faculty partners in STEM areas and colleges of education as well as from other professionals that integrates mathematics and science content with effective pedagogical strategies.

Section 5:

Project Evaluation Design

The Math and Science Partnership program represents a significant investment by the NSF. Accordingly, project-level evaluations are critical to helping the NSF understand and assess the value of its investment. Project evaluation should be planned to guide the annual assessment of progress and to measure the impact of the effort. Formative evaluation should provide evidence of the strengths and weakness of the project, informing the partnership's understanding of what works and what does not, in order to inform project evolution and success. Summative evaluation should give an objective analysis of qualitative and quantitative data, in order to determine the effectiveness of the project in contribution to positive student and teacher outcomes and institutional changes.

The MSP program seeks to improve student outcomes in mathematics and science for all K-12 students. Within the context of the MSP, the purpose of evaluation is to provide scientific insights grounded in evidence to document how the projects are implemented and how they can be improved by making data-driven decisions.

All MSP projects are required to gather data on teacher content knowledge and evaluate their own project's effectiveness. Projects are required to report on two aspects of their evaluation findings: 1) gains in teacher content knowledge based on pre- and post-testing; and 2) proficiency levels on state-level assessments of students of teachers who received professional development. Cohort 6 is in year one of a three year project. Therefore, student outcomes are not reported in this evaluation but will be reported in 2012-2013 and 2013-2014.

This section describes the types of evaluators and evaluation designs used by MSP projects in Cohort 6, the measures used in evaluation, and teacher outcomes which are used to assess the effectiveness of the MSP interventions.

Evaluators and Evaluation Designs

All projects (8) in Cohort 6 reported using an external evaluator. Using an external evaluator allowed these projects to independently evaluate their work and to receive help from these specialists in implementing the most rigorous designs possible. All Cohort 6 projects used a quasi-experimental design with 25% (2) using a matched comparison group design and 75% (6) using a non-matched comparison group design. All projects used pre-tests and post-tests to assess the gains of the teachers served by the MSP although one project was not able to administer the post-test until fall 2012. Projects used a variety of measures to conduct pre- and post-tests of teacher content knowledge.

All projects shared common goals: improving teacher content knowledge and teaching methods. And for all eight projects the primary target was individual teachers as opposed to whole school reform.

All of the project's evaluations have served a *formative* role. In this role, they have provided a project's directors with early feedback about the design and implementation of their project's activities. The directors can make adjustments and changes as needed to the following year's activities.

Overview of Data Collection

The legislation that authorizes the MSP program, Title II, Part B, Section 2202 (f) of the Elementary and Secondary Education Act of 1965 as amended by the No Child Left Behind Act of 2001 (P.L. 107-110), requires each of the projects funded by the states to submit an annual report to the U.S. Department of Education (USDE), documenting the partnership's progress in meeting its MSP goals and objectives. The state evaluation was conducted through an analysis of the annual required external evaluator reports that were submitted by each of the projects in 2012. Additionally, each project was examined regarding their teacher content knowledge measure. All MSP projects utilizing quantitative measures with a test previously established as valid and reliable were noted. These project directors were contacted to provide the pre- and post-test raw scores for each participant on their measure of teacher content knowledge.

Implementation fidelity is built into the state level evaluation framework. The state requirements rely on the local evaluation models using a variety of data sources to establish the levels of implementation of grant goals in participating teachers' classrooms. Although there are broad commonalities across grants, the unique scope and sequence of the content, strategies, resources, and technologies across programs precludes the use of a single implementation measure for everyone. In addition to the differences in goals and design, differences in local school settings require flexibility at the local grant level for measuring implementation.

Approaches and Strategies for Data Collection

The annual reports from the Arkansas MSP projects were examined by two members of the evaluation team. Annual reports were reviewed for consistency between project narratives and evaluation, the research and practice surrounding the method of professional development, utilization of appropriate statistical methods, and fidelity of implementation. Projects that were identified as having problems with statistical analysis and reporting were returned to the project directors, with feedback from the state evaluators on the appropriate changes to be made. The state evaluation team also requested additions to the evaluator's interpretation of the data where deemed necessary. Project directors were asked to have their evaluators reanalyze the data and/or

rewrite the results, and resubmit these sections before the report would be accepted for final data collection.

For this evaluation report, all reports were read and summarized. In particular, the evaluation team examined the reports to determine how teacher subject matter and pedagogical knowledge were measured, and which evaluation design was utilized . Project participants, professional development models, assessment instruments, and project implementation were also explored. The summaries were then examined for common practices and concerns across projects.

Data Analyses and Reporting

Descriptive statistics were used to analyze the report data (i.e., largely frequencies and means). The teacher content knowledge measure across projects was analyzed with a meta-analytic approach. All raw data scores were reviewed for complete data. Only participants with both pre- and post-test scores were included. All raw pre- and post-test score gains were analyzed with a Pearson correlation. This statistic was then examined with the corresponding Fisher Z-transformation in order to examine effect size of the projects. Data analyses are summarized in tables with appropriate explanatory narratives. The collected data yielded information to aid the evaluation team in making judgments and recommendations about the Arkansas MSP program initiative as a whole.

Data and Assessment

All MSP projects are required to gather data on their teacher content knowledge and evaluate their own project's effectiveness. The method of evaluation varies by nature of the project and the type of instrument/s used to measure teacher content knowledge. None of the projects used a true experimental design. All projects have attempted some form of quasi-experimental design.

The most frequently reported assessments of teacher content knowledge in mathematics were nationally normed/standardized tests (75% of projects). Locally developed assessments that were not tested for validity and reliability were the next most frequently reported type of assessment for mathematics. Student achievement outcomes were not evaluated since this was the first year of the cohort. They will be evaluated the next two years (2012-2013 and 2013-2014).

As can be seen in Table 5.1 all projects gathered pre-test data and all but one gathered post-test data to measure teacher content knowledge gains. The project that did not gather post-test data will do so in fall 2012. The most commonly used assessment was the Diagnostic Mathematics Assessment for Middle School Teachers.

Table 5.1

Content Knowledge Instruments Utilized by MSP Projects

Instrument	Projects Using Instrument
Diagnostic Mathematics Assessment for Middle School Teachers	3
Diagnostic Teacher Assessment of Mathematics for Elementary Teachers	1
Learning Mathematics for Teaching	1
Full Option Science System	1
Mathematics Teaching Efficacy Belief Instrument	2
Number and Operations of Learning and Teaching Inventory	1
Locally Developed Using Questions from LMT	2
Locally developed	1

Note: Some projects reported using more than one assessment instrument and more than one assessment type.

Pedagogical Knowledge

In addition to teacher content knowledge, MSP projects also address pedagogical knowledge. Projects emphasize that teachers not only require stronger content knowledge but the skills to teach that knowledge. In order to assess teacher gains in pedagogical knowledge seven of the eight projects used the Reformed Teaching Observation Protocol (RTOP) to measure classroom practices and beliefs. RTOP was designed by the Evaluation Facilitation Group of the Arizona Collaborative for Excellence in the Preparation of Teachers (ACEPT). RTOP was developed as an observation instrument to provide a standardized means for detecting the degree to which K-20 classroom instruction in mathematics or science is reformed. It is a 25-item classroom observation protocol that is (a) standards based, (b) inquiry oriented, and (c) student centered.

Attitudes and Perceptions

All projects assessed participants' perceptions and attitudes toward professional development by using a variety of Likert scale and open response surveys or questionnaire instruments for the purpose of formative and summative assessment. Feedback indicated a high degree of satisfaction with the workshops including format and content.

Section 6:

Conclusions and Recommendations

Conclusions

Completing the planned MSP activities is a critical first step toward the intended outcomes. Therefore this report gives considerable attention to the ability of the MSP to carry out the planned activities and to the quality of these activities. We found that the MSP has been very successful in completing the planned activities for Year One. The majority of MSP activities were implemented as planned, and according to evaluations, were well received by participants.

Although it is too early to see achievement of long-term outcomes, examples of short- and mid-term outcomes are becoming evident, such as increased awareness of research-based instructional practices and materials, increase in teacher content knowledge, increased collaboration among different partners and alignment of curriculum with professional development and State Common Core Standards.

This section will address the six evaluation questions guiding the statewide evaluation reports listed in Section One.

1. Did Arkansas' MSP projects provide professional development with significant and meaningful content that models the instructional strategies that will enable teachers to teach in a manner that will improve student achievement in mathematics?

Yes. There were research-based models for professional development implemented in all partnerships. Teachers report better understanding of what is needed to change instructional practices. According to the workshop evaluations, the majority of participants in the Arkansas MSP professional development activities said they felt better prepared to teach math. However, since this was the first year of the project it remains too early to determine if student achievement has increased.

One teacher commented: "I found that understanding the content my students are expected to learn and be able to use well will determine their progress in the higher grades. I feel that by my understanding of what is expected in 6th through 8th I can help prepare my students with practice, exploration and an acceptance of their own discoveries becoming more of a facilitator than a teller or presenter of information. Although I felt overwhelmed at times, I ended with a better understanding of how to develop lesson plans and address the content my students will need to become better mathematicians."

2. Did Arkansas' MSP projects improve and upgrade the status and stature of mathematics teaching by encouraging IHEs to assume greater responsibility for improving

mathematics teacher education through the establishment of a comprehensive, integrated system of professional development that continuously stimulates teachers' intellectual growth and upgrades teachers' knowledge and skills?

Yes. Fifty percent of the projects had an IHE as the lead organization. All projects involved STEM faculty, and many projects utilized education faculty as well, though in most MSP annual reports the level of involvement of the STEM faculty is not clear. Across all projects 34 IHE faculty were involved. The role of the IHE varied from partnership to partnership, including their role in governance and leading actual professional development.

One IHE allows some graduate credit for participation in the professional development, but more for-credit options for teachers are needed in the partnerships to assist participants in attaining NCLB "highly qualified" status.

One issue still remains--with regard to promotion and tenure, many IHEs view faculty participation in the MSP as service to the community or teaching. This method of recognizing MSP participation is not of much value to faculty because they can gain service credits through other less labor intensive methods. Some IHEs are willing to recognize faculty participation if publications are forthcoming. For STEM faculty, this is a challenge since publishing in one's own discipline is more widely acknowledged as scholarly research than publishing in other fields. Most IHE faculty are given no research credit and very little service credit for working with the public schools. Therefore, it is not a priority for IHE faculty desiring promotion and tenure.

One project director noted a major success as: "Significant use of university faculty in delivering teacher content information in mathematics, and in implementing the hands-on design-oriented workshop."

3. Did Arkansas' MSP projects provide opportunities to focus on ways to deepen teachers' subject matter knowledge, increase teachers' knowledge of how students learn particular subject matter, provide opportunities for engaging learning, and establish coherence in teachers' professional development experiences?

Yes. All of the Arkansas MSP projects' professional development activities were designed to increase teachers' content and pedagogical knowledge. The projects focused on depth instead of breadth and provided hands-on classroom examples for engaging learning. Coherence was provided through each MSP project utilizing follow-up sessions to summer institutes or to sustained professional development throughout the academic year. As one teacher remarked:

"Teachers need to see math instruction modeling how to develop deeper understanding. This is important after teaching the 'mile wide and an inch deep' type of instruction. The

workshop is challenging and can be frustrating, but the outcome is worth it. The environment is a safe place for the participants to learn a deeper understanding of geometry."

4. Did Arkansas' MSP projects bring mathematics teachers in elementary schools and secondary schools together with scientists, mathematicians, and engineers to increase the subject matter knowledge of mathematics and/or science teachers and improve such teachers' teaching skills?

Yes. Of the 34 IHE faculty involved in the MSP projects, 28 of them were STEM faculty. One participant remarked:

"The quality of the sessions that were presented and facilitated by the lead instructor was excellent. She really "gets" what the Common Core State Standards and "reformed" mathematics instruction are all about. Central to all that was going on was the allowing for flexible time for participants to construct meaningful mathematics and allowing sufficient time for discussion and de-briefing at the end of the "work" time by participants."

5. Did Arkansas' MSP projects develop more concise and rigorous instructional resources that are precisely aligned to state and local academic content standards and with the standards expected for preparation of students for postsecondary study in engineering, mathematics, and science?

Maybe. Professional development activities were designed to prepare teachers for the state's Common Core. All partnerships rely on the theory that increased content knowledge of teachers and the ability to utilize effective pedagogical practice will translate into challenging courses and curricula. It is unclear whether more concise and rigorous instructional resources have been developed. One participant remarked:

"The scaling up and down of the lessons based on Common Core Standards was very helpful. I can see the concepts being taught to 4th grade up to 8th grade with increasing complexity. Since this is the first year on implementation for the Common Core, I have not had the opportunity nor the understanding of how to implement. Although I am not 100% comfortable with Common Core yet, I feel much more confident about the upcoming change because of this grant/workshop."

6. Did Arkansas' MSP projects provide opportunities to improve and expand training of mathematics teachers, including training such teachers in the effective integration of technology into curricula and instruction?

Yes, to some extent. Projects integrated technology into the curricula and instruction at varying levels. However, some participants commented that although they enjoyed the technology pieces they did not have access to that kind of technology at their schools.

Recommendations

Recommendations are organized into three categories: general, evaluation, and implementation. General recommendations are suggestions related to overall improvement of the MSP projects, and should be addressed by state level personnel, project directors, and project evaluators. Evaluation recommendations are specific to the evaluation component of the annual reports, and should be addressed primarily by project e valuators. Implementation recommendations are suggestions for improving the quality of the MSP projects through closer attention to fidelity of implementation, and should be addressed primarily by project directors.

General Recommendations

The following general recommendations are proposed:

- A strategy should be established for disseminating and supporting the use of research-based resources and tools.

- Project directors should work closely with the local evaluators on the importance of evaluating key measures. Each partnership needs to document the effectiveness of their projects. Where possible, more rigorous evaluation needs to take place.

- A way to track specific teacher/student data should be identified. Most projects report student data at the school or district level but data needs to be reported at the teacher level.

- Beyond the scope of the three year grant period, evaluation needs to be conducted at the project level to determine the impact MSP has had on student performance. In what ways have student outcomes and course taking changed in K-12 schools implementing the MSP. If change occurred, what is the connection between implementation of the MSP plan and these changes? The overall bottom line for the MSP is to demonstrate improved student learning in mathematics and science. This imperative is reflected in the goals of the partnership.

- Continued matching should be made in professional development across grade level taught and Common Core Standards.

- IHE faculty need to examine what they personally are learning from their involvement and begin to determine how that learning can be translated into institutional change. The learning that faculty and professors gain to enlighten their own practice is only the first step toward reforming pre-service and in-service programs throughout the state.

Evaluation Recommendations

- Project directors should include fidelity of implementation as part of the evaluation plan from the beginning of the project. The concept of implementation of fidelity is described and defined in the literature in terms of five elements that need to be measured including: adherence to an intervention (program is being delivered as it was designed); exposure or dose (the frequency and duration of the intervention as prescribed by its designers); quality of delivery (the manner in which the teacher delivers the program); participant responsiveness (how much the participants are involved in the intervention); and program differentiation (identifying unique elements of the program and determining which elements or the program are essential for the program to achieve its intended effect).

- Projects should continue to utilize RTOP on multiple occasions to measure changes in classroom practices.

- A description of the development process, validity and reliability should accompany all modified or locally developed used by projects. Thus, the fairness, accuracy, and credibility of the instruments can be established.

- In years two and three of Cohort 6, student assessment needs to be evaluated by specific teacher level data by all projects. Specifically, all students within project participants' classroom should be compared to non-participant classrooms when possible. Data should not be reported simply as entire school or district data.

- All local evaluators should report raw scores for pre- and post- tests. Some evaluators report raw scores converted to IRT scores.

- Project directors should make sure that they are selecting or developing measures of teacher subject matter knowledge that reflect the emphases of the professional development and the grade levels served.

Implementation Recommendations

The following implementation recommendations are proposed:

- Projects should explicitly indicate how professional development is driven by a comprehensible and sustained long-term plan with plans for continued access to professional development materials beyond the tenure of the project.

- Documentation should be kept for any teachers that leave or enter MSP projects. If projects collect data on why teachers left or why they decided to join after the project had

started, this can provide valuable information to project staff on how to improve the project.

- Losing project key staff while the project is progressing can greatly influence the impact of a project. Project evaluators should address this more clearly by collecting data that describes how remaining project staff handled the loss in personnel and how the project staff perceived the impact on the project.

- Project directors should attempt to gain greater administrator involvement. Administrators are often recognized to be a pivotal factor in successful professional development efforts. By not including administrators, MSP projects have exclude an advocate for state and local policies and programs that reflect sustained MSP professional development models and frameworks.

Next Steps

Student achievement is the ultimate measure of the MSPs impact. The first year of Cohort 6 was spent developing baseline data and providing intensive professional development to teachers. The evaluation of year two will focus on additional professional development as well as the effect the intervention has had on student achievement.

References

Birman, B., LeFloch, K.C., Klekotka, A., Ludwig, M., Taylor, J., Walters, K , Wayne, A., Yoon, K.S., Vernex, G., Garet, M., O'Day, J.(2007). State and local implementation of the No Child Left Behind Act, Volume II--*Teacher quality under NCLB: Interim Report.* Washington, D.C.

Blue, C, (2011). State outcomes in math and science education reveal big disparities. *American Institute of Physics.* Retrieved from http://www.aip.org/press

Coe, R. (2002). *It's the effect size, stupid: What effect size is and why it is important.* Paper presented at the Annual Conference of the British educational research Association, University of Exeter, England. Retrieved from www.leeds.ac.uk/educol/documents/00002182.htm

Fennema, E., Carpenter, T.P., Franke, M.L., Levi, L., Jacobs, V.R., Empson, S.B. (1996) A longitudinal study of learning to use children's thinking in mathematics instruction. *Journal for Research in Mathematics Education,* 27(4), 403–434.

Glass, G.V., McGaw, B. and Smith, K.L. (1981). *Meta-Analysis in Social Research.* London: Sage.

Goe, L. (2007). The link between teacher quality and student outcomes: A research synthesis, Washington, DC: National Comprehensive Center for Teacher Quality.

Grossman, P. (2008). Responding to our critics: From crisis to opportunity in research on teacher education. *Journal of Teacher Education, 59*(1), 10–23.

Hill, H.C., Rowan, B., & Ball, D.L. (2005). Effects of teachers' mathematical knowledge for teaching on student a chievement. *American Educational Research Journal*, 42, 371-406.

Krauss, S., Baumert, J., & Blum, W. (2008). Secondary mathematics teachers' pedagogical content knowledge and content knowledge: Validation of the COACTIV constructs. *The International Journal on Mathematics Education,* 40(5), 873-892.

National Science Foundation. (2003). *Math and Science Partnership Program Solicitation* (NSF03-605). Washington, DC.

National Research Council. (2001). Adding it up: Helping children learn mathematics. J. Kilpatrick, J. Swafford, and B. Findell (Eds.). Washington, D.C.: National Academy Press.

Provasnik, S., (2012). H*ighlights from TIMSS 2011 mathematics and science achievement of U.S. fourth and eighth grade students in an international context*. U.S. Department of Education. (NCES 2013-009).

Saxe, G.B., Gearhart, M., & Nasir, N. (2001). Enhancing students' understanding of mathematics: A study of three contrasting approaches to professional support. *Journal for Research in Teacher Education,* 4, 55-79.

Yoon, S., Duncan, T., Lee, S.,Scarloss, B., & Shapley, K. (2007). *Reviewing the evidence on how teacher professional development affects student achievement*. U.S. Department of Education Inc. REL No. 033. Retrieved from http://ies.ed.gov/ncee/edlabs/regions/southwest/pdf/rel_2007033_sum.pdf

Wei, R., Darling-Hammond, L., Andree, A., Richardson, N. & Orphanos, S. (2009). S*chool redesign network at Stanford University*. Published by the National Staff Development Council and the School Redesign Network at Stanford University as part of their multi-year study, The Status of Professional Development in the United States.

Appendix

Project Summaries

This section will describe each project individually. All projects are listed alphabetically and contain key characteristics as provided by project directors in the MSP reports. These key characteristics are listed and described below in a model summary.

Project Title:

Project Abstract: (As written by the projector in the submitted annual report)

State of Implementation:
State 1: new (conducting start-up tasks such as formalizing partnerships and implementing the professional development model for the first time)
Stage 2: developing (revising, enhancing, or further developing professional development model)
Stage 3: Fully developed (all components of the planned MSP model are fully operational)

Total Teacher Participants: The total number of teachers and/or administrators participating in MSP professional development activities by grade level (elementary K-5, middle 6-8, or high school 9-12)

Project Title: 6th-8th Grade Algebra Common Core Interactive Project

Project Abstract: NEEDS: The Northeast Arkansas Education Cooperative, Harding University, and 13 high-need members' school districts have established an MSP 6th, 7th, and 8th grade Common Core Algebra Initiative. This project is a three-year (2011-2014) project designed to address the needs of teachers to be actively involved in implementation of the new Arkansas CCSS. The new Algebra Common Core Standards aligned to the existing algebra SLEs add new rigor and difficulties for middle grades students and teachers. Stronger content as well as pedagogical knowledge will be required to master algebra in the future.

THREE YEAR (2011-2014) GOAL I: Forty-two (42) 6th, 7th, and 8th grade algebra teachers in the 13 NEA Co-op member school districts will deepen their mathematical content knowledge of Common Core Algebra, develop interactive algebra lessons, and integrate the lessons into eBook for their classroom instruction over a three-year period.

Year I (2011-2012) Objective 1: The NEA Co-op planning team and assessment team will conduct a series of planning activities necessary to prepare the groundwork for an effective research-based MSP algebra project with a quasi-experimental evaluation design by April 30, 2012.

Year I (2011-2012) Objective 2: Forty-two (42) 6th, 7th, and 8th grade algebra teachers from 13 school districts will gain a greater content knowledge of Common Core Algebra and Learning Progression through an unpacking process of the critical focus areas during 2011-2012.

MAJOR ACTIVITIES: Year 1 included training of the 42 MSP participants in both whole group and grade-level groups (14 per group) in the CCSS Algebra & Learning Progression process and the unpacking process, which are the critical elements in deep understanding of the content knowledge and pedagogy. The long-term objective of this project will result in the development of interactive, technology-based lessons and iBooks for the Common Core 6th, 7th, and 8th grades in Year 2 and Year 3 (2012-2014). The 42 MSP participants attended two Saturday orientation workshops in the spring 2012 and a ten-day Summer Institute in June-July, 2012.

Throughout the project's three years content knowledge development will be stressed among participants, as Common Core lessons design and development are undertaken with interactivity and deep understanding being emphasized.

QUASI-EXPERIMENTAL EVALUATION: A project assessment team worked for eight months in Year I to ensure that an effective formative and summative evaluation plans was refined. An external evaluator and internal evaluator were employed to oversee a quasi-experimental evaluation design and implementation. The design compared participants with a

control group. the valid and reliable 6th-8th grade Common Core aligned content knowledge teacher test was developed from LMT released items and incorporated into an on-line, secure test which was administered by the NEA Co-op internal evaluator for pre-test and post-test during Year I to the MSP participants and a control group of 48 middle grade math teachers.

Stage of Implementation: 1

Total Teacher Participants: 42

Total Students Effected: 2090

Total Grant Amount and Cost per Participant: $149,750/$3,559

PD Contact Hours: 84

PD Model: 70 summer institute hours and 14 Saturday workshop hours

Evaluation Design: Non-matched comparison group

Teacher Content Knowledge Instrument: Content Knowledge Test constructed from LMT items pre/post test

Type of Evaluator: External

University of Arkansas Engineering & Mathematics Partnership

Project Abstract: The University of Arkansas Engineering & Mathematics Partnership is a partnership of the University of Arkansas (UA) and public and private schools in northwest Arkansas (NWA) and eastern Arkansas (EA). The goal of the partnership is to provide increased content knowledge depth and content delivery tools that middle school teachers need to effectively implement the new mathematics Common Core State Standards (CCSS). The UA Engineering & Mathematics Partnership (UA-EMP) will focus on 6th-8th grade mathematics content areas that move one or two grade levels higher or lower than the current Arkansas Mathematics Curriculum Framework. This is the start of year two implementation of the University of Arkansas Engineering & Mathematics Partnership.

University of Arkansas participants include faculty and administrators from the mathematics department, the college of engineering, the college of education and the honors college. In addition, a mathematics specialist from the Northwest Arkansas Education Cooperative is actively involved in the program. The UA participants have a proven track record for designing and implementing highly successful curriculum related workshops and solid evaluations and results for middle school teachers, including Arkansas Department of Education grants.

Public and private school participants include administrators and 6th-8th grade teachers from 21 middle and junior high schools in northwest Arkansas and eastern Arkansas plus St. Joseph Catholic School (private) in NWA. Huntsville Public Schools (HPS) is the focus Local Education Agency (LEA) for the partnership. The UA-EMP aims to specifically target teachers who serve student populations of high poverty, high English Language Learners (ELL), or school in improvement.

The 2011-2012 (year 1 of the grant) academic year involved 85 teachers. The training consisted of two one-day mini-workshops, an eight-day summer workshop, and classroom observations for each teacher. The content for 6th and 7th grade teachers focused on the number system as well as ratios and proportional relationships. The 8th grade teachers focused on algebraic functions. In addition, all teachers received content training in probability and statistics.

An external evaluation utilizes both quantitative and qualitative measures. The evaluations provide guidance for continuous improvement to ensure the project achieves maximum results. Expected results are 1) improved teaching effectiveness, 2) increased student achievement scores, and 3) increased student and teacher enthusiasm in mathematics.

Stage of Implementation: 3

Total Teacher Participation: 85

Total Students Effected: 8400

Total Grant Amount and Cost per Participant: $283,515/$5,994

PD Contact Hours: 80

PD Model: Activities other than summer institutes only or summer institutes with follow up activities (8-day summer institute, two mini-workshops and RTOP follow-up visitation activities).

Evaluation Design: Matched comparison group design

Teacher Content Knowledge Instrument: Diagnostic Mathematics Assessments for Middle School Teachers

Type of Evaluator: External

Project Title: Thinking Mathematically for Common Core State Standards in Grades 3-5

Project Abstract: The "Thinking mathematically for Common Core State Standards (CCSS) in Grades 3-5" MSP project is a 3-year project developed by Henderson State University (HSU) and Dawson Education Cooperative (Dawson) to provide training in the new CCSS and cognitively guided instruction. The project's primary goal is to increase teacher content knowledge related to grade 3-6 common Core State Standards for mathematics and improve teacher classroom practice in grades 3-5 mathematics. The secondary goal is to improve student achievement on the relevant standards-based Arkansas mathematics examinations for students of teachers participating in the training program. Specific objectives include:

Objective 1: Thirty (30) teachers of mathematics in grades 3-6 (participants) from 11 districts in the Dawson service area will demonstrate increased content knowledge related to the CCSS in grades 3-6 mathematics compared to teachers in a control group as measured by the Diagnostic mathematics Assessment for Elementary Teachers after participating in an intensive, sustained program of professional development provided by HSU mathematics faculty and Dawson personnel between 2011 and 2014.

Objective 2: Participants will incorporate cognitively guided instructional practices in classroom instruction as measured by the Reformed Teaching Observation Protocol (RTOP) after participating in an intensive, sustained program of professional development provided by HSU mathematics faculty, Dawson personnel, and consultants from Teachers Development Group between 2011-2014.

Objective 3: A statistically significant percentage of the approximately 3,700 students taught participants in each of the 2012-2013 and 2013-2014 school years will demonstrate greater achievement on the Arkansas Augmented Benchmark Examination in mathematics compared to students of teachers in a control group.

Stage of Implementation: 1

Total Teacher Participants: 29

Total Students Effected: 3700

Total Grant Amount and Cost per Participant: $134,986/$4,382

PD Contact Hours: 70

PD Model: Activities other than Summer Institutes only or Summer Institutes with follow up. (2 4-day summer institutes and 3 1-day workshops, one-on-one follow-up)

Evaluation Design: Matched comparison group design

Teacher Content Knowledge Instrument: Diagnostic mathematics Assessment for Elementary Teachers (DMAET)

Type of Evaluator: External

Project Title: Common Core Boot Camp

Project Abstract: Common Core Boot camp (ASU-CCBC) is a partnership between Arkansas State University and public and private schools in north central Arkansas. The high-needs focus school district is Southside School District in Batesville. The overarching goal of Common Core Boot Camp is to promote ideas and ways of thinking that contribute to greater student understanding of the Common Core State Standards for mathematics in grades 3-7 by engaging teachers in learning experiences that strengthen their content knowledge, teaching methods, and use of materials and technology. The project will combine content knowledge of the concepts of fractions, decimals, percentages and content knowledge of the concepts of fractions, decimals, percentages and proportional reasoning with the progression of these concepts in the Common Core State Standards (CCSS) for mathematics.

The following are objects of the ASU-CCBC. By the end of the first year of the project:

1) 80% of participants will increase their content knowledge of fractions, decimals, percentages, and proportional reasoning as shown by a gain score of at least 20% using a valid and reliable content test.

2) 75% of participants will show an increase of 20% in levels of confidence in teaching fractions, decimals, percentages, and proportional reasoning based on CCSS for mathematics as measured by a self-efficacy survey and classroom observations using the Reformed Teaching Observation Protocol (RTOP).

3) 70% of the participants will have increased their use of technology in teachin gas measured by self-reporting, classroom observations, and/or assessment by their administrators.

Professional development for the project will begin in November 2011 with participants attending a short course on Common Core State Standards at the Arkansas Curriculum Conference. Instruction and collaboration will continue throughout the spring using a virtual environment supported by the Center for Digital Initiatives at Arkansas State University and classroom observations using RTOP. The virtual classroom will be maintained during the entire year for participants as well as after the conclusion of the project to allow for sharing experiences and further training after completion of the project. Professional development will culminate with a two-week intensive summer institute in June 2012. Twenty-five teachers will participate in at least 100 hours of professional development, and approximately 1000 students will be served by these teachers.

All information developed throughout the project will be available through the ASU Rural STEM Education Center and a summary of the results will be posted on their website. Lessons written by participants will be uploaded to the ASU Lesson Portal for use by all mathematics teachers in the state. Results from the project will also be disseminated in peer-reviewed journals and at professional conferences.

The evaluation plan for the project utilizes a multifaceted approach utilizing both quantitative and qualitative methodologies. A comparison group of teachers and students will also be recruited to participate, resulting in a quasi-experimental design. Comparison data will be collected, including outcome data and demographics. As much as possible, the evaluator will attempt to match comparison group and participant teachers on outcome variables and factors such as school size, gender, and experience teaching.

Stage of Implementation: 3

Total Teacher Participants: 23

Total Students Effected: 978

Total Grant Amount and Cost per Participant: $146,244/$5,718

PD Contact Hours: 112

PD Model: Summer institute and on-site professional development during academic year

Evaluation Design: Non-matched comparison group design

Teacher Content Knowledge Instrument: Instructor generated test

Type of Evaluator: External

Project Title: 6th-8th Grade Geometry Common Core Interactive Project

Project Abstract: PARTNERSHIP NEES: The Wilbur D. Mills Education Service Cooperative, Harding University, and 16 high-need member school districts have established a 6yh, 7th, and 8th Grade Common Core Geometry Interactive MSP Project. This three-year project (2011-2014) has been designed to address the need of teachers to be actively involved in the implementation of the new Arkansas Common Core Mathematics Standards (CCSS). A comprehensive needs assessment has been conducted, which involved LEA officials, training consultants and WDMESC staff members.

Three Year (2011-2014) Goal: 6th, 7th, and 8th grade geometry teachers will deepen their mathematical content knowledge of Common Core Geometry, develop interactive geometry lessons, and integrate the lessons into their classroom instruction over a three-year period.

Year 1 (2011-2012) Objective 1: The WDMESC MSP geometry planning team and assessment team will conduct a series of project planning activities necessary to prepare the groundwork for an effective research-based MSP project with a quasi-experimental evaluation design by April 30, 2012.

Year 1 (2011-2012) Objective 2: 48 6th, 7th, and 8th grade geometry teachers from 16 school districts will gain a greater knowledge of Common Core Geometry and Learning Progression through an unpacking process of the critical focus areas during 2011-2012.

IMPLEMENTATION - YEAR 1: Year 1 included intensive training of the CCSS Geometry Learning progression process and unpacking process, which are the critical elements of the project which will result in the development of interactive lessons for Common Core 6th, 7th, and 8th grades in Year 2 (2012-2013) and Year 3 (2013-2014). The 48 MSP participants attended two Saturday orientation workshops in the spring of 2012. A 10-day summer institute will be completed by July 2012. Experienced mathematics trainers/mentors, Dr. Mike hall from Arkansas State University, Dr. Linda Griffith from the University of Central Arkansas, and Dr. Ron Smith from Harding University are leading the workshop and summer institute activities.

DEVELOPING ASSESSMENT FOR COMMON CORE GEOMETRY: A project assessment team worked for eight months in Year 1 to ensure an effective formative and summative evaluation plan was refined. An external evaluator was employed to oversee the quasi-experimental evaluation design and implementation. The design has been established to compare participants and a control group of middle grade math teachers from the northeast Arkansas Education Cooperative member schools. The validity and reliability of a teacher content knowledge test was assured by the design of a 20-question Common Core geometry pre/post test which is constructed for on-line, supervised administration. The questions are 6th-8th grade geometry questions taken from the middle grades (6-8) released question files. The MSP geometry assessment team aligned the questions with the common Core (6th-8th) Geometry

Standards to match the content knowledge which will be emphasized in the three-year project syllabus. The MSP participants' scores will be compared against the control group scores to measure the differences made on an annual basis.

Additionally, during Year 1 an on-line IMPAC evaluation questionnaire was designed to measure the qualitative aspects of the MSP year-long training sequence. This questionnaire will be completed by MSP participants at the final day of the 2012 Summer Institute. It will be used by the evaluator in the Year 1 APR and in Year 2 final preparations of activities. In Year 2 and year 3 the Reformed Teacher Observation Protocol (RTOP) will document the results of MSPs experiences in actively teaching he designed CCSS geometry lesson to their students. Four RTOP observers will conduct on-going site evaluations using iPad technology to record and report their findings to the project director, trainers and evaluators in a seamless and instantaneous manner. This will allow for immediate feedback.

Stage of Implementation: 1

Total Teacher Participants: 48

Total Students Effected: 2784

Total Grant Amount and Cost per Participant:

PD Contact Hours: 84

PD Model: 70 hours Summer Institute and 14 hours on-site professional development

Evaluation Design: Non-matched comparison group

Teacher Content Knowledge Instrument: Middle School Geometry Learning Mathematics for Teachers (LMT)

Type of Evaluator: External

Project Title: Math Core Team

Project Abstract: The UCA Institute for STEM Professional Development and Education Research (UCS STEM Institute) in collaboration with Arch Ford Educational Cooperative seeks to create an ongoing partnership between three high-need LEA school districts and University of Central Arkansas STEM faculty. The program proposes to develop mathematics initiatives which will enhance learning progressions that support the coordination of the Common Core State Standards (CCSS).

The project goal is to improve the academic achievement of Arkansas students in the areas of mathematics by improving the mathematics content knowledge of teachers and by developing closer partnerships between the district and the IHE mathematics department. A 5% increase in the student scores on the Benchmark exam in mathematics or other adopted exam of students in the treatment class as compared to students in the control classrooms as measured by is expected. The Mathematics Core Team (MCT) project will provide a long-term sustained high quality professional development opportunity for 30 mathematics teachers from grades 4-6 for a minimum of 100 contact hours during each year of the project. Based on the needs assessment data, concepts of specific domains of CCSS (primary focus) and the most effective ways to teach them (secondary focus) will be thoroughly explored.

To evaluate the success of the project, a quasi experimental design with a delayed treatment for the comparison group will be used. A comprehensive evaluation that will use formative and summative assessments and include both qualitative and quantitative measures for each program goals will be conducted by an experienced external evaluation specialist.

Stage of Implementation: 1

Total Teacher Participants: 30

Total Students Effected: 1518

Total Grant Amount and Cost per Participant: $128,171/$4,320

PD Contact Hours: 75

PD Model: hours Summer Institute and on-site professional development

Evaluation Design: Matched comparison group design

Teacher Content Knowledge Instrument: Diagnostic mathematics Assessments for Elementary School Teachers (DTAMS)

Type of Evaluator: External

Project Title: The South Arkansas Mathematics Standards Partnership

Project Abstract: The South Arkansas Mathematics Standards Partnership (SAMSP) is a collaborative effort of Southern Arkansas University, the University of Central Arkansas, South Central Service Cooperative, the SAU Education Renewal Zone (SAU ERZ) and 11 school districts. The majority of partnering school districts are rural, isolated, high-needs school districts with at least one building in school improvement.

SAMSP is designed to create and provide professional development activities to enhance both teacher content knowledge and instructional skills in two learning progressions identified in the Common Core State Standards (CCSS) for mathematics. The two learning progressions are the Measurement and Data domain in grades 3-5 and the Statistics and Probability domain in grades 6-8.

Thirty-seven 3rd-8th grade teachers from 11 school districts participated in the two-week common Core Mathematics Standards Summer Institute in June/July of 2012. Approximately one-half of the participants attended the summer institute at the South Central Service Cooperative in Camden, and the other half participated via compressed interactive video (CIV) broadcast from South Central Cooperative to Texarkana School District during both weeks. The summer institute included 10 days of intensive instruction to engage teachers in content-focused sessions in measurement, data, probability, and statistics. Additionally, teachers participated in six follow-up professional development Saturdays and were visited by professors conducting classroom site visits at least twice during the academic year. Professors trained in the use of the Reformed Teaching Observation Protocol (RTOP) as an observation instrument provided a standardized means for detecting the degree to which K-20 classroom instruction in mathematics or science is reformed per the national science and mathematics standards.

The goals of the South Arkansas Mathematics Standards Partnership were: 1) increase teacher content knowledge in mathematics as measured by the Diagnostic Mathematics Assessments for Middle Level Teachers; 2) expand teaching skills of participants as measured by RTOP; 3) increase student academic performance as measured by the Arkansas Mathematics Benchmark exams for students of participating teachers, and 4) create a sustained partnership among all partners/participants to address the implementation of the Common Core State Standards in south Arkansas.

An external evaluator collaborated with the project director to guide and monitor the project's formative and summative evaluation plan. The evaluation plan utilized a quasi-experimental research design using a matched comparison group. Separate control groups, one for teachers and one for students, were employed as a means to further measure and compare the impact of this particular professional development model on teacher content knowledge, teaching skills, the integration of the Common Core State Standards into classroom practices, and student performance on standardized state benchmark exams.

Stage of Implementation:

Total Teacher Participants: 30

Total Students Effected: 907

Total Grant Amount and Cost per Participant: $167,807/$4,671

PD Contact Hours: 96

PD Model: 60 hours Summer Institutes with 36 hours follow-up professional development

Evaluation Design: Non-matched comparison group design

Teacher Content Knowledge Instrument: Diagnostic Teacher Assessments in mathematics and science (DATMS)

Type of Evaluator: External

Project Title: Getting to the Core: Grades 3-5 math & Science Partnership

Project Abstract: The Getting to the Core partnership is comprised of 40 grades 3-5 teachers from school districts in northwest Arkansas, faculty from the Department of Mathematical Sciences and College of Education and Health Professions at the University (UA), and the northwest Arkansas education Services Cooperative (NWAESC). The goals of this project are:

1) To improve teachers' content knowledge and pedagogical content knowledge with respect to the mathematics that comprises the grades 3-5 curriculum in the common Core State Standards for Mathematics.

2) To increase student achievement in mathematics across the various content strands, including number 7 operation, algebra, geometry, measurement, and data.

3) to impact teacher practice by emphasizing and exploring student centered methods of instruction.

To achieve these goals, we have designed and are implementing a three-year focused professional development in the areas of whole number/base 10 operations & algebraic reasoning (Year 1); fractions & multiplicative reasoning (year 2); and data, measurement and geometry (Year 3). These three areas comprise the mathematical content strands across the grades 3-5 Common Core State Standards.

The Getting to the Core professional development model is based on the latest research on how students think about and process these mathematical concepts and is being led by leading researchers in the field of mathematics education. Summer workshops and school-year follow-up workshops, including classroom-embedded professional development, have been and will be used for content delivery. The content of the summer workshops will focus both on students' informal approaches to solving problems across the mathematical areas under study each summer as well as their connections to more abstract concepts and procedures. Problem types and related areas under investigation will be explored in detail as well as anticipated trajectories of students' progression of strategies from these initial starting points. Teachers have been and will also be engaged with ideas regarding how the Standards for Mathematical Practice can be incorporated in mathematics lessons and how these skills can be developed in students.

Stage of Implementation: 2

Total Teacher Participants: 40

Total Students Effected: 1333

Total Grant Amount and Cost per Participant: $135,666/$3,444

PD Contact Hours: 105

PD Model: Summer Institute and on-site professional development

Evaluation Design: Non-matched comparison group design

Teacher Content Knowledge Instrument: Learning Mathematics for Teaching (LMT) and Number & Operation Teaching and Learning Inventory

Type of Evaluator: External