

Annual Report for Period:02/2003 - 02/2004

Submitted on: 11/04/2003

Principal Investigator: Tucker, Alan C.

Award ID: 0230847

Organization: Math Assn of America

Title:

Preparing Mathematicians to Educate Teachers

Project Participants

Senior Personnel

Name: Tucker, Alan

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Moore, Lawrence

Worked for more than 160 Hours: No

Contribution to Project:

Dr. Moore's role has been reduced because website knowledgeable staff at the MAA headquarters and at the U Arkansas PMET office have been able to handle the initial website work fo the PMET project. His role may increase later in the project.

Name: Madison, Bernard

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Dubinsky, Ed

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Lewis, William

Worked for more than 160 Hours: Yes

Contribution to Project:

PMET regional coordinator and co-leader of Nebraska workshop

Name: Narayan, Jack

Worked for more than 160 Hours: Yes

Contribution to Project:

PMET regional coordinator and co-leader of Potsdam workshop

Name: Oliver, Dale

Worked for more than 160 Hours: Yes

Contribution to Project:

PMET regional coordinator and co-leader of California workshop

Name: Lien, Magnhild

Worked for more than 160 Hours: No

Contribution to Project:

PMET Regional coordinator

Name: Heaton, Ruth

Worked for more than 160 Hours: Yes

Contribution to Project:

PMET regional coordinator and co-director of Nebraska workshop

Name: Hirst, Holly

Worked for more than 160 Hours: Yes

Contribution to Project:

PMET regional coordinator and co-director of North Carolina workshop

Name: Royster, David

Worked for more than 160 Hours: Yes

Contribution to Project:

PMET regional coordinator and co-director of North Carolina workshop

Name: Stackelberg, Olaf

Worked for more than 160 Hours: No

Contribution to Project:

PMET regional coordinator

Name: Klarreich, Naomi

Worked for more than 160 Hours: No

Contribution to Project:

PMET regional coordinator

Name: Groman, Margaret

Worked for more than 160 Hours: No

Contribution to Project:

PMET regional coordinator

Name: Pearson, Mike

Worked for more than 160 Hours: Yes

Contribution to Project:

Project Manager at MAA Washington headquarters

Post-doc

Graduate Student

Undergraduate Student

Technician, Programmer

Name: Trzeciak, Tami

Worked for more than 160 Hours: Yes

Contribution to Project:

Project administrator at the PMET project office at U Arkansas

Name: Hetzel, Sandy

Worked for more than 160 Hours: Yes

Contribution to Project:

Project administrator at PMET Workshop Office at Kent State

Other Participant

Research Experience for Undergraduates

Organizational Partners

Other Collaborators or Contacts

PMET project personnel have collaborated with leadership of, or made presentations of meetings of, the American Statistical Association, the Association of Mathematics Teacher Educators, Educator Trust's National Association of System Heads, Project Kaleidoscope, and the New York State Department of Education and the New York Board of Regents.

Activities and Findings

Research and Education Activities: (See PDF version submitted by PI at the end of the report)

Four summer workshops for mathematics faculty to prepare them to educate future teachers.

Minicourses at the MAA's summer MathFest and the annual joint MAA/AMS national meeting in January 2004 (scheduled).

Presentations at: the MET II Summit, the TEAMS statistical education conference of the American Statistical Association, the Education Trust's National Association of System Heads, a SUNY-system Mathematics Education Conference. PMET mini-courses or panels are scheduled to be given at five MAA sectional meetings in early 2004.

Findings:

PMET is finding widespread interest among mathematics faculty in reworking courses for future teachers and adoption of the MET Report recommendations. In the initial round of 40 PMET mini-grant proposals, 6 were from research universities, 2 involved community colleges, 2 were from HBCU's and the rest were split between colleges and comprehensive universities.

Training and Development:

The PMET summer workshops trained 87 mathematics faculty to provide better mathematical instruction to future teachers.

Outreach Activities:

Collaboration with quantitative literacy initiative-- pending NSF proposal with Madison as co-PD.

Journal Publications

Books or Other One-time Publications

Web/Internet Site

URL(s):

www.maa.org/pmet

Description:

The PMET website has extensive information about PMET and its activities. In the coming year, materials for math professors from PMET workshops and other resources and website links will be added to make the PMET website a one-stop source for resources to enhance mathematics instruction for future and practicing teachers.

Other Specific Products

Contributions

Contributions within Discipline:

PMET's goal is promote improved mathematical education of teachers and raise the attention given to the mathematical education of teachers in the mathematics community. The PMET summer workshops and minigrants are supporting efforts by mathematics faculty to improve teacher education in their departments. PMET conference presentations, minicourses, and panels are increasing the visibility of mathematics education in coordination with other interested parties.

Contributions to Other Disciplines:

Contributions to Human Resource Development:

Improving the mathematical instruction in K-12 classrooms is perhaps the most important way to strengthen the future Science, Math, Engineering and Technology workforce in this country. International comparisons highlight the weakness of mathematical education of

American students. Employers cite the superior quantitative skills of workers in other Asian countries, along with lower labor costs, as a major incentive for exporting technology-based jobs to that part of the world.

Surveys consistently indicate that the U.S. public believes that a highly qualified teacher is by far the most important factor in improving K-12 education.

Contributions to Resources for Research and Education:

See earlier comments about website resources.

Contributions Beyond Science and Engineering:

Improving the mathematical education of teachers is critical to improving the mathematical instruction in schools which is critical to helping the U.S. maintain a workforce that is technical competitive in the 21 century.

Special Requirements

Special reporting requirements: None

Change in Objectives or Scope: None

Unobligated funds: less than 20 percent of current funds

Animal, Human Subjects, Biohazards: None

Categories for which nothing is reported:

Organizational Partners

Any Journal

Any Book

Any Product

Contributions: To Any Other Disciplines

PMET First-year Annual Report

Strengthening the mathematical education of America's teachers is the immediate goal of the project, Preparing Mathematicians to Educate Teachers (PMET). The primary lever for PMET in achieving this goal is to assist college and university mathematics faculty in providing better courses for future K-12 teachers. During the first eight months of PMET, 105 faculty have participated in PMET workshops, eighteen have attended a PMET mini-course, and numerous others have been encouraged to join PMET's effort.

An extensive series of workshops and mini-courses for college and university faculty is the central PMET activity and the first to get into full swing. However, the other three components -- information and resources dissemination, mini-grants, and regional networks -- are well underway. This report is in six sections, one for each of the major PMET components following an initial section on organization and ending with a section on budget.

PMET Organization

PMET was launched with a mailing to all 2-year, 4-year, and university mathematics department chairs that included copies of the full CBMS MET report and a copy of Liping Ma's *Teaching and Learning Elementary Mathematics*. At the same time, a letter announcing and describing PMET was mailed to all college and university chief academic officers inviting their support for mathematics faculty to participate in PMET. The PMET project office was set up at the University of Arkansas, Fayetteville and Tami Trzeciak was employed as PMET project coordinator. The PMET workshop office was set up at Kent State University and Sandy Hetzel was employed as workshops and mini-course coordinator. The MAA Washington Headquarters provided considerable administrative support of the initial workshop applications which arrived before staff were in place at Fayetteville or Kent State. An attractive first-contact pamphlet describing PMET was prepared and distributed widely. Copies will be distributed to all two-year and four-year college mathematics departments in MAA mailings this fall.

An attractive, informative PMET website was in place by July 2003 (see www.maa.org/pmet) with information about the various PMET programs and a handbook for workshop directors and regional coordinators. The website also has a variety of useful links for faculty to use as resources about the mathematical education of teachers. The website serves as a communication center for PMET leaders: various documents are posted there concerning operating workshops and mini-courses and with a password, the leaders access the information. An extensive handbook has been developed along with templates of various forms needed by workshop directors and applicants for the different PMET programs and all are available on the website. The Fayetteville office is building and maintaining the website, which includes collecting and sorting resources for posting and maintaining a calendar of events relevant to the mathematical education of teachers. The office is also managing all the mini-grant proposals, reviews, and records of each project and coordinating the activities of the PMET National Advisory Committee. The Kent State office will manage all the administration of the workshops and mini-courses, including managing the Workshops Advisory Committee.

The PMET National Advisory Committee (NAC) had its annual meeting in September in Chicago. NAC made a number of constructive suggestions which the PMET project leadership are attempting to implement. The minutes of that report are attached at the end of this file.

Faculty Development Workshops

The summer workshops are the central feature of the PMET project. While the proposal called for just three workshops in the first year of the project, a fourth workshop was added to maximize the initial impact of PMET. Despite very little time to publicize the initial PMET summer 2003 workshops (the grant only started in February), all four workshops met or exceeded their planned size of 20 participants. A total of 89 participants were in the four workshops.

Summer 2003 PMET Workshops

California (Arcata), June 15-21, led by Patrick Callahan. The workshop focussed on the Elementary level and the invited faculty were: Phyllis Chinn and Walter Stroup.

Nebraska (Lincoln), June 1-7, led by Ruth Heaton and Jim Lewis. The workshop focussed on the Elementary level and the invited faculty were: John Beem, Patience Fisher, Alfinio Flores, Michelle Homp, Ira Papick, Judy Walker, John Wolfe and Gordon Woodward.

New York (Potsdam), June 8-19, 2003 and June 6-17, 2004, led by Ed Dubinsky and Jack Narayan. The workshop focussed on the Secondary level and the invited faculty were: Dick Askey, Deborah Ball, Hy Bass, Jim Cottrill, Bryan Lee, Robin Lock and Rose Zbiek.

North Carolina (Boone), August 3-10, led by Holly Hirst, Mary Beth Searcy and David Royster. The workshop focussed on the Elementary level and the invited faculty was: Sybilla Beckman Kazez.

More information about the four summer 2003 workshops and their evaluation is attached as appendices. A mini-course was given at the MAA annual summer meeting, and another mini-course is scheduled for the annual winter meeting in Phoenix.

Workshop Publicity: Publicity and recruitment of participants for these workshops were conducted through articles in MAA publications, web announcements, trips to MAA Section meetings, messages on various email lists and personal contacts. Although the time period available was far shorter than is reasonable, all of the workshops filled up and the California workshop had more than twice as many applicants as available slots. A possible reason for this latter is that through supplemental funding, the leaders of this workshop were able to support the travel of participants. In any case, this overall strong response to what was a necessarily less than adequate publicity program suggests that what PMET is offering is being well received by the mathematical community.

Workshop Programs: The programs in the four workshops were varied and extensive. All workshops conducted demonstration classes with undergraduates preparing to be teachers so that participants could have a common experience on which to base their considerations of how students

think about mathematics. Participants worked with Workshop Faculty to design the sessions, then observed the sessions conducted by workshop faculty and finally discussed in detail what they had observed. Topics in the demo classes included arithmetic with fractions, quantitative reasoning, geometry and the concept of function.

Other workshop activities engaged in by some or all of the workshops included: studying the mathematical issues arising in K-12 teaching; discussions of the mathematical knowledge needed by K-12 teachers; work on mathematics content courses for teachers; study of theories of learning; teaching statistics; observation and discussion of pedagogical strategies; considerations of the similarities and differences between elementary, middle and secondary mathematics education; use of manipulatives and technology in the classroom; reading and discussion of curriculum materials, NCTM Standards and the MET report; consideration of the mathematics that arises out of the building and construction industry; interactions with local K-12 teachers; work on mini-grant proposals, capstone courses, and preparations for Intervening Year Projects (for the two-summer workshop).

Technology in Workshops: All of the workshops made extensive use of sophisticated calculators, generously provided on loan by Texas Instruments.

Workshop Follow-up: It seems to be a generally accepted principle (and there is some evidence) that workshop experiences are much more likely to have long-term, lasting effects if there is follow-up activity. Of course, the two-summer program at Potsdam with its intervening year projects has a built-in follow-up. The leaders are also conducting other follow-up activities and will continue them after their second summer in 2004. The workshop at Boone is having two meetings of participants during this academic year to report on their current activities related to PMET and to reflect on their PMET experiences.

Summer 2004 Workshops: Planning is well along for the eight scheduled workshops for next summer. The locations, leaders, and levels were announced in early October. The summer 2004 workshop leaders held a three-day planning meeting in mid-October at the MAA Washington headquarters; a similar meeting was held last April for the 2003 workshop leaders. Locations, dates and workshop leaders for next summer's workshops are all set, local planning for each is progressing, and draft schedules of activities exist. At this writing, the MAA Pacific Northwest, Southeastern, Allegheny, Metro New York, and Seaway sections have requested PMET sponsored mini-courses or panels at section meetings during the 2003-2004 academic year. More are expected as mini-courses and panels were offered to all MAA section officers at their meeting at MathFest 2003 in Boulder, CO, in August.

PMET 2004 Schedule of Workshops

For preparing future elementary teachers:

Humboldt State University, Arcata, CA - Phyllis Chinn and Dale Oliver, Leaders
University of Nebraska, Lincoln - Ruth Heaton and James Lewis, Leaders
Kent State University, OH - Michael Battista and Olaf Stackelberg, Leaders
State University of New York at Stony Brook - Kathy Ivey and Alan Tucker, Leaders

For preparing future middle school teachers:

Appalachian State University, Boone, NC - Holly Hirst and David Royster, Leaders
Bowling Green State University, OH - Thomas Hern and Barbara Moses, Leaders

For preparing future high school teachers:

University of San Diego - Maghild Lien and Perla Myers, Leaders

State University of New York at Oswego - Jack Narayan and Stephen West, Leaders

Planning is starting for the summer 2005 workshops. One will be held at an HBCU and one probably at a research university. There have been preliminary discussions about holding one at MSRI. Having a PMET workshop at a major research university or MSRI responds to the National Advisory Committee's concern that PMET needs greater visibility among research mathematicians.

Mini-grants

The initial round of PMET mini-grant proposals has been received in response to an RFP with a due date of October 15. The RFP set the range of funding for mini-grants at \$2000 - \$5000, although in reality, virtually all mini-grant proposals asked for the maximum of \$5000. Forty proposals were received from institutions in 23 different states. Two proposals were from HCBU's, two proposals involved two-year colleges, and six proposals were from institutions with doctoral mathematics programs. Of the rest, half were from comprehensive universities and half were from colleges. While it was anticipated that most mini-grant applications would come from summer 2003 workshop participants, half of the applications involved no workshop participants.

Each proposal will be given three reviews, one by a regional coordinator, one by Madison or Dubinsky, and one by Tucker. Tucker will coordinate the final assessment of each proposals, based on its three reviews. Members of the national advisory board will also be consulted for help in the reviewing. The Management Council will have the final say on how many awards to make and who will receive them. Decisions about the initial awards should be announced in mid-December.

At this writing, preliminary assessment of the 40 proposals indicates that about two-thirds of the proposals were judged worthy of consideration for funding by at least one reviewer. There was \$75,000 in the PMET budget each year for new mini-grants, each of which is funded for a period of 2 years. Since the mini-grant program was started late in the first year (proposals could not be due until at least a month in the fall following the initial set of summer workshops), mini-grant funds from the first and second years budgets could be combined to fund more than 15 mini-grants at \$5000 each. Also, the amount of the awards may be reduced from the amount requested.

Virtually all the proposals involved an honest collaboration of at least one mathematics professor, one mathematics education professor and one practicing teacher. Most of the proposals were for reworking existing courses in the foundations of elementary school mathematics or to create a course(s) in this subject. Happily, their goal was often to add a third such course, thus implementing the recommendation in the *MET Report* for three courses for future elementary teachers about the mathematical knowledge needed for offering high quality K-6 mathematics instruction. About half a dozen proposals were to develop a first such course at institutions where currently future elementary teachers' only mathematics requirement is a course such as

Intermediate Algebra or Mathematics for Liberal Arts. The objectives for new and reworked these courses reflected *MET Report* recommendations— (i) connecting mathematics closely with what is taught in the K-6 classrooms; and (ii) integrating mathematics and mathematics education viewpoints, what Lee Shulman termed ‘pedagogical content knowledge’.

The proposals aimed at secondary level teachers were typically about introducing a new capstone course for secondary mathematics teachers along the lines recommended in the *MET Report*. Some secondary proposals called for a major rethinking of many upper-division traditional mathematics major courses at institutions where most mathematics majors are future secondary mathematics teachers. The goal again was to align the content of these traditional courses more closely with content of secondary school mathematics. The proposals were acknowledging the failure, highlighted in the *MET Report*, of traditional mathematics major programs to instill a deep understanding of secondary school mathematics through some sort of ‘trickle down’ effect.

Given that the PMET project was the MAA’s initiative for disseminating the recommendations in the *MET Report* and supporting efforts to adopt them, the initial set of mini-grant proposals showed a very welcome acceptance of those recommendations and a collection of thoughtful approaches to implementing them.

Regional Networks

The core members of the PMET regional networks are supposed to be the project directors of mini-grants along with many of the workshop participants. All regional networks will become active in spring 2004 as the mini-grant projects get going and mini-grant directors begin sharing ideas about their projects. Planning has started for the initial mini-conferences of the regional networks.

One regional network, in New York, is already very active and the activities there will serve as examples of possibilities for the other regional networks as they become more active. The New York network, focusing initially on public institutions, was launched a year ago by the PMET co-director Alan Tucker in collaboration with the SUNY System Provost’s Office under the rubric of the SUNY Mathematics Education Task Force. SUNY has funded two one-day conferences in Albany that each attracted over 60 attendees. The network has formed three working groups: pre-service education, in-service education, and school-college articulation (SUNY has funded meetings of the leaders of the working groups). At a conference this October, the SUNY Provost announced plans to adopt within the SUNY system these recommendations from the working groups: (i) that all elementary level teachers should be required to take 9 credits of mathematics specifically focused on foundations of elementary school mathematics; (ii) that the Master’s degree required of elementary teachers for professional certification should require one course in mathematics; and (iii) that the state-mandated 175 hours of professional development every 3 years for practicing teachers should include 30 hours in mathematics for elementary teachers and 100 hours of mathematics for teachers who teach just mathematics. This later recommendation will be forwarded to the NY State Education Department, which just endorsed a similar recommendation for its Math A Panel (see below).

An ancillary goal of the PMET project is to help the college and university mathematics community become more engaged in K-12 education in America, re-establishing the constructive 'steady state' role of mathematicians in school mathematics that had existed for decades before the New Math debacle. Many of the PMET project personnel have been active in state systemic initiatives and other NSF and Department of Education projects to help schools. But the fact remains that most state education departments came to rely on school teachers and education faculty for input in designing school curricula in the later third of the 20th century.

New York is such a state, but recently, the PMET-SUNY network has developed very productive collaborations with the New York State Education Department (NYSED). A senior NYSED official was a featured speaker at the network's mini-conference in October. The PMET co-PD Alan Tucker played a leading role in a recent report that recommended totally restructuring the Regents Math A and other tests in parallel with greatly enhancing professional development in mathematics for teachers, i.e. higher standards for students must be matched with higher standards for teachers. The Board of Regents recently adopted all these recommendations which are closely aligned with the recommendations of the PMET-SUNY network which in turn closely follow the MET report. Mathematics faculty will have a major role in all aspects of planning and implementing the new NY K-12 mathematics standards and tests. The Regents called for a major state-wide university-school partnership for in-service and pre-service teacher training. Since the No Child Left Behind Act was modeled closely after the New York math and English testing program in grades 4, 8 and high school, these steps in New York are likely to be influential in other states that are just starting to develop the math assessments required by NCLB.

Information, Resource Dissemination and Collaboration

The project leaders have publicized PMET at a variety of conferences and presentations outside the MAA: the MET II Summit in Arlington, VA, on October 11-12, the MER Conference on Teacher Education, the American Statistician Association's TEAMS Conference on October 30-November 1, and The Education Trust's National Association of System Heads (NASH) annual meeting. Further presentations have been scheduled at the national meetings of NCTM and AMTE (Association of Mathematics Teacher Educators). The MER Newsletter has, and will continue to, publicize PMET workshops. A two-day workshop for Project NExT fellows is being discussed, to be co-funded by Project NExT and PMET. In Arkansas, discussions are underway for private funds to be used to fund an additional PMET-type summer workshop. With PMET encouragement, the Allegheny, Eastern Pennsylvania and North Central MAA sections are planning to have the mathematical education of teachers be the topic for their annual week-long summer short courses in 2004 or 2005. PMET is helping the organizers of these short courses identify speakers and is supplying supplemental funding to bring in guest lecturers.

Madison is also a co-project director of a pending NSF proposal about a national Quantitative Literacy initiative involving 12 collaborating organizations: MAA, NCTM, AMATYC, ASA, NASH, and five state higher education systems.

The previous section of this report discussed extensive collaboration between the PMET New York regional network and the New York State Education Department in reworking New York's K-12

mathematics curriculum and testing program. While it is hoped that other regional networks will have similar collaborations, PMET is also interested in collaborations with non-governmental projects to improve K-12 mathematics instruction. PMET leaders have been in discussions with the U Michigan-U Georgia Center for Learning and Teaching that is focusing on teacher professional development in mathematics. Bernie Madison has been a leader of the Quantitative Literacy movement that spans school and college education. He is project director on a large pending QL proposal to NSF that involves the Woodrow Wilson Foundation.

Through Ed Dubinsky, PMET has made connections with Bob Moses' Raising the Floor project growing out of Moses' highly praised Algebra Project. Moses will make presentations at several of the 2004 PMET Workshops and a PMET team will help develop the mathematical content component of the teacher training program in the Raising the Floor project.

Budget

The project is living within its budget and used some flexibility in funds to organize a fourth workshop in the first year to raise the visibility of PMET. Funds targeted at the initial round of mini-grants will be carried over to the second year because the first mini-grant proposals only came in during fall 2003 and by the time that award decisions are made, the first year of the PMET project will almost be over. Note that the mini-grant deadline could not be earlier because many of the mini-grant proposers were summer workshop participants who needed some time after the workshops to refine their proposals.

Evaluation

See the attached evaluations of the four workshops. The regional networks and mini-grants will be evaluated beginning next year.

PMET WORKSHOP REPORT, Arcata, CA, 2003

Name

Mathematics for Teaching Prospective Elementary Teachers

Dates

June 15-21, 2003.

Site

Humboldt State University, Arcata, CA.

Leader

Patrick Callahan

Faculty

Phyllis Chinn, Walter Stroup

Graduate Assistants

Amy Ellis, Mark Hoover, Debbie Junk

Participants

Names and emails

ap #	first name	last name	email address	institution
1	Cheryl	Carrera	carrera_cheryl@sac.edu	Santa Ana College
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24	Ginger	Warfield	warfield@math.washington.edu	University of Washington

25	Stan	Yoshinobu	yyoshinobu@csudh.edu	CSU Dominguez Hills
26	Joel	Zeitlin	joel.zeitlin@csun.edu	CSU Northridge

Demographic Information

17 females, 9 males; from 4 states(1 NE, 1 UT, 1 WA, 26 CA); 17 institutions.
12 with Ph.D. (10 math, 1 math ed, 1 biology), 16 with M.S. (12 math, 4 math ed)

Program

Activities

Three main components: the Lab Class (preparation, observing, analyzing, and discussion), Studying the Mathematical Work of Classroom Teaching, and Work on Mathematics Content Courses for Teachers. Woven throughout are theories of learning and issues of pedagogy. There are also special topics, like technology and calculators in the classroom.

Daily Schedule

Sunday, June 15.

- 8:00 – 3:30 Arrival and registration
- 3:30 – 5:30 Intorduction and Opening Session
- 5:30 – 6:30 Dinner
- 6:30 – 8:00 Framework for observing lab class, preparation for lab class

Monday, June 16.

- 7:00 - 8:00 Breakfast
- 8:15 - 9:00 Preparation for model class
- 9:00 - 10:45 Lab class, (intro, video clip “3/4 of 12”, work on representations of 3/4)
- 10:45 - 11:00 Break
- 11:00 - 12:00 Analysis of Lab Class (three groups, foci: mathematics, student thinking, teacher moves)
- 12:00 - 1:30 Lunch
- 1:30 - 2:30 Analysis of Lab Class continued
- 2:30 - 4:00 Discussion of Lab Class
- 4:00 - 5:00 Work on Mathematics Content Courses for Teachers (first day problems and activites)
- 5:00 - 6:30 Dinner
- 7:00 - 8:30 “Town Hall Meeting” Informal discussion of standardized and high stakes testing
- Evening Reflection and informal discussions.

Tuesday, June 17.

- 7:00 - 8:00 Breakfast
- 8:15 - 9:00 Preparation for model class
- 9:00 - 10:45 Lab class, (fractions and keeping track of the unit, the “Cookie Jar Problem”)
- 10:45 - 11:00 Break
- 11:00 - 12:00 Analysis of Lab Class (three groups, foci: mathematics, student thinking, teacher moves)
- 12:00 - 1:30 Lunch
- 1:30 - 2:15 Discussion of Lab Class (group reports)
- 2:15 - 3:30 Studying the Mathematical Work of Classroom Teaching (rescaling problems)
- 3:30 - 5:00 Hike in the Redwood forest
- 5:00 - 6:30 Dinner
- Evening Reflection and informal discussions.

Wednesday, June 18.

- 7:00 - 8:00 Breakfast
- 8:15 - 9:00 Preparation for model class
- 9:00 - 10:45 Lab class, (the “Bagel Problem”, fractions as division, role of units)
- 10:45 - 11:00 Break

11:00 - 12:00 Analysis of Lab Class (three groups, foci: mathematics, student thinking, teacher moves)
12:00 - 1:30 Lunch
1:30 - 2:00 Discussion of Lab Class (group reports)
2:00 - 3:30 Studying the Mathematical Work of Classroom Teaching (groups work on specific topics)
3:30 - 5:00 Work on Mathematics Content Courses for Teachers (problems of “coverage”)
5:00 - 6:30 Dinner
Evening Reflection and informal discussions.

Thursday, June 19.

7:00 - 8:00 Breakfast
8:15 - 9:00 Preparation for model class
9:00 - 10:45 Lab class, (division of fractions, and models of division)
10:45 - 11:00 Break
11:00 - 12:00 Analysis of Lab Class (three groups, foci: mathematics, student thinking, teacher moves)
12:00 - 1:00 Lunch
1:00 - 3:30 TI calculators, technology, and elementary mathematics (presented by Walter Stroup)
3:30 - 5:00 Trip to the beach
5:00 - 6:30 Dinner
7:00 - 8:30 “Town Hall Meeting” Informal discussion on technology and education
Evening Reflection and informal discussions.

Friday, June 20.

7:00 - 8:00 Breakfast
8:15 - 9:00 Preparation for model class
9:00 - 10:45 Lab class, (revisit reps of $\frac{3}{4}$, video clip “Shea #s”, definitions of even and odd)
10:45 - 11:00 Lab class students and workshop participants ask each other questions
11:00 - 12:00 Analysis of Lab Class (three groups, foci: mathematics, student thinking, teacher moves)
12:00 - 1:30 Lunch
1:30 - 2:30 Discussion of Lab Class (small groups), reflect on entire week
2:30 - 4:00 Studying the Mathematical Work of Classroom Teaching (role of definitions in elementary mathematics)
4:00 - 5:00 Discussion: instruments for measuring teacher content knowledge
5:00 - 6:30 Dinner
7:00 - 8:30 “Town Hall Meeting” Scientific research on education and NCLB
Evening Reflection and informal discussions.

Saturday, June 21.

7:00 - 8:00 Breakfast
9:00 - 10:30 Studying the Mathematical Work of Classroom Teaching (assessing teachers’ content knowledge)
10:30 - 11:30 Discussion: What have we learned? Where do we go from here?
11:30 - 12:00 Final remarks and reflections
11:00 - 12:00 Analysis of Lab Class (three groups, foci: mathematics, student thinking, teacher moves)
12:00 - 1:30 Lunch
1:30 DEPARTURE
Evening Reflection and informal discussions.

Evaluation

Evaluation forms provided by the PMET Evaluator, Peter Ewell, were distributed. Peter Ewell will submit a report and conduct follow-up activities.

PMET WORKSHOP REPORT, Lincoln, Nebraska, 2003

Name

Elementary Level Workshop, Lincoln, Nebraska

Dates

June 1-7, 2003

Site

Lincoln, Nebraska

Leader(s)

Ruth Heaton and Jim Lewis

Faculty

John Beem, Patience Fisher, Alfinio Flores, Ruth Heaton, Michelle Homp, Jim Lewis, Ira Papick, Judy Walker, John Wolfe, Gordon Woodward

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Demographic Information

12 females, 6 males; from 12 states; 11 universities, 7 colleges. 6 with Ph.D. in math, 3 with Ph.D. in math ed, 3 with EED in Math Ed, 1 with EED in Curriculum & Instruction, 4 with Masters in math, 1 with Masters in math ed.

Program

Observing and de-briefing demonstration class, discussions with student in demonstration class, using Deborah Ball videotapes to study practice. The Demonstration Class was taught by Ruth Heaton and Jim Lewis. Nine students who previously had been in the UNL Math Matters program taught by Heaton and Lewis were the students for the class. This provided an opportunity for

PMET participants to question the students about Lewis and Heaton’s mathematician – math educator partnership. During the Demonstration Class, Lewis taught portions of the *Quantitative Reasoning* module developed with NSF funding at San Diego State University by Judy Sowder and her colleagues. Heaton engaged the students in discussions that are typical of her math methods classes at UNL. This included some discussions of Deborah Ball videotapes.

In-depth discussion of the math – math education partnership at UNL, sessions on using technology (including Geometer’s Sketchpad and several TI calculators) in the mathematics education of elementary teachers, discussion of specialized mathematics courses and curriculum materials for elementary and middle level teachers, dinner and panel discussion with Roper Elementary teachers, assessment discussions (including materials from the Developing Teachers’ Knowledge for Teaching Mathematics Study at U. Michigan), work on mini-grant proposals.

Daily Schedule

Sunday, June 1, 2003 (Hewit Place, 1155 Q Street, 6th Floor)

5:00 p.m. – 6:00 p.m. Check In

6:00 p.m. – 7:00 p.m. Pizza dinner for participants and friends

7:00 p.m. – 8:30 p.m. Opening Activities

Lincoln, Nebraska, PMET Workshop Schedule, June 2 – 7, 2003						
(All workshop activities will be in 270 Mable Lee Hall Except Where Noted)						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
8:30 - 9:00 a.m.	Continental Breakfast					
9:00 – 9:30 a.m.	Welcome and Orientation	Participants’ Requests and A Look at Student Work			GeoSET at OSU John Wolfe	Modeling and ECR at UNL G. Woodward P. Fisher (until 11:30) Catered Lunch And More Videotapes
9:30 - 11:00 a.m.	Demonstration Class					
11:00 - 11:45 a.m.	Discussion of Demonstration Class and A Further Look at Student Work			More Videotapes		
11:45 - 1:15 p.m.	Lunch in Select Dining Hall					
1:15 – 3:00 p.m.	Using Videotapes to Study Practice	Algebra and Geometry for Middle Level Teachers Ira Papick and John Beem	Incorporating Technology in the Education of Elementary Teachers Alfinio Flores	Making Diversity Part of Teacher Education Alfinio Flores	Assessment: Connecting Mathematics Assessment to Teacher Practices	Assessment: (continued)
	A Look at Teacher Education			Using Videotapes To Study Practice		
3:30 – 5:00 p.m.	Linking Math to Teacher Education at Nebraska Heaton and Lewis			Using DMI materials in Summer workshops M. Homp	Number Theory for Elementary Teachers Judy Walker	Free Time
5:00 – 6:15 p.m.	Dinner in Select Dining Hall					

Evening Activities	Free time	7:00 p.m. Dinner with Roper Teachers Cornhusker Hotel	Free time	7:00 p.m. Work on MiniGrant Course Proposals	Free time	7:00 p.m. PMET Banquet Cornhusker Hotel
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Note: Each afternoon there was a break from about 3:00 to 3:30 p.m.

PMET WORKSHOP REPORT Potsdam, NY, 2003

Name

Teaching Future High School Teachers II

Dates

June 8-19, 2003. Dates for 2004 to be determined

Site

Potsdam, NY. Site for 2004 to be determined

Leader(s)

Ed Dubinsky and Jack Narayan

Faculty

Dick Askey, Deborah Ball, Hy Bass, Jim Cottrill, Ed Dubinsky, Bryan Lee, Robin Lock, Jack Narayan, Rose Zbiek

Participants

Names and emails

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Demographic Information

11 females, 14 males; from 14 states; 20 universities, 5 colleges.

13 with Ph.D. in math, 6 with Ph.D. in math ed, 4 with Masters in math, 1 with Masters in math ed, 1 EED.

Program

Activities

Preparation, observing and de-briefing model classes, presentations on mathematics arising out of K-12 teaching practice. These sessions focused on future teachers understanding of the concept of function including various representations of functions, seeing functions in a situation, using technology to deal with functions.

Preparation of capstone courses; readings and discussion on MET report and book of LipingMa; discussion of various learning theories, and preparation of intervening year activities, reflection and informal discussion.

Dick Askey gave an overview of his view of the mathematical knowledge that students coming out of high school (and therefore future high school teachers) should know. This included proofs of the Pythagorean Theorem, Ptolemy's Theorem, Fibonacci numbers, laws of sines and cosines, convex functions, Newton's method, odd/even functions, convex functions, geometric series, Pascal's triangle and recursive relations.

Deborah Ball and Hy Bass focused on issues in elementary teacher education that are also relevant to middle and secondary teacher education. Their main concern was the question: What mathematics knowledge is necessary for one to be an effective teacher.

Robin Lock introduced participants to a new way to look at teaching statistics, through dynamic data analysis. He used a software package called Fathom.

Bryan Lee demonstrated some of the mathematical issues that arise in building houses and other activities in the physical world.

Daily Schedule

Sunday, June 8.

- 1:00 - 6:00 Arrival and registration, Lehman Lounge.
- 6:15 - 8:00 Opening Dinner and Introductions, Thatcher.

Monday, June 9.

- 7:00 - 8:15 Breakfast, Union Court.
- 8:30 - 9:15 Preparation for model class, Dunn.
- 9:15 - 10:45 Model class, Jim Cottrill, Dunn.
- 9:45 - 10:00 Break, Dunn Hall, Room 217.
- 10:45 - 12:00 Discussion of model class, Dunn.
- 12:15 - 1:45 Lunch, Union Court.
- 2:00 - 5:30 Session conducted by Dick Askey, Dunn.
- 3:15 - 3:30 Break, Dunn Hall, Room 217.
- 5:45 - 6:30 Dinner, Union Court.
- 7:00 - 7:30 Meeting on Intervening Year Projects, Discussions of MET Report and book of Liping Ma, Ed Dubinsky and Jack Narayan, Lehman Lounge
- Evening Reflection and informal discussions.

Tuesday, June 10.

- 7:00 - 8:15 Breakfast, Union Court.
- 8:30 - 9:15 Preparation for model class, Dunn.
- 9:15 - 10:45 Model class, Jim Cottrill, Dunn.
- 9:45 - 10:00 Break, Dunn Hall, Room 217.
- 10:45 - 12:00 Discussion of model class, Dunn.
- 12:15 - 1:45 Lunch, Union Court.
- 2:00 - 5:30 Session conducted by Dick Askey, Dunn.
- 3:15 - 3:30 Break, Dunn Hall, Room 217.
- 5:45 - 6:30 Dinner, Union Court.
- Evening Individual meetings on IYPs, Jack Narayan
Reflection and informal discussions.

Wednesday, June 11.

- 7:00 - 8:15 Breakfast, Union Court.
- 8:30 - 9:15 Preparation for model class, Dunn.
- 9:15 - 10:45 Model class, Jim Cottrill, Dunn.

9:45 – 10:00 Break, Dunn Hall, Room 217.
10:45 - 12:00 Discussion of model class, Dunn.
12:15 - 1:45 Lunch, Union Court.
2:00 - 3:15 Capstone courses, set up project, Ed Dubinsky, Dunn
3:15 - 3:30 Break, Dunn Hall, Room 217.
3:30 - 5:30 Learning Theories, Jim Cottrill
5:45 - 6:30 Dinner, Union Court.
Evening Individual meetings on IYPs, Jack Narayan
Reflection and informal discussions.

Thursday, June 12.

7:00 - 8:15 Breakfast, Union Court.
8:30 - 9:15 Preparation for model class, Dunn.
9:15 - 10:45 Model class, Jim Cottrill, Dunn.
9:45 – 10:00 Break, Dunn Hall, Room 217.
10:45 - 12:00 Discussion of model class, Dunn.
12:15 - 1:45 Lunch, Union Court.
2:00 - 5:30 Teaching statistics, Robin Lock, Dunn.
3:15 - 3:30 Break, Dunn Hall, Room 217.
5:45 - 6:30 Dinner, Union Court.
Evening Individual meetings on IYPs, Jack Narayan
Reflection and informal discussions.

Friday, June 13.

7:00 - 8:15 Breakfast, Union Court.
8:30 – 12:00 APOS Theory, Ed Dubinsky, Dunn.
9:45 – 10:00 Break, Dunn Hall, Room 217.
12:15 - 1:45 Lunch, Union Court.
2:00 - 5:30 Teaching statistics, Robin Lock, Dunn.
3:15 - 3:30 Break, Dunn Hall, Room 217.
5:45 - 6:30 Dinner, Union Court.
Evening Reflection and informal discussions.

Saturday, June 14.

8:00 – 10:00 Breakfast, Lehman Dining Hall.
9:00 – 12:00 Discussion of MET Report, MA book, Ed Dubinsky, Lehman Lounge
12:30 - 1:45 Lunch, Union Dining Court.
Open - 6:00 Dinner, Union Dining Court.

Sunday, June 15.

8:00 – 10:00 Breakfast, Lehman Dining Hall.
11:00 - 5:00 Participants will spend the day at Pyrites, NY
(about 30 minutes drive from SUNY Potsdam) with
activities including a session on mathematics and
carpentry led by Bryan Lee, an educational walk
in the woods, and a cook-out.

Everyone will meet at Lehman Hall and travel by cars
in caravan led by Ed Dubinsky

Open - 6:00 Dinner, Union Dining Court.

Monday, June 16.

7:00 - 8:15 Breakfast, Union Court.
8:30 - 9:15 Preparation for model class, Dunn.
9:15 - 10:45 Model class, Rose Zbiek, Dunn.
9:45 – 10:00 Break, Dunn Hall, Room 217.

10:45 - 12:00 Discussion of model class, Dunn.
12:15 - 1:45 Lunch, Union Court.
2:00 - 5:30 Session conducted by Deborah Ball and Hy Bass, Dunn.
3:15 - 3:30 Break, Dunn Hall, Room 217.
5:45 - 6:30 Dinner, Union Court.
7:00 - 9:00 Session conducted by Deborah Ball and Hy Bass, Dunn.

Tuesday, June 17.

7:00 - 8:15 Breakfast, Union Court.
8:30 - 9:15 Preparation for model class, Dunn.
9:15 - 10:45 Model class, Rose Zbiek, Dunn.
9:45 - 10:00 Break, Dunn Hall, Room 217.
10:45 - 12:00 Discussion of model class, Dunn.
12:15 - 1:45 Lunch, Union Court.
3:15 - 3:30 Break, Dunn Hall, Room 217.
3:30 - 5:30 Attend IYP presentations from TFHS 1
5:45 - 6:30 Dinner, Union Court.
Evening Reflection and informal discussions.

Wednesday, June 18.

7:00 - 8:15 Breakfast, Union Court.
8:30 - 9:15 Preparation for model class, Dunn.
9:15 - 10:45 Model class, Rose Zbiek, Dunn.
9:45 - 10:00 Break, Dunn Hall, Room 217.
10:45 - 12:00 Discussion of model class, Dunn.
12:15 - 1:45 Lunch, Union Court.
2:00 - 5:30 Capstone Course reports, Dunn.
3:15 - 3:30 Break, Dunn Hall, Room 217.
5:45 - 6:30 Dinner, Union Court.
Evening Individual meetings on IYP, Jack Narayan
Reflection and informal discussions.

Thursday, June 19.

7:00 - 8:15 Breakfast, Union Court.
8:30 - 12:00 Reflections on the Workshops
12:15 - 1:45 Lunch, Union Court.
2:00 - 5:30 Individual meetings on IYP, Jack Narayan
3:15 - 3:30 Break, Dunn Hall, Room 217.
6:00 Closing Dinner

Friday, June 20 DEPARTURE

PMET NORTH CAROLINA WORKSHOP REPORT

Name

Mathematics for Elementary Education Teachers

Dates

August 3 – 10, 2003

Site

Appalachian State University, Boone, NC

Leaders

Holly Hirst, Mary Beth Searcy, and David Royster

Faculty

Sybilla Beckmann Kazez, Holly Hirst, Mary Beth Searcy, David Royster

Participants

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Demographic Information

Program

This workshop focused on mathematics content courses for elementary education (K-5) teachers. We examined several issues as foci for our discussions:

- The current state of elementary curricula - NCTM and State standards and NSF funded projects
- The differences in K-5 and 6-8 mathematics
- The current recommendations on educating teachers - Liping Ma book, MET Report and others
- The technology (computer and hand-held) currently available for elementary schools
- The manipulatives currently available for elementary schools

From that background, we examined as a group the following:

- What mathematics content should future elementary teachers know?
- What teaching methods should mathematicians try to use in these math content courses knowing that people often teach as they were taught?

Activities

Preparation, observing and de-briefing model classes. Sybilla Beckmann Kazez taught 3 one hour classes of 7 elementary majors “in the round”. The classes were observed by all of the participants. At the end of the class Dr. Beckmann-Kazez lead a discussion about the mathematics necessary to understand the concepts discussed that day. Lively discussions ensued.

Holly Hirst gave a presentation on NCTM’s *Principles and Standards of School Mathematics* (at the elementary level) and the AMATYC Mathematics Standards and led a number of discussions on the use of the TI-10, TI-15, and TI-73 calculators in the elementary and elementary education classroom.

David Royster led a discussion of the MET Report.

Participants were asked to read Liping Ma’s book *Knowing and Teaching Elementary Mathematics* and Holly Hirst led these discussions with the assistance of Mary Beth Searcy and David Royster. , preparation of activities for Fall 2003 Semester prior to follow-up meeting.

Mary Beth Searcy introduced the participants to *Fathom* (dynamical data analysis) and *Geometer’s Sketchpad* (dynamic geometry).

Sunday, August 3

- 1:00 – 7:00 PM: Arrival and check-in
- 7:00 – 9:00 PM: Reception and Introductions
Hand out Notebooks and Liping Ma book.

Monday, August 4

- 8:30 – 10:00 AM: Overview and Discussion of PSSM for K-6 and State standards for states represented
- 10:30 – 12:00 PM: Activities to highlight PSSM
Activities from some of the texts for K-6
- 1:30 – 3:00 PM: Discussion of MET Report on Elementary Education
Examples of Math for Elementary Education Curricula
Activities from texts
- 3:30 – 5:00 PM: Activities from Liping Ma
Liping Ma Discussion and Assignment

Tuesday, August 5

- 8:30 – 9:00 AM: Set the stage for class
- 9:00 – 10:00 AM: Teach class on Fractions
- 10:30 – 12:00 PM: Discussion of class
- 1:30 – 3:00 PM: Calculator and computer activities on number and operation – both calculators
- 3:30 – 5:00 PM: Discussion of technology and elementary education preparation

Wednesday, August 6

- 8:30 – 9:00 AM: Set the stage for class
- 9:00 – 10:00 AM: Teach class on Multiplication
- 10:30 – 12:00 PM: Discussion of class
- 1:30 – 3:00 PM: Calculator and computer activities on algebra – both calculators
- 3:30 – 5:00 PM: Continued discussion: Teaching Approaches

Thursday, August 7

- 8:30 – 9:00 AM: Set the stage for class
- 9:00 – 10:00 AM: Teach class on Geometry and Measurement
- 10:30 – 12:00 PM: Discussion of class
- 1:30 – 3:00 PM: Calculator and computer activities on geometry and measurement – both calculators
- 3:30 – 5:00 PM: Continued discussion: Assessment Approaches
Liping Ma Discussion
Introduction to *Geometer's Sketchpad*

Friday, August 8

- 8:30 – 10:00 AM: Probability and Data topics
- 10:30 – 12:00 PM: Calculator and computer activities on probability and data -both calculators
- 1:30 – 3:00 PM: Discussion of Elementary Education Program structures (UNC Charlotte, Appalachian State University, others)
Discussion of Middle Grades Education versus Elementary Education
Introduction to *Fathom*

3:30 – 5:00 PM: Discussion of modes of teaching: lecture, physical and virtual manipulatives, calculators

Saturday, August 4

8:30 – 10:00 AM: Break out groups: Discuss and then share with the group ideas on coverage of the 4 areas
Hands-on activities for probability and data

10:30 – 12:00 PM: Breakout group presentations: Discussion

1:30 – 3:00 PM: Participant work time: Prepare something to use (Syllabus, Activities, Lessons, etc)

3:30 – 5:00 PM: Participant work-time

Sunday, August 4

8:30 – 10:00 AM: Participant Presentations

Summary of PMET National Advisory Committee Meeting 09/28/03 Chicago O'Hare Hilton

NAC Members Present: Richard Askey, Richelle Blair, Ronald Graham, Kati Haycock, Jeremy Kilpatrick, Dale Oliver, Richard Scheaffer, Annie Selden, Tina Straley, Zalman Usiskin, Irvin Vance, Hung-Hsi Wu

NAC Members Absent: Richard Schaar

PMET Personnel Present: Bernard Madison (co-Director), Ed Dubinsky (Workshops Director), Michael Pearson (Project Manager), Tami Trzeciak (Project Coordinator)

Bernie Madison opened the meeting at 8:30 am welcoming attendees and conveying Alan Tucker's regrets that he is unable to attend. Bernie gave a brief history on the origin and planning for PMET, and emphasized that the issue of diversifying the participation in PMET was one on which PMET personnel wanted advice and suggestions from the NAC. The discussion then approximately followed the prepared agenda, as below.

A. Introductions

B. Discussion of Reports

- PMET Project Structure
- Evaluation
- Workshops
- Mini-courses
- Networks
- Mini-grants
- Information Dissemination and Collaborations

C. Consideration of the following questions and others as suggested by Committee members:

- 1) How might PMET *influence* the mathematics community to speak more constructively on areas of teacher education while respecting differing viewpoints?
- 2) How can PMET *involve* a wider range of (research) universities in the issues being addressed by the PMET project? How can we convince our mathematics colleagues that the education of teachers is a critically important and worthwhile activity for departments?
- 3) How can PMET *increase* awareness in the mathematics community of the need to make changes in the content and pedagogy of courses for future teachers?
- 4) What are *important organizations and projects* that could strengthen, or profit from, the PMET regional networks?
- 5) What are good *avenues for publicizing or leveraging* PMET's efforts?
- 6) What does a *mathematician* need to know or be able to do in order to be considered prepared to educate teachers?

D. Other activities that PMET might sponsor or co-sponsor, e.g. a conference for faculty working on the mathematical education of teachers.

E. Summary of recommendations from Advisory Committee

PMET Project Structure

The report at the top of the agenda was the text of an article written by Bernie to appear in November 2003 MAA *Focus*. The content of article was sent by email to all NAC members two weeks prior to the meeting and also included in the meeting packet.

Specific suggestions by NAC for PMET Project Structure:

- (1) Break PMET activities down, to get more people involved in the pieces.
- (2) When listing workshops in article/web site, also list the institutions where workshops are held, not just the city and state.
- (3) Include research mathematicians on the Workshops Advisory Committee.

PMET Project Evaluation

PMET Project evaluation is under the direction of Peter Ewell, Vice President of NCHEMS (National Center for Higher Education Management Systems, website <http://www.nchems.org>). Peter Ewell is a political scientist by academic credentials. He is one of the most prominent consultants for higher education issues in the world and he has long been involved in issues of assessment, evaluation, and management of higher education systems. He has been a consultant to hundreds of institutions. Bernie has known Peter as the evaluator for the NSF-supported MAA project, Supporting Assessment in Undergraduate Mathematics. Peter's evaluation in that and other projects has been both helpful and formative. The evaluation helps keep us focused on the project; it highlights what is important. Both Bernie and Ed feel that Peter's work with them on PMET is constructive and worthwhile.

In discussing "Characteristics of Effective Departments," the evaluation report referred to a "Steering Committee." Questions were raised about who is the "Steering Committee" and are these "characteristics" being compiled. The "Steering Committee" referred to is technically the Management Council and consists of the PMET PIs and Regional Coordinators. Both the "characteristics" and a mention of "inventory of important features" were of interest to the NAC members and some asked that these be made available. This effort is ongoing, in its early stages and not yet in any form for distribution.

Questions were raised about the sample in an e-mail survey of departments. In particular, were two-year colleges included? The answer is yes; the sample was stratified by kind of institution.

There was extended discussion regarding purpose and goal of PMET project evaluation. The immediate goal of PMET is the preparation of college and university faculty for the mathematical education of teachers. The long term goal of better mathematical education of students, which cannot be measured in the lifetime of this grant. Questions were raised about the time frame of the evaluation. NSF funding requires evaluation within the life of the grant, not follow-up. We hope to extend beyond that. Perhaps someone could design an evaluation of students after this project. The question becomes "who" are the subjects of the evaluation. Are the subjects the mathematicians you are preparing, the teachers the mathematicians are teaching, or the students the teachers are teaching? In the case of the immediate evaluation, it is the mathematicians.

Comments on the evaluation from NAC members:

The evaluation should be designed to measure substantive, significant changes in the ways these mathematicians teach future teachers, a qualitative evaluation.

After the MET report, all of the CBMS organizations were asked to sponsor organized projects that responded to the MET report at all different levels / audiences. The MAA's purpose is to stay

focused on the undergraduate mathematics education. This project has the hope to actually make inroads in the culture and raise the public awareness of college and university faculty in the importance of teacher education as part of their mathematics programs.

PMET should offer solution, not assessment. Teach fractions in a more mathematically correct way.

PMET's focus is on preparing mathematicians – to increase the numbers involved. It is different from a focus on curriculum. Goals of PMET: teach the math we teach in our courses and model better teaching there. PMET is a synthesis of all these comments: to make changes in mathematics and the way in which it is taught.

A statistician would approach this as a research study: How to select who does what in which workshop? State basic research questions and then make a scientific comparison of A versus B.

How to attract research faculty: Pose an interesting question to statisticians—can we design a study to figure out how to do this? A question such as this, well phrased, would attract research colleges.

Specific suggestions by NAC members for PMET project evaluation:

- (1) Involve mathematicians in any evaluation of PMET. (NAC members were invited to suggest mathematicians who would be candidates for involvement in evaluation.)
- (2) External evaluator should attend the NAC meeting(s). (Peter was invited, but had a schedule conflict.)
- (3) Design various kinds of workshops and compare the results.
- (4) Include “Resources” as posted on the website in the evaluation
- (5) This appears to be a general evaluation of the workshops. Can we have specific reports from workshops? (Ed will send the reports from the individual workshops.)

NAC members Ron Graham and Jeremy Kilpatrick are members of an NSF panel that is looking at ways to make the evaluation of NSF projects more meaningful. They stated that many of the concerns expressed about the PMET evaluation are concerns about most evaluations of NSF projects. The possibility of asking for a supplementary grant to extend the evaluation of PMET beyond the four years of the current project was viewed favorably.

PMET Workshops

Comments from NAC members:

Question: Will PMET be comfortable with a Big 10 approach to different views on mathematics education?

A suggestion was made to read beyond the MET report when some of the teaching vignettes are exactly the same. In *Adding it Up* there are examples of elementary school teaching that are not all the same.

If you want research universities involved in PMET, it is very important to have some research mathematicians involved in the Advisory Committee for the Workshops.

The schedule of workshops does not indicate the University, but indicates cities and towns. If you are trying to enlist universities or institutions to get involved, one way you do this is by giving them names of other universities that are already involved.

Question asked about what have we learned from the workshops that have already taken place, and how can we go forward? Ed Dubinsky reported that we have learned several things:

- 1) It is difficult to convince participants that the purpose of the workshop is not to gain specific information, projects activities that they can take back home and begin to use in their very next courses, although there is a certain amount of that.
- 2) It is possible to convince them to re-think in a profound way 'how to teach teachers.'
- 3) The demonstration course is very effective.
- 4) It is difficult (but possible) to get participants to work very hard for more than 4-5 days. (There is resistance to longer workshops, longer than 4-5 days, from participants and from workshop leaders; the norm in higher education seems to be 2-3 days. PMET leaders believe that longer workshops are more productive.)
- 5) Lectures by mathematicians do, in fact, work.
- 6) There are lots of variations in format and structure for workshops and these variations are being tried.
- 7) Start advertising and recruiting efforts earlier than Feb. 1. (During this first year we struggled with a short time frame, but for the coming year we have already begun and we are able to be more deliberate and thorough.)
- 8) Pay attention to individual workshops. (Ed will have time to that this year as he will not be conducting a workshop himself. He can focus on the details of individual workshops for '04.)

There was discussion about the gaps in workshop participants' mathematical knowledge. Is there a way to document the knowledge of people attending workshops in a non-threatening way so that we can know where the gaps are?

If we have ideas on the mathematics that teachers need, then we can address that in future workshops.

Make a requirement that workshop leaders provide materials to make them available to a wider audience, both on-line and in book form. (This is a sub-project of PMET: compile mathematical examples/topics out of the workshops that are not adequately covered in undergraduate education of future teachers. Ed would like to find someone to work on this, so that a serious list may be

compiled by summer 2004 to be used in 2005 workshops and to look for connections.) There is a difference in how mathematics majors think and how other students think. Mathematics majors tend to think in logical sequences, many non-mathematics majors do not. This effects the way in which teachers teach mathematics topics and courses.

How and what is the process for selecting workshop topics & leaders? (According to PMET proposal, recommendations are sought from various sources – from last years leaders, NAC suggestions, announcements at MAA section meetings for topics and leaders, joint workshops / short courses.)

What is the demand for workshops? (In spite of the short time frame for '03, all 2003 workshops were filled, and we expect to fill the '04 workshops as well.)

Has Mathematics and Education Reform (MER) been contacted, for publicity, etc. to advertise workshops in their newsletters? Those are people who profess to be interested in reforms such as those of PMET. (We have talked to MER about a cooperative workshop. We are on their special session in Phoenix.)

There was discussion about what motivates people to come to workshops when they have other career pressures. Many times it is the new person in a mathematics department that is assigned to teach mathematics education courses, and they are concerned about doing their research, earning tenure, and now they have this assignment to teach future teachers. One of the primary reasons for the workshops, and the resources, and the mini-grants, is to give these people help. They need help, they say they want help, and we have to make sure we are giving them that help in the way that they need it and can use it. The reason for coming to these workshops doesn't have to be altruism. This is the pipeline to the future of mathematics in the country, for all mathematics departments. There is a regional reason as well: programs for preparation of teachers at the state level tend to change a lot and departments are always re-thinking how they are going to react to those changes; that motivates people to get together and find out how other faculty and institutions are going to deal with these issues, i.e. No Child Left Behind. The PMET workshops might be a great opportunity to do that. Having workshops respond to regional needs, to state needs is another draw. Many of these motivations are most strongly felt at smaller institutions or comprehensive universities or community colleges where there is a concerted effort to respond to these needs. But like Project NEXT, there isn't much involvement from research institutions. Could we ask the members of our NAC who are in research universities to help us recruit participants from their departments? Target community colleges (30% of Elementary Education teachers are from community colleges). Those participants might more readily come to a workshop as opposed to research mathematicians who don't teach many of the future teachers.

In February '03, the University of Arizona had a conference on "Educational Work in Mathematics" and they have a list of people who are interested in educational work and a list-serve of these people. You can get the list from Bill McCallum at the University of Arizona. Would you like suggestions from the NAC for faculty participation? (Yes.)

Specific suggestions by NAC for PMET Workshops:

- (1) Involve research mathematicians on the Workshop Advisory Committee.
- (2) Require that workshop leaders provide materials to make them available to a wider audience.
- (3) Contact MER, and other groups, for publicity, etc. in their newsletters.

- (4) Target community colleges, smaller institutions responding to state/regional changes.
- (5) Hold a workshop at an elite research university for national exposure.
- (6) Get list-serve from Bill McCallum at University of Arizona.

Regional Networks and Mini-grants

Clarification was requested on funding of mini-conference and awarding of mini-grants. In each of 5 regional areas, there is money allocated for a mini-conference. Where is the expectation stated that leaders will attend a mini-conference, is there an MOU with the leaders that they must attend a mini-conference? (No MOU; expectation is stated in mini-grant information. Leaders and mini-grant awardees should attend a mini-conference or an alternative, there is some flexibility we can work with them on where/what they attend.) Where does travel funding come from? (That comes out of the general travel budget.) How are awardees chosen? What about mini-grant awardees from outside the region vs. inside the regions? (Criteria for choosing has not been specified that finely, but no one is excluded.)

Question on the regional networks are defined as being 'initially' in the five regions / states. How long is 'initially'? Do you intend to expand? (Yes, we'd like to move in that direction, and have workshops outside the regions.)

Plan a certain number of mini-grants and encourage other funding, which is getting harder to come by. Is the number and amount set? (No, the number of mini-grants is not set. The amount is \$ 2,000 to \$ 5,000 with the possibility of a 2nd year.)

Specific suggestions by NAC members for Regional Networks and Mini-grants:

- 1) State expectation for workshop leaders and mini-grant awardees to attend mini-conference in MOU.
- 2) Plan a certain number of mini-grants and encourage other funding.

Information and Awareness Activities, Web Site

Discussion centered around criteria to use for selecting materials for posting. Should we screen or not screen for mathematical content of resources? Some members of the NAC stated that resources that are flawed "beyond the pale" should be removed from website, and an example was cited. Other members suggested the resources remain on website with added comment(s) from NAC member on deficiency of an item. Bernie stated that we are trying to determine posting guidelines for the PMET web site and that this opens up possibilities of linking to / posting something that is flawed as an appropriate recommendation for mathematical education. Should the PMET web site be "informational" or discriminating? "Some members preferred informational, screen only for 'taste,' and not for intellectual content, with comments from NAC, rather than not having the item there at all.

Suggestions by NAC for Information and Awareness Activities, Web Site:

- (1) What goes up on the web site should be based on what is does, not what is doesn't do.
- (2) Before posting a resource/article, run it by the NAC for advice, with, for example, with a 10 day response time frame.
- (3) If there are numerous examples of kinds of postings, then various postings with perceived deficiencies will be less troublesome. If a posting is relatively unique and is seen as flawed, then that is more of a problem.

Consideration & Discussion of Questions / NAC responses

How might PMET influence the mathematics community to speak more constructively on areas of teacher education while respecting differing viewpoints?

- (1) Take certain issues and make them interesting. Pose a problem / solution, and ask for input.
- (2) Pose issues as research questions to attract interest. Articulate key questions to focus on, not broad questions.
- (3) Involve and invite research mathematicians to speak at workshops
- (4) Breakdown the problem—gifted students, minorities, geometry students vs. mathematics education as a whole, then it might be more inviting.

What are important organizations and projects that could strengthen or profit from the PMET regional networks?

- (1) Work with leadership to provide introductory work, Project NEXT. (NAC members, if you can help on this please contact Ed Dubinsky)
- (2) In Wisconsin, those who teach college courses for elementary teachers meet each spring; such groups probably exist elsewhere.
- (3) NCTM has research groups. Contact Joan Ferrini-Mundy.
- (4) State coalitions and NASMC. Bill Steenken (Ohio, Retired from GE) is NASMC chair.
- (5) Mathematics Teaching and Learning Centers (MTLC) in Georgia and Michigan are planning an institute the summer of '04. (NAC members, if you will help on this please contact Ed Dubinsky)
- (6) CTL funded on curriculum at Missouri, Michigan State, and Western Michigan to write monographs on curriculum for K-12.
- (7) MAA sections are a natural way to reach people.
- (8) HBCU—Leon Woodson, Jack Alexander.
- (9) AMATYC, two-year colleges list. Rikki Blair has email addresses.
- (10) Dale Oliver reported that we have a panel presentation for PMET at AMTE's meeting.
- (11) Is networking for all these different groups happening somewhere? MSPs are supposed to meet once a year; there is a definite need to coordinate. MAA/NSF could develop a coordinating grant!
- (12) MSEB (Carole Lacampagne)
- (13) NAM

What are good avenues for publicizing or leveraging PMET's efforts?

- (1) State meetings of Chairs can be very effective. Get their attention at a national meeting.
- (2) Postcards to every member, by 'name' not generic title.
- (3) There is a chair meeting at AMATYC Nov.12-13 and another at the ASA meeting in October at the University of Georgia.
- (4) Advertise in the mathematics organizations' publications and newsletters.
- (5) List-serve via internet.
- (6) Dean's meetings / Influence at the administrative level.

What does a mathematician need to know or be able to do in order to be considered prepared to educate teachers?

- (1) Consider how the pre-service teachers think about mathematics concepts and how their students think. There are good videos available on this from Carolyn Mar and Deborah Ball. (There are confidentiality issues with using the videos and many are copies of copies and not good quality.

The same purpose is served with the demonstration course, which brings in education students to see an actual classroom.)

- (2) Perhaps we could change one word in the question and make it—“what does a mathematician need to see...” Get them out into a real classroom. The Potsdam workshop had 5 local teachers talking to mathematicians, it went very well. Can the scope of the project, or mini-grants, do this? Yes, to an extent.
- (3) Many students in K-12 never get to college...the kinds of explanations for even the slowest college student won't work for some K-12 students; the logical explanation or saying it slower, or louder, doesn't help these students. There are 3 kinds of things 1) skills: which are algorithms, 2) mathematical concepts: definitions of something, and 3) applications: solving a problem.

How can we bring more diversity in the people of PMET?

A major part of diversity for PMET is including people of color as participants and leaders. Currently PMET diversity is satisfactory on gender at all levels and not so bad on type of school (2 year / 4 year); we've had only one black faculty, none for workshop leader, and few participants of color. We still have openings for faculty visitors at workshops; it would be good to utilize those for diversity.

Specific suggestions from the NAC on bringing more diversity to PMET:

- (1) Get Liping Ma to speak at workshop.
- (2) Look at data on teacher education at HCBUs.
- (3) Write to minority institutions. Encourage participants and ask these colleges to host a workshop.
- (4) Ask workshop participants of color for recommendations of future participants, etc..
- (5) HSSIs and HBIs should be specifically targeted for recruitment.
- (6) Ask NAM for faculty recommendations.
- (7) Reach out actively to involve research institutions.
- (8) Seek supplemental funding for travel; this is necessary for involvement of many minority faculty members.
- (9) Hold workshops in large, urban universities and urban community colleges. Examples: Clark Atlanta, CUNY campuses, and Maricopa Community Colleges.
- (10) Suggestions of persons to ask for help and advice included Michael Bleaker, Sadie Bragg, David Blackwell, Bill Velez, Manuel Berriozabel, and the CUNY Chancellor.
- (11) The MET Summit II in Arlington VA on October 11-12 will have many HBCU faculty in attendance. NAC Member Irving Vance is directing this Summit and both PMET co-Directors are on the program.
- (12) October 16 is the Workshop Leaders Conference. NAC members were invited to send suggestions for minority workshop faculty.
- (13) Engineering and Chemistry associations network very well. Ask them how they do it.

Item D: Other activities that PMET might sponsoring or co-sponsor / a conference for faculty working on the mathematical education of teachers?

- (1) Invite the best people (leaders, mini-grant awardees) from workshops to make presentation at conference.
- (2) Have a conference of workshop participants.
- (3) The mini-grant conference is an avenue for this, make it as public as possible –like it was a contributed paper session or national meeting.

(4) Less on presentations, more on study, a working conference.

Other questions/comments:

The number of bachelor degrees in mathematics has dropped dramatically. There appears to be no sense of urgency; why isn't the discipline concerned?

The problems that PMET is attacking seem to be broader in college mathematics. How do we attract more mathematics majors? The culture is this: "Mathematics is eternal and unchanging... failing is normal... we don't have to change what we are doing... it is the same now as in ages past." It is very hard to change this culture and attitude. There are characteristics of some (but not all) those who teach mathematics, a certain arrogance, as to what is wrong – all the reasons why it's wrong, but not the way they are teaching. There are pressures on middle school / high schools to teach areas not taught before to students they've not taught it to. Mathematics departments are not getting the numbers of honors students as before. They go to computer science or engineering. Bright kids go in to other areas, which develop their own mathematics, for example, mathematics for engineers. Many mathematics faculty, when approached about tailoring courses for teachers, say it doesn't work, that they "water down the math." There is very strong resistance to change in mathematics faculty. That is why engineering faculty teach their own mathematics.

Do you want to encourage people to be mathematics majors when there are no jobs out there?

There needs to be a connection from mathematics major to job/career. This is difficult. There are very few readily identifiable jobs for mathematics majors. Michael Pearson researched jobs and careers for mathematics majors and wrote a brochure with a listing of jobs. The response to this: 85,000 of these brochures have been pre-ordered, more than twice the original printing!

There is powerful technology that can do mathematics now. Some universities don't allow use of the technology; this puts some mathematics majors at a disadvantage if, when applying for jobs, they have no, or little, experience with the technology as compared to students that do have that experience.

When will this committee meet again? The National Advisory Committee will meet at least once each year. We would like to meet earlier next year (2004), perhaps in the spring. The NAC members expressed satisfaction with the arrangement of a one-day meeting at a major airport hotel.