

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

**Symposium presentation at the 2006 Association for the Study of Higher Education Annual Meeting, Anaheim, CA, November 4, 2006.**

**Presenters:** Penelope Earley, Center for Education Policy, George Mason University; Patricia Maloney, Change and Sustainability in Higher Education Project (session chair); Luz Mangurian, Towson University; and Richard Millman, University of Kentucky.

### **Abstract**

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 (the so-called No Child Left Behind Act), policy and legislation has turned to the role of postsecondary education as a lever for school reform. In conjunction 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 has provided \$600 million for institutions to create and sustain partnerships between K-12 and higher education to improve STEM teaching and learning in both K-12 and higher education. Symposium presenters include two STEM faculty involved in MSPs, a policy scholar involved in research on alignment and teacher preparation, and a researcher with the NSF-funded Change and Sustainability in Higher Education (CASHÉ) project (National Science Foundation, 2005).

### **Objectives**

Presenters will share experiences and research on advances in policy and practice resulting from the NSF MSP initiative, including the challenges of defining and maintaining partnerships across distinct educational sectors; the roles involved in creating and sustaining curricular changes that align with local, state, and disciplinary standards; the nature of university reward systems, and the challenges of managing partnerships for change within and across different types of IHEs.

### **Perspectives and Background**

Federal imperatives to improve the teaching workforce have had an increasing impact on the ways in which teachers are prepared (Earley and Ross, 2006; ACE, 1999 and 2002). Concurrently, concerns about declining enrollments in STEM fields have been the topic of numerous policy reports and demands to increase the number of well-prepared STEM graduates to enter both K-12 education and the general workforce change in the teaching and learning of mathematics and science in both K-12 and higher education (National Academy of Science, 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 special 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.

In addition to the NSF MSPs, the Department of Education (ED) has established its Mathematics Science Partnership program, which provides funding to partnerships through state-level grants. The ED MSPs are funded in substantially smaller amounts, and involve less extensive partnership activities than those in the NSF initiative. Whereas the majority of the NSF MSPs are overseen by NSF program directors with extensive STEM backgrounds, the ED program officers are staff with education or general management backgrounds. Some NSF MSP faculty and staff have interactions with the ED partnerships, but there is a considerable distinction in both the scope and the funding for the individual partnerships.

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) program. The evidence-based nature of the NSF partnerships includes substantial internal and external evaluation conducted by each of the 48 partnerships. In addition to the annual report that projects submit, 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 (Silverstein, Bell, Frechtling, and Miyaoka, 2005).. Two of the RETAs that NSF has funded study higher education engagement: STEM faculty Engagement RETA conducted by Westat, and Alternative Approaches to Evaluating STEM Education Partnerships. The Change and Sustainability in Higher Education (CASHE) 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 and Waschak, 2005; Change and Sustainability in Higher Education, 2006).

### **Perspectives**

Presenters at this symposium will bring their individual perspectives grounded in this session. Two presenters are STEM faculty—one an anatomist 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 in the MSP. (Mangurian, 2000; Davidson, Mangurian, Boucher, and Sokolove, 2000; Mangurian, Boucher, and Radius, 2003; Mangurian, Benson, and Sokolove, 2006). 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; Leep and Millman, 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, 2006; American Council on Education, 1999). The fourth presenter will share findings from the CASHE project and the MSP MIS (Labov, Garton, Shapiro, and Maloney, 2005; Benson, Hamos, Langenberg, Maloney, and Shapiro, 2006; Maloney, 2006; Benson, Shapiro, Maloney, et al., 2006).

### **Discussion**

Symposium 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?

### **Significance**

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 Academy of Science, 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.

### **Session Structure**

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. The symposium presenters from the mathematics and science disciplines will discuss their work within their own MSPs, the role of the university reward structure, and the disciplinary and alignment challenges presented by the partnership work. The policy scholar will present findings from research on standards, alignment and teacher recruitment and preparation. Each will discuss ways in which IHE STEM faculty partners 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.

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