Mathematics Infusion into Science Project (MiSP) 2009 – Present
Mathematics Science Technology Partnership (MSTP) 2003 -2009

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MSTP Project Goals

- Improve mathematics achievement in high needs middle schools by:
  - Infusing mathematics into existing science and engineering/ technology curriculum
    - Math must be relevant and contextualized *within* science or engineering/technology lessons
  - Creating professional STEM communities within middle schools that enhance communication and pedagogical understandings across science, technology, and mathematics, with added support from STEM University Faculty members

MSTP Project Goals (cont.)

- Study the impact of this process on:
  - Students' mathematical content knowledge
  - Students' NYS mathematics assessment results
  - Students' attitudes and affect about mathematics and mathematics infusion
  - Teachers' mathematical pedagogical content knowledge and attitude toward mathematics infusion

Proof-of-Concept Studies
Math Infusion in Science and Technology

Goal: to examine changes in middle school students' math content knowledge and attitudes before and after participating in math infused lessons and in comparison to students in classes without math infusion

Science: 20 days of math-infused science lessons developed by science teachers with MSTP Project staff support

- Proof-of-concept study I (Fall 2007) -- Six math infusion teachers (600 students) and five comparison teachers (400 students)
- Proof-of-concept study II (Fall 2008) -- Eight math infusion teachers (500 students) and four comparison teachers (350 students)

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Proof-of-Concept Studies (cont.)

Technology: Enhanced math infused into an existing technology lesson: Bedroom Design. A 20 day lesson where students virtually design and physically model a bedroom

- Proof-of-concept study I (Fall 2008) -- 15 math infusion teachers (500 students) and 15 comparison teachers (300 students)
- Proof-of-concept study / National Sample I (Spring 2009) – 20 math infusion teachers from various locations in country (600 students)

Proof-of-Concept Studies: Findings

Findings were similar for science and technology

- Mathematical content knowledge
  - Analyses of covariance revealed that infusion students scored statistically significantly higher than comparison students on relevant content knowledge
  - Greatest improvements were found for the bottom one-third of the students in math infused classes
- Attitudinal differences
  - Statistically significant positive differences between infusion and comparison students' post scores on items dealing with enjoyment of math during science, interest in math, math not being a waste of time, and math not being boring

What was learned from MSTP

- Math infusion is possible within the regular school day
  - Students who are exposed to math infused lessons:
    - Recognize the value of math for science and technology
    - Are better able to solve math problems that are relevant to the science content of what they are learning
  - Science and Technology teachers who infuse math into their lessons
    - Report an increase in student engagement in math
    - Find the math helped their content teaching
    - At times, struggle teaching the embedded math concepts

MSTP to MiSP

- MSTP Project developed the math infusion framework
- Framework being researched through MiSP
- MiSP is focusing on science only

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The Math Infusion Model of MiSP

Model promotes connections between Mathematics and Science

- Each subject maintains its own perspective
- Mathematics is *infused* into various science topics
- Science remains the primary subject
- Requires exposure to math within different science lessons to allow for transference of understanding of concepts
- Sequence of science topics determined by teacher/ school.
- Assumes students have competency and fluency with basics of math skills before being introduced to math infused science lessons

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The Math of MiSP

Math must ..

- Be meaningful and difficult for students
- Fit naturally into science (typically as part of a lab)
- Facilitate the learning of the science
- Be introduced multiple times to assure student learning and ability to apply in different situation
- Build in complexity, allowing for practice and mastery of easier skills before complex applications are required during science labs

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The Math of MiSP (cont.)

For MiSP the math focus is linear relationships and its applications in science. Students are exposed to three levels of math

- Graphical representation of data
- Determination of unit rate of change (slope); develop understanding of linear verse non-linear lines
- Developing linear equations, $y = mx + b$, from data

Building a Math Infusion Infrastructure

- Requires building a STEM community
- Science and math while separate, must build links through
  - Pedagogy (inquiry based instruction)
  - Language (noting similarities and differences in terminology)
  - Examples (Applications of math in science or technology)

What We Know about Building STEM Communities

- MSTP professional development created STEM learning communities within schools
- A National Mathematics Infusion into STEM Symposium held in March 2009

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Mathematics Infusion into STEM Symposium: Creating a dialog among the STEM disciplines

- Two and a half day event with 45+ STEM national leaders including researchers, practitioners and educators
- Discussed and debated advantages of connecting STEM disciplines
- Produced:
  - Practical recommendations for making STEM connections
  - Began to develop a mathematics infusion into STE research agenda

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Mathematics Infusion into STEM Symposium Goals

- Characterize what mathematics infusion looks like in STE curricula across grade levels
  - Determining the logistics of interconnectedness: Which STEM disciplines can logically and practically be connected?
  - Define roles and responsibilities of teachers from each discipline
  - Decide how to develop and implement infusion materials
  - Decide whether infusion is best as a separate curriculum or as a way to supplement the existing STEM curricular materials
- Consider how student learning should be assessed when working within an infusion paradigm to capture the benefits of interconnected instruction and math infusion using reliable, and valid assessment tools

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Facilitating Interconnectedness at the STEM Symposium

STEM symposium modeled learning communities

1. One facilitator and one recorder (non-participant) for each small group
2. Provided a discussion question to maintain a focused topic
3. Group participants were from different disciplines, to allow for optimal perspectives to be heard
4. Group make-up changed with each activity, allowing for participants to network and work with different people
5. All participant voices considered equal
6. Feedback loops created to allow for additional input from participants

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Modeling STEM Learning Communities

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Your Inter-Connected STEM Task

- Work in small multi-disciplinary groups
- Discuss the question you are given
- Write on poster board at least three points that the group feels are important for this question
- All members do not need to agree, but anything put on poster must be discussed by group

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STEM TASK

- Each group should choose a question to examine. If the group cannot reach consensus within two minutes about which question to address we will assign you a question.

Discussion Questions

- What are the barriers to mathematics infusion in STE and how can these barriers be overcome in K-12 classes?
- What evidence would be needed to capture the benefits of interconnected instruction?
- Who should be responsible for interconnecting STEM areas (e.g., curriculum developers, teachers, state policy makers, etc.) and why?
- How would state standards need to be changed to support interconnected content knowledge and pedagogy in K-12 classes?
- What does implementation of high-quality mathematics infusion look like when it occurs in the STE classroom?

Thank you

For further information

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