BREAKOUT SESSION

Engaging Higher Education Faculty in K-16 STEM Education Reform

2009 Math and Science Partnership Learning Network Conference

Research Findings in Teacher Education:

New Approaches → Transformative Possibilities?

January 25-26, 2009 • Washington, DC

TERC

2067 Massachusetts Avenue
Cambridge Massachusetts 02140
617-547-0430

MSPnet

An electronic learning community for all MSP projects.

www.mspnet.org

NATIONAL SCIENCE FOUNDATION

CONTENTS

This documentation is part of the **MSPnet** project, funded by the National Science Foundation and designed and facilitated by **TERC Inc.**, a not-for-profit education research and development organization based in Cambridge, Massachusetts.

Participant comments have been paraphrased; they are not exact quotes. The contents of this document do not necessarily reflect the views of TERC, the National Science Foundation, or the organizations of any participants.

MSPnet

An electronic learning community for all MSP projects.
www.mspnet.org

Principal Investigators
Joni_Falk@terc.edu
Brian_Drayton@terc.edu

Conference Documentation
Catherine McEver

About This Summary

This documentation of the 2009 Math and Science Partnership Learning Network Conference offers a brief summary of the presentations that took place during one conference breakout session and focuses on questions, answers and discussions during the session.

Readers interested in pursuing information about the projects discussed in this breakout session are encouraged to visit MSPnet to access the full PowerPoint presentations.

Cover: *from left, Barbara Shoemaker, Deborah Pomeroy, Linda Beardsley, Xiaodong Zhang*

Visit the MSP LNC 2009 Virtual Poster Hall

For all conference abstracts, as well as post-conference commentary and dialogues concerning the abstracts.

Visit MSPnet.org and click on Conferences or go to:

http://hub.mspnet.org/entry.cfm/msp_conf_2009_abstracts

ENGAGING HIGHER EDUCATION FACULTY IN K-16 STEM EDUCATION REFORM

Learning Network Conference Breakout
Session Number: 3 - 35

A Special Interest Session:
A time for participants to come together for sharing and discussion around an area of common interest that may reside slightly outside the conference theme.

Area of Interest:
A central tenet of the NSF MSP program is that deep and sustained involvement of higher education faculty is crucial for the success of efforts to improve K-16 teaching and student learning in the STEM disciplines. This panel examines 1) the impact of MSP program work on faculty teaching and research, and 2) the progress that has been made in creating effective faculty reward systems in MSP projects.

Moderator:
Charles Kutal, University of Georgia

Discussants:
Linda Beardsley, Tufts University
Deborah Pomeroy, Arcadia University
Barbara Shoemaker, University of Kentucky
Xiaodong Zhang, Westat, Inc.

Presentation Recap

Moderator Charles Kutal opens the session by introducing the two topics addressed in this special interest group: the impact of MSP programs on faculty teaching and research; and the progress in creating effective faculty reward systems in MSP programs.

MSP of Greater Philadelphia (MSPGP)

Case Study of an MSP: Synergistic Interactions of K-16 Partnership Work, Research, and Teaching in Higher Education STEM Faculty Members

Deborah Pomeroy, Arcadia University

Pomeroy notes that here the term "partnership" denotes a true partnership, one that both demands and results in bidirectional transformations. She explains that this research supplement was generated by the following hypothesis.

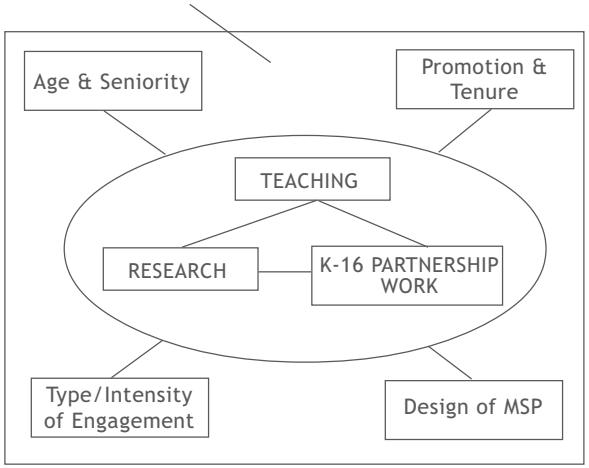
Hypothesis

K-16 partnerships involving rigorous scholarly work may have transformative effects not only on professors' teaching, but also either directly or indirectly on their disciplinary knowledge and ultimately their research.

The study was based on eight volunteer professors from the MSPGP project, purposefully selected based on their level of engagement, and draws heavily on Boyer's and Braxton's work at the Carnegie Institute of Higher Education. Pomeroy explains that Boyer chose to talk about the application of knowledge as being different from what institutions of higher education often call service. The work described here fits into Boyer's definition of the application of knowledge.

Pomeroy also offers her definition of rigorous scholarly work: reflection on and analysis of ideas and observations, especially in terms of the academic literature; testing of ideas according to the standards of the discipline; engaging in critical analysis of findings with a community of peers; and disseminating findings to a scholarly audience. She proceeds to explain how this MSP work fits that definition.

The following schematic illustrates the bidirectional interactions involved and the external



Deborah Pomeroy

K-16 Partnership Work and Teaching

Finding 1:
The biggest impact of the MSP on teaching was the professors' willingness, and often eagerness, to engage in serious and scholarly examination of their own teaching practices.

Finding 2:
Through the true partnership relationships developed between professors and school teachers, half of the professors transformed their teaching practices.

Finding 3:
Work in the MSP
- Reinforced interest in pedagogy,
- Provided a pool of like-minded colleagues,
- Inspired research,
- Supported trying new practices,
- Provided a peer community for reflective practice.

K-16 Partnership Work on Knowledge and Research

Finding 1:
This study confirms the hypothesis that the robust scholarly aspects of K-16 partnership work could lead to new discoveries in the disciplines and could impact professors' disciplinary knowledge understandings.

Finding 2:
Through the MSP K-16 partnership work, some of the STEM faculty reported discovering new applications of their knowledge.

factors at play that might shape these interactions. Pomeroy was sensitive to both in her research.

She offers a thumbnail sketch of how this plays out in terms of one faculty member, a physical chemist and a very traditional professor, teaching introductory and physical chemistry and utilizing a hundred-percent lecture and formulaic lab. As a result of the MSP work, he totally rewrote both of his courses and they are now 100% guided inquiry. In addition, his work with one of his high school teachers involving development of an apparatus to test an existing theory about molecular motions led him to challenge that existing theory, which has the potential for significant impact in the fields of both theoretical and applied chemistry.

Pomeroy then reviews some of the findings from her research, beginning with the bidirectional interaction between K-16 partnership work and teaching. She proceeds to the impact of the interaction between K-16 partnership work on knowledge and research, and the interaction between research and teaching.

Research and Teaching

Finding 1:
Half the subjects in this study indicated that teaching positively impacts their disciplinary knowledge, skills and/or research.

Finding 2:
To at least some degree, five of the subjects have begun to use their own teaching as a subject of research.

Pomeroy shares two conclusions from the research.

Conclusion #1

Improvement of pedagogical practices in higher education was confirmed in this study.

Conclusion #2

This study provides evidence of the positive impact of MSP work on professors' research and disciplinary knowledge and skills

She explains that part of the original incentive to engage in this work was to use the evidence noted in conclusion two to raise the discourse when talking about promotion and tenure. Pomeroy ends with the statement, "Maybe we can reconnect with Boyer's notion of the application of knowledge, and maybe we can ramp this up a little bit and say that this is not service, this is something very substantively different."

The Fulcrum Institute for Education in Science

Splits or Connections?

Linda Beardsley, Tufts University

Beardsley's presentation focuses on The Fulcrum Institute's work to promote opportunities for arts and science education faculty to collaborate to improve the science knowledge and practice of experienced K-8 teachers. She observes that the nature of that challenge can be found in the history of teacher preparation

in the United States, particularly in the state of Massachusetts. In Massachusetts there is a history of what is called the "normalites," women who were encouraged to go into normal schools to learn to teach. She reviews some of the aspects of this history.

Normalites:

- A richer tradition of intellect, voice, and feminist perspectives than the academy tends to acknowledge.
- Normal schools developed into the state colleges …literary circles and pedagogy groups were replaced by sororities and football games.
- Teacher education in normal schools focused on how to teach basic knowledge, not on deep understandings and debates about the shape of knowledge in academic disciplines.

Source: Ogren, C.A. (2000). "A large measure of self-control and personal power": Women students at state normal schools during the late-nineteenth and early-twentieth centuries. *Women's Studies Quarterly, 28*(3&4), 211-232.

There is much to be learned about the development of the profession of education and teaching by looking at what happened in these normal schools, Beardsley notes. What began as a much richer tradition developed into the state colleges, where literary circles and pedagogy groups—the precursors of what we now call collaborative learning and coaching—morphed into sororities and football games. Teacher education focused on how to teach basic knowledge rather than on deep understanding or discourse about the shape of knowledge in academic disciplines.

It is at this point, Beardsley states, that the "split" between the worlds of knowledge and pedagogy occurred, which has philosophically been seen as a product versus process debate. It was seen to be intellectually more rigorous to talk about the shape of mathematics rather than about how we learn and understand mathematics.

"At Tufts University," Beardsley explains, "we are not a school of education. We are under the umbrella of the graduate school of arts and sciences and engineering. In some ways, that means we have to learn to talk to our arts and science colleagues in a very rich way." The Fulcrum Institute MSP has offered the chance to leverage those opportunities, and to think about these questions.

Beardsley notes that in doing research for a chapter of her book, *Acting Civically*, she explored the involvement of universities in work with the community and community issues—work that has seen a drop in respect on the part of communities regarding what professors can add to the conversation. In this MSP, she explains, they were looking at how they could really talk to and learn from the teachers and their own faculty resources.

How has the Fulcrum Institute MSP addressed this "split"? The most important finding in bringing scientists from the faculty (particularly the physicists and chemists), the teacher education faculty, and administrators and K-8

- The "split" between the "worlds of knowledge and worlds of pedagogy"
- Philosophically, a product versus process debate.

Source: Maher, F. & Tetreault, M.K. (2000). Knowledge versus pedagogy: The marginalization of teacher education. *Women's Studies Quarterly, 28*(3&4), 194-201.

Linda Beardsley

- How does the marginalization of teacher education programs on college campuses influence quality of university, K-12 school partnerships?
- How has the MSP at Tufts University, the Fulcrum Institute, begun to address this "split?"

Evidence that the collaboration between scientists and education faculty has had an impact on:

- Faculty interests, research, practice

  Faculty interest grew as they heard alternative perspectives, saw how excited sixth graders were looking at the phenomena, and interacted with teachers online and face-to-face. It has dramatically increased faculty interest in thinking about the role of the academy, the university, that proposes to be about the life of the mind and about ideas. What does that level of education have to say about, and what is the responsibility to K-12 public school systems?

- The development of K-8 teachers as science leaders in their schools

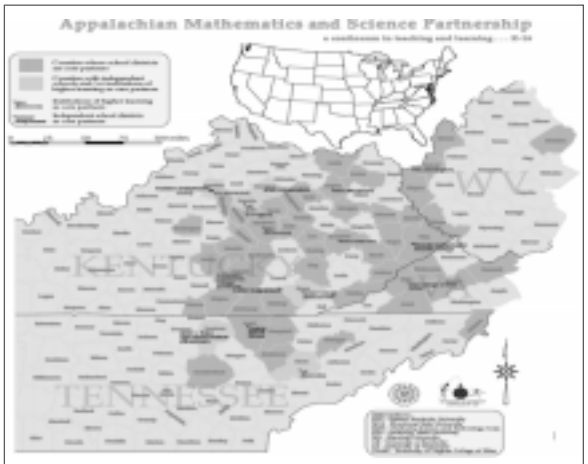
  K-8 teachers have developed dramatically as a result of their ability to be able to talk to scientists in face-to-face sessions and online; to learn that scientists are flummoxed about some of the same phenomena that puzzle a sixth grader; and to learn that it is okay to have these questions.

teachers together was that they had important work to do together. The heart of the Fulcrum Institute is three online courses that provide a rigorous and significant look at developing the K-9 teachers' academic knowledge in the sciences. The emphasis is on major themes in physics, such as the particulate theory of matter and its meaning and implications.

This involved bringing a number of different voices together, during which they discovered that the fourth grader and the tenured research professor in physics very often have the same questions about topics like friction, or why three spoons, one metal, one plastic, and one wooden, react differently when submerged in hot water. "Those were wonderful conversations," Beardsley relates, "and they weren't about who's the smartest or who has the best theory or approach. It was about, what are these complex, interesting, exciting phenomena that we can all talk about and learn from with our various perspectives?"

What they found, Beardsley, states, is that the "split" could be healed in many ways by doing significant work together and by having K-8 teachers in their classrooms giving continuous feedback regarding what it means to look at these theories and ideas from different perspectives. The collaboration had an impact on both the faculty and the K-8 teachers. "In the words of one of our scientists," Beardsley concludes, "what they have all learned together is that you don't ever really get to the end if you've got a really good science question that you're exploring. You can get to some really neat different levels of inquiry, understanding, and material, but together you really can pursue some interesting ongoing projects."

Appalachian MSP



Barbara Shoemaker, University of Kentucky

Shoemaker explains that in this MSP, which covers four states in the Appalachian region, the partnership between IHE's and the rural schools is a strong component. The MSP had four lines of investment: a preservice program, an inservice program, school programs, and a research and evaluation piece. In all activities, from planning through implementation, school teachers collaborated with IHE faculty.

Nine IHE's were involved, and in 2007 a survey was conducted of all faculty members involved with the MSP program. The results of that survey are offered below.

AMSP 2007 Faculty Survey
Conducted Jan/Feb 2007 • 157 Faculty Members

- 69 at research institutions
- 88 at comprehensive/ private institutions
- 70 math
- 39 science
- 22 education
- 26 other/unknown

AMSP Influence >= Somewhat
Individual Question Response Rate: 26.7% to 36.9%

- 88% Changed the instructional materials and/ or content used in their courses
- 86% Influenced their teaching methods
- 73% Changed the instructional content of courses in their department
- 71% Changed the teacher preparation curriculum at their institution

Conclusions

- Influence on individual professors slightly greater than on their departments
- Individual and departmental influences highly correlated, especially between departmental course content and individual factors

Shoemaker notes that this project's experience with professors was similar to that of the MSPGP described by Deborah Pomeroy. "Once they got involved working with teachers, they discovered the state standards," Shoemaker recounts, "and they were suddenly knowledgeable about what the teachers had to teach each year, and sometimes they were appalled that teachers had to cover all of that material in one year."

More importantly, Shoemaker states, the professors became involved in creating teacher-friendly terms so that the teachers could understand the standards, as well as student-friendly terms so the students could read and understand the standards.

Below is a breakdown of the institutions involved, which included community colleges, private institutions, regional institutions, and research institutions. In all types of institutions, response to questions regarding the impact of MSP was positive.

Shoemaker explains that her own involvement focused on the Partnership Enhancement Program, which differs from the usual activities

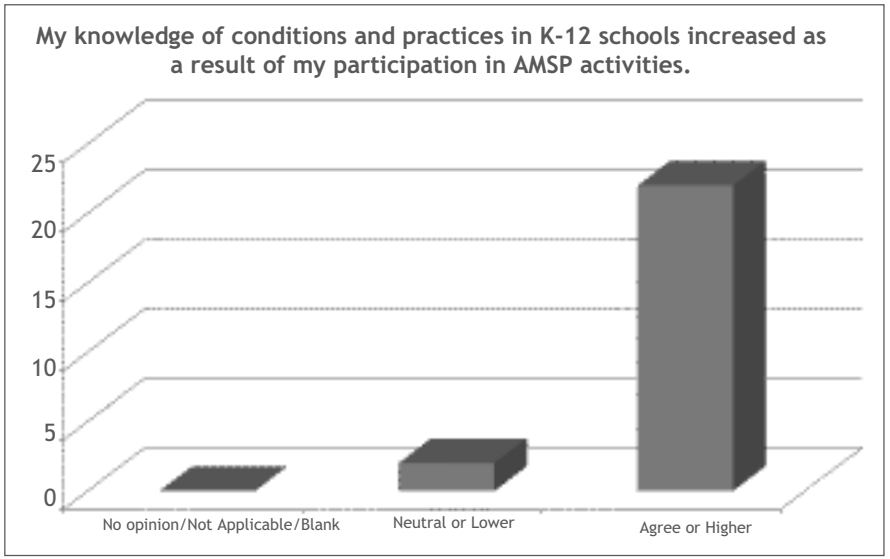
View original PowerPoint slides on **MSPnet** for a more legible rendition of the chart below.

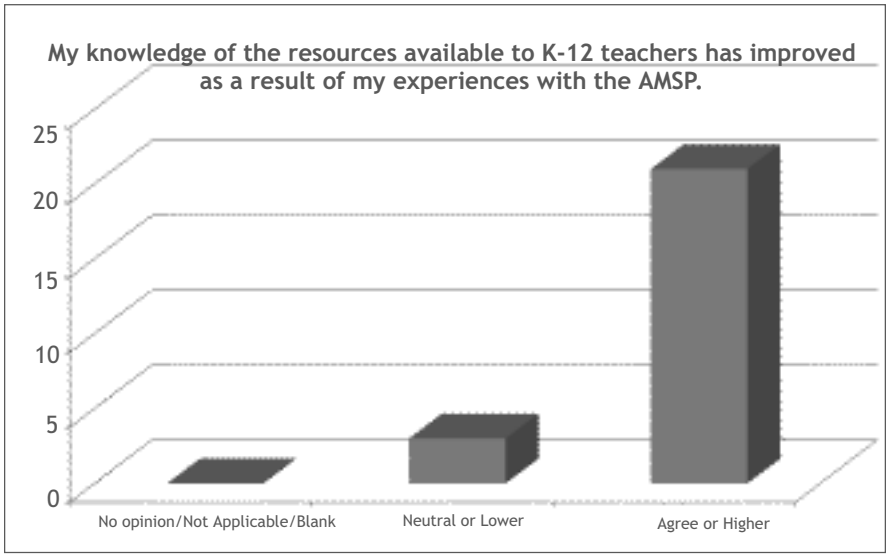
January 2007
157 faculty members surveyed
n = 68 respondents (43.4%)

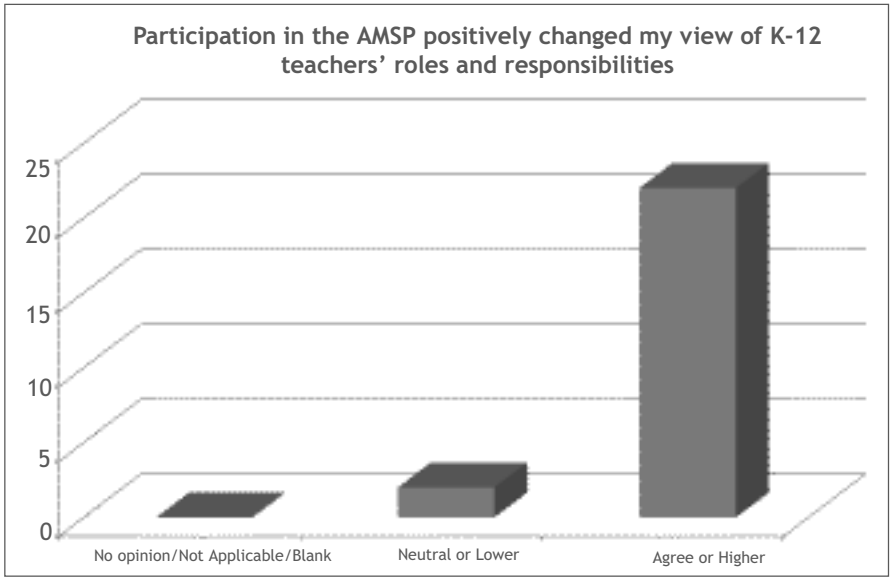
Impact Rating Scale: 5=very much 4= much 3=somewhat 2=little 1=not at all

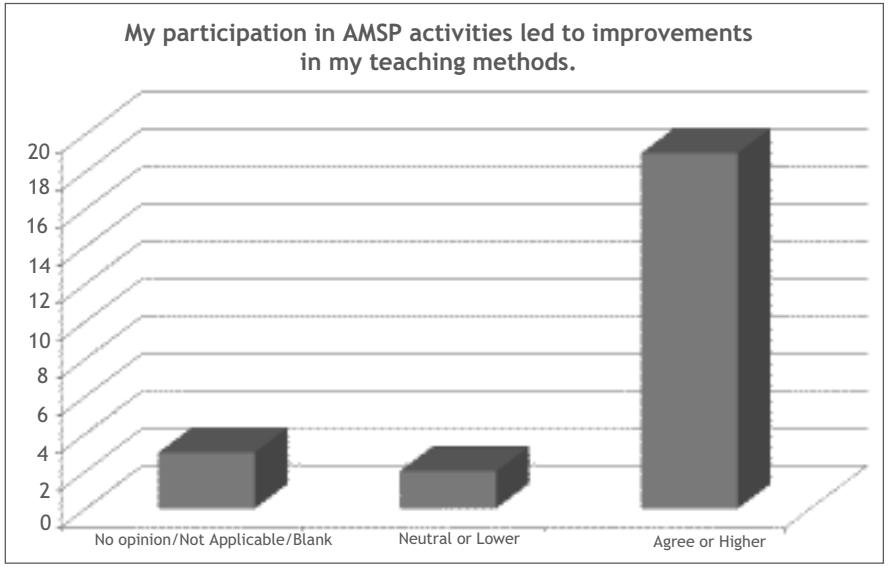
Question	Discipline	Avg.	Institution Type	Avg.
A. How much did your participation in the AMSP serve to enhance your knowledge of K-12 school teachers' responsibilities?	Education Mathematics Science	4.5 4.3 4.2	Com Col, Private, Regional Research	4.3 4.3
B. To what extent has your participation positively changed your view of K-12 teachers' knowledge and abilities?	Education Mathematics Science	4.3 4.1 4.0	Com Col, Private, Regional Research	4.1 4.2
C. To what extent has your knowledge of K-12 schools increased?	Education Mathematics Science	4.4 4.3 3.7*	Com Col, Private, Regional Research	4.0 4.3*
D. To what extent has your perception of the resources available to K-12 teachers changed?	Education Mathematics Science	4.1 4.3 3.7*	Com Col, Private, Regional Research	3.9 4.3*
E. To what extent has your participation in the AMSP enhanced your understanding of what it is like to work in a K-12 school?	Education Mathematics Science	4.4 4.1 3.8*	Com Col, Private, Regional Research	4.0 4.3*
F. To what extent have you changed the instructional materials and/or content in the courses that you teach?	Education Mathematics Science	4.3 4.3 4.3	Com Col, Private, Regional Research	4.3 4.3
G. To what degree has your participation in the AMSP influenced your teaching methods?	Education Mathematics Science	4.3 4.3 4.3	Com Col, Private, Regional Research	4.3 4.3
H. To what extent has departmental faculty participation in the AMSP led to changes in the instructional content of courses in your department?	Education Mathematics Science	4.3* 4.0 3.9	Com Col, Private, Regional Research	4.0 4.0
I. To what degree has departmental faculty participation in the AMSP led to changes in the teacher preparation curriculum at your institution?	Education Mathematics Science	4.6* 4.2 4.3	Com Col, Private, Regional Research	4.2 4.7*

of this MSP in that representatives from higher education work one-on-one with a particular school district, partnering in an application or grant proposal to do professional development in that school district. Twenty-four respondents to the survey were involved in that program, and the series of charts below reflect their responses. These professors worked one-on-one with a group of teachers for over a year. One professor, Shoemaker notes, is working with

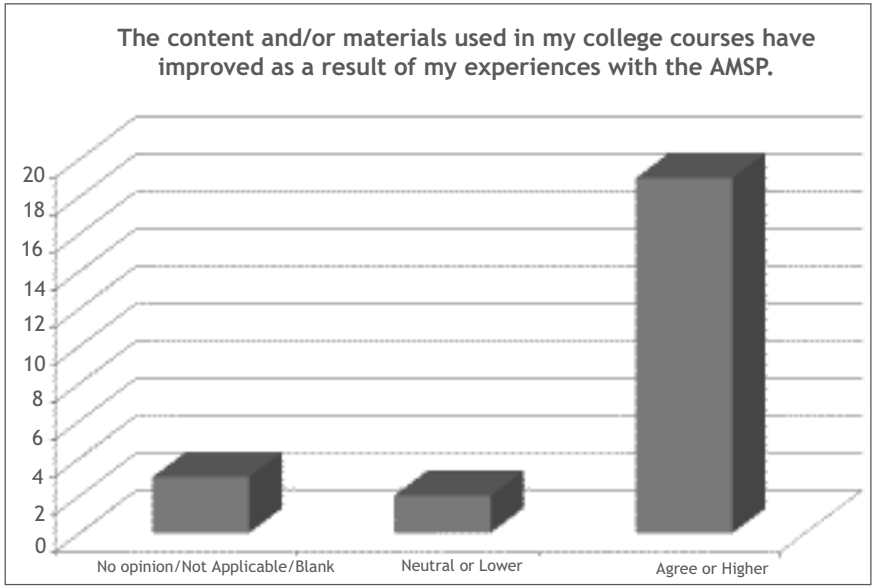








three school districts while also carrying his full teaching load as a chemistry professor at Eastern Kentucky University. The same professor represents a poster child for the program, Shoemaker adds, because he also changed his classroom practice from lecture to guided inquiry in his classrooms and his labs.



Deborah Pomeroy

Effect of STEM Faculty Engagement in MSP

Engaging STEM Faculty—Process and Impact

Xiaodong Zhang, Westat, Inc.

Xiaodong Zhang outlines the goals from this four-year RETA project focusing on STEM faculty engagement.

Project Goals

- Understand how STEM faculty members are involved in MSP.
- Examine the effects of STEM faculty engagement on K-12 teachers, students, themselves, and their institutions.

Zhang then describes the two-pronged study design. The first involved case studies of eight MSP projects, purposefully selected based on their proposals and evidence of a higher level of STEM faculty engagement. The second entailed using the MIS for analysis of all MSP projects.

The case studies involved annual site visits for three to four years as well as secondary analysis of evidence regarding the impact of STEM faculty engagement based on project evaluation data.

In addition to the case studies the project looked at data collected annually by the MIS, with a specific focus on the survey for IHE faculty, as well as the district survey providing student achievement data. This analysis included all of the MSP projects in Cohorts One through Three.

Zhang proceeds to share findings from the

Study design

- Case studies (8 MSP projects)
  - Annual multi-day site visits: document reviews, interviews (PI, STEM faculty, education faculty, IHE department chair, teachers, principals), classroom observations
  - Secondary analysis of project-collected data
- MIS analysis (all MSP projects)
  - IHE faculty survey
  - District survey (student achievement)

Xiaodong Zhang

study, beginning with findings on process. STEM faculty involvement is primarily defined as service/outreach. In other words, Zhang explains, the traditional reward structure and faculty perception of their involvement are considered as major obstacles to their involvement. Further, Zhang notes, very few of the IHEs involved in the MSPs have revised their traditional reward policies.

The project did conduct a special site visit to one project in which the tenure and rewards policy was altered at the IHE level. In that project they discovered the importance of strong vision and commitment from the leadership, broad buy-in from all players, careful planning throughout the process, and perseverance. In other cases in which the study identified projects making attempts to reform the IHE reward structures, those involved underestimated the challenge involved in the process. "Our second finding on this," Zhang observes, "is that changing policy is hard, but changing culture is even harder. That would require a deeper implementation and more aggressive advocacy." It also requires further clarification of the policy, he notes, because while administrators appear to have clear understanding of the policy, those in the trenches have varying degrees of understanding. "Most importantly," Zhang states, "we found it critical to incorporate the policy within the university and department tenure and promotion guidelines."

While most of the MSP projects are not charged with the task of changing policy at the IHE level, there are a number of tools that can be employed to encourage faculty engagement, Zhang observes. Those tools include both extrinsic and intrinsic incentives. In general, extrinsic incentives are well understood, but sometimes intrinsic incentives are underestimated, and those intrinsic incentives are important.

Turning to findings on impact, Zhang characterizes those findings according to the type of stakeholder involved. The main benefit for K-12 teachers are primarily in terms of pedagogy and confidence. There was some evidence of content knowledge, at least in the short term, but STEM faculty were rarely seen as the sole contributor to the impact. "Very often they are part of the team and not the sole contributor," Zhang cautions, "so we have to be very careful in making those statements."

Student achievement has improved overall, although direct attribution cannot be estab-

Findings on Process

- STEM faculty involvement in MSP is primarily defined as service/outreach among IHEs.
- Traditional reward structures and faculty perceptions about the status associated with service/outreach are considered major barriers for faculty involvement in K-20 partnerships.
- Few IHEs in MSP have changed their tenure and promotion (T&P) policies.
- The success in reforming T&P policies speaks to the importance of strong vision and commitment from the leadership, broad buy-ins at all levels, careful planning, and perseverance.
- Changing the university culture is more daunting. Deeper implementation requires aggressive advocacy, further clarification of the policy, and incorporation of a new policy within university and department T&P guidelines.
- For MSP projects, both extrinsic and intrinsic incentives need to be created.
  - Extrinsic: release time, stipends
  - Intrinsic: professional development, partnership, sensitivity, and flexibility
- Extrinsic incentives are well understood while intrinsic rewards are often underestimated.

lished. "It could be because of the MSP project, it could be because of the accountability movement. When we started on this project we had more of an idealistic notion of approaching these topics, but we find it very hard to examine these issues in terms of a more controlled environment," Zhang explains.

When the project started, the main impact was viewed in terms of teachers and students. Surprisingly, it is STEM faculty who benefit most from the MSP experience, specifically in terms of their teaching skills through exposure to different pedagogy techniques, their understanding of the K-12 context, exposure to teamwork and, increasingly, pedagogical research.

The study looks at institutional impact in terms of both K-12 schools and IHEs. In K-12 schools, there was some evidence of a new mindset on the part of teachers involved in the process. There are some cases where you'll see an emerging learning community, Zhang relates, through establishment of teacher associations and the like. There are also instances of institutionalization of instructional practices, where the district or school will endorse the approach that has been advocated by the project, resulting in resource allocation for that approach.

In IHEs, the effects are primarily seen on participants and not on the institutions, Zhang reports. "We are talking in general about less than 10% of the faculty participating in a given MSP, and that's from the lead institution. From partner institutions it is primarily individual faculty." However, he notes, the study found some course and curriculum changes, and these are thought likely to be lasting. There were also small steps at the departmental level to elevate the status of service or outreach, or to redefine what is meant by "scholarship."

Zhang concludes with a quote: "Sustainability is the hardest thing."

Partnership for Reform in Science & Mathematics

PRISM – A Comprehensive MSP

Charles Kutal, University of Georgia

Charles Kutal opens with a brief snapshot of this Comprehensive MSP. He notes that this has been a true state partnership and confirms remarks by keynote speaker Arthur Levine earlier at this LNC regarding the importance of working at the

PRISM

Regional Partners:

- 275 urban and rural schools in 15 school districts
  - 270,000 K-12 students
  - 10,000 teachers
- 7 colleges and universities
  - Prepare 44% of teachers in USG

State Partners

- Georgia Department of Education
- University System of Georgia

Findings on Impact

- K-12 teachers benefit in pedagogy and confidence, as well as content learning—at least in the short term. However, STEM faculty are rarely seen as the sole contributor.
- Student achievement has improved, although direct attribution cannot be established.
- STEM faculty learned from MSP experience in terms of teaching skills, understanding of K-12 perspectives, exposure to teamwork, and pedagogical research.
- For K-12 schools, changes include a new mindset among teachers, an emerging professional learning community, and the institutionalization of instructional practices and resource allocation.
- For IHEs, the effects are primarily on participants. Changes in course and curriculum are likely to last. Small steps at the departmental level either elevate service/outreach or redefine MSP as scholarship.
- *Sustainability is the hardest thing.*

Newly Adopted Policy
Board of Regents' Policy 803.17.
Work in the Schools

- Board of Regents' approval of University System of Georgia institutions to prepare teachers includes the expectation that state colleges and universities with a teacher preparation mission will collaborate with the K-12 schools. **University System institutions that prepare teachers will support and reward all faculty who participate significantly in approved efforts in teacher preparation and in school improvement efforts through decisions in promotion and tenure, pre-tenure and post-tenure review, annual review and merit pay, workload, recognition, allocation of resources, and other rewards.** Participation in teacher preparation and in school improvement may include documented efforts of these faculty in:
  - Improving their own teaching so as to model effective teaching practices in courses taken by prospective teachers.
  - Contributing scholarship that promotes and improves student learning and achievement in the schools and in the university.
  - Collaborating with public schools to strengthen teaching quality and to increase student learning.
- The Chancellor shall issue guidelines, to be published in the Academic Affairs Handbook, which serve to encourage formal institutional recognition and reward for all faculty in realizing the expectations embodied in this policy.

state level. "Working at the state level is really the way to go," Kutal states, "and PRISM has followed that model."

The project has ten strategies covering a range of goals. In this presentation, Kutal focuses on strategy ten, which addresses the higher education reward structure. "If you really want sustained, deep involvement of higher education faculty, there has to be some reward structure, some incentive," he remarks. The approach PRISM used was to convene a committee. The original idea was that they would accomplish their goal in a year. In fact, it has been two-and-a-half years, and the membership has expanded greatly based on the realization that input from a large number of stakeholders was required. The process included focus groups, large state meetings to which all thirty-five institutions in the system were invited, and meetings on individual campuses.

The focus was on tenure and promotion policies. "There were two principles that emerged for me from this study," Kutal relates. "One size doesn't fit all, particularly when you're talking about a state system of thirty-five different institutions. Secondly, that sustainable change is going to require both a top-down, macro-level approach, a change in policy; and a bottom-up approach, the micro environment of the individual faculty member and the department. Both of those changes have to occur if you want this thing to be sustained over time."

The macro component was developed by the committee, has been adopted by the Board of Regents, and is now the policy for all thirty-five institutions in the state of Georgia (see sidebar). The rewards listed in the text are a menu, Kutal explains, and not every school will adopt every one of the rewards and incentives, but it offers schools an idea of what is possible. The policy also provides examples of the types of activities that could lead to rewards.

Policies buried in the body of an administrative handbook are often overlooked, Kutal observes, so the intent here was to make this more real than simply a policy. As a result, the committee also developed and issued guidelines that now appear in the guidelines for the *Academics Handbook* for the entire system. It also provides examples and definitions of the kind of work that can be rewarded. The intent was to embed this faculty work in K-16 education reform, Kutal explains, rather than having it simply be identified as service, so the guidelines include definitions and snippets of case studies.

Resources for *Policy*

http://www.usg.edu/academics/handbook/section4/4.03.02.phtml provides definitions, examples of evidence, and illustrative cases of faculty work in:

- *Scholarly teaching*
- *Scholarship of teaching and learning*
- *Scholarship of engagement*
- *Scholarship of discovery*
- *Service*

The second part of the strategy is a bottom-up approach, convincing the faculty that this is

worthwhile and that they will be rewarded for their efforts. Again, Kutal notes, one size does not fit all, so the way this is being implemented at the University of Georgia will be completely different at Georgia State.

One incentive that was found successful was to offer faculty mini-grants in amounts from three to four thousand dollars to undertake research in this area, working on pedagogically related topics such as improving an introductory chemistry course and working with K-12 teachers.

Engaging Faculty in K-16 Work

Faculty incentives:

- Mini-grant program to improve teaching and student learning in introductory STEM courses
- Opportunities for participation in learning communities, State and Regional Institutes, and faculty-initiated meetings about instruction

Learning communities have also been very effective in bringing together faculty with K-12 teachers or faculty on their own. At statewide and regional institutes, experts are brought in to talk about various aspects of pedagogy and K-16 education reform and engage participants in dialogue.

The process has resulted in changes in culture and the following outcomes.

Outcomes - Changes in *Culture*

- Increased interest and participation in improving student learning in core SM college courses
- Increased interest in the Scholarship of Teaching and Learning
- Increased participation of faculty with K-12 teachers

Sustainability is a key issue, Kutal states. "Once PRISM is gone, what is going to be left?" He points to the following elements.

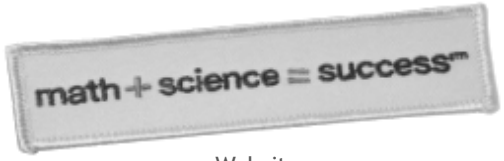
Sustainability

State Level
- New Board of Regents Policy
- STEM Initiative
  http://www.usg.edu/pubs/sys_supp/

Institutional Level
- Change in Workload and P & T Policies
- State & Regional Institutes for Faculty
- Faculty Mini-grant Programs

The STEM Initiative, Kutal explains, is something the Chancellor of the Board of Regents undertook about a year ago, taking some of the best strategies from PRISM to form a statewide initiative with funding available to all schools in the system. In the first round, eleven schools were funded for $2.6 million. That has increased to $3.8 million in the last year and the hope is that it will go higher. "So there is now sustainable funding at the state level for this kind of work," Kutal reports.

PRISM Information



Website
www.gaprism.org

Book
Increasing the Competitive Edge in Math & Science, J. S. Kettlewell & R. J. Henry (Eds.), R & L Education, Lanham, MD (2009).

Charles Kutal

Entering Common Parlance

• I would point out that STEM has become a common English noun. • Participant

Using Competitiveness in a High-Tech World as a Lever

• First let me say that the Georgia statewide policy is a major achievement, and one we're trying to copy in Maryland. We're not there yet, but we have some help and high hopes. The point I want to make is, it has become mandatory for people in high places—governors, legislators, university system chancellors, and university presidents—to talk about how important STEM education is to our state's maintenance of global competitiveness in an increasingly high-tech world. It is very easy to make the case that something like this could be a major tool for helping our universities to do it. If you can get university presidents' attention with this argument and convince them, then one little step can take you to the board of trustees or regents, and that helps. • Participant

Regarding changes in tenure and promotion policies, Kutal notes that while the policy hasn't changed at the University of Georgia, expectations regarding faculty work in these areas as well as the metrics on which they will be evaluated are made explicit during the hiring process and in the offer letter. As a result, faculty are judged on that basis and the system has been very successful.

Questions and Answers

Changing State Policy: Overcoming the Barriers

- The new Regents' policy is phenomenal and is a huge accomplishment. Could you say a word about the biggest barriers to accomplishing that? • Participant

- The original proposal identified a committee of about ten or twelve people. My view was that they were the wrong people because they were a little distant from the work. That was rapidly recognized and the regional Co-PIs, the people on the ground actually doing the work, were added to the committee. We spent a number of meetings just talking about what some of these terms mean: What is the "scholarship of teaching," and what is "scholarly teaching"?

  Then we bought into the recognition that we needed a policy that was going to encompass all of the institutions, so it had to be broadly enough written, with enough latitude that it could be applied to each individual case.

  Thereafter, probably the biggest hurdle we had was getting it on the agenda of the Board of Regents. When we first took submitted it, the person in control of the agenda didn't want to put it on. Jan Kettlewell, to her credit, marshalled the forces, marched up to the Board of Regents office, and convinced them this should be on the agenda. As soon as that was done, the presidents bought in and it was brought forward.

  It's going to be very dependent upon the situation in your state. It really helps to have friends in high places. The fact that Jan Kettlewell, the PI for PRISM, was also in the Board of Regents office really helped. She knew what levers to pull. • Charles Kutal

Sustainability and Overcoming Barriers

- One of the aspects of sustainability for the University System of Georgia's *Work in the Schools* policy is that the chancellor is requiring annual evaluation of all presidents, asking them to speak to this regarding how they are doing with the various benchmarks they've been asked to reach.

  Also, Charles mentioned that there was significant opposition at the Regents' staff level in trying to get this on the agenda. Actually, one of the reasons was that they didn't like the fact that this was just for work in the schools and said, "What about the people who are involved with nursing or health policy?" We managed to overcome that particular narrow view. • Ronald Henry, PRISM

Turning Work With Schools into Policy; Redefining Scholarship

- At a much lower level, I'm trying to persuade my department to change our work load policy. Part of my issue is that I can't get work in the schools into the work load policy. Everybody is throwing in their favorite nontraditional piece of mathematics, so the document is rapidly ballooning. • **Participant**

- We found that the important thing we wanted to put in here was basically the Boyer definition of scholarship and what we mean by scholarship. It had to be something that can be evaluated by one's colleagues, and it has to be a substantive piece of work. As far as working with the schools was concerned, it wasn't a matter of turning up and working with them. You had to do something that was of interest to the schools, not just something that you were interested in but something that would be part of the school's own strategic plan in terms of what they want to see improved. And then the faculty members would be involved in that, and you have to document that your involvement is making a difference with respect to whatever that particular piece of work is. • **Ronald Henry, PRISM**

- I emphasized the two words, "significant" and "improved" in the policy. Regarding the significant part, it has to be something more than just going to a school for an afternoon and giving a demonstration, which is fine, but it's not going to qualify as significant. • **Charles Kutal**

- I can hear my colleagues saying, "Well I do that kind of thing," or "I can do that kind of thing." The problem is, once it starts going in that direction it never stops. There's always some new area that somebody wants to add in and the document never gets completed. • **Participant**

- You basically have to examine what the mission of your department is and how that fits in with the mission of your college and university and say, "We cannot be all things to all people, so what exactly do we want to focus on?" • **Ronald Henry, PRISM**

Recognizing the Scholarship of Teaching and Learning at a Research Extensive University

- I'm a little surprised that a place like the University of Georgia would go along with all of this because they have a reputation of being very research oriented. • **Participant**

- My discipline is chemistry. There's a long history of having faculty involved in the scholarship of teaching and learning in chemistry departments. It has expanded to other science areas through one of our deans of arts and sciences several years ago. I think the faculty have bought in for a couple of reasons. These folks are held to the exact same standards for tenure and promotion, it's just that their scholarship is in a different

Promoting Institutional Change to Strengthen Science Teacher Preparation

- I'm with the National Association of State Universities and Land-grant Colleges. It is largely research universities and state universities and we have started an initiative, the Science and Math Teacher Imperative. We're about to announce that we've got 73 research university leaders committed to setting targets for increasing the quality and quantity of their math and science teachers in their systems. Counting the institutions in those systems, 106 largely public research universities are making this commitment.

  I want to echo the idea that there is a tide at the moment that is happening. In our RETA MSP we have got 27 institutions joining what we call the Leadership Collaborative, and we're going to help them work together over the next few years. The title of that grant is Promoting Institutional Change to Strengthen Science Teacher Preparation. Of those twenty-seven, twelve or thirteen are research extensive and ten are research intensive. We're in all different parts of the spectrum right now in working on this and we're very excited. • **Participant**

Scaling Up and Case Studies

- I want to thank you for putting together a panel for common interests. As we've heard this morning there's this whole scaling idea. I'm at Washington University in St. Louis, and we have twelve faculty who are seriously taking in this work and scholarly criteria. But looking across the nation, those twelve don't look like a very big number when you're talking about scaling and the size of the problem. I think this collective effort of doing case studies and looking in-depth is the only way we're really going to see the effect of this kind of work with STEM faculty. So thanks for starting that work. • **Participant**

area. They're not expected to bring in half-a-million dollar grants from NSF to set up a normal chemistry or biology lab. They're expected to provide scholarship of teaching and learning materials and textbooks; to bring in grants. As you know, there is big money available for the types of things we're talking about here. And bottom line, their resumes and letters are sent out to external experts and they're judged on their impact: Has this person made an impact in their field? That's the criterion by which we judge all faculty, so they're not treated differently.

Secondly, we're not talking about a large number of faculty. At a research extensive university like the University of Georgia, you don't expect every faculty member to be involved in this kind of work, and certainly not at every point in his or her career, but people can come in and out.

So I think there's room at any university, and certainly a research extensive one as large as the University of Georgia, for this kind of work and in general, the faculty value it and recognize the importance of it. • **Charles Kutal**

- At the University of Kentucky, based on the MSP work, they started a new institute, the Partnership Institute in Math and Science Education Reform (PIMSER), fully funded by the University of Kentucky. There's a freeze right now on hiring, but they just hired five new professors. Fifty percent of their time is with math and science education, the other fifty percent is with the PIMSER office, doing work with the schools. • **Barbara Shoemaker**

Enlisting Faculty in Fashioning More Sensible Standards

- Someone mentioned faculty being appalled when they realized what teachers were expected to cover. Is there any success in getting the weight of STEM faculty behind making more sensible standards, even though they helped cause the problems by everyone loving their discipline and wanting to get it in? • **Participant**

- The person who originally brought up the statement about the number of concepts being taught followed it up with, "but you know, we do not have standards in our classroom in higher ed." That was a discussion that we had that day because there is not a transition from K-12 to higher education with an understanding of what is to be taught. That opened the dialogue. They're not involved with state standards. A lot of states involve schools, but they do not involve higher education all the time. • **Barbara Shoemaker**

- Some of our faculty actually have gotten involved in statewide review or design of the state assessment. We've had a few instances in which the professors have been so stunned by what they've seen that they've asked how they can get involved. It has come from them as much as it has from us telling them it's an opportunity for them. So yes, I think there is an interest in that. • **Deborah Pomeroy**

- Massachusetts has a tradition of involving college level people in the development of standards and curriculum, which is sometimes good and sometimes not so good. I think what is also emerging, as the framework stage and test development issues unfold, particularly for those STEM faculty we've really been able to bring along, is the ability to see the importance of the relationship between universities and schools. We have to take ownership of the fact that the academy is dictating a lot of what is happening at those middle and high school levels. It is either by assumption (e.g., if they're going to take a premed course they have to take this and this), or by just continuing the traditions of thinking in very parochial ways about the discipline. • **Linda Beardsley**

- In regard to this question, curriculum is a real issue. We're never going to get anywhere with it unless standards change. Don't national standards have to change before you can change state standards? In New York they make a big deal about mapping the local standards onto the national standards. • **Participant**

- You need a revolution. • **Participant**

- There's also the National Science standards and AAAS. It comes to the point of, what are you looking at? Secondly, a lot of math and science professors have no knowledge of those documents either. • **Barbara Shoemaker**

- I think one of the new games that's coming is that we have environmental standards. That involves every topic and every kind of discipline. This is just starting in Colorado in a big way, and we're having large meetings at each of the universities and everyone is coming to these environmental standards discussions. My sense of what's starting to happen is not just a revisiting of the science standards. The focus of school kids and teachers is not by discipline, it's by world problem. We're a first-year project and we're doing cultural relevancy and environmental education, and we're trying to figure out what that means. • **Participant**

Differences Working With Elementary and Secondary Schools

- No one has talked about differences between STEM involvement with elementary and secondary. Has that been an important factor? • **Participant**

- We've had a lot of involvement in elementary, but the movement is towards middle school, high school and college, and looking at working with professors and high school and middle school teachers. In our program we had just as many high schools involved as we did elementary schools. • **Barbara Shoemaker**

- I ask because I've heard both arguments. One is, we have to get the base right and build from there. The other is, we want better quality students coming into the university so we'd better work with them. • **Participant**

- If it's teacher initiated, and if it's school

Triggering a Revolution

- The scale of the problem seems daunting. I heard the word "revolution," and it would in fact be a revolution. I once heard a talk by a sociologist who said that it's a well established principle that the fraction of the population you need to convert to trigger a revolution is ten to fifteen percent. • **Participant**

Drop Off in Science Interest in Middle School

- I had a really interesting experience this fall in teacher preparation. Probably like most of you, we've been very challenged to get people interested in math and science education. We have lots of people who want to work in teaching the humanities but very few in math and science. This year we were able to attract a really good cohort of math people but only one science candidate. And yet when I asked my class of thirty-five would-be teachers to reflect on their own experiences as K-12 students, all of them said that up until middle school, science was their favorite subject. I asked them to really think about that. What happened? I think the shift that happens is really one in which the academy needs to take some ownership. In the long term, I'm hoping the kind of interest that these MSPs can generate in bringing the arts and sciences faculty into the world of K-12 will begin to enable them to see that they need to have a different kind of impact. • **Linda Beardsley**

NSF Career Awards and Mini Grants

• I'm curious I haven't heard anyone speak of the NSF Career Award process. At the University of California, Irvine we've had several faculty come to us to learn how to do education outreach program design. We've helped five or six faculty get these awards, and it's fantastic because they are cutting edge, they're young. What they can do in the classroom to inspire kids to join that pipeline is fantastic. • **Participant**

• That's why, just within the last six months, we've established an Office of STEM Education at the University of Georgia. We're a resource now and we want those people to come to us for exactly that kind of information. And I think other schools within the system are doing the same thing. • **Charles Kutal**

•You mentioned your mini-grants. Some of these single investigator proposals are not very big, say seven or eight thousand a year. Is that the type of thing you're talking about? You're hoping professors team up with teacher leaders, develop materials, and so on? • **Participant**

• In many cases it's for a very focused project, such as redesigning a course to include more inquiry. In other cases it's to collect data for a bigger grant. I look at it more or less as seed money and a kind of hook to draw people in. • **Charles Kutal**

• We've been using MSP money as seed money. We offer to do a letter of support in exchange for faculty joining us in a pilot project to give them experience and learn how to translate their knowledge so teachers can benefit. • **Participant**

districts initiating the work, they can look at their data and determine where they need the work. • **Barbara Shoemaker**

• We didn't look at the distinction of interaction between STEM faculty and elementary versus high school teachers. My impression is, I don't really see a lot of difference. I think the groups enjoy the experience of getting to know each other. In other words, STEM faculty are not as intimidating to the teachers as they thought they would be. There are some expectations that they bring to this experience. For example, I think STEM faculty came in and primarily wanted to talk about teaching content. In many cases, teachers felt that content was not their primary objective for getting involved. They don't even see it as a major problem. • **Xiaodong Zhang**

Breakout session participants