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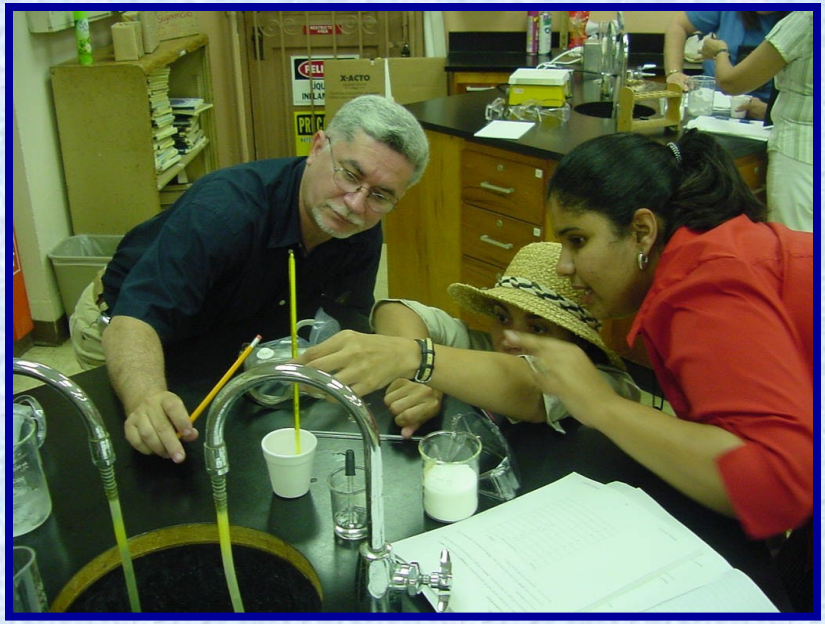
Math and Science Partnership (MSP) Program

A Research and Development Effort



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and

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Today's Agenda

- What are we learning?
- Revisiting the STEM Summit
- Funding Opportunities
- Tools & Instruments

Disclaimer

The instructional practices and assessments discussed or shown in these presentations are not intended as an endorsement by the U.S. Department of Education.

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119 Funded MSP Projects

12 **Comprehensive Partnerships** (FY 2002, FY 2003)

36 **Targeted Partnerships** (FY 2002, FY 2003, FY 2004, FY 2008)

16 **Institute Partnerships** (Prototype Award in FY 2003, FY 2004, FY 2006, FY 2008)

9 **MSP-Start Partnerships** (FY 2008)

2 **Phase II Partnerships** (FY 2008)

44 **RETA** projects (Design Awards in FY 2002, FY 2003, FY 2004, FY 2006, FY 2008)

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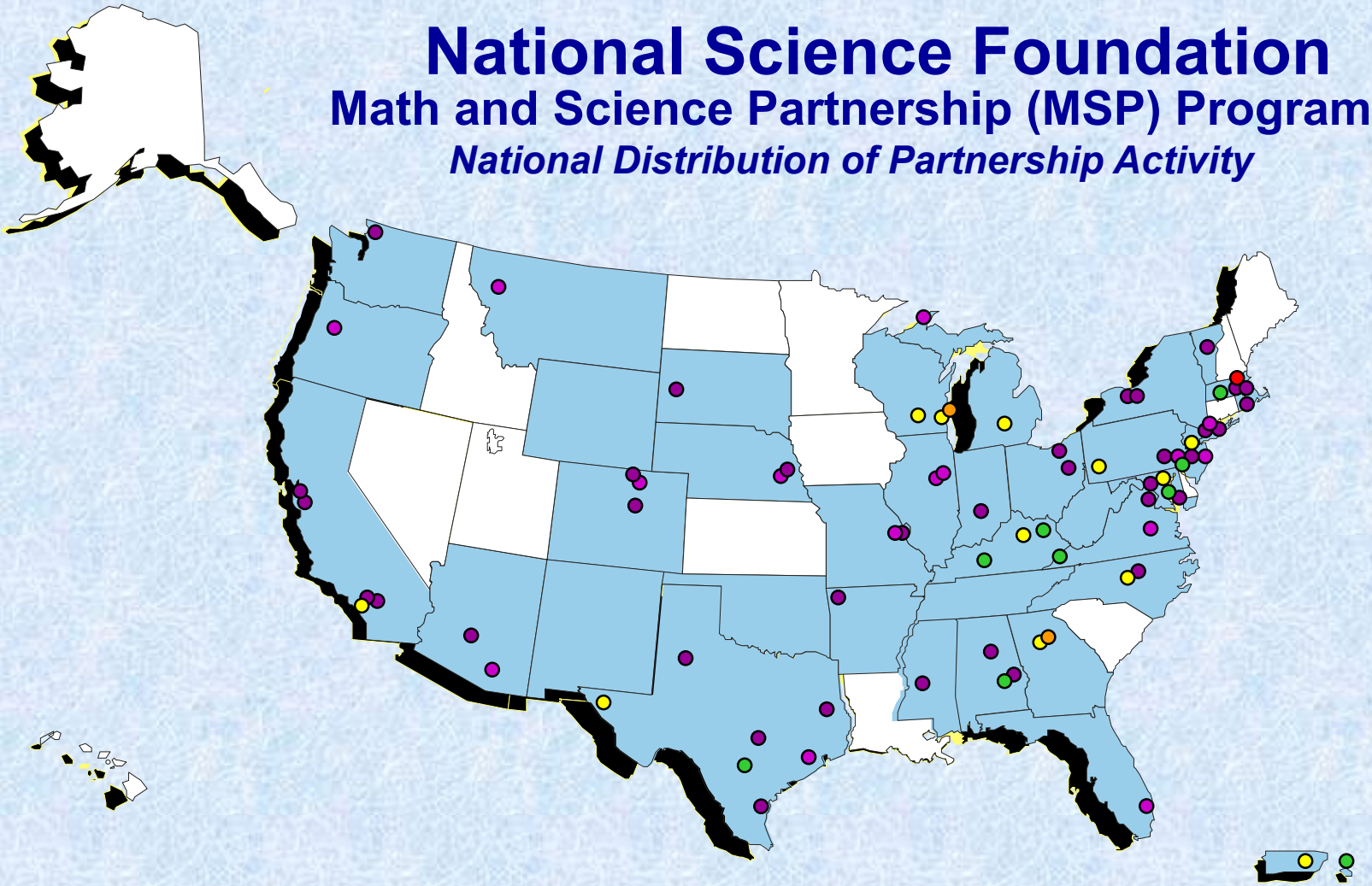
Math and Science Partnership (MSP) Program

National Distribution of Partnership Activity



- Lead institutions / **Comprehensive** partnership projects
- Lead institutions / **Targeted** partnership projects
- Lead institutions / **Institute** partnership projects
- Lead institutions / **MSP-Start** partnership projects
- Lead institutions / **Phase II** partnership projects
- States in which partnerships are active

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Scope of Partnership Projects

- Over 800 K-12 school districts
- ~5 million students
- ~147,000 teachers of K-12 math and science
- 198 institutions of higher education
- Over 2600 faculty, administrators, graduate and undergraduate students

Key Features

- Partnership-driven, with significant engagement of faculty in mathematics, the sciences, and engineering
- Teacher quality, quantity, and diversity
- Challenging courses and curricula
- Evidence-based design and outcomes
- Institutional change and sustainability

What are we learning?

New tools and instruments, with documented reliability and validity, help professional developers accurately assess the content that teachers need to know for the teaching of math and science

Research projects – at the *University of Michigan*, the *Harvard-Smithsonian Center for Astrophysics* and *Horizon Research* – have developed instruments to assess growth through teacher professional development. By using the new instruments, validated on a national scale with strong attention to psychometric properties, it is expected that professional developers and their evaluators will better learn how to improve teachers' mathematics and science knowledge for teaching. Several studies have found that higher scores on the teacher assessments are correlated with higher quality instruction and increases in student achievement.

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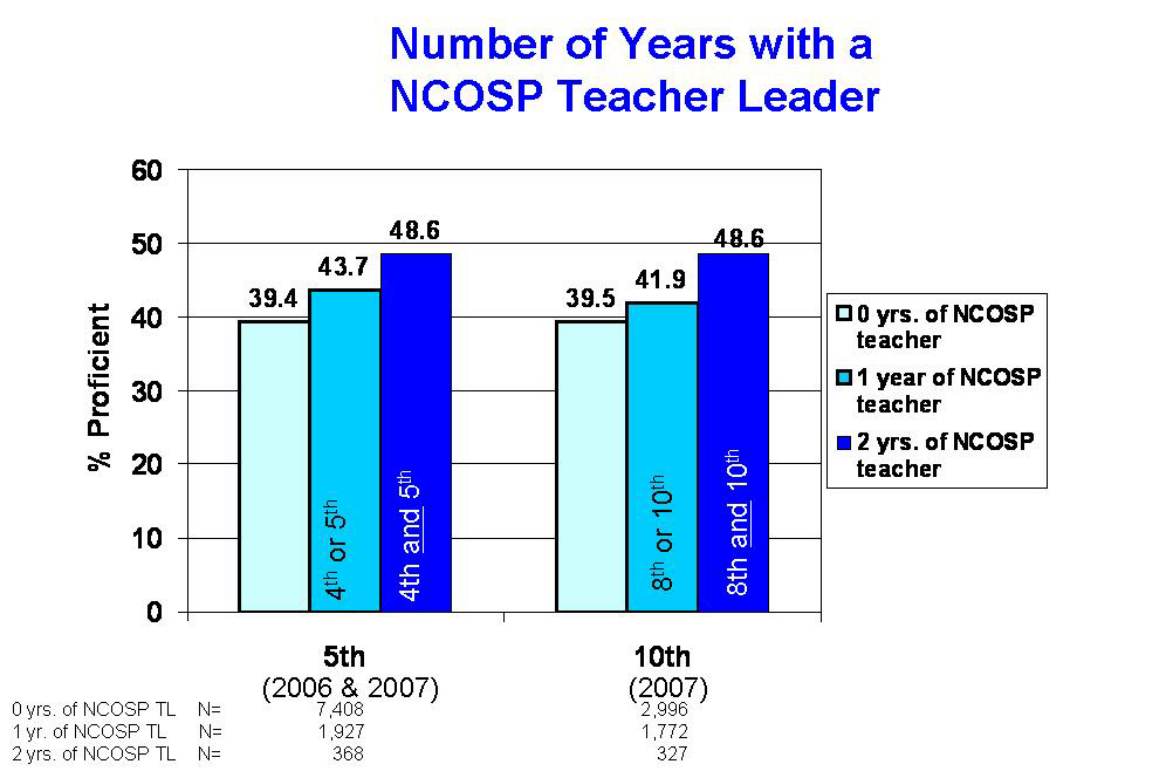
What are we learning?

Through new long-term and coherent courses and programs, the involvement of STEM faculty and their departments in pre- and in-service education enhances content knowledge of teachers

In Western Washington University's *North Cascades and Olympic Science Partnership*, which includes local community colleges and 28 predominately rural school districts, over 150 teachers have been engaged in a long-term experience of three 80-hour summer academies and at least 40 hours of professional development in each of the academic years. The sequence of learning experiences included immersions in science content with connections to instructional materials and classroom practice. Additional experiences focused on collaborative practices, facilitation strategies and leadership skills. This strategic, systematic approach to professional development has resulted in positive and measurable changes in teacher leaders' knowledge and skills.

North Cascades and Olympic Science Partnership



Students who have NCOSP teacher leaders for one and two years of instruction are more likely to score proficient on state assessments than students who do not have such a teacher.

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What are we learning?

Teachers-in-residence on college campuses incorporate teacher expertise to broaden discussions of teaching and learning, and to support new efforts in teacher preparation

The *Math & Science Partnership of Southwest Pennsylvania*, led by the *Allegheny Intermediate Unit*, designed its Teacher Fellow experience to build intentional feedback loops between K-12 and IHEs, and also improve math and science learning experiences for undergraduates. K-12 Fellows and higher education mentors revise courses with the ultimate goal of improving undergraduate education and preparing pre-service students aspiring to become teachers. By the summer of 2007, 43 K-12 teachers, representing nearly 30 school districts, had participated in the Teacher Fellow program. Further, 74 college courses had been revised through this process, and this has resulted in greater success for IHE students: in at least 75% of revised courses, more than 80% of the students are attaining proficiency (a grade of C or above).

What are we learning?

Research methods in ethnography and social network analysis help document change in institutions and partnerships

The *Milwaukee Mathematics Partnership*, led by the *University of Wisconsin – Milwaukee*, has a major objective to distribute leadership across Milwaukee's schools based on the premise that schools (1) with stronger collaborative networks and (2) where key personnel such as the school-based math teacher leader and district-based math teaching specialist play important roles in that network will demonstrate stronger student achievement results in mathematics. The project has employed Social Network Analysis – the study of relationships within the context of social situations – as a method for assessing distributed leadership, and found that schools embracing the concept of distributed leadership demonstrated stronger school-level achievement outcomes.

Milwaukee Mathematics Partnership

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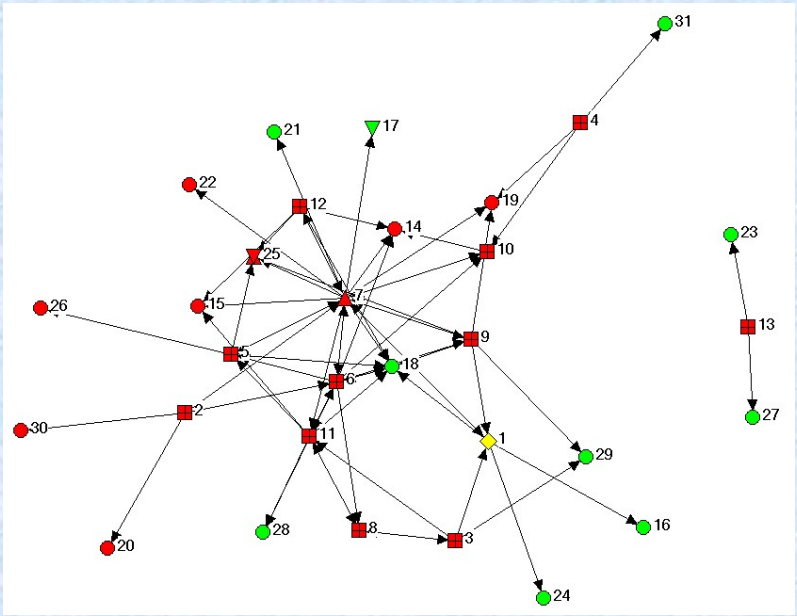
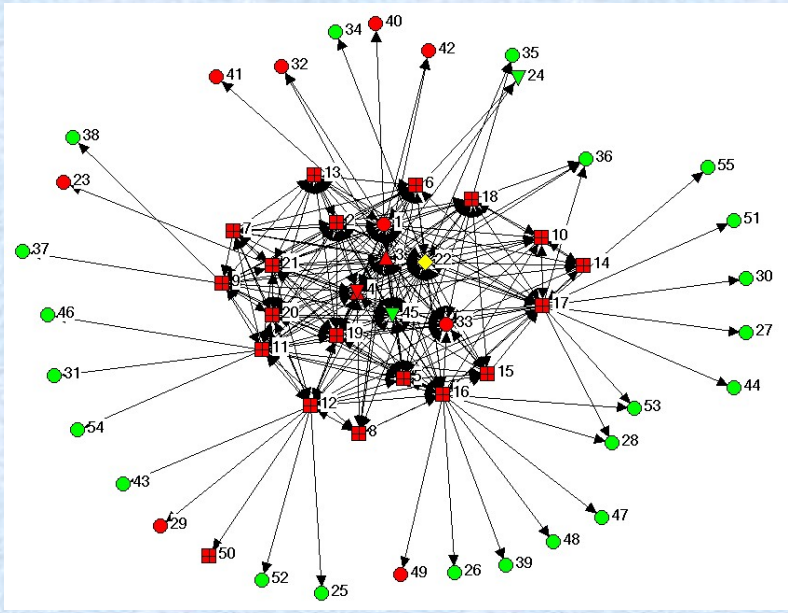
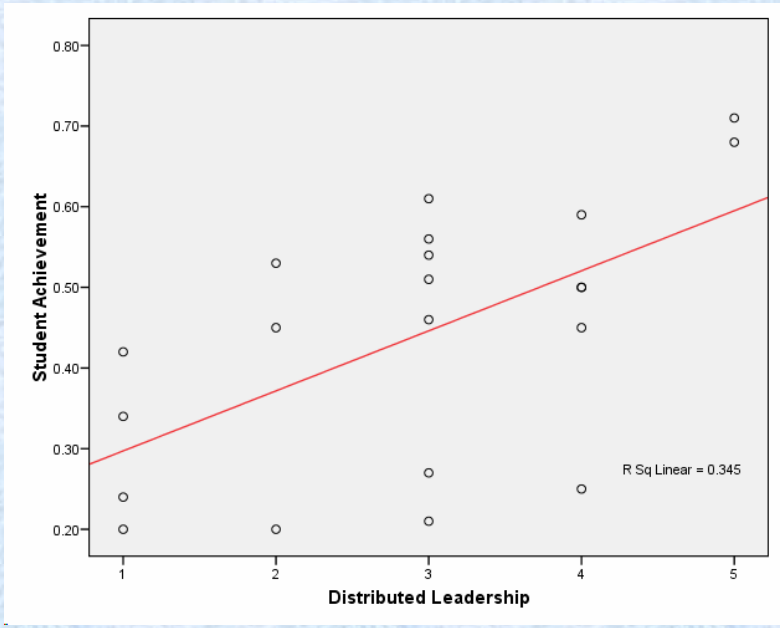


School with Emerging Distributed Leadership



School with High Distributed Leadership

- Distance is important. Closer nodes are more tightly connected than nodes that are further apart.
- Color is important. Individuals from the subject school are colored red and those who are not at the school are green. The MTL for each school is colored yellow.
- Shape denotes role as follows: Diamond = MTL; Overlapping Triangles = Principal; Up Triangle = Literacy Coach; Down Triangle = MTS; Square = Teacher; Circle = Other role



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What are we learning?

New centers and institutes devoted to K-16 math and science education facilitate interactions between higher education and K-12, offer professional development for STEM faculty, and advance the scholarship of teaching and learning

Emerging out of the *Math Science Partnership of Greater Philadelphia*, led by *La Salle University* but also including 12 other institutions of higher education and 46 schools districts, is the *21st Century Partnership for STEM Education,* a Pennsylvania nonprofit corporation that will be operated exclusively for educational and research purposes, to promote public awareness, and to provide support for the improvement of student achievement in the sciences, technology, engineering, and mathematics. The Partnership aims *to* be a regional leader in data-based analysis, program planning, innovative curricula and professional development in K-12 and post-secondary institutions.

What are we learning?

STEM professional learning communities are new exemplars in professional development

In the *Rice University Mathematics Leadership Institute,* a professional learning community emerged among participating lead teachers from the Aldine and Houston ISDs and continues to sustain itself today. This community came to be through formal participation and collaboration in intensive summer leadership institutes over multiple years and through informal means, and embodies the characteristics of a sustaining and coherent *knowledge community* among participants within and across schools, resulting in:

- knowledge and resource sharing, uncharacteristic of typical high school teacher culture;
- a significant increase in the number of Master Mathematics Teacher (MMT) certifications at the 8 – 12 grade level within the state;
- increased student achievement for these teachers; and
- participant teachers' abilities to take counter-culture stands when they perceive personal professionalism to be at risk.

Rice University Mathematics Leadership Institute

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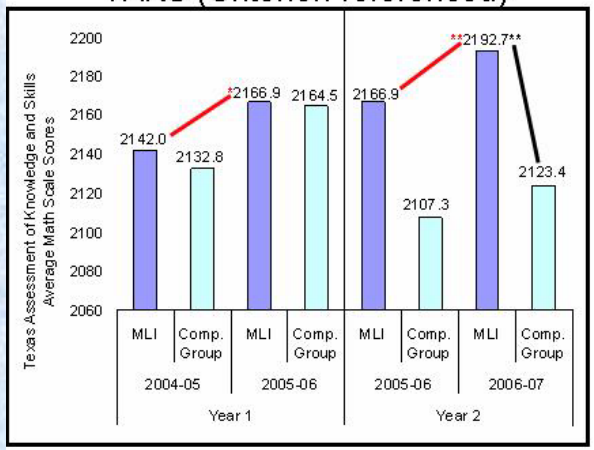
HISD Student Achievement Data

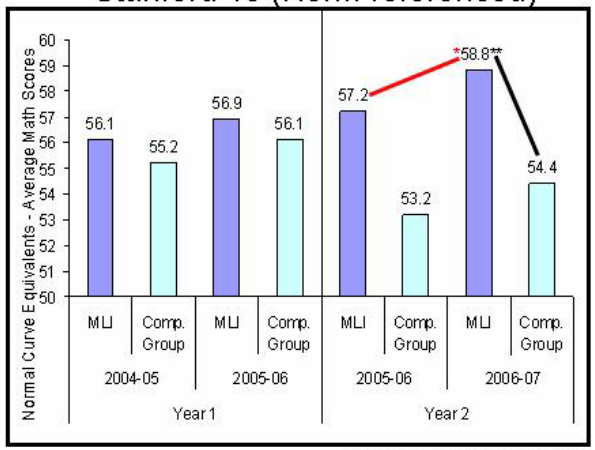
MLI

Comparison Group

TAKS (Criterion referenced)



Stanford 10 (Norm referenced)



*signif.@ p<.05 **signif.@ p<.01

Students of MLI teachers consistently outperformed the students of comparison teachers who were matched on course(s) taught, years of experience, and HISD region.

What are we learning?

Revised tenure & promotion policies recognize faculty for scholarly contributions to the advancement of math and science education

A hallmark of the MSP program is its requirement that science, engineering and mathematics faculty from higher education partner organizations commit to working on issues of K-12 mathematics and science education. Some MSP projects have developed strategies to reduce barriers and motivate faculty to increase their time and effort on activities potentially critical to increasing K-12 student achievement. PRISM's Strategy 10 – involving all levels of the *University System of Georgia*, from individual faculty members to departments to Schools and Colleges to the Board of Regents – resulted in a new advocacy policy that encourages and values joint higher education / K-12 work. Faculty in Georgia can now be promoted based on Scholarship in Discovery, in Teaching & Learning and/or in Engagement.

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Using the *Inventory of Teaching and Learning (ITAL)*, PRISM has studied whether or not participation in learning communities (LCs) increases K-12 teachers' uses of varied teaching practices in science and/or mathematics classes, and if having an IHE faculty member engaged in LCs increases teachers' uses of varied teaching practices. In a 2006 study, based on ITAL data from over 4000 STEM teachers, those who participated in PRISM LCs reported greater emphasis on standards-based teaching and learning practices than those who did not. Moreover, **teachers who participated in PRISM LCs that had IHE faculty members** reported greater emphasis on both **inquiry-based and standards-based teaching and learning practices** than participants in PRISM LCs that did not have higher education involvement.

Improved Science Scores – GA High School Graduation Test

100% of PRISM districts increased pass rates from 2004-2005. In 2004, only 1 PRISM district had a pass rate greater than 75%; in 2006 – 8 had pass rates greater than 75%.

2003-04

7 PRISM Districts pass rate ≥ the state average pass rate (68%)

2004-05

9 PRISM Districts pass rate ≥ the state average pass rate (68%)

2005-06

10 PRISM Districts pass rate ≥ the state average pass rate (73%)

STEM Summit – December 2007

Why Do STEM Faculty Get Involved in the K-12 Work?

- **People/Personal**
- **Responsibility**
- **Teaching for Learning**
- **Professionalism**

STEM Summit – December 2007

Impact of MSP Involvement on STEM Faculty

- Increased sophistication in pedagogy and praxis of STEM faculty
- IHE STEM course redesign
- Awareness of the importance of the STEM faculty role in pre-service preparation—including encouraging strong STEM students to consider teaching as an appropriate career path
- Paradigm shift of Respect—Professionalism—Mutual Benefit
  - Teachers learn from STEM faculty who have deep subject knowledge and can make vertical and horizontal connections across the discipline
  - STEM faculty learn from teachers relative to pedagogy and praxis, including the importance of differentiation (e.g., second language learners)

STEM Summit – December 2007

Charting a Course for the Future—the need to

- engage IHE leadership in dialogue around the importance of involvement in improving P-20 STEM education and to give greater value and prestige to STEM faculty contributions
- bridge the divide between Education and STEM faculty through interdisciplinary work
- involve STEM disciplinary societies in developing standards and measures for evaluating the intellectual merit of the scholarship associated with MSP-type work
- expose future teachers of K-12 science to university and industry labs
- increasingly engage social scientists in the work and examination of MSPs

STEM Summit – December 2007

Ultimately, there are no quick fixes… the substantive improvement of K-20 STEM education requires long-term attention from people who are committed to long-term solutions.

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New FY'09 Solicitation:

NSF 09-507

FY'09 MSP Solicitation
NSF 09-507

In this solicitation, NSF seeks to support six types of awards:

- ***Partnerships***
  - ***Targeted *****
  - ***Institute***
  - ***MSP-Start***
  - ***Phase II***
- ***Research, Evaluation and Technical Assistance (RETA)***
- ***Innovation through Institutional Integration (I^3)***

Targeted Partnerships

- Focus on improving student achievement
- Choose a grade range, critical juncture, or a specific discipline where analysis indicates effort would result in great improvement
- Involve teachers in multi-year, content and pedagogical content learning experiences
- Contribute evidenced-based findings to the knowledge base about teacher and student learning
- Articulate institutional changes for all core partners

Institute Partnerships

- Develop master/lead teachers through multi-year programs of coherent study within a particular discipline, plus a strong leadership component
- Contribute evidenced-based findings to the knowledge base about teacher leadership and its impact on student learning
- K-12 core partners are:
  - Districts from which participants are selected, and
  - Required to grant sufficient non-classroom time for participants to carry out responsibilities

MSP-Start Partnerships

- Not a prerequisite for a full partnership proposal
- NSF seeks to diversify the types of institutions engaged in the NSF MSP effort--institutions of higher education of varying scope, size, experience and perspectives emphasizing minority-serving institutions (e.g., Tribal Colleges, Historically Black Colleges and Universities, Hispanic Serving Institutions), community colleges and primarily undergraduate institutions
- Will conduct the data collection, analysis, team building and evaluation necessary for developing a proposal for a full MSP Targeted or Institute Partnership
- Successful MSP-Start awardees build strong partnerships, with or without further NSF Funding

MSP Phase II Partnerships

- From any institution of higher education partner in a previously funded Comprehensive or Targeted Partnership whose work began in 2002 through 2004
- Concentrate on analysis, adaptation, dissemination and use of existing innovative practices developed through prior MSP support.
- Phase II Partnerships must include:
  - Some, but not necessarily all, of the original partners and the rationale for the new Partnership,
  - One or more research questions, in conjunction with appropriate research methodologies,
  - Detailed Evaluation Plan with benchmarks and measures that will demonstrate results, and
  - Plans to continue longitudinal analyses on aspects of the prior work and must continue to contribute data to the MSP Management Information System

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Research, Evaluation and Technical Assistance (RETA)

- RETA directly supports the work of the Partnerships

- In Solicitation 09-507, RETA seeks methodologically rigorous studies on the impacts of MSP activities on student or teacher learning. Longitudinal and cross-site studies are particularly encouraged as are those that test innovative methodologies

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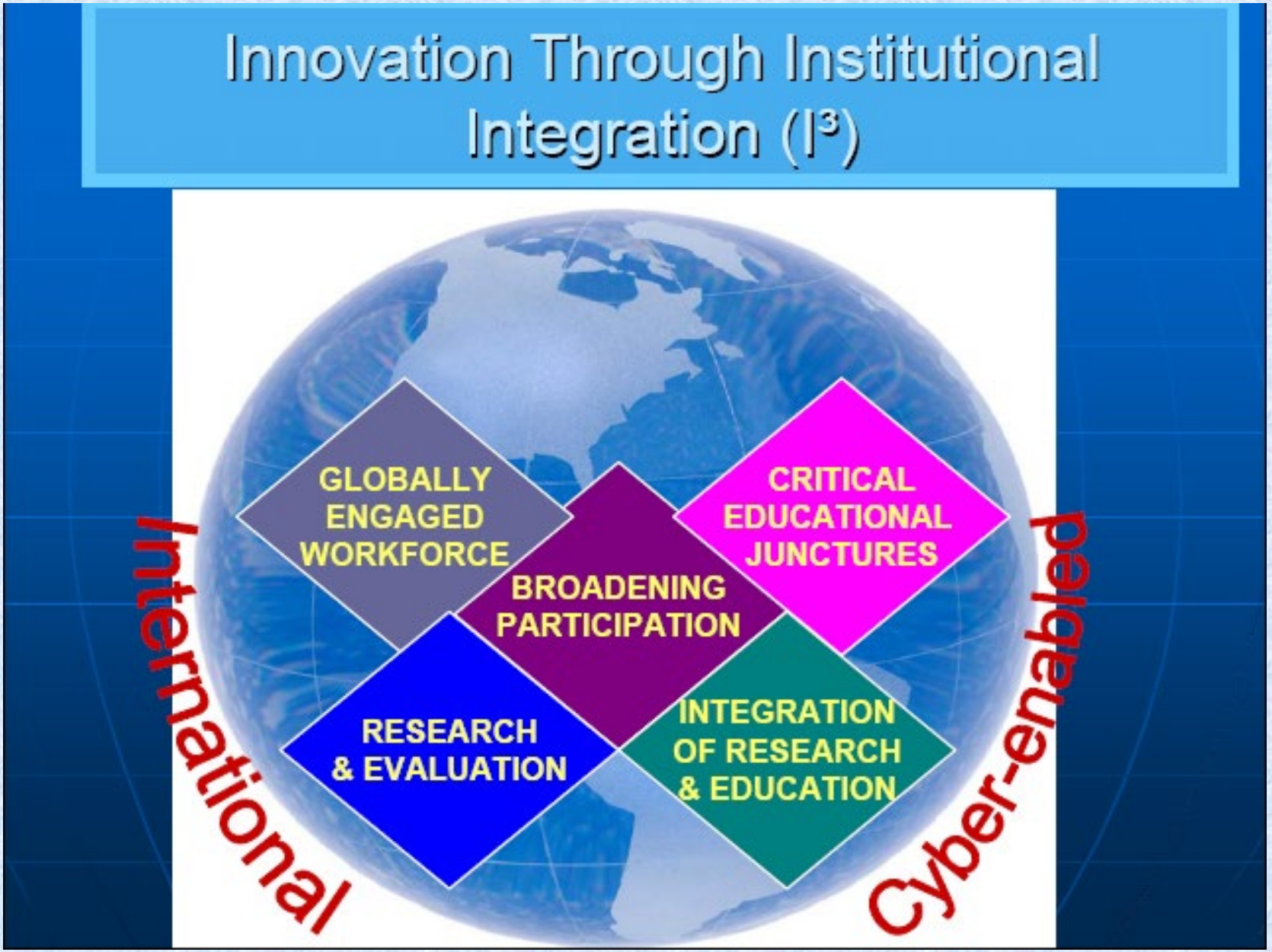
Innovation Through Institutional Integration (I^3)



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Innovation through Institutional Integration (I^3)

- I^3 challenges institutions to think strategically about the creative integration of NSF-funded awards, with particular emphasis on awards managed through programs in the Directorate for Education and Human Resources (EHR), but not limited to those awards
- In FY 2009, proposals are solicited in multiple EHR programs that advance I^3 goals: CREST, GSE, HBCU-UP, ITEST, LSAMP, MSP, Noyce, RDE, and TCUP
- All I^3 proposals are reviewed in competition with one another
- An institution may submit only one I^3 proposal in only one program; Does not affect submission to other programs

Other Opportunities for Funding

Advanced Technological Education (ATE)

Focuses on the education of technicians for the high-technology fields that drive our nation's economy in part through programs that are designed to improve existing as well as prospective K-12 teachers' technological understanding; to provide them with experiences to use in engaging students in real world technological problems; and to strengthen their preparation in science and mathematics overall

Course, Curriculum and Laboratory Improvement (CCLI)

Supports efforts to create, adapt, and disseminate new learning materials and teaching strategies, develop faculty expertise, implement educational innovations, assess learning and evaluate innovations, and conduct research on STEM teaching and learning

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Other Opportunities for Funding

Robert Noyce Teacher Scholarship Program

Encourages talented STEM majors and professionals to become K-12 mathematics and science teachers through scholarships, stipends, and academic programs if they commit to teaching in high-need K-12 school districts. The program also provides professional development and salary supplements for exemplary math and science teachers to become Master Teachers in high-need school districts.

NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM)

Makes grants to institutions of higher education to support scholarships for academically talented, financially needy students, enabling them to enter the workforce following completion of an associate, baccalaureate, or graduate level degree in science and engineering disciplines.

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Tools & Instruments

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Evidence: An Essential Tool

Planning for and Gathering Evidence Using the Design-Implementation-Outcomes (DIO) Cycle of Evidence

NSF 05-31

RETA Developed Tools

Design, Validation, and Dissemination of Measure of Content Knowledge for Teaching Mathematics [University of Michigan; PI - Heather Hill] – http://sitemaker.umich.edu/lmt/home

- Assessment items for mathematics teachers in the upper elementary and middle school grade levels
- Approximately 300 items in number, operations, pre-algebra and algebra, and geometry
- Disseminated to approximately eighty projects, including ten NSF MSPs and numerous U.S. Department of Education MSPs

RETA Developed Tools

Assessing Teacher Learning About Science Teaching (ATLAST) [Horizon Research, Inc. and AAAS; PI - Patrick Smith] – http://www.horizon-research.com/atlast/

- Instruments that measure change in knowledge needed by middle school teachers in three topics of science
- Provides assessment materials, scoring and reporting as part of its technical assistance
- Eight of the U.S. Department of Education's MSP sites, and a number of NSF MSPs, are using the assessments to gauge the impact of their professional development activities

RETA Developed Tools

Misconception Oriented Standards-based Assessment Resource for Teachers (MOSART) [Harvard University; PI - Philip Sadler] – http://www.cfa.harvard.edu/smgphp/mosart/index.html

- Content instruments for K-12 physical science and earth science, based on the research literature on students' science misconceptions
- A free, open web site that provides versions of its tests to any interested party, including an online tutorial that explains how the tests were developed and their intended uses
- Expertise shared with U.S. Department of Education MSPs

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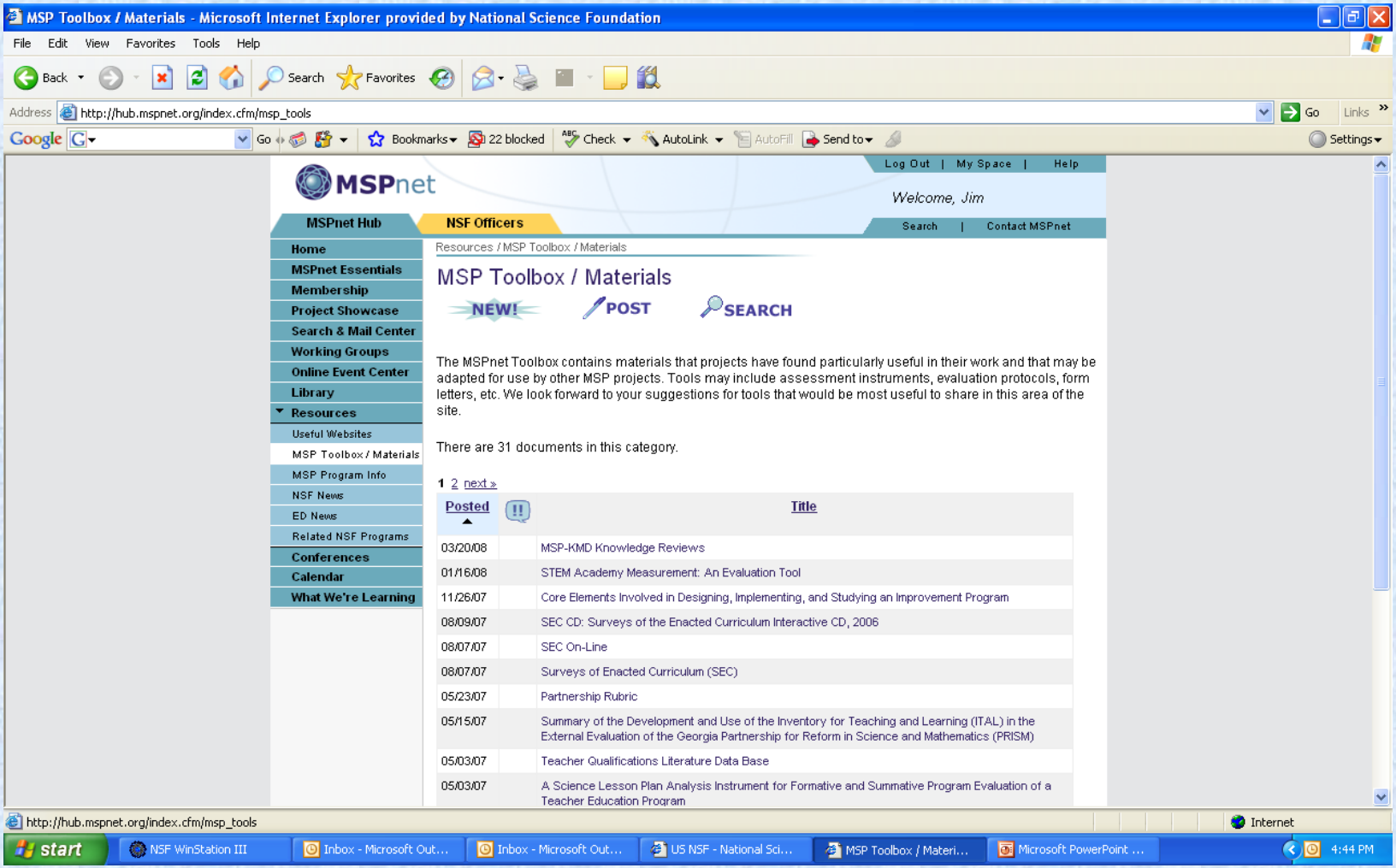
MSPnet Toolbox



http://hub.mspnet.org/index.cfm/msp_tools

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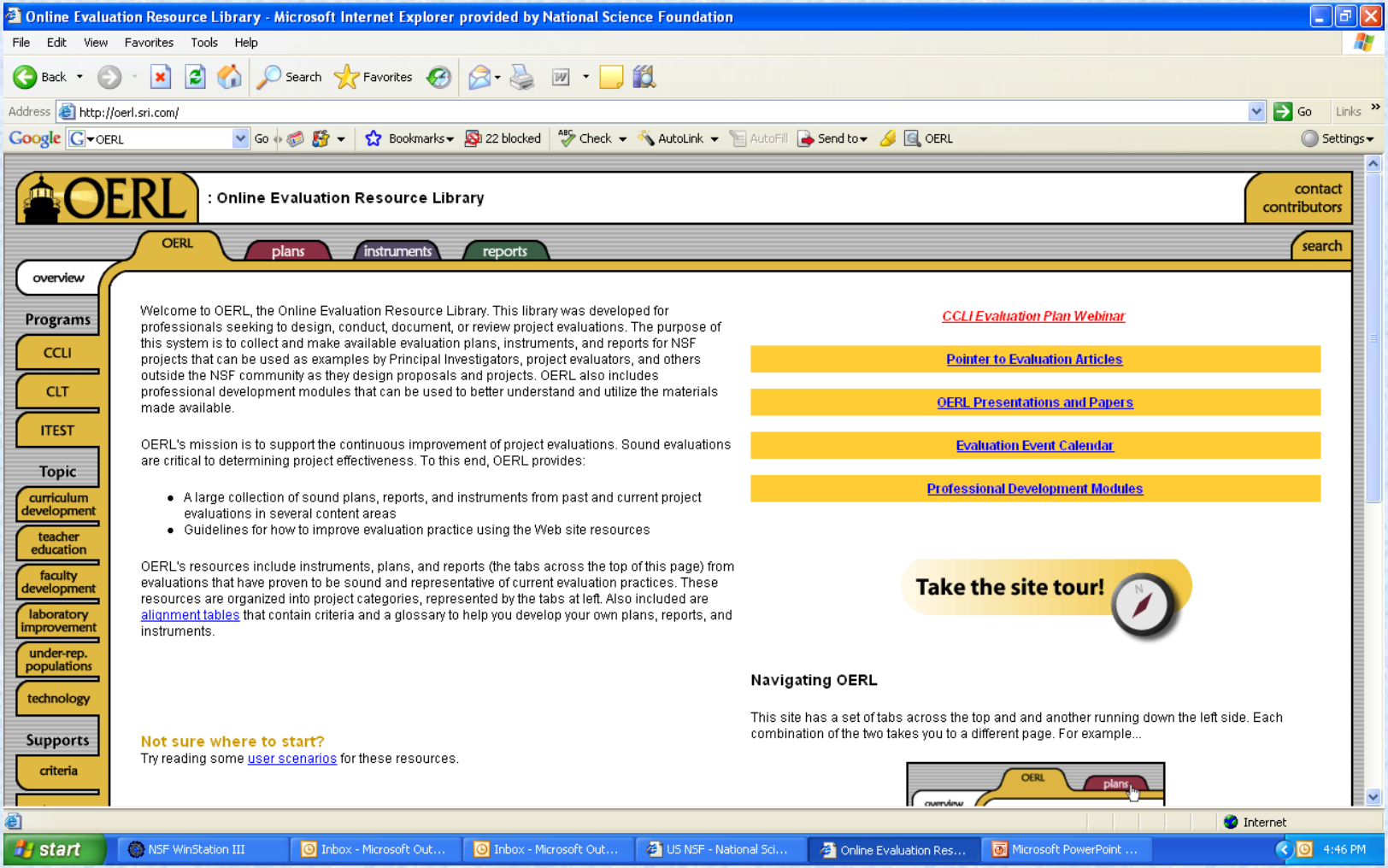
OERL Toolbox



http://oerl.sri.com/

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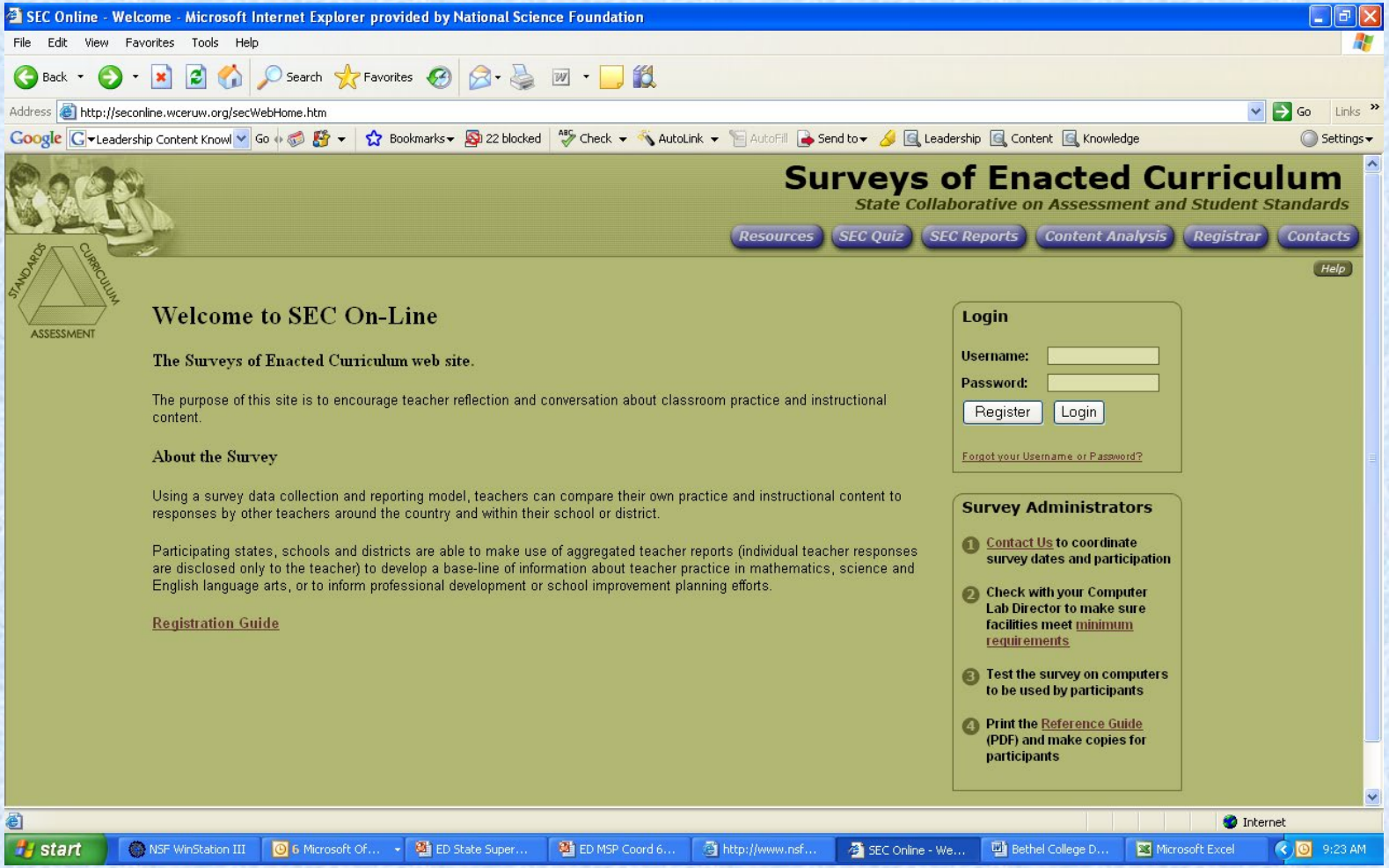
Surveys of Enacted Curriculum



http://seconline.wceruw.org/secWebHome.htm

Teacher Content Knowledge & Teacher Leadership

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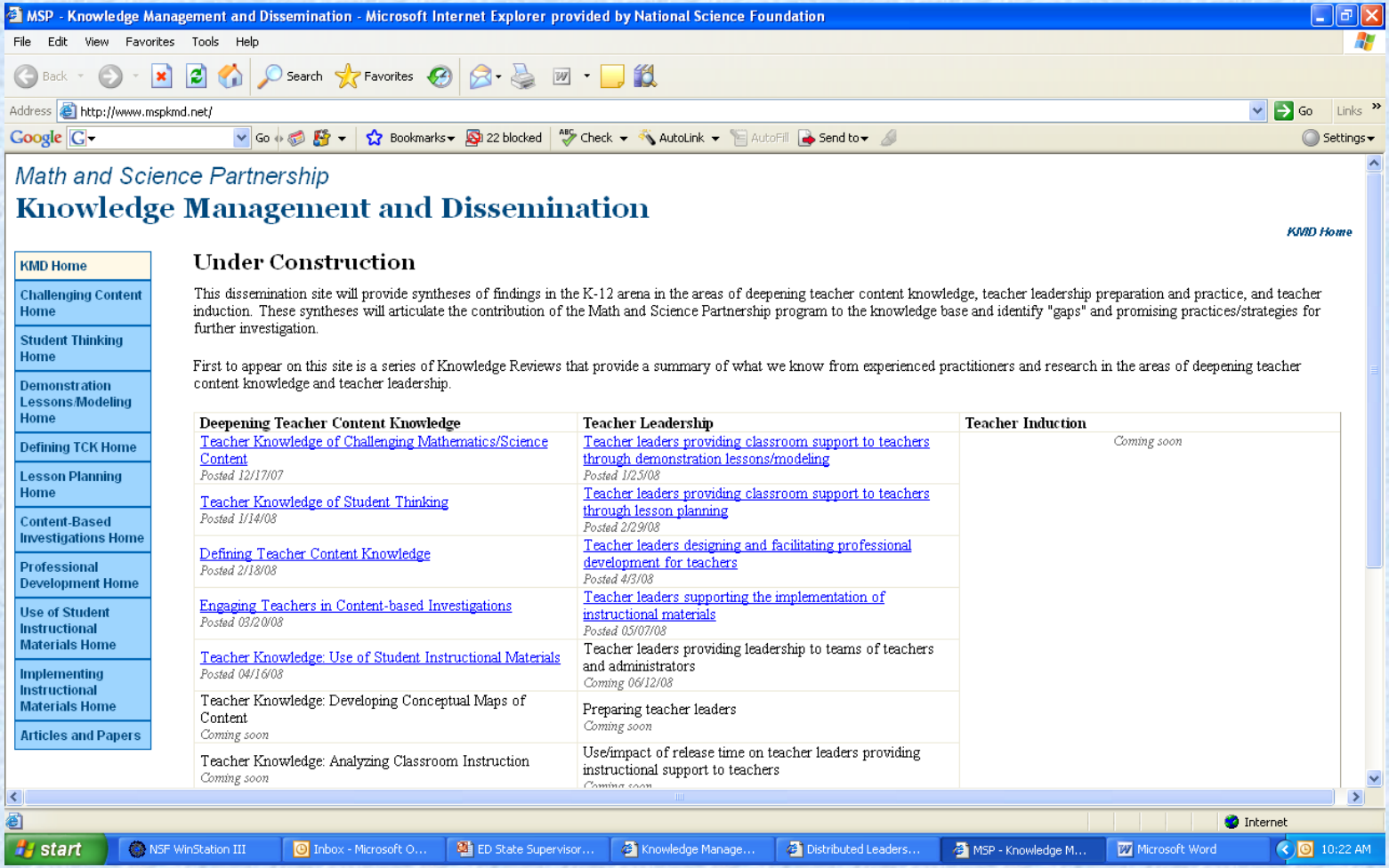
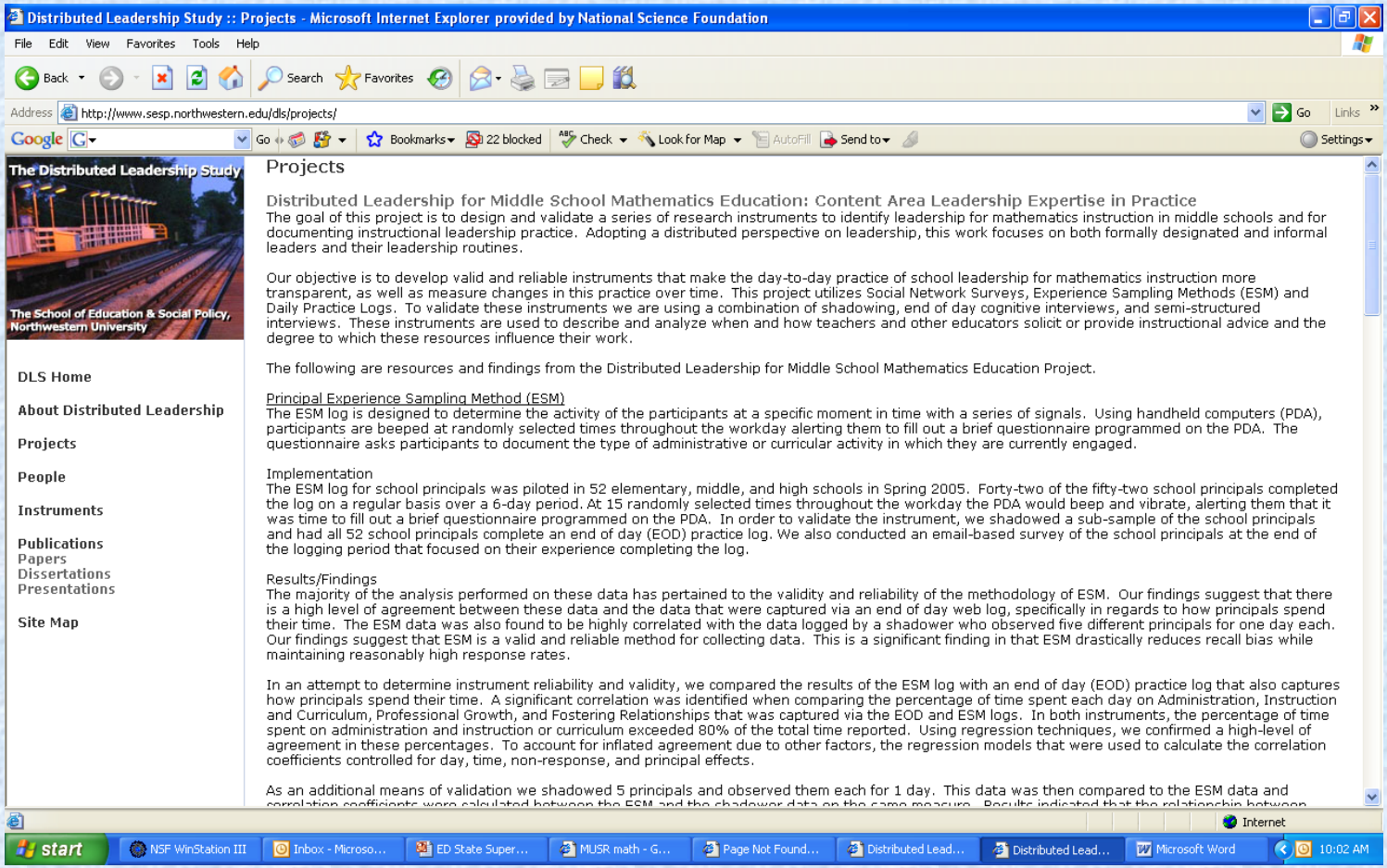


http://www.mspkmd.net/

Distributed Leadership



Instructional Leadership Daily Practice Log
Principal Experience Sampling Method (ESM) Log
School Staff Network Survey

http://www.sesp.northwestern.edu/dls/projects/

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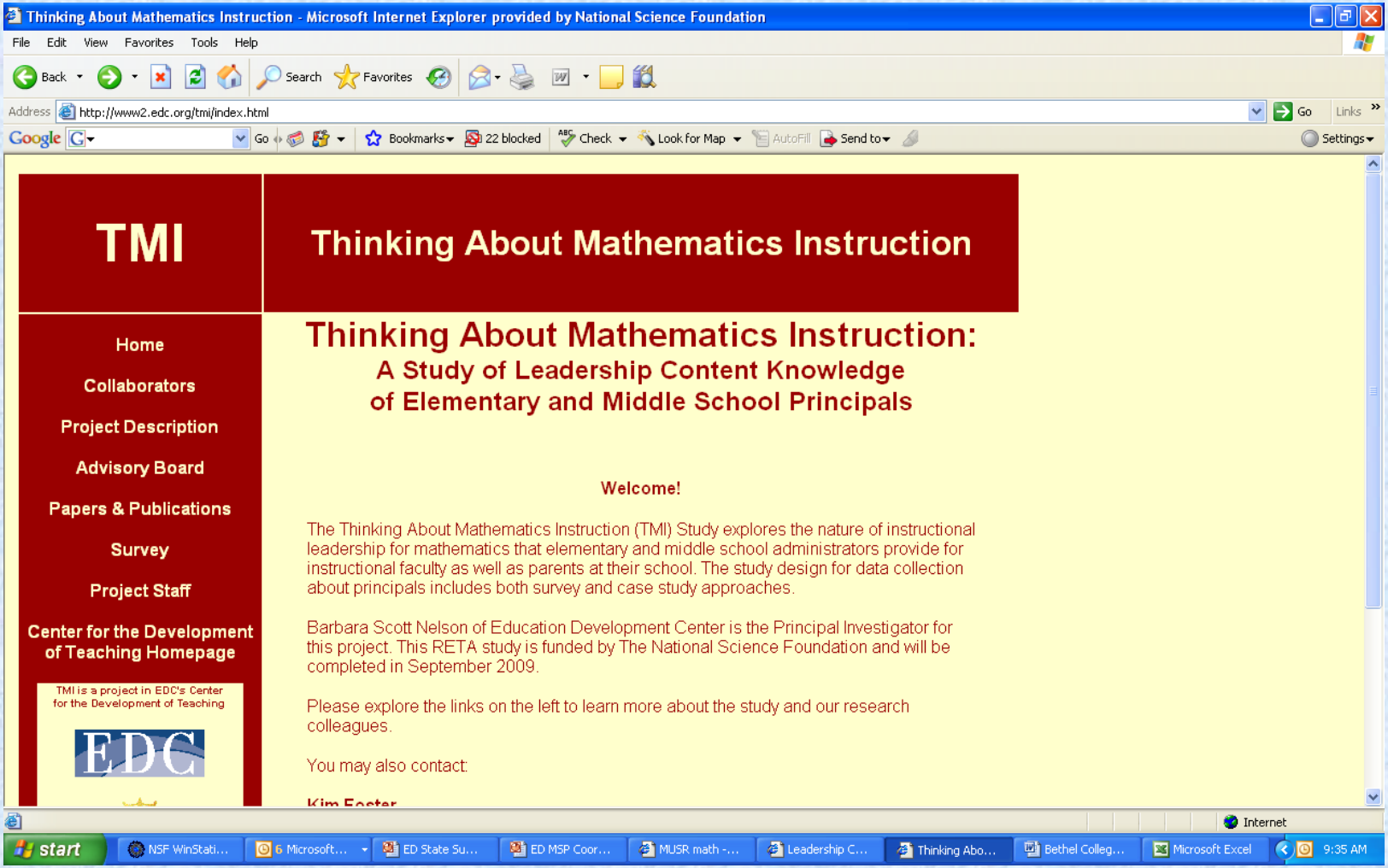
Leadership Content Knowledge



http://www2.edc.org/tmi/index.html

Website for MSP at NSF

http://www.nsf.gov

Click on Program Area – Education

Click on Division of Undergraduate Education (DUE)

Click on Math and Science Partnership Program

Website for MSPnet

http://mspnet.org

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General Information on NSF's Math and Science Partnership Program

NSF's Math and Science Partnership

- A research & development effort at NSF for building capacity and integrating the work of higher education with that of K-12 to strengthen and reform mathematics and science education
- Launched in FY 2002 as a key facet of the President's NCLB vision for K-12 education
- Strongly reauthorized as part of the America COMPETES Act of 2007

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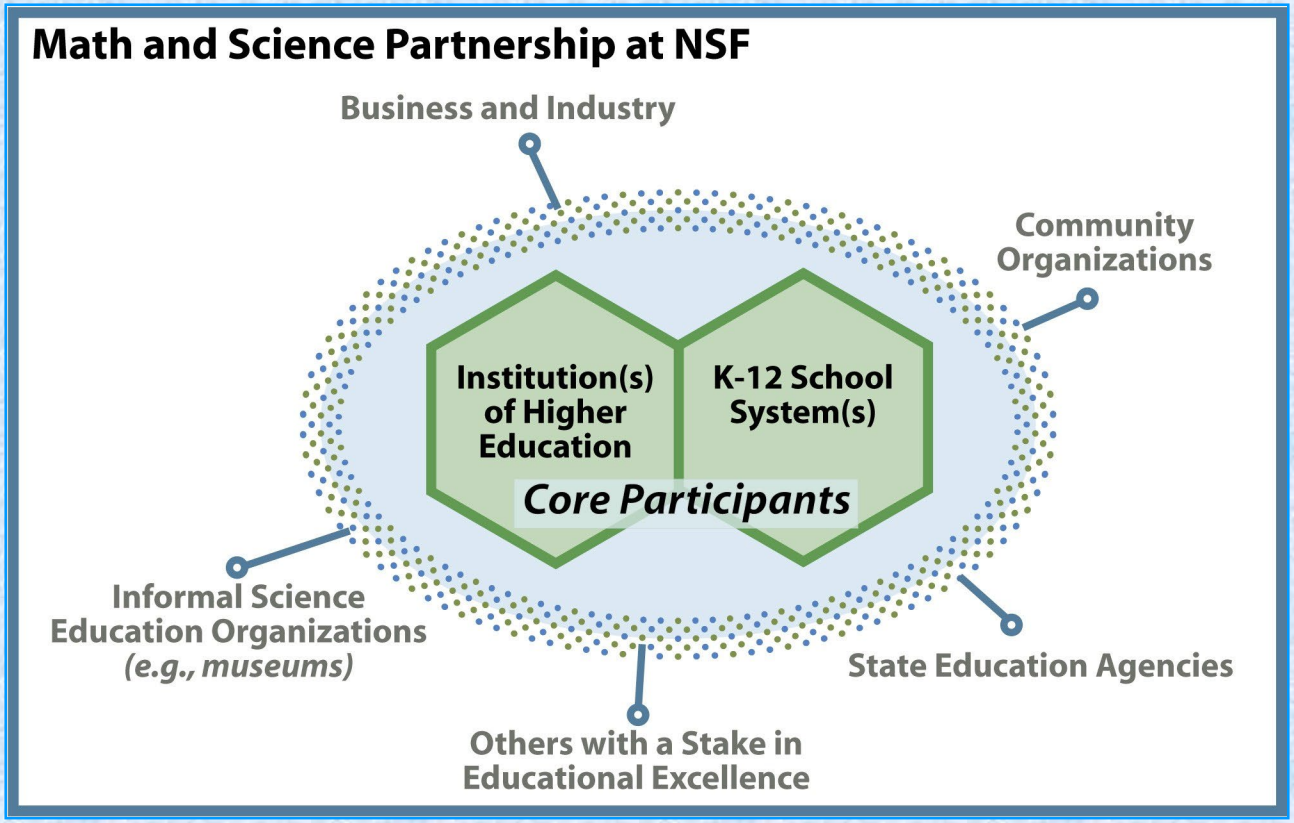

Through the Math and Science Partnership program, NSF awards competitive, merit-based grants to teams composed of institutions of higher education, local K-12 school systems and supporting partners. At their core, Partnerships contain at least one institution of higher education and one K-12 school system.

NSF's Math and Science Partnership

- Seeks to improve student outcomes in mathematics and science for all students, at all K-12 levels
- Is a coordinated effort between NSF and ED, who together have defined the program linkages necessary to manage investment for greatest effectiveness

What distinguishes NSF's MSP Program?

- Substantial intellectual engagement of mathematicians, scientists and engineers from higher education in improving K-12 student outcomes in mathematics and the sciences
- Depth and quality of creative, strategic actions that extend beyond commonplace approaches

What distinguishes NSF's MSP Program?

- Breadth and depth of Partnerships – Partnerships between organizations, rather than among individuals only
- Organizational/institutional change driven by Partnerships
- Degree to which MSP work is integrated with evidence; degree to which the work of the Partnerships is itself the work of scholars who seek evidence for what they do

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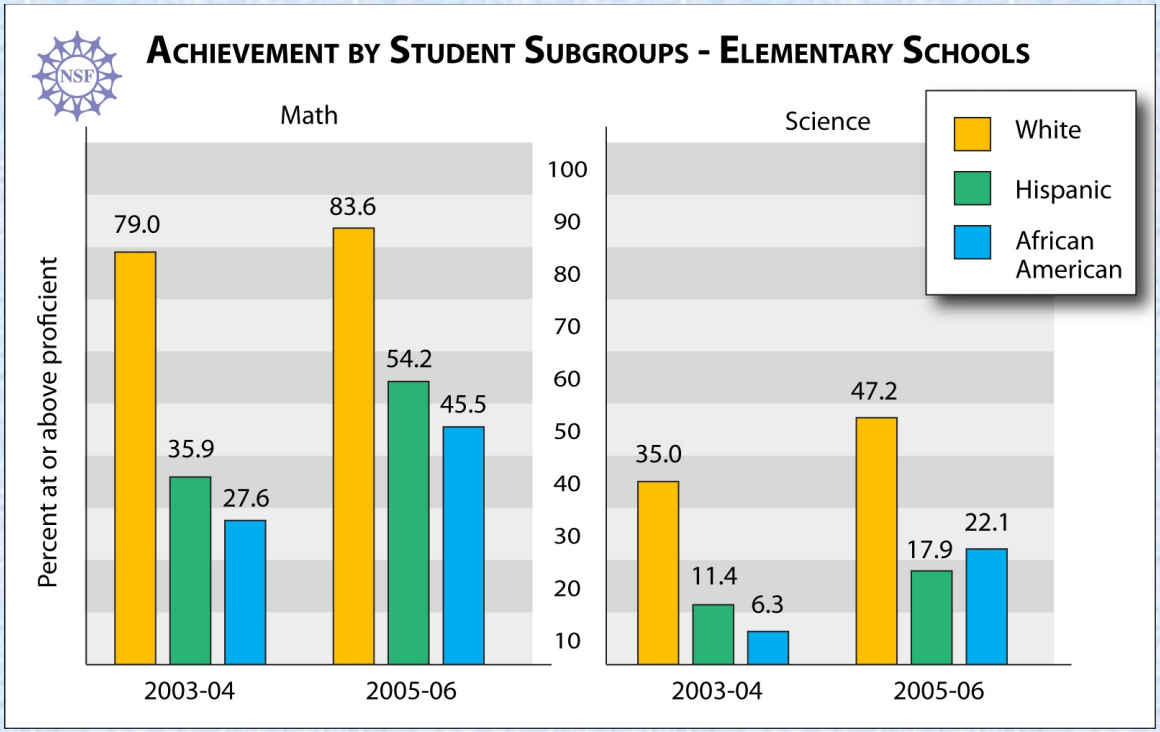
Examining Student Achievement

- Year-by-Year Trend Analysis
- Matched comparisons
- Meta-analysis pre/post assessments

Closing the Achievement Gap



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What tools and instruments are you aware of in current use in your state funded MSP projects?

What tools and instruments are needed?

What else should we be learning about?