Math, Science & Technology Project (MSTP) and Math Infusion into Science Project (MiSP)

Mathematics Science Technology Partnership (MSTP)

- Five-year National Science Foundation funded project situated in 10 districts in New York, where on average 74% of students failed to meet state standards in 8th grade math
- Project designed to improve student mathematics learning and performance by embedding math in science and technology education instruction
- Created professional STEM communities (A/B Workshops) within middle schools to enhance communication and pedagogical connections across science, technology, and math teachers, with added support of STEM University Faculty members

Why Math Infusion?
- Math infusion is defined as math content taught in science or technology classes, where science or technology is the major discipline of instruction, but math is relevant and contextualized within science or technology activities
- National Council of Teachers of Mathematics (NCTM) contends that students should connect math to daily lives, and situations from science, social science, and commerce
- Math connections can help students relate math topics to their daily lives, understand math better and help them see math as a useful and interesting subject (Reed, 1995)
- Czerniak, Weber, Sandmann and Ahem (1999) suggest that integrating math and science enables students to develop a common core of knowledge, form deeper understandings, and find relevance in the curriculum

Why Learning Communities?
- Collaboration, collegiality and learning communities among teachers promote teacher satisfaction and performance (McLaughlin & Talbert, 2002)
- Provide teachers with content knowledge and skills needed to implement math in constructivist ways (must know math content and math pedagogy)

Proof-of-concept studies I (Fall 2007) and II (Fall 2008)
- Used a quasi-experimental design (comparison and infusion teachers) to examine impact of math infusion on middle school student math content knowledge and attitudes
- Infusion lessons developed or enhanced by teachers and MSTP Project staff
- Math-infused science lessons focused on various science topics (teachers selected their own) and lasted for 20 days. Math infused technology lessons were an enhanced version of an existing lesson: Bedroom design which lasts approximately four weeks
- Lessons introduced a variety of math concepts embedded within primary content area
- Each study involved over 500 middle school infusion science students and their teachers; 300 middle school technology students and their teachers, and similar numbers of comparison students
Successes of the MSTP Project

Proof of Concept Study Results
• Math infusion is possible within the regular school day
• Students 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

Select Presentations and Publications
**Mathematics Infusion into Science Project (MiSP)**

- MSTP Project developed math infusion framework that is being researched through MiSP
- Partnership with the New York State Education Department (NYSED) and eight high-need Phase I school districts in New York
- MiSP will develop and research the academic potential of an instructional model and a set of prototypical materials that infuse standards-based mathematics into eighth-grade science programs
- Since algebra is the ‘gatekeeper’ subject that often affects students’ educational progress and career aspirations, MiSP will emphasize infusion of algebra into eighth-grade science contexts

**The Math Infusion Model of MiSP promotes connections between Mathematics and Science**

- Each subject maintains its own perspective; promotes connections between the Mathematics and science but does not attempt to combine into a curricular whole
- 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

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

**Level 1:** Graphical representation of data

**Level 2:** Examination of slope, visual understanding of linear verse non-linear lines

**Level 3:** Contrasting linear and non-linear lines; developing linear equations for prediction
**MiSP Science Lessons**

- Math is infused into science labs
- Numerous science topics are available to accommodate existing science scope and sequence in schools
- Sample of science topics: Chemical Reactions; Density; Ecology: Predator Prey; Motion; Permeability Porosity; Photosynthesis; Simple Machines; Solubility; Thermal Conduction
- Lessons offer teacher the opportunity to infuse math at the appropriate level of math complexity (each lesson includes a choice of three labs which vary only in how far the students are expected to investigate the data)

**Challenges of MiSP and Math infusion**

- Possible teacher resistance and perception time will be lost from primary subject (science)
- Teachers must understand the math and math pedagogy
- Assuring students have competency and fluency with basics of math concepts before expecting them to use the math in more complex ways
- School state testing schedules and required test-prep time

**Studying Math infusion through MiSP**

- In 2010-2012 conducting a quasi-experimental study with a wait-list control to investigate the impact of MiSP on student content knowledge, attitudes and interests