Making Good on Our Word

STEM Faculty and K-16 Partnerships
Patricia Maloney, Ph.D.

2006 ASHE Annual Meeting
NSF MSPs and the Policy Climate

Patricia Maloney, Ph.D., Project Manager/Consultant, Change and Sustainability in Higher Education Project (NSF MSP Knowledge Management Dissemination)
Purpose and Meaning

- Who we are and how we all got here
- Partnerships and collaborations
- The inner and outer work of partnership
Who We Are

- Penelope Earley, Professor and Director, Center for Education Policy, George Mason University
- Patricia Maloney, Coordinating Director, National Postsecondary Education Cooperative
- Luz Mangurian, Professor Emerita, Towson University
- Richard Millman, Professor, University of Kentucky
What are Some Definitions of...

- Partnership?
- Sustainability?
Making Good…

- Placing policy in context
- “Making nice” in a challenging climate
- One institution, learning communities, and growth
- Institutional and leadership perspective
- Where this might lead
Policy Framework: Climate

- Fifty years of competitive spirit—Sputnik to outsourcing
- Additional funding sources and pressures
- *A Nation at Risk* to the Spellings Commission
- HEA & ESEA pressures
- Demands for quality counterbalanced with demands to “teach the controversy”
- Let a hundred reports bloom….
Policy Framework: Drivers

- Business-Education continuum
- State math/science boards
- State executive and legislative agendas
- Regulatory and fiscal climate
- Assessments and results (TIMSS, NAEP, PISA, et alia)
The Perceptions

- We are falling behind other nations in science/productivity/innovation.
- We are failing to prepare students in K-12 for rigorous work in the sciences and mathematics.
- Our good jobs are going overseas.
- We don’t measure up any longer.
- Our teachers don’t know how to teach what our students need to know.
- Our colleges and universities aren’t doing their parts.
Challenges Facing U.S. Education in the 21st Century

- Supply and demand of teachers
- Aging of teaching force
- Retention of teachers
- Too much teaching out of field
- Too few students taking *and succeeding* in advanced coursework
- Too few schools/districts offering challenging curricula and textbooks
Established a program that would:

- Engage higher education (NSF’s core constituency) with a critical role and responsibility for furthering K-12 education reform.
- Higher education’s involvement in the teacher professional continuum also would undergo reform.
- Strongly emphasize and fund development of effective partnership models, resulting in institutional change that could be implemented, expanded, and sustained.
NSF Math Science Partnerships (NSF-MSP)

- First MSPs funded 10/2002
- Project-based
- Various types of partnerships
  - Targeted
  - Comprehensive
  - Institutional
  - Evaluation and evidence
- Numerous stakeholders
NSF Math Science Partnerships (NSF-MSP)

- **Increase achievement through a sharp focus on three related issues:**
  - Ensure that all students have access to, are prepared for, and are encouraged to participate and succeed in challenging and advanced mathematics and science courses;
  - Enhance the quality, quantity and diversity of the K-12 mathematics and science teacher workforce; and
  - Develop evidence-based outcomes that contribute to our understanding of how students effectively learn mathematics and science.
NSF MSPs: Five Key Features

- Partnership-driven
- Evidence-based design
- Teacher quality, quantity, and diversity
- Institutional change and sustainability
- Challenging courses and curricula
STEM Faculty Engagement

- Project directors, managers, lead faculty
- Initial planning and outreach
- In IHE labs and classrooms
- Professional development/preservice
- In K-12 classrooms
- Course and program design/redesign
Common Issues

- What is partnership? Who says it’s partnership?
- Funding agencies’ visions may vary or change over time
- STEM work is critical, but education faculty also play a role in K-16
CASHE FINDINGS (2006)

- “Drilldown” of 21 MSP IHE curricular activities
  - 100% involved in curricular change
  - Nearly half involved several IHE partners
  - > 85%: new/redesigned PD courses
  - > 75%: new/redesigned STEM u/g courses
  - Nearly half new/redesigned PST courses
Findings from STEM Faculty RETA (2006)

- Eight case studies combined w/ data from MSP-MIS
- Traditional reward structures remain barrier to partnership
- 15% MSP faculty new to K-16 partnership
- 80% IHE faculty had 40 hrs./yr.; 41% 160 hrs. (increase over first 2 years)
- Disciplinary faculty role key to partnership success
In the MSP world, executive and legislative branches have been at odds over which agency should “lead” in STEM/K-16 work.

House and Senate science committees both endorse rigorous STEM learning at all levels, and seem to favor continued funding for NSF-MSP.

NSF is funding a small number of new MSPs and RETAs beginning this FY.
Follow the Money: Some Good News

- In a number of MSPs, promotion and tenure have followed as a result of partnership work.
- In a number of MSPs, new models for joint faculty hiring and outreach have taken root.
- In a number of MSP IHEs, partnership has become a key feature.
“Prestige economy” of higher ed rewards research over teaching, especially in STEM

Teaching still not seen as prestigious in most institutions

MSP/partnership work often denigrated as “service” and low priority

Follow the Money: Higher Ed
Follow the Money: Some Other News

- NSF-MSP is first major (but not ONLY) “R & D” effort to fund and evaluate K-16 partnerships
- Initial data (qualitative and quantitative) shows promising results
- Are these replicable?
- What can make them replicable?
Sustaining K-16 Partnerships in a High Stakes, Fluid, Policy Environment

Penelope M. Earley, Director
Center for Education Policy
George Mason University
Culture of Externally Funded Partnerships

- Expect institutionalization and sustainability but not fund it
- Focus on start-up rather than long term
- Policymakers’ expectation of immediate impact (associated with election cycles)
Bringing the Casserole

- Participate because money is available
- Show good citizenship
- Fulfill a perceived obligation
- Issue across levels and disciplines
Pressures on K-16 Partnerships

- NCLB pressures on schools
  - Time
  - Focus
  - Personnel
- Differing definitions of curricular alignment
  - Align K-12 curriculum with colleges’ expectations
  - Align teacher candidate content with K-12 standards
Pressures continued

- Can the partnership be sustained without external funding?
  - How important is it to the stakeholders?
  - What are fiscal tradeoffs?
- Differing forms of accountability and rewards
  - Test scores vs. P & T
  - Individual vs. school
Pressures continued

- Generally, K-12 and higher education are supported through different (competing) funding streams
- Lack of understanding of nuances of each other’s governance systems and pressures.
VIP K-16 Towson Faculty Learning Community

Luz P. Mangurian
Professor Emerita
Towson University
Recruitment

- Invitation sent to faculty emphasizing the use of science inquiry in the classroom
- Chance to team teach
- NSF-supported honorarium
Selection Criteria

- Active research program
- Interest in improving students’ understanding of discipline
- Tenure track
Faculty Learning Community

- Started with nine from Biology, Chemistry and Physics
- Now includes seventeen fellows
- Four of these are Science Education faculty (tenured at the college of Science and Mathematics)
Mechanics of the Faculty Learning Community

- Four mentors
- One director
- Team teaching
- Newly developed or modified science courses
Course Support

- Partners and courses were self-selected
- NSF funds provided fellows’ stipends and supported adjunct replacements for faculty
- Course materials provided
Although team teaching requires more work to coordinate content, it enables one to provide additional insights that one couldn’t do alone.
Exhilarating to see students become actively engaged in the course activities and to have a good percentage of them excel.

Not yet clear whether it is effective in preparing students for subsequent biology courses.

Will be tracking all of the 200 students that take the course in 2006-2007 to find out.
Steve Lev
Geochemist

Rachel Burks
Structural Geologist
Physical Geology (GEOL 121)

- Students are encouraged to apply their knowledge to investigate real-world problems
- Collaborative inquiry activities in large lecture sessions and laboratories fosters higher-level thinking and problem-solving
Guided inquiry experiments:

What influences the rate of a chemical reaction?
How does pH change during an acid-base titration?
How does the pressure of a gas change as the temperature, volume, and amount of a gas are changed?

Use of technology (Palm Pilot E2) empowers student inquiry learning
Physical Science for Teachers (PHSC 511)

- Different sections of the same “inquiry” course will have varying degrees of success.
- This is dependent on the degree to which the instructors have had prior experience with inquiry-based instruction.
Roland Roberts
Botanist

Sarah Haines
Ecologist
Science Education
Biodiversity (BIOL 206)

- We wanted to use science inquiry to teach diversity
- Students learned more by doing rather than following a lecturing professor’s “walk through the kingdoms”
Assessment as Learning

- Faculty self-assessment surveys
- Student assessment surveys
- Classroom observations by peers
- Classroom observations by outside reviewers
Development Opportunities

- Monthly meetings to determine activities
- Books and article on science inquiry provided
- Opportunities to critique work in progress
- Attending cohort conferences, summer institute and partners retreats
New Fellows

- Joseph Topping
  Analytical Chemistry
- Susie Feldman
  Cell Biologist
- Jennifer Scott
  Astronomist
- Phuoc Ha
  Particle Physicist
AMSP, Algebra Cubed, and the Role of Leadership in Partnership

Richard S. Millman, Outreach Professor of Mathematics, University of Kentucky; PI, NSF Algebra Cubed
Appalachian Math Science Partnership

- 51 School Districts
- 9 Colleges, Universities (IHEs)
  - 430+ Schools
- 100,000+ School Students
- 1300+ Math/Science Teachers,
  - 6000+ Elementary Teachers
- 20,000+ Square Miles in 4 States
Overarching Goals

• To eliminate the “achievement gap” in K-12 science and mathematics education in the region

• To build an integrated K-16 education system that supports a diverse, high quality mathematics and science teacher workforce
Strategic Goals

- Improve the pre-service training of mathematics and science teachers

- Improve pre K-12 in-service mathematics and science teachers’ knowledge of both content and pedagogy

- Increase student opportunities and levels of achievement

- Institutionalize mathematics and science program improvements

- Advance the understanding of education reform in rural school environments
ALGEBRA CUBED
A GK-12 proposal funded by the National Science Foundation

- Funding: $1,829,662
- Project Dates: March, 2006 – March 2009
- # of Graduate Fellows: 10 STEM graduate students per year
- # of Teacher Mentors: 13 per year
- Principal Investigators: Richard Millman (Math), G.T. Lineberry (Mining Engr), Xin Ma (Curriculum & Instruction), Jeff Osborn (Bio), Paul Prater (Principal, Bath High School)
- Includes all (one each) middle school and high school in Bath and Powell Counties. Each county is rural and poor with about 11,000 residents.
Objectives of Algebra

- Focusing on algebra, increase the mathematical conceptual understanding and procedural fluency of middle and high school students in Bath and Powell Counties.

- Establish professional learning communities across levels of teachers, middle and high school students, faculty, Fellows (graduate students at UK) and other stakeholders to enrich all participants.

- Increase the algebraic content knowledge and enrich the view of applications among all participants/teachers.
Objectives of Algebra

- Develop and utilize lessons for algebra that stress the use and applications of algebra in the context of the Kentucky Core Content.

- Establish a lifelong interest in the math and science of middle and high school in the Fellows.

- Increase the communication and teaching skills of the Fellows through interactions with the teachers in the schools and add to professional development opportunities for the math teachers resulting in content gain.

- Increase the performance of the students on the algebra portion (especially) of the Kentucky Core Content Test (statewide assessment).
Experiences from the Partnership

- What is an outreach professor?

- Reward structure
  - Presidential support is not enough: vertical belief system
  - Mission statement and outreach/connects and disconnects

- Integrated leadership in partnerships
  - Multiple levels of equally influential voices: Teachers, faculty, STEM graduate students, principals
  - Need to grow leadership for sustainability