

# Math<sup>in</sup> Middle<sup>the</sup>

## Institute Partnership

**Report to Nebraska**  
**December 2009**



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# An overview of Math in the Middle

The Math in the Middle ( $M^2$ ) Institute Partnership is now in its sixth year and has evolved into part of the larger NebraskaMATH partnership. This **Report to Nebraska** is designed to look back at how the partnership got started; to assess what has been accomplished; and to consider what lessons might be learned as Nebraska teachers, education leaders and public policy leaders work together with the common goal of making Nebraska a national leader with respect to K-12 mathematics education.

The National Science Foundation's (NSF) Math Science Partnership (MSP) program was created because of the NSF's view that innovative partnerships, between the K-12 community and higher education, and between disciplinary expertise and education expertise, were necessary if we are to significantly improve math and science education in our K-12 schools. The Institute component of NSF's MSP program seeks to create a generation of intellectual leaders with strengths in both the discipline they teach and in teaching that discipline.

Officially, Math in the Middle began on August 1, 2004, as a five-year, \$5,000,000 grant from the NSF, but the foundation for the partnership began much earlier. Education leaders at ESUs 6 and 13



**Jim Lewis and Ruth Heaton**

had worked with UNL faculty as part of the NSF-funded Nebraska Math & Science Initiative (NMSI) in the 1990s and agreed to be part of the  $M^2$  proposal. They were joined by ESU 7 as early partners in  $M^2$ . LPS also had been part of the NMSI and, in 1999, Matt Larson and Jim Lewis began a series of summer professional development workshops that focused on opportunities to learn mathematics. On the UNL campus itself, Lewis, Ruth Heaton and Patience Fisher had begun a mathematics education/mathematics partnership in 2000 with the very successful NSF grant, Math Matters.



## Math in the Middle Courses

**MATH 800T: Mathematics as a Second Language**

**MATH 802T: Functions, Algebra, and Geometry for Middle Level Teachers**

**TEAC 800: Inquiry into Teaching and Learning**

**MATH 804T: Experimentation, Conjecture and Reasoning**

**TEAC 801: Curriculum Inquiry**

**MATH 805T: Discrete Mathematics for Middle Level Teachers**

**MATH 806T: Number Theory and Cryptology for Middle Level Teachers**

**STAT 892: Statistics for Middle Level Teachers**

**TEAC 888: Teacher as Scholarly Practitioner**

**MATH 807T: Using Math to Understand Our World**

**MATH 808T: Concepts of Calculus**

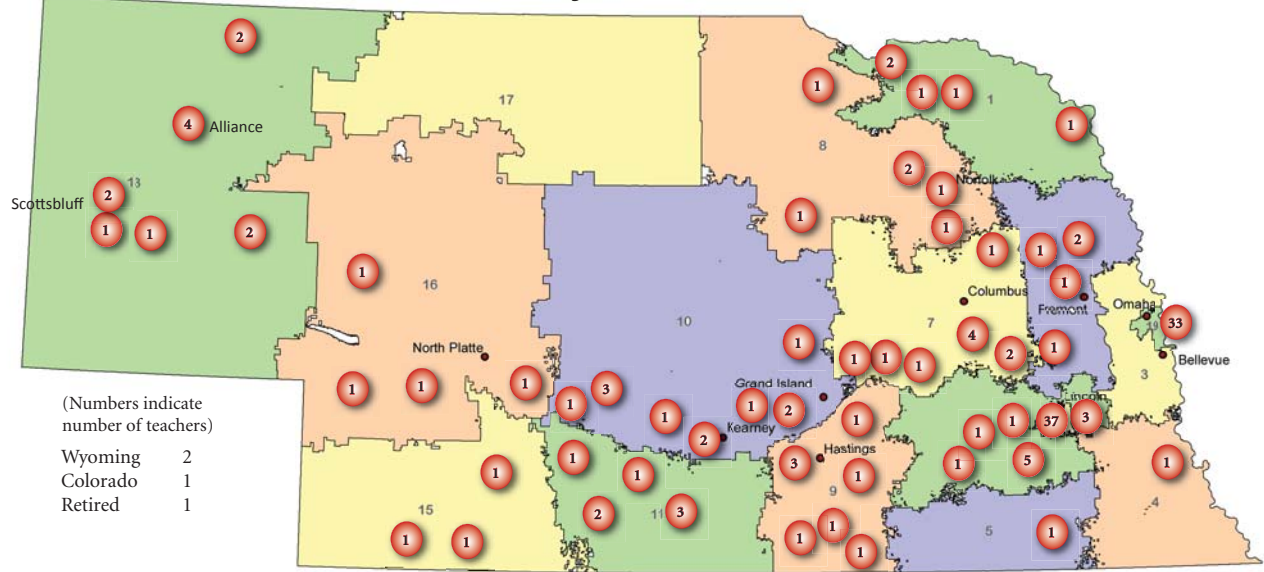
**TEAC 889 or MATH 896: Integrating the Teaching and Learning of Math (Capstone Course)**

For further information and course descriptions, visit: <http://scimath.unl.edu/MIM/gradpgm.php>

The Math in the Middle proposal was written in Fall 2003 by a team of principal investigators that included UNL's Lewis, Heaton and Tom McGowan and Barb Jacobson from LPS. Under the leadership of Vice Chancellor Prem Paul, UNL's Sponsored Programs office provided substantial support as the proposal was written and authorized UNL's Center for Science, Mathematics and Computer Education to provide substantial staff support for the grant at UNL's expense. Because of this support, a larger

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## Math in the Middle Teachers by Nebraska Educational Service Units



### Overview from Page 3

portion of the award could go toward participant support dollars, enabling  $M^2$  to work with a large number of teachers. Two recent supplements have added \$900,000 to the funding, bringing the total value of the grant to \$5,900,000. In addition, the success of Math in the Middle played a significant role in positioning UNL and its Nebraska education partners to be successful in obtaining the Nebraska-MATH grant.

As stated in the proposal to NSF, the vision of the Math in the Middle Institute Partnership was to create a University/Educational Service Unit (ESU)/Local School District partnership with the capacity to educate and support teams of outstanding middle level mathematics teachers to become intellectual leaders in their schools, districts and ESUs. The basic strategy was to:

- i) Build a sustainable partnership starting with LPS, ESU 6, ESU 7 and ESU 13;
- ii) Create the Math in the Middle Institute, a master's program for middle level math teachers;
- iii) Make a special investment in supporting rural Nebraska schools and teachers;
- iv) Work with our ESU/local school district partners to support the  $M^2$  teacher leaders.

### The $M^2$ Partnership

As reported above, when our proposal was submitted, we had partnership commitments from Lincoln Public Schools and three rural Educational Service Units plus a few smaller districts served by those

ESUs. Six years later, we have worked with nearly 160 teachers representing more than 106 schools and 60 school districts (because of consolidation, some early district partners no longer exist) including the Lincoln Public Schools and the Omaha Public Schools. We have worked with teachers from all 15 rural ESUs. See the map (above) included in this report for the current locations of our Math in the Middle teachers. Now, having obtained the NebraskaMATH grant from NSF, we believe that we have a truly statewide partnership that can continue to serve teachers from an expanding number of Nebraska school districts.

At the university level, in addition to UNL faculty, Math in the Middle and the Nebraska Math & Science Summer Institutes (NMSSI) have benefited from the talent of faculty at the University of Nebraska at Omaha (UNO), the University of Nebraska at Kearney (UNK) and Nebraska Wesleyan University. An NRI grant that was received from the University of Nebraska will further support efforts to involve faculty from UNO and UNK as part of an expanding P-16 partnership to support K-12 mathematics education in Nebraska. Now, as long as sufficient resources can be obtained, we can continue providing professional development opportunities for Nebraska math teachers for many years.

The NMSSI is our effort to provide professional development opportunities for Nebraska teachers with local funds. An article in this report discusses the NMSSI and a flier has been produced that describes the 15 courses for math teachers and 10 courses for science teachers that will be available in Sum-



mer 2010. It should be noted Summer 2010 is a very special opportunity as UNL is discounting tuition for teachers participating in the NMSSI to 80 percent of in-state graduate tuition, and fellowships are available to cover the costs of fees. Some additional fellowships also will be available to support teachers who want to take an NMSSI course.

To further develop the potential of the Nebraska-MATH grant, Math in the Middle funds were used in September to host a one-day meeting that included representatives from many ESUs, the executive director of the ESU Coordinating Council, NDE, the Nebraska Association of Teachers of Mathematics and the executive director of the P-16 Initiative. The purpose of the meeting was to explore ways that we could work together to better meet the needs of mathematics teachers in Nebraska.

The Nebraska Summit on Mathematics Education scheduled for December 14, 2009, is an additional effort to expand the partnership begun by Math in the Middle. The Summit holds great promise for building an even larger and stronger partnership for mathematics education in Nebraska as speakers include Governor Dave Heineman, Commissioner of Education Roger Breed, and J. B. Milliken, President of the University of Nebraska System.

### The M<sup>2</sup> Institute

The Math in the Middle Institute is a 12-course, 36-hour graduate program that leads to a master's degree from the Department of Teaching, Learning and Teacher Education (MA) or the Department of Mathematics (MAT). The curriculum consists of seven mathematics courses for middle level mathematics teachers that were specifically created for the Institute and approved as part of the Department of Mathematics graduate curriculum; three math education specific versions of courses that are part of the core graduate curriculum in Teaching, Learning and Teacher Education

(TLTE); a statistics course offered by the Department of Statistics; and a capstone course that can be taken as either a math or an education course, depending on the master's degree being pursued by the teachers.

Some of the course titles, such as Mathematics as a Second Language, are unique. A listing of the curriculum appears as part of this report (see Page 3). Brief descriptions are posted at <http://scimath.unl.edu/MIM/coursedescript.php>, and more complete descriptions are available at <http://scimath.unl.edu/MIM/coursematerials.php>. This site includes a complete set of all materials we use plus information about how the courses are taught for four of the mathematics courses and for our action research course, all of which were developed locally. Faculty at other institutions are welcome to use these materials to teach a comparable course. (A text is needed

for one of the courses and a text is a useful resource for a second course.) The Illinois state Math & Science Partnership program distributed our course materials at their 2007 workshops, and faculty at the University of Arizona have consulted with Dr. Heaton to adopt a version of the M<sup>2</sup> action research course.

M<sup>2</sup> was funded to be an institute partnership for middle level mathematics teachers. The proposal spoke of "middle level" rather than "middle school" and described our audience as teachers from grades 5-8. In many smaller, rural schools of Nebraska, rather than having "middle school mathematics teachers," one has

teachers who are responsible for teaching mathematics in grades 7-12 or 8-12 and our applicant pool has represented this diversity. We even have had applicants who are best described as high school teachers (grades 9-12). Often the local Educational Service Unit partner was eager to have them considered for the program.



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A “typical” Math in the Middle cohort has approximately the following distribution of participants:

Typical Cohort	5th	6th	7th	8th	7-12	HS
32 teachers	7	7	5	7	3	3

As the chart below indicates, 125 teachers have earned a master’s degree as a result of their participation in M<sup>2</sup>. Thirty-three more teachers, from two cohorts of OPS teachers, are expected to graduate in 2010 or 2011. Although the original proposal only budgeted for 122 teachers, we used our resources carefully and admitted a total of 136 teachers (organized into four cohorts) as part of the original program. This represents a 92 percent rate of retention to graduation. Because we believe our program is quite challenging, we are rather proud of this retention rate.

	Entered	Withdrawn	Inactive	Still Active	Graduated
Cohort 1	33	2	1	--	30
Cohort 2	33	3	2	--	28
Cohort 3	35	0	0	--	35
Cohort 4	35	2	0	1	32
OPS Cohort 1	20	0	0	20	--
OPS Cohort 2	13	1	0	12	--
Total	169	8	3	33	125

All teachers who earn the MAT degree write an expository paper on a mathematics topic we assign and write a report on their action research. Teachers who earn the MA expand their action research report to write a scholarly paper. This work represents a significant body of evidence that our teachers have become intellectual leaders able to learn mathemat-

ics and to teach to very high standards. Thus, we are posting our teachers’ expository mathematics papers and action research papers on our Web site. Currently, we have 83 action research papers posted at <http://scimath.unl.edu/MIM/ar.php> and 49 expository mathematics papers posted at <http://scimath.unl.edu/MIM/mat.php>. Additional teachers’ work will be posted in Spring 2010.

### Supporting Rural Teachers and Schools

A focus of the Math in the Middle Institute Partnership is on offering opportunities to teachers representing rural ESUs, districts and schools, and this constitutes the most significant aspect of our efforts to address the needs of rural schools. The grant paid for all teacher expenses associated with travel to Lincoln or meals and housing while in Lincoln. We have invested considerable effort in trying to provide adequate support for rural teachers in our project, recognizing that they may be far from Lincoln when taking academic year distance-education courses. In particular, we have made a substantial investment (both dollars and human resources) to the use of Polycom and Adobe Connect for weekly homework sessions. In August 2009, we installed the latest Polycom equipment into our conference room. This equipment will allow Math in the Middle instructors and leaders to conveniently conduct meetings with teachers from across the state.

Offering NMSSI courses in communities across Nebraska is another example of efforts to address the needs of rural schools. Between Summer 2008 and Summer 2010, we will have offered courses in Scottsbluff, Kearney, Hastings, Norfolk, Neligh and Columbus in addition to both Lincoln and Omaha.

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# Gordon-Rushville reaps benefits of Math in the Middle

Kacy Heiser found she enjoyed breaking the “rules.” Stacie Lefler picked up some new, good “habits of mind.” And both of these rural-community teachers use these techniques to enhance the ways in which they teach in their mathematics classrooms.

Heiser and Lefler are teachers at Gordon-Rushville Public Schools, a school district near Chadron in the Nebraska Panhandle. Both are graduates of the Math in the Middle (M<sup>2</sup>) program. Among the goals of Math in the Middle is the improvement of mathematics education in all of Nebraska’s schools and communities, and such improvement cannot be made without reaching out to Nebraska’s rural communities and recognizing the unusual challenges they face.

Math in the Middle supposes that the best way to impact mathematics education in rural schools is to start with bright, dedicated teachers who are already part of their community and help them deepen their mathematical, pedagogical and leadership skills. Such teachers return to their home communities able to contribute in important ways to strengthening mathematics education in their school, district and ESU.

Heiser and Lefler are prime examples of this model. In 2006, Gordon-Rushville Middle School teacher Lefler earned a master’s degree through M<sup>2</sup>, and encouraged her colleague, Kacy Heiser, to enroll in the program as well. Heiser, a teacher at Gordon-Rushville High School, also earned a Master’s of Arts in Teaching degree from the Department of Mathematics, in 2008.



**Stacie Lefler**

Lefler, who was a part of Cohort 1, heard about M<sup>2</sup> from a former UNL graduate student who encouraged her to apply. “It was a big decision because I knew that it would require a lot of time and work, but the opportunity to become a better math teacher and earn my master’s degree was too good to pass up,” Lefler said. “Before Math in the Middle, I had taken a few classes through Chadron State College, but hadn’t really considered looking into what UNL had to offer.”

Lefler teaches mathematics for the seventh- and



**Kacy Heiser (right) and two of her students**

eighth grades in Rushville. The seventh-grade has about 60 students and eighth-grade has around 40. Each grade is split into groups of about 20 students. Lefler has five math classes in the morning and teaches two periods of math intervention in the afternoon.

“I loved Math in the Middle because I was able to gain so many math skills and learn great ways to help my students learn math as well. The classes offered in Math in the Middle were full of math problems and teaching techniques that I could use with my middle-school students. I appreciated learning about ‘habits of mind’ problems and find them to be interesting, challenging and fun to use with my students,” she said.

Heiser put in her application for Cohort 3 after hearing so much great information about the program from Lefler. Heiser currently teaches several math classes, including pre-algebra and algebra, to the ninth through 11th grades at the high school in Gordon. Initially, Heiser was the only high school math teacher in Rushville, but was assigned the eighth-grade math position after the schools consolidated with Gordon, making the Math in the Middle program a good fit for her professional development needs.

Not unlike Lefler, Heiser would drive for almost seven hours to Lincoln to attend Math in the Middle classes. But, it was worth it, according to Heiser.

“I personally gained confidence in my ability to teach mathematics with the students in mind and not simply the subject. I also gained many friends from my Cohort and a great network of people for advice and help,” Heiser said. “Professionally, I believe that I have become a better teacher who is willing to look at more than simply the ‘rules’ of mathematics. I am more willing to take risks in my teaching and to allow the students to guide the classroom instead of staying on a strict schedule to make sure everything gets covered.”

Outside of the mathematics classroom, Heiser is the

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### Rural from Page 7

school's Student Council Sponsor, chairperson of her district's Continuous Improvement Steering Committee, a member of the district's data team and a Teacher Leader in Math in ESU 8's NMPDS with five teachers on her team.

Heiser came to Rushville after growing up in Wyoming. She attended Chadron State College, receiving her bachelor's degree in Secondary Education with a Field Endorsement in Mathematics in 1998.

"I am currently married to Chris Heiser (our 10-year anniversary is Dec. 31, 2009), and we have one son, Aiden Cole. He is 15 months old, and we adopted him in August 2008. It worked out perfectly because Aiden was born four days after we went through graduation in Lincoln to receive our master's degree," said Heiser, who added that she loves the atmosphere in Rushville and has no desire to change schools.

Lefler moved to Gordon after getting married to Clint Lefler nine years ago. Since then, Gordon and Rushville consolidated and created the current middle school.

"I love working and raising a family in these two wonderful communities," said Lefler, who gave birth to their first child, a son named Riley in June 2009. Lefler grew up in Ponca, Neb., and attended UNL, receiving a bachelor's degree in middle-school education.

Lefler and Heiser are among the most capable teachers who have completed the program, and, being committed to mathematics education in their community, are making a definite difference to the students in Gordon and Rushville. Jim Lewis, Math in the Middle Principal Investigator, said, "Stacie and Kacy are very bright and during our program they genuinely became mathematicians. The Gordon-Rushville Public Schools are fortunate to have such outstanding teachers and we are pleased to have played a role in helping them learn more mathematics and more about teaching mathematics."

"I don't know if I can put into words all that I gained from M<sup>2</sup>," Heiser said. "I believe that it has changed my perspective on not only my own teaching, but also education in general." ■

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Our research effort also has focused on rural issues, publishing findings from analyses of interviews with rural teachers in our program and a needs assessments that focused on learning about the work lives and needs of rural teachers. In addition, members of our research team were actively involved in an American Education Research Association session sponsored by their Rural Education SIG at their annual meeting in San Diego.

### Developing Teacher Leaders

MSP Institutes are intended to do more than provide graduate education for teachers. Ideally, they educate leaders who have a major impact on their peers and on strengthening the education of students in their schools. An external assessment of our efforts to develop school and district leaders was provided by a team from the Educational Development Corporation that visited M<sup>2</sup> as part of a NSF-MSP Knowledge Management and Dissemination project. Neil Schiavo, the EDC representative who led the site visit wrote the following:

"We identified the Math in the Middle Institute as one of five MSPs selected for a volume of cases on teacher leadership, which will be part of a set of volumes on strategic leadership. A case about Math in the Middle offers a compelling example of a program that prepares teachers to lead in the markedly different settings of urban and rural school districts in Nebraska. The Math in the Middle Institute also provides a thoughtful approach to training teacher leaders that builds from deepening their content knowledge for teaching through a focus on mathematical habits of mind. The volume set on strategic leadership will be a resource to future developers of teacher leader programs."

Teachers exercise leadership in many ways. They inspire their students. They share what they have learned with their peers. They assume roles such as department chair or are chosen by their district to be a math coach. At least 30 Math in the Middle teachers have worked alongside university faculty as part of an instructional team teaching courses for mathematics teachers as part of Math in the Middle, NebraskaMATH or the NMSSI. We expect more M<sup>2</sup> graduates to assume similar roles as we expand the number and locations of the courses we offer. This report includes several feature stories that offer further evidence of the many ways that M<sup>2</sup> teachers are giving back to their educational communities. ■

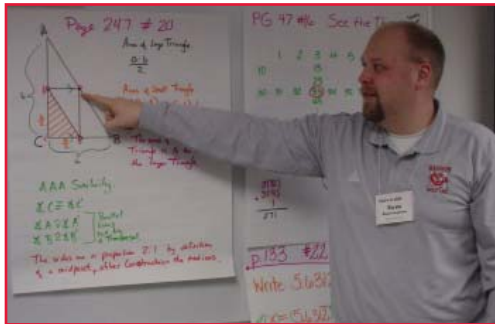


# Courses enhance teaching abilities

The goal of the Nebraska Math & Science Summer Institutes (NMSSI) is to offer Nebraska teachers of math and science intellectually rich graduate coursework that will enhance their ability to offer their students challenging courses and curricula. The Nebraska Math & Science Summer Institutes began as an effort to continue offering Nebraska teachers the opportunity to take courses that were created as part of the NSF-funded master's program, Math in the Middle. While our previous offerings reflect that origin, we have expanded our offerings to include mathematics and science courses for K-12 teachers.

NMSSI courses are designed with teachers' schedules in mind. Forty hours of instruction is concentrated in a single week or two weeks with a pair of courses that complement each other. In 2010, some science courses will experiment with an online component. Our experience is that teachers appreciate our format because it allows for collaboration with colleagues while protecting most of the summer for other pursuits. This minimizes housing and subsistence costs and time away from home for teachers who must travel to the course location to pursue graduate education.

Many Nebraska math teachers and their students have benefitted from our NSF-funded grants. It is not possible, however, to obtain enough federal funds to meet the professional development needs of all of Nebraska's math (and science) teachers. Thus, it is important to develop the capacity to offer Nebraska teachers professional development opportunities using local funds. To make these opportunities more affordable to teachers, UNL has offered a 20 percent tuition discount through the Teach Nebraska program, and, in Summer 2010, fellowships to cover the cost of fees for Nebraska teachers who take a NMSSI course. In order to sustain this program, however, it is important that we are able to



demonstrate to UNL administrators that there is teacher demand for these courses. Thus, in order to increase participation in 2010, additional fellowships will be available on a competitive basis to teachers. We are even offering lunch to each teacher participant while they are enrolled in an NMSSI course! For more information about the NMSSI Summer 2010 course offerings or to apply for a supplemental fellowship, visit our Web site at [www.scimath.unl.edu/NMSSI](http://www.scimath.unl.edu/NMSSI).

The NMSSI program began in Summer 2007 with four courses for math teachers. In 2008 we offered six courses for math teachers, with one held in Hastings and another in Norfolk. In 2009, the program officially became known as the Nebraska Math & Science Summer Institutes and our course offerings were expanded to include 11 courses for Nebraska math teachers. More than 100 teachers were enrolled in the program, and through partnerships with ESUs 7, 8, 10 and 13, three of the courses were offered in locations outside of Lincoln (in Norfolk, Kearney and Scottsbluff).

For Summer 2010, we anticipate offering 15 courses for math teachers and 10 for science teachers, including some offered as distance education courses, and six of the courses in locations outside of Lincoln (Scottsbluff, Kearney, Neligh, Columbus and Omaha). Our goal is to reach a total enrollment of 250 teachers who are interested in deepening their knowledge of science, mathematics and pedagogy. ■

## Here are comments from teachers about our NMSSI courses:

*"It was filled with problems that were applicable and useful on all levels."*

*"The instructor really is very knowledgeable about the topic and her patience with the class when learning new concepts really helped with the challenging topics."*

*"They had a way of explaining very difficult material in an easy to understand, calm manner. They seemed to know when we were confused and when we needed help. They were also very enthusiastic about the subject material and that always helps."*

*"This is a great class to explain why we do many things in math that are taken for granted."*

# Graduates excel as LPS teacher leaders

Several graduates of the Math in the Middle (M<sup>2</sup>) program in the Lincoln Public Schools (LPS) district have gone on to become teacher leaders, offering assistance to colleagues, ranging from teaching demonstration lessons to collaborative planning, therefore allowing other teachers to learn from their M<sup>2</sup> experience.

Cohort 1 graduates Julie Kreizel, Laura Parn, Darla Berks, Anne Schmidt and Delise Andrews, and Cohort 2 graduate Amy Nebesniak, are all teacher leaders for LPS. Staff development is a primary focus for LPS teacher leaders. Part of their role is to assist other teachers in the district with lesson-plan preparation, engage colleagues in co-teaching and work with teams to find solutions to specific classrooms or curricular challenges.

“Math in the Middle helped me realize the importance of being a leader. Prior to Math in the Middle, I had no intentions of pursuing further degrees or other roles,” said algebra coach Berks.

After her M<sup>2</sup> participation, Berks decided to pursue certification from the National Board for Professional Teaching Standards (NBPTS). In 2008, Berks became one of the few teachers in Nebraska to earn National Board Certification. According to the NBPTS website, only 0.3 percent of Nebraska teachers have earned National Board Certification.

Nebesniak is also an algebra coach for LPS. Parn is a fifth-grade instructional math coach, Andrews is a fifth- and sixth-grade instructional math coach, Kreizel is a seventh- and eighth-grade instructional math coach who still spends one period each day in the classroom and Schmidt is a math coach at Culler Middle School.

“Math in the Middle helped me to see the deeper meaning of mathematics. Before the program, my teaching was driven by procedures and the memorization of mathematics. The professors and coursework prompted me to approach my math instruction in a more conceptual manner, pushing myself and my students to become mathematical thinkers,” Nebesniak said. “As an algebra instructional coach, I am now working to promote a similar mindset among the teachers I work with. Math in the Middle has made me a better teacher and a stronger teacher leader.”

Math in the Middle began with LPS as its largest local school-district partner. Thirty-six LPS teachers have earned a master’s degree and strengthened their leadership skills through the M<sup>2</sup> program. The district reports that M<sup>2</sup> graduates have served in the following roles since the beginning of the program:

- six of 10 middle-level math liaisons (the equivalent of a middle-school department chair)
- three sixth-grade math liaisons
- one district-wide implementation leader
- three fifth-grade district-quadrant implementation leaders
- seven professional development leaders

“I believe I help deepen student understanding of mathematics and improve their confidence in their abilities to solve mathematical problems regardless of their personal history of success (or lack of success) with math,” Schmidt said.

## Presidential Award for Excellence in Mathematics & Science Teaching



**Delise Andrews, Kristin Johnson, Myrna Bornemeier**

In addition to teacher-leader achievements, three LPS teachers associated with Math in the Middle have been awarded the Presidential Award for Excellence in Mathematics & Science Teaching. The Presidential Award of Excellence in Mathematics and Science Teaching recognizes outstanding kindergarten through sixth-grade and seventh through 12th-grade math and science teachers. The program is administered by the National Science Foundation.

Delise Andrews was a recipient of the Presidential Award in 2007. At that time, she taught fifth-grade at Clinton Elementary School in Lincoln and had begun a part-time role as the Grade 3-5 math teacher leader. She was a member of M<sup>2</sup>'s first graduating cohort.

Two other Math in the Middle participants were nominated in past years for the award, which is the nation’s highest honor for teaching mathematics or science. Myrna Bornemeier, an eighth-grade math teacher at Lux Middle School in Lincoln, was a 2003 award winner (before she was in the Math in the Middle program), and Kristin Johnson, an eighth-grade math teacher at Lefler Middle School in Lincoln, won the award in 2005.

Andrews said her participation in Math in the Middle helped her understand mathematics more deeply: “I am better able to build understanding with my students because I know more about the topic myself.” The institute’s action research project also benefited Andrews. “Reading current research and then actually doing an action research project in my own classroom forced me to better develop my teaching practices,” she said. ■

# Exemplary leaders in math education

Nebraska teachers who have participated in the Math in the Middle Program continue to make contributions to K-12 mathematics education in our state. Our graduates take their gained knowledge, shared experiences and newfound confidence with them back to their schools, benefiting both their colleagues and students. While some work quietly and tirelessly to improve student achievement in their own classrooms and schools, others are contributing through community outreach.

From implementing changes in the classroom to revising standards that will impact mathematics education across the state, whatever their leadership role, Math in the Middle graduates have the knowledge and confidence to make fundamental changes that impact mathematics education. The articles that follow describe only a few of the ways in which Math in the Middle teachers are making a difference.

## M<sup>2</sup> graduates participate in Nebraska State Standards revision process

Recent legislation requiring a statewide assessment in mathematics prompted the Nebraska Department of Education (NDE) to initiate a revision of Nebraska's Mathematics Standards. The revision of the standards, which is now close to completion, began in April 2007, with the selection and meeting of a "Standards Advisory Team." This team consisted of more than 60 leaders in mathematics education from across the state, including NDE staff, ESU and district leaders and K-12 teachers of mathematics. Math in the Middle graduates selected to serve as members of this team included Delise Andrews, Doug Glasshoff, Kristin Johnson, Sandi Snyder, Tricia Buchanan, Tom Harrington, Dot Snesrud, Tina Thompson and Marci Ostmeyer. Patience Fisher, an instructor for Math in the Middle, served on the committee as a university representative.

## Professional leadership in NATM

The Nebraska Association of Teachers in Mathematics (NATM) is Nebraska's affiliate of the National Council of Teachers of Mathematics. NATM is following the development of the statewide standards and assessments very closely. NATM's leadership is replete with M<sup>2</sup> participants and educators. Past NATM President Dan Schaben is a M<sup>2</sup> graduate currently at Arapahoe Public Schools. M<sup>2</sup> instructor and Nebraska Wesleyan Professor Kristin Pfabe is the current First Vice President. Jill Edgren, Wood River Public Schools and M<sup>2</sup> graduate, is the current Second Vice President. Patience Fisher, UNL Mathematics Education and M<sup>2</sup> instructor, is the College Math Representative.

Other M<sup>2</sup> participants on the Executive Board include: Chad Larson, Scottsbluff, Region I Representative; Stacey Aldag, Norfolk, Workshop Coordinator; Dot Snesrud, Osceola, Newsletter Editor; Bob Christensen, retired (formerly Keya Paha), Web Master; and Sandi Snyder, Shickley, Public Relations. Additionally, Tina Thompson, M<sup>2</sup> graduate, served as the Elementary School Representative on the Executive Board in the recent past. For more information on NATM, please visit its Web site at [www.natmonline.org](http://www.natmonline.org).

## ESU 8 hires M<sup>2</sup> graduate Slack



JaLena Slack

JaLena (Clement) Slack began the Math in the Middle program as a teacher in Hall County District #501. After graduating in 2008, Slack accepted a position at ESU 8 in Neligh, where she is the Project Coordinator for the Nebraska Mathematics Professional Development Series (NMPDS). Its mission is very similar to the Math in the Middle Institute – to assist

students as they make the precarious transition from the middle grades to the advanced high school curriculum. Slack indicated that one of her responsibilities involves traveling to different parts of the state to "make sure that our teachers are well taken care of." Slack also has taken the lead in the NMPDS project entitled, "Collecting, Analyzing and Representing Data." Several other Math in the Middle graduates are serving in leadership roles for the NMPDS project, including Tina Thompson and Linda Moore, both of Lexington; Kacy Heiser of Gordon-Rushville; and Deb Borgelt of Norfolk.

## M<sup>2</sup> grad transitions to higher education

Math in the Middle graduate Stacey Aldag (a secondary teacher while she participated in M<sup>2</sup>) accepted a position at Northeast Community College (NECC) in Norfolk in 2008. The Mathematics Department at NECC has continued to enjoy increasing enrollment and, with it, new positions. Aldag has taught courses such as Elementary Algebra, Math for Nurses, Math for Physical Therapist Assistants, and a Foundations class. Aldag said, "I am excited for my spring semester classes as I will be teaching a class for elementary-teacher majors, allowing me to utilize my Math in the Middle training to help train 'new' teachers."

## Parn receives Japan Fulbright Award

Laura Parn, a fifth-grade teacher at Elliott Elementary

*Grads Continued on Page 12*





**Laura Parn**

School in Lincoln, received the Japan Fulbright Memorial Fund Award, a Fulbright sponsored by the Japanese government. In October 2007, Laura traveled to Japan and visited schools, administrators, school boards and families in Tokyo and the surrounding suburbs. Parn is a graduate of the first cohort of the Math in the Middle Institute.

Parn said some of the issues educators in Japan are working on improving are “probably quite familiar to many educators in Nebraska. Such issues include bullying, students cramming to pass high-stress tests (in Japan there is a prevalent existence of ‘crammie’ schools), unsupportive (‘monster’) parents, and personal skills such as an underdeveloped social and moral side and a delayed development of independence.”

## Two M<sup>2</sup> graduates honored as NTV’s ‘Teacher of the Month’

Megan (Kelly) Abresch and Michael Ford were both honored by central Nebraska’s NTV television station as “Teacher of the Month.” Abresch received her degree in August 2007 and was honored in December 2007. Ford graduated in August 2009 and won the award in November 2008.

In December 2007, Abresch was surprised to see her students waiting in anticipation as representatives from the local station paid tribute to her dedicated service to her school and community. Abresch teaches fifth-grade at the school and has impacted the lives of lots of her students. “I just love her so much. She’s taught me more than just science and math. She’s taught me just to be myself,” said student Katelyn Shriver. Abresch added, “I’m just very overwhelmed. I work with a wonderful group of kids and I just love my job. And to think that I’m making a difference and an impact and touching their lives, it just means the world to me.”



**Michael Ford**

Students of Ford, a fifth-grade teacher at Elm Creek Public School, collectively wrote to NTV to nominate him. In their nomination letters, they wrote that he “even makes recess a learning experience.” Ford said, “I can’t believe that they did it without me knowing because I’ve only been gone one or two days this year and for them to sneak that in on me, and then my wife knows about it, it is a pretty big surprise.” ■

## Schaben, former NATM president, reflects on Math in the Middle



**Dan Schaben**

“I have always taught and learned in a small school environment and cherish the almost family-like atmosphere. For the past three years, I have taught Algebra II, Algebra III, Geometry and Advanced Topics in the tech-rich environment of Arapahoe Public Schools in southwest Nebraska. Arapahoe is a Class D school with approximately 90 students in grades 9–12. My typical class size ranges from two students to 23 students. Previously, I taught 10 years at Orchard Public School in northeast Nebraska. There I taught most of the 7–12 mathematics curriculum, coached two sports, and drove the bus. In both cases I was one of two mathematics teachers for grades 7–12.

Before Math in the Middle, I had not participated in any mathematics education professional development. Instead, I had taken a few courses as part of working toward my administrator’s endorsement. I heard about Math in the Middle from ESU 8 and decided to get involved because I was not happy with my ability to connect mathematically with students in my classroom. I was teaching very abstractly with few connections to anything. I thought I needed either to get help or leave the profession completely.

Math in the Middle has helped me in four important ways.

1. It has given me confidence in myself.
2. It gave me a vision for what a mathematics classroom should look like.
3. It connected me to peers I didn’t know existed.
4. It showed me what I have to potential to become. (This was the most intellectually challenging three years of my life.)

In terms of NATM and confidence, I never would have seen myself as a mathematics leader before Math in the Middle. During my NATM presidency, I hosted two statewide conferences. I was able to pull this off because of the great peers and instructors that surrounded me from Math in the Middle, and of course, the NATM board.

I can’t completely measure all of what my students have gained because of Math in the Middle. I always will be in debt to Jim Lewis and Ruth Heaton for bringing Nebraska this program. It has kept me in math education and gave me the tools to become a great educator.” ■

# Math Teachers' Circle: The drive to learn continues

Once teachers experience the joy of working with colleagues to solve challenging math problems, especially problems that are adaptable for their classrooms, they want the experiences to continue. Math in the Middle graduates, Anne Schmidt and Julie Kreizel had this notion in mind when they launched the Lincoln Area Teachers' Mathematics Circle in 2007 with the goal of encouraging a culture of problem solving in middle grade and algebra classrooms.

The opportunity to create a teachers' math circle began in Summer 2007 with a workshop at the American Institute of Mathematics (AIM) in Palo Alto, California. Schmidt and Kreizel, who are LPS teachers and M<sup>2</sup> graduates, were joined in Palo Alto by M<sup>2</sup> professors Steve Dunbar (UNL) and Cheryl Miner (Nebraska Wesleyan) and LPS Mathematics Supervisor Sue Graupner. There they learned how to create and sustain a Teachers' Circle as a partnership between school teachers and collegiate mathematicians.

In Fall 2007, the Lincoln Area Teachers' Mathematics Circle began gathering monthly for a dinner and an evening of fun mathematics. Math teachers from Lincoln and surrounding communities such as Crete, Friend and Shickley join with school administrators, ESU representatives, mathematicians and mathematics educators "to discover and pass along to students the excitement and richness of problem solving in deep yet accessible mathematical topics."

"The focus is on problem solving and learning how to craft solutions to problems," said Joshua Zucker, one of the organizers of the AIM workshop. He went on to explain, "An exercise is something where you already know what to do and you just have to go through the motions. Exercises are boring. A problem is a challenge where you have to first figure out how to approach it. That is what we want students to learn, and the Circle helps the teachers bring this into the classroom."



Cheryl Miner, Steve Dunbar, Julie Kreizel, Sue Graupner, Anne Schmidt



Pari Ford

UNK Professor, Pari Ford, who attended the Lincoln-area teachers' circle as a graduate student and was involved in multiple instructional teams teaching M<sup>2</sup> courses, recently launched a Math Teachers' Circle in Kearney.

Ford felt it was important to provide math teachers in central Nebraska with the opportunity to "establish a community of problem solvers, bringing together middle-level and high school math teachers, pre-service teachers, math educators and mathematicians to enhance problem solving skills and reenergize a passion for mathematics."

While the joy of learning new mathematics is one of the goals of the circle, there is a special focus on learning mathematics that teachers can use in their own classroom.

For more information about the Lincoln-area and Central Nebraska Teachers' Circles, visit [www.nebrwesleyan.edu/people/cminer/teachercircle.html](http://www.nebrwesleyan.edu/people/cminer/teachercircle.html) or [www.unk.edu/mathcircle/](http://www.unk.edu/mathcircle/). ■

## Action Research Projects

Math in the Middle Institute participants take Teacher as Scholarly Practitioner, a course in which they learn about and plan an action research project. Each teacher conducts an action research project in the spring of their second year and writes a paper about their findings. The Math in the Middle Web site (<http://scimath.unl.edu/MIM/ar.php>) has posted 83 action research papers, and more will be posted in Spring 2010. These papers represent that Math in the Middle teachers have become intellectual leaders who think deeply about their own teaching and what is required to inspire students to achieve at a high level. Below are abstracts from two action research papers.

### **Discourse and Cooperative Learning in the Math Classroom, by Karen Hillen (teacher at Leigh Elementary School in Leigh, Nebraska)**

*In this action research study of my sixth grade math classroom I investigated the effects of increased student discourse and cooperative learning on the students' ability to explain and understand math concepts and problem solving, as well as its effects on their use of vocabulary and written explanations. I also investigated how it affected students' attitudes. I discovered that increased student discourse and cooperative learning resulted in positive changes in students' attitudes about their ability to explain and understand math, as well as their actual ability to explain and understand math concepts. Evidence in regard to use of vocabulary and written explanations generally showed little change, but this may have been related to insufficient data. As a result of this research, I plan to continue to use cooperative learning groups and increased student discourse as a teaching practice in all of my math classes. I also plan to include training on cooperative learning strategies*

### **Mathematical Communication, Conceptual Understanding, and Students' Attitudes Toward Mathematics, by Kim Cotton (teacher at Garden County Junior High in Oshkosh, Nebraska)**

*This action research study of my eighth grade classroom investigated the use of mathematical communication, through oral homework presentations and written journals entries, and its impact on conceptual understanding of mathematics. This change in expectation and its impact on students' attitudes towards mathematics was also investigated. Challenging my students to communicate mathematics both orally and in writing deepened the students' understanding of the mathematics. Levels of understanding deepened when a variety of instructional methods were presented and discussed where students could comprehend the ideas that best suited their learning styles. Increased understanding occurred through probing questions causing students to reflect on their learning and reevaluate their reasoning. This transpired when students were expected to write more than one draft to math journals. By making students aware of their understanding through communicating orally and in writing, students realized that true understanding did not come from mere homework completion, but from evaluating and assessing their own and other's ideas and reasoning. I discovered that when students were challenged to communicate their reasoning both orally and in writing, students enjoyed math more and thought math was more fun. As a result of this research, I will continue to require students to communicate their thinking and reasoning both orally and in writing. ■*

## Math Expository Papers

Each teacher who pursues the MAT degree through the Department of Mathematics must complete an expository mathematics paper as part of their Master's Exam. The teacher is given a topic to research and write about, with the goal of communicating challenging mathematics to their peers. This has been an empowering experience for M<sup>2</sup> teacher leaders as they learn that they are capable of learning mathematics independently and communicating mathematics successfully without the need to study it in a formal classroom setting. Some examples of papers written by Math in the Middle teachers are as follows:

*Diana French*, a math teacher in Alliance, wrote about Perfect Numbers. A perfect number is a whole number that is the sum of its proper divisors. There are only four perfect numbers less than 3,000,000 and only 20 perfect numbers were discovered by 1961. At the time that French wrote her paper, there were 43 known perfect numbers and a 44th has been discovered since that time.

*Cindy Steinkrueger*, a teacher in Blue Hill, wrote a paper entitled The Volume of a Platonic Solid. As part of her work, she studied trigonometry and learned to use the software, GeoGebra, in order to visualize a regular octagon inscribed in a cube.

*Kyla Hall*, a fifth-grade teacher in Lincoln, wrote about The Polygon Game. To play the polygon game, take a regular,  $n$ -sided polygon and the numbers,  $\{1, 2, 3, \dots, (2n-1), 2n\}$ . Place one number at each vertex and midpoint of each side of the polygon. A side sum is the sum of the number assigned to any midpoint plus the numbers assigned to the vertex on either side of the midpoint. A solution to the game is any polygon with numbers assigned to each point for which all side sums are equal, i.e. equal side sums. The most general problem is, "Find all solutions to The Polygon Game." This is an open question worth of a Ph.D. in mathematics. For her paper, however, Hall was able to find all solutions for triangles, squares, pentagons and hexagons and one solution for each regular polygon with an odd number of sides.

*Marlene Grayer*, now a teacher with the Omaha Public Schools, read a paper published in the March 2009 issue of the *Notices of the American Mathematical Society*, and then wrote Sudoku: A plan for a Successful End. In her paper, Grayer explained a paper and pencil algorithm for solving any sudoku puzzle.

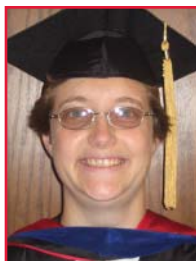
**To read these and 45 more expository papers written by Math in the Middle teachers, see our Web site, <http://scimath.unl.edu/MIM/mat.php>. Additional papers will be published on the Web site in Spring 2010. ■**



## Doctoral Students and Math in the Middle

The Math in the Middle Institute Partnership involves graduate education and research that extends beyond the master's degrees earned by M<sup>2</sup> teachers. Two University of Nebraska-Lincoln (UNL) students have already graduated with Ph.D.s based on dissertations done with data gathered from the Math in the Middle Institute Partnership under the direction of one of the co-PIs, Ruth Heaton.

Dr. Wendy Smith is currently employed as the Research Coordinator for NebraskaMATH, overseeing the day-to-day research tasks being done by research assistants across all parts of NebraskaMATH. While Smith's Ph.D. has led to her advancing local research efforts, Dr. Yolanda Rolle moved East



Wendy Smith



Yolanda Rolle

and took a job at Boston University as an assistant professor of mathematics education. Both Smith and Rolle continue to analyze project data and have submitted journal articles for publication. Information on Smith and Rolle's dissertations is available on the Math in the Middle Web site: <http://sci-math.unl.edu/MIM/dissertations.php>. The site will continue to be updated as other graduate students complete their dissertations. A doctoral student at Northwestern University will graduate in December 2009 with a Ph.D. based on data gathered in Nebraska in the context of a research partnership the Math in the Middle PIs established with Dr. James Spillane at Northwestern University. Three other UNL doctoral students are working on dissertations based on Math in the Middle project data, with completion of their degrees expected in 2010. The efforts of doctoral students across the Math in the Middle project in data collection, analysis, and writing for publication have greatly enhanced our capacity to disseminate what we are learning in ways that are academically rigorous and contribute to national conversations in mathematics education on the impact of professional development on teachers' practices, students' learning, as well as the nature of teacher learning and change.

In addition to providing opportunities for graduate students to engage in research, Math in the Middle and the Nebraska Math and Science Summer Institutes have provided 40 UNL graduate students with the opportunity to be part of an M<sup>2</sup> instructional team. These opportunities go well beyond offering financial support for graduate students. Because of Math in the Middle, they learn about teaching as they observe outstanding faculty who teach in the program, they learn about K-12 education as they work with mathematics teachers in a professional development setting, and they come to believe that this kind of work is an important part of a faculty member's duties. After they earn their Ph.D., these attitudes have an impact on their work as university professors.

Examples of graduate students who have taught in the Math in the Middle program include statistician Kendra Schmidt who was hired by the University of Nebraska Medical Center and who will teach a Math in the Middle course for OPS teachers in Summer 2010. Another example is Pari Ford, now a mathematician at UNK who taught two NMSSI courses in Summer 2009. A third example is Diana White whose position with the Department of Mathematics at the University of Colorado Denver emphasizes working with teachers. White already has used her Math in the Middle experience to write a successful grant proposal to NSF. ■

## Publications

### Funded in part by the Math in the Middle Institute Partnership

Nebesniak, A. & Heaton, R. (in press). Using cooperative learning to promote a problem-solving classroom. *Mathematics Teaching in the Middle School*.

Heaton, R. M., Lewis, W. J., & Smith, W. M. (2009). Building middle level mathematics teachers' capacities as teachers and leaders: The Math in the Middle Institute Partnership. *The Journal of Mathematics and Science: Collaborative Explorations*, 11(Spring 2009), 1-18.

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