Critical Issues in Education: Teaching Teachers Mathematics
May 30 – June 1, 2007

Wednesday, May 30

Charter Bus Scheduled Departures	Bus 1 3:30 Depart Durant Hotel
	Bus 2 3:30 Depart Downtown Berkeley BART Station 3:45 Depart Rose Garden Inn
	UC Berkeley "Hill" shuttle departs UC Berkeley's Hearst Mining Circle every half hour beginning at 7:40

Session 1	**Introduction to the Conference: Plenary Session in the Simons Auditorium**	

4:00-4:30	David Eisenbud,
	    MSRI Director
	Deborah Ball,
	    University of Michigan
		Welcome, Overview and Purposes of Workshop

4:30-5:30	Jeremy Kilpatrick, University of Georgia	How do we do it? Teaching Mathematics to U.S. Teachers (See Abstract)
5:30-7:00	Reception and light buffet dinner in the **Atrium**	

Session 2	**Plenary Session in the Simons Auditorium**	
7:00-7:10	Barbara Lee, Representative for the 9th Congressional District of California	(Tentative) Congressional involvement in Math Education
7:15-7:45	Deborah Ball, University of Michigan	A conversation about the challenges in teaching teachers
7:45-8:45	Robert Fefferman, University of Chicago	Working with Teachers to Improve Mathematics Instruction: Some Experiences and Views (See Abstract)

Charter Bus Scheduled Departures	Bus 1 9:00 Depart for Durant Hotel
	Bus 2 9:00 Depart for Rose Garden Inn Depart for Downtown Berkeley BART Station

Thursday, May 31: Courses and programs for mathematics teachers

Charter Bus Scheduled Departures	Bus 1 7:45 Depart Durant Hotel
	Bus 2 7:30 Depart Downtown Berkeley BART Station 7:45 Depart Rose Garden Inn
	UC Berkeley "Hill" shuttle departs UC Berkeley's Hearst Mining Circle every half hour beginning at 7:40
8:00-8:30	Coffee, tea in the **Atrium**

Session 3	**Mathematical Knowledge for Teachers: Plenary Session in the Simons Auditorium**	
8:30-8:40	Overview of the Day	
8:40-9:30	Hung-Hsi Wu, University of California, Berkeley	The mathematics K-12 teachers need to know (See Abstract)
9:30-10:00	Coffee, Tea, Danish, etc. in the **Atrium**	

Session 4	**Designing Opportunities for Teachers to Develop Mathematical Knowledge for Teaching: Parallel Sessions**	
4a	**Simons Auditorium**	
10:00-10:50	Ken Gross, University of Vermont and Judi Laird, Vermont Mathematics Initiative	The Vermont Mathematics Initiative (See Abstract)
10:55-11:45	Reuben Farley, Virginia Commonwealth University Kristina Anthony, Virginia Commonwealth University Susan Birnie, Alexandria City Public Schools	Collaborative Efforts to Prepare K-8 Mathematics Specialists (See Abstract)
11:50-12:10	Moderator	A discussion of the Vermont and Virginia projects
4b	**Baker Board Room**, 2nd floor, turn right at the top of the stairs	
10:00-10:50	Efraim Armendariz, University of Texas Altha Rodin, University of Texas Margaret Batchelor, University of Texas	UTeach at the University of Texas (See Abstract)
10:55-11:45	Irwin Kra, Math for America Jonathan Schweig, Math for America	MfA: A replicable NYC program (See Abstract)
11:50-12:10	Moderator	A discussion of UTeach and Math for America
4c	**Commons Room**, 2nd floor, turn left at the top of the stairs	
10:00-10:50	Richard F. Voss, Florida Atlantic University Markus Hohenwarter, Florida Atlantic University Guy Barmoha, Broward County Public Schools	MSP Content and Technology Training for Middle Grades Teachers (See Abstract)
10:55-11:45	Phil Wagreich, University of Illinois at Chicago Bonnie Saunders, University of Illinois at Chicago	A Mathematics Concentration for Pre-service Elementary School Teachers: An Existence Proof and New Conjectures (See Abstract)
11:50-12:10	Moderator	A discussion of the Florida Atlantic MSP and the UIC mathematics concentration program

4d	**Library**, first floor, to the left as you enter the front door	
10:00-12:10	Susan Jo Russell, TERC Virginia Babstable, Mount Holyoke College Sybilla Beckmann University of Georgia Ben Ford Sonoma State University Deborah Schifter, EDC Ana Vaisenstein, Boston Public Schools Carol Walker, Boston Public Schools	Mathematicians Writing for Educators: Collaboration Across Disciplines (See Abstract)

12:15-1:25	Lunch at MSRI in the **Atrium**. Please enjoy all the eating spaces on the decks surrounding the building, and the picnic area across from the patio adjoining the front door.

Session 5	**Courses for Teaching Teachers Mathematics: Parallel Sessions**	

5a	**Baker Board Room**, 2nd floor, turn right at the top of the stairs	
1:25-2:15	Glenn Stevens, Boston University Al Cuoco, EDC Wayne Harvey, EDC Ryota Matsuura, Boston University Steve Rosenberg, Boston University Sarah Sword, EDC	The Impact of Immersion in Mathematics on Teachers (See Abstract)
2:20-3:10	Ruth Parker, Mathematics Education Collaborative	Learning Together: Implementing Inquiry-based Content Courses for K-20 Teachers of Mathematics (See Abstract)
3:15-3:30	Moderator	A discussion of Focus on Mathematics and the Greater Birmingham Mathematics Partnership

5b	**Simons Auditorium**	
1:25-2:15	Deborah Ball, University of Michigan Wendy Aaron, University of Michigan Hyman Bass, University of Michigan Laurie Sleep, University of Michigan Mark Thames, University of Michigan	Learning Mathematical Knowledge for Elementary School Teaching at the University of Michigan (See Abstract)
2:20-3:10	Dawn Berk, University of Delaware James Hiebert, University of Delaware	The Mathematical Education of Elementary Teachers at Delaware (See Abstract)

3:15-3:30	Moderator	A discussion of the Michigan and Delaware elementary education programs

5c **Library**, 1st floor, to the left as you enter the front door.

1:25-2:15	Heather Calahan, UCLA Theodore Gamelin, UCLA	Teaching Teachers in a Research Mathematics Department (See Abstract)
2:20-3:10	Dale Oliver, Humboldt State University	Content and Process in a Year-Long Capstone Sequence for Secondary Teachers (See Abstract)
3:15-3:30	Moderator	A discussion of the capstone courses at UCLA and Humboldt State

5d **Commons Room**, 2nd floor, turn left at the top of the stairs

1:25-2:00	Amy Cohen, Rutgers University	Connecting Math Major Content to High School Curriculum (See Abstract)
2:05-2:40	Bret Benesh, Harvard University Thomas Judson, Harvard University Matthew Leingang, Harvard University	Two non-traditional content courses for in-service high school teachers at the Harvard Extension School (See Abstract)
2:45-3:30	Richard Askey, University of Wisconsin	Using TIMSS videos for professional development (See Abstract)

3:30-4:00	Coffee, Tea, Snacks in the **Atrium**

Session 6 **Teachers' Opportunities for Learning Mathematics for Teaching: Plenary Session in the Simons Auditorium**

4:00-5:00	Raven McCrory, Michigan State University	The Mathematical Education of Elementary Teachers: Courses, Textbooks, and Opportunities to Learn (See Abstract)

Session 7 **A Closer Look at Programs: Parallel Sessions**

5:10-6:00 A Closer Look: Representatives of 11 programs will be available to meet with participants in small groups, offering an opportunity to ask questions and learn more about their program

• Elementary Math Education at Delaware	Second Floor North Corridor (1)
• Elementary Math Education at Michigan	Simons Auditorium, balcony
• Elementary Math Education at UIC	Second Floor South Corridor
• Florida Atlantic MSP	Second Floor North Corridor (2)
• Focus on Mathematics	Atrium (2)
• The Humboldt Capstone Course	Library (1)
• Math for America	Baker Board Room
• UTeach	Atrium (1)
• The UCLA Capstone Course	Library (2)
• Vermont Mathematics Initiative	Commons Room
• Virginia Math Specialists	Third Floor South Corridor

Charter Bus Scheduled Departures	Bus 1	6:10	Depart for Durant Hotel
	Bus 1	6:10	Depart for Rose Garden Inn Depart for Downtown Berkeley BART Station

UC Berkeley "Hill" shuttle departs MSRI every half hour beginning at 7:55am (last departure is 7:15pm)

Friday, June 1

Charter Bus Scheduled Departures	Bus 1	7:45	Depart Durant Hotel
	Bus 2	7:30	Depart Downtown Berkeley BART Station
		7:45	Depart Rose Garden Inn

UC Berkeley "Hill" shuttle departs UC Berkeley's Hearst Mining Circle every half hour beginning at 7:40

8:00-8:30	Coffee, tea in the **Atrium**

Session 8	**Connecting Communities in Teachers' Mathematical Education: Plenary Session in the Simons Auditorium**
8:30-8:40	Overview of the day
8:40-9:25	Judit Moschkovich, University of California, Santa Cruz	What mathematics teachers need to learn about language (See Abstract)

9:25-10:15	Ruth Heaton,
	    University of Nebraska-Lincoln
	Jim Lewis,
	    University of Nebraska-Lincoln
	Cynthia Anhalt,
	    University of Arizona
	Matt Ondrus,
	    University of Arizona
		Panel Discussion
		Mathematics Educator-Mathematician partnerships for educating teachers: Examples from Nebraska and Arizona (See Abstracts)

Time	Speaker	Description
8:40-9:25	Judit Moschkovich, University of California, Santa Cruz	What mathematics teachers need to learn about language (See Abstract)
9:25-10:15	Ruth Heaton, University of Nebraska-Lincoln; Jim Lewis, University of Nebraska-Lincoln; Cynthia Anhalt, University of Arizona; Matt Ondrus, University of Arizona	Panel Discussion. Mathematics Educator-Mathematician partnerships for educating teachers: Examples from Nebraska and Arizona (See Abstracts)

10:15-10:45	Coffee, tea, in the **Atrium**

Session 9	**Materials for Teaching Teachers' Mathematics: Parallel Sessions**

9a	**Simons Auditorium**
10:45-11:35	Judy Sowder, San Diego State University	Reconceptualizing Mathematics: Curriculum Materials for Elementary and Middle School Teachers (See Abstract)
11:40-12:30	Sybilla Beckmann, University of Georgia	Mathematics for Elementary Teachers: A Focus on "Explaining Why" (See Abstract)

9b	**Baker Board Room**, 2nd floor, turn right at the top of the stairs
10:45-11:35	Nanette Seago, WestEd	Learning and Teaching Linear Functions: Video Cases for Mathematics Professional Development (See Abstract)

11:40-12:30	Deborah Schifter,
	    EDC
	Susan Jo Russell,
	    TERC
	Virginia Bastable,
	    Mount Holyoke College
		Developing Mathematical Ideas: A Program for Teacher Learning (See Abstract)

9c	**Commons Room**, 2nd floor, turn left at the top of the stairs
10:45-11:35	Hung-Hsi Wu, University of California, Berkeley	Professional Development: The Hard Work of Learning Mathematics (See Abstract)

11:40-12:30	Markus Hohenwarter,
	    Florida Atlantic University
	 Guy Barmoha
	    Broward County Public Schools
		GeoGebra: Open Source Software for Learning and Teaching Mathematics (See Abstract)

12:35-1:45	Lunch at MSRI in the **Atrium.** Please enjoy all the eating spaces on the decks surrounding the building, and the picnic area across from the patio adjoining the front door.

Session 10	**Examining Efforts to Teach Teachers Mathematics: Plenary Session in the Simons Auditorium**
1:45-2:05	Sybilla Beckmann, University of Georgia	Mentoring faculty and graduate students interested in teaching teachers (See Abstract)

2:05-3:20	James Hiebert,
	    University of Delaware
	 Heather Hill,
	    University of Michigan
	 Ken Gross,
	    University of Vermont
		Studying the effectiveness of our efforts to teach teachers mathematics (See Abstract)

3:20-3:50	Coffee, Tea, and snacks in the **Atrium**

Session	**Resources for Teaching Teachers Mathematics: Parallel Sessions**

11a	**Simons Auditorium**
3:50-4:40	Thomas Parker, Michigan State University	A focused course for elementary teachers: building teacher knowledge and confidence via Asian textbooks (See Abstract)
4:45-5:35	Gary Jensen, Washington University	Arithmetic for Prospective Teachers: How should we begin the road to PUFM? (See Abstract)

11b	**Baker Board Room**, 2nd floor, turn right at the top of the stairs

3:50-4:30	Judith Jacobs,
	    California State Polytechnic
	    University, Pomona
	 Greisy Winicki Landman,
	    California State
	    Polytechnic University, Pomona
		Incorporating English Learner Strategies in Mathematics Courses for Teachers (See Abstract)

4:35-5:05	Ann Shannon, Ann Shannon Consultants	Using extended mathematics tasks to increase teachers' mathematical knowledge for teaching (See Abstract)
5:10-5:35	Virginia Warfield, University of Washington	What French Didactique can say to American mathematics educators (See Abstract)

11c	**Library**, first floor, to the left as you enter the front door.	

3:45-5:30	Susan Jo Russell,
	    TERC
	Virginia Bastable,
	    Mount Holyoke College
	Sybilla Beckmann
	    University of Georgia
	Ben Ford
	    Sonoma State University
	Deborah Schifter,
	    EDC
	Ana Vaisenstein,
	    Boston Public Schools
	Carol Walker,
	    Boston Public Schools
		Mathematicians Writing for Educators: Collaboration Across Disciplines II
		
		(This session is a continuation of the Thursday morning session 4d)

11d	**Commons Room**, 2nd floor, turn left at the top of the stairs	
3:50-4:20	Alexander Givental, University of California, Berkeley	Will mathematics ever make sense? (See Abstract)
4:25-4:55	Harold M. Murai, University of Kansas	Foundation Mathematics for Teaching at the Elementary and Secondary Levels (See Abstract)

5:00-5:35	Mike Winders,
	    Worcester State College
	Richard Bisk,
	    Worcester State College
		Model Drawing: Connecting Arithmetic to Algebra (See Abstract)

Session 12	**Closing Session: Facing the Challenge of Teaching Teachers Mathematics : Plenary Session in the Simons Auditorium**	
5:40-6:00	Deborah Ball, University of Michigan	Final thoughts about teaching teachers mathematics

6:00-7:00	Reception in the **Atrium**

Charter Bus Scheduled Departures	Bus 1 7:15 Depart for Durant Hotel
	Bus 1 7:15 Depart for Rose Garden Inn Downtown Berkeley BART Station
	7:15 UC Berkeley "Hill" shuttle bus last departure from MSRI

Abstracts

How do we do it? Teaching Mathematics to U.S. Teachers

Jeremy Kilpatrick, University of Georgia

If a system is a functionally related set of elements, then we have no system for teaching mathematics to U.S. teachers. We have courses and programs, but they do not operate in an organic fashion. In this talk, I address four questions: Who teaches? What mathematics? To whom? And how? Abandoning any attempt to be comprehensive, I make observations and raise issues arising from each question so as to provoke some thought on how we mathematics teacher educators and developers might improve our practice. Just as mathematics teachers need a coherent vision, so do we.

Working with Teachers to Improve Mathematics Instruction: Some Experiences and Views

Robert Fefferman, University of Chicago

This will describe my experiences over the years in working with Chicago Public School teachers to improve both their understanding of mathematics, and their ability to teach it. I will explain what I've found in conducting classes for teachers and in visiting their schools. I will also offer some opinions on the role mathematicians should play in improving mathematics instruction and what children need to master in order to succeed in their studies of mathematics.

The mathematics K-12 teachers need to know

Hung-Hsi Wu, University of California, Berkeley

This talk discusses the nature of the mathematics K-12 teachers need to know, and why they should know it.

The Vermont Mathematics Initiative

Ken Gross, University of Vermont
Judi Laird, University of Vermont

The *Vermont Mathematics Initiative* (VMI) is a statewide mathematics professional development program that represents a partnership of the University of Vermont, the Vermont State Department of Education, and local school districts. At the heart of the VMI is a comprehensive, three-year, master's degree program, begun in 1999, designed to build a corps of mathematics teacher leaders across the state of Vermont who are deeply knowledgeable in mathematics content and can apply their knowledge to improve mathematics instruction. In formal evaluations conducted over several years, comparisons of VMI grouped schools with control schools has yielded an overall consistent pattern of the VMI schools exceeding the performance of control schools in both cross-sectional and longitudinal analysis. Originally designed for K-6 teachers, the program has been found to be equally successful with middle school teachers as well.

The second stage of the VMI, currently being piloted in AY2006-2007, is designed to reach all elementary teachers in the state with a core set of mathematics courses distilled from the VMI master's degree curriculum, in which the learning and transfer to the classroom is sustained regionally and in districts through mentoring by the VMI teacher leaders.

The VMI model has been adopted in other locations – in Nebraska, New Mexico, Massachusetts, and Little Rock, Arkansas – and the Intel Foundation is in the process of developing a national initiative based on the VMI.

This presentation will describe key features of the program that have resulted in improved teacher content knowledge, classroom practice, school and district leadership, and student learning.

Collaborative Efforts to Prepare K-8 Mathematics Specialists

Reuben Farley, Virginia Commonwealth University
Kristina Anthony, Virginia Commonwealth University
Susan Birnie, Alexandria City Public Schools

The Mathematics Specialist movement in Virginia was initiated by mathematicians in the early 1990's and has progressed to the point where the Virginia Department of Education licensure endorsement for Specialists is anticipated to be finalized by July 1, 2007. This presentation focuses on the statewide preparation program for Mathematics Specialists which features pedagogical content courses and educational leadership courses which are collaboratively developed by statewide teams consisting of university mathematics and mathematics education faculty, school system mathematics supervisors and practicing mathematics master teachers. Mathematicians from universities across the state work with mathematics educators and school system mathematics supervisors and teachers in the development, teaching and continuing refinement of the pedagogical content courses and the leadership courses which constitute this preparation program. The functioning of course development teams and team-teaching teams will be presented. The Statewide Masters Degree Program under which much of the Mathematics Specialist preparation is offered will be discussed. Financial support sources will be acknowledged. Web page links to sites which provide many details concerning the aforementioned activities will be specified.

UTeach at the University of Texas

Efraim Armendariz, University of Texas
Altha Rodin, University of Texas
Margaret Batchelor, University of Texas

UTeach is a collaborative program of the Colleges of Natural Sciences and Education as well as the Austin Independent School district. Its goal is to prepare and support secondary mathematics, science, and computer science teachers at UT Austin. The program was established in 1997 in response to the growing shortage of mathematics and science teachers in the secondary schools. Upon completion of the four-year program, students receive a bachelor's degree in the field in which they will teach as well as teacher certification.

Twenty-five percent of students in the College of Natural Sciences express an interest in teaching. The UTeach program is designed to give these students an opportunity to explore this possibility with hands-on experience in a public school classroom beginning in their freshman year. Students work with experienced AISD teachers who mentor them. In carefully calculated steps, the students' teaching experience becomes progressively longer and more independent.

UTeach combines rigorous preparation in mathematics and science with this early and on-going field experience in public schools. New pedagogy courses, focused on teaching science & mathematics, have been developed by both colleges, and are taught by UT professors and Master Teachers with advanced degrees. The curriculum emphasizes inquiry-based teaching and learning, use of technology, and research experience in mathematics and science.   Emphasis is also placed on making connections between mathematics and the other sciences as well as between the mathematics taught at the university level and high school mathematics.

Expanding on the foundations of the UTeach Natural Sciences undergraduate program, the SUMMER UTeach Master of Arts in Science and Mathematics Education was introduced in 2004. This degree program is designed to produce the next generation of Master Teacher leaders - individuals who will return to the classroom and their school districts as highly qualified content and instructional specialists.

MfA: A replicable NYC program

Irwin Kra, Math for America
Jonathan Schweig, Math for America

The five year Math for America (MfA) Fellowship program is designed to attract, train and retain outstanding public secondary school math teachers. During the first year Fellows complete a full MA program that includes significant supervised student teaching experiences at an MfA Partner University and obtain initial New York State teaching certification. For the four remaining years of the program, the Fellows commit to teaching in a NYC public school. Currently, there are nearly 50 Fellows at a wide range of secondary schools throughout the five boroughs.

MfA deals with the challenge of increasing teacher's mathematical knowledge for teaching in a variety of ways. Fellows come into the program with a deep understanding of mathematics; many of the Fellows have degrees in mathematics or in other fields, such as engineering, that require extensive work in mathematics. However, they have limited pedagogical knowledge, and often struggle to find productive and appropriate ways in which to bring translate their extensive work in higher mathematics into their classroom teaching experiences. For this reason, during their year of full time study, MfA Fellows take mathematics courses based in mathematics departments, as well as an assortment of general education and mathematics education courses.

Throughout the Fellowship, MfA provides forums for Fellows to come together to improve their mathematics and pedagogy. These professional development sessions are lead by invited experts from the broad education community and by individuals from the Math for America community. They cover topics with a strong emphasis on connecting the mathematics learned in the university with the mathematics being taught in high school, and about ways in which to work in the intersection between the content and the pedagogy. A recent session covered the topic of combinatorics and discrete mathematics, and ways in which these subjects could be introduced into a high school curriculum.

The forums and social events for Fellows organized by MfA are part of our program to create a Corps of dedicated outstanding mathematics and science public secondary school teachers.

For MfA, the issue of mathematical knowledge for teaching is a distinctive one. It is not just a matter of equipping our Fellows with more knowledge; it is a matter of figuring out what kinds of knowledge are important, and ways in which to make that knowledge relevant to their professional lives. As we aim to create a program that has a profound impact on the shape of mathematics education, what kinds of mathematics knowledge should we be looking at? What kinds of questions should be asked during screening and selection to see if our Fellows have an understanding of math in a profound way? Is it enough to understand math procedurally? How important is it for someone to be able to understand how two different disciplines connect together, or to provide multiple representations for fundamental mathematical ideas? How can we create a program that encourages individuals who have had success in mathematics to hypothesize what mathematics looks like to a student that struggles?

Richard F. Voss, Florida Atlantic University
Guy Barmoha, Broward Public Schools
Markus Hohenwarter, Florida Atlantic University

The National Science Foundation sponsored Math Science Partnership Institute between Florida Atlantic University and the School Board of Broward County is designed around a new Master's degree program for Middle Grades teachers offered by the Dept. of Mathematical Sciences. Its goal is to provide a broad content background that emphasizes connections within mathematics such as between algebra and geometry as well as to other areas such as science and art. It relies on discovery learning, interactive technology, awareness of state mandated standards, and teachers teaching teachers to stimulate interest and motivation while enhancing pedagogy and content knowledge. We will describe our experience with this program from both faculty and teacher participant points of view.

A Mathematics Concentration for Pre-service Elementary School Teachers: An Existence Proof and New Conjectures

Phil Wagreich, University of Illinois at Chicago
Bonnie Saunders, University of Illinois at Chicago

For over 30 years the mathematics department at the University of Illinois at Chicago has offered a mathematics concentration for undergraduates who are preparing to become elementary school teachers (grades K-9 certification). A set of four courses has been designed to give students the opportunity to study a mathematical subject at the college level: geometry, number theory, calculus, and integrating mathematics and science. A significant feature of three of the courses is that students have the opportunity to practice methods of teaching. The current curriculum for one of these courses, Introduction to Calculus and the Graphing Calculator, centers on a collection of 150 questions that take the students on a journey through calculus while suggesting methods they can use to teach each other the subject. Student teaching activities include presentation of material, design of group activities, and assessment of both student and teacher performance. While answering these calculus questions, students come to see the many ways that middle school mathematics provides a foundation for further mathematical study

We offer this approach – practicing teaching while learning new mathematics -- as one possible way to increasing the content and pedagogical knowledge of perspective teachers. We also pose the question -- what is an ideal mathematics concentration and how would we know it if we saw it?

Mathematicians Writing for Educators: Collaboration Across Disciplines

Susan Jo Russell, TERC
Virginia Bastable, Mount Holyoke College
Sybilla Beckman , University of Georgia
Ben Ford, Sonoma State University
Deborah Schifter, EDC
Ana Vaisenstein, Boston Public Schools
Carol Walker, Boston Public Schools

This project involves mathematicians writing essays about mathematics for preservice and inservice professional development. Mathematicians and educators work jointly at writing conferences where mathematicians draft essays and receive immediate critique and feedback from classroom teachers and other educators. In an effort to learn more about what each community can offer the other in discussions of the teaching and learning of mathematics, the two communities consider together videotaped examples of students working on mathematics in classrooms. In two related MSRI workshop sessions, participants will hear about the project from a panel of mathematicians and educators, engage in thinking together about a video clip of a classroom, and then read and consider two essays written for teachers by mathematicians, each paired with a learning episode from an elementary classroom. Participants will read these brief essays between the Thursday and Friday sessions in order to be prepared to engage in the discussion on Friday. Note that the two sessions build on each other. We strongly encourage participants to commit to attending both sessions.

The Impact of Immersion in Mathematics on Teachers

Glenn Stevens, Boston University
Al Cuoco, EDC
Wayne Harvey, EDC
Ryota Matsuura, Boston University
Steve Rosenberg, Boston University
Sarah Sword, EDC

Over almost 20 years we have developed and refined an "immersion" approach to professional development, through our collective work in programs like *PROMYS for Teachers*, *Focus on Mathematics*, and the *Park City Mathematics Institute*. The approach is based on our belief that deep personal experience of doing mathematics in the spirit of exploration is a necessary prerequisite for developing what the National Academies have called a "mathematical disposition". Our presentation will describe a few of the experiences we have shared and will attempt to outline the ideas that have grown out of those experiences.   The afternoon workshop will offer participants an opportunity to personally experience, albeit briefly, a simple example of a "mathematical immersion." Key questions include: What is the impact on teachers of doing mathematics in "mathematical" ways?   What understanding of mathematics do we hope teachers will gain? Can/How can our particular approach to immersion be generalized and used successfully in other settings?   How does this approach affect the involvement of mathematicians in the work of mathematics education?

Learning Together: Implementing Inquiry-based Content Courses for K-20 Teachers of Mathematics

Ruth Parker, Mathematics Education Collaborative

This session will describe the content, pedagogy and assessment practices employed in a series of inquiry-based mathematics content courses that are part of the Greater Birmingham Mathematics Partnership. Fourteen college and university mathematicians, engineers and teacher educators have attend these 9-day courses alongside over 350 K-12 classroom teachers, and have worked with MEC instructors to study and assess teacher learning. External researchers and evaluators have studied the impact of the courses on teacher practice. The mathematics content courses model the content, pedagogy and assessment practices that GBMP hopes to see in K-20 classrooms.

Learning Mathematical Knowledge for Elementary School Teaching at the University of Michigan

Deborah Ball, University of Michigan
Wendy Aaron, University of Michigan
Hyman Bass, University of Michigan
Laurie Sleep, University of Michigan
Mark Thames, University of Michigan

Our course focuses on developing mathematical knowledge for teaching--that is content knowledge, but geared toward the ways in which our students will have to use mathematical ideas, skills, and instincts in the context of their work as teachers. The course centers on number theory and fractions, and develops students' skills with mathematical language, representation, and mathematical explanation, as well as awareness of the need for and value of precision. Although the course provides explicit practice in the mathematical skills needed for teaching, it is not a methods course, and explicitly avoids becoming one. In our presentation, we will describe the course territory, structure, and goals; show examples of problems, assignments, and tests; and discuss its successes and challenges.

The Mathematical Education of Elementary Teachers at Delaware

Dawn Berk, University of Delaware
James Hiebert, University of Delaware

A sequence of three content courses comprise the mathematics preparation for elementary teachers at U. of Delaware. Faculty and doctoral students serve as instructors for multiple sections of the courses each semester. For seven years, we have been studying and refining the content of the courses with the goal of increasing the likelihood that graduates will use what they learn to improve their own teaching of mathematics. We will describe and illustrate (with sample lessons, activities, problems, etc.) a few principles we have developed for guiding decisions about the content and pedagogy of mathematics courses for pre-service elementary teachers.

Teaching Teachers in a Research Mathematics Department

Heather Calahan, UCLA
Theodore Gamelin, UCLA

We discuss the program developed at UCLA for teaching future mathematics teachers. The main components of the program include a yearlong hybrid capstone/methods course for seniors interested in teaching and a Mathematics for Teaching major. Mounting such a program requires the collaboration of mathematicians and math educators to address the overlapping mathematical and pedagogical aspects of the mathematical knowledge required for teaching. The program is attuned to the special circumstances of a department whose primary focus is research and the training of graduate students. We discuss some of the problems encountered in developing such a program.

Content and Process in a Year-Long Capstone Sequence for Secondary Teachers

Dale Oliver, Humboldt State University

If the preparation of prospective secondary teachers of mathematics is to include a study of school mathematics, then attention must be paid both to particular content areas as well as the processes that connect these content areas. At Humboldt State University we've recently expanded our program of study of school mathematics from an advanced viewpoint from one semester to two semesters. The talk will include the motivation and details of the program as well as initial indications that the year-long sequence is a productive learning experience for our students.

Amy Cohen, Rutgers University

This talk describes a course for students in the fifth year of the Rutgers 5-year BA-MEd-Certification program for secondary teachers. It draws out explicit connections between upper-level math major courses required of future teachers and the high school content which is implicitly dependent on the college content. While some formal exposition is presented, students work extensively in groups on rich problems which guide them to recognize the connections and to present their results to the full class.

Two non-traditional content courses for in-service high school teachers at the Harvard Extension School

Bret Benesh, Harvard University
Thomas Judson, Harvard University
Matthew Leingang, Harvard University

We will describe two mathematics content courses at the Harvard Extension school for in-service high school teachers. We will begin by giving an overview of the Extension school's program for in- service high school mathematics teachers, and then describe two courses. The first course is a course on geometry, and is being taught in the spirit of the Core Plus and Connected Mathematics Project curricula. The second course is a probability and combinatorics course, and is being taught via the Moore Method. We will discuss the rationale for deciding to teach with these approaches, a specific description of these approaches, and the results of some informal evaluation for these two teaching approaches.

Using TIMSS videos for professional development

Richard Askey, University of Wisconsin

The TIMSS videos from 1999 are a rich source of information about teaching in seven countries, and can be used to help teachers learn what students in other countries are learning. A resource guide has been prepared to help professional developers use these CDs in their work with teachers.

The Mathematical Education of Elementary Teachers: Courses, Textbooks, and Opportunities to Learn

Raven McCrory, Michigan State University

The Mathematical Education of Elementary Teachers (MEET) project is an NSF funded study of undergraduate mathematics classes for prospective elementary teachers in two states – Michigan and South Carolina – and in New York City. MEET researchers are investigating undergraduate mathematics classes required for elementary certification. We have collected data from mathematics departments at 57 institutions and piloted and administered over 2000 assessment forms to students at 13 schools in 58 sections of mathematics classes of 43 instructors. We have also analyzed all the published textbooks written specifically for such classes. Our data include information about who teaches the classes, what topics are covered, and what students learn.

McCrory, who is the Principal Investigator on the project, will discuss initial findings from the project. Analyses suggest that these classes are little influenced by policy or certification testing, but may be strongly influenced by the textbook used. Most instructors in the initial sample are not familiar with key policy documents such as the CBMS publication *Mathematical Education of Teachers*. They rely on their textbook and also frequently use the NCTM 2000 standards as a resource for teaching.

Data about the number of courses required suggests that most undergraduate certification programs in these states now require 2 or 3 mathematics classes – the mean in this sample is 2.3. For middle school certification, these schools now require an average of 6.9 classes.

Other results address student (prospective teacher) learning, characteristics of students and instructors, topical emphasis in the classes, and instructor use of resources. McCrory will also discuss the conceptions of teachers mathematical knowledge reflected in current textbooks available for these classes.

What mathematics teachers need to learn about language

Judit Moschkovich, University of California, Santa Cruz

In this presentation I describe what mathematics teachers need to learn and unlearn about language and learning mathematics. The presentation builds on Wong Fillmore and Snow's piece (2002) "What teachers need to know about language," draws on research on language and learning mathematics, and focuses on language issues that are specific to learning and teaching mathematics.

A Mathematics Educator-Mathematician Partnership for Educating Teachers at Nebraska

Ruth Heaton, University of Nebraska-Lincoln
Jim Lewis, University of Nebraska-Lincoln

In 2000, we began teaching together as part of an NSF grant designed to strengthen the preparation of future elementary school teachers. As a result of the grant, all students in elementary education at Nebraska participate in *The Mathematics Semester*, a block of courses that integrates mathematics instruction with pedagogical instruction and field experiences. We will discuss our experiences in building a partnership between education faculty, mathematics faculty and mathematics teachers as well as our efforts to deepen our students' understanding of mathematics while connecting the mathematics they study to the tasks faced by an elementary school teacher.

A Mathematics Educator-Mathematician Partnership for Educating Teachers at Arizona

Cynthia Anhalt, University of Arizona
Matt Ondrus, University of Arizona

As part of an NSF-funded Center for Learning and Teaching (CEMELA), we were given a unique opportunity to co-teach a mathematics course in the area of algebra for a cohort of middle school teachers whose students were primarily English Language Learners. There was no syllabus for the course, we had recently finished graduate school (one of us in mathematics education and one of us in mathematics), we did not know the teachers, and we had recently met each other. The resulting semester was often very successful, occasionally somewhat frustrating, and always an incredible learning experience. We will discuss this course and some of the things we learned along the way, and the evolution of our relationship as instructors.

Reconceptualizing Mathematics: Curriculum Materials for Elementary and Middle School Teachers

Judy Sowder, San Diego State University

We have developed instructional materials for preservice and inservice teachers that lead them to learn mathematics in ways that will provide them with the content knowledge needed to teach mathematics well. The program is research-based, classroom tested, provides opportunities for in-class activities and discussions, motivates learners by providing examples of elementary student work, provides an abundance of assistance for instructors, and is in alignment with the CBMS *Mathematic Education of Teachers*, the NCTM *Standards* and *Focal Points*. Modules on Number and Quantity, Algebra and Change, Shapes and Measurement, and Chance and Data provide sufficient coursework for four semesters. W.H. Freeman is the publisher.

Mathematics for Elementary Teachers: A Focus on "Explaining Why"

Sybilla Beckman, University of Georgia

Everyone agrees that teachers should have a deep understanding of the mathematics they teach. But how can prospective elementary teachers begin to develop this deep understanding in college mathematics courses? This session will describe features of a textbook that aims to help prospective elementary teachers develop this deep understanding and will discuss the rationale for these features. The book focuses on explaining why the standard procedures and formulas of elementary mathematics are valid, why nonstandard methods can also be valid, and why other seemingly plausible ways of reasoning are not correct. The text is centered on activities that are designed to help prospective teachers reason about, explain, investigate, and discuss important ideas of elementary mathematics in class, often in multiple ways, and often by drawing explicitly on fundamental principles and ideas of elementary mathematics. Participants will try several activities during the session.

Learning and Teaching Linear Functions: Video Cases for Mathematics Professional Development

Nanette Seago, WestEd

This session will provide participants insight into the design and usability of the Learning and Teaching Linear Functions materials. These materials have been created for use by professional development facilitators in their work with grades 6-10 mathematics teachers. The major goals of these materials are to help facilitators to deepen teachers' mathematical knowledge for teaching, specifically related to linear functions.

Developing Mathematical Ideas: A Program for Teacher Learning

Deborah Schifter, EDC
Susan Jo Russell, TERC
Virginia Bastable, Mount Holyoke Colleg

Developing Mathematical Ideas (DMI) is designed to help K-8 teachers learn the mathematics needed for their teaching. Consisting of seven modules, each focuses on a particular mathematical theme (e.g., Building a System of Tens, Examining Features of Shape, or Patterns, Functions, and Change). By integrating the study of mathematics content with analyses of cases, both print and video, teachers are better positioned to interpret the mathematical conversations documented in the cases. At the same time, sets of cases allow teachers to see how the mathematics they are learning arises in different contexts with students of different ages. In this session, we will view a set of video cases and then discuss the mathematics the students are shown engaging in.

Professional Development: The Hard Work of Learning Mathematics

Hung-Hsi Wu, University of California, Berkeley

The most difficult part of a mathematics teacher's education is learning the mathematics. In this session, we will look at some of the knotty problems in K-12 mathematics.

GeoGebra: Open Source Software for Learning and Teaching Mathematics

Marcus Hohenwater, Florida Atlanic University
Guy Barmoha, Broward Public Schools

GeoGebra is a free multi-platform software that combines dynamic geometry, algebra and calculus in one easy-to-use package for mathematics education. Students from middle grades through college can use it in their classroom and at home. Educators may also create interactive web pages with this versatile tool (see http://www.geogebra.org). Supplement NSF grants have enabled the strong integration and continued development of GeoGebra as part of the NSF Math and Science Partnership Institute between Florida Atlantic University and the School Board of Broward County. Our intent is to increase the use and usefulness of GeoGebra within the entire math-science education community. Dr. Hohenwarter, the developer of GeoGebra, will provide an introduction to the software and discuss its underlying design principles and future directions. Guy Barmoha, one of our MSP lead teachers, will demonstrate some of the creative uses of GeoGebra in classroom situations.

Mentoring faculty and graduate students interested in teaching teachers

Sybilla Beckman, University of Georgia

The mathematical preparation of elementary teachers is a critically important duty of many mathematics departments, but mathematicians often find courses for elementary teachers difficult to teach. At the University of Georgia we have been developing a program to prepare *new* mathematicians---graduate students and postdoctoral fellows---to teach courses for prospective elementary teachers. We are finding that with suitable preparation and guidance, new mathematicians have an easier time learning to teach good courses for prospective teachers than do some of the older, more experienced mathematicians. (In contrast with old dogs, it seems you *can* teach new dogs new tricks.) A key feature of this program is that it is time-efficient. New mathematicians need time to establish themselves in mathematics research and they need some experience teaching standard math major courses. Another valuable feature of the program is that it allows new mathematicians to discuss elementary mathematics with new mathematics educators and new elementary teachers, which we hope will promote future interactions among mathematicians, mathematics educators, and teachers.

Studying the effectiveness of our efforts to teach teachers mathematics

James Hiebert, University of Delaware
Heather Hill, University of Michigan
Ken Gross, University of Vermont

Many commendable efforts to teach teachers mathematics are being described at this conference. As the professional community conducting this work, we can increase our own effectiveness as well as our credibility to others by studying our efforts and learning more about the conditions under which our efforts work well (and not so well). The panel members will propose an argument for the importance of this work, suggest some specific strategies for carrying it out, and provide an example of this work in practice.

A focused course on elementary mathematics for teachers

Thomas Parker, Michigan State University

This talk describes a mathematics course, designed by mathematicians, for prospective elementary teachers. I will describe three unique features of the course: the extensive use of the Primary Mathematics books from Singapore, the idea of a ``Teaching Sequence'', and the use of ``Teacher's Solutions'' in class and in homework. The goal of the course and its two textbooks (by T. Parker and S. Baldridge) is to present the mathematics clearly while keeping the focus directly on the material that elementary school teachers address, grade by grade, in their classrooms.

This approach overcomes many of the practical challenges that university mathematics departments face in teaching such courses.

Arithmetic for Prospective Teachers: How should we begin the road to PUFM?

Gary Jensen, Washington University

Liping Ma's book "Knowing and Teaching Elementary Mathematics" suggests that excellent math teachers strive for Profound Understanding of Fundamental Mathematics (PUFM). After years of teaching the math content course for the elementary education majors at Washington University, I began to write lecture notes for the course that would implement what I thought Ma was advocating in her book. I think that the path to PUFM begins with a careful review of elementary arithmetic as a rational set of ideas that are grounded in common experience and can be explained at every step. These notes became the text book, "Arithmetic for Teachers, with Applications and Topics from Geometry". In this talk I will highlight some of the details of this approach.

Incorporating English Learner Strategies in Mathematics Courses for Teachers

Judith E. Jacobs, California State Polytechnic University, Pomona
Greisy Winicki Landman, California State Polytechnic University, Pomona

Content courses for teachers can be a vehicle to model how teachers can address the needs of English Learners while reinforcing the content learning of the teachers. We will present a way of doing that begins with a theoretical framework and transitions to actual examples of practice.

Using extended mathematics tasks so as to increase teachers' mathematical knowledge for teaching.

Ann Shannon, Ann Shannon Consultants

In this presentation a selection of extended mathematics tasks will be shared. Their essential features will be identified and the importance of these discussed in terms of their potential to increase teachers' mathematical knowledge for teaching. Their usability and effectiveness will be explored through looking at various responses to the tasks.

What French Didactique can say to American mathematics educators

Virginia Warfield, University of California, Berkeley

Since the 1960's the French research field of Didactique of Mathematics has been growing and thriving. Recently its founder, Guy Brousseau, has directed some of the analytical tools and results from the classroom context towards the study of educational systems. Specifically, he has been concentrating on an area where the French and the Americans are undergoing highly similar controversies: the excessive use of testing. I will give a brief summary of the history and basic concepts of Didactique and then discuss Brousseau's current work.

Will mathematics ever make sense?

Alexander Givental, University of California, Berkeley

To most students, math is nonsense. We will try to assess those features of math education which cause this phenomenon. Focusing on early grades' math, we will try to illuminate the depth of the subject, and the frequent lack of teacher's "content knowledge" even at the level of grade K. We will outline a specific proposal how to improve the situation, indicate the role mathematicians should play in this, and describe available literature, including the book "Arithmetic for Parents" by Ron Aharoni recently published by "Sumizdat."

Foundation Mathematics for Teaching at the Elementary and Secondary Levels

Harold M. Murai, University of Kansas

What level of mathematics knowledge should teachers have for teaching basic mathematics, geometry and algebra? How should proficiency be defined? These are questions which should be addressed by decision makers concerned about the increasing need for qualified teachers of mathematics at the elementary and secondary levels. This talk is based on interviews of mathematicians and math educators.

Model Drawing: Connecting Arithmetic to Algebra

Dr. Mike Winders, Worcester State College
Dr. Richard Bisk, Worcester State College

This talk centers on the model drawing technique of solving word problems which is used in the mathematics curriculum of Singapore to help students make the connection between arithmetic and algebra. . We will introduce the general technique and demonstrate how it can be used to solve a variety of problems. We will also discuss the importance of providing elementary teachers with clear definitions and interpretations for concepts in K-8 mathematics.