Arkansas Math and Science Partnership Project Evaluation for 2013-2014

Project Conducted by the Arkansas Department of Education

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

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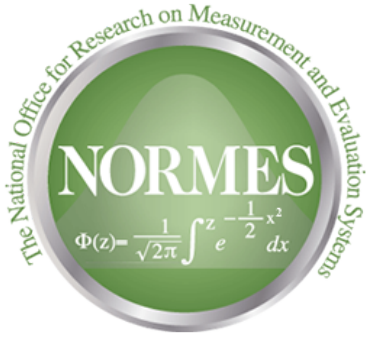

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Executive Summary

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 USDE Math and Science Partnership (MSP) program has awarded Arkansas over $21,260,000 to fund 54 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.

USDE awarded Arkansas over $2,927,893 during the 2013-2014 funding period to fund eight partnerships in Cohort 6 for their third year of a three year project and seven partnerships in Cohort 7 for the first year of a three year project.

Characteristics of MSP Projects and Participants

Eighty-six faculty members from institutions of higher education including 59 from STEM areas were involved with the MSP projects in Performance Period (PP) 2014, with an average of 5.73 IHE faculty members per project. MSP projects reporting in 2014 had an average of 14 partner organizations and 11 school districts. The number of partners ranged from 3 to 26. The number of school districts ranged from 1 to 22.

The number of participants involved in MSP professional development across all projects in 2013-2014 for Cohort 6 was 315; for Cohort 7, 324. Almost 640 participants across both projects attended professional development in PP 2014. The number of participants for each project in Cohort 6 ranged from 21 to 84. Expenditures per participant in Cohort 6 ranged from $3,279 to $7,502 with the average expenditure being $4,996. In Cohort 7, the number of participants ranged from 31 to 79. Expenditures per participant ranged from $2,965 to $5,122 with the average expenditure being $4,451.

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: 39 percent at the

elementary level, 59 percent at the middle school level, and two percent at the high school level. Across all projects in Cohort 6, 16,004 students benefited from the MSP.

The target population for Cohort 7 MSP professional development is classroom teachers in grades 5-8 with 9 percent at the elementary level, 86 percent at the middle school level and 5% at the high school level. Across all projects in Cohort 7, 18,580 students benefited from professional development. In all, 34,584 students benefited from professional development in math and science partnerships in Arkansas during the 2013-2014 school year.

Teacher Content Knowledge Gains

Increasing teacher content knowledge is important to achieving changes in teacher practices. Seven of the eight funded projects in Cohort 6 reported significant gains in teacher content knowledge in 2013-2014. The percent of teachers with significant gains ranged from 0 to 70 percent. Three out of seven projects in Cohort 7 reported significant gains in teacher content knowledge with the percent of teachers with significant gains ranging from 0 to 91 percent. (Note: two projects in Cohort 7 did not report pre and post test scores and two projects did not have teachers with significant gains in content knowledge).

For 2013-2014 a meta-analysis is also provided. The individual effect sizes (Fisher z-transformation) ranges from -0.09 to .45 with an overall average score of 0.35—considered a small to medium change. 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 teacher practices and ultimately student learning.

The professional development activities offered by MSP projects focus on increasing teachers' content knowledge in mathematics and science and enhancing their pedagogical skills. All projects offered summer institutes with school-year follow-up activities. Projects reported offering from 72 to 105 hours of professional development with the average number of hours being 92 hours. All projects used Reformed Teaching Observation Protocol (RTOP) to assess classroom practice.

Most MSP projects addressed multiple content areas and topics. Across schools, mathematical practice was the most frequently addressed content area with 12 (80%) projects offering professional development in this area. Eleven projects (72%) offered professional development in problem solving and 10 projects offered professional development in number and operations, measurement and data, and probability and statistics (67%). Reasoning and proof was the least frequently addressed content area with six projects concentrating on this area.

Respondents were generally positive about their perceptions of local MSP progress toward objectives. Projects noted changes in teacher knowledge and instructional practices. Although some projects did not report any teachers with significant gains in content knowledge participants indicated they were much more comfortable implementing the common core and were much better prepared to teach math and science.

Project Evaluation Design

The Math and Science Partnership program represents a significant investment by the US Department of Education (USDE). Accordingly, project-level evaluations are critical to helping the USDE 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 (or planning to use) 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 (13 or 87 percent of projects.) The 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.

Conclusion

As is typically the case, the first year of Cohort 6 and Cohort 7 focused on establishing infrastructure, which required rather rigid adherence to MSP policies. The second year the projects in Cohort 6 spent more time on applying lessons to the Common Core. In the third and final year of Cohort 6 time was spent honing teaching skills and developing lessons and projects that could be used in the classroom. Teachers participating in the MSP professional development received intensive and sustained content-rich professional development form college and university faculty partners. Participants reported becoming more comfortable in changing their mathematical practices and enjoyed developing lessons that can be used in teaching the Common Core. Some teachers reported changing everything about the way they teach to be more student-

centered rather than teacher-centered. Others reported an entire culture change where teachers are working together to plan, discuss student strategies, compare student work and discuss next steps. MSP teachers are empowered to be leaders, sharing what they have learned about student-centered instructional strategies and ways to implement the Common Core with their school peers.

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).

Based on publicly available data the Science and Engineering Readiness Index (SERI) measures how high school students are performing in physics and calculus. 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 (41st 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 2001 (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 2014 of $2,927,893.

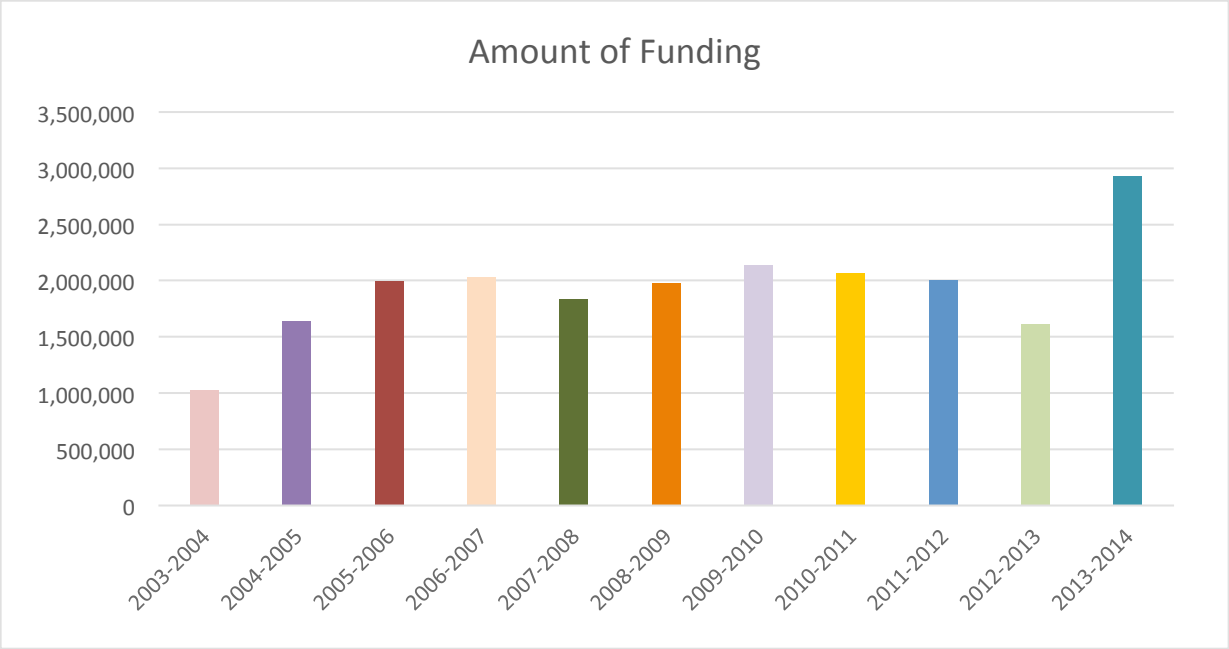

Figure 1: MSP Program Funding, Fiscal Years 2004-2014

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 (which completed the third and final year) and seven funded projects in Cohort 7.

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 (Kellogg Foundation, 20).