

**Annual Report for Period:**02/2007 - 01/2008**Submitted on:** 01/31/2008**Principal Investigator:** Tucker, Alan C.**Award ID:** 0230847**Organization:** Math Assn of America**Submitted By:****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, J Michael

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Ivey, Kathy

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Dr. Ivey ran several PMET summer workshops in 2004, 2003, and 2006.

**Name:** Evans, Joan

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Dr. Evans ran a 2-summer PMET workshop at Texas Southern University

**Name:** Callahan, Patrick

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Dr. Callahan ran PMET workshops in California and Utah

**Name:** Knight, Genevieve

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Dr. Knight organized a PMET workshop in summer 2006

**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 Mathematical Society, the American Statistical Association, the Association of Mathematics Teacher Educators, Educator Trust's National Association of System Heads, and Project Kaleidoscope. PMET is collaborating with the Common Ground initiative of Richard Schaar from the Business Roundtable and funded a Common Ground conference last March. PMET is collaborating with the Park City Mathematics Institute in running workshops at PCMI for mathematicians interested in improving school mathematics instruction.

In 2007, PMET collaborated with the Numeracy Network, led by Lynn Steen and Bernie MARDison

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

Organizing a workshop at Wingspread Conference center about quantitative literacy in college.

Organizing a workshop at the Univ. of Michigan School of Education of leading mathematicians and mathematics educators to analyse the teaching of fractions.

**Findings:**

PMET is finding widespread interest among mathematics faculty in reworking courses for future teachers and adoption of the MET Report recommendations. PMET-sponsored workshops at Park City laid the foundation for the recent NCTM Curriculum Focal Points report. PMET workshops have played a significant role in ending the Math Wars. Last summer, a follow-up workshop looked in depth at differences mathematicians and math educators have in structuring the mathematical foundations of fractions.

**Training and Development:**

NO TRAINING in the past year

**Outreach Activities:**

Collaboration with the Common Ground initiative of Richard Schnaar of the Business Roundtable. A supplement to the PMET grant funded a Common Ground conference spring.

Collaboration with NCTM and the Inst. of Advanced Studies's Park City Mathematics Institute to organize meetings on school mathematics that bring together school teachers, math educators, and mathematicians to discuss ways to improve school mathematics instruction.

### **Journal Publications**

Johnny Lott and Alan Tucker, "Mathematicians and Mathematics Educators Working Together at PCMI", NOTICES of the American Mathematical Society, p. , vol. , ( ). Accepted,

### **Books or Other One-time Publications**

### **Web/Internet Site**

#### **URL(s):**

[www.maa.org/pmet](http://www.maa.org/pmet)

#### **Description:**

The PMET website has extensive information about PMET and its activities. In particular, it holds a set of 6 essays and working papers resulting from the PMET-sponsored Park City workshops. For example, the essay by Roger Howe entitled Taking Place Value Seriously has been widely circulated and used in a number of professional development programs for in-service 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. The PMET supported Park City essay project is engaging leading research mathematicians, such as Dick Askey, Roger Howe, Andrew Gleason, James Milgram, and HH Wu, in efforts to rethink the K-12 mathematics curriculum in concert with math educators and school teachers.

A valuable by-product of the PMET workshops and Park City essay project is that they are giving forums to mathematicians interested in school mathematics to communicate their views to others. Many of these people had been quite critical of the NCTM Standards and curricula based on them. Now that they have a chance to have their views on school mathematics heard, these people are acting less combative. At the Park City workshops, these people have started working constructively with mathematics educators and teachers.

The recent NCTM Curriculum Focal Points report was heavily influenced by one of the Park City essays, titled What Is Important in School Mathematics. and in turn, mathematicians have been generally supportive of this NCTM report.

#### **Contributions to Other Disciplines:**

None

**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

**Animal, Human Subjects, Biohazards:** None

**Categories for which nothing is reported:**

Organizational Partners

Any Book

Any Product

## PMET Fourth-Year Annual Report

The goal of the project, Preparing Mathematicians to Educate Teachers (PMET), is strengthening the mathematical education of America's teachers as recommended in the 2001 CBMS report, *The Mathematical Education of Teachers*. PMET's strategy for achieving this goal is a set of activities to engage and educate college and university mathematics faculty in effective instruction for future K-12 teachers. This past summer, PMET ran five workshops for over 100 mathematics faculty. Two of the workshops were the second years of workshops that met first during summer 2005. The total attendance at all PMET workshops has been about six hundred people. Along with face-to-face workshops, PMET is now sponsoring an initiative to produce materials written by mathematicians about K-12 mathematics instruction. These materials will both assist mathematicians teaching courses for future teachers and also foster greater involvement by mathematics faculty in K-12 mathematics education reform.

PMET has an extensive evaluation effort to assess changes in how faculty teach future teachers and how future teachers are learning. A follow-up survey last spring of participants in the PMET workshops in summer 2005 produced a quite positive assessment of the impact of the workshops, similar to the follow-up surveys of participants in the earlier rounds of PMET workshops. Almost all the respondents reported keeping 'promises' to themselves, made at the summer workshops, to change their teaching. About 90% of the participants reported using more collaborative approaches. All but one reported a greater concern for teaching for understanding as opposed to covering the curriculum. Three-quarters reported significant changes in the way they approached teaching certain mathematical topics. More importantly, three-quarters of those making major changes reported that their students seemed to understand the topics better now than they did the previous year. Another impressive finding related to the impact of the PMET summer workshops was that over 40% of respondents had made a presentation related to PMET at a professional meeting.

Here are quotes from the follow-up survey about changes participants instituted in their teaching:

"I inserted more exploration into my classes. . . This was the first time I had forced myself to make time for [group projects] and it was reasonably successful."

"The students were given more homework [assignments] in which they had to explain their understanding. Several students commented that by doing this they understood the concepts better."

"For each concept, I tried to have an active learning experience. As a result, the students were more motivated and, based on their evaluations of my class, they also felt they had learned more than ever before. Test scores concur."

Another goal of the PMET workshops is to make the participants agents for change in their departments, that is, to share what they learned in PMET workshops. 61 of 66 respondents reported that they had been able to start conversations with departmental colleagues on improving teaching education in their departments. For example, one participant wrote: "I successfully pioneered a program to redesign our university's middle school mathematics curriculum which we will launch this fall."

An extensive series of workshops for college and university faculty is the central PMET activity. Another significant component of PMET is a series of minigrants to faculty at individual institutions to rework existing courses for future mathematics teachers or to create new courses for future teachers. No new minigrants were awarded this year. In previous years, a little over \$200,000 was awarded in 54 mini-grants. The majority of these mini-grants were active this year. Although most PMET efforts were targeted at five chosen states, mini-grant proposals were received from 30 states. Fourteen mini-grants have had site visits, discussed below. Their findings were generally very positive.

Another component of PMET is regional networks, composed of PMET workshop participants, minigrant recipients, and other faculty interested in the mathematical education of teachers. Regional networks were centered in California, Nebraska, New York, North Carolina and Ohio. Follow-up conferences in all five regions were held this past year to help sustain the reform efforts of faculty who participated in PMET workshops in previous years.

The final component of PMET is resource creation and dissemination in conjunction with collaboration with other groups working to improve school mathematics and the mathematical education of teachers. This component has become quite active in the past two years. The most visible effort has been PMET's collaboration with Richard Schaar's Common Ground Initiative which sought to broker an end to conflicts among mathematicians and mathematics educators about school mathematics that has come to be called the Math Wars. A supplement to the PMET funded a major Common Ground conference in March at Indianapolis. A preliminary presentation of the recommendations in the forthcoming NCTM Curriculum Focal Points report set a very positive tone for the conference, since these recommendations were developed on substantial input from mathematicians.

PMET has also be funding a series of workshops at the Park City Mathematics Institute (PCMI) whose discussions and working papers played a significant role in the development of the NCTM Curriculum Focal Points report. An article will appear in the AMS NOTICES shortly describing the collaboration of mathematicians, mathematics teachers and mathematics educators at the PCMI workshops and its impact on the Focal Points report. Continuing the development of the theme of the 2006 PCMI workshop, preparation for fractions, will be the focus of a no-cost extension for PMET that is discussed below.

This report is in seven sections, one for each of the major PMET components following an initial section on organization and ending with sections on evaluation and budget.

## **PMET Organization**

The PMET project office is at the University of Arkansas, Fayetteville. The office is run by PMET co-project director Bernie Madison under a PMET subcontract from the MAA. Tami Trzeciak is the PMET project coordinator at this office, assisting Madison. The PMET workshop office is at Kent State University was closed after the third year and it duties for the reduced set of workshops in 2006 was assumed by the PMET office in Fayetteville. The MAA Washington Headquarters provides administrative support for financial matters, e.g.,

processing and disbursing most expenses. The key staff assisting PMET in Washington are Michael Pearson, MAA Associate Director for Programs, and Silja Sostok-Katz, his assistant.

PMET maintains an attractive, informative website (see [www.maa.org/pmet](http://www.maa.org/pmet)) with information about the various PMET programs and a handbook for workshop directors and regional coordinators. The website has posted the working papers coming out of the PCMI workshops. The website includes information about all minigrants, including their latest progress reports. 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. The U. Arkansas office is 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 PMET National Advisory Committee (NAC) did not meet in the fourth year because of the winding down of the workshop program and the absence of any new initiatives. An e-mail report was made to NAC.

## **Faculty Development Workshops**

The summer workshops are the central feature of the PMET Project. For Summer, 2006, the original PMET budget only provided funds for the second summers of two 2-summer workshops started in summer 2005. With carryover funds, we will also have four new workshops. Two workshops, Texas Southern and Coppin State, are at HBCUs.

<b>PLACE</b>	<b>LEVEL</b>	<b>CO-DIRECTORS</b>
<b>Second Summers</b>		
Univ. of Alabama.	Secondary Level.	Co-Directors: Holly Hirst, David Royster
Texas Southern	Secondary Level.	Co-Directors: Joan Evans, Kathy Ivey
<b>New Workshops</b>		
Coppin State University, Bernard Madison	Elementary and Middle Level,	Co-directors: Genevieve Knight and
Univ. of Nebraska-Lincoln,	Middle Level,	Co-Directors: Jim Lewis and Ruth Heaton
El Paso CC/Univ. of Texas-El Paso,	Elementary Level,	Director: Bernard Madison.
CSU-Fresno,	Elementary Level,	Director: Patrick Callahan

The El Paso and Fresno workshops were initiated locally by groups of faculty at El Paso and at Fresno who identified a critical mass of faculty at local institutions who wanted a PMET workshop and then contacted PMET to ask for a workshop. These workshops will have about

a third the cost of a typical PMET workshop because there will be no costs for local arrangements or for room and board for participants. These workshops already have at least 20 participants and any additional participants from outside the area will have to cover their own lodging expenses.

*Participant Feedback:* The preliminary evaluation reports on the summer 2006 workshops are very positive. All components of the workshops were generally well received, but participants noted that sessions about problem solving activities were very useful to participants. One respondent stated, “[the PMET sessions] confirmed the need for more problem solving activities, as they help students gain deeper understanding.” Sessions that allowed participants to interact with each other were praised by 71 out of 73 respondents. Sessions, often evening social events, that allowed participants to interact with workshop leaders, were highly praised by 42 out of 73 respondents.

There were just two aspects of the workshops that elicited some criticism:

- i) Some presentations that had little or no “hands-on” activities or relied too heavily on lecture.
- ii) More direct connection was needed between role modeling, sessions, and how to improve teaching

For more details about the participants reactions to the 2006 workshops as well as the follow-up evaluation of the 2005 workshops, see the Evaluation’s Report.

*Workshop Publicity:* Publicity and recruitment of participants for these workshops are conducted through articles in MAA publications, web announcements, trips to MAA Section meetings, messages on various email lists and personal contacts.

*Workshop Programs:* 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 collaborated with workshop faculty to design the sessions, then observed the sessions conducted by workshop faculty and discussed in detail what they had observed.

Afternoons at workshops were largely devoted to guest speakers who presented a range of points of view, including the mathematical knowledge needed by teachers, issues in current school mathematics reform efforts, use of technology and manipulatives, theories of learning, teaching statistics, and pedagogical strategies. Two summer workshops have intervening year projects that the workshop directors monitor.

*Technology in Workshops:* All of the workshops made extensive use of various forms of technology including sophisticated calculators, generously provided on loan by Texas Instruments, and the World Wide Web.

*Diversity:* The PMET Workshop program is reaching out to several special groups. In summer 2006, along with a second summer of Texas Southern, an HBCU, a new workshop will be held at Coppin State, an HBCU, and at U. Texas-El Paso/El Paso CC, institutions serving regions with a very large Hispanic-American population.

We note with pride that Robert Moses received an Honorary Degree from Harvard University this past June. Moses who spoke at 7 PMET workshops in 2004 and 2005. He is Founder and Director of the Algebra Project a program to raise the floor of achievement and preparation for college by students from under-represented minorities, specifically, African-American students.

## **Mini-grants**

There were no new mini-grant awards this year.

A sample of fourteen mini-grant were reviewed with visits by project leaders and regional coordinators. At twelve campuses, reviewers found that most of the mini-grant's objectives had been accomplished. These objectives were usually to create a capstone course for prospective secondary school mathematics teachers, as recommended in the *MET Report*, or to develop new courses (or totally revamped courses) for prospective elementary school teachers. Ten reviewers found "a lot" of collaboration among department members in designing courses for future teachers. The Evaluation Report discusses the findings of these site visits in more detail.

## **Regional Networks**

The regional networks in California, New York, North Carolina, and Ohio all held conferences last summer at Pacific Grove, CA, Kent, Ohio; Boone, NC; and Oswego, NY., respectively. A volume is planned that will contain a number of the papers presented at these conferences. The primary component of the conferences was sessions with presentations by mini-grant directors and past summer workshop participants of reform in teacher preparation at their home institution. Other components was technology sessions, grant writing sessions, and informal interactions of attendees.

Kathy Ivey, an organizer of the Oswego conference noted, "This year there was a telling indicator of the success of PMET in engaging mathematicians and mathematics educators in productive dialog and lasting change. Participants did not constantly identify themselves as either mathematicians or mathematics educators as if establishing camps."

For more about the regional conferences, see the Evaluation Report below.

## **Information, Resource Dissemination and Collaboration**

Developing and disseminating resources about school mathematics and the mathematical education of teachers was one of the components of the PMET grant. While there are a number of well-known resources such as the NCTM Standards and the CBMS Mathematical Education of Teacher report, they are written mostly by mathematics educators. Individual mathematicians have written articles about their thoughts on school mathematics and preparing

teachers and such people have been frequent guest speakers at PMET workshops. However, there is virtually nothing in writing on these subjects by groups of mathematics faculty. PMET is now working to change this situation.

For the past three summers, groups of research mathematicians interested in school mathematics have met at the Park City Mathematics Institute, in parallel with groups of teachers and mathematics educators. Alan Tucker and Roger Howe have organized an essay writing project growing out of these meetings. Writing essays about the key mathematical ideas in elementary school, middle school and high school are emerging. Five essays already exist and are posted on the PMET website, What Is Important in K-6 Mathematics, Guiding Principles of K-4 Mathematics, and Preparing for Fractions, all by Alan Tucker; Taking Place Value Seriously, by Roger Howe; and Ratios and Proportions, by Jim Milgram and H.H. Wu. The mathematicians at the 2005 Park City meeting were Richard Askey, Susanna Epp, Bert Fristedt, Andy Gleason, Roger Howe, Jim Milgram, Alan Tucker, and H.H. Wu. Four of these participants were also guest speakers at the regular PMET workshop that was taking place at Park City at the same time. The mathematicians at the 2006 Park City meeting were Richard Askey, Susanna, Roger Howe, William McCallum, Ira Papick, Richard Schaar, Alan Tucker, and Steve Wilson.

The essays are meant to be a resource for pre- and in-service professional development. The process of developing these essays and getting broad input to them is as important as what they say. These PCMI workshop discussions have also been developing common ground about school mathematics among concerned mathematicians and between mathematicians and other concerned constituencies.

Since their publication in 1989, the NCTM Standards have served as the basis for most school mathematics standards, curricula, and textbooks as well as the accreditation of teacher preparation programs. In initial efforts to reform school mathematics, many mathematicians felt like frustrated bystanders. Recently, mathematicians have been asked to play a major role in creating standards and curricula in some states and in national efforts, such as Achieve. This essay project seeks to draw upon the experiences of these mathematicians and assist similar efforts of other mathematicians in the future. To be effective, mathematicians need to do more than express their own individual views about school mathematics; they need to be able to draw upon documents that express the consensus views of groups of mathematicians. A goal of this essay project is to produce some of these documents.

PMET and the essay project has developed ties with the Common Ground initiative of Richard Schaar. Schaar, a former Senior Vice President at Texas Instruments and member of the PMET Advisory Board, headed a task force of the Business Roundtable looking at mathematical skills of the workforce. Schaar has been working to end the 'Math Wars' between mathematicians and mathematics educators in order to focus the energies of both groups on working together to improve U.S. school mathematics education. Milgram, a Park City participant, is part of Schaar's 5-person planning team. Jeremy Kilpatrick, a member of the PMET Advisory Comm., is also a member of Schaar's planning team. Schaar spent a day with the Park City mathematics group in 2005 and 2006.

The PCMI workshops and the resulting essays were responsible for a lot of groundwork, out of the limelight, that set the stage for harmonious proceedings at Schaar's Common Ground conference (funded by a supplement to the PMET grant). First, a major stimulus for the Curriculum Focal Point project was an essay called What Is Important in K-6 Mathematics that was developed by mathematicians after the 2004 Park City workshop and discussed extensively with teachers and mathematics educators by e-mail and at the 2005 Park City workshop. Instead of reacting to recommendations that others developed as in the past, mathematicians were now involved in initiating reform recommendations. Discussions between Jim Milgram and math teachers at the 2005 Park City workshop led to Milgram having extensive input to the Focal Points. He had been one of the most vocal critics of the NCTM Standards, but he was recently quoted in the NY Times praising the Focal Points recommendations.

A second way that PMET has help reduce tensions about school mathematics among mathematics faculty was by providing dozens of forums at its workshops where mathematicians concerned about school mathematics could express their views to other mathematics faculty. Recall that afternoons in PMET workshops were devoted mostly to presentations by guest speakers. The guest speakers included the following research mathematicians, several of whom had been quite critical of the NCTM Standards:

- George Andrews (Penn Stat)
- Dick Askey (Wisconsin)
- Sybilla Beckmann (ran a workshop) (Georgia)
- Herb Clemens (Ohio State)
- Ted Gamelin (UCLA)
- Ken Gross (Vermont)
- Guershon Harel (UCSD)
- Dave Henderson (Cornell)
- Reuben Hersh (U New Mexico)
- Roger Howe (Yale)
- Jim Milgram (Stanford)
- Ira Papick (Missouri)
- Michael Starbird (Texas)
- HH Wu (UC Berkeley)

The 2006 PCMI workshop looked at teaching fractions in middle school and preparing students for fractions in elementary school. Historically mathematics faculty have been most interested, among K-12 levels, in high school mathematics, as preparation for college studies. Recently, the writings of Deborah Ball, Liping Ma, and others have awakened a new appreciation of the mathematical substance in elementary school mathematics. Middle school mathematics and fractions have not been the subject of such attention, although a few mathematicians, especially H H Wu, have been very active in this area. This neglect needs to stop.

A generation or more ago, whole number arithmetic was all the mathematical knowledge that vast majority of the (blue-collar and white-collar) workforce needed. Today this arithmetic is done with technology, and quantitative information, especially in white-collar jobs, centers increasingly around rates and percents, that is, fractions. Unfortunately, the TIMSS data show that US students are good in 4th grade at whole number arithmetic but later in 8th grade are poor at fractions. All

mathematicians have horror stories to tell about errors with fractions in calculus classes. Readiness for algebra is a popular theme today, e.g., the President's Math Panel, but mastery of fractions and their uses is much more critical for the workplace. Moreover, when fractions are learned well, the underlying reasoning that is developed is an excellent preparation for learning algebra well.

On the stage of popular opinion, we think most Americans do not see why one really needs algebra for success in the world (it is seen just as a requirement to get out of high school and into college). But people appreciate that one needs to know about rates and percents today-- further that one needs to reason about them, not just calculate them. If elementary school mathematics in the U.S. were taught with an eye towards preparing students to understand fractions-- with a consensus developed by educators, policy makers, business, and the general populace that this educational agenda was good for America-- it would constitute a sea change for improving U.S. mathematics instruction and teacher preparation.

PMET plans to spend most of its residual funds during a no-cost extension year on issues related to learning fractions. A 2007 PCMI workshop is being planned to refine ideas on fractions from the 2006 workshop and plan for a major conference in 2008 at PCMI that will develop guidelines for a major rethinking of the U.S. K-6 mathematics curriculum that gives a much greater role to laying a sound foundation for learning fractions. We note that a key concept underlying fractions, namely, units, is also critical in analyzing many multi-step word problems—also an area where U.S. students are weak by international standards.

PMET is also funding in 2007 a workshop at the Wingspread Conference Center about the quantitative literacy, particularly working with fractions, for non-quantitative college graduates. Of course, for PMET, the group of such college graduates of interest is future elementary school teachers. They, like most college graduates in the humanities, seem to graduate from college with decreased ability in quantitative reasoning compared to what they had when they entered college. Some leading scholars in liberal arts education, like Stanley Katz, director of the Center for Arts and Cultural Policy Studies at Princeton, and Carol Schneider, President of AACU, are agreeing that in this day and age college should be place with quantitative literacy grows, not decays.

## **Budget**

The PMET project has been holding costs down in a variety of ways and expects to end the grant period (2/1/2003- 1/31/2007) with a residual balance of around \$250,000. There are two reasons for this carryover. One is that workshop expenses have generally been under budget. One aspect of the workshop underspending has been the lower attendance than projected in the second and third years. For example, the 12 workshops in summer 2005 enrolled slightly over 200 participants for an average size of 17. The anticipated size was in the range of 20-25. The other reason for a carryover was that materials development not been as active as planned. We plan to use the residual funds in this area. There will be a larger workshop at Park City in 2007, including some state math supervisors as well as mathematicians, teachers and mathematics educators to refine the essays produced in 2006 about teaching fractions and laying the foundations earlier grades for learning fractions. In advance of this workshop, summaries will be prepared outlining how the foundation for fractions is laid in the following

textbook series, including the Singapore textbooks, Japanese textbooks, Everyday Math, Math In Context, and the Harcourt/Scott textbooks.

Essay project:

Park City 2007 workshop, \$40,000, includes \$1000 honaria for participants;  
Stipend to Alan Tucker to refine essays and prepare summaries of the development  
of fractions in various textbook series, \$20,000)  
\$60,000

Editing, publication, and distribution of a volume of selected papers presented at 2006 PMET  
regional conferences along with essays produced at the PCMI workshops  
\$15,000

2007 workshop at Wingspread conference center about common issues in learning fractions for  
quantitative literacy of the general populace and the preparation of elementary school teachers.  
\$50,000

Follow-up mini-grants to university mathematics departments undertaking model teacher  
education activities, e.g., special training for TAs who help deliver instruction to future  
elementary teachers.  
\$20,000

Continuation of Univ. of Arkansas PMET office with staff member reduced to ½ employment.  
This office will coordinate preparation for the two  
\$55,000

(FUTURE PLANS) Major Conference in 2008 at PCMI to produce guidelines to restructure K-  
6 mathematics curriculum to be prepare students to learn fractions.  
\$100,000 (ESTIMATE)

TOTAL DIRECT COSTS IN NON-COST EXTENSION  
\$300,000

INDIRECT-COSTS (ESTIMATE)  
\$60,000

TOTAL BUDGET FOR NO-COST EXTENSION  
\$360,000

NOTE: This budget is dependent on the size of residual funds on 1/31/2007, the end of the  
initial grant period. The actual number of participants funded at the Park City and Wingspread  
conferences will depend on the final determination of residual funds.

## **Fourth-Year Evaluation Report**

*(report prepared by the PMET project evaluator, Dr. Peter Ewell, Vice President of the National Center for Higher Education Management Systems)*

As the PMET project ends its fourth year, evaluation activity includes summer workshop follow ups and evaluations of mini-grant activities. As was the case in previous years, evaluation of the workshops is conducted in two areas each year: a) the design and conduct of the workshops themselves for the previous summer and, b) the impact of the workshops in terms of effectiveness. Information for the first is collected through a Feedback Form completed by each participant on the last day of the Workshop. Information for the second is collected through a follow-up survey of participants conducted the following spring. The evaluation of mini-grant activities also draws on two sources of evidence: a) site visit reports completed according to a standard protocol by Regional Directors and, b) an annual independent review of five selected mini-grants conducted by NCHEMS.

**Follow-up on the Effectiveness of the 2005 Summer Workshops.** A follow up survey of participants in the eight PMET Workshops held in the summer of 2005 was conducted by NCHEMS via email in May 2006. The primary intent of the survey was to determine the extent to which participants were applying what they learned in the Workshop to their own teaching during the following year. The basic method employed was similar to that used in the two previous years. Topics addressed were based on responses to a Feedback Form completed at the end of each Workshop tailored to the Workshop's individual content. Participants were also asked to respond to a set of individualized questions based on their own answers about how they intended to change their teaching provided in a Reflective Exercise also completed at the end of each Workshop.

Seventy-six participants in the 2005 Workshops completed the survey for an overall adjusted response rate of 42%.<sup>1</sup> This was somewhat lower than the response rates achieved the previous year, though still high enough for a meaningful interpretation of results. Response rates for individual 2005 Workshops ranged from a high of 58% to a low of 27%. The fact that many of the workshops involved repeat participants may be a factor here. As in all previous follow ups, those who did respond for the most part provided in-depth, thoughtful responses.

As in previous years, responses indicate that 2005 participants are actively applying what they learning in the Workshops to their own teaching. Highlights of the overall response are described below for questions asked of all participants.

- The vast majority of participants reported greater emphasis in their teaching on group work and collaborative approaches (37 of 70 reporting “a great deal” and 31 more reporting “somewhat). This is a higher favorable proportion than the past two surveys. As was the case in previous surveys, however, many respondents noted that they had always used these approaches and participation in the workshop reinforced this behavior. As one participant typically reported, “I have always used collaboration...it was nice for this to be reinforced at the workshop, but it was not new to me.” Another observed favorably, “individual and collaborative work in combination often works well in producing multiple representations in problem solving.”

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<sup>1</sup> This response rate was adjusted by eliminating 20 bounced email addresses from the denominator of 121 total participants.

- The vast majority also reported more emphasis on teaching for understanding rather than content coverage (34 of 55 reporting “a great deal” and 20 more reporting “somewhat”). This was also a somewhat higher proportion of favorable responses than was obtained in past follow ups. Reporting on efforts to cover fewer concepts in greater depth, one participant observed, “the curriculum is fixed, but I can pick and choose how much time to spend on each topic and this is where PMET helped.” Another observed, “ the important thing I learned was not to give answers too readily and to give the students more time to think about questions.
- A high proportion of participants reported direct applications of material from the MET Report or Liping Ma’s book (18 of 45 reporting “a great deal” and 19 more reporting “somewhat”). This was about the same proportion of favorable response as obtained in past follow ups, but the character of response suggests that these resources are no longer new to participants. As one reported, “I believe that ‘a great deal’ is the box that should be checked by the content of what is happening in my classroom, but the actual report is not being used actively at this point.” But clearly this material is new to some, and highly effective. One put it simply, “I changed my whole way of thinking because of the Ma book.”
- Somewhat fewer participants reported increased use of technology (12 of 49 reporting “a great deal” and 28 more reporting “somewhat”), though many respondents noted that their use of technology was already high. This was almost identical to last year’s result. There was almost no reported use of video.
- As was the case in previous years, virtually all the participants reported that they had followed through on the “promises” they made to themselves in the Reflective Exercise they completed at the close of the Workshop. The responses again were unusually thoughtful and extensive. The following responses are illustrative:

I inserted more exploration into my classes. In particular, I assigned a group project in Pre-Calculus, Algebra and Trigonometry in the fall. This was the first time I had forced myself to make time for it and it was reasonably successful.

The students were given more homework writings in which they had to explain their understanding. Several students commented that by doing this they understood the concept better.

I spent more time having students think about and talk about the nature of mathematics. This was, as I expected, difficult for them. It was also difficult to monitor the discussion, suspend judgment, promote presentation of ideas that are not yet well formulated, and finally arrive at some reasonable positions.

For each concept, I tried to have an active learning experience. As a result, the students were more motivated and, based on their evaluations of my class, they also felt they had learned more than ever before. Test scores concur.

I have added types of problems that I hope will be relevant to their teaching. For example, “find the mistake in this working,” or “a child submits the following working to solve this problem...decide if the method is correct and, if so, use it to solve this other problem.”

- Three-quarters of 2005 Workshop participants (compared to two-thirds for 2004 participants and one half for 2003 participants) reported making significant changes in the way they approached teaching a specific mathematical topic or concept. Examples again included a wide range from incorporating fewer topics in greater depth, making connections among mathematical concepts, and use of active learning techniques. Of those reporting major changes, three-quarters reported that their students seemed to understand the concept better now than they did last year. As one participant put it, “performance on assessments was better and students seemed to enjoy the topic more than in previous years.” Another reported, “students are no longer afraid of ‘why’ type questions...in general, their responses provide evidence of deeper conceptual understanding.” Finally, a third indicated, “the major evidence for enhanced understanding is students’ ability to now apply these concepts to realistic settings of value to their own interests and needs.”
- When asked about whether their teaching this year had been affected by a deepening of their own mathematical understanding of the topics or concepts being addressed, the majority responded much as they did last year. Most responded in terms of a deepened pedagogical understanding rather than referring to changes in mathematical understanding. The following response was typical: “I am not sure whether changes in my teaching this year were a result of deeper understanding of mathematics or the results of deeper understanding of my students’ poor mathematical skills or lack of understanding in mathematics.” Another reported, “I learned that what may at first seem to me to be a single, simple mathematical step turns out, under close examination, to involve many issues that need to be discussed.”
- More than half of 2005 Workshop participants (36 of 67 responding) reported that they had been in contact with other participants to get help, share examples or ideas, or to talk about teaching. This was a slightly higher proportion than last year and about the same as 2003 participants.
- About two thirds of 2005 participants (47 of 67 responding) reported consulting resource materials provided or referenced at the Workshop during the year—about the same as in the past two follow ups.
- The same high proportion of 2005 participants (61 of 66 responding) reported that they had been able to start conversations with departmental colleagues on improving instruction for pre-service teachers. In some cases, the outcome of these conversations was positive, as many reported plans to launch a new class or a capstone experience. The following response was typical: “actually, I’ve been *continuing* conversations with them, trying to keep alive our ongoing efforts to improve pre-service teacher education...we’ve had much success, but there is always more work to do.” Another reported, “I successfully pioneered

a program to redesign our university's middle school mathematics curriculum, which we will launch this fall. However, many continued to report that making progress with such conversations was extremely difficult. One responded, "I am a little disconcerted that most people in my department still feel as though the mathematics ed classes are classes to avoid teaching at all costs and many still believe that the needs of future teachers are the same as other students." Another reported, succinctly, "a Neanderthal has taken over our department."

- Twenty-seven of 65 of the participants responding reported that they have made a presentation related to PMET in a professional meeting—a somewhat higher proportion than last year. Examples noted again were primarily MAA Section meetings, MathFest, the Joint Mathematics meetings, and the NCTM Conference.

Overall, despite a somewhat reduced response rate compared to the previous Follow-Ups, these results strongly support the conclusion that the PMET Workshops are continuing to have a beneficial effect on participants' teaching after they return to their home institutions. This is especially notable given the fact that the number of workshops and participants grew markedly.

**Design and Conduct of the 2006 Summer Workshops.** A review of the feedback forms completed by participants in the PMET workshops and Regional Conferences held in the summer of 2006 was completed by NCHEMS in November of 2006. The feedback forms were designed to be flexible and open-ended—allowing participants to comment on what worked well and to provide suggestions for improvement under sets of topics selected by workshop leaders. The Feedback forms also give participants the opportunity to rate various aspects of the workshop on a standard scale and to provide overall comments and suggestions for improvement.

Of the six workshops offered, five returned completed evaluation forms. The following evaluation summary is based on the five workshops (73 participants responded).

Participants were very positive in their feedback. Particular features receiving positive comments included:

- The sessions, across the workshops, that included problem solving activities were very useful to participants, as one respondent stated, "[the PMET sessions] confirmed the need for more problem solving activities, as they help students gain deeper understanding." Another respondent indicated that, "the problem solving was very exciting. This workshop allowed us to engage in problems that are appropriate for our pre and in-service teachers."
- Almost all respondents (71 of 73 responding) ranked *opportunities to interact with other participants* at the highest two levels. Participants indicated that interactions with other participants were one of the highlights of the workshop and a large part of the overall workshop experience was the chance to network and learn from colleagues around the nation. For example, one respondent indicated that "hearing the opinions of the other folks from other schools, and those of the student participants, and realizing that things are the same all over."

- More than half of respondents (42 of 73 responding) reported that the *opportunities to interact informally with leaders* were excellent. One respondent stated, “the presenters were very engaging and enthusiastic.” Another participant noted that the best part of the conference was the, “opportunities to meet presenters and discuss the topics presented.”

Aspects of the Workshops that participants felt, in general, might be improved included:

- Presentations that had little or no “hands-on” activities or relied too heavily on lecture.
- More direct connection between role modeling, sessions, and how to improve teaching.

In the summer of 2006, four regional conferences were also conducted by PMET. The following evaluation summary is based on all four regional conferences, which include 77 participant responses. Highlights of their responses are as follows:

- **Technology Sessions.** The participants seemed to enjoy and learn from the technology talks, which is in direct contrast to past workshops. When asked what sessions “got you excited” several participants indicated the sessions of technology, for example, a participant noted that the “discussion on technology and the importance of using technology to enhance teaching mathematics.”
- **Grant Writing.** These sessions were well received by participants at the Boone regional conference. Participants noted that they learned more about what type of grants are available and the techniques for writing a grant proposal. As one respondent stated, “I got encouragement about grant writing, and that was great. I never felt I could apply for an NSF grant – now I will try.”
- **Mathematicians, Mathematic Educators, and Teacher Education.** Kathy Ivey, a PMET regional conference organizer noted, “As a final observation, this year there was a telling indicator of the success of PMET in engaging mathematicians and mathematics educators in productive dialog and lasting change. Participants did not constantly identify themselves as either mathematicians or mathematics educators as if establishing camps.”
- **Individual Presentations.** Participants found the individual sessions useful and engaging, as one respondent stated, “I found the format of this year's conference that involved former PMET workshop attendees making presentations particularly effective. I also thought that it was helpful to hear presentations of professors interested in both pre-service elementary and pre-service secondary teachers.”
- **Opportunities to interact with other participants.** More than half the respondents (57 of 77 responding) ranked *opportunities to interact with other participants* at the highest level. Participants emphasized how useful it was to speak with the other participants about issues surrounding mathematics and education.

**Evaluation of Mini-Grants.** As noted, NCHEMS has two sources of evidence for evaluating mini-grants. First, PMET Regional Directors visit a selected number of mini-grants each year to monitor progress. When they do so, they are asked to complete a brief template to report progress. Second, NCHEMS directly reviews five mini-grants annually.

Fourteen review templates have been completed by Regional Directors to date.

- Most of the visits took place after considerable activity had occurred. Six were reported to be “almost completed” and the remaining eight “well along in the work.” Most courses planned with mini-grant support were complete with respect to design, while about half had actually been offered by the time of the visit (one twice). A few reported delaying the beginning of the project because of scheduling difficulties but all had overcome these difficulties by the time of the visit.
- Twelve reported that most of the project’s objectives had been accomplished, with one reporting “some” and one reporting “too early to tell.” In several cases, visitors interviewed students as well as faculty. One reported, “I spoke to two students and I could sense the enthusiasm and relevancy of the work.” Another noted, “the project has gone beyond what was proposed.” And a third observed, “I observed a class in one of the revised courses and saw interesting topics being taught with cooperative learning and good handouts.”
- Nine reported that the mini-grant was raising departmental awareness “a great deal,” with two reporting “some,” two more reporting “not much,” and one reporting “too early to tell.” Five reported that there was already a good deal of awareness among the department’s faculty. Several noted that attendance was excellent for talks made during the visit. One observed, “faculty are definitely more cognizant of mathematics education for future teachers and very impressed with the new course...the department has been very supportive.” Another reported, “they now have a department committee to look at [mathematics education] related issues and also have a seminar for graduate students.”
- Ten reported that the mini-grant was fostering collaboration among department members designing courses for future teachers “a lot,” with two reporting “some,” one reporting “not much,” and one reporting “too early to tell.” In many cases, visitors reported that departmental collaboration was already very good but in several others, the mini-grant seems to have made a difference. As one visitor noted, “before this mini-grant project, no collaboration existed...now there is growing communication and good collaborative efforts...in fact, the Education Chair attended the class and helped expand discussion.” Eight of the fourteen projects had also contributed departmental funds to supplement the mini-grant.
- Seven reported that the mini-grant was generating ideas and approaches that are being applied beyond the target course “a lot,” with four reporting “some,” and three reporting “too early to tell.” One noted, “aspects of the grant like cooperative learning and developing enrichment materials...are impacting other courses.” Another reported, “math faculty members [in this department] have had little or no experience with manipulatives

and the project is changing that...the manipulatives are being used by growing numbers of instructors.”

- The only area of potential disappointment was that visitors for the most part did not yet see the mini-grants as contributing much to the PMET state networks. Only two reported “a lot,” with two more reporting “some,” seven reporting “not very much,” and three reporting “too early to tell.” In most cases, visitors noted that there was no state network in place (though some reported “informal” contacts beginning to develop). Several visitors said that they expected such developments “for the future” although nothing much had happened yet. Several also explicitly noted that the isolation of the mini-grant projects meant that in many cases participants did not know about one another and that PMET might act to correct this.

NCHEMS surveyed a subset of five mini-grant recipients through email interviews and some follow up phone interviews. These five were chosen to provide as much representation as possible across institutional types, project focus, and geographic location. The five mini-grant recipients interviewed were:

- 1. CSU-Stanislaus**  
*California (Middle School focus)*
- 2. Calvin College**  
*Michigan (Elementary K-8 focus)*
- 3. University of Northern Iowa**  
*Iowa (Elementary focus)*
- 4. Union College**  
*Nebraska (High School focus)*
- 5. University of Alabama @ Tuscaloosa**  
*Alabama (Elementary focus)*

Participants were overwhelmingly positive in their feedback concerning the mini-grant projects. Highlights of their responses are as follows:

- Four out of five mini-grant recipients contacted indicated that their project was either complete or would be complete by the end of the calendar year.
- All five of the mini-grant projects have accomplished their initial objectives. Several of the projects have added additional courses, seminars, and workshops to their project in order to reach more people or to strengthen their original project. For example, one mini-grant project director stated that he “proposed another course that all elementary education prospective teachers would take to try to strengthen ties with local school districts, so that my students could [have] hands-on experience with students.” Another project director

indicated that although their project was completed months ago, she continues to travel and speak at conferences and special workshops designed to help mathematics departments create similar courses at other institutions across the state.

- Four out of five mini-grant recipients surveyed indicated that the mini-grants were effective in raising awareness of the need to improve mathematics instruction for future teachers in their department. Several project directors noted that the project “facilitated awareness” and “brought the issue of improving mathematic instruction for future teachers to the fore.”
- Participants noted that the mini-grant projects have fostered collaboration among their own department faculty and between faculty in various other departments. As one project director stated, “We are working closely with education faculty as a result of this project.” Another project director noted, “The interplay of perspectives from mathematicians and educators has been critical to the success of the program.” Not only are faculty working together between departments, but there has also been collaboration with local elementary school teachers—building relationships between the college campus and K-12 schools.
- All five mini-grant recipients reported that they were not receiving institutional or department matching monies for their project. Two indicated that the mini-grant did serve as “seed funding” for additional proposals to develop coursework. One project director indicated that their department received a grant from the Jim Walters Foundation supporting evaluation of these courses for pre-service elementary teachers. This grant also supports collaboration with three local elementary school teachers to provide perspectives leading to future refinement of their materials. Another project director noted that their department received a grant to work with local teachers to build relationships between the schools and the university. Four of the five recipients surveyed indicated that their home institution is supportive of the PMET mini-grant projects. Universities have provided travel funds, multi-media equipment, software, and classroom space in support of the projects.
- All five project directors indicated that the mini-grant has had some effect on generating ideas or techniques in other courses or at other institutions. For example, one project is now working with two community colleges to offer courses for elementary teachers based on their PMET mini-grant model. Another project is trying to determine ways to implement activity-based learning in larger sections based on their original PMET mini-grant model. Participants indicated that this outcome was the least successful. However, in other areas of the survey and in follow-up emails and conversations, we found that almost all of the project directors were discussing their findings across their home states, but not through any identifiably PMET-established network. Therefore, this objective, although not indicated specifically by the recipients of the mini-grants nor through any formal network, is being met to some extent.
- Finally, there appears to be a lot of interest among mini-grant recipients to continue moving their projects forward even though the funding has ceased. Several project directors indicated that they were continuing to attend conferences and workshops to talk about what their project was able to achieve and to help others make changes to their own courses and programs.

**PMET Secondary Workshop: University of Alabama  
May 29-June 2, 2006**

**Evaluation Summary**

The PMET Workshop conducted in Tuscaloosa, Alabama at the University of Alabama had 14 participants with 9 responding to the evaluation survey. Participants were overwhelmingly positive in their feedback about this Workshop. Particular features receiving positive comments included:

- All respondents (9 of the 9 responding) ranked *opportunities to interact with other participants* at the highest level. One respondent noted, “Everyone had something to contribute to the discussion we had. The varied backgrounds of the participants enriched the experience. I’m in a mathematics dept, and I think it was great having mathematics education and education psychology people in the workshop. They have some very helpful insight.” Another respondent stated, “Interaction with [varied] participants was extremely useful.”
- Almost all respondents (7 of the 9 responding) ranked *opportunities to interact informally with leaders* at the highest level. As one respondent noted, “I loved Dr. Perissini’s interaction with the participants! His knowledge and expertise made this such a valuable experience.”
- Respondents indicated that the sessions and discussions on ways to help students think about proving and writing proofs in conjunction with the need to improve student’s verbal and writing skills were effective and useful.
- When asked what activities or sessions “got you excited”, several respondents indicated that the discussions on how we could change how we teach mathematics courses that include future teachers were particularly useful and engaging. One participant noted that learning “what aspects or activities would help prepare future teachers in the class.” the most exciting sessions during the workshop.

Aspects of the Workshop that participants felt, in general, might be improved included:

- Respondents ranked *allocation of time to topics* the lowest. Several respondents thought that some of the information was a “rehash” of other workshops and still others thought that more participant discussion would have been beneficial.
- A suggestion from several participants included having a moderator guide the Afternoon sessions on course design, content, and delivery discussion to keep participants more on task. Another suggestion was to discuss the issues in smaller groups and then have the groups report to the larger group.

Comments specific to particular aspects of the Workshop included:

**Morning demonstration course sessions:**

**What worked best?**

Observing presenter work with students.

Student demonstration classes – seeing how students engaged with the material.

Sharing activities.

Participant led problem investigations with student demo class.

The workshop idea/format.

Discourse between students and observers. Displayed several ways to solve the same problem.

The choice of problems seemed to engage both the workshop participants and the demonstration class students.

It went fine.

The demonstration classes with the students. Also sample lessons from participants on Day One.

I liked that three were students that served as the “class”.

Having students that worked on worksheets.

**What worked least well?**

The students were not encouraged to display their thinking process (from incorrect direction to correct direction). How they reached solution.

It seemed as if we simply expanded our group to include 8 more participants, rather than have a demonstration class.

Participants and students questions conflicted.

I think the timing of the workshop would have better if more students (mathematics/sec education) were available.

**Suggestions for Improvement:**

Could have spent more time asking students in demo class what worked, what didn't.

More discussion or the use of these as a teacher.

The student demonstration is a great setting to simulate how classroom activity progressed. I wouldn't change it.

Perhaps if the participants simply observed rather than trying to solve the problem ourselves and interacting with the class. Would have been nice to see Dr. P interact more and model appropriate feedback.

Participants should have been observers only and let only the "teacher" interact with the students.

Would have been more beneficial if there were more mathematics/sec education students.

**Afternoon sessions on course design, content, and delivery:**

**What worked best?**

Group discussions and sharing ideas.

Discussion of what to do differently.

Work time/interaction.

The discussion about how to implement "Mathematics for High School Teacher" into a capstone course. Teaching experiences were exchanged, Dr. Peressini offered inside look of how to use this book.

Hearing the opinions of the other folks from other schools, and those of the student participants, and realizing that things are the same all over.

It went fine. I thought Anthony Penessini did a great job conducting the workshop.

Sample classes by participants.

Presentation about the book.

**What worked least well?**

Discussion of course content – we didn't get away from discussing this independently of existing courses.

The topic is so vast and discussions were enthusiastic. I felt we should give more time for this discussion.

Rehashing the same material over and over.

The discussion on Thursday about the design of courses was not very useful.

I would have liked more information on how the book and which topics can be used in course.

**Suggestions for Improvement:**

Have a moderator guide the discussion to keep us more on task. Maybe discuss the issues in smaller groups with reporting out times.

It is not obvious to me that this was done. Some afternoon sessions were also demo classes by participants. While this was interesting I had hoped to see an “expert” or “leader” lead some demo classes.

I would like to know if there is any coordination between PMET and NCTM and if the NCTM standard were considered when writing this book.

Please rate the following aspects of the workshop:	Excellent — Inadequate				
	1	2	3	4	5
Opportunities to interact with other participants	9	0	0	0	0
Opportunities to interact informally with leaders	7	2	0	0	0
Allocation of time to topics	1	5	2	1	0
Relevance of content to my own situation	2	4	1	2	0
Opportunities to visit actual classrooms (if applicable)	0	0	0	0	0
Guest presentations (if applicable)	3	2	0	0	0

**Additional Comments:**

Dr. Peressini was an excellent presenter.  
Mostly overstated in elementary education.

**Identify one discussion you (and others) got excited about. What prompted the discussion? Identify the issues that caused the excitement. Were they about mathematics, student thinking, something else?**

Discussing how we could change how we teach mathematics courses that include future teachers.

What aspects or activities would help prepare the future teachers in the class?

Most of us engaged with solving the problems that were the basis for activities.

Getting participants involved in designing problem investigations for me, thinking about extending a problem engaged me very much.

I really enjoyed our discussions on the advanced analysis of problems. Dr. Peressini’s insights of the importance and valuable using these types of problems.

The discussion about how to enhance student’s mathematical communication skill which was prompted by the concern that students lack of experience in writing and verbal skill.

Ways to help students think about proving and writing proofs. Some insights were presented that made me think of the concept in new ways.

How to change the curriculum to benefit future teachers. We all got excited because we all had ideas about what needs to change.

The discussion about ways to help our colleagues learn about better ways to teach mathematics courses was helpful – discussions about getting MAA, AMS...involved was useful.

I really liked the problem solving classes. However, I am not sure that this helped me any in thinking about how I can change a design.

**Was there an activity or discussion that failed to engage your interest? If so, can you explain it and explain why?**

Multiple sessions of extended problem analysis – good for 1 or 2 but lost interest after already did some.

Not really. My only concern was that the participants did not engage with the demonstration class in the most effective methods.

None!

The overview of the text on Tuesday afternoon. It seemed to be a rehashing of the session on Tuesday morning along with occasional references to the text.

The discussion about topics taught in high school and design of our courses was somewhat awkward.

As above, I enjoyed working on problems, but what I needed were some ideas on how to improve my teaching of courses for future teachers. At my school we don't have a capstone course so there are not many ideas that I saw that can be used in our general courses.

**What did you learn from this Workshop?**

Ways to change/add to what/how I teach mathematics major courses while (explicitly) thinking.

Confirmed the need for more problem solving activities (engaging students in a problem with carried approaches, with extensions).

I am continually learning! I am not sure I could adequately list all of my learning.

How to design a better worksheet. Essential of giving feedback when grading homework. Give time to observe student's thought process, when guiding student toward correct direction, do not give the answer too soon. Challenging student is not a bad thing.

I learned more from the informal interaction with the other participants – discussing things that they've tried and sharing ideas – then I did from the planned program.

I'm on the right track. There is yet much work to do. Others experience same challenges as I do.

I loved Dr. Perissini's interaction with the participants! His knowledge and expertise made this such a valuable experience.

There is a great interest in reforming mathematics/sec education program (nationwide). There is a need to have a course or two that require students to learn mathematics taught in high school in depth. Although there are efforts to reform high school pre-service teacher, this effort is uncoordinated among the different organizations that are leading the effort (like PMET and NCATE).

**Tell about your experience at this PMET Workshop on discussing issues and interacting with people from other fields. The participants were not all from mathematics department or mathematics education departments, or even from universities. In what ways did that affect your experience this past week?**

While we were mostly mathematics, it was helpful to have some mathematics education – focused faculty to help us see aspects of our discussions from different viewpoints.

Having mathematics education participant gave perspective in some of our discussions.

Excellent. Very inspiring!

Did not have such experience in this PMET workshop.

But weren't they? We were all from mathematics and mathematics ed. at four-year institutions? Having said that, since we were all from similar situations, it's a morale boosting experience to hear that we all have the same struggles with our students.

Everyone had something to contribute to the discussion we had. The varied backgrounds of the participants enriched the experience. I'm in a mathematics dept, and I think it was great having mathematics education and education psych people in the workshop. They have some very helpful insight.

Interaction with participants was extremely useful. I think it will be helpful to have people with training in Mathematics-Education as well as some high school experienced teachers. I have learned the most from other people's ideas and what they have tried in their classes.

**PMET Elementary and Middle School Workshop: Coppin State University  
May 29 – June 2, 2006**

**Evaluation Summary**

The PMET Workshop conducted in Baltimore, Maryland at Coppin State University had 15 participants with all 15 responding to the evaluation survey. Participants were overwhelmingly positive in their feedback about this Workshop. Particular features receiving positive comments included:

- A majority of the respondents (11 of 15 responding) ranked *opportunities to interact with other participants* at the highest level. One participant stated, “The various backgrounds of participants made the experience rich. Another respondent noted, “I talked to almost every presenter and participant; we exchanged different teaching ideas and thoughts on diversity application in the classroom.” Finally, another participant stated, “This has been one of the best workshops I’ve attended. The mix of participants has helped to make that possible.”
- Respondents found the discussions and sessions that focused on mathematical disabilities very useful. One respondent noted that the sessions were “enlightening” another participant noted that the sessions on disabilities and mathematics “helped us [the participants] visualize and empathize with students who had disabilities.”
- Participants indicated that the problem solving activities were very exciting. One participant stated, “This workshop allowed us to engage in problems that are appropriate for our pre-/in-service teachers.”
- The majority of the respondents indicated that the resources and contacts made at the workshop were valuable. For example, one participant stated, “I gained a wealth of resources, contacts, and information that will benefit my students and university colleagues. I can now be an agent of change in my institution and community.”

Aspects of the Workshop that participants felt, in general, might be improved included:

- Participants ranked *guest presentations* the lowest. Although this may be a reflection of a few presenters and presentations that were not well received and not indicative of the majority of guest presentations. Several participants indicated how valuable the guest presenters were, as one such participant stated, “Supported by research and rich illustrations, speakers provided a wealth of mathematical ed. Concepts/knowledge. I really learned a lot through their modeling.”
- The most common critiques throughout the survey responses was the need for more interactive sessions, more group work, and less lecture. For example, one participant noted, “While some speakers provided moments for interaction, it would have been nice to have worked more as a group (small) among participants.” Another respondent stated, “when asked what did not work well at the workshop, “The solid lecture presentations without participant interaction.”



Comments specific to particular aspects of the Workshop included:

**Morning demonstration course sessions:**

**What worked best?**

Appropriate format

I enjoyed the hands-on interaction between the group and the presenters. They were very helpful and informative and distributed loads of information that I could use with my students. I really enjoyed Dr. Vance's presentation.

Black Saga. A simulation of mathematics disabilities. Real work applications. Connecting the mathematics preparation of teachers (SUMMA)

Hands-on demonstrations by presenters, video clips, real-world problems solving techniques

Bern. Session was very informative. Vance – session was something I do (hands-on method), I plan to do more.

The activities were wonderful and engaging.

The interactive sessions definitely worked very well. Differentiated instruction is necessary even for adults.

Networking with participants, opportunities to meet presenters and discuss the topics presented.

Working breakfast, being able to utilize the computer (internet), interactive workshop.

Irving Vance, Mike Starbird and other more interactive speakers.

Time for breakfast and conversation was a good idea.

The logistics, resources, sessions and food were of the highest of quality.

I really liked the variety of views and topics covered at this conference. This has been one of the best!!!

Michael Starbird, UTA. Effective thinking. I liked the interactive presentations.

1) Hands-on activities that were mentally engaging, 2) "Wisdom from the ages (experienced)", 3) Discussion, 4) Viewing and analyzing videotaped segments of students' explanations.

**What worked least well?**

The presentations that were lecture based.

Non-hands on and non-visual presentation.

PM Friday's presentation on Geometry.

The lectures were not engaging.

Having direct lecture/instruction for 1+ hour.

The style of presentation by some speakers. I would rather have PowerPoint as a visual and have the speakers add content that is not on the slide.

Thinking problems.

Mathematics Bigots like Askey advising that "There's one way to prove this" and "this can't be taught at \_ level."

"Lecture sessions"

All facets worked well.

Doing mathematics well beyond middle school preparation without making any connection to the conference theme.

**Suggestions for Improvement:**

Interactive activities to engage the participants.

There should be more opportunities for participants to have hands-on.

More mathematics in reference to hands-on or computer program on geometry would be nice to have.

Include more speakers like Vance whose activities were pedagogically aligned with NCTM.

Encourage participants to consider the need for differentiation.

Request that speakers have a more interactive presentation similar to Dr. Vance's presentation.

Have five minute breaks.

The conference went beyond my expectations. It was quite obvious that the organizers reflected on the participants needs and scheduled the presentations accordingly.

I think one or two speakers did not address his/her given topic. Greater communication may be needed.

More interactive presentations. Presentations with activities.

**Afternoon sessions on course design, content, and delivery:**

**What worked best?**

Appropriate format.

Again, this was very interactive and informative.

Teacher preparation is more than a sequence of mathematics courses. Field trip.

Having the opportunity to confer with guests and colleagues since this was not disclosed in advance.

The beginning of the discussion that increased teacher knowledge of multiple ways to present the mathematics and the need for a deeper understanding of the mathematics that they will teach.

Hands-on, experiential stuff.

Interactive sessions, especially after lunch.

The presenters were knowledgeable and gave valuable resources that can be shared at respective locales.

Supported by research and rich illustrations, speakers provided a wealth of mathematical ed. Concepts/knowledge. I really learned a lot through their modeling.

Teacher preparation is more than a sequence of mathematics courses. Joan Goodman, Genevieve Knight.

1) Hands-on activities that were mentally engaging, 2) “Wisdom from the ages (experienced)”, and 3) discussion.

**What worked least well?**

Eliminate evening sessions after 6 pm.

The solid lecture presentations without participant interaction.

Not having the same access to those conversations for local individuals since this was not disclosed in advance.

The discussion did not get to where there was commitment for working on the solution.

Having un-integrated speaker discussions.

Talking heads.

“Lecture” sessions.

It was a challenge after the well prepared lunch to maintain your focus on the afternoon sessions.

Understanding Mathematical Understanding. M. Kathleen Heid.

Doing mathematics well beyond middle school preparation without making any connection to the conference theme.

**Suggestions for Improvement:**

I would extend the time on the Kallam’s presentations on Mathematics Disabilities.

Schedule hands-on presentations in the afternoon.

There should be more opportunities for participants to have hands-on.

Include presentations that will involve the participants.

None of the speakers was able to share how their topics impacted/could impact the education of African-American students (overtly).

1) have courageous conversations about parental involvement and student culture of anti-academic success, 2) Overt teacher statements of “can do”, mathematics is a participatory discipline, hard work + determination + perseverance = success.

Food was great; Reduce lunch time 45 min instead of 1 hr 15 min; have active (engaged) workshops after lunch.

Turn on air conditioning. This place was too hot many times.

A bucket of ice at all times would be appreciated. It was too warm in the room at Coppin.

If this conference improves, it will become a vocation destination.

While some speakers provided moments for interaction, it would have been nice to have worked more as a group (small) among participants.

No lectures. More interactive presentation and hands-on activities.

Have closing discussions each day to bring us back to the workshop theme to help participants synthesize and extend what they are learning.

Please rate the following aspects of the workshop:	Excellent —→ Inadequate				
	1	2	3	4	5
Opportunities to interact with other participants	11	3	1	0	0
Opportunities to interact informally with leaders	7	7	1	0	0
Allocation of time to topics	6	8	1	0	0
Relevance of content to my own situation	7	6	2	0	0
Opportunities to visit actual classrooms (if applicable)	0	0	0	0	0
Guest presentations (if applicable)	4	10	1	0	0

**Additional Comments:**

Student musicians were great.

**Identify one discussion you (and others) got excited about. What prompted the discussion? Identify the issues that caused the excitement. Were they about mathematics, student thinking, something else?**

The following presentations were relevant and informative: Mon: Heid and Madison – very good and useful; Tues: Madison Video Clip – powerful and useful; Wed: Dr. Christian – museum was excellent; Thurs: Starbrid – very good, Askey – informative. The Museum was awesome! It was great to have NCTM President come.

Kallam’s presentation was very exciting and should have been longer. Dr. Knight’s presentation was also relevant to my situation. She gave me a number of ideas that will assist me in updating my course. Both presentations were relevant to today’s state of mathematics education. The ability to see what a student with a disability feels was eye-opening.

1) Teacher preparation is more than a sequence of mathematics courses; 2) Recognition of areas of teacher weakness; 3) the concept of language in mathematics; the differences in students’ language and teacher language.

A simulation of mathematics disabilities. The approach of the speakers and the issues covered with active participation of participants was exciting. Illuminating various forms of disabilities experienced by students. It covered mathematics, students’ thinking, and faculty.

The professor who presented his book “Heart of Mathematics”. It was quite interesting and our involvement made the topic/activity exciting and fun.

The problem solving was very exciting. This workshop allowed us to engage in problems that are appropriate for our pre-/in-service teachers.

I thoroughly enjoyed Dr. Vance’s presentation. He kept us mathematically engaged which prompted excitement about the potential applications could have for some of our students and future teachers.

1) There was a brief discussion about expectations and role models for under performing students. There was slight disappointment that there was not a greater in-depth discussion about possible solutions in the larger whole group setting.

1) Video RealPlayer – when presenters showed real-life/classroom demonstrations – student thinking; 2) Mathematics disabilities – recognizing others frustrations

Mathematics disabilities prompted by presentation. Simulation provided an alternative perspective to what is typically considered.

I enjoyed Irving Vance's presentation on patterns and plan to use many of his ideas in several of the classes I teach. I was intrigued by Michael Starbird's presentation, especially his discussions of infinity and the 4<sup>th</sup> dimension.

The discussion of Mathematics Disabilities was very enlightening. In some cases the instructor own mathematics deficiency creates students' challenges. Instructors must be able to identify Mathematics Disabilities in their students. That session covered students thinking and research that illustrates the need for identifying these challenges.

Bernie's advocacy in analyzing student work is important. I especially liked the video clips demonstrating students' misconceptions of fraction knowledge. Even at college, I will pay closer attention to my mathematics education students. Kathy H. also provided a very nice food for thought.

Effective Thinking; Resources for Teachers. Problems were very interesting. We discuss about different institutions and how to apply to our students. Problems are easily applicable to different level (elementary through college).

Mathematical disabilities. The presentation (as a simulation) was lively and helped us to visualize and empathize with students with disabilities. I wanted to know more about students' mathematical thinking and areas in which – being deficient – they would need focused support from the teacher. About 5 of us met with the presenters in the evening (Woodland Room) and discussed that issue and more!

**Was there an activity or discussion that failed to engage your interest? If so, can you explain it and explain why?**

All were relevant, different presentation styles, but the information was valuable.

I would rather not name any particular presenter. I will say that presentations were not engaging or hands-on did not keep my attention.

“School Geometry in the Elementary and Middles Grades.” I was expecting a discussion of content that focused primarily on the elementary and middles grades.

Dr. Askey presentation was not properly organized and out of theme most of the time.

The speaker in the afternoon on Friday how presented information on geometry. It was too long and uninteresting.

I had difficulty with the last presentation. The presentation did not model good teaching or activities that might be engaging with pre-/in-service teachers.

Not at all! Mostly the presentations are/were engaging.

Due to lack of sleep, I needed more interaction during all of the presentations.

Workshops that did not address how to teach teachers to teach students.

K. Heid. My use and application is minimal. Askey talked to 2 mathematicians and forgot about mathematics for the masses.

I think Kathleen Heid had some good information but it wasn't presented in a manner that allowed us to get involved. Dick Askey's presentation provided very little information that was appropriate for pre-service elementary teachers.

I wish the field trip to the R.F> Lewis museum provided more personal anecdotes dealing with African-American struggles in obtaining education Lewis provided a pathway to success. I think there is an opportunity to reinforce that our profession is to provide education, which will lead to greater success in life.

Understanding Mathematical Understanding. It was only lecture. After lunch, listening lecture without any activity was hard to concentrate.

The evening mathematics discussion seemed to lack a specific focus – addressed a sampling of different mathematics content, seemingly unrelated to each other, to our workshop work, or the workshop theme.

### **What did you learn from this Workshop?**

I gained a wealth of resources, contacts, and information that will benefit my students and university colleagues. I can now be an agent of change in my institution and community.

A lot. Things/topics that I can incorporate into my existing program to strengthen it and make it better. I appreciate having the opportunity to meet and network with other teacher's mathematics/mathematics methods courses to elementary pre-service teachers.

I gained new information every day and will list specifics below:

1. Singapore Mathematics
2. Graphing capabilities using T.I. graphing calculations
3. Black Saga competition
4. Reginald Lewis Museum and what it offers
5. How teachers cause mathematics disabilities.

Although I have infused multicultural concepts in my classes it was pleasant to hear Joan's presentation and Dr. Christian's presentation to validate and support what I am currently doing.

Better appreciation of different learning disabilities, reappraisal of understanding of learning pattern of students, infuse more critical thinking questions geared towards better understanding of concepts, application of real work problem solving technique.

I gleaned several activities and strategies that I will use in my summer course, "Teaching Problem Solving in Grades K-12".

Mathematics can be accessible for all students (and teachers). If we can instill that belief in our teachers (pre-service) we might have a chance to redeem ourselves as a nation!

1) Greater understanding of the importance of making connections with my students on a personal level, 2) I learned to reinforce the understanding of the mathematics with the use of group work, writing and manipulatives.

Be careful about reinforcement; correct mathematics thinking cautiously, don't bring mathematics standard down, make mathematics fun, if you expect students to fail – the will, teachers need to do things beyond what they are assigned to teach, have students explain – it bring reality to classroom.

Quite a bit. "May I have your attention please?" Culture and differences and adherence to a schedule. Appearance is important and usefulness may be less important.

This workshop reinforced many of the pedagogical and conceptual ideas I've been promoting for those teaching at the elementary level. There were also several techniques for teaching certain concepts that I hadn't seen before. I didn't see that African- Americans learn differently from others, but the perception of their ability to learn tends to be less than accurate.

Teachers at all levels have common challenges in mathematics regardless of grade level. That there are many proven effective strategies that can be of resources to teachers who are struggling in their classroom.

Providing multi-cultural views in mathematics in important. Greater analysis of students' work is important. Great insights! Really appreciate sharing the experience. We need to maintain a high standard.

There are different grants for educators (PMET and TI). How to use diversity in mathematics classrooms. Different hands-on activities, which I will definitely use in my classroom. Special education presentation was great. I learned about learning disabilities in mathematics.

I gained a new or deeper insight about:

- Mathematical disabilities
- Ways to make African American history more appealing in the mathematics classroom
- Another way to visualize and develop the fourth dimension

- A way to model the sum of an infinite sequence differently or more complex than the ones I've done before
- About GDB feature or graphing calculator and had opportunity to see TI – smart new work.

**Tell about your experience at this PMET Workshop on discussing issues and interacting with people from other fields. The participants were not all from mathematics department or mathematics education departments, or even from universities. In what ways did that affect your experience this past week?**

Learning and hearing others perspectives about mathematics, mathematics education and teacher preparation will serve me well in my future endeavors in an educational setting. It seems to me that we all have similar problems and challenges in our particular schools or institutions.

The exposure and just meeting these folks broaden my knowledge base.

In-service Teachers: Discussions with these ladies were extremely beneficial. Since each one continues to work with students, they present a view of realism. They bring perspectives to mathematics educators and teacher educators of the practicing classroom teacher. It is easy to omit and/or forget the pressures of the regular education teacher when discussing what teachers need to know and do. Ms. Powell is an excellent resource. Pre-service Teachers: My discussions with the CSU teacher education majors provided additional insight that will help me as I plan for instruction. Additionally, I was motivated by the remarks presented by Chancellor Kirwan. Side Bar: As a participant, I felt wonderfully welcome. Everyone involved in hosting this institute was supportive and willing to address whatever we needed. The lunches were beautifully presented and were so tasty. Thank you so very much!

The week at the workshop was very productive. Exposed to different way of teaching using graphing calculator. Gained more insight into disabilities in students, especially in the area of mathematics.

I take home with me a rich experience of a State, that has a rich background historically and a university that is very connected to the school district and community in the surrounding areas. This is so wonderful. I was extremely impressed with the speakers and visitors. They were rich in information. The meals were excellent. I am so pleased that I had the opportunity to participate in the workshop – Thank you!!

My course, Diverse Learners, will be richer because of the Kallum presentation. This was extremely useful!

The various backgrounds of participants made the experience rich. While I feel certain individuals from the K-12 public/private sector could benefit from the experience, I am not certain that it was valuable say for an elementary teacher. However, the participation of the teachers of elementary students definitely offers a much needed perspective to be heard.

The PMET workshop gave me the opportunity to speak and listen to people from the different areas that impact future teachers and students. The discussions gave me a better understanding of the turf war between the PhD mathematician and the PhD mathematics educator. I believe that a truce should be called and everyone should work for the benefit of the future teachers and their students.

Having different career paths helps other see educational issues thru a different lens. We can learn from one another strengths. Thanks for the time to reflect and network.

Caused me to think in different ways.

I enjoyed the interaction between participants, but believe the differences in mathematical training were sometimes difficult to reconcile.

The conference was a fruitful experience giving the opportunity to interact with professionals from diverse backgrounds. The quality of instruction was at the highest level.

I especially enjoyed being with other minority faculty members. At NY, I taught 3 years teaching mathematics at Bronx. My experience was not very good and the PMET experience totally changed my view about African-Americans in general. I feel much more comfortable being around them and I am very glad that I came.

I talked to almost every presenter and participant; we exchanges different teaching ideas and thoughts on diversity application in the classroom. Course requirements for certifications in different states.

This has been one of the best workshops I've attended. The mix of participants has helped to make that possible –mathematics educators in Mathematics or Ed Dept, mathematicians, classroom teachers, and others representing the various administrative roles. We have had discussions during activities and during every free moment we've had. We brought different perspectives on many topics, and had different areas of expertise to blend together.

**PMET Elementary Workshop: El Paso Community College  
May 22 – May 26, 2006**

**Evaluation Summary**

The PMET Workshop conducted in El Paso, Texas at El Paso Community College had 20 participants responding to the evaluation survey. Participants were overwhelmingly positive in their feedback about this Workshop. Particular features receiving positive comments included:

- Almost all the respondents (16 out of 20) ranked *opportunities to interact with other participants* at the highest level. As one respondent stated, "I had a positive experience this week because I was able to discuss what we were learning with people from different areas, departments and schools to get a different perspective. Another participant, reflecting on what

they learned during the workshop added, “Because of the mixture of people, I obtained a better general picture of how people may teach prospective elementary teachers. I also had a chance to exchange ideas on general teaching issues with two colleagues in a community college. This was a great experience for me as well.”

- A majority of the respondents (15 out of 20) ranked *relevance of content to my own situation* at the highest level. One participant stated, “His [Dr. Wu] presentation was well structured and relative to courses I will teach.” Another respondent noted, “I surely learned a lot from this week particularly, effective way to approach students and get topics delivered.”
- The participants enjoyed hearing from a diverse set of speakers and having discussions with mathematicians, mathematics educators, and teachers. As one participant noted, “Diversity provides greater context and specialized information. It was nice to have a physicist and a statistician as presenters. It was also helpful to see that pedagogic issues/ concerns do not seem to differ greatly from one part of the country to another.”
- The participants repeatedly mentioned Dr. Wu, Dr. Kader, and Dr. Romagnano’s presentations as being engaging and enlightening. Clearly these two presenters were well received by the participants. As one participant stated, “Drs. Romagano and Kader presented material that I know will be extremely useful in my teaching.” Another participant noted, “Dr. Wu’s presentation was also marvelous; the transformation of objects in the plane is the heart and soul of congruence and similarity, which is the core concept in high school geometry.”

Comments specific to particular aspects of the Workshop included:

**Morning demonstration course sessions:**

**What worked best?**

The presenters were very engaging and enthusiastic.

Sessions conducted by Dr. Kader and Dr. Romagnano. Sessions on technology and mini-lessons were great. Everything worked well.

For me it was the statistics workshop by Gary Kader because he really demonstrated the ways of explaining statistics in my elementary class.

Everything.

The idea focuses all of us in getting ready for the day.

I liked all the morning sessions; I have no complaints.

All the morning sessions were helpful to me. I will be able to use most of the ideas in my classes.

The guest speakers – wonderful ideas!

Group work! I enjoyed all the problems work.

I liked the student participation sessions and the morning lectures. Presentations allowed me to see various ways of conducting elementary teachers' courses and morning lectures provided their views to compliment the presentations. Both of these were great ways for me to open to other ideas.

CD's and activities. Items to take home: All such activities were most valuable.

Hearing the students' take on the demo course.

Tuesday was the best day I attended. I missed Wednesday. I found that all three presentations were helpful and could be applied to myself and my classes.

I am very impressed about Dr. Romagnano's presentation on how he restructured the mathematics course for elementary school teacher in his campus. The next day, Dr. Duval modeled discovery-based teaching and learning. The sequence of the sessions fit perfectly. Dr. Wu's presentation was also marvelous; the transformation of objects in the plane is the heart and soul of congruence and similarity, which is the core concept in high school geometry. His presentation makes the rotation, reflection, translation so easy to understand, this lead to the understanding of congruence and similarity. I wish we could have more these type of workshop/professional development to expand our conceptual understanding of these fundamental mathematical concepts.

I liked those guest speakers and their workshops.

When we were actively participating.

The problem presented by Dr. Art Duvall. The presentation by Dr. Hung-His Wu.

Lew Romagnano's workshop. Bill McCallum's workshop. Gary Kader's presentation.

It was interesting to see the different approaches students used in problem solving.

**What worked least well?**

There as not one that worked "least" well but some talks needed more motivational (technology) to keep us more involved in discussion.

Some discussions got going right after we needed to go on break.

Student "lessons."

In the distance problem I saw a few problems with how groups did problems which were not really mentioned although that may have been because of time. Also in this exercise I noticed one group did not interact much.

It would've been great if we had more interaction among the participants. For example during the breakfast and welcome session, participants could form some informal chatting groups. I mean chatting on teaching. ☺

Lectures without hands-on activities.

One "demo course" was more of a lecture about a piece of technology, not so much a course, and so was not so useful to me.

The organization of discussion with Local Elementary Teachers: it is a good idea that did not have sufficient time to plan ahead. It would be nice to have in-service elementary school teachers shared their experience, concern, and their opinions about whether college and university adequately prepared them to teach mathematics class in elementary.

The guest speakers should be given more time.

When we were not participating and the speaker was just speaking.

Discussion of questions (memorization devices, ethnomathematics, 3 concepts entering and leaving, etc...).

**Suggestions for Improvement:**

Have one person to be at the front to register last arrivals all week.

More thought into lessons – perhaps some time for “instructor” to interact with students before lesson. Is there a way for “observers” to hear conversations in student group work?

Maybe some kind of microphones on tables that could be switched on and off for each group to be able to hear the discussions in solving problems.

No lectures in the afternoon when people get tired and sleepy.

Have more than 2 morning’s worth! Get someone (other than the instructor) to moderate the session.

Elementary school teachers may be intimidated to come and present in front of college and university professors and instructors. Can we video tape the interview? Also can we video tape their actual lesson?

How about make the workshop more intense but last shorter, say, 3-4 days instead of a whole week?

Include more hands on problems as provided in this workshop.

More time on Romagnano’s presentation. Shorter overall program, maybe 3 days would be enough.

**Afternoon sessions on course design, content, and delivery:**

**What worked best?**

The variety of the topics.

Technology sessions. Again, sessions by Dr. Kader and Dr. Romagnono. Everything worked well.

Again, stats, he really gave us all something to start talking about among our community college and university.

Everything.

Most of these gave us very interesting practical and useful information. They were also very diverse. All/Most were from people still in classrooms.

The presentations with activities worked best because I was a little low on energy in the afternoon.

All the afternoon sessions also provided me with ideas how to better organize and present the topics in my classes.

Continuation of guest speaker's talks

Not sure what sessions you meant. Really loved Lew R's presentation on his different way to teach mathematics for pre-service elementary.

I absolutely loved hands-on sessions.

Ideas shared by groups and individuals.

The first 3 were all very good. Lew Romagnano's summary of a course package was most useful to me. A mix between presentation and audience participation worked best.

The session presented by Dr. Kader was very hands on and most participants are engaged in the activity.

When we were actively participating.

Involvement of the students.

The presentations by Dr. Paul Mason, Dr. Olga Kosheleva, and Dr. Hung-His Wu.

Gary Kader's statistics hands on in the afternoon. Kept us awake.

Drs. Romagnano and Kader presented material that I know will be extremely useful in my teaching.

**What worked least well?**

They were all excellent.

The sessions mostly involved us doing some activities while we are discussing the class.

I really don't think the Alternative Certificate program really pertained to me.

Repetition of some comments. Group sharing should be limited to new contributions.

Prof. Wu gave us a (good) summary of a (good) college geometry course, but I did not learn much new from it. It was not very interactive, except for one activity at the end and that was more tedious than instructive.

I did not see the relevancy of UTEP ACP, I have the impression that they presenter felt that education courses are irrelevant, pedagogy is not the issue, the most important things is teachers' mastery of content knowledge. I personally do not fully support the presenter's point of view on the problems that exist in our educational system.

When we were not participating and the speaker was just speaking.

Dr. Koshelenva's workshop. Alternative Teaching Certificate program.

**Suggestions for Improvement:**

Better presentation and wrap up of some speakers.

Everything was wonderful.

More time for sharing. A product for us at the end.

Try to schedule more dynamic presentations in the afternoon.

Afternoon speakers should have more advanced notice (especially Tues speaker)

I think we really needed the break 2:00 – 2:20 to be used as a break. One tends to be a little too occupied with the digestion after lunch and cannot concentrate on a lecture/activity for too long.

Find a way to have more people participate in these workshops either by release time, stipends, or by dividing the presentations over the school year and presenting on short segments; possibly on weekends.

Since 3 of the 4 were so good, I don't have any.

Invite elementary, middle, and high principals, teachers from various grade levels, other MSP staff developers to share their experience and talk with participants about their vision of educational reform. The feedback and evaluation form would be email to us and we can email back to you after the workshop is over.

Have the participants walking around seeing the students work in groups – it was hard to hear what students were doing.

Include more hands on problems as provided in this workshop.

A) The use of technology is important but the vignettes were addressing very elementary mathematics problems, they were not challenging. Seems the students learned more how to use the camera, editor, and software than mathematical concepts. B) It didn't really help us improve our teaching or engage us in any way. Speaker was very boring.

Please rate the following aspects of the workshop:	Excellent ————— Inadequate				
	1	2	3	4	5
Opportunities to interact with other participants	16	3	0	0	1
Opportunities to interact informally with leaders	12	4	2	2	0
Allocation of time to topics	11	8	0	1	0
Relevance of content to my own situation	15	4	0	1	0
Opportunities to visit actual classrooms (if applicable)	2	3	4	1	2
Guest presentations (if applicable)	15	1	1	1	1

**Identify one discussion you (and others) got excited about. What prompted the discussion? Identify the issues that caused the excitement. Were they about mathematics, student thinking, something else?**

One of the things that I liked was the hands on activities and information that the presenters provided. I believe that they topics covered gave me the opportunity to have a deeper understanding in topics of congruence and similarity. These topics were covered by H.H. Wu.

Again, I would like to point to the presentations of Dr. Kader and Romagnono as most interesting. Both stressed conceptual knowledge and demonstrated how to organize activities that strengthen students’ conceptual knowledge. Another presentation that initiated interesting discussion was the presentation by Gabriel Mendoza on the use of “clickers” in mathematics classroom. What is important is that both students and faculty participated.

The topic by Lew Romagnano because he is using stuff we are barely developing at EPCC so we started to talk about this between colleges (campuses) and the university.

Religion, Di Vinci Code

The session at Metro State mostly because we are getting ready to go in that direction and the presenter was so graciously willing to share his work. We are going to use some funds to prepare this summer to use the problems by Lew Romagnano in our 1350 and 1351 courses. This will be a way we can plan as a group and also we will meet in groups throughout the year and revise as needed.

I was very excited about Lew Ramagno’s reorganization of his mathematics classes for pre-service teachers. I have been trying to reorganize my classes in this way and it was wonderful to have someone share all of the work he has done.

Bill McCallum’s presentation and discussion of the course they are developing at University of Arizona sparked much discussion with my colleagues regarding hoe to improve our elementary teacher education course in mathematics. The discussion was on how to teach the mathematics to analyze student thinking and also the work with our deans to have more time to better assist our students learning.

Discussions with Dr. Wu were wonderful! I like the way he thinks.

I felt very excited about the problem solving approach to teaching mathematics for Elementary Pre-Service Teachers. Talking about different ways to present material was exciting.

Bill McCallum's talk on 5 Strands of Mathematical Proficiency was really interesting. We tried to identify the strands present in a problem that we all went over in groups. We finally decided that the strands are somewhat subjective and it's hard to make up good questions to measure all of the strands. It made us to think how to prepare good questions.

Probability and statistics. Watching Dr. Duvall teach. Excitement was over advancing my knowledge and perspective on the mathematics and student thinking and methods.

Two discussions:

1. The presentation on alternative certificate evolved into a discussion about more generally the coursework for pre-service teacher preparation.
2. Lew Romagnano's presentation prompted lots of general agreeing murmurs. Later I had a nice discussion with someone from a nearby institution about coordinating our 2 programs, possibly using Lew's materials.

When we worked in our groups and talked about what we did or expect in our classes, this allowed a more personal connection to what we and others are doing (Tuesday morning).

The majority of participants were excited about Dr. Romagnano's detail presentation of how he reformed the mathematics course for elementary school teachers in his campus. Most of the participants in the workshop are frustrated about the level of mathematics skill and conceptual understanding our students possessed. Most of participants are excited about the alternative approach Dr. Romagnano incorporated into his mathematics courses seems to bear positive results. Dr. Romagnano generously shared his instructor's guide with participants and we think we get a blue print to start our restructure of the similar course here in EPCC. Personally I am looking forward to applying what I learned from Dr. Wu about transformation and finding area. I learned a better more efficient strategy to introduce congruence and similarity and finding area of different shape, even the shapes are irregular.

Dr. Wu's workshop about geometry. He helped me to get profound understanding of these commonly used geometry concepts.

One discussion was about the way one of the presenters teach his class. We were excited to get his CD so that maybe we can use this more often.

Lew worked out a format that many of us would like to use in their format. He uses a structure for teaching that helps teachers involve students to learn by discussion.

The problem regard SAD & MAD presented by Dr. Gary Kader. The presentation by Dr. Hung-His Wu regarding areas. His presentation was well structured and relative to courses I will teach.

Lew Romagnano's workshop got us all excited because for a few years we've been trying to find a program such as his where the students are taught problem solving skills. His program resembles the Japanese way of teaching mathematics. It's wonderful that he has all the lessons written out with pedagogical aids for the instructors. We hope to adopt this program at EPCC.

I was thrilled to receive actual materials that can enhance my teaching.

**Was there an activity or discussion that failed to engage your interest? If so, can you explain it and explain why?**

Everything was very interesting.

The ATCP because I was not shown what resources (physically) are being used to teach these teachers through ATCP.

The session by Mason.

Paul Mason from Doña Ana Community College. I felt he was unorganized and underprepared and **way** below the level our students are at.

None did. I was able to use little too much of the activities and discussions to improve my teaching.

Paul Mason's talk – measurement in mathematics – was a bit too disorganized.

Alternative Ed Certificate. Just didn't pertain to me.

I was a little confused about H. H. Wu's presentation on Geometry. I am familiar with all of the content material he presented but I find that content to be abstract. I wasn't sure (and am still not sure) as to how to make some of that abstract material clear to students. He said that he's not presenting the material as we would tell our students but then I don't know how to present that material to my students. I have struggled with trying to explain that content to linear algebra students before.

Alternative teaching lecture.

The presentation on measurement. The presenter did not seem aware of some relevant changes in mathematics classroom in recent years concerning geometry and measurement. He seemed to think we still focus on memorizing formulas.

Everything made me think about how to improve the class.

The activity of finding density personally I would not care about it one way or the other. I do not really understand the formula; the presenter seemed piled too many activities into the session.

The guy that talked about Alternative Teaching Programs. I did not think it fit with the rest of the program.

Teaching Measurement in Mathematics. I had already seen this presentation at the NMMATYC conference. Too much time is spent on deciding whose measurements to use for the experiments.

Alternative teacher certification was less engaging, partly because I am not living or working in Texas.

### **What did you learn from this Workshop?**

I learned several methods of application of mathematical methods that I will be able to apply in several of my courses. (Not only my mathematics education courses). The videos at (Bernie Madison) gave me the opportunity to observe and digest some of the mathematics (misconceptions) in fractions. I believe that I will use this video in my mathematics education courses.

First of all, I found out that EPCC has a lot of wonderful mathematics instructors, who design innovative lessons; try to incorporate technology, manipulatives, etc... Also, I met several mathematicians who came from other cities. I had a chance to share their experiences with me. We found that we had common difficulties with educational students disliking mathematics. We discussed how to deal with these problems, and shared positive experiences.

There is too many to list in this page. But as a first year teacher this really summed up my examples, problems, difficulties, methodologies being address at other institutions. My eyes are opened to new suggestions and my knowledge of teaching has really been exposed to new material that I can take back into the classroom.

A lot! Just be a (tiger) and give workshops of your own.

There are many facets about preparing elementary teachers. It helped to get a clearer picture about what an overwhelming job it is to figure out what it means to prepare these elementary teachers to teach mathematics.

I learned a lot of things to take back to my classes for teacher pre-service teachers:

- Specific activities for many topics
- Using video studies
- Reorganizing the class

I learned that as educators of pre-service teachers, we need to address both that the beginning teachers understand the fundamentals of mathematics and to be able to analyze their students thinking during the learning process.

Each of the guest speakers gave me something new (a new direction) to think about (why) teaching.

Very much! I feel I learned so much in many different areas. New materials and technology to use – new ways and methods to teach material – new and different techniques and ways to look at things.

Many different ways of teaching the mathematics for elementary teachers' course. I've learned that the other people have different pre-reqs for this course and their students take more mathematics. They also have a different perspective as to how students should approach, meaning which methods they can use, what type of background they expect, etc... I was also pleased to know that there was at least one other school who used the same style as I did.

A reinforced value of "problem-solving strategies", "hand-on activities" and need for probability and statistics.

I finally understood standard deviation! I understand better the 5 strands in Adding It Up and how they relate (esp. strategic competence) to algebraic thinking. How videos can be used in class to show student thinking and motivate pre-service teachers.

I have as much to learn as my student so that I can be the best they need to be.

I learned that engaging students in their own learning will be more productive; students will have ownership in their learning. In a problem-base learning environment, students would have first hand experience on how to work in unknown situation and try to collaborate with their teams to find the possible solutions. As student struggle on their way to discover solutions, students need to utilize many different mathematics concepts to design their strategy in solving the problems; in turns they could have a deeper understanding of the mathematics concept. If more mathematics classes use this kind of problem-based learning approach, students will gain more confidence on problem solving in an unknown environment; and they would be more adapt to face challenge later in their work and work with co-workers as a team.

I surely learned a lot from this week particularly, effective way to approach students and get topics delivered.

I learned that people all around are trying to do the same things.

There are plenty of ideas that I can use in my classes. Technology can be used in class. The book does not need to be the center of class.

To research other method, methods of presentation a specific topic in the text book being utilized.

I learned how important it is for our future teachers to understand students thinking. It reinforced my belief that students need to learn problem solving by engaging in problem solving repeatedly and regularly. It gave me creative ways of teaching statistics, algebra, geometry, and measurement.

More than I can list! I feel that I now have greater clarity regarding the teaching of content vs. method.

**Tell about your experience at this PMET Workshop on discussing issues and interacting with people from other fields. The participants were not all from mathematics department or mathematics education departments, or even from universities. In what ways did that affect your experience this past week?**

I was able to learn how different people cover similar topics and how their students tackle similar problems. I also learned that I need to work to devote more time to some topics that students need more help by providing them with more hands on activities and group participation.

Even though not all participants were from mathematics or mathematics education department, I think the common goal was improvement of education by teachers. How this experience affected me? I decided that we need more collaboration between UTEP faculty and EPCC faculty. Another great opportunity for both UTEP and EPCC faculty to present with the students GEPCTM.

I enjoyed the blend of EPCC and UTEP and outsiders coming together and talking after every speaker and during lunch and discussing their ideas and our goals for our future elementary teachers.

I have a wonderful experience of meeting professionals from other colleges and universities as well as EPCC where I am currently posted. I have wonderful conversations including religion, world politics and teaching of mathematics, of course.

The experience by hearing, working with, and interacting with both mathematicians and mathematics educators. This is rarely something people get to do for an entire week. I believe we all grew from this.

I have to admit that I mainly interacted with those that I already knew, but I felt that for the (team) of us that teach these classes, I think we can be more unified in our approach and working together to pool our resources.

I had a positive experience this week because I was able to discuss what we were learning with people from different areas, departments and schools to get a different perspective. Also, I realized that many of us are working on the same issues.

It has been a good opportunity to interact with people from other EPCC campuses and UTEP on a more informal basis (not committee work). This was a “commuter” workshop – but I think the organization of the workshop gave everyone a different platform to interact - in a good way!  
Thanks!

I learned so much and met so many wonderful, friendly, helpful, and generous people. I feel very excited about trying many of these things. I value all the new friendships I have made this week. Thank you to all who made this workshop possible!

This question is partly addressed above. Because of the mixture of people, I obtained a better general picture of how people may teach prospective elementary teachers. I also had a chance to exchange ideas on general teaching issues with two colleagues in a community college. This was a great experience for me as well.

All participants were from mathematics, that I worked with, and all contributed valuable suggestions and ideas.

Actually, all the participants were from mathematics and mathematics education depts., and all were from community colleges and universities. (Except one who is in the school district, but was a recent graduate from our masters program). I already knew all but a handful of participants. The 3 out-of-towners provided a little but only a little diversity, but their situations seem very similar to ours.

I enjoyed the interaction with the people participating in this workshop. Everyone has unique contributions to offer.

Most participants are educators and we have open discussion about many issues in our existing education system. We may not be able to find the solutions, but I do walk away with different perspectives on many issues.

All members from my group are in mathematics dept. But we shared a lot of tricks each used in classroom.

The experience was great it just took a lot of dedication from us because we are supposed to be on vacation and these sessions are from 8 to 5. Besides that it was ok.

I feel that all participants share common goal of improving their teaching methodology to the students.

Diversity provides greater context and specialized information. It was nice to have a physicist and a statistician as presenters. It was also helpful/listening to see that pedagogic issues/ concerns do not seem to differ greatly from one part of the country to another.

## **PMET WORKSHOP REPORT**

**Fresno, CA, 2006**

**A regional workshop for Fresno State University and its feeder Community Colleges**

### **Basic Information** (See the attached flyer)

#### **Name**

Teaching Mathematics to Future Elementary Teachers

#### **Dates**

June 5 – 9, 2006

#### **Site**

Fresno State University, Fresno, CA

### **Site Coordinators**

San Joaquin Valley Mathematics Project  
Lisa Portella, Agnus Tuska, Carol Fry Bohlin

### **Leader(s)**

Dale Oliver and Phyllis Chinn

### **Faculty**

Dale Oliver (Humboldt State), Phyllis Chinn (Humboldt State), Patrick Callahan (University of California, San Diego), Lisa Clement (San Diego State University)  
With guest faculty Jeanie Behrend and Melanie Wenrick (Fresno State University)

## **Successes and Difficulties**

By all indications, the week-long program was very successful.

The workshop came together under the cooperative efforts of the San Joaquin Valley Mathematics Project and Fresno State University Faculty from the math department and the school of education, and the regional PMET coordinator. The local organization included recruitment of students for a “lab class” and commitment of local funds to provide the participants with a stipend for their participation. This latter commitment proved to be very valuable, as all available slots in the workshop were filled. The Fresno State Faculty also provided mechanisms for follow-up dialogue among the community college and university faculty during the 2006-07 academic year. The PMET regional coordinator provided faculty and the “PMET Model” for faculty development. The model seemed to fit well within the context of the local organization and regional needs. The content focus, many of the attending faculty hoped that we would return to Fresno, perhaps with a different content focus.

Difficulties: There were a few logistical barriers to pre-planning of the workshop that precluded us from making meaningful pre-workshop assignments for the faculty. Often such assignments are intended to give a common knowledge set about the issues and challenges in preparing prospective teachers mathematically. Fortunately the regional group already had enough in common from their experiences in working within the service area for Fresno State University to provide a basis for moving forward. Another slight difficulty was the non-residential format of the workshop. Although the group was very hard-working and focused, missing out on the informal evening working groups and discussions that have occurred in other PMET workshops was missing.

## **Approximate expenditures**

The expenditures from PMET for the Fresno workshop were approximately \$15,000.

## Participants

First Name	Last Name	e-mail	School
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Shawn	Jackson	shawnjackson@westhillscollge.com	West Hills College

### *Demographic Information*

8 female, 17 male; all from California; 1 university, 4 community colleges

Fill-in degree types

- 7 Ph.D. Mathematics
- 3 Ph.D. Mathematics Education  
EED
- 15 Masters, Mathematics  
Masters, Mathematics Education  
Masters, Other

Ethnicity – Unsure (did not collect this data locally).

In the initial one-year extension the following limited set of activities were undertaken.

A. Last summer a workshop on fractions was organized at Ann Arbor, involving leading mathematics educators and mathematics interested in the teaching of fractions. Note that the report of National Mathematics Panel placed heavy emphasis on fractions as a critical foundation for learning algebra. The notes of last summer's workshop will be posted on the PMET website by Dec 31, 2007. We plan to have a follow-on workshop next summer in association with the Park City Mathematics Institute (PCMI). The workshop will be devoted to drafting syllabi and sample lessons for units about fractions, based on the guidelines sketched out at last summer's workshop. Last summer's workshop revealed that some mathematicians and mathematics educators have differing concerns about fractions instruction. It was felt that the most constructive way to resolve these concerns was to move away from statements of principles and focus instead on actual classroom instruction. Resolving these concerns is critical to developing widely accepted strategies for improving fraction instruction.

The 20-25 participants at next summer's PCMI workshop would include mathematicians, mathematics educators and school teachers. Estimated cost = \$100,000, including planning and post-workshop polishing/web-publication of unit plans.

B. Last summer, PMET sponsored a conference at Wingspread about quantitative literacy in non-scientific college majors. This topic reflected an awareness that quantitative literacy for future elementary school teachers cannot be isolated from the quantitative education of the broader cohort of non-scientific college students to which future teachers belong. The Wingspread papers and discussion notes will be published next year as a Mathematical Association of America Reports volume. The cost is estimated to be \$25,000.

C. This past year, PMET gave mini-grants to two research university mathematics departments, at Univ. of Georgia and UCLA, where there was substantial interest in pre-service and in-service aspects, respectively, of teacher education. (The earlier PMET minigrant program had no participation by major research universities.) UCLA, led by former chair Ted Gamelin, has been involved in a range of professional development activities, including a state-wide outreach program to teachers. Out of the materials developed for professional development came a new preparation-for-algebra textbook that was just chosen for use in all California 8th grade classrooms. Last year, the UCLA Math Department received the annual AMS award for Excellence of a Mathematics Department, in part for these efforts.

In June 2007, the UCLA Mathematics Department established the Philip Curtis Center for Mathematics and Teaching. The Center, dedicated to developing and supporting pre- and in-service teacher development, is named for former department chair Phil Curtis who not only made major contributions personally to improving school mathematics instruction in California but also championed involvement in school mathematics among UCLA mathematics faculty. If funds are available after covering the costs of A and B above, PMET would like to help seed some of the worthy start-up activities of the Curtis Center. We see the UCLA Mathematics Department's efforts in teacher education as a model that other mathematics department should seek to emulate.

