

## **Making Good on Our Word: STEM Faculty and K-16 Partnerships**

### **Strand Three: Vision to Action**

#### **Symposium for 2007 AACTE Annual Meeting**

##### **Abstract:**

In K-16 partnerships, the National Science Foundation Math Science Partnerships provide substantial support to improve of teaching and learning in K-16 and higher education, highlighting evidence-based research to promote partnership.

##### **Statement of Purpose**

For the last quarter century, the focus on education reform has been directed at the K-12 sector. With the 1998 reauthorization of the Higher Education Act and the 2002 reauthorization of the Elementary and Secondary Education Act, policy and legislation has turned to postsecondary education as a lever for school reform. Along with demands for improved teacher preparation, a number of organizations have issued public calls for colleges and universities to increase the number of science, technology, engineering, and mathematics (STEM) graduates to combat a perceived loss in U.S. technological and scientific expertise (Cordova, 2006; National Academies, 2005; Business Higher Education Forum, 2005).

One major response to these demands is the National Science Foundation (NSF) Math Science Partnerships (MSP) program, which to date has provided \$600 million to create and sustain partnerships between K-12 and higher education to improve STEM teaching and learning in both sectors. A critical feature of the NSF MSP initiatives is the evidence-based nature of the partnerships. Each NSF MSP includes a research and evaluation component that allows for dissemination of findings to the NSF MSP and the larger education communities. In addition to the partnerships, NSF funds a number of research and evaluation projects charged with evaluating and analyzing numerous aspects of the projects, including a large-scale quantitative study of the partnerships, as well as two knowledge management dissemination projects that study all of the MSPs in the framework of the partnerships' key features.

The first MSP projects were funded in FY 2003, and will be coming to an end in late 2007. This presentation will provide an overview of the impact of the NSF MSPs to date, and the implications of the partnerships on the schools and higher education institutions (IHEs) involved. Presenters include senior STEM faculty involved in different MSPs, a policy scholar involved in research on alignment and teacher preparation, and a researcher with a MSP-funded Knowledge Management Dissemination (KMD) projects that are studying the five key features of the NSF partnerships, in this case, change and sustainability in higher education (National Science Foundation, 2005). This symposium will provide an overview of the NSF MSP initiative, experience and research from the field, and implications for further research and practice.

##### **Literature Review**

Literature cited in this project is found throughout this text and in the reference section.

##### **Contribution**

Federal imperatives to improve the teaching workforce have had an increasing impact on the ways in which teachers are prepared (Earley, in press; ACE, 1999 and 2002). Concurrently, numerous policy reports have addressed demands to increase the number of well-prepared STEM graduates to enter both K-12 education and the general workforce through changes in teaching and learning of mathematics and science in K-12 and higher education (National Academies, 2005; Business-Higher Education Forum, 2005).

Embedded within this policy framework is a conversation on standards and alignment in which disciplinary and regulatory actors may use the same language to describe different conceptions of curriculum and learning (Earley, 2005).

In 2002, the National Science Foundation established a major initiative called the Math Science Partnership (MSP) that seeks both to develop partnerships between the K-12 and education communities and to provide substantial and rigorous evidence on the partnerships. The NSF MSPs are large-scale, multi-year projects that share five key features: partnership-driven; evidence-based design; teacher quality, quantity and diversity; institutional change and sustainability; and challenging courses and curricula. (National Science Foundation, 2005). The partnerships directly engage STEM faculty (rather than education faculty) in partnership activities with schools and across higher education institutions involved in the partnerships. There are three types of NSF MSPs—comprehensive, targeted, and institute—and several partnership models. Targeted MSPs involve a single curricular area (mathematics or science) and usually focus on a single K-12 segment, such as middle school. Comprehensive MSPs involve a number of school districts and multiple grade levels. Some MSPs involve several IHEs and a single school district; others partnerships may involve a single IHE and district. Other partnerships may involve multiple IHEs, school districts, disciplines, and geographical areas. Most MSPs are funded and managed through higher education partners. (National Science Foundation, 2005). As of 2005, NSF had funded 48 MSPs as well as a number of Research, Evaluation, and Technical Assistance projects (RETAs) engaged in study of various aspects of the partnership projects. In 2004, NSF also funded two Knowledge Management Dissemination (KMD) projects, whose work focuses on the partnerships' progress in the five key features. Each MSP also includes an evaluation component. MSPs provide NSF with an annual report, and each project also receives a site visit from NSF program staff. The general work of the NSF MSPs is linked by an online RETA, [www.mspnet.org](http://www.mspnet.org), that serves as a portal for MSP publications, resources, and discussions.

STEM faculty perform a variety of roles as partners in the NSF MSPs. Some prepare undergraduate and graduate STEM non-teaching majors to work with K-12 faculty in school classrooms and labs; some design and deliver extensive professional development; some work in concert with IHE faculty across several institutions to develop and design new courses and programs; and some develop learning communities that involve K-12 and higher education faculty. These examples represent a small sample of the diversity of partnership activities in which STEM faculty are involved with MSPs.

A number of participants involved in the NSF MSPs have experience with other NSF programs and K-16 partnership activities, including ED Title II (teacher quality enhancement) programs and NSF GK-12 (Graduate K-12) programs. The evidence-based nature of the NSF partnerships includes substantial internal and external evaluation conducted by each partnership. In addition to required annual project reports, NSF collects data from projects through its MSP Management Information System (MSP-MIS), a quantitative survey that identifies the types and extent of involvement by partnership staff, faculty, and teachers. Two NSF evaluation projects study higher education engagement: STEM Faculty Engagement RETA, and Alternative Approaches to Evaluating STEM Education Partnerships. The Change and Sustainability in Higher Education (CASHÉ) project has collected and analyzed data on curricular change in over half of the MSPs and has also embarked on an intensive study of STEM faculty engagement in a subset of these partnerships (Westat, 2005; Kingsley, 2005; Change and Sustainability in Higher Education, 2006).

## **Relevance**

Presenters at this symposium will bring their individual perspectives grounded in this session. Two presenters are STEM faculty—one a biologist and the other a mathematician—active in MSP partnership activities. One has been co-principal investigator for an MSP and has been instrumental in the development of MSP faculty learning communities at her institution, and with other IHEs participating in the partnership. (Davidson, Mangurian, Boucher, and Sokolove, 2000; Mangurian, Boucher, and Radius, 2003; Mangurian, Benson, and Sokolove, 2006; Mangurian, 2000). The other professor has been designated as an “outreach professor” at the flagship institution in a southern state, funded half by MSP funds and half by the institution. His work

includes redesign of the math content year sequence for future teachers that is being extended throughout the public institutions in the state (Ma and Millman, 2005, 2006; Eakin, Yopp, and Millman, 2005; Millman, Svec, and Williams, 2005). He will also discuss the need for the reward system for faculty to include the values of K-12 outreach.

The other presenters will frame their discussion in terms of research and policy implications for the future of K-16 partnerships. One will provide a scholarly perspective on the ambiguity of alignment and standards and a critique of teacher preparation (Earley, 2006; Earley and Ross, in press; American Council on Education, 1999). The fourth presenter will share findings from the CASHÉ project and the MSP MIS (Labov, Garton, Shapiro, and Maloney, 2005; Benson, Hamos, Langenberg, Maloney, and Shapiro, 2006).

### **Discussion**

Presenters will address several questions in the session, and attempt to arrive at agreement on the words that are important to the success of the Math Science Partnerships. First, what is partnership? Who defines it? (Kingsley, 2005) What defines the success of the partnerships? What are the challenges? What has the evidence collected by and about the MSP projects show? What are the challenges faced by the MSPs? What difference have MSPs made to date? What will sustain the partnerships—the faculty support, the evaluation work, the training, and the research—after the projects end? Who is critical to the succession—the next steps—of these partnerships? What is critical for their success?

### **Implications for Action**

Policy makers, educators, business leaders, and other segments of U.S. society have demonstrated growing concern over the presumed decrease in “competitiveness.” A perception of declining numbers of STEM graduates, scarcity of qualified STEM teachers, and a low rate of minority graduation in STEM fields are three policy elements that have created a climate of concern about a “gathering storm” where the United States falls behind in education and innovation (National Academies, 2005). Federal legislation makes higher education accountable for the preparation of teachers, and serves as an attempt to bring K-12 and higher education together in efforts to prepare qualified teachers for America’s schools, who in turn prepare students qualified for rigorous higher education study in STEM fields.

### **Outcomes and Methods**

Conference participants will be introduced to the role of the NSF Math Science Partnerships in the framework of policy and institutional challenges and changes in higher education. Presenters will discuss the challenges of balancing demands for educational change with faculty roles and rewards, as well as the role of sustainability.

The session chair will provide a brief overview of the NSF Math Science Partnerships and research conducted by the MSP RETAs and the CASHÉ project that relates to disciplinary faculty engagement in K-16 partnerships. Mathematics and science faculty members on the panel disciplines will share findings from their own MSPs, the role of the university reward structure, and the disciplinary and alignment challenges presented by the partnership. The policy scholar will present research on standards, alignment and teacher recruitment and preparation. Each will discuss ways in which IHE STEM faculty have helped to keep their word—creating challenging courses and curricula, seeking evidence, developing alliances, recruiting and teaching diverse learners, and identifying ways of sustaining the partnerships between teachers, professors, schools, and universities beyond the five years of the MSP grant. Panelists and conference participants will engage in dialogue regarding the changes in the MSPs themselves, and the implications that findings from these partnerships hold for school reform and partnership once the funded projects conclude.

## References

- American Council on Education (1999). To Touch the Future: Transforming the Way Teachers Are Taught. Washington, DC: Author.
- American Council on Education (2002). Touching the Future: Final Report. Washington: DC.
- Benson, S., Hamos, J., Langenberg, D., Maloney, P. & Shapiro, N. (2006). Tensile Strength: Change and Sustainability in STEM Higher Education. Presentation at Association for American Colleges & Universities annual meeting, Washington, DC.
- Business-Higher Education Forum (2005). Tapping America's Potential: The Education for Innovation Initiative Business Roundtable. Washington, DC: Author.
- Change and Sustainability in Higher Education Project (2006). Interim Report on Course and Curriculum Changes in Math Science Partnerships. Adelphi, MD: Author.
- Cordova, F. (2006). Robert Atwell lecture. American Council on Education annual meeting, Los Angeles, CA.
- Davidson, N., Mangurian, L.P., Boucher, L.J., and Sokolove, P.G. (2000). Science and Mathematics Faculty as Scholars of Teaching: Challenges and Opportunities. Lilly Conference on College and University Teaching-Atlantic. Towson, MD.
- Eakin, P., Millman, R. and Yopp, J. (2005). Partnership Enhancement Projects in the area of Mathematics. NSF/ED Math Science Partnership State Coordinators' Meeting, Washington, D.C.
- Earley, P. (2005). Standards alignment and government policy: Unresolved policy dilemmas. Report to National Evaluation Systems. Published in After Standards Alignment: Proceedings of the 20th Annual National Evaluation Systems Conference. Amherst, MA: National Evaluation Systems.
- Earley, P. and Ross, S. (in press). Teacher Recruitment and Retention: Policy History and New Challenges. In Teacher Recruitment and Retention: How do we get and keep teachers? Amherst, MA: National Evaluation Systems.
- Labov, J., Garton, J., Shapiro, N., & Maloney, P. (2005). Title. Paper presented at MSP Evaluation Summit, Minneapolis, MN.
- Leep, D. and Millman, R. (2005): Capstone Course for Future High School Teachers Teacher Quality Summit VI, Louisville, KY
- Mangurian, L.P., Boucher, L.J. and Radius, S. (2003). The Art and Science of Faculty Learning Communities. Lilly Conference on College and University Teaching-East. Towson, MD.
- Ma, X. and Millman, R. (2006). Design of a Mathematics Content Course to Integrate the Assessment Principle: Recent Results. Proceedings of the 4th Annual Hawaii International Education Conference, (4552-4558)
- Ma, X. and Millman, R. (2005). Using self-assessment and peer assessment. NCTM Bulletin 42 (2005), p. 9.

Mangurian L.P., Benson, S., and Sokolove, P. (2006). Where the Neurosciences and Pedagogy Intersect in Support of Student Learning. Presentation at the Lilly-East Conference on College and University Teaching, Newark, DE.

Mangurian, L.P. (2000). The Scholarship of Teaching in the Sciences. Lilly Conference on College Teaching. Oxford, OH.

Millman, R., Svec, K, and Williams, D. (2005). Use of Video Clips of Children in a Content Math Course for Future Elementary Teachers. Appalachian Association of Math Teacher Educators. Lexington, KY.

National Academy of Sciences (2006). Rising Above the Gathering Storm. Washington, DC: National Academies Press.

National Science Foundation (2005). Math and Science Partnership Program: Strengthening America by Advancing Academic Achievement in Mathematics and Science. Arlington, VA: Author.

Silverstein, G., Bell, R., Frechtling, J. & Miyaoka, A. (2005). MSP MIS Summary Data for Comprehensive and Targeted Partnership Projects: 2002-2003 and 2003-2004 School Years. Rockville, MD: Westat.

Westat (2005, April). Effect of STEM Faculty Engagement in MSP—A Longitudinal Perspective. Rockville, MD: Author.