Summer 2005

Mathbits

Spring Conference Highlights

Cool but pleasant spring weather welcomed Minnesota mathematics education professionals to the shores of Lake Superior for the 2005 Spring Conference jointly sponsored by MCTM and MinnMATYC. On Thursday, April 28, participants in the Seventh Symposium on Mathematics Education focused on "Classroom Assessment—Connecting Mathematical Understanding with Instruction." Keynote speaker Dr. Ken Vos had participants analyzing their own views and understanding of assessment, evaluation, and testing as well as examining common misconceptions. His presentations included active problem solving and humor as means to engage all participants with the issues around the theme of the session. Symposium participants also had the opportunity to work in grade level groups examining cases of student work on assessments and in mixed grade groups to design tasks that could be used to assess students mathematical understanding at a variety of levels.

The conference theme "Quality Teaching: The Key to Understanding Mathematics" was carried out in two days of exciting, active, informative, and productive sessions and workshops designed to inspire and interest everyone from preservice teacher education students to seasoned veteran teachers. It was evident that Minnesota has many high quality mathematics teachers because Minnesota's teachers never cease to be learners themselves.

Conference attendees were entertained and challenged Friday evening by the unique spin Laurie Boswell and Don Balka put on the six *NCTM Principles* as the Patriots and the Colts battled it out to demonstrate their knowledge of the curriculum, learning, teaching, assessment, technology, and equity principles. The conference closed on Saturday afternoon with James Rubillo's presentation "Why study math? Finally giving students, parents, and the public and answer that makes sense." Rubillo emphasized that mathematics is not just a set of rules, skills, and procedures, but that mathematics is characterized by the types of questions that are explored. The questions that mathematics explores are actually "life's questions" examined from a quantitative and logical point of view. A copy of Rubillo's list of "Life's Key Questions" relevant to all persons in all applications of life has been posted on the MCTM website.

Honors and Recognitions

Martha Wallace was awarded Honorary MCTM Membership in recognition of her long and dedicated service to MCTM and mathematics education in Minnesota. Excerpts from Nancy Nuttings' introduction of Martha at the Friday evening banquet are as follows:

"I am pleased to share some of Martha Wallace's con-

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Plan to attend:

Fall Conference
Andover HS
October 21

See p. 21

Pondering by the President

Karen Coblentz
MCTM President

Happy Summer! I hope your school year ended with wonderful memories and anticipation of next year! The end of the school year is always busy, chaotic, and wonderful, all at the same time. As principal of an elementary building (K-4), I know how excited the students and the staff get! One of the joys of working with elementary students is the precious stories they share. As I was doing bus duty one day, a kindergarten boy, who struggles in math, came by me and said, "There's my bus! A 2 and a 1! (Bus 21)." He continued to his bus, and then stopped suddenly, causing the domino affect to happen down the line. He ran back to me, and emphatically stated, "No! I was wrong! That's a 20 and a 1!" Isn't it great when students are developing a wonderful base for number sense!

First of all, I would like to thank our 2005 Spring Conference chairs, Don Karlgaard, Denise Anderson, and Jeannine Salzer for putting on a wonderful spring conference. We also thank Judy Stucki, our program chair for putting together a spectacular program. These are all volunteer positions, and we thank these people and everyone else who worked hard to provide us with a professional development opportunity.

This coming fall we will have our Fall Conference at Andover High School. I hope many of you can take advantage of this professional development opportunity. Not only will great sessions be offered, but it is also a great time to network with other math educators from around the state and around the country.

As I begin the presidency of MCTM, I ask for your help in communicating with our membership. Please note my email address and drop me a note if you have a question, concern, or comment. *I look forward to hearing from you!*

Karen Coblentz
Karen.Coblentz@dc.k12.mn.us

District Directors' Corner

Kaye Tavernier
Director, District 8

MCTM's eight district directors were glad to see all who attended the district meetings on Friday at the Spring Conference in Duluth. Special thanks to the teachers who gave up extra time to participate in the delegate assembly later that afternoon. We depend on members' input to determine MCTM's efforts each year.

In order for MCTM to best represent the interests and concerns of Minnesota teachers of mathematics *we need to hear from you!* Besides giving input at the spring conference we hope you will feel welcome to contact your district director or any officer of this organization whenever you have an issue or question you think we might help with.

One of the concerns raised by many teachers is the challenge of getting all students to take the MCA's seriously, especially the older students. What does your school do to ensure that students try their best on the MCA? Are the MCA results reported on students' transcripts? Do the MCA results in any way impact coursework for students the following year? Does your school celebrate MCA results somehow?

If your school district has found a way that appears to help motivate students to do their best on the MCA's, please send a description of the strategy to your district director. We would like to share the ideas with others statewide. For example, in Cook County we entered a float in the town festival parade with students from a class that all got passing scores.

To determine your MCTM district by school see www.mctm.org/board.html.

Dist 1	Bill Putnam	putnamw@rconnect.com	Dist 5	Jane Kostik	jkostik@mpls.k12.mn.us
Dist 2	William Johnson	johnsonb@district112.org	Dist 6	Margaret Williams	margaret.williams@anoka.k12.mn.us
Dist 3	Rose Gundacker	rosemary.gundacker@district196.org	Dist 7	Sonja Goerdt	dsgoerdt@mail.mainstreetcom.com
Dist 4	Deb Guthrie	Deb.Guthrie@moundsviewschools.org	Dist 8	Kaye Tavernier	ktavernier@isd166.k12.mn.us

Reflections and Observations on April 2005 MCTM Spring Conference

Nancy Berkas, Chairperson

NCTM Affiliate Services Committee

Central 2 Region Representative

As the Central 2 Region's Representative for the NCTM Affiliate Services Committee (ASC), Nancy Berkas has the opportunity to visit and participate in numerous state and regional mathematics conferences. Here's a listing (in no particular order) of thoughts she shared with us at the MCTM Board Meeting about what makes our Duluth Conference so special:

1) The **CONNECT Project** is an outstanding example of outreach! With the current NEA estimation that 55% of our new teachers leave the profession within the first five years, the kind of support and encouragement that Connect offers our preservice and new teachers is crucial. I have spoken with Connect Coordinator Larry Luck and he is going to put something together for me to share with the entire ASC group when we meet at NCTM Headquarters June 10-12.
2) I was so impressed with the **Delegate Assembly**! We struggle each year at the Annual Meeting to help Affiliate Delegates & Alternates understand the purpose and procedures for our NCTM Delegate Assembly and yet here in Duluth this democratic process is alive and well. Hats off to all of the Delegates and the Alternates and to Bill Eppright for facilitating the process with professionalism and humor!
3) The **Program** was comprehensive with a great variety of offerings. My compliments to Judy Stucki and her committee. As a speaker myself, I was greeted by an MCTM Board member and presented a very thoughtful gift of appreciation. And my presider could not have been more welcoming and helpful. You need to know that at many state conferences the practice of having presiders has been abandoned – they just cannot get that many people to take on this task – a task that adds so much class and professionalism to a conference! Congratulations Minnesota!
4) Speaking of class – having the tables with coffee and tea in the aisles of the Exhibit was just a really nice touch.
5) Collaboration rarely makes a task easier or take less time, but it appears that MCTM's work with **Minn MATYC** is a win-win situation. Again, my congratulations!
6) The **Luncheons** were definitely a major highlight of the convention. Not many state conferences have the facility where all attendees can dine, laugh and share together in the middle of the day. Two additional notes: The DECC service staff was extraordinary throughout the conference. And, Jim Rubillo's talk on Saturday was exactly what was needed!
7) Speaking of Saturday – the **Saturday Attendance** was impressive! Many state conferences have given up Saturday offerings because of low attendance. When I walked into the Saturday Luncheon and saw people at every single table (and many of those tables had 6 to 8 people) I was amazed. Congratulations!
8) The **Door Prizes** blew me away. WOW!! Enough said!
9) This **Board of Directors** is an impressive group in and of itself! The 8 District representation system along with the 8 Vice Presidents and the 10 other positions that have very specific duties and responsibilities (not the least of which is the President and the MCTM Executive Director!) makes for a large, but not too large board. This system allows for representation from throughout the state as well as a democratic process for decision-making and capacity building in the area of leadership.
10) The **MCTM Executive Director** position is a critical position for this organization and I hope you all understand what a gem you have in Arnie Cutler! I wish I could clone him and get him out to other Affiliates who are struggling.

Well, I think that's enough of my reflections and observations. I just wanted to highlight some things about this Duluth conference that make it very, very special and yet might be things that you all take for granted because it's always been this way!

Thank you for the opportunity to be in Duluth and I look forward to my return visit in 2006!

Mathematics Specialist Report

Tom Muchlinski

MDE Academic Standards & Professional Development

Several of my past columns have been devoted to the central role that classroom instruction plays in the achievement of students in mathematics. A consistent theme running through those columns has been the need to be open to using a wide variety of instructional strategies in order to improve the mathematics achievement of all students. The National Research Council has published a book *How Students Learn: Mathematics in the Classroom (2005)* that focuses on "three fundamental and well-established principles of learning" that are particularly important for teachers to incorporate into instruction.

These principles are:

1. Students come to the classroom with preconceptions (both misconceptions and correct conceptions) about how the world works. If their initial understanding is not engaged, they may fail to grasp the new concepts and information, or they may learn them for the purposes of a test but revert to their misconceptions outside the classroom.
2. To develop competence in an area of inquiry, students must (a) have a deep foundation of factual knowledge, (b) understand facts and ideas in the context of a conceptual framework, and (c) organize knowledge in ways that facilitate retrieval and application.
3. A "metacognitive" approach to instruction can help students learn to take control of their own learning by defining goals and monitoring their progress in achieving them. (pp. 1-2)

The three principles imply a framework for designing instruction and the learning environment. These design characteristics can be used as lenses to evaluate the effectiveness of the teaching and learning environments.

- The *learner-centered lens* encourages attention to preconceptions, and begins instruction with what students think and know.
- The *knowledge-centered lens* focuses on what is to be taught, why it is taught, and what mastery looks like.
- The *assessment-centered lens* emphasizes the need to provide frequent opportunities to make students' thinking and learning visible as a guide for both the teacher and the student in learning and instruction.
- The *community-centered lens* encourages a culture of questioning, respect, and risk taking. (pp. 12-13)

***How Children Learn: Mathematics in the Classroom* gives us a solid research base upon which to build our instruction.**

While each of the design characteristics has a number of components, which can each be discussed at length, the point I wish to make is that *How Children Learn: Mathematics in the Classroom* gives us a solid research base upon which to build our instruction. Whatever the approach to instruction (whole group, cooperative groups, direct instruction, inquiry-based instruction, etc.) research is telling us we need to pay attention to these characteristics. Instruction that is designed with attention given to students' prior understandings, the need for developing procedural skill as well as conceptual understanding, the need for frequent, appropriate, and varied assessments to inform and guide instruction (as opposed to assigning a grade), and the need for promoting a culture that makes it safe for students to question and share their thinking will help students learn mathematics well.

Meanwhile, Isaiah Benjamin has been working with his parents and younger sister on sorting and classifying. This spring, while walking along a creek near his house he was picking up small rocks and throwing them into the creek. Under one rock was a worm which was classified as a snake. A little later he came upon a horse "dropping" which had apparently been left several days earlier and had solidified. He picked up this "rock", played with it, and ultimately threw it into the creek, much to the chagrin of his mother. However, she was grateful that this was not the day for picking and eating "berries".

Editor's note: *How Children Learn: Mathematics in the Classroom* published by The National Academies Press (2005) can be read free online and ordered at http://books.nap.edu/catalog/11101.html

What's New in Statewide Assessment ?

Rosemary Heinitz

Math Content Specialist
MDE Assessment & Testing

As the legislature moves into special session, work on statewide assessment is moving forward based on what is proposed in legislation.

BST

The governor's initiative wants students graduating from Minnesota schools to have skills and knowledge in mathematics necessary for post-secondary opportunities and work environments of the 21st century. This effectively raises the bar from what was often viewed as "basic" or "survival" skills. The BST served its purpose and it is time to move to the next level.

The graduation requirement will become a component of the Grade 11 MCA-II. The Grade 11 MCA-II must be constructed according to the specifications to meet NCLB. A part of the items that count for AYP (adequate yearly progress) will also be counted for the graduation requirement score. There will also be additional items that count only for the graduation requirement part of the test. These items may include selected standards and benchmarks from grade 8 and grade 7. This will increase the total number of items on the test.

Since each student will have had opportunity for three additional years of math instruction, there should not be a large percentage of students who do not pass. For the students who do not pass the graduation requirement, there will be opportunities for retakes. The retakes will only include the items that are scored for graduation requirement. The Assessment and Testing division is exploring ways that students can fulfill the graduation requirements. Decisions will be made after the results of the legislative session are known.

The proposed specifications for the graduation requirement part of the test are posted on the MDE website for public feedback. Encourage folks to go online and give feedback. The link is http://education.state.mn.us

TEAEM

Specifications are also being written for a math test for English Language Learners (ELL). The name of the test is TEAEM Test of Emerging Academic English – Math. The draft of the specifications will also be posted on the MDE website for public feedback. If you work with ELL students, this may be of special interest to you.

Assessment Advisory Panels

Summer is a busy time in the Assessment division. Our days are scheduled with groups that serve as advisory panels. We are always in need of qualified teachers to help review items that are included in the MCA-II. To find out more about how you can serve on a panel, go to http://education.state.mn.us and follow the links: Home- MDE Programs - Assessment & Testing- Assessment Advisory Panels.

For further information about statewide assessments, contact Rosemary Heinitz (rosemary.heinitz@state.mn.us) or Jennifer Dugan (Jennifer.dugan@state.mn.us).

Bits of Humor

A teacher was trying to impress her students with the fact that terms cannot be subtracted from one another unless they are like terms. "For example," she continued, "we cannot take five apples from six bananas." "Well," countered a student, "can't we take five apples from three trees?"

"The problems for the exam will be similar to the ones discussed in the class.
Of course, the numbers will be different. But not all of them. Pi will still be 3.14159... "

Teacher: How many times can you subtract 7 from 83, and what is left afterwards?
Student: I can subtract it as many times as I want, and it leaves 76 every time.

(Continued from page 1)

tributions to MCTM and the special passion for mathematics for which we honor her tonight.

"One of her colleagues at St. Olaf, Lynn Steen, summed up Martha well in this comment: 'Everyone in Minnesota who pays attention to education knows that we face a serious shortage of graduates who are well educated in science and mathematics—a shortage of specialists who can help lead future Honeywells and Medtronics, of generalists who will influence legislators and school boards to make wise decisions based on good science, and of teachers who will guide the next generation with expertise and enthusiasm. Colleges and universities address these needs by preparing scientists, citizens, and most importantly, teachers—three very different challenges. Whereas most college faculty are fortunate if they can meet one or two of these challenges well, Martha has met all three with consistent energy, practical imagination, and unwavering common sense.'

"MCTM has benefited greatly from her energy, imagination and zeal for exemplary mathematics teaching. She has served on many committees and held office as Vice President for Mathematics, Vice President for Mathematics Education, and President of MCTM – years that brought thoughtful direction to this organization.

You think she's just asking a simple question but she always gets YOU to say the new idea...

"Martha has long been an advocate for quality mathematics education. She has served on a national committee for NCTM. Martha helped create the Minnesota Mathematics Mobilization (M3), the nation's first state coalition that enlisted leaders of education, business and government in support of mathematics education. She has served for several years on the Mobilization's successor, SciMathMN and played a key role for that organization in publications and meetings of college faculty across the state to transform teacher education.

"As several of her students told me last night – you think she's just asking a simple question but she always gets YOU to say the new idea, to verbalize a difficult concept, to state an important generalization. She doesn't merely tell, she teachers.

"Her students also say they talk a lot in class – they talk to learn but they also talk about themselves. Martha often shares stories about her students. She knows what they know about mathematics, how they think, what math ideas are blocking their understanding AND she knows them as people. She doesn't just teach mathematics, she teaches PEOPLE mathematics. "

Congratualtions, Martha!

MCTM Board Members completing terms of service

Five MCTM board members who have completed their terms of service were given recognition on Friday at the Spring Conference. They were each thanked publicly and awarded a plaque in recognition of their service.

The outgoing board members as pictured left to right are:

Jon Arnold, District 1 Director
Donna Forbes, District 4 Director
Lisa Conzemius, District 7 Director
Brad Larson, VP Senior High
Don Karlgaard, VP at Large

Thank You

The many and varied experiences...

...of Spring Conference 2005

MCTM Foundation

The MCTM Foundation provided financial support for four beginning teachers to participate in the MCTM 2005 Spring Conference. The awardees were:

Jeanine Backer, Middle School Mathematics Teacher in Sleepy Eye
Aaron Nesvold, High School Mathematics Teacher in Sleepy Eye
Casey Rutherford, High School Mathematics Teacher in Shakopee
Sarah Zimmermann, High School Mathematics Teacher in Redwood Falls

Sarah Zimmermann, Aaron Nesvold, and Jeanine Backer

In the application for conference support, teachers with fewer than five years of experience must explain what they hope to gain from attending the conference and present a plan for sharing their conference experience with colleagues and others following the event. A summary of the applicant's background and experience along with a letter of support from the school principal are also required as part of the application.

The 2005 awardees applied for conference support with such goals as to learn about dealing with diversity in the mathematics classroom, to prepare for new teaching assignments, and to gain knowledge to assist in revising district curriculum. After the conference, the awardees were enthusiastic about their experiences in Duluth. Here are some of their comments:

I hope that many other new teachers will be brought into this wonderful family that is the MCTM...

- It was wonderful to spend some time outside of school with other math teachers.
- The Thursday evening meeting for new teachers made me feel very welcome.
- The activities and ideas I learned were very valuable, and some I've already been able to use in my classroom.
- I attended sessions on topics that I can take back to my school to use and share with others.
- I was able to attend my regional meeting, which was a great insight on how we move ideas forward in MCTM.
- I hope that many other new teachers will be brought into this wonderful family that is the Minnesota Council of Teachers of Mathematics through similar grants.

Congratulations to the 2005 awardees, Jeanine, Aaron, Casey, and Sarah. Welcome to the profession!

Sonja Goerdt and Cathy Wick along with bricks representing Foundation donors.

Watch *Mathbits* and the MCTM website for information on applying for MCTM Foundation support for Spring Conference 2006.

Contact the chair of the Foundation Governing Board, Cathy Wick (cwick@ties2.net) for more information about Foundation awards or to offer your service to the Governing Board.

Mentoring Project

MCTM's new mentoring project will be in full swing when school opens in the fall. Conducted by the CONNECT Committee in response to several Delegate Assembly resolutions, the project will connect a beginning teacher or a pre-service teacher to an experienced MCTM member who will serve as a mentor for a period of at least two years. The mentor will make regular email contact with the beginning teacher and will be available for telephone conversations as well.

While many school districts provide mentors for their new teachers, some do not or the mentor provided does not meet the new teacher's needs. MCTM is providing this service to any teachers in their first few years of teaching who would like to participate. Expected topics of concern might include classroom management, teaching tips, lesson design, mathematics questions, school politics issues and ideas for teaching difficult topics. Ideally, mentors and mentees would meet at MCTM conferences where the mentor will help the mentee attain the maximum benefit from the conference.

If you are a pre-service or beginning teacher and would like to have an MCTM mentor, contact Larry Luck at larryluck@aol.com or at 763-784-0084. If you have a colleague who may be interested in this opportunity, please encourage them to contact Larry. There is no charge for this service and the only expectation of the new teacher is that they maintain communication with their mentor.

Please help us to keep outstanding beginning teachers in our profession.

Teacher education students and new teachers exploring new activities at Spring Conference.

New MCTM Board Members

The following new MCTM Board members officially assumed their duties at the board meeting following the spring conference.

Karen Coblentz, President
Donna Forbes, Vice President for Senior High
JoAnn Luhtala, Vice President at Large
Bill Putnam, District 1 Director
Deb Guthrie, District 4 Director
Sonja Goerdt, District 7 Director

Peggy House Honored with Lifetime Achievement Award for Distinguished Service to Mathematics Education

Peggy House is nationally recognized for her dedication to improving mathematics education. She has mentored pre-service teachers, edited and authored numerous books, articles, and reports and has made more than 230 mathematics presentations in the United States and abroad. Throughout her career she has included students in her endeavors, several of whom nominated her for this award and noted that her encouragement of their participating in programs and presenting at meetings has had long-lasting, positive effects on their careers.

Peggy House receiving NCTM Mathematics Education Trust Lifetime Achievement Award. Presented by Kathy Seeley, NCTM president, on April 8, 2005.

Photo reprinted with permission.

Peggy House has served NCTM as a member of the Board of Directors (1995-98), as an editor and contributor to a multitude of educational publications, as an active committee member, and as a planner for annual and regional conferences. Among her most notable contributions to the Council are her ongoing efforts as general editor of NCTM's best-selling Navigations series. The series – which will include 35 books and CDs—is the largest and most ambitious in the Council's history. House's commitment to the Navigations Series will span more than eight years when the project is complete.

In addition to her service to NCTM, House was vice-president for mathematics education for the Minnesota Council of Teachers of Mathematics (1982-84). She was director of the Glenn T. Seaborg Center for Teaching and Learning Science and Mathematics at Northern Michigan University from 1993 to 2003, and she worked with NASA to develop the recently released series, Mission Mathematics II: Linking Aerospace and the NCTM *Standards*. She is currently a professor of mathematics at Northern Michigan University. (Source: NCTM *News Bulletin, April 2005)*

A former colleague at the University of MN wrote, "she had major responsibility for the organization and implementation of the pre-service program for secondary mathematics teachers. Through her leadership this program became an outstanding example of how to prepare secondary school mathematics teachers. Because of her effort and her role model image, more than half of he graduates from this program were female."

The following quotes are from some of Peggy's former students here in Minnesota:

"Peggy kept her students focused on sound and significant mathematics accessible to all students…"

"To this day, Peggy is in mind every time I plan a course for future or practicing teachers of mathematics. She is my role model. I ask myself, what Peggy would do in a given situation to both teach and inspire her students, and then try to emulate her. And I am not alone; House-trained mathematics educators see Peggy as a role model for the kind of teaching and mentoring they want to do."

"We were forced to think about what it means to be an excellent teacher of mathematics, because in every class session we witnessed excellence. I learned to keep reading, keep studying, keep expanding my perspective. My writing improved in response to those purple pen editing notes from Peggy on my papers. Peggy kept her students focused on sound and significant mathematics accessible to all students, even before those phrases appeared in print in NCTM documents."

"As I reflect on my years in mathematics education, I've had the good fortune to be involved at a variety of levels and had the opportunity to try many new things in my career. It

all started with you! I think you helped me to be a "risk taker" and as a result, I decided to tackle new and different challenges and I gained confidence in my ability to work with a wide variety of people. I've had many fabulous moments with students and all kinds of awards for my work. While all of the accolades are wonderful, it was the *teamwork* that meant the most and enabled me to accomplish the things I've wanted to do. I've had lots of support and encouragement from a variety of places, but you were the *one who started it all. You were the catalyst and I thank you from the bottom of my heart!"*

2004 Presidential Award Winner

Kathleen Miller, teacher at Hoover Elementary in Anoka, is the Minnesota winner of the 2004 Presidential Award for Excellence in Mathematics Teaching. Presidential Awardees receive:

- A citation signed by the President of the United States.
- An opportunity to join a dynamic network of Presidential Awardees.
- A $10,000 award from the National Science Foundation.
- A paid trip for two to Washington, DC, to attend a week-long series of events in April.
- Gifts from sponsors of the program.

The idea that each student is unique and valued is central to Kathleen Miller's class. Kathleen Miller's class uses the curriculum "Investigations," which centers around hands-on inquiry.

"When kids have a problem, they'll solve it with a partner or in small groups. They learn to communicate math, not just do it. It's all built around the concept of making sure math is hands-on. Kids are allowed to use pencil-and-paper or cubes, whatever helps them learn. In my class, they use what's best for them. Each student is different. At the beginning of the year, I tell them that all of us are teachers, not just me. Each of us has information that all of us can learn from. And as an adult, I can still learn from second grade students. In order to do that, we all have to talk, and we all have to learn. In the past, teachers were preaching on stage. Now, we step back and let the students learn how to think. We're not stuck. We adapt and do what's best for kids." - Kathleen Miller

Minnesota's three sate finalists were also recognized at the Spring Conference.

Mary Kennedy, McKinley Elementary, Fergus Falls
Kathleen Miller, Hoover Elementary, Anoka
Liz Stamson, Forest Hills Elementary, Eden Prairie

On November 21st, their contributions to the education of our students were celebrated at the annual Minnesota Presidential Supper. Previous awardees were invited. Sue Westegaard , representing MCTM, presented each state awardee with a check for $500 as well as a certificate for a two year MCTM membership, free registration for the spring conference, one night's hotel for the conference, and one day of substitute coverage.

Mary Kennedy and Kathleen Miller

For more information about the Presidential Awards for Excellence in Mathematics and Science Teaching and a list or all past awardees see www.paemst.org

New Feature:

Focus on the Elementary Grades

Judy Hansen
First Grade Teacher
Brown Elementary
Pipestone, MN
judy.hansen@pas.k12.mn.us

This new Elementary Grades column in Mathbits will be used to share ideas and comments concerning teaching and learning mathematics at the elementary school level. In this section, MCTM members can take turns writing articles.

If anyone is interested in sharing please contact Judy Hansen, the column coordinator, either by email: judy.hansen@pas.k12.mn.us *or by calling* 507-825-6756. *Everyone is welcome and encouraged to write!*

My students were having a difficult time with positional vocabulary. I found one particular lesson from the NCTM *Navigating through Geometry* series to be very helpful for the students We really liked it so I will share it with you.

Match My Grid Activity

Summarized from *Navigating through Geometry in Prekindergarten-grade 2, Chapter 2: Location and Position, pp.36-38.*

Place two chairs side by side at a table. Place a barrier (such as a tall book or a file folder) on the table between the two chairs so that neither student can see the other's work. Demonstrate the activity, sit on one side of the barrier and have a student sit on the other side. Show that you and the student have identical sets of shapes (e.g., a circle, a square, and a hexagon) and identical grids with four sections. Explain that the student's task will be to put the shapes on the grid and describe the positions to you without actually showing you the arrangement. Your job will be to make, with your shapes, the arrangement that the student describes. Repeat the activity trying to catch any errors. After the directions have been given, lift the barrier so that the students can verify that the locations and positions of the shapes match.

Have the students repeat the activity in pairs, taking turns playing the role of the person who describes the arrangement and the role of the person who follows the direction. Give the students three to five shapes, as appropriate. The first student may put all the shapes on one quadrant, distribute them among the quadrants, or lay the shapes on the lines between the quadrants. Explain that the second student is not allowed to peek at the arrangement that is being described. Decide before the start of play whether or not questions may be asked. To describe the locations of the shapes, the students should use spatial and geometric vocabulary terms such as above, short side, two fingers below, to the right of, and near the edge

This activity brought out and strengthened many verbal skills for the students, and they enjoyed doing it!

Findell, C. R., Small, M., Cavanagh, M., Dacey, L., Greenes, C. E., & Sheffield, L.J. (2001). *Navigating through Geometry in Prekindergarten-grade 2.* Reston, VA: NCTM.

Technology Problems of the Week

http://mathforum.org/mathtools/tpow

Technology problems (tPoWs) are modeled on the Math Forum's Problems of the Week, with the additional feature that the problems take advantage of an interactive mathematics tool. After students submit their solutions, they have the opportunity to view hints and answer checks to help them think more about the problem and revise their work.

Squares in a Square http://mathforum.org/mathtools/tpow/18047/
If you have a checkerboard that is 50x50 with small squares inside it, how many squares will there be all together? Use a Java applet from the Freudenthal Institute to think about the question. Using a spreadsheet to find the total number of squares is encouraged.

Miranda and the Rookie http://mathforum.org/mathtools/tpow/18197/
Use a spreadsheet to compare salaries of the star basketball player and the rookie.

What About Tracking?

The challenge of addressing diverse students' needs so that ALL students can learn meaningful mathematics at ALL times causes one to investigate ability grouping. The pendulum swings back and forth in educational philosophy from one extreme of grouping students with similar abilities to the other extreme of delivering the same course material to all students in heterogeneous groups. Another personal observation is that quite often the least experienced teachers are assigned the most challenging lower track classes and our most experienced teachers have classes where the students often learn in spite of the teaching! Conditions like this contradict the intent to do what's best for our students.

I would like to share some research findings from the Position Statement on Ability Grouping submitted by the National Association of School Psychologists.

Extensive research on ability grouping has documented the following negative effects.

1. Students with lower ability achieve less in lower track classes than in mixed ability classes.
2. Students with higher ability do not achieve more in tracked classes than in mixed ability classes.
3. Placing students with lower ability in tracked classrooms reduces self esteem, with a particular negative effect on students' sense of their own academic competence.
4. Tracking students reduces the likelihood that students placed in lower track classes will choose college preparatory courses.
5. Tracking students reduces opportunities to develop relationships among students from other racial, ethnic, and socioeconomic groups and has a negative effect on race relations.
6. The placement decision concerning ability grouping is often made very early in the students school career, is often based on questionable data, and is enduring.

When implemented appropriately, heterogeneous grouping:

1. gives all students equal access to an enriched curriculum and the highest quality instruction schools have to offer;
2. avoids labeling and stigmatizing students with lower ability;
3. promotes higher expectations for student achievement;
4. reduces inschool segregation based on socioeconomic status, race, gender or ethnicity, or disability;
5. encourages teachers to accommodate individual differences in students' instructional and social needs;
6. enables students to learn from their peers, including students whose background may be very different from their own; and emphasizes effort more than ability.

Adopted by the NASP Delegate Assembly, April 17, 1993
Reapproved by the NASP Delegate Assembly, July 25, 1998
This position statement drew on material from George, P. (1992). How To Untrack Your School.

New Feature:

Focus on the High School Level

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Brainerd, MN
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Math Websites for Kids

Fun Brain	http://funbrain.com/
Celebrity Math Quiz	http://www.getsmarter.org/index.cfm
Coolmath	http://www.coolmath4kids.com/
Math Café	http://www.mathfactcafe.com/
Visual Fractions	http://www.visualfractions.com/
Moneyopolis	http://www.moneyopolis.org/
Word Problems - Kids	http://www.stfx.ca/special/mathproblems/welcome.html
MathCats	http://www.mathcats.com/

THEORY & PRACTICE:

Mathematical Knowledge for Teaching

What types of mathematical knowledge are necessary for teaching?

What have you found to be effective ways to impact that specialized mathematical knowledge?

This Theory and Practice question was sparked by discussions and activities at the Center for Proficiency in Teaching Mathematics 2004 Summer Institute *Developing Teachers' Mathematical Knowledge for Teaching*. Three of the respondents (Allen, Borkovitz, and McDuffie) participated in that summer institute. The perspectives represented here include that of a system level mathematics supervisor, mathematicians, and mathematics educators.

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Response by Shelly Allen
Mathematics Supervisor
Richmond County
Augusta, Georgia

Teaching mathematics is a complex process. Not only do you have to know and understand the mathematics that you are currently teaching, you must also be prepared for the wide variety of solutions students will have when the task you have selected provides access, engagement, and challenge for ALL students. In addition, a teacher must know what mathematical skills came before and, following the trajectory, what mathematical skills will follow in later grades. Whew!

So what is mathematical knowledge for teaching and how do you approach this issue with practicing teachers? As a district mathematics supervisor, I have been working to first create a community of mathematics teachers who share common goals so that we can begin to work on improving our practice and mathematics content knowledge. In our twelve schools, this work has been centered on student learning of algebra. I believe student content knowledge and teacher content knowledge are intertwined in math classrooms.

Our focus on student learning within this project has provided the group with an opportunity to look at student work together and plan tasks and questions that will help uncover student misunderstanding. Through this professional development, we have uncovered teacher misunderstandings about the mathematics. Saying, "I'm not good at this." "I don't understand how to teach this." or "I need some help." is not a part of the teaching culture so the work of collaborative reflection on our own teaching practice and our own understanding of the mathematical concepts is very slow.

How does the lack of teacher content knowledge surface in a middle grades math class? As teachers begin to understand the meaning of the mathematics they are teaching, the classroom begins to look and sound different because students shift to understanding, inventing, and making sense of the mathematics they are studying. Some of the focus questions teachers in our project are using include

As teachers begin to understand the meaning of the mathematics they are teaching, the classroom begins to look and sound different.

- Do student explanations and justifications emphasize mathematical meanings? Do they show why the students' methods do or don't work?
- Do students determine the validity or correctness of an idea or solution based on the mathematical reasoning presented?
- Are student conjectures, generalizations, mathematical justifications, "what-if" questions, and invented procedures the norm?
- Do students approach problems and ideas in a variety of ways using a variety of representations (visual, verbal, numerical, algebraic, graphical, or everyday contexts)?

This group of middle grades mathematics teachers meets together every month and just recently began planning together and then observing student learning while one member of the group teaches the planned lesson. This adapted lesson study format allows the group to work on their own mathematical content issues as they arise while still focusing on collecting evidence on student learning.

Recently we began our session with the question, "What are my students struggling with right now and what are the ideas and skills that support learning this content?" This question really pushes on one aspect of the specialized mathematical knowledge that teachers must have, being able to listen for understanding when a student is explaining mathematics and posing student questions that foster continued student thinking about the task.

Within my school district, we have chosen to work on enhancing teacher content knowledge through this practice-based professional development model. As we continue this process and as our collegial community strengthens, my hope is that our focus questions begin to shift to include not only questions about students, but also teacher knowledge of mathematics. Some of these questions might include

- Do I pose questions and tasks that foster student conjectures, justifications, and generalizations involving core mathematical ideas?
- Do I listen intently to my students' thinking and respond according to the mathematical direction in which we are headed?
- Do I pose questions and tasks that foster access, engagement, and challenge for all students?

These changes within our middle grades math classrooms involve major shifts in the way we have been thinking about mathematical knowledge for teachers and have been providing professional development for our practicing teachers. Mathematical knowledge is clearly not just about the number of college mathematics courses taken.

At the Joint Meetings of the American Mathematical Societies in January, I interviewed several recent Ph.D's in mathematics for a faculty position that includes working with prospective K-6 teachers. The conversation often turned to "specialized mathematics knowledge for teaching," a phrase that was new to the applicants.

Response by
Debra K. Borkovitz
Department of Mathematics and Science
Wheelock College,
Boston, Massachusetts

To explain, I used a canonical example, first asking them to come up with a story situation for elementary students that goes with $6 \div 2$ and then asking them to modify their situation to model $6 \div \frac{1}{2}$. I used this same example at Wheelock's summer orientation, and both the first year college students and the job applicants chose partitive interpretations, such as two kids sharing six cookies, and then had trouble adapting them to the second problem. The problem sparked interesting conversations with the job applicants, and it's also nice to reassure the students that even people with Ph.D.'s in math find the problem challenging.

Of course, figuring out how to teach people with Ph.D.'s in math about specialized mathematical knowledge for teaching is different from figuring out how to teach young college students. A mathematician can master the mathematics involved; I'm more concerned that he or she loves math, wants to make math accessible, that he or she is respectful, not arrogant, and has good social and communication skills. Mathematics graduate programs often do not value these traits, but many young mathematicians nonetheless embody them.

In teaching undergraduate pre-service elementary teachers, we could easily spend more semesters than we have on the mathematical technicalities of things like partitive and quotitive division, without exhausting the K-6 curriculum. Thus, we will always be engaged in conversation about what topics are most important to highlight and at what depth. However, what is most important for our students transcends specific topics. They need to learn that mathematics is a connected body of knowledge, not a random assortment of procedures, to see mathematics as something creative, where there are many ways to solve problems, and to gain the confidence to try new problems. They need to develop reasoning skills within themselves rather than relying solely on external authority to evaluate their mathematical thinking. In conducting the job interviews, it was easy to see that the candidates had these dispositions.

How do we best help our students learn to "think like mathematicians," when many of them do not enter college with such a personal goal?

So, how do we best help our students learn to "think like mathematicians," especially when many of them do not enter college with such a personal goal? Clearly, the details of such a task are a lifelong conversation for those of us involved in mathematics teacher education, but for a start, our classrooms need to promote and model mathematical exploration, reasoning, creativity, and understanding. We need to frame mathematical learning as a lifelong process, a process for which students can take responsibility. We need to help them learn to reflect, to continually integrate new knowledge, so that they can better learn from books, other teachers, each other, children, and life in general.

The phrase "specialized knowledge for teaching" frames mathematics for preservice teachers in terms of their existing, deep motivation to be good teachers, which for many prospective elementary is initially much stronger than their motivation to learn mathematics for itself. I sometimes use the metaphor of a taxi driver with my students – that if you are new to a city, you might know how to go from home to school and to the store, but if you are a taxi driver, your knowledge of the streets is much more connected, you can take shortcuts and detours or the scenic route. Perhaps specialized knowledge for teaching is more like simultaneously being a taxi driver, pilot, and deep-sea diver of elementary mathematics. Certainly, acquiring such knowledge is difficult, but, as I also tell my students, they can do difficult things.

(Continued on page 16)

Response by Larry Lesser
Department of Mathematical Sciences University of Texas at El Paso

To be effective, teachers of mathematics need to know not only the immediate topics they are teaching, but also how those topics connect to other rungs of the ladder of PreK – college mathematics, and a nice example of this is the book for preservice high school teachers by Usiskin, Peressini, Marchisotto, and Stanley (2003). Other features of this book include examination of alternate definitions, alternate approaches (with and without technology), applications, and historical context. Cuoco (2003) discusses how prospective teachers "at the right level of abstraction and in the right contexts" would be well served by courses organized by central themes in mathematics, such as decomposition, representation, reduction, localization, completion, and extension. A trio of big themes (for elementary, middle and high school mathematics, respectively) offered by Seeley (2005) are equivalence, proportionality, and function.

Rather than just list more types of PCK or MKT teachers need, let us examine a concrete mathematical example which could be encountered by a broad range of grade levels, from upper elementary through college. Teachers certainly have the knowledge to work numerically with a three-way contingency table of data, but may not realize there is a possibility that a comparison may be reversed upon aggregation of categories, a possibility which is listed as essential to citizenship by NCED (2001). Even teachers who are aware of this possibility (Simpson's Paradox) in the abstract may not know the necessary numeric al condition (Cornfield's condition) or how to readily track down specific real-life instances that could trigger an animated classroom discussion of how best to interpret this dataset. Knowing how to find or make such connections beyond the math classroom is vital to make mathematics "come alive" for students with poor motivation. (Some of the articles on curricula I have created to share with my students connect mathematics to diverse areas such as ethics, lotteries and music!) And finally, few teachers may be aware of how to constructively utilize such counterintuitive results in the classroom and what alternative, non-numerical representations are available (e.g., Lesser, 2001) to make more intuitive when the phenomenon occurs.

Perhaps specialized knowledge for teaching is more like simultaneously being a taxi driver, pilot, and deep-sea diver of elementary mathematics.

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Response by Amy Roth McDuffie
Department of Teaching and Learning Washington State University Tri-Cities

As teachers take on the goals of teaching for students' understandings, they are faced with new questions and dilemmas in planning, implementing, and reflecting on lessons. Many of these questions are either directly or indirectly related to understanding mathematics from a learners' perspective while at the same time knowing how mathematical concepts and procedures connect and sequence to form a coherent system.

In my work with accomplished teachers who have developed Standards-based practices and in my reading of professional development literature (e.g., Carpenter, Fennema, Franke, Levi, & Empson, 1999; Schifter, Bas table, & Russell, 1999; Smith, 2001), I have compiled questions for teachers to consider that draw upon their mathematical knowledge for teaching. While the list below is certainly not exhaustive, the questions illustrate some of the ways teachers need to use mathematics in teaching for students' understanding.

1. What are the key mathematics concepts and processes my students need to learn?
2. Are these concepts and processes appropriate for my students to take on now or must other ideas be understood first (i.e., how do concepts and processes build on one another relative to particular students' learning)?
3. What "activities" (mental or physical actions a student might experience, see Simon & Tzur, 2004) will promote students' development of key concepts and processes? How might a student come to understand the mathematics through these activities?

4. How are key concepts and processes represented in my instructional materials? How do my instructional materials provide opportunities for students to experience these activities? Do I need to find or design alternative materials?
5. What are key questions I need to ask to facilitate students' understanding of a particular concept or process? What numbers or representations might I use for students to confront an idea? What examples and non-examples might help students to form an understanding? What mathematical terms are appropriate to use or to introduce? How can I describe these terms in language familiar to students and remain mathematically valid?
6. What are ways in which students might solve a problem (anticipating both correct and flawed methods prior to teaching)? Given a seemingly correct student's solution, will the methods work every time (i.e., is the approach generalizable)? Given a flawed solution, is part of the work mathematically valid? Why might a student have reasoned through a problem in a particular way?

When teachers incorporate these types of questions into planning, implementing, and reflecting on lessons, they are drawing on mathematical knowledge in a way that "end users" of mathematics do not encounter. By asking questions such as these, teachers bring mathematics to the forefront of their work. Consequently, I regularly include these questions in working with preservice teachers for activities such as viewing classroom video, studying student work, and designing and reflecting on lesson plans. Additionally, in my work with practicing teachers, I ask these questions as we co-plan and reflect on lessons. I have found that after asking questions such as these, preservice and practicing teachers begin to ask these questions of each other and of themselves. By considering these questions and discussing responses, teachers can develop their mathematics knowledge through situations that are most meaningful to them: learning mathematics through teaching students.

When teachers incorporate these types of questions into planning, implementing, and reflecting on lessons, they are drawing on mathematical knowledge in a way that "end users" of mathematics do not encounter.

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I would like to rephrase the question to address aspects of mathematical *understanding* and to focus on three aspects of mathematical understanding that are not "specialized" but *pervasive* in mathematics. These understandings are

Response by
Martha K. Smith
Department
of Mathematics
University of Texas

1. *Mathematics is about figuring things out.*
2. One important part of mathematics is *expressing information*.
3. Many mathematical problems have *many correct methods of solution, and even more incorrect methods* (some of the latter being only slightly incorrect and others being way off base.) Consequently, a teacher needs to be willing and able to listen open-mindedly to different approaches, able to distinguish correct methods from incorrect ones, and (ideally) able to give hints that will help students progress from their own approach when possible.

The best way I have found to help impart these understandings of mathematics is through a problem-solving course that I have taught off and on for about 15 years. Most students in the class intend to teach secondary mathematics, but a few are preparing to teach elementary school, middle grades, or two-year college mathematics. In addition to practice solving problems, the class includes discussion of problem solving methods, emphasizing what is often called the "understanding" or "analyzing" stage of problem solving.

The idea that mathematics is about figuring things out permeates the whole class. Sadly, many students who take the course have previously experienced "problem solving" only as following procedures that have been taught to them.

(Continued on page 18)

Emphasizing understanding and analysis helps students understand how mathematics can express information, and helps them progress in the skill of expressing information mathematically and using that skill to solve problems. This emphasis is addressed largely through work on carefully designed exercises in small groups, followed by whole class discussion. Many of these exercises serve as scaffolding for assigned problems.

The third understanding is fostered by whole class discussion of problems students have solved. I routinely ask after a student has presented a solution, "Did anyone solve it another way?" Usually the answer is yes. We sometimes spend more than an hour discussing different solutions of the same problem.

Getting the Word Out
Advocating for Mathematics Education

The National Council of Teachers of Mathematics debuted the NCTM Advocacy Toolkit in 2004. The materials in the toolkit were developed and assembled as a start to giving members the tools needed to assist in advocating for mathematics education. MCTM members are needed as advocates for mathematics education in Minnesota because the public at large does not necessarily understand many of the important issues concerning the mathematics education of Minnesota's children.

In the February issue of *Mathbits* you encountered some of the key messages of NCTM. Here we will explore the content of the *NCTM Communications Guide* which contains sections devoted to media outreach, media relationships, interviewing, getting the word out to the media, responding to the news media, attracting the media., and government relations. When you read the *Communications Guide*, you basically work through a short course on how you can affect both the media and the legislative process and exert influence on the issues that have an impact on you, your work, and mathematics education.

If you're thinking of writing to your local or state representative, read the "Ten Steps to Composing Persuasive Letters" in chapter VIII, "Government Relations." Here are two of the steps listed.

Step 1. Identify yourself as a constituent. Put your name and complete address on both the envelope and the letter. Legislators feel responsible only to constituents, so it's important to establish immediately that you live in their district.

Step 9. Make your message timely. Don't procrastinate. Your letter is not helpful if it arrives after a vote. Be aware of the legislative process (is the bill in committee or coming up for a vote on the floor?), and time your letter accordingly. Faxes can allow you to get your letter to a legislator at critical junctures in the process.

Highlight on *NCTM Communications Guide*

In chapter IV, "Getting the Word Out," you will find information on the many ways to get your information to the media, whether they're in print, radio, or television sources. The most common methods to communicate with your local newspaper are through a press release about an event you would like covered, an opinion piece that gives your side of a controversial issue, or a letter to the editor where you correct misstatements or opinions in a recent article. The Letters sections of local newspapers are popular with readers, and most editors are willing to print letters with opposing views on the page. It is a good place to start voicing your opinion and gaining credibility with the editor. Chapter IV also includes samples and guidelines for the common methods of reaching the media. You can find helpful hints for writing a letter to the editor. A few of the suggestions include:

- Keep your letter short.
- Contact the paper for word count and how to submit your letter (e-mail, fax, mail).
- Write as soon as possible after the article appears.
- Put your most important point first.
- Check your grammar and spelling.

NCTM now has an Advocacy Web page at http://capwiz.com/nctm/home/ This site gives you the ability to search for elected officials by zipcode and by state, locate both national and local media and even fine tune your search to locate individual reporters, editors, and producers, and access information on key bills in congress along with house and senate voting records.

Copies of the NCTM Advocacy Toolkit may be obtained by contacting Ken Krehbiel, NCTM Director of Communications at (703) 620-9840 or by email kkrehbiel@nctm or by making a request online at http://www.nctm.org/advocacy/toolkit.asp

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Instructional Strategies That Shape Students' Thinking and Learning in Mathematics and Science

Asta Svedkauskaite, Program Associate
Learning Point Associates™
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The need to understand and be able to use the knowledge of mathematics and science in everyday life has never been greater (National Council of Teachers of Mathematics [NCTM], 2000). The need for teacher and student growth has never been more obvious, more demanding, and, in fact, more promising. The No Child Left Behind Act mandates schools be equipped with sound, research-based instructional practices so each child is achieving. Attaining individual competence in modern life requires schools to teach students mathematics and science for life, for the workplace, for the scientific and technical community, and as a part of their cultural heritage (NCTM, 2000).

Not surprisingly, teachers feel a great demand to stay professionally competent. For them to teach students to *talk* mathematics and science and *do* what scientists and mathematicians do, they have to be accountable for helping students master the skills of "observing, describing, comparing, classifying, analyzing, discussing, hypothesizing, theorizing, questioning, challenging, arguing, designing experiments, deciding, concluding, generalizing, [and] reporting" in the language of science and mathematics (Lemke, 1990). It is a challenging task to say the least. Luckily, there are more and more teacher-friendly resources based on years of classroom research for teachers to use today. This article introduces one such resource on powerful practices in mathematics and science.

Eight years of classroom research conducted by the National Center for Improving Student Learning and Achievement in Mathematics and Science (NCISLA), a former mathematics and science center located at the University of Wisconsin–Madison, shows there are three key instructional practices that are fundamental in allowing new visions of mathematics and science to become the norm in the classroom. Three practices—modeling, generalization, and justification—are supported by long-term research as critical yet still invisible practices necessary for students to be successful and productive in learning mathematics and science.

Based on its research, NCISLA proposes four forms of mental activity from which mathematical and scientific understanding emerges: (1) constructing relationships, (2) extending and applying mathematical and scientific knowledge, (3) justifying and explaining generalizations and procedures, and (4) developing a sense of identity related to taking responsibility for making sense of mathematical and scientific knowledge (Carpenter, Blanton, Cobb, Franke, Kaput, & McClain, 2004).

Carpenter et al. (2004) argue that constructing relationships is not simply about appending new concepts and processes to existing knowledge—it involves the creation of rich, integrated knowledge structures. Such structures need to be further extended and applied. When students or teachers acquire knowledge with understanding, they can apply the knowledge to learn new topics and solve new and unfamiliar problems they encounter (Carpenter et al., 2004). Furthermore, justifying and explaining generalizations and procedures brings students to the practice and the experience of professional mathematicians and scientists in the real world. Through collaboration with their own classmates, students can develop an identity as learners and "generate mathematical and scientific ideas to make sense of science and mathematics, and … justify whether their ideas are valid" (Carpenter et al., 2004).

However, such mental activities cannot take full shape if left unexamined. According to Carpenter et al. (2004), mathematical and scientific knowledge can only be consolidated through the reflection process. When students consciously examine the relation between their existing knowledge and a problem situation, they are more likely to acquire this ability if reflection is a part of the knowledge-acquisition process. Articulation of ideas is part of such reflection. It means that students can focus on the critical ideas of an activity and communicate the essence of that activity.

Finally, really making mathematical and scientific knowledge one's own requires students and teachers to develop a personal investment—an ownership—in building the knowledge. For such investment to happen, classroom practices in which communication and negotiation of meanings are important facets cannot be allowed to falter.

According to Thomas P. Carpenter, one should strive to disprove the pervasive belief that mathematics and science can be learned only by students who have the required aptitude and ability. It is necessary to help students understand what is entailed in the successful practice of mathematics and science and make these subjects accessible to every learner (Carpenter & Romberg, 2004). The National Council of Teachers of Mathematics (2000) has long supported this notion in its *Principles and Standards for School Mathematics* document, which alludes to the power of mathematics and equitable learning for all. The document highlights the following as the most prominent components of equity:

- Equity requires high expectations and worthwhile opportunities for all.
- Equity requires accommodating differences to help everyone learn mathematics.
- Equity requires resources and support for all classrooms and all students.

Enhancing instructional practices that are equitable and attend to different student learning styles requires teachers to develop skills that address all of these equity components and ensure that students receive high-quality mathematics and science education.

In March 2004, the North Central Eisenhower Mathematics and Science Consortium (NCEMSC) and NCISLA completed, through their partnership, the production of *Powerful Practices in Mathematics and Science: Research-Based Practices for Teaching and Learning*. The *Powerful Practices* package represents years of NCISLA research, observation, analysis, and data in mathematics and science classrooms. Public school teachers and researchers collaborated to design instruction that yields impressive student learning. This research-based multimedia package contains a print monograph and two CD-ROMs featuring classroom video episodes with descriptive content.

The *Powerful Practices* package is designed to empower teachers to improve their instructional practices. It provides a vision for teaching big ideas in mathematics and science; insight into the ways modeling, generalization, and justification can help build students' content knowledge and understanding; research-based explanations and resources; and video clips of classroom discussions and student interviews. The three powerful practices are defined as follows:

- Modeling: A central practice in the work of mathematicians and scientists that uses the construction of models to represent and explain natural phenomena
- Generalization: A practice of making explicit general, unifying ideas or principles
- Justification: A practice of constructing and developing appropriate arguments to defend and justify generalizations that students make

As Carpenter states in the introduction on one of the CDs:

> "Modeling, generalization, and justification are not learned in the abstract. These practices are embedded in the process of learning important mathematics and science ideas …. Students learn critical practices of modeling, generalization, and justification in the process of learning important mathematics and science content. In fact, students do not really understand the content if they do not understand the role of modeling, generalization, and justification; and they cannot appreciate the power of these forms of thinking unless they use these practices in learning important mathematics and science ideas. Furthermore, because different disciplines have their own forms of modeling, generalization, and justification, students can most productively learn these practices in the context of learning important mathematics and science content. From this perspective, the practices of modeling, generalization, and justification, applied in the service of learning important mathematics and science content, are in fact a critical part of the content students need to learn" (Carpenter & Romberg, 2004).

To state it concisely, in classrooms that use modeling, generalizing, and justifying:

- Learning is viewed as problem solving rather than drill and practice.
- Students apply existing knowledge to generate new knowledge rather than simply assimilating facts and procedures.
- Mathematics and science become languages for thought rather than merely a collection of facts and ways to get answers.

Through the *Powerful Practices* product, teachers are encouraged to focus on making wise choices in the instructional practices for mathematics and science. They are able to use the video clips that show exemplary teaching and learning, and they can participate in several group processes for reflecting, and sharing ideas, on improving their instructional practices.

NCEMSC is currently disseminating *Powerful Practices* regionally as well as nationally and internationally. A facilitator's guide (available in the summer of 2005) will support and assist districts and schools in using *Powerful Practices* as a professional development tool to help educators use the research-based instructional practices of modeling, generalization, and justification more effectively. The *Powerful Practices* package is available by e-mailing mscproducts@contact.learningpt.org or by contacting Liz Kershaw at 630-649-6654.

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MCTM Fall Conference

Minnesota Council of Teachers of Mathematics

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8:00 –– 9:15 • Opening Session

9:30 – 10:15 • Session I

10:30 – 11:15 • Session II

11:30 – 12:15 • Session III or Lunch

12:30 – 1:15 • Session III or Lunch

1:30 – 2:15 • Session IV

2:20 – 2:40 • Door Prizes

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For more information contact:

Melissa Shepard, Conference Chair
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mashepard@stthomas.edu

Arnie Cutler, Registration
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Terry Wyberg, Conference Chair
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Visit www.mctm.org for registration and speaker forms and more information as it becomes available.

Professional Development Opportunities

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Join other teachers as we strive to provide opportunities for a better mathematics education for all students in Minnesota. Investigate strategies to encourage students' mathematical reasoning and their knowledge and understanding of the mathematics in Minnesota Spatial Sense, Geometry and Measurement Standards. Plan for effective classroom implementation.

In August 2005, participants will engage in mathematics activities and investigate instructional strategies related to these standards. Return to share their classroom experiences October 18, 2005. Participating school districts will fund substitute pay for Oct. 18 plus a day in which participants visit other participants' classes. In June 2006, participants will return to campus for 3 days to share experiences and explore elementary navigational applications. Participants will be able to see geometry in action aboard the research ship LLSmith! Other activities will be determined in consultation with participants.

Participants may elect to register for 3 graduate credits at a cost of $200/credit. All other program activities, food, and lodging are free to qualified participants. Continental breakfasts and lunches will be provided. For participants residing more than 50 miles from campus, dormitory lodging, all meals, and a travel allowance are provided. Upon completion of the program, participants will receive a stipend of $200. For more information, please contact Alice Mae Guckin or Gerry McGraw. For more information or to apply either contact Gerry McGraw or Alice Mae Guckin.

Time & Location:	Instructors:	Director:
8:30 A.M. to 3:30 P.M.	Ms. Patricia Bambenek	Alice Mae Guckin aguckin@css.edu
Aug. 8,2005 -Aug.12, 2005	Ms. MaryJo Furtman	Address: Weaving the Strands;
Oct. 18, 2005	Dr. Alice Mae Guckin	Mathematics Department;
June 13 - 15, 2006	Mr. Don Kuusinen	The College of St. Scholastica;
The College of St. Scholastica	Ms. JoAnn Luhtala	1200 Kenwood Ave.; Duluth, MN 55811
		FAX: 218 723 6472

Administrative Support:
Gerry McGraw
Gmcgraw@css.edu
Phone: 218 723 6055
FAX: 218 723 6462

Information: http://www.css.edu/users/aguckin/SummerMath05.html
Application:http://www.css.edu/users/aguckin/MathRegistration05.html

Becoming a Teacher of Statistics

A popular graduate course, EPSY5271 Becoming a Teacher of Statistics, will be offered at U of M Fall 2005. The course is on teaching and learning statistics at the high school and college level. Teachers of AP or other high school statistics courses are invited to enroll in the course as either degree or non-degree students. The course may be taken even if you are not enrolled in a degree program. It can be taken for graduate credit or for undergraduate credit (much less expensive).

Course Topics Include:

- **First courses in statistical science:** Introduction to first courses in statistics: what they are, how they differ in types of students, course goals, and outcomes.
- **The research on learning statistics:** A summary of research across the disciplines of psychology, mathematics education, and statistics, that investigates difficulties students have learning statistics and why statistical reasoning is so difficult to develop.
- **Educational reform in statistics:** Reports from the Statistical Association and the Mathematical Association of America (ASA-MAA) joint committee, landmark papers on differences between statistics and mathematics, and new goals for students.
- **Course content:** Examining the content of first courses: how has this changed in light of changes in the discipline and the practice of statistics.
- **The role of technology:** Examining multimedia, Web materials and resources, simulations tools, and statistical software.

- **Student assessment:** The role of projects, writing, performance tasks, problems, web based testing, and traditional item formats.
- **Teaching methods:** Focus on active learning, types of activities to build concepts and reasoning, integrating activities, technology, and innovative assessment methods.
- **The importance of data:** Learning about where to find good data sets to use in class, features of good data sets, issues in collecting and producing data for activities and projects.
- **Innovative projects in statistics:** A focus on several innovative, NSF-funded projects such as The Chance Project, A Data-Oriented, Active Learning, A Post-Calculus Introduction to Statistical Concepts, Methods and Theory (SCMT), Activity Based Statistics, Workshop Statistics, The Statistics Laboratory, Tools for Teaching and Assessing Statistical Inference, etc.
- **Focus on Advanced Placement Statistics:** Examining the course, the exam and grading procedures, and the implications for changes in second courses for these students.
- **Putting it all together:** designing a course, syllabus, choosing a textbook, activities, student projects, and assessments.
- **Becoming a member of the statistic education community:** Learning about the different organizations that support statistics education, the venues for publishing and presenting on statistics education, etc.

The class format will be one of lecture, discussion, demonstrations and activities. The class will meet in a computer lab so that students may explore and experience many of the software and web tools learned about in class. There will also be student presentations of various activities, projects, and data sets.

Comments from students in the course; some of these students were AP statistics teachers:

- Great course! The mix of hands-on and lecture was great. The syllabus and readings were very focused and helpful. Our class had a wonderful group of educators and personalities.
- I would highly recommend it to everyone who is interested in teaching statistics. A 3-hour course, that never felt boring!
- This course was, without a doubt, the most useful of all the education courses I have taken.
- It was great to get so much information about how to teach statistics from an instructor who is so prominent in the field. I have so many ideas now I don't know where to start!
- This has been the best course related to education I have ever taken.

Registration information can be found at: http://education.umn.edu/catalogs/FAQS/registration.html. For questions regarding the course contact Joan Garfield, Professor of Educational Psychology, University of Minnesota, email: jbg@umn.edu; phone: 612-625-0337

Professional Development Opportunities

Education Development Center, Inc. K-12 Mathematics Curriculum Center will offer two professional development opportunities to help you learn more about choosing and implementing *Standards*-based mathematics programs. Programs will be in Newton, MA.

Considering New Curricula, October 19-20, 2005

Are you currently evaluating new mathematics curricula and could use support in the decision-making process? Learn about 11 different curriculum programs from teachers who are using them in their classrooms, as well as how to select, pilot, and implement these programs.
Learn more and register at: http://www2.edc.org/mcc/seminar1.asp

Curriculum Implementation: Making it Work for Your District, November 2-3, 2005

Do you want to get a head start on developing your implementation plan? Or perhaps you need to adjust the plan that you currently have in place. Learn how to implement a new curriculum effectively by taking into account factors such as teacher professional development, parental concerns and community support.
Learn more and register at: http://www2.edc.org/mcc/seminar23.asp

Either of these seminars can be taken as a stand-alone program, but we encourage districts to take a comprehensive look at curricular change by registering for both.

For answers to questions contact: Kim Foster, K-12 Mathematics Curriculum Center, Education Development Center, Inc. Phone: 800-332-2429 ext. 7 email: mcc@edc.org

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Mission Statement: *The MCTM is an organization of professionals dedicated to promoting the teaching and learning of meaningful mathematics for all students by supporting educators in their efforts to improve mathematics education.*

Mark Your Calendar

Oct 21	MCTM Fall Conference, Andover High School
April 20-22	MCTM Spring Conference 2006, Duluth

Do we have your correct address?

Check the mailing label for your membership renewal date. Renew online at www.mctm.org

MCTM strives to provide membership with current information regarding mathematics education in the state of Minnesota. To accomplish this goal, we need an accurate, permanent address for each member. Is your correct address printed on the label of this issue of *Mathbits*? If not, contact Exec. Director Arnie Cutler at 612-626-8326 or cutler@tc.umn.edu or visit the MCTM web site (www.mctm.org) membership page to make your change. Student MCTM members and members in transition are encouraged to provide a permanent address. Thank you for helping us stay in touch!

FYI: In an effort to be cost effective, MCTM sends newsletters at USPS bulk rate. As a result, delivery times may vary between postal districts. MCTM is working to ensure timely delivery of information. Please contact Teresa Gonske or Arnie Cutler with any concerns.

Please submit items for the Sept/Oct issue of *Mathbits* to tlgonske@nwc.edu by September 1, 2005. Email or call 651-631-5228 if you have questions. - Teresa Gonske, Editor