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 day. 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

La Fata Almendral, C., & Russo, M. (2008). Infusing Mathematics into Science & Technology at the Middle School Level. *8th Grade Science in Savannah Symposium*.

Russo, M., Hecht, D., & Burghardt, M.D. (2009). Development of a Multidisciplinary Middle School Math Infusion Model. Paper Presentation at the American Educational Research Association *AERA 2009 Annual Meeting*.

Burghardt, M.D. (2008). Development of a Math Infusion Model for Middle School Engineering/Technology Education, *ASEE*.

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
- M_iSP 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, M_iSP will emphasize infusion of algebra into eighth-grade science contexts

The Math Infusion Model of M_iSP 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 <u>meaningful</u> and difficult for students
- <u>Fit naturally</u> into science (typically as part of a lab)
- <u>Facilitate</u> the learning of the science
- Be <u>introduced multiple times</u> to assure student learning and ability to apply in different situation
- <u>Build in complexity</u>, allowing for practice and mastery of easier skills before complex applications are required during science labs
- For MiSP the math focus is <u>linear relationships</u> 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