Conference Overview

Engaging STEM Faculty in MSP: Promises and Challenges

2007 Math and Science Partnership Learning Network Conference

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TERC

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About This Overview

This overview of the 2007 Math and Science Partnership Learning Network Conference offers brief summaries of the presentations, panel discussions and breakout sessions that occurred during the conference. The intent is to provide a sense of the overall conference themes and highlights. Readers interested in pursuing any of the plenary session presentations summarized here are encouraged to access MSPnet.

Full video recordings of the plenary session presentations and of select breakout sessions are available on MSPnet. As noted where applicable in the summaries that follow, PowerPoint slide shows used in presentations are also available on MSPnet.

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.

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OPENING REMARKS

Diane Spresser
Senior Program Coordinator
National Science Foundation
Math and Science Partnership

Diane Spresser poses a series of challenges and questions for conference attendees to consider. In doing so, Spresser highlights the importance of IHEs in preparing teachers and the critical role STEM faculty play in that preparation.

Lack of academic progress evidenced by student test scores and level of college preparedness indicates that curriculum reform alone—specifically "The New Basics," recommended by the National Commission on Excellence in Education in 1983 in its landmark report, "A Nation at Risk"—is not, by itself, enough. What is going wrong?

A recent study from the Illinois Education Research Council (IERC) indicates that students who take advanced courses in schools that employ the fewest well-qualified teachers are much less likely to be adequately prepared for or to succeed in college than students who take the same courses or even less advanced courses at schools with the most qualified teachers.

The IERC developed a Teacher Quality Index (TQI) for teachers and a College Readiness Index for students. Students who took calculus in the lowest TQI schools were five times less likely to be well-prepared than students who took calculus in the highest TQI schools. Students who took calculus in schools with a TQI below the 10th percentile had a lower preparedness rate than students who took only Algebra II in schools that were above the 25th percentile.

These studies show that teacher quality matters, especially as the content becomes more advanced. The students in these courses are part of the pipeline that feeds into students majoring in STEM disciplines in college and those who will eventually become teachers themselves.

An important element of the MSP program is the engagement of STEM disciplinary faculty. This meeting will explore the nuances regarding the who, what, why, and how of that engagement.

> "As you know, an important requirement of the MSP program is the engagement of STEM disciplinary faculty in the work of K-12 math and science education, including the preparation and professional development of teachers in K-12. Requiring engagement is one thing; getting more information about the who, the what, the why and the how is another."

"I am convinced that the most enlightened places will make a difference simply because they truly believe the future of our country will rest in producing these teachers and in dedicating ourselves to solving these problems."

KEYNOTE: FREEMAN A. HRABOWSKI III

Freeman A. Hrabowski III
President
The University of Maryland
Baltimore County

Citing the report by the National Academy of Sciences, "Rising Above the Gathering Storm," and best seller, *The World is Flat*, Hrabowski poses the question of how we will rise to the challenges we face. Those challenges include the need to recruit many more people interested in becoming teachers, providing additional training to current teachers, and creating a pipeline that feed students capable of succeeding in STEM disciplines into college.

We can profit as institutions, Hrabowski suggests, by looking at current and past grants from NSF. What has been helpful in working to transform the IHE culture to one that has a substantive, sustained approach to being involved with K through 12?

Hrabowski then poses a number of questions:

- Are faculty involved in work in K-12 education deemed worthy of a tenure track position? Is that work considered respectable or important enough to be considered part of a reward system and acknowledged in terms of prestige?
- Are we taking advantage of the money we receive from NSF for a range of programs to build synergy between all the efforts and practices developed in those programs?
- Who do we believe should be teaching K-12 math and science? Do we assume the best and brightest academically, if they opt for teaching at all, will naturally be teaching at the college level? Are we communicating that teaching at the K-12 level is a valuable, respected profession and a viable career option, or are we (consciously or unconsciously) communicating to gifted academic students that their academic aspirations should be focused on teaching at the college level?

One of our challenges as people working in this area, Hrabowski notes, is to help the general public and our campuses understand how difficult this work is, and understand the need for steady, gradual, substantive process.

Another challenge relates to the changing nature of our society and the culture of our schools, and the implications that has for fulfilling the role of teaching. Clearly we want to make sure that teachers have the substance, the math or science content, and they have to understand how to teach, how to explain concepts, but they also require the quality of 'cultural responsiveness.' "How," Hrabowski questions, "do we prepare teachers to work in classrooms with children who often are not prepared academically or emotionally, who don't necessarily have the same values we had when we were growing up?"

In the effort to involve more STEM faculty,

Hrabowski proposes that those from IHEs ask the following questions about their campuses:

1. What is the attitude of your campus, broadly, with regard to involvement in K through 16 work?
2. Are there opportunities for rewards or recognition as a result of that work?
3. How often are there conversations about the challenges involved in this work?
4. To what extent is the work involving K through 12 connected to the work involving undergraduate teaching itself?

The college preparedness issue, Hrabowski observes, is more than a minority issue, it is a general problem. To address that problem, we need to examine the relationship between student performance in science courses in the first or second year of college and the backgrounds of the students coming to the institution. We need to look at how we prepare students in the first year of science and the performance or preparation of students in the K-12 system, and we should involve not only the faculty from our campuses, but the teachers from the K-12 schools so that they can see how their students are doing.

Regarding STEM faculty involvement, Hrabowski advises that an effort should be made to match faculty to various levels of involvement, and also notes that not all faculty are suited for this type of work. The ideal candidates, he suggests, are those who can work with K-12 teachers without being condescending, those who can effectively explain difficult concepts, and those with the interpersonal skills to make K-12 teachers feel comfortable and unthreatened about their math skills.

Hrabowski offers a range of suggestions concerning how to initiate, legitimate, and sustain this type of work at IHEs, including:

- Prioritizing and including the work in public addresses;
- Holding ongoing dialogues among faculty, K-12 and administration and bringing in outside experts to stimulate those dialogues;
- Awarding visible recognition to those engaged in the work and incorporating recognition into institutional practice;
- Encouraging faculty to parallel their work with research and publication;
- Making a sustained fundraising effort for this type of work a priority and incorporating that priority in capital campaigns and endowment drives;
- Allocating real estate to the effort (e.g., a planned Center for STEM Education at the University of Maryland, Baltimore County).

The presentation concludes with a question and answer session, during which Hrabowski tackles questions concerning rewarding and legitimizing faculty, the role of NSF, and further ways to assure that this effort is sustained beyond the funding period of the MSP project.

> "The most important thing I can say to you today is this: These projects will only work, will only have the kind of substantive involvement of STEM faculty, if STEM faculty truly believe it's important."

- Who are the STEM faculty involved in K-12 work? Do they have some common characteristics? Do most stay engaged over time, or is their involvement episodic?

- What is their engagement? What roles do they assume? Are some roles more productive or strategic in terms of impact on K-12? What are the effects and impact of their work?

- Why do they want to do it? What motivates their interest and commitment?

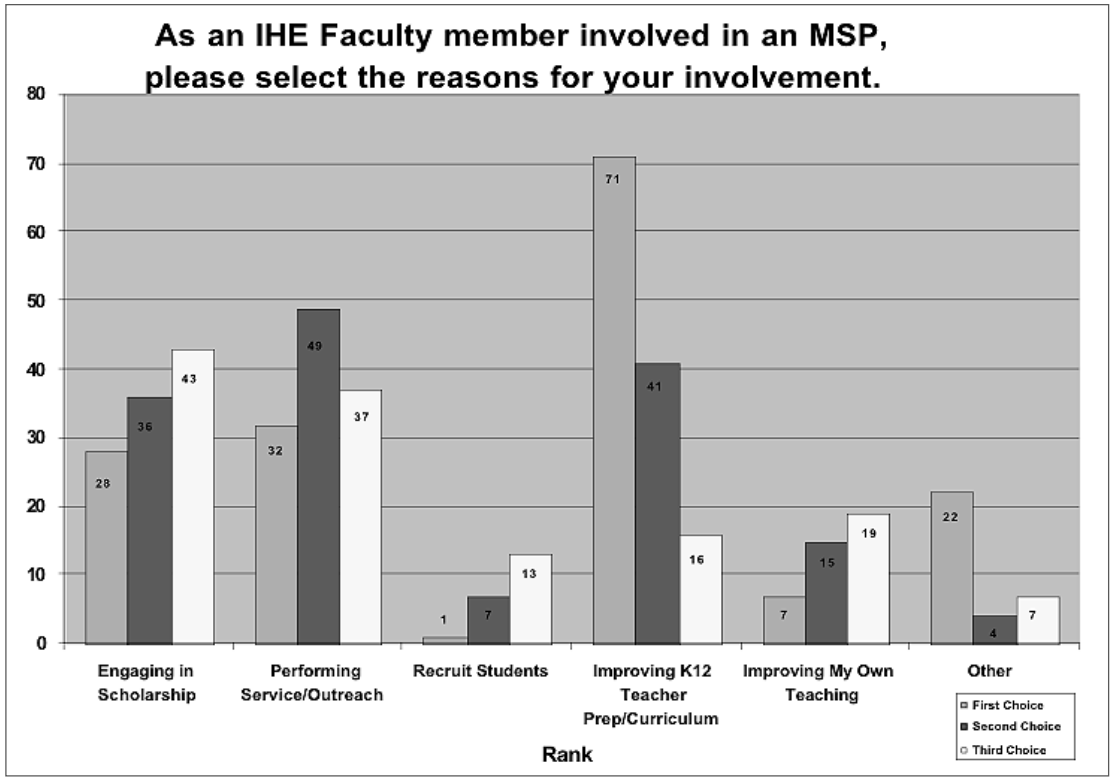
- How do MSPs recruit and prepare STEM faculty to effectively do this work? How do universities reward faculties who engage in the work?

REFLECTIONS: WHO, WHAT, WHY, HOW

Diane Spresser
Senior Program Coordinator
National Science Foundation
Math and Science Partnership

In thinking about STEM faculty engaged in K-12 work, Diane Spresser observes, we come back to the who, the what, the why, and the how. Spresser then poses the questions featured in the sidebar to the left.

Spresser concludes by sharing the data below. During the registration process for this meeting, participants were asked to respond to questions with the hope that the responses would inform the discussions here.



To view the graph of the K-12 educators response, visit MSPnet.

3 key reasons for involvement of IHE faculty:
- Improving K-12 teacher prep/curriculum
- Performing service/outreach
- Engaging in scholarship

3 key reasons for involvement of K-12 educators:
- Professional development
- Professional learning community
- Curriculum align./dev./rev.

IHE FACULTY ENGAGEMENT IN MSP: A PROFILE

Joy Frechtling and Xiaodong Zhang
WESTAT

Frechtling and Zhang present data that unpacks STEM and Education faculty engagement in MSP, as well as the differences in engagement between different disciplines of STEM faculty, particularly in math, science and engineering

Frechtling examines data from the online data collection system that MSP projects fill out yearly (MSP MIS), while Zhang presents data from the STEM Effect RETA, digging more deeply into the effect of STEM faculty engagement and the value-added from that engagement.

Highlights: MSP MIS

Joy Frechtling

DATA SOURCE:
MSP Annual Reporting System (MSP MIS)

- Who are the faculty that are participating?
- In which activities are faculty engaged?
- How does this change over time? Differ by discipline/content area?

Some Presentation Highlights

All figures are for the 2005-06 school year.

- 1,122 faculty participated in the MSPs
- 51.5% were tenured and 25.3% held the rank of professor
- Approximately 55% came from doctoral granting institutions or master's colleges and universities
- A little over a third of the faculty spent more than 200 hours on MSP activities
- 36.1% of the faculty were involved in educational research
- Around a third of faculty had not previously been involved in K-12 educational reform

Q & A

Post-presentation, Frechtling and Zhang field comments and questions in the following areas:

- The complexity of assessing and evaluating continuity of STEM faculty participation.
- Faculty impact in terms of understanding state and national standards.
- The need to identify means of changing the culture of IHEs, from going beyond reward systems, to working from the top down, to thinking about inservice and preservice at the IHE level, to engaging grad students and post-docs in this work.
- The distinction between IHE administration voicing support and actually giving support.
- NSF's role and the potential benefit of providing grants to individual STEM faculty as incentive for participation.

STEM Effect

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

Case studies (8 MSP projects)

- Annual site visit: document reviews, interviews (PI, STEM faculty, education faculty, IHE dean/chair, teachers, principals, classroom observations
- Secondary analysis of project-collected data

MIS analysis (all 48 projects)

- IHE faculty survey
- District survey (student achievement)

STEM Effect

Xiaodong Zhang

The presentation focuses specifically on STEM faculty engagement in terms of how STEM faculty are engaged and the impact of such engagement. The presentation combines summaries of findings from a triangulation of the data sources used, accompanied by quotes from MSP staff, STEM faculty and K-12 teachers to illustrate those findings.

The research and findings address the following questions:

- What kind of qualities do we look for in STEM faculty?
- What are the tenure and reward policies for STEM faculty for this type of engagement at the IHE institutional level, the departmental level, and the school level? What are the perceptions of STEM faculty regarding these policies? What can MSP projects do in terms of faculty rewards?
- In what ways can faculty be engaged in MSPs? What roles are STEM faculty playing in MSPs? As STEM faculty work in a team environment within MSP projects, what is their working relationship with their peers, with education faculty, and with teacher leaders?
- What are the impacts of STEM faculty involvement: on teachers, on students, on the STEM faculty themselves, and on their IHEs?
- What are the characteristics of those MSP projects that evidence a high level of STEM faculty involvement?

> "As we all know, STEM faculty engagement is a hallmark of the MSP program. The premise is that the STEM faculty hold the knowledge that the teachers need, and if they are successfully involved in this process, the chain of professional knowledge will be expressed and have a result in increased student achievement. Because STEM faculty involvement is an elusive element, there is very little empirical evidence to support that premise. That is why we are conducting a four-year RETA project to investigate this subject."
>
> • Xiaodong Zhang

Detailed PowerPoint slide shows of the Frechtling and Zhang presentations are available on MSPnet in addition to videos of the presentations.

BREAKOUT GROUPS:
DISCUSSING FACULTY ENGAGEMENT IN MSPS

Participants broke into sixteen separate groups, clustered by MSP type into Comprehensive, Institute and Targeted MSP forums, to discuss the following questions:

Questions for Group Discussion

- To what extent do these findings about faculty engagement ring true in your own MSP project?
- What are the major challenges you've faced with respect to faculty engagement in your project, and what strategies have you used to overcome these challenges?
- To what degree do you believe that faculty engagement will be sustainable beyond the life of your MSP grant? Are there specific changes (structural, policy-oriented, etc.) your projects have implemented to make sure this happens?

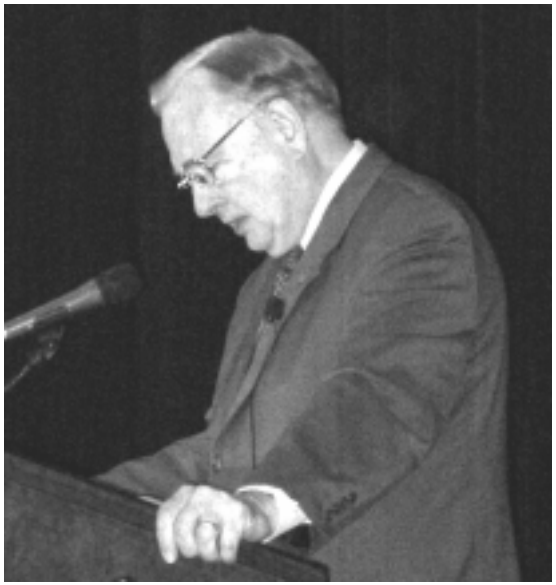
The following synthesis of common themes that emerged in breakout groups was prepared by Jennifer Frank, Project Manager of CASHE, and delivered by Joyce Evans:

- A common initial selling point for STEM faculty involvement is improving K-12 education, but for many it becomes so much deeper than that—the opportunity to benefit from what K-12 teachers have to offer, opportunity to work on K-16 alignment issues, and improvement of their own courses and pedagogy.
- The importance of creating concrete, specific roles for STEM faculty involvement in projects and differentiating these roles to attract faculty with different types of interests and talents.
- The need to continue to promote faculty engagement in the research and scholarship of this work. This is a challenge because educational research is not necessarily recognized in traditional STEM reward structures.
- The relationship-building that occurs among STEM faculty, education faculty, and K-12 teachers builds an important foundation for sustainable collaboration beyond the life of these MSP grants.
- The importance of demonstrating the broader impacts of MSPs. Most project outcomes are not immediately tangible or recognizable. We need to acknowledge the reality that culture change is "slow and glacial."

A video record of the discussion by one of the Institute MSP breakout groups may be forthcoming on MSPnet. Participants included:

- Oregon Mathematics Leadership Institute Project
- Preparing Virginia's Mathematics Specialist
- Standards Mapped Graduate Education and Mentoring
- The Fulcrum Institute for Education in Science
- Washington University Life Sciences Teacher Institute

"I can't overstate the importance of your work to raise the math and science literacy in the nation's K-12 student body."



"It is difficult to measure success in education, we all know that. MSP is engaged in an extensive effort to learn what works and what doesn't, for whom, and under what circumstances."

REMARKS FROM THE DIRECTOR OF NSF

Arden Bement
Director
National Science Foundation

Bement commends the enthusiasm, dedication and progress of the MSP projects, noting that this work is critical in order for students to gain the necessary skills to face the challenges before them in a global society—a sentiment recently underscored by President Bush in his State of the Union address.

The MSP program is a successful model of partnering among universities and K-12 schools as a comprehensive approach to develop the learning capacity of both students and teachers. As such, Bement notes, it is important to synergize and maximize the gains of the respective MSP project efforts.

Bement observes that data shows that the MSP program results in continued improvement in student proficiency at high school, middle school and elementary levels, citing the El Paso MSP as a noteworthy comprehensive model, and commending IHEs for the work they have done in initiating new preservice, certification and master's courses for teachers. For MSP to continue to contribute to furthering student achievement, ongoing work is needed in the following areas:

- If we expect to see these gains continue over time, sustainability is one of the issues.
- If we expect to see continued improvement in student achievement, we have to continue to address other areas such as enhancing teacher content knowledge and pedagogical skills, and the skills and methods to evaluate student learning and student development.
- Furthering student achievement in K-12 math and science also requires that we develop the tools to evaluate whether or not there are gains in student learning. We need the measures to determine if what we are doing is working, and whether we should discontinue or pursue specific projects.
- Engaging university STEM faculty is crucial, and all STEM faculty are urged to go out and recruit more of their colleagues. A critical mass of STEM faculty is necessary in the effort to create a seamless continuum of learning in secondary and higher education.

This remains an uphill battle, Bement acknowledges, and the need is pressing. There is a goal that we all share, and that we can derive satisfaction in working towards: that of assuring that every child have an opportunity for an excellent K through 12 education, and that those who are attracted to science, technology, engineering and mathematics receive the very best career preparation.

PANEL PRESENTATION:

MATH IN THE MIDDLE PARTNERSHIP &
ROCKY MOUNTAIN MIDDLE SCHOOL MATH SCIENCE PARTNERSHIP

Facilitator: Nancy Shapiro
CASHE Project
University of Maryland System

- **WHO** are the mathematicians who take on K-12 educational work?
- **WHAT** roles do they assume?
- **WHY** involve mathematicians?
- **HOW** do you recruit them and **HOW** do you prepare them for the work?

PowerPoint slide shows for these panel presentations are available on MSPnet in addition to video recordings of the presentations.

Engaging Mathematicians in the Mathematical Education of Teachers

Math in the Middle Partnership

A Mathematics — Mathematics Education Partnership at the University of Nebraska-Lincoln

Delise Andrews, Teacher, Clinton Elementary School
Ruth Heaton, Co-PI, University of Nebraska-Lincoln
Jim Lewis, Co-PI, University of Nebraska-Lincoln

Participants from the Math in the Middle Partnership describe the inspiration, context, vision, demographics, faculty involvement, current operation and accomplishments of their MSP program. Some of the highlights from their presentation are offered below.

HOW?

- Leadership matters.
- Be very specific when first asking a mathematician to be involved.
- Promote change gradually.
- Respect each other and the contribution of each discipline.
- Support and reward mathematicians' work in K-12 educational work.

Ten ideas for creating and sustaining mathematics-mathematics education partnerships from a mathematics educator's perspective:

1. Value integration of content and pedagogy.
2. Commit to a long-term partnership.
3. Build on existing relationships and capitalize on strengths.
4. Appreciate mathematics for teaching as rigorous.
5. Recognize pedagogical content.
6. Mediate expectations for learning mathematics for teaching.
7. Support one another's goals.
8. Understand differences in how instruction is delivered.
9. Accept cultural differences in how students are assessed.
10. Develop partnerships beyond the relationship of two individuals.

WHO are the mathematicians who take on K-12 educational work?

- Senior mathematicians
- Mathematicians who are parents
- Mathematicians in leadership positions
- Mathematicians who have colleagues with whom to work
- Mathematicians who are asked
- Graduate students

"When you have challenges that are actually addressed, and addressed thoughtfully and thoroughly, those challenges become benefits."

• Doris Kimbrough

Three Perspectives on STEM Faculty Participation

Rocky Mountain Middle School Math and Science Partnership (RM-MSMSP)

Doris R. Kimbrough, Chemistry, PI and Co-PD
Carole Basile, School of Education, Co-PI and Co-PD
University of Colorado at Denver
Scott Wallace, Englewood Public Schools

Participants from the Rocky Mountain Middle School Math and Science Partnership highlight the ways in which challenges that are addressed can become benefits. After outlining the membership in their partnership, they relate their project goals relating to teacher quality challenging curriculum, and improving diversity in the teacher pipeline. They proceed to review their summer academy coursework as well as academic year structured follow-up. Each participant then describes the challenges and benefits of working with MSP from his or her perspective. Highlights are offered below.

Questions Heard from STEM Faculty

- Are we teaching enough content for middle school teachers; high school teachers?
- What we're teaching isn't really graduate level content. How do we justify the course numbers?
- If no one can agree what or how much content we should be teaching teachers, how do we know what and how much to teach?
- I'm really worried about the content they are teaching in the classroom... so many misconceptions.
- They just don't understand the theoretical, the scientific, the constructs, the concepts, the underpinnings... what are we going to do about that... do we teach them breadth or depth?
- Why can't I teach them everything I know?
- Why can't I teach them everything everyone knows?

Teacher's Perspective: Benefits of Working with Higher Ed STEM Faculty

- Access to in-depth content area knowledge
- Exposure to higher level laboratory experiences
- Experience with instructional technology specific to content
- Working knowledge of the systems and processes that exist in Higher Ed institutions
- Access to an "expert" to help answer students' questions
- Increased confidence in teaching science and willingness to engage in district-level conversations
- First-hand knowledge of students' struggle with content.

We Need...

- More opportunities for Education and STEM faculty to co-teach and experiment. This breeds not only some great teaching, but mutual respect.
- More joint appointments between Schools/ Colleges of Education and Math and Science Departments without pulling people in half.
- Better communication with STEM colleagues related to the barriers of K-12 teachers and teacher educators imposed by federal and state systems.
- STEM faculty to help bridge the gap between K-12 and 12-20 in terms of standards continuation and articulation in order to counter the high attrition rates of math and science undergraduates across the country.
- To figure out how STEM faculty can get "credit" for this work with institutional tenure and promotion systems.

BREAKOUT SESSION:

LESSONS LEARNED ABOUT THE INVOLVEMENT OF STEM FACULTY IN DEEPENING TEACHER CONTENT KNOWLEDGE

MSP Knowledge Management and Dissemination Project

Iris Weiss, President, Horizon Research Inc.
Barbara Miller, Center Director, EDC
Dan Heck, Horizon Research, Inc.

This session builds on the work of the MSP Knowledge Management and Dissemination project. Participants were asked to react to a number of statements about what is known about deepening teacher content knowledge, and in particular the role of STEM faculty in deepening teacher content knowledge. The session enabled participants to learn from one another, while the examples they contributed during the session will enrich the information to be shared with the broader field.

During the first portion of the session, participants were asked to indicate the amount of emphasis their projects place on five different facets of teacher content knowledge within a self-identified content area and grade level. Participants then attempted to identify the facets of content knowledge involved in a series of examples provided.

During the second portion of the session, participants were asked to indicate the degree to which STEM faculty play a role, if any, in deepening teacher content knowledge in the following areas (note that a number of these categories included detailed sub-activities):

- Design experiences to deepen teacher content knowledge;
- Prepare PD providers/teacher leaders/coaches to work to deepen TCK;
- Implement experiences to deepen teacher content knowledge;
- Serve as an ongoing content resource for teachers/teacher leaders/coaches;
- Assess impact of PD on teacher content knowledge.

Participants were then asked to respond to and discuss the following questions:

- What is the primary way in which STEM faculty have been involved in deepening teacher (or teacher leader) content knowledge in your MSP?
- What has been the most effective way in which STEM faculty have been involved for that purpose in your MSP?
- What advice would you give others about involving STEM faculty in deepening teacher (or teacher leader) content knowledge?

Five Facets of Teacher Content Knowledge

- Knowledge of advanced mathematics/science
- Ways of knowing in mathematics/science
- Profound knowledge of basic mathematics/science ideas
- Knowledge of students' mathematical/scientific thinking
- Knowledge of mathematics/science content in the curriculum.

Presenters from this and other breakout sessions are making summaries of their presentations available on MSPnet. In addition, video recordings of some presentations are also available. See MSPnet for details.

TEAM REFLECTIONS:

ISSUES, CHALLENGES, QUESTIONS

Nancy Shapiro
Associate Vice Chancellor for Academic Affairs
University System of Maryland

Shapiro observes that the conference appears to be focusing on two sets of issues:

- Promising practices: areas where we can see some progress, evident or potential, in terms of engaging STEM faculty and faculty roles.
- Challenges: maintaining, encouraging and sustaining STEM faculty engagement.

Comments and ideas from participants regarding promising directions include:

- Investment in these communities of practice in a sustainable way, where those involved come together and talk about issues. This may involve exchange between teachers and faculty, between institutions, and between STEM faculty and Education faculty.
- The 'aha' moment experienced by faculty members when they talk to K-12 teachers and recognize the pressures that teachers face and the impact that has on the work they do.
- When we think in terms of rewards for this kind of work, it does not just involve rewards for individuals in the form of tenure or promotion. Institutions can identify a range of reward structures and recognition for engagement from individual to departmental levels.
- There is national attention accorded to the problems that we are facing, and if "interdisciplinary" is the key word, NSF is on the cutting edge.

Challenges that remain include:

- MSP work is viewed as community service rather than scholarship.
- Faculty members are overextended when they attempt to do more than one job.
- There are systemic barriers to change in our own institutions that have to be addressed.
- There are cultural differences between K-12 schools and IHEs for various reasons, and while we don't want to homogenize, we need to bridge those differences.

Joy Frechtling
WESTAT

Frechtling observes that a number of things we've heard at this conference are not new, but confirm and validate our expectations concerning what is occurring in our community:

- The issue of leadership and the question of identifying the leverage points for bringing about not just change, but continuous change. Can you build from the bottom up or must it occur from the top down? While we've heard a number of instances where individual efforts can make a difference, the power of support from the top-down has been emphasized over and over again, whether the top is at the department level, the president's level, or the chancellor's level. Leadership with top-level support is a theme that comes across strongly.
- Forming partnerships between IHE STEM faculty, education faculty and K-12 teachers is not for the meek. It can be a very rewarding path to take, but when you take it you need to know that there are going to be a lot of struggles. The rewards are profound, and the challenges are also profound.

Frechtling goes on to note that one of the sessions she attended raised some very provocative foundational questions concerning the topic that forms the basis for this conference: STEM faculty, engagement. The questions included the following:

- What do we mean by STEM faculty "engagement"?
- Is "engagement" too strong a word? Do we mean "participation"? Do we mean "involvement"?
- Are we really requiring engagement and all that it implies?

Frechtling observes that the terms we use frequently in talking about our MSPs, like "engagement," "sustainability" and "partnership" entail a struggle to define what we actually mean by those terms.

Frechtling concludes by sharing an intriguing analogy heard from Ken Gross during the conference about the path of faculty engagement and involvement being akin to the path of an evolution of a marriage, and the idea that if you don't change during a marriage over time, your marriage won't be viable. The faculty should, can, and hopefully will change over time as they progress from the from the start of their careers to becoming distinguished scholars, and in their potential roles in engagement or involvement and how they interact with other parts of the system .

One of the challenges is trying to figure out how to optimize that path, and how to communicate with the institutions supporting faculty that supporting faculty in different ways along that path is not only in the faculty members' interest, but also in the institution's interest.

> "Forming partnerships between IHE STEM faculty, education faculty and K-12 teachers is not for the meek."
>
> • **Joy Frechtling**

"I'm here to try to convey to you how much what you do is absolutely necessary to make sure that the thing that brought me to Washington, D.C. is absolutely successful, and that is No Child Left Behind."

• Raymond Simon

For more information on the measures included in the reauthorization proposal for NCLB, go to http://www.ed.gov.

REMARKS FROM THE DEPUTY SECRETARY, U.S. DEPARTMENT OF EDUCATION

Raymond Simon
Deputy Secretary
U.S. Department of Education

Simon begins by stressing the importance of addressing the nationwide problem of finding adequate numbers of good teachers, particularly math and science teachers, citing his own experiences as a superintendent and as Chief State School Officer for Arkansas.

No Child Left Behind (NCLB) brought a mission with focus and clout, and the states are doing a great job, Simon observes. The logical next step is to move this rigor into the high schools. As a result, part of the recently announced reauthorization and new rollout of NCLB is increased emphasis on math and science at the middle school and high school levels.

The Department of Education wants to establish what they call "Math Now" at the elementary school and middle school levels to do for math instruction what Reading First has done for reading. They will draw on the ongoing work of the National Math Panel, which has a report due in February of next year, to identify and focus on what teachers need to know and what students need to know in order to develop their math skills to grade capacity.

Finally, the authorization states that high schools should develop, if they have not already, two reading courses and two math courses specifically aligned to college standards and standards those students need to be successful in the workplace in the 21st century.

The DOE is also putting money in the Teacher Incentive Fund, which has $99 million available to encourage local districts to change their pay scales and encourage states to change their certification so that professionals in these assorted areas have the incentive to teach and get paid to do it. Right now, for example, it may be necessary to pay a physics major more if that's what it takes to get somebody from those fields suffering from a scarcity of teachers. In the effort to recruit teachers from those fields, it may be necessary to go outside the traditional recruitment routes, and to make state certification more friendly to people who want to come in.

Last year, the DOE introduced ACI Smart Grants for Pell-eligible students in the freshman and sophomore years if those students will major in and maintain a B average in a shortage area, including math and science.

The DOE is doing what it can to encourage what MSP is about, and in turn needs the help of those involved in MSP to reach its goals for students.

REMARKS FROM THE ASSISTANT DIRECTOR DESIGNATE, DIRECTORATE FOR EHR, NSF

Cora Marrett
Assistant Director Designate
Directorate for Education and Human Resources
National Science Foundation

Marrett begins by commending the work of those involved in MSP to date for their dedication to advancing education in science, technology, engineering and mathematics, and emphasizes the pivotal importance of this program to the portfolio of NSF and specifically the Directorate for Education and Human Resources.

This quest for excellence, Marrett explains, requires linkages within EHR and its mosaic of programs, effective and sustained partnerships among and across funding agencies, the intellectual partnerships being formed in the MSP programs, and partnering with the DOE to assure ongoing dissemination and implementation.

Marrett cites a range of examples of effective partnering in MSP projects. Given the noteworthy accomplishments at the level of individual projects and programs, Marrett observes, this is an opportune time for us to examine the types of crosscutting themes and questions listed in the sidebar.

To address these questions, Marrett notes, there is the need for integration of research and discovery. These questions suggest attention not only to programs and project outcomes, but an examination of the processes though which the outcomes are derived. This means attending not only to successes, but also to failures to identify the conditions that influence specific outcomes.

Large scale implementation and change also require the integration of programs with mutual goals. One of the themes that EHR continues to harken to in the MSP program is the interchange of experiences, the exchange of ideas, and the sharing and clarity of goals.

This will mean measuring progress using rigorous evaluation and assessment strategies, strategies that can provide evidence of change. MSP is accomplishing this by refining evaluative studies that can clearly document the change derived from the MSP investment.

The questions have no simple answers, Marrett concludes. They require thoughtful deliberation and careful analysis. The level of dedication shown by those involved in MSP indicate that they will not shy away from these challenges.

- What are we learning about effective partnerships that can help foster the capacity to achieve excellence?
- How do we replicate the effective partnerships to make sure that what we've learned at the project level can make a difference for the large-scale changes that are needed across all levels of education?
- What, in fact, constitutes effective change, and how do we know that we're making progress?

"The reason I was willing to do it was not because I wanted more physics, or more physicists, or more science; it was because I believed then, and I believe now, that in order to get people to be decent in this world they have to have some kind of intellectual training that involves knowing [about] Observation, Evidence and the Basis for Belief."

Goldstein J.S. 1992. *A Different Sort of Time*, Cambridge, MA: MIT Press.

STEM AND IHE INVOLVEMENT

Joyce Evans
Senior Program Director
National Science Foundation

Excerpts from Joyce Evans's remarks are offered below.

We have heard reasons why STEM faculty should be involved in K-12. I am aware of the challenges that many of you face in recruiting faculty to the work and I often get asked by STEM faculty, "Why should we be engaged?"

We have heard a great deal about the content knowledge and pedagogical content knowledge that teachers need so students can better learn. I would now like to present a different reason that illustrates why I believe we need STEM faculty engaged in MSP.

First, the history, and for some of you this may sound familiar. In 1956, prior to the launch of Sputnik, some scientists had already begun examining the way America was educating its young, especially in the sciences. Notable among these were physicist Jerrold Zacharias and Francis Friedman who, along with other colleagues at MIT and leaders in industry, formed the Physical Science Study. Early in 1957, Zacharias ordered a team of the faculty of the Department of Physics at MIT to launch an initiative to develop a course for high schools. In 1960, the first edition was produced.

With this as the context, I would like to read a quote from the biography of Jerrold Zacharias regarding why he became involved in writing high school curriculum. [*See sidebar.*]

I believe we need mathematics, science and engineering faculty engaged in the MSP work for the same reason. We all agree that this work is not for the weak hearted. We need individual faculty, with their unique habits of mind, who are willing to dedicate their time and energy to K-12.

But the work of individual faculty will only gain traction if the numbers involved reach a critical mass. For this to happen, we have to extend our thinking from the level of the individual to that of the institution. To reach a critical mass, there has to be, in some form, institutional support, recognition and/or reward for engaging in this work.

KEYNOTE: DIANA NATALICIO

Diana Natalicio
President
University of Texas at El Paso

Diana Natalicio offers a detailed description of the institutional transformation at the University of Texas at El Paso and what the MSP program and others like it have meant to the University as it changed from a small, isolated institution into an institution that understands its region, its mission and its commitment to service in a way that it didn't previously.

When Natalicio arrived almost twenty years ago, the University was struggling with its identity and striving to be something it wasn't in an attempt to achieve national prestige. Faculty waited for students to come, complained about their preparation when they arrived, and felt the way to improve the caliber of students was to raise university entrance requirements—a move that might further isolate the university. UTEP needed to regain a sense of focus, begin to serve the region in which it was located, and address itself to meaningful work suited to the context of the institution and the region.

In fact, Natalicio notes, they were dealing with a closed loop. UTEP draws 82% of its students from El Paso County schools. It produces approximately two-thirds of the teachers in those schools. "If you start pointing fingers," she observes, "they come right around back to you."

Starting Context

- Over 90 years old, founded as a mining school, emphasis on engineering history. Now the only 4-year university within 342 miles in Texas.
- Located in metropolitan area of 2.5 million people, 2/3 of whom live on the Mexican side of the border.
- El Paso has about 750,000 students. The University's 20,000 students come mostly from El Paso County (82%) but student demographics didn't mirror the demographics of El Paso County.
- Another 1,800 (10%) cross the border every day from Mexico to attend.
- Many students are first generation and low income, depending on the University as their sole opportunity to transition from the working class into professional careers.

Natalicio urged faculty to be bold and focus on a mutually beneficial engagement with K-12 and the community college as a natural niche for UTEP and a way to make a significant mark. She launched a systematic process of organizational transformation in partnership with the local schools, community college and business community. Highlights of that process are outlined below.

Ongoing Collaborative

The El Paso Collaborative for Academic Excellence began in the early 1990s with Susana

> "The investment that NSF made at the University of Texas at El Paso has been truly transformational in terms of bringing our institution to where we are today and where we will surely go tomorrow because our ambitions won't stop here... This has been an evolution in our institutional development, and it has transformed how we do our business, how we think about our students, how we think about our mission, and who we are as an institution."
>
> • Diana Natalicio

> "We have gotten far more national attention, far better recognition from our regents, from our state legislature because we are doing what we do well, we're doing it intentionally, and we're doing it in a way that is making a major contribution not only to El Paso but to our state and I believe, because of the changing demographics, to this entire nation."
>
> • Diana Natalicio

Navarro as director. It is a partnership between the University of Texas at El Paso, the one community college, the nine school districts, and civic and business leaders, with Natalicio serving as board chair. Keys to success include insistence on high-level representation (presidents, superintendents, CEOs); relying on data to focus productive discussion; and working together on policy issues that affect the articulation of education in El Paso, such as curriculum alignment and testing.

Vocal and Frequent Validation

"One thing that a university president just absolutely has to do," Natalicio advises, "is validate this notion over and over to every audience you can possibly find." That means talking about the Collaborative and the MSP program within the university, to civic organizations, to business and corporate leaders, to the board of Regents and all of those in the University of Texas system, to the state legislature, and to national policy makers and shapers.

Faculty Buy-in and Support

This program, or any other program of this kind, Natalicio cautions, will not happen successfully if faculty don't buy in, and it has to be a sustained commitment. A ground swell of faculty and administrative support is required, and faculty have to understand that this is important to the president. Gaining faculty commitment starts at the recruitment process, making clear to prospective faculty and administrators from the beginning that engagement with the schools is a priority.

For those faculty who are early adapters and pioneers in this work, the administration has a responsibility to insure that faculty members don't jeopardize their career plans, which requires really thinking through those issues about rewards and advancement.

Reward policies and procedures must be consistent, with no mixed signals. Promotion and tenure are very important, as well as any other kind of recognition or awards. Faculty doing this work should receive university awards and be nominated for statewide awards to give them higher visibility and communicate to the entire university community that these are the people who are making a big difference in what the university is trying to do.

Raising and Leveraging Funds

In the development process at UTEP, Natalicio notes, they consistently attempt to identify funding opportunities to augment what they are doing with MSP and related projects, and ask corporate partners to join them to support dimensions of these efforts. Funding and development efforts include scholarships for prospective teachers in math and science, funding transfer scholarships for community college students, raising money for faculty and student endowments, and assisting students in taking advantage of Smart Grants from the USDOE.

BREAKOUT SESSION: THE EFFECTS OF MSP WORK ON STEM FACULTY

Deborah Pomeroy, Co-PI
Math and Science Partnership of Greater Philadelphia
Arcadia University

In this session, Pomeroy reviews a framework being developed for a supplemental research grant to examine the pushback effects of MSP-related work on STEM professors in terms of their teaching, their professional careers and their research. The session served as a forum for participants to discuss their experiences either as STEM professors or as MSP staff faced with the challenges of engaging STEM professors in educational improvement, both in K-12 schools and in their own institutions. The session utilized the diagram exercise shown here, and focused on the following:

- What kind of positive effects occur and under what circumstances?
- What are the factors that constrain STEM faculty's deep engagement in educational reform?
- What can we learn about maximizing the benefits of this work?

Pomeroy has identified the following four elements of MSP work with a positive pushback. Additional ideas culled during the breakout session will be included in her report on the breakout sessions, posted on MSPnet.

Positive Pushback on Research

1. (In pre-professional development planning) When confronting concepts that they want to help teachers understand, STEM faculty increase their own understandings of their disciplines by finding new proofs and examples, sometimes leading to new understandings.
2. (During professional development with novices) Working in an area of their expertise with novices or teachers in a forum that nurtures questions and the sharing of ideas, sometimes the naive questions prompt STEM professors to rethink their conceptual frameworks or take them in directions they've never been before.
3. (During professional development with content specialists) Conducting authentic science or mathematical work with teachers and/or other STEM professors on the outer edges of their disciplinary expertise sometimes raises questions for professors that cause them to look at their disciplines or their research from new vantage points, leading them to new questions or insights.
4. (Within MSP itself) STEM faculty from small IHEs find colleagues with whom they can establish virtual departments and networks to enhance their own professional resources, thereby enhancing their research potentials.

Those with other examples or ideas to contribute should contact Deborah Pomeroy: pomeroy@arcadia.edu

Relate the "School-based outreach" component to the other components using arrows or link lines. Be sure to describe the relationship (e.g., is an example of, gets in the way of, supports, detracts from, informs). Feel free to add others or X-out the ones that do not apply to you.