



Nebraska **MATH** FINAL REPORT



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Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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UNL CENTER FOR SCIENCE, MATHEMATICS AND COMPUTER EDUCATION

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Jim Lewis

On behalf of my colleagues at the University of Nebraska-Lincoln, we are pleased to offer this report to Nebraska highlighting many of the accomplishments of the NebraskaMATH grant over the past six years.

When we submitted our proposal to the National Science Foundation in the spring of 2008, we identified two critical junctures for K-12 students: the transition to formal education in the primary grades and the move from middle to high school. We also focused attention on the important induction period for new teachers, from preparing to be a teacher to the challenging first few years as a secondary mathematics teacher. To address these transitions, we created three key programs for teachers: Primarily Math, Nebraska Algebra and the New Teacher Network. Five years later, nearly 500 teachers across the state have been impacted by these three programs, and the numbers continue to grow as NebraskaMATH partnerships are built and strengthened.

NebraskaMATH is designed to be a partnership that includes those at the university interested in mathematics teacher education, together with K-12 mathematics teachers and school district leaders. For NebraskaMATH, our core partners are the Grand Island Public Schools, Lincoln Public Schools, Omaha Public Schools and Papillion-La Vista School District. To extend our work to include teachers in many other school districts in Nebraska, we also collaborate with Nebraska's Educational Service Units.

In many ways, NebraskaMATH was made possible by the foundation laid by our previous Math Science Partnership, Math in the Middle. The NebraskaMATH proposal pledged that we would put our collective energy into building a sustainable statewide partnership aimed at strengthening K-12 mathematics teaching and learning. The short stories in this publication are intended to offer a glimpse into how NebraskaMATH has helped to create new leaders and leverage new grants and collaborations to accomplish this goal.

We have much to be thankful for and many people and organizations for whom we are grateful. Certainly, this includes the core partner leaders; the administrators at UNL who have supported our work; the staff in the Center for Science, Mathematics and Computer Education; and the faculty, graduate students and master teachers who have played a role in our research and teaching endeavors. We also thank the many teachers who have taken our courses and have gone back into their classrooms dedicated to the young people of Nebraska. You inspire us, and we have learned much from you. Most of all, we want to thank the National Science Foundation for its support and confidence that we would be good stewards of its funds.

Many readers of this publication will know that I recently accepted a position at the NSF on loan from UNL. As NebraskaMATH completes its final reports and brings a few continuing projects to a close, it will be ably led by my colleague and co-PI Ruth Heaton. To stay connected with our projects, sign up on our website to receive our NebraskaMATH newsletter. 

Jim Lewis



W. James "Jim" Lewis

Aaron Douglas Professor of Mathematics

*Director, Center for Science,
Mathematics and Computer Education*

*NebraskaMATH Principal Investigator
2009-2014*

*Deputy Assistant Director, Education
and Human Resources Directorate,
National Science Foundation, 2015*

NebraskaMATH

CORE PARTNERS

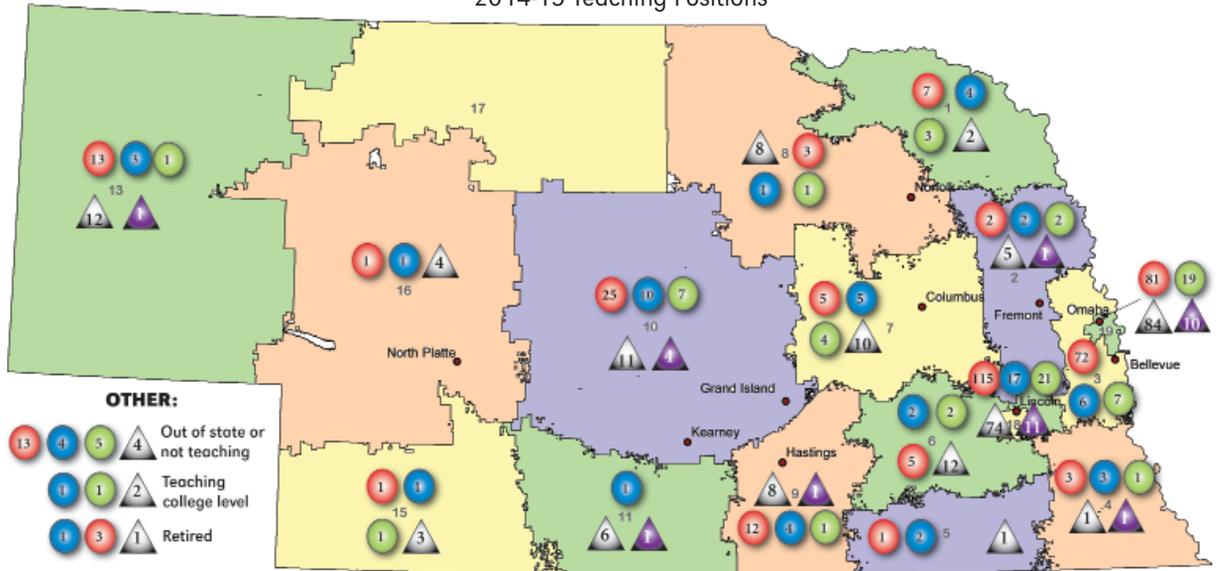


LINCOLN PUBLIC SCHOOLS



Nebraska **MATH** TEACHER LEADERS

by Nebraska Educational Service Units
2014-15 Teaching Positions



OTHER:

- ● ● ▲ Out of state or not teaching
- ● ▲ Teaching college level
- ● ▲ Retired

● Primarily Math ● Nebraska Algebra ● New Teacher Network

KEY:



Math in the Middle
2011-2012 Teaching Positions



Noyce Master Teaching Fellows

Nebraska **MATH** goals

Goal 1: Develop an active and mature K-16 partnership that can be sustained after the end of the NSF funding by state dollars and other grants and that links mathematics teachers and school administrators from across Nebraska with university mathematicians and mathematics educators to improve mathematics education statewide.

Goal 2: Strengthen participating teachers' mathematical and pedagogical knowledge for teaching and their professional interactions with other teachers in their schools, while improving their attitudes toward the teaching and learning of mathematics.

Goal 3: Improve students' attitudes toward mathematics, their appreciation of the importance of sustained effort, and their knowledge of mathematics.

Nebraska **MATH**

A partnership to improve mathematics achievement

Goal 4: Contribute to research in mathematics education through a mixed methods research design studying K-3 teachers' knowledge, attitudes, and leadership in relationship to student attitudes and achievement. □

BY THE NUMBERS

\$9,235,407

Amount awarded by the *National Science Foundation* for the NebraskaMATH grant

\$11,134,367

Amount generated as a result of NebraskaMATH, through a *combination of additional grants* from the National Science Foundation, grants from local foundations, and school district funds for teacher professional development

40

and

66

FACULTY

GRADUATE STUDENTS

served on *instructional teams and/or conducted research* supported by NebraskaMATH.

The 40 faculty included 26 professors from UNL and 14 professors from: UNO, UNMC, UNK, Nebraska Wesleyan, Wayne State and Northern Colorado.

The 66 graduate students' education came from *six* different departments:

MATHEMATICS

PSYCHOLOGY

STATISTICS

TEACHING, LEARNING &
TEACHER EDUCATION

EDUCATIONAL
PSYCHOLOGY

CHILD, YOUTH &
FAMILY STUDIES

26

Courses created at UNL
(MATH, TEAC, EDPS)
for K-12 teachers



80 TEACHERS

served on
instructional
teams
teaching other
teachers



278 TEACHERS

COMPLETED PRIMARILY MATH

with 91 more in progress



72 TEACHERS

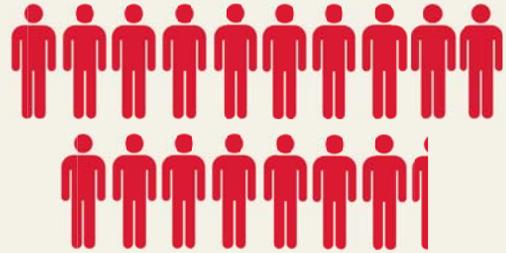
*earned a **master's degree** from UNL after completing a NebraskaMATH program:*

24 Primarily Math teachers have completed a MA degree from TLTE and 48 teachers have graduated with a MAT from Mathematics



68 TEACHERS

**COMPLETED
NEBRASKA ALGEBRA**



174 TEACHERS

*are currently pursuing a **master's degree** at UNL*



75 TEACHERS

**PARTICIPATED IN THE
NEW TEACHER NETWORK**

taking up to 24 credit hours of graduate courses from UNL, including the Nebraska Algebra courses



613 TEACHERS

have taken 1,504 courses from one of 15 different locations across Nebraska as part of the Nebraska Math and Science Summer Institutes



= 10 teachers



18 TEACHERS

*are currently working on a **doctoral degree** from UNL*

2014 Summit brings together 450 educators

The Nebraska Summit on Math and Science Education brought together more than 450 attendees from across the state on Dec. 8, 2014, at the Nebraska Innovation Campus Conference Center.

Teams of administrators and teachers of math and science from K-12 schools, universities, colleges, and state and district offices assembled to take stock of Nebraska's strengths and the challenges that face education as all educators strive to ensure high quality math and science education in Nebraska's K-12 schools.

The Summit opened with presentations by plenary speakers Matt Blomstedt, Nebraska's Commissioner of Education, Diane Briars, president of the National Council of Teachers of Mathematics, and Jerry Valadez, director of the Central Valley Science Project in Fresno, California.

Blomstedt emphasized the need to develop sustained professional development and other support structures, which will equip Nebraska's teachers to "support every student, every day." Blomstedt also presented the Accountability for a Quality Education System, Today and Tomorrow (AQuESTT) framework, designed around six tenets on which strengths and needs of schools will be assessed with the goal of better teaching, not more testing.

Briars followed with a call for identifying 21st century competencies to guide K-12 math and science education and determining the best teaching practices that will lead us to them. Organizations charged with articulating these competencies



CRAIG CHANDLER | UNIVERSITY COMMUNICATIONS

(Clockwise from top) Matt Blomstedt, Nebraska's Commissioner of Education, Diane Briars, president of NCTM, and Jerry Valadez, director of the Central Valley Science Project in California, give plenary talks at the 2014 Nebraska Summit on Math and Science Education at Nebraska Innovation Campus on Dec. 8, 2014.



all agree that American students need to become problem-solvers, with cognitive, interpersonal and intrapersonal skills. A way to begin this process is to stop teaching students tricks to arrive at answers and instead focus on teaching for understanding.

Valadez concluded the opening session by agreeing that teaching students to think and become problem-solvers is vital for STEM education. In particular, Valadez emphasized the need to provide less-privileged children with opportunities to explore science regardless of socio-economic or ethnic background, so that all students can develop a high academic self-concept and a belief that they can be successful in STEM fields.

Following morning breakout sessions, lunch featured a presentation by Jim Spillane, Olin Professor of Learning and Organizational Change at Northwestern University, via video-conference. Spillane challenged participants to examine (and re-examine) organizational

routines within schools and educational organizations to determine where changes in formal or informal leadership can facilitate interactions among teachers within and across school buildings and districts (see social networks research on page 17). Since subject matter knowledge is an important component of leadership, focused professional development can strengthen an individual's role as a leader.

An afternoon panel on creating and sustaining PK-16 partnerships featured Jim Lewis, Aaron Douglas Professor of Mathematics (UNL); Matt Larson, Lincoln Public Schools' mathematics curriculum specialist and NCTM president-elect; Jim Harrington, Omaha Public Schools' supervisor of mathematics; and Julie Thomas, research professor, Department of Teaching, Learning and Teacher Education (UNL). Panelists discussed the history of the partnerships among them, how these partnerships have led to successful programs such as NebraskaMATH, and the



CRAIG CHANDLER | UNIVERSITY COMMUNICATIONS

Jim Spillane, Olin Professor of Learning and Organizational Change at Northwestern University, spoke during lunch via video-conference. Spillane challenged participants to examine organizational routines within schools and educational organizations.

enormously positive impact the programs have had on education in the LPS and OPS school systems. Thomas brought the discussion to a close with the charge of using existing partnerships around mathematics as a model that science partnerships might emulate.

Closing remarks about the Summit were offered by Jon Pedersen, Professor and Associate Dean for Research in the College of Education and Human Sciences, and Carolyn Edwards, Willa Cather Professor in Psychology and Child, Youth and Family Studies.

Breakout sessions at the Summit featured Nebraska State Senator Greg Adams, 2015 Nebraska Teacher of the Year Shelby Aaberg, Nebraska Department of Education Mathematics Director Deb

Romanek and numerous other esteemed stakeholders in STEM education.

A conference pre-session featuring sessions particularly applicable to K-12 math and science teachers took place at the Embassy Suites Downtown Lincoln on Sunday evening. More than 250 STEM K-12 teachers, practitioners and educators were in attendance.

The 2014 Summit marked the closing of the NebraskaMATH NSF grant, which opened with a Nebraska Summit on Mathematics Education on Dec. 14, 2009. The 2009 Summit featured keynote speaker Cathy Seeley, a senior fellow at the Dana Center at the The University of Texas at Austin who is a past president of NCTM, as well as (then) Governor Dave Heineman and (then) University of Nebraska President J.B. Milliken. □

Download slides

Slides and handouts from the Sunday pre-session and the Monday plenary and breakout sessions at the 2014 Summit on Math and Science Education at Nebraska Innovation Campus are posted online and available for download at <http://scimath.unl.edu/conferences>. This web page also links to information from the 2009 Nebraska Summit on Mathematics Education, featuring a video of keynote speaker Cathy Seeley and the slides from the plenary and breakout session speakers. □

Building on curiosity

It's all thanks to a stranger named Penny.

Coincidentally, Penny couldn't understand her finances. On the first day of every month, Kristine Ray, then assistant branch manager for a local bank, would explain to Penny why she only had a certain amount of dollars in her account after her bills were automatically paid. Ray wondered why the longtime customer didn't understand. And that's when she made a decision.

"I realized I was spending most of my time arguing with adults who could not think logically about their money situations,"

the old YWCA building, Ray started upon a teaching degree. After attending UNK for a year, she came back to Lincoln, got married and started a family of her own. While working at a bank, she completed the UNL academic transfer program at Southeast Community College. She went on to student-teach at West Lincoln where she taught second grade for one year before switching to kindergarten.

Since finishing *Primarily Math* in 2013, Ray has continued her graduate work at UNL and will earn her Master of Arts in Curriculum and Instruction from the Department of Teaching, Learning and Teacher Education in May 2015.

Other opportunities also

have come her way. Next summer, she will co-teach a cohort of LPS Title 1 teachers taking *Primarily Math* courses; she has had a Ph.D. student come into her classroom to film and conduct interviews; she co-taught a parent group on mathematics and the Common Core; and she has sat on two panels regarding her experience with *Primarily Math*.

"Hands down, *Primarily Math* is the best professional development I have ever taken," the Lincoln native said. "I feel confident in making IEP goals for students. I know how to analyze and assess student errors and place them on a trajectory if needed. I have a sense of curiosity around student thinking, more than I ever have before, and a sense of risk-taking in the classroom to push the envelope a little more."

said the *Primarily Math* Cohort 4 Lincoln teacher, who quit her job at the bank to finish her teaching degree at UNL. "I decided I was going to become a teacher so students would grow up to be adults who could be productive members of society. I was going to save the world, one classroom at a time!"

Ray has been teaching for five years now at Lincoln Public Schools' West Lincoln Elementary School. It's been a long road to success. Growing up, Ray's parents were blue-collar workers. She and her family didn't know much about college, but Ray said, "I knew enough that I was only going to get one shot at it, and I couldn't mess around."

Led by her love of a volunteer position at the University of Nebraska Child Care Project in

LINCOLN PUBLIC SCHOOLS

Kristine Ray



I think about, what can these kindergarteners *really* do? And I get excited about all of it!"

Instilling this excitement within parents and colleagues has become natural at West Lincoln Elementary, where *Primarily Math* Cohort 1 participant Lynn Fuller is assistant principal and Ray's fellow Cohort 4 peer Lisa Sparks is a first-grade teacher.

"Our school is always functioning as a PLC group," Ray said. "We collaborate in impromptu hallway meetings



LINDSAY AUGUSTYN | UNL CSMCE

Primarily Math's Kristine Ray works on the "teen" numbers with her kindergarten class at West Lincoln Elementary in Lincoln.

regarding an upcoming lesson or test, and we meet weekly on Wednesdays to problem-solve any issues that have come up or to offer advice for upcoming curriculum. We have bi-monthly parent information nights, one dedicated to literacy and the other to mathematics. We are hoping to instill a love and passion for learning in our parents as well as our students.”

This collaboration inspires Ray to become a leader in LPS.

“I think it takes a leader to step

up, open up his or her classroom for others to come in to observe, co-teach, problem-solve, make meaningful, purposeful plans, and guide reflection on best practices,” Ray said. “I think it also takes someone who is willing to say, ‘I don’t have all the answers, nor do I know them, but I do know how to make a plan to start.’ I enjoy working as part of a team that continually keeps student needs, and what is developmentally appropriate, at the heart of everything they do.”

Building these relationships with peers in LPS and finding her own strengths while working in a peer group were cultivated for Ray through her Primarily Math experience.

“I can honestly say through my educational career, I have never been pushed so hard, or been so rewarded, so I am a huge advocate of this program,” said the mother of two biological children and one foster child. “It has done wonders for me and for the students in my classroom.” □

Primarily Math:

Primary grades become primary focus

How it all started

The idea for Primarily Math began as the result of a meeting Jim Lewis and Tom McGowan had with Marjorie Kostelnik, dean of the UNL College of Education and Human Sciences. Kostelnik, co-author of *Getting It Right From the Start: The Principal's Guide to Early Childhood Education*, persuasively argued that real and lasting improvements in K-12 mathematics education begin in the primary grades.

The idea resonated with Lewis and McGowan's colleague Ruth Heaton, whose scholarship focuses on teaching and learning to teach mathematics in the elementary grades. She sought out Carolyn Edwards, an expert in early childhood education, and they began planning Primarily Math. To design a major research study that would inform the NebraskaMATH project as to the impact of the program on both teacher knowledge and beliefs and on student achievement in mathematics, they worked with Statistics Professor Walt Stroup. Together they designed Primarily Math, a program and research study that became the largest and most important part of NebraskaMATH. □

Elementary school teachers and administrators know that many children, especially students from economically disadvantaged backgrounds, arrive at their doors eager to begin formal education but significantly behind their more advantaged peers with respect to readiness to learn and possessing appropriate school-entry reading and math skills.

Historically, formal education in the primary grades focused on the socialization of young children and teaching children to read. A lesser importance was assigned to teaching mathematics in the early grades and to showing elementary teachers how to teach mathematics. There is, however, a growing body of research that argues that the early years matter for the development of mathematical thinking and reasoning.

Duncan and his colleagues (Duncan et al., 2007) reported that both math and reading skills at the point of school entry are consistently associated with higher levels of academic performance in later grades. However, early math skills not only predicted later achievement in math, but also in reading skills.

At the same time, research (Hill, Schilling, & Ball, 2004) shows that teachers' mathematical knowledge for teaching relates to teachers' instructional practices in the classroom and also predicts children's mathematics achievement. However, a large number of mathematics teachers in the early grades may possess high levels of mathematics anxiety.

Mathematics anxiety can be "contagious." Biellock et al. (2010)

showed female teachers' math anxiety was not related to student math achievement at the beginning of the school year. However, by the end of the school year, for teachers who are more anxious about mathematics, girls in their classrooms (but not boys) tended to have lower math achievement and were more likely to believe that girls are good at reading while boys are good at math.

Knowing that teachers' attitudes can be assimilated by their students, NebraskaMATH set out to create the Primarily Math program, wanting to increase primary teachers' knowledge of mathematics for teaching, lessen their mathematics anxiety and increase their confidence.

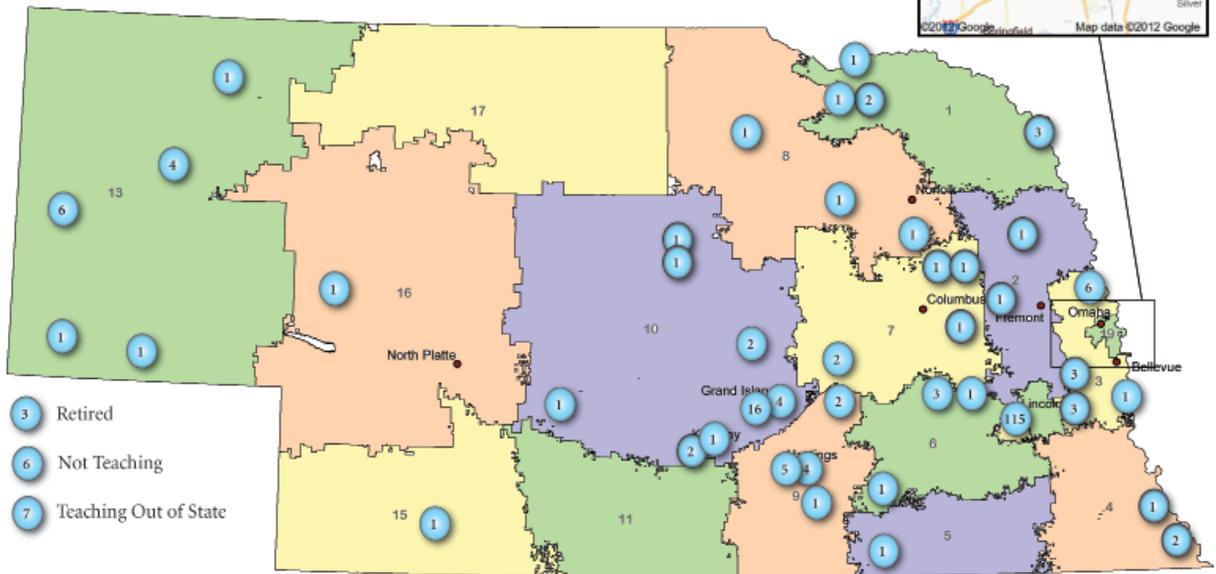
To the NebraskaMATH team, a new emphasis on mathematics teaching and learning in the primary grades meant that primary grade teachers who were superbly prepared to teach math could make a major difference in the lives of the children they teach, shrinking the mathematics knowledge gap and ensuring all their students an outstanding mathematics education. This, in turn, holds promise for the students as they progress to higher grades.

In 2009, Primarily Math began educating a community of mathematically strong K-3 teachers eager to teach math and to share what they have learned with their peers. Today, 278 teachers have completed Primarily Math, with 91 more in progress.

The map on page 11 shows where these teachers are currently located across the state. □

Primarily Math Teachers by Nebraska Educational Service Units

2014-2015 Teaching Positions



Primarily Math offers graduate courses, K-3 certificate

Primarily Math is an 18-credit hour graduate program for teachers of kindergarten or grades 1, 2 or 3 that leads to earning a certificate as a K-3 Mathematics Specialist.

Teachers take three courses focused on pedagogy and children's mathematical development from UNL's Department of Teaching, Learning and Teacher Education and three mathematics courses especially designed for teachers from the Department of Mathematics. The program also offers an optional seventh course that focuses on leadership in an elementary school environment.

The courses use the method of delivery first developed by the Math in the Middle Institute Partnership. During the summer, teachers are in class for two weeks from 8 a.m. until 5 p.m. and then work on nightly homework, often

Sample math class problem

Suppose Laura is a student in your classroom and declares that she has made the following discovery:

As the perimeter of a rectangle increases, so does the area.

Do you agree? Either verify or disprove Laura's assertion and describe how you might respond to Laura.

Note: This problem has an interesting history that includes its use in research studies conducted by Deborah Ball (then at Michigan State and by Liping Ma for her Ph.D. dissertation at Stanford.

for three hours or more. At the end of each course, teachers work on an end-of-course assignment that offers an opportunity to deepen teachers' knowledge of what has been studied in face-to-face classes.

Academic-year courses are linked to the teachers' classroom practice and are offered using a blended model of several Saturday

class meetings with individual and online work.

Each Primarily Math course was designed, taught and revised with input from both university faculty and master teachers. For example, the first two courses in the program, Math 800P and Math 801P, were created by Michelle Homp, a mathematician at UNL and Laura Parn, a Math in the Middle graduate and, at the time, a grade 3-5 math coach with the Lincoln Public Schools. Based on their experience co-teaching the courses, Homp, Parn, and Susie Katt, a K-2 math coach for LPS who was a participant in the first cohort of Primarily Math (see page 42), revised the two courses.

Through this teach and revise process, each cohort of teachers in Primarily Math has the opportunity to participate in a program that

Continued on Page 12

was designed with teachers in the primary grades in mind.

The mathematics courses model the pedagogy NebraskaMATH wants teachers to use. Learning is active, with small-group work, participant presentations and whole group discussions. Math courses have daily problem sets with problems ranging from straightforward to accessible but challenging “habits of mind” problems designed to develop the “habits of mind of a mathematical thinker.” As teachers work on homework during the summer, they benefit both from discussions with their peers and from members of the instructional team who are available to help them get over any intellectual “bumps in the road.”

TEAC 808A and TEAC 808J are taught during the academic year, so that participants can complete assignments that directly tie course content to their teaching practices, including work with both students and parents. The courses focus on helping teachers become more intentional, planful, observant, and reflective in their teaching of all students. Major assignments include:

- Cycles of lesson/unit planning: Teachers set mathematical goals, elaborate upon lessons’ mathematical ideas, and plan subsequent lessons based on students’ understanding.
- Family projects: Teachers enact a family project to better partner with parents, and then conduct a second iteration to further improve their efforts.
- Child studies: Teachers follow two students closely for eight weeks, and analyze learning trajectories, strengths and weaknesses of each child.
- Talk moves: Both courses focus on “math talk” and how to facilitate mathematical discourse in math class to support the learning



LINDSAY AUGUSTYN | UNL CSMCE

Primarily Math Cohort 4 LPS participants Jessi Potter (left) and Jennifer Jenkins discuss an assignment in Jim Lewis’ Math 802P course in June 2013.

of all young children.

During their second summer, teachers take Math 802P, which takes teachers out of their comfort zone as they study fractions and geometry. The companion course, TEAC 907, focuses on how to analyze the cognitive demand of mathematical tasks and how the use of particular teaching strategies may raise, lower or sustain cognitive demand for learners.

Teachers also create a leadership plan. They identify aspects of mathematics teaching and learning from Primarily Math that can be included in work with colleagues who have not participated in Primarily Math and design learning opportunities for their peers.

The Primarily Math website features descriptions from the program’s seven courses.

The Primarily Math graduate program is challenging and intense, but it is also rewarding for the teachers who participate. Teachers appreciate the substantial support they receive from instructors. Each course is taught by an instructional team that includes university faculty, master teachers who have participated in the program in the past and graduate students.

This publication includes

several features on teachers who have participated in Primarily Math who discuss the impact the program has had on their teaching.

If there is one constant throughout the Primarily Math graduate program, it is the instructors’ admiration for the teachers in the program. Overwhelmingly, these teachers are dedicated to the students they teach, they are passionate about learning so that they can improve their craft, they demonstrate the perseverance they want to develop in the students they teach, and they are wonderfully supportive of one another. As a result, both university faculty and graduate students believe they learn from teaching in the program and find the work rewarding.

At the same time, NebraskaMATH is learning, or relearning, important lessons about changing teaching and learning:

- change is slow and difficult;
- beliefs and practice change in related but nonlinear manners;
- cycles of inquiry and ongoing learning and reflection are critical; and
- teachers are continual learners in, of and from practice (Lampert, 2009). □



LINDSAY AUGUSTYN | UNL CSMCE

Primarily Math Cohort 5 participants Gwen Schultz (left) and Carissa Phillips use interlocking cubes for a lesson in Math 802P in Grand Island in June 2014.

Perseverance pays off

In Gwen Schultz's classroom, the focus is no longer only on reading.

"I feel like I have become a more well-rounded teacher," the Shickley, Nebraska, kindergarten teacher said. "Previously, my focus was on reading, and now, I feel like



I am doing a really good job in both reading and math, because of the strong foundation Primarily Math has given me."

As a student, Schultz struggled with mathematics. After earning her bachelor's degree in elementary education, the Primarily Math Cohort 5 participant went on to receive a master's degree in reading from Northwest Missouri

State University. But now, after Primarily Math, Schultz has gained confidence with mathematics.

"Gwen had the right attitude for learning and a great sense of humor. She had the strength of character that one needs to achieve their goals," said Jim Lewis, who was the lead instructor for Math 802P, the third mathematics course of Primarily Math. "In that sense, I never saw her as weak in mathematics. Many teachers struggle with my expectations initially, but the successful ones persevere."

Schultz said she knew she wanted to "be a teacher for life" after working as a student teacher in high school. Growing up, she watched her parents progress through various careers, influencing her to understand that

"everyone has to work hard for what they have."

Schultz has been teaching kindergarten for four years at Shickley Elementary, and taught Title I for the four years prior. She began her career in Wymore, Nebraska, also teaching kindergarten, for one year. She and her husband, Chad, live in Shickley with their two daughters, Lynzie and Paizley.

"I enjoy sharing what I have learned with my colleagues and offering advice to new teachers," she said. "The teaching philosophy at my school involves lots of collaboration with our peers to help guide our instruction. The other teachers are aware of my participation in Primarily Math, and they approach me if they have questions or need some suggestions to guide their math instruction."

Working with the other teachers in her cohort has been Schultz's favorite part of her professional development experience.

SHICKLEY PUBLIC SCHOOL

Gwen Schultz

"My favorite part of Primarily Math was the networking and collaboration that occurs with other teachers who are doing the same things in their classrooms," said Schultz, a native of Missouri. "I made many lifelong friendships."

While Schultz admits the program is intense, it's worth it.

"Participating in this program was the smartest decision I have made since becoming a teacher," she said. "I would tell anyone considering any additional professional development, especially Primarily Math, that they should absolutely go for it!" ▣

How does Primarily Math impact K-3 teachers?

One of the goals of Primarily Math was to learn how a well-designed professional development program might change teachers' knowledge (knowledge of mathematics, teaching, and students) and beliefs and, subsequently, teachers' practices in the classroom.

In 2009, more than 100 teachers were recruited to begin Primarily Math and assigned to begin graduate study in 2009, 2010 or 2011. This plan enabled teachers assigned to the second or third cohorts to serve as part of a comparison group of teachers prior to participation in the program.

In addition, comparison group teachers were recruited from buildings in the core partner districts (Grand Island Public Schools, Lincoln Public Schools, Omaha Public Schools and Papillion-La Vista School District) with student demographics comparable to the schools of Primarily Math participants.

Beginning in 2010, additional comparison teachers were recruited, and as math coaches were placed in buildings, the research team recruited teachers from those schools to participate in the research study. The focus of research data collection was on these first three cohorts, although survey data has been collected from later cohorts that began coursework in 2012 or 2013.

Over the past six years, the research team has collected a large amount of data from teachers including teachers who participated in Primarily Math, those who were part of a comparison group, and eventually teachers in buildings with Primarily Math-educated math coaches.

Upon reflection

Analyzing teachers' course reflections tells the story that Primarily Math participants see themselves as changing in the following ways:

- asking questions and keeping lesson objectives in focus;
- valuing shared ownership of learning;
- intentionally planning for increased student responsibility;
- supporting students' meaning-making and establishing mathematical connections;
- using knowledge of student understanding to inform teaching; and
- applying knowledge of NCTM process standards and CCSS standards for mathematical practice. 

The data included:

- Mathematical Knowledge for Teaching (Hill, Schilling, & Ball, 2004);
- annual surveys of Attitudes toward Mathematics (Mulhern & Rae, 1998 adapted from the short form of the Fennema-Sherman Mathematics Attitude Scales, 1976); and
- annual surveys of Teaching Practices (adapted from a version used with Math in the Middle; includes the Mathematics Beliefs Scales, Fennema, Carpenter & Loef, 1990; Caprano, 2001).

In addition, for teachers in Primarily Math, the research team conducted interviews, collected copies of coursework in graduate classes, and video-taped teachers

teaching mathematics.

In partnership with colleagues at Northwestern University, social network data in elementary schools in the core partner districts were collected to gain a better understanding of the professional networks within schools, particularly to examine the advice networks related to mathematics teaching and learning.

Analyzing video recordings of teachers' mathematics teaching, change was most visible across the Mathematical Quality of Instruction Lite (Learning Mathematics for Teaching, 2010) categories of Richness of Mathematics, Errors and Imprecision, and Student Participation in Meaning-making and Reasoning. Change was less visible related to categories of classroom work connected to mathematics, and working with students and mathematics. The research team hypothesizes that this was because those areas started off strong, so did not have much room for growth.

The Richness of Mathematics score for a mathematics lesson seemed to be generative for change in instruction: as teachers focused on engaging students in mathematically rich tasks, they also used more precise mathematics language, engaged students in more math talk, and had more student-centered practices. The further the teachers got into Primarily Math, the richer their lessons were mathematically.

The research team often also saw increases in errors and imprecisions. However, as teachers engage students more in math talk, and in explaining reasoning, that frequently means students are

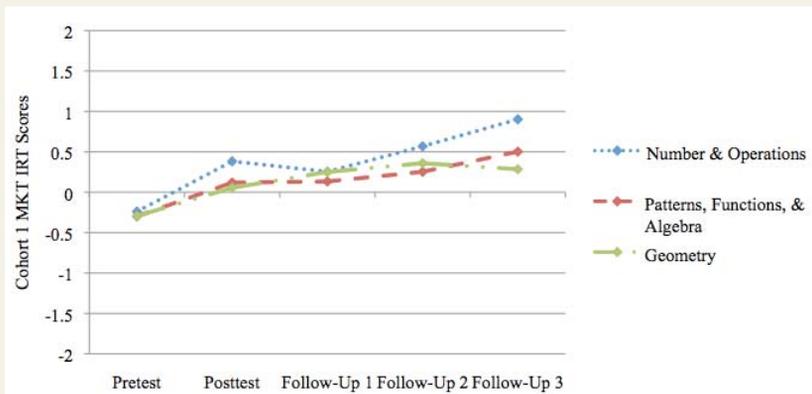
Continued on Page 16

Growth in teachers' Mathematical Knowledge for Teaching

Teachers grow in their mathematical knowledge for teaching, both during and after Primarily Math participation. The graph below shows results for the first cohort of Primarily Math teachers as measured by the Knowledge of Mathematics for Teaching assessment developed at the University of Michigan, illustrating the continued growth of teachers after completing Primarily Math coursework. Teachers in later cohorts showed similar trajectories.

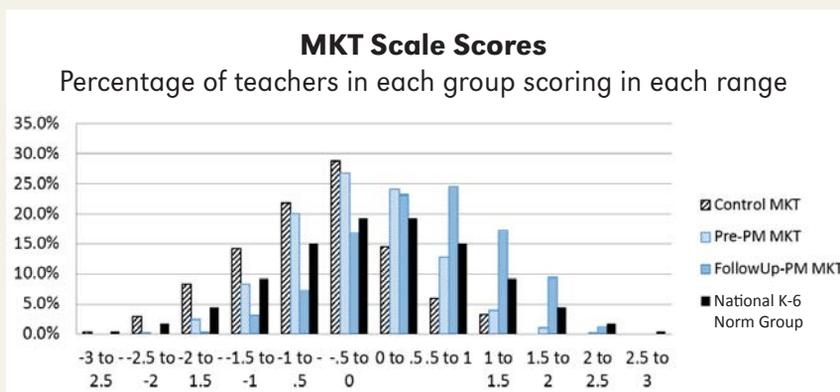
Scores on the Mathematical Knowledge for Teaching (MKT) assessment are given as standardized scores, with a mean of zero and standard deviation of one. When compared with a large national sample, Primarily Math participants' beginning knowledge of mathematics for teaching averaged about -0.5. This would imply that for the typical teacher in the

group, their mathematical knowledge for teaching would put them at about the "33rd percentile" of all K-6 elementary math teachers in the U.S. This was not a surprising finding in that researchers expected that even K-3 teachers who were positive about learning mathematics would average below the full comparison group because grade 4-6 teachers, on average, would be expected to be stronger mathematically than K-3 teachers. What is remarkable is that at the conclusion of the program (i.e., the posttest administration) the cohort had grown mathematically almost 0.75 standard deviations, indicating dramatic growth during the program. Equally interesting is that the teachers continue to grow mathematically after completing the program. In particular, their knowledge of Number and Operation would place them among the top 20 percent of K-6 elementary mathematics teachers in the U.S. Because knowledge in the Number and Operation domain is so important to teaching math in grades K-3, this is especially good news.

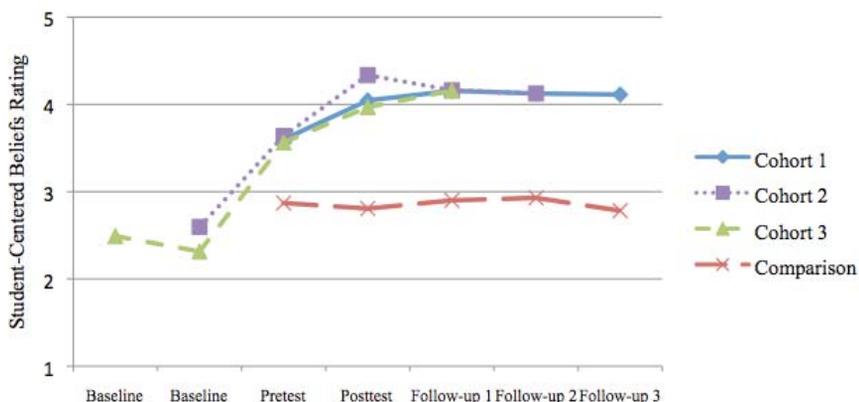


The research team also looked at the first three Primarily Math cohorts and compared their Mathematical Knowledge for Teaching scores with those of the comparison group. Researchers saw that with each Primarily Math cohort, while teachers began in different places, they had steep growth in their

mathematical knowledge for teaching. The comparison group's mathematical knowledge for teaching stayed statistically flat across three measures (2009-2012) and increased slightly in 2013. Reported above is the Control MKT for the period 2009-2013. This recent growth is thought to be due to the focus on mathematics and good work being done within the partner districts that is separate from Primarily Math. It is also possible that there is a diffusion effect where Primarily Math participants benefit their peers as teachers have additional mathematical conversations in their schools. □



This graph compares the changes over time for the first three Primarily Math cohorts and the comparison teachers' student-centered beliefs. The data show Primarily Math teachers grow through their participation in Primarily Math, and that growth is sustained over time.



Advanced degrees

Twenty-four Primarily Math teachers have completed a Master of Arts degree from the UNL Department of Teaching, Learning and Teacher Education, with 39 more in progress. Teachers are able to use the six Primarily Math courses as the foundation for a master's degree from TLTE with a minor in mathematics.

Twenty-seven people associated with NebraskaMATH are working on or have completed doctorates. Five doctoral dissertations have been awarded based on research done as part of the NebraskaMATH grant (see page 54). Another dissertation is expected to be completed in Summer 2015.

Eighteen of the 27 teachers who have been part of NebraskaMATH or NebraskaNOYCE (see page 40) projects are pursuing doctorates from TLTE. One of those teachers originally completed Primarily Math (see page 42), and all 18 are involved in NMSSI course instruction. □

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making more observable mistakes. Student errors, if recognized and used by the teacher, can be a terrific jumping-off point for rich mathematical discussions.

Charts on page 15 explain the growth seen in teachers' Mathematical Knowledge for Teaching.

Teachers' confidence and motivation also has increased significantly, and their anxiety decreased at statistically significant levels across participation in Primarily Math. In particular, while teachers in each Primarily Math cohort had significant decreases to their anxiety, the comparison group's anxiety levels remained constant. The patterns for confidence and motivation were comparable.

For teacher beliefs, there are two subscales: student-centered beliefs and teacher-centered beliefs. Teachers showed significant increase in their student-centered beliefs and significant decrease in their teacher-centered beliefs across Primarily Math. The graph above compares changes over time for the first three Primarily Math cohorts and the comparison teachers' student-centered beliefs. The teacher-centered beliefs were comparable.

Considering the evidence of teacher change, the analyses also considered how NebraskaMATH might attribute such changes

to Primarily Math. Through interviews and other qualitative data analyses, the research team concluded that there was no single facet of Primarily Math responsible for the changes, but rather the whole of Primarily Math, its content, sequence and structure of the courses. Content-wise, the program focused on both mathematical content knowledge and pedagogy, so teachers not only learned more mathematics, but also how to teach young children. Sequence-wise, teachers took mathematics courses during the summer, which was very intense, and thus provided a strong foundation for a close professional community of educators. During the academic year, teachers' graduate coursework helped them to focus on improving their practices, particularly related to lesson planning, formative assessment and family involvement. The courses were all taught in an active style, with combinations of small-group discussion, whole-group instruction, peer presentations and individual assignments.

The program is more than the sum of its individual parts. The content, sequence and structure of the coursework are collectively responsible for teacher changes, along with the teachers' development as a professional community. □

Investigating teachers' social networks

Research has shown repeatedly that teachers learn on-the-job through interactions with peers. The Primarily Math research team partnered with a research team led by Dr. Jim Spillane at Northwestern University to investigate the changes to teachers' professional mathematics networks over time.

Spillane, together with Dr. Megan Hopkins (Penn State University) and several graduate students, designed and analyzed a teacher network survey administered to elementary school teachers in the four NebraskaMATH core partner districts.



Jim Spillane

The survey asks teachers to report who they turn to for advice about teaching mathematics and

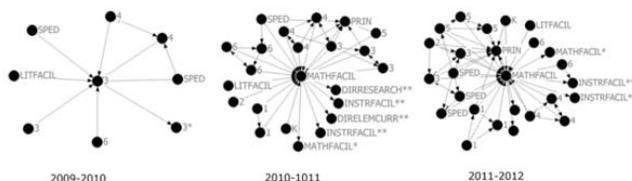
who turns to them for that advice.

Repeating the survey annually allows one to see changes in the professional advice network for teaching mathematics in a school.

The hypothesis is that after teachers complete Primarily Math, the mathematics advice networks in their schools would become denser, i.e., more conversations would be happening about teaching mathematics, and that Primarily Math teachers would become more central in the advice networks as more teachers seek their advice. The survey findings confirmed these hypotheses, and found that when Primarily Math teachers became mathematics coaches, they became even more central to the mathematics advice networks in their schools.

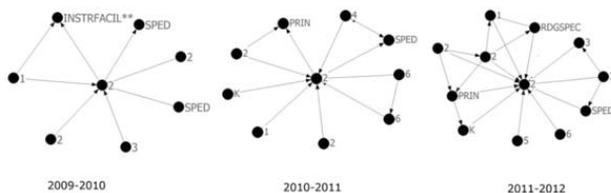
The research team also interviewed a number of survey respondents to determine the quality of the additional conversations about mathematics teaching, and found the conversations often were quite deep, as teachers were very intentional about planning rich mathematics lessons for students to support student learning. Additionally, the Teacher Network Survey shows the importance of school system infrastructures to enriching the mathematics advice network among teachers. When school districts prioritize mathematics professional development, and invest in on-the-job mathematics learning through mathematics coaches, then more teachers have more conversations about teaching mathematics with one another. □

Coach (Emily) Facilitates Interactions



"[Emily] really wasn't our facilitator [last year], though she was my co-worker, just a third grade teacher. I knew she had a wealth of knowledge, I just wasn't in [her classroom] when she was teaching math. But, now that she's moved into this math facilitator position, that's different...She's been trained in it. And, she's gone to school for it and she's a great coach. She knows a lot about math and I trust her that she has a lot of, a wealth of knowledge... She's the go-to person." – Angie, Special Education

Primarily Math Participant (John) Supports Interactions



"Because he's a second grade teacher....He's kind of become the math person to see because he's taken this extra training that nobody else in the building has done, and I know that he's interested in math so, he's just one that I've gone to that I know focuses very heavily on, I like his beliefs and the way that he has his room set up and the way that he carries himself." –Karen, 1st grade

Connections with parents prove vital



STEPHANIE VENDETTI | UNL CSMCE

Cohort 4 teacher Allie Elsasser assists one of her kindergarten students at Patriot Elementary in Papillion in 2013.

Building a strong connection with parents is central to Primarily Math and has been fundamental for kindergarten teacher Allie Elsasser, a Cohort 4

PAPILLION-LA VISTA SCHOOL DISTRICT

Allie Elsasser

participant. Elsasser’s philosophy for teaching math in kindergarten revolves around not only creating a strong yet flexible number sense, but also giving parents the tools to develop this number sense at home.

She uses this teaching philosophy with Patriot Elementary’s incoming students as well, through a grant the Papillion La-Vista School District teacher was awarded from Region II.

“The grant allows me to hold a math day, where I invite parents of incoming kindergartners to come to Patriot and share some ideas and resources on how to create an early number sense

before their child starts school,” Elsasser said. “My goal is to have a ‘make and take’ with some activities and to help parents gain some ideas and strategies to help develop strong questioning and math communication. This includes using visual images, math vocabulary, math games and literature to use.”

Elsasser held the math event “Dive in to Math” in April 2013. More than 30 incoming kindergartners and their families attended, learning a range of skills, including using five and ten frames, and integrating technology, math vocabulary and problem solving in a small-group setting. After taking a year off from the event with the birth of her daughter, Elsasser hopes to apply for another grant to hold the event again.

Parents of Elsasser’s students are amazed at how much their children have learned about math. One parent said of her son, “He counts

everything! Sometimes he turns it into a song. I even hear him teaching his 3-year-old little sister math problems. He loves to learn, and it is obvious he is being taught very well.”

Another parent said when she asked her son what he thought about math, “He said, ‘Math is awesome!’ He is learning about patterns, adding and skip counting, which is helping him learn to tell time, and he’s so excited about it!” The daughter of another parent proudly proclaimed to her mother, “I have learned that six is less than eight.”

Originally from Omaha, Elsasser knew from an early age

she wanted to be a teacher. “From my earliest memories, I played teacher and school. I knew I wanted to teach and was fascinated by young children’s development.”

Now in her eighth year of teaching, Elsasser completed Primarily Math in the summer of 2013, along with getting married that July. She was encouraged to join Primarily Math by her principal, Mary Scarborough, and her math coach at the time, Danielle Inserra, a participant in Cohort 1. Fellow Patriot teacher Erin Case also joined her cohort.

Elsasser said the program has made her become more strategic, reflective and knowledgeable.

“My students have blown me away with their math journaling, discussions, sharing their work on the ELMO/smart board, and teamwork during math workshop. They celebrate one another’s successes and push one another’s thinking. This experience has helped me see that even kindergarten students can be effective math communicators.”

Elsasser also has helped write kindergarten assessments and guide instruction on her district’s kindergarten math toolbox group and has led several professional development sessions for K-6 teachers on math workshop, math note booking, calendar math and math communication.

“I use so much of what I learned through Primarily Math to help fellow teachers become better math educators. I am forever grateful to UNL and the Primarily Math staff for giving me this invaluable opportunity. It has truly opened so many doors and has allowed me to become a leader in my district.” □

How does Primarily Math impact K-2 students?

There are few studies that demonstrate the causal effect of teacher participation in professional development on any student outcomes, much less on mathematics achievement. However, there is some evidence that growth in student outcomes related to teacher change takes time and is difficult to detect. To study whether Primarily Math would make a difference in the mathematical education of students in the primary grades, the NebraskaMATH research team collected data from a subset of participating classrooms, using the Test of Early Mathematics Ability, 3rd Edition (TEMA-3, Ginsburg & Baroody, 2003) and a Survey of Competence Beliefs (adapted from Wigfield et al., 1997).

Initially, the research team collected both belief and achievement data from K-3 students in a sample of classrooms from the first three cohorts of Primarily Math, along with students in classrooms in the comparison group and in buildings with math coaches. The TEMA-3 assessment is designed to assess children through age 8. Many third-grade students turn 9 during the third grade, and the research team recognized a ceiling effect that limited their ability to measure growth in the third grade. Thus, the data reported here are for approximately 4,500 K-2 students for the period 2009-2013.

Since data were longitudinal and nested (students in classrooms in buildings in districts), hierarchical linear modeling techniques were applied to the data. Our statistical model connected teachers' participation in Primarily Math, mathematical knowledge for teaching, attitudes



LINDSAY AUGUSTYN | UNL CSMCE

Primarily Math teacher Alysia Augustus works with a pair of first-grade students during math time at Anderson Grove Elementary in Papillion in 2013.

and beliefs to children's TEMA-3 change scores from fall to spring. TEMA-3 is a standardized test, and scores are constructed based on age and raw scores. Thus, if a child is learning at the expected rate, he or she would have the same score at multiple testing occasions. Growth from fall to spring thus translates to larger than expected knowledge gains.

The research team adapted a child competence beliefs survey to have a pictorial scale and thus be appropriate for young children. Students were asked five questions each about math and reading, asking them how good they are in each subject, how good they are compared to peers, and how good they are at learning new things. The results found their beliefs to be positive and quite stable from fall to spring. The research team also interviewed more than 100 students to better understand how they were completing this survey. K-2 students actively strove to make meaning of their personal mathematical experiences in order to interpret what it meant to be

“good” at math. They were able to articulate coherent belief systems that were built on their experiences (e.g., “I know I’m good at math because sometimes I get stuck on [a problem] but I sit and figure it out”).

Based on the findings of these interviews, there are two reasons why paying attention to student beliefs is an important activity for teachers. First, self-beliefs have an indirect effect on how students approach learning. Healthy or positive self-beliefs may not guarantee that learning will occur, but negative self-beliefs assure academic and social disengagement. Self-beliefs are formed early and self-perpetuate, persevering even in the face of contradictions caused by reason, time, schooling or experience. Second, students need to develop an accurate image of their competencies and capacities based on relevant and reliable indicators of performance from multiple sources in order to make

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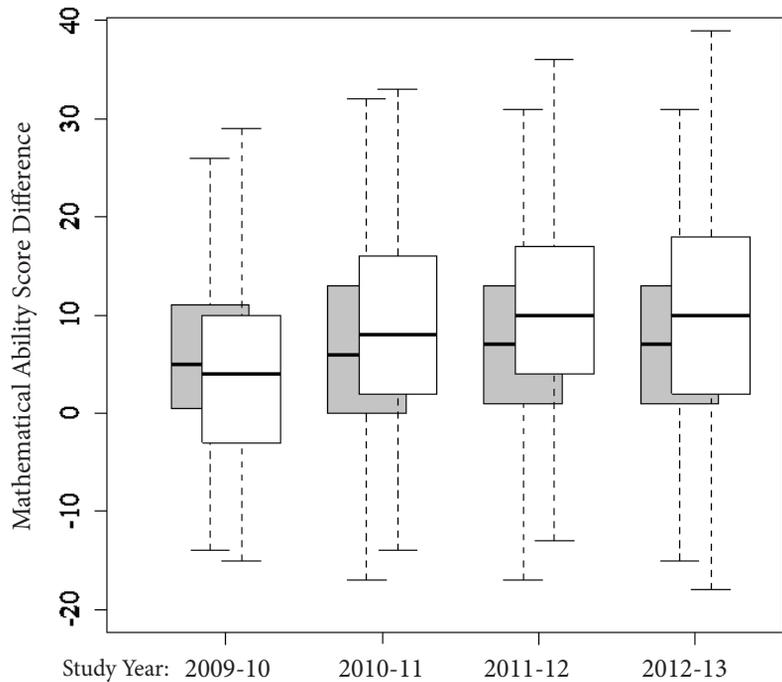
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intelligent adaptations to future action within learning contexts. Teachers can help students develop positive self-concepts by reinforcing students' identities as mathematical thinkers, and emphasizing a growth mindset.

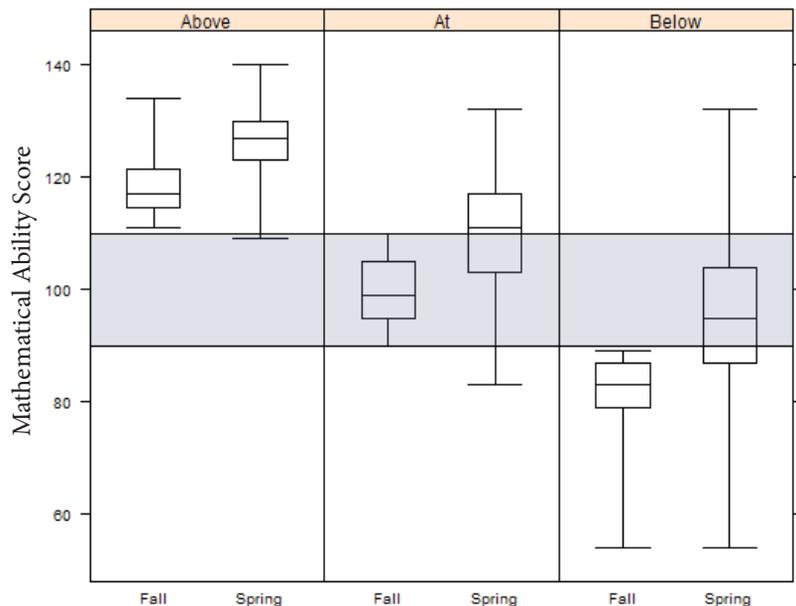
Overall, the research team has found growth in mathematics achievement in all groups of students. Thus, in the four core partner districts, district-wide efforts to increase student mathematics achievement are working. Additionally, starting in the second year of the research study, after the first Primarily Math group had completed the professional development courses, the research team started seeing greater growth in students who had a Primarily Math teacher (see top graph).

In addition to the overall good news of student growth, the research team also disaggregated scores within each district, to see if having a Primarily Math teacher had the same impact on all subgroups of students, or if there was a differential impact on certain groups. Researchers found that when students have a Primarily Math teacher, those who start the year scoring in the below average range on the TEMA have the greatest growth (more than half score in the average range by the end of the year), and those who start in the average range have the next largest growth (half score in the above-average range by the end of the year).

Primarily Math has made a positive impact on student achievement. While students in all the partner districts are benefiting from the increased focus on mathematics achievement, students in classrooms of Primarily Math teachers have larger mathematics achievement gains. □



Above, the box plots show the average change in TEMA-3 scores from fall to spring (expected change is 0); the control group is in gray and the PM group is the overlapping white. The boxes represent the interquartile range, with the solid black horizontal lines representing the medians. The dotted lines mark the remainder of each distribution. You can see that starting in the second year, students in classrooms of Primarily Math teachers score higher on average than students in classrooms of comparison teachers.



The graph above shows box plots that separate students based on their fall score (above average, average, or below average). Notice that more than half of the students who start below average or average move up to the next category by the end of the school year. This graph shows the picture for one district; the others were comparable.

Taking on teaching math's 'big ideas'



STEPHANIE VENDETTI | UNL CSMCE

Primarily Math teacher Kristy Kennedy teaches math to her kindergarten students at Kloefkorn Elementary in Lincoln.

After completing *Primarily Math* in 2012, Kristy Kennedy now understands why she did not love math as a high school student.

"I never gained a deep conceptual understanding of the many big mathematical ideas, and I did after *Primarily Math*," Kennedy said. "I had simply relied on the procedural understanding of applying a formula to specific problems."

Now, Kennedy is teaching and modeling these "big" mathematical ideas to her peers at Lincoln's Kloefkorn Elementary School. She has had numerous opportunities to share her experience and knowledge gained through collaborative discussions with colleagues as well as an informal coaching role.

"My colleagues know that I have had extensive training in the teaching and learning of mathematics through *Primarily Math* and frequently seek my guidance and have conversations about various lessons," the Cohort 3 LPS participant said. "I partner with teachers by observing their lessons, plan lessons with teachers while discussing objectives in-

depth, and invite other teachers into my own classroom to observe me teaching math lessons."

Kennedy also assists teachers in developing their personal Math Talk Action Plan, part of the Math Expressions curriculum. Academically-productive classroom discussions

about mathematics, otherwise known as Math Talk, have many benefits. Math Talk assists in developing student understanding of mathematical ideas and creates a collaborative classroom culture where students contribute to the success of others.

Being a participant in *Primarily Math* has led to multiple leadership opportunities in the district for Kennedy. She has helped plan and lead some professional development sessions for the District as well as participate as a member of a focus group that has studied the Mathematical Practices in order to teach them to other educators.

"Kristy has played an integral role as a leader within her team, building and the district," said LPS district math coach Susie Katt. "Kristy's desire to learn and grow as an educator, along with her grace and kindness, makes her a leader whose work truly makes a difference in the lives of our young children."

Kennedy began her 10th year of teaching in 2014 at Kloefkorn Elementary where she has taught since the school opened in 2012. She chose to follow her principal, Sue Braun, from Rousseau Elementary (where Kennedy taught for seven years) to Kloefkorn due to Braun's "amazing leadership and a desire for all students to achieve at high levels."

Braun said it was a conscious decision to ask *Primarily Math* teachers to come to Kloefkorn due to their additional training.

"Kristy has the exceptional ability to take students to a deeper level of understanding mathematically. She provides kindergartners with such a solid base on which to grow their math knowledge," Braun said.

Originally from Schuyler, Nebraska, Kennedy and her husband, Ricky, have three

LINCOLN PUBLIC SCHOOLS

Kristy Kennedy

children, Carson, Colton and Everly. Kennedy has always loved helping children learn. After experiencing this program and its strong support system, her confidence in her mathematical skills has grown to a greater confidence in her teaching of math.

"I firmly believe in the power of a professional learning community to partner with one another in assisting all teachers and students to develop into mathematical thinkers," Kennedy said. "A strong partnership must have trust, perseverance and commitment in order to have a powerful impact on student learning." □

Realizing her full potential as a coach



STEPHANIE VENDETTI | UNL CSMCE

Omaha Public Schools district math coach Marni Driessen jumps for the decade numbers with first-grade students at Mount View Elementary in 2013.

Becoming a math coach after Primarily Math has enabled Marni Driessen to “realize my full potential,” the Omaha Public Schools educator said.

“Primarily Math has given

View and Wakonda, for the 2012-13 academic year.

In the spring of 2015, Driessen will start a new position as the District Title I Math Coach, to extend her reach to more

administrators and teachers seeking help throughout OPS. Funding for this position comes from the OPS Teacher Leader

Academy grant (see page 43).

Jim Harrington, supervisor of mathematics for OPS and member of the NebraskaMATH leadership team, supports the move toward utilizing math coaches.

Harrington said, “The Omaha Public Schools believes that coaching teachers is a major component of professional development for classroom teachers. When NebraskaMATH director Jim Lewis approached us with an offer to fund two elementary math coaches, it fit right in with district initiatives to improve math instruction.”

Driessen said the coaching

opportunity appealed to her for a variety of reasons. “I love sharing my ideas with others and offering my support,” she said. “I also realized that I gained a lot of knowledge about the teaching and learning of math through the Primarily Math program and thought I could make a difference by sharing my expertise.”

As a coach, Driessen has many responsibilities, including mentor, data coach, resource provider, curriculum and instruction specialist, and facilitator of professional development.

“Some typical things you may find me doing include helping teachers plan lessons, modeling a teaching move or strategy, analyzing student work, planning professional development sessions, reading research articles, reviewing data, observing lessons and giving feedback,” Driessen said. “I strive to support all teachers by highlighting and building on their strengths.”

Originally from North Dakota, Driessen said she has always enjoyed math. Now in her tenth year of teaching, Driessen was greatly influenced by her second-grade teacher, Mrs. Fix.

“I will never forget the sound of her high heels, the way she passed out papers, or the sweet notes she wrote on my work. More than anything, she cared about me and took care of me in many ways for years. From that point on, I wanted to do the same for other children who needed it,” she said.

Driessen has been married to her husband, Ray, for almost 14 years, and they have two sons, Dylan and Caden.

“They are good at math,” Driessen added with a smile. □

OMAHA PUBLIC SCHOOLS

Marni Driessen

me confidence in my teaching of mathematics. I no longer question if what I am doing is going to benefit the students,” the Cohort 2 participant added. “Now I know that with careful and purposeful planning, my lessons will positively impact student achievement.”

OPS created two K-3 mathematics coaching positions beginning in January 2012 with subaward funds from NebraskaMATH. Driessen and fellow Cohort 2 participant Jill House were selected to fill these positions. After starting 2012 as a full-time math coach in her building, Driessen shifted to two high-need elementary schools, Mount

Math Studio reveals layers of teaching

Kindergarten teacher Jimmi Watts has a tough lesson ahead of her. At Belle Ryan Elementary, she's got to get 21 squirmy kindergartners to pay attention to an hourlong math lesson that covers some challenging material, including a tricky word problem.

Some of her kids struggle with counting numbers between 10 and 20, while others are zooming ahead, easily grasping larger numbers.

Thankfully, Watts has backup: a team of math coaches, principals and other educators. They meet with her occasionally to review her lesson plans ahead of time and then observe her classroom the next day. Afterward, there's a debriefing session, where everyone recaps how the lesson went.

It's an even trade — Watts gets real-time help, and coaches and administrators get valuable practice interacting with teachers and students inside the classroom.

There are layers upon layers of teaching going on here. Watts is teaching the kindergartners how to identify numbers. The math coaches are helping her plan a more effective lesson while they learn how to improve their own coaching. The mood is open and collaborative, and the overall goal is simple: deliver better math instruction to kids.

It's all part of a process called Math Studio, a model classroom of sorts that provides professional development for teachers, coaches and administrators. It's a small piece of a \$5.5 million grant to bolster math instruction in the Omaha Public Schools from The Sherwood Foundation® and the Lozier Foundation and began during earlier cohorts of Primarily Math. During studio sessions, UNL



REBECCA S. GRATZ/THE WORLD-HERALD

Kindergartner Donato Cruz pauses to think while working on a math problem worthy of a hard hat in Jimmi Watts' class at Belle Ryan Elementary in Omaha.

researchers also study how teachers and coaches can work together to craft better lesson plans and identify students who need extra help.

A recent two-day Math Studio session showed the behind-the-scenes work that goes into coaching and lesson planning

On the first day, Watts met with a dozen OPS administrators and elementary math coaches during her planning period to review the following day's lesson on number patterns. Watts, a Primarily Math participant, explained the concepts she wanted her students to understand, named a goal for herself and gave her observers instructions, too.

When kids fill in missing numbers on a 100s chart, she told the coaches and administrators to ask her students to describe how they arrived at the answer. That's one way to get kids engaged in what's called "math talk."

The next day, the Math Studio team filed into Watts' kindergarten

Making an impact

Based on Linda Foreman's Mathematics Studio Program, www.teachersdg.org, studio work has been a powerful learning opportunity for Primarily Math graduates and their peers. Since 2011, Ruth Heaton has organized and led six studios in partner school districts including three in the Papillion-La Vista School District and three in Omaha Public Schools. One of the first studio teachers was Alysia Augustus, a first-grade teacher at Anderson Grove Elementary School in Papillion, Nebraska. In 2012, Augustus was named the recipient of Nebraska's Presidential Award for Excellence in Mathematics and Science Teaching. □

Continued on Page 24

Studio cycle steps

Math studio is an extraordinarily rich research site for gathering data on the decision-making of teachers during planning and enactment of lessons.

Math studio is a process whereby a math studio teacher, who is an elementary teacher, works together with Ruth Heaton in a studio cycle. A studio cycle includes the public planning, teaching and debriefing of a single math lesson. Heaton coaches the studio teacher and discusses publicly with the teacher while others observe the many decisions and possible consequences of those decisions that occur while planning and teaching a math lesson. Math coaches, elementary administrators, and/or other elementary teachers are among those who observe Heaton and the studio teacher work together.

A cycle concludes with the entire group of observers reflecting with Heaton and the studio teacher about what happened during the lesson, focusing in great detail on features of the tasks children worked on, the strengths and limitations of children's understanding during and as a result of the lesson, and what to do next.

Additional layers of reflection and learning are added to a studio cycle when Heaton asks observers who are math coaches or administrators to reflect on her moves as a coach in the studio setting. ▣

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class for the math lesson, armed with pens and notepads.

Watts broke the lesson up into several smaller chunks designed for short attention spans and started off with a math cheer to get her kids focused and excited about math. As a quick warm-up drill, students guessed a number she was thinking, based on clues she gave.

"My number has two digits," Watts said. "It has a 5."

As the guessing game progressed, several kids switched numbers around — mixing up 17 and 71, for instance. Math Studio project leader and UNL professor Ruth Heaton stepped in with a reminder.

"How do you work on this?" she asked Watts. "At this age, kids do number reversals."

Observers sat down with students as they moved on to filling in the worksheet with the missing numbers. The adults gently prompted the students to explain their answers.

"Carly, why did you think a 2 went there?" Rose Hill Elementary Principal Tylee Hanson asked kindergartner Carly Plofkin, who drew a 2 to fill in the number 27.

"I looked at the patterns going up and down," Carly said, pointing to a row of numbers that ended in 7 — 17, 37, 47.

Hanson smiled. "That's when the light bulb goes off," she said.

Belle Ryan is one of two school sites to participate in Math Studio sessions this year. Separate sessions are held at Miller Park Elementary, with a fairly new teacher. Scores on the state math test are on the upswing at both schools, and Watts volunteered her class for the studio, while district officials picked the teacher at Miller Park.

The emphasis on math coaching comes at a convenient time. Last year, OPS adopted a new math program, Go Math! This



REBECCA S. GRATZ/THE WORLD-HERALD

Belle Ryan kindergarten teacher Jimmi Watts holds up cards with dots for her students to count during a math lesson. Watts volunteered to put her lessons under the microscope to improve the experience for her students.

year, it extended math blocks to 75 minutes for kindergarten through second grade and 90 minutes for third through sixth grades. Increasing student performance in math is a major goal for OPS.

Watts, who has been teaching for 12 years, was nervous about the extra scrutiny at first.

"But I looked at it as a benefit for my kids, as a way to get ideas from other educators," she said.

Coaching is sometimes directed at weaker or inexperienced teachers, said Heaton. But by giving feedback on lesson plans or classroom observations, skilled coaches can help even seasoned teachers like Watts improve.

During the math lesson, Mount View Elementary math coach Marni Driessen (see page 22), tested out the role of head coach and helped Watts navigate a word problem that she rightly predicted would be a challenge for the kindergartners.

The kids donned yellow hard hats — part of a routine to ready them for tough problems — and tried to tackle the word problem.

"Skylar has 19 oranges," Watts told the class. "Taylor has two less than Skylar."

Watts left the problem open-

ended. She wanted to see how the kids processed the problem before giving them more instructions.

But as the kids broke off into pairs to tackle the problem, Driessen drew Watts aside.

“I think there’s more the kids need to know,” she said. Should the kids subtract, compare the two numbers or just draw two different sets of oranges to practice counting?

“I was worried if I told the kids to draw, they’d just worry about drawing and not think about comparing the numbers,” Watts said. She wanted the kids to explore the problem at their own pace.

The kids clearly struggled with the open-ended word problem. The names Skylar and Taylor confused them. They didn’t know if they should draw a traditional equation on their paper or stack blocks to represent the oranges. Watts tried to give them a simpler problem, but time ran out.

She wrapped up the lesson, and the group headed in for a debriefing session, where they talk about what went right during the lesson, what misfired and how to move forward. “Debrief is essential for this type of tough lesson,” Driessen said.

Indian Hill Elementary math coach and Noyce Master Teaching Fellow Matthew Timm said some students still struggled with numbers in between 10 and 20 — one was trying to write “19” and asked him “what does a teen look like?”

The group praised Watts’ ability to think on her feet and reminded her that even imperfect lessons provide a glimpse into how students’ brains work.

“Did many of them get it right today? No,” Watts said. “But to see some of their thought process is helpful for me, too.” □

– Erin Duffy, *The Omaha World-Herald*, published Feb. 26, 2015

Math coaches focus on teachers’ practices

Due to the generous support from NebraskaMATH funders, UNL has been able to work with school districts to hire instructional coaches focused on mathematics. It can be shown that the most talented athletes have the best coaches, and the higher-performing the athlete, the more individual coaching they receive. NebraskaMATH’s partner school districts, especially their teachers and principals, are striving to improve levels of student achievement, and believe that specially trained math coaches can help these efforts become even more effective.

Primarily Math has preliminary data that show that teachers in Nebraska districts are raising K-2 student achievement substantially. In districts which have employed elementary math coaches for the last several years, larger increases in student math achievement are starting to be seen, compared to buildings without math coaches or participants in NebraskaMATH programs. It is crucial to understand that an instructional coach is a long-term solution, not a short-term fix. It takes time for coaches to develop relationships with teachers and to then affect changes in teachers’ instructional practices. The benefits to student outcomes may not be seen until the second or third year that a math coach is in a building.

In GIPS, LPS and PLSD, grant funding supported multiple full-time math coaches for three years. All of these math coaches were Primarily Math participants and worked extensively with teachers and administrators to support elementary mathematics teaching and learning. In two of the three districts, the support for math coaching has been continued with district funds. In the third district, while specific funding for mathematics coaching has not been sustained, the coaches have remained in instructional leadership positions. What the project has been learning about coaching has resulted in support for nine math coaches funded by the OPS Teacher Leader Academy (see page 43).



Paula Jakobovic

NebraskaMATH math coaches have received training through an NSF-funded project at Montana State University, the Examining Mathematics Coaching Project. This training has equipped the coaches with coaching knowledge as well as mathematical knowledge needed for coaching. Heaton has provided further professional development for OPS coaches through the Math Studio. One of these OPS coaches is Paula Jakobovic, who earned her master’s degree through Math in the Middle and is now a Noyce Master Teaching Fellow (see page 40). She is currently a full-time elementary

math coach while working part-time on her Ph.D. with Ruth Heaton as her adviser. Most recently, Jakobovic has been gathering data on the coaching practices of OPS coaches as part of her dissertation. Her research will contribute to current research in mathematics education on productive mathematical coaching practices. □



LINDSAY AUGUSTYN | UNL CSMCE

OPS Primarily Math teacher Jennifer Kaminski counts with her third-grade students at Benson West Elementary in 2014.

'I want to create the most change possible'

When Jennifer Kaminski's students tell her that they love math, it is music to her ears.

"When I tell the students that it is time to clean up their manipulatives and put their materials away, I love it when they tell me that they don't want math to end," said the third-grade teacher

understanding, students must be able to explain their reasoning, justify their answers, and take in the thoughts of their classmates and decide if they agree or disagree. With each lesson, I am creating problem-solvers who will one day be responsible citizens of society."

Kaminski also believes

OPS TLA and Primarily Math have created a family of teachers.

"I have gained a network of teachers whom I

can contact to share ideas with and gain new thoughts and strategies. We have a shared experience," the Maryland native said. "In a way, the cohort you are in becomes your family. As you go through the classes, you rely on one another. Maybe I was able to grasp a concept but the person to my right was struggling. I automatically jumped in to help. The same then goes for when I was struggling, the person to my left or right would jump in to help."

After joining the Air Force in 2000, Kaminski spent six years serving the country as a weather forecaster/observer. She was

first stationed in Spagdahlem, Germany, and then was assigned to Offutt Air Force Base in Bellevue, Nebraska, working with satellite imagery. She began pursuing a business administration degree from the University of Nebraska at Omaha, but quickly found she had no interest in business courses.

"I woke up in the middle of the night and said, 'I want to be a teacher.' I decided not to renew my contract with the Air Force and focus all my energy on becoming a teacher."

Kaminski earned her degree in Elementary Education and Deaf Education. She started out as a long-term sub with the Hearing Resource traveling teacher team at the OPS Teacher Administrative Center but soon discovered she longed to have her own classroom.

Now, she is in pursuit of her master's degree from the University of Nebraska-Lincoln.

"I want to create the most change possible," Kaminski said. "I have witnessed the impact that Primarily Math is having on students' understanding. If I can teach the skills I have learned to other teachers, I will be impacting not only my own classroom but also other classrooms in my building." □

OMAHA PUBLIC SCHOOLS

Jennifer Kaminski

at Benson West Elementary in Omaha.

She joined the first cohort of Primarily Math through the Omaha Public Schools Teacher Leader Academy, which began in 2013 thanks to a \$5.4 million grant from The Sherwood Foundation® and Lozier Foundation (see page 43).

Primarily Math has renewed her own love of math, "igniting a fire" inside her to become the best math teacher she can be.

"I believe in creating a strong student and teacher relationship based on respect," said Kaminski, who has been teaching at Benson West for four years. "For true



UNL OFFICE OF RESEARCH AND ECONOMIC DEVELOPMENT

UNL researchers *Tori Molfese* (from left), *Ruth Heaton* and *Carolyn Edwards* have been working with the staff at three Educare schools.

Math Early On targets preschool teachers

Giving early childhood educators tools to foster math learning in 3- and 4-year-olds' everyday activities is the aim of Math Early On. During the two-year pilot project, UNL researchers have been devising and assessing professional development activities for preschool teachers at three Educare schools in Lincoln and Omaha. More than 700 Nebraska children attend Educare schools, which serve at-risk children from birth to age 5 and their families.

"We want to help teachers better understand the big math concepts that young children should be learning and how these ideas might play out in multiple settings, whether it's in the classroom or during outdoor play," said Ruth Heaton, project leader and Gilmartin Professor of Math Education.

Research shows rote counting and memorization don't help preschoolers develop the higher-level mathematical reasoning skills needed for later academic success. Young children should be learning to recognize patterns and shapes, understand quantity and develop number sense, Heaton said.

Math Early On aims to help teachers become more strategic,

observant and reflective. The program consequently encourages educators to present mathematical scenarios that give children opportunities to explore key concepts such as patterns, numerals, measurement and geometry.

"From the earliest age, children show curiosity about the numerical and quantitative aspects of objects and events around them. Research has established that children who enter school excited about math and equipped with a basic foundation are more likely to do well both immediately and in the long run," said Carolyn Edwards, Willa Cather Professor of Psychology and Child, Youth and Family Studies.

With a \$528,071 grant from the Buffett Early Childhood Fund, Math Early On builds on what UNL researchers learned from Primarily Math. Heaton, Edwards and Tori Molfese, Chancellor's Professor of Child, Youth and Family Studies (CYFS) began the project with the Educare schools at Indian Hill and Kellom in Omaha in January 2014, working with 18 staff members. They identified the book *Big Ideas of Early Mathematics*, developed by scholars at the Erickson Institute in Chicago, as a

key resource for the mathematical content for all of the professional development.

Supported by the Buffett Fund, Educare aims to narrow the achievement gap through full-day, year-round educational programs. The university's Buffett Early Childhood Institute is an Educare Lincoln research partner.

Molfese said one goal is helping educators become more confident in recognizing math learning opportunities in their classrooms.

Researchers will assess teachers' and students' beliefs about their math abilities. The team hopes the project becomes a model for the nation's 21 Educare schools, including Educare Winnebago in northeastern Nebraska, which opened in 2014 as the first to serve an American Indian reservation.

Approximately 24 teachers are participating in the program, which runs through May 2015. As the project winds down, the research team will commence plans to expand Math Early On to the nationwide Educare Learning Network Initiative and explore future opportunities with the Buffett institute. □

- Office of Research and Economic Development, CYFS, and Ruth Heaton

Learning value of listening in leadership

In just his fifth year of teaching, Andrew Boone already is making a difference. Between his Primarily Math coursework in Cohort 4 and the mission of Gretna Public Schools, the former first-grade teacher has gained a new understanding of math – and has been able to put it into practice even more now as a fifth-grade teacher.

“I have the opportunity to serve on the math improvement team at Thomas Elementary that is working on educating our staff about current trends in math teaching and the resources that are out there for us to use,” Boone said. “We have also been working to identify areas in which we see a need for improvement with math instruction, problem solving in particular. We have had the opportunity to collaborate with our colleagues and learn where they see a need for math resources in the classroom.”



UNL CSMCE

Former first-grade teacher Andrew Boone has become a leader in professional development in Gretna and now teaches fifth grade.

project, we focused on perseverance in problem solving as well as using models and representations in problem solving. When looking at perseverance in problem solving, we had the chance to observe two other Primarily

attributes in an outstanding mathematics teacher.”

Boone said he has become more knowledgeable of children’s developmental levels and what we can do as professionals to help each child grow as a mathematician.

Boone has become a district leader in professional development.

He is working as a math mentor as the district looks to devise a coaching/mentor model. In November 2014, he attended the NCTM

Regional Conference in Houston, and over the past year he was an assistant instructor for three Primarily Math courses.

Last spring, Boone also coached teachers in Bennington Public Schools as part of a project with Bennington, the University of Nebraska at Omaha and ESU 3. He also was part of a major presentation to the Gretna board of education regarding the impact of Primarily Math.

“Through the Bennington project, I had an opportunity to work with four other teachers in second, third and fourth grades. During the

Math teachers, Jessica Dickes and Carter Pratt. After the observations, we had a chance to debrief and reflect on how students persevered in problem solving as well as how the format of the lesson and questioning contributed to it. We have also been doing online discussions and have set up a resource board to share ideas and resources online,” Boone said.

Growing up in Iowa, Boone enjoyed the challenges math presented, whether through participating in the local sixth-grade math bee or doing challenge math games in junior high.

Boone, who lives in Gretna with his wife, Kim, and daughter, Madilynn Ann, said the most important thing he has learned from Primarily Math is the value of listening.

“With time, I have learned the value of listening to children, regardless of whether they are right or wrong, to more deeply understand their misconceptions and how deep their knowledge of the topic is,” he said. “This has helped me better identify where children are at developmentally and what I can do to guide the individual.” □

GRETNA PUBLIC SCHOOLS

Andrew Boone

Driven by the mission and philosophy of Gretna’s school system (“the unconditional and undeniable acceptance of all students”), Boone has found his favorite part of Primarily Math to be the collaboration it affords, whether that be with the other teachers in his cohort or with his peers at Thomas.

“Andrew Boone thinks deeply about the mathematics that he teaches,” said Primarily Math instructor and Nebraska Wesleyan mathematics professor Kristie Pfabe. “His fascination with mathematics and the zest with which he embraces challenges are important

Nebraska Algebra and New Teacher Network: Mentoring secondary math teachers

Through a focus on mentoring and supporting secondary mathematics teachers, Nebraska Algebra and the New Teacher Network have promoted the growth of a statewide professional community of mathematics teachers since 2009. More than 130 teachers have participated in Nebraska Algebra and/or the New Teacher Network with NSF funding, taking graduate courses designed to deepen their knowledge of mathematics, cognition, motivation and mathematical pedagogy.

Other funding, including the Math Teachers for the 21st Century Fund at the University of Nebraska Foundation, The Sherwood Foundation® and the Lozier Foundation, has continued to fund the New Teacher Network (see page 43) and to provide fellowships to teachers who wish to take Nebraska Algebra courses as part of the Nebraska Math and Science Summer Institutes (NMSSI, see page 36).

Nebraska Algebra and the New Teacher Network are designed to assist with two challenges facing secondary teachers: ensuring student success in Algebra I and new teacher retention, respectively.

Nebraska Algebra supports school districts and their algebra teachers as they work to find success for all students in the important gateway course of Algebra I. It has become increasingly clear that students who do not pass Algebra I by the end of ninth grade are not on track to graduate from high school “college and career ready,” which is currently a focus of education



STEPHANIE VENDETTI | UNL CSMCE

New Teacher Network’s Emily Romkema (second from left) collaborates with other teachers in Math 812T: Geometry for Geometry Teachers on their hyperbolic geometry assignment in the summer of 2014.

policy in the United States.

Because algebra instruction typically plays a central role in the secondary mathematics teacher’s career, New Teacher Network participants typically begin the program by taking Nebraska Algebra courses.

The New Teacher Network, a three-year mentoring and graduate education program, tailors to the needs of new secondary mathematics teachers, who have no more than three years’ experience at the time they apply for and are accepted into the program.

A recurring challenge for K-12 education is that too many newly certified teachers leave teaching within their first three to five years. Nationwide, half of all new teachers leave teaching within their first five years of teaching. Research shows that first year teachers are typically not as effective as more

experienced teachers, so having lots of teachers leaving the profession creates many problems (e.g., Ingersoll & Strong, 2011).

The New Teacher Network addresses this issue by providing each participant the opportunity to take 24 graduate credit hours at no cost to the teacher for tuition and fees. The idea behind providing this opportunity for graduate education is to accelerate each teacher’s journey from “well-started beginner to master teacher.” Furthermore, these new teachers now have access to both experienced secondary mathematics teachers and university faculty as mentors, and they become their own professional community of superbly educated mathematics teachers.

Between 2009 and 2012, 68 teachers completed Nebraska

Continued on Page 31

Combining benefits of coaching, teaching

As a teacher and an athletics coach, Tony Jacobsen has found his philosophies for approaching this work to be similar: the best teachers and coaches are the best learners.

“If you progressively work to learn more about what you do, then you will find success,” said Jacobsen, a New Teacher Network teacher who will graduate with his Master of Arts for Teachers degree (MAT) in August 2015. “I have really appreciated the opportunity through the New Teacher Network to take classes and advance my knowledge of mathematics at an affordable rate.”

After teaching for three years at Central City High School, Jacobsen is now in his first year at Crete High School, teaching Calculus, Pre-Calculus and Pre-Algebra. He uses materials and problems from his graduate courses at UNL



LINDSAY AUGUSTYN | UNL CSMCE

Crete High School's Tony Jacobsen, shown teaching using GeoGebra in Calculus, will earn his master's degree in 2015 from participating in the New Teacher Network.

CRETE PUBLIC SCHOOLS

Tony Jacobsen

to challenge his students, whether that's by adapting the problems to the current level of the student or leaving them as “challenge problems.”

Jacobsen also is a firm believer in using GeoGebra in his classroom.

“At Crete, I have made it a personal goal to have all of my students use GeoGebra at some point in time throughout the year. Most of my Calculus students prefer it when learning a new topic so they can see the concept occurring as opposed to taking definitions and doing examples. The win-win of this is that they will

still do homework but have a better hold of the concepts visually,” said the Laurel, Nebraska, native.

On the sporting front, Jacobsen and Crete coach Jordan Cudney have started a performance club for the middle school athletes to help them prepare for high school athletics.

“It is a good time away from the classroom to connect with students on an entirely different level,” Jacobsen said.

While math was his favorite subject in high school, he admits he decided to become a teacher late in the game.

“Combine working with others, the love I had for math in high school, and my passion for sports and coaching, and teaching became a natural fit,” he said. “I was a late bloomer in the education world. I did not declare my major as math education until my sophomore year of college but still managed to graduate in four years

and haven't looked back.”

Jacobsen said his favorite part of New Teacher Network has been working with other math teachers throughout the state, including his mentors Shelby Aaberg of Scottsbluff High School who is the 2015 Nebraska Teacher of the Year, and Jason Vitosh of Falls City High School, who are both Noyce Master Teaching Fellows (see page 40).

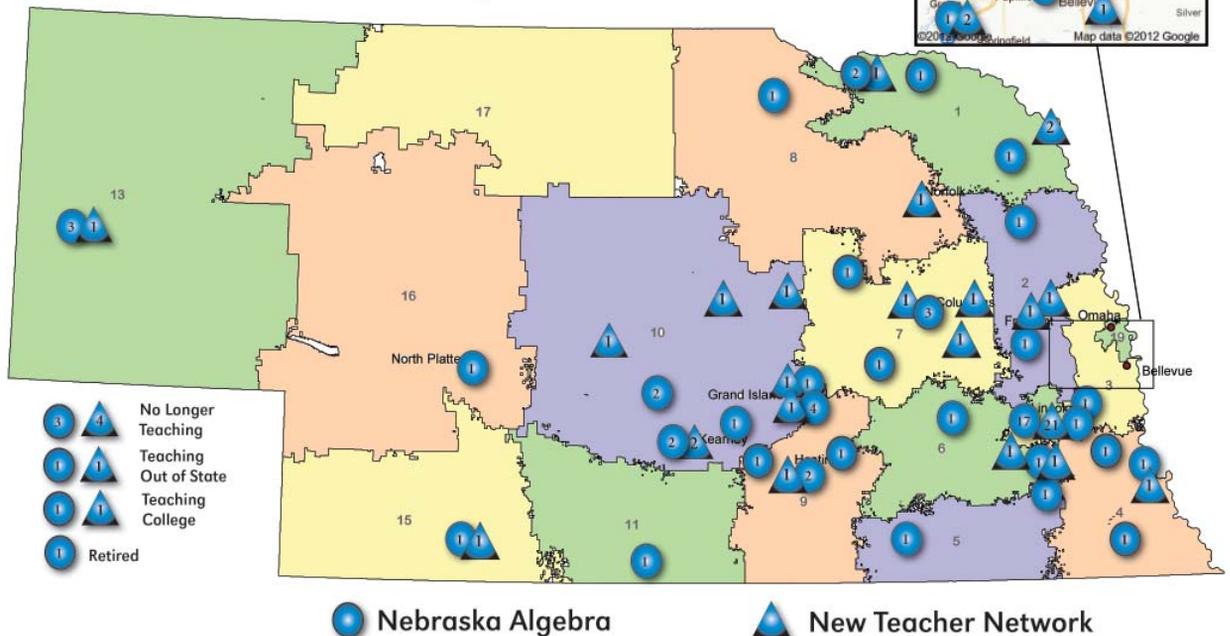
“Working with other teachers has proven to be both a humbling and opportunistic experience,” Jacobsen said. “You think that you understand math and are at the top of your game, then someone shows you an easier way to solve a problem.”

With a future goal to teach a GeoGebra course to his peers, Jacobsen aspires to lead his district in mathematics education and feels confident in doing so after his New Teacher Network experience.

“I personally appreciate math more now than ever because I have a much deeper understanding of it, and I credit that to the opportunities the New Teacher Network has offered me.” □

Nebraska Algebra & New Teacher Network by Nebraska Educational Service Units

2014-2015 Teaching Positions



From Page 29

Algebra, and between 2009 and 2014, 75 teachers participated in the New Teacher Network. Of those 75, 69 are still teaching mathematics in Nebraska. Many of these teachers, taking advantage of the free graduate credit hours, have continued to take graduate courses at UNL as part of earning a master's degree and a few are already pursuing a doctorate. To date, 40 have earned a master's degree and 20 are currently pursuing their degree.

New Teacher Network teachers Danielle Buhrman of Grand Island Public Schools and Amber Vlasnik of Lincoln Public Schools have both gone on to become Noyce Master Teaching Fellows (see page 40) and are pursuing doctorates from UNL. Both Buhrman and Vlasnik started their New Teacher Network journey with the three Nebraska Algebra courses and continued taking New Teacher

Network courses in the summers through the NMSSI, earning their Master of Arts for Teachers (MAT) degrees from the UNL Department of Mathematics in 2011 and 2012, respectively (see page 34).

"It took me three years to complete my MAT, and I was able to do most of the coursework during the summer," said Vlasnik, the math department chair for Lincoln High School. "Participating in the New Teacher Network and Nebraska Algebra has greatly influenced my teaching, and I am thankful to see the work directly benefit my students on a daily basis."

Nebraska Algebra and the New Teacher Network use an intensive instructional approach where teachers are in class eight hours a day for two weeks. The culture of these courses emphasizes collaborative learning through content-specific instruction and classroom-focused activities centered on group work.

Participants are actively engaged through small- and large-group discussions, presentation of problems and articles, and preparation of assignments and projects.

Despite the intensity of this approach, teachers respond positively to it for two primary reasons: first, this approach is respectful of a teacher's time, and second, the programs provide substantial instructional support, as instructors and graduate assistants are readily available during and after class to assist participants in the completion of their class work and assignments.

In addition, starting in the fall of 2010, "master teachers" led the instructional team for the Nebraska Algebra academic-year pedagogy course, which included Nebraska Algebra graduates and Noyce Master Teaching Fellows as teacher liaisons to support

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current participants as part of the mentoring component of the course. Thus, teacher participants enrolled in the courses receive ample support and immediate feedback as they work to strengthen their mathematical and pedagogical knowledge.

Beyond the Nebraska Algebra program, the New Teacher Network has stimulated the development of new courses for high school mathematics teachers by faculty in the Department of Mathematics. In 2011, both the department and UNL's Office of

Graduate Studies approved three new courses for teachers: Math 811T: Functions for High School Teachers, Math 812T: Geometry for Geometry Teachers, and Math 816T: Math in the City for Teachers. The first two were developed for the New Teacher Network and the third was developed to meet the needs of Noyce Master Teaching Fellows.

In 2012, Math 809: Mathematical Modeling for High School Teachers also was formally approved, and two statistics courses, one for middle-level and one for high school teachers, were

also approved as official courses.

All Nebraska Algebra and New Teacher Network participants completed a survey of teaching practices that NebraskaMATH researchers adapted for Nebraska Algebra. All participants also took the Knowledge of Algebra for Teaching assessment, an algebra version of the MKT taken by Primarily Math participants. Overall, teachers showed growth in their knowledge of algebra for teaching, and gained in confidence for teaching algebra and beliefs that they can effectively teach algebra to all students. □

New Teacher Network's mentoring program

To support the networking of secondary mathematics teachers, NebraskaMATH developed a mentoring program, with an ultimate goal to build a community of secondary mathematics teachers that actively supports its members by providing them with a forum for communication and collaboration. The mentoring program is largely linked to the Nebraska Algebra pedagogy course, TEAC 991, which is completed during the first academic year following the summer institute.

During the academic year, new teachers are supported by teacher liaisons. Each teacher liaison (usually a teacher who had already completed Nebraska Algebra) works with a small group of four to six new teachers, in a relatively small geographic area, when possible. Teacher liaisons are responsible for being familiar with the goals of the program as a whole, and specifically with the goals of the pedagogy course; supporting teacher participants as they endeavor to meet the requirements of the course by communicating with them on a regular basis and providing feedback on weekly reflections submitted online; communicating in an informal and power-free manner to provide basic advice or resources, as requested by the teacher, about mathematics and/or mathematics teaching; and attending workshops associated with the course where they are introduced to the teachers they will work with and discuss expectations as well as serve as leaders for their group and support the course instructors.

The structure of the course and the utilization of teacher liaisons has been extremely successful. In fall 2012, the master teachers who developed and served as instructors for the course, Jerel Welker (LPS), Sue Kilmer (LPS, retired) and Linda Hayek (PLSD, retired) worked with Research Coordinator Wendy Smith to co-author a publication about the experience. The article appeared in the California Mathematics Project's monograph for Supporting Teachers to Increase Retention. The article can be found at CMP STIR Monograph: Mathematics Teacher Retention: <http://cmpstir.cmpso.org/monograph>.

Kelly Gomez Johnson, a New Teacher Network participant who is now an instructor of teacher education at the University of Nebraska at Omaha, continued to work with her mentor throughout her time in the NTN. "My mentor continued to teach me how to see the big picture of conceptual understanding, get the most out of my students without merely settling for compliance, and how passion for my students comes before the math. She once told me, 'Success is in the struggle.' This was a powerful message to me as a young math teacher. It is a natural urge to want to help students immediately when they don't understand mathematics. My mentor motivated me to require more thoughtful problem solving without apologizing for struggle," said Gomez Johnson, who graduated with her MAT degree (see page 34) in 2011. □

Shared experiences lead to confidence



LINDSAY AUGUSTYN | UNL CSMCE

Fremont High School's Karen Clinch (left) checks the progress of her students during Pre-Calculus. Clinch earned her Master of Arts for Teachers degree in August 2014.

When am I ever going to use this?" – the ongoing question of high school students in mathematics class.

For Fremont High School mathematics teacher Karen Clinch, the New Teacher Network courses gave her the ammunition to reply.

"The classes gave me ideas of how I can incorporate real-world situations into my mathematics questions, so when I get that age-old question, I have an answer," the Lincoln native said. "The New Teacher Network helped me gain confidence in my trade. The courses went deeper into the subject as well as gave hands-on ideas to help students, giving me many different tools to use."

Clinch earned her Master of Arts for Teachers degree from UNL in August 2014, after starting the New Teacher Network in 2012. Currently in her fourth year of teaching, Clinch teaches Algebra 1, Algebra 2 and Pre-Calculus.

In her first year, Clinch struggled with classroom management. Thanks to veteran teachers who were instructors for

the New Teacher Network, she has quickly become a much improved teacher.

"I am now able to build camaraderie with my students in the first couple of days of teaching. New Teacher Network gave me ideas for activities to do the first couple of weeks, and these activities help start the school year out right," Clinch said.

"Students are able to build relationships with other students in the class so cooperative activities go more smoothly. My class sizes are big so the more cooperative activities I can do the better, so students can help other students. Through the New Teacher Network, I was able to work with wise teachers who had been teaching for a while."

During her undergraduate education at UNL, Clinch said she learned a lot about the classroom and got ideas of how to run it, but after actually being in the classroom, she found she didn't

know half of the problems she would face. The New Teacher Network allowed her to discuss these problems with other teachers who were not only having the same experiences, but also taking the same graduate classes.

"It was nice to hear about what others had tried," Clinch said. "Now that I have technology activities, cooperative activities and more efficient ways of teaching concepts, I am able to pay more attention to my classroom management. In turn, my classroom stays on task, learns more material, and students are successful."

Growing up in a family of teachers and engineers, Clinch started out as a civil engineering major but ended up making the switch to mathematics education. The time she spent as a 4-H camp

FREMONT PUBLIC SCHOOLS

Karen Clinch

counselor working with kids persuaded her to want to teach math, which has always been her favorite subject.

"I have a new view of what a math class should look like, where students reason and make sense of the material, as opposed to just have notes and then have homework," Clinch said.

"I teach mathematics, but I also teach skills so students can think for themselves. Problem solving is a big part of mathematics as well as life. Students should be allowed to question and wonder why and how mathematics works." □

Master of Arts for Teachers: Degree evolves to meet teachers' needs

UNL graduates Jared and Jason Vitosh both teach high school mathematics in Nebraska.

Both hold a Master of Arts for Teachers from the UNL Department of Mathematics. The two brothers from Odell, Nebraska, took Math 809: Mathematical Modeling together.

Both agreed that their favorite course has been Math 806T: Number Theory and Cryptology. However, the educational comparisons stop there.

Their journeys to earning their graduate degree took diverse paths. Jason earned his MAT degree from UNL in 2006, driving “to campus five days a week for 10 weeks each summer for four summers to take classes during the regular summer sessions,” the teacher at Falls City High School explained.

Jared, on the other hand, completed his degree in 2012 after participating in Nebraska Algebra and was privy to taking courses that emphasized “mathematical knowledge for teaching” in their current summer format – one course for 40 hours a week or two half-day courses over two weeks.

“I was much more connected to other students and professors than Jason,” said Jared, a teacher at Norris High School. “He kind of helped pioneer the program, but that meant he took a lot of graduate classes when there were not many others taking the same courses.”

As part of its commitment to being a leader with respect to the mathematical education of teachers, the department offers courses that lead to the MAT to any certified mathematics teacher who wants to earn a content-rich



LINDSAY AUGUSTYN | UNL CSMCE

Jason Vitosh (standing), a teacher at Falls City High School, teaches Math 806T in 2013 to a group of teachers on their way to earning their MAT degrees. Vitosh earned his MAT degree in 2006, and six years later his brother, Jared, followed suit.

master's degree. First developed with the support of an NSF grant in the 1960s, the MAT now offers two tracks, one for secondary mathematics teachers and one for middle-level teachers that offers a specialization in the teaching of middle-level mathematics.

With the support of several NSF grants over the course of the past decade, faculty in mathematics have developed 17 mathematics courses for K-12 math teachers that stress the development of mathematical knowledge for teaching. Mathematics also partners with the Teaching, Learning and Teacher Education and Statistics departments to aid them in development and offering of courses for K-12 teachers working on master's degrees.

The NSF Math Science Partnership Institute grant, Math in the Middle, resulted in

115 Nebraska teachers earning the MAT degree between 2006 and 2011. As part of the institutionalization of the Math in the Middle grant, the Center for Science, Mathematics and Computer Education developed the Nebraska Math and Science Summer Institutes (NMSSI) program (see page 36) to continue to offer the courses from Math in the Middle to more teachers. Subsequently, NebraskaMATH aided the NMSSI in allowing teachers to be able to continue to take math and pedagogy courses each summer and to pursue the MAT degree. Following the initial NSF funding for Math in the Middle, 91 middle-level teachers (grades 4-8) are currently pursuing a master's degree from UNL through locally-funded Math in the Middle cohorts that are operating in partnerships with OPS and LPS. Forty-eight other



LINDSAY AUGUSTYN | UNL CSMCE

Jared Vitosh (right) helps a student in algebra class at Norris High School. Vitosh earned his MAT degree in August 2012.

teachers are currently pursuing their MAT degree through UNL.

“I encouraged Jared to begin his MAT as soon as he could make it work,” Jason Vitosh said, who is also a Noyce Master Teaching Fellow (see page 40). “The session format had changed to short one- or two-week courses with all-day instruction. He also was able to get in on some of the new programs like the New Teacher Network from the NebraskaMATH grant. I missed out on making connections with peers like Jared did, but through the Noyce fellowship now, I have been able to see how powerful and helpful those connections can be.”

The Vitosh brothers, whose father also was a math teacher, enjoyed the connections to tangible, real-world applications in Math 806T, their favorite course. It was also the only course Jason got to take in the one-week format.

“I loved the intense focus that came from doing nothing but studying one topic 24/7. I devoured the content and read about a dozen supplemental texts that week,” Jason said. “I was extremely honored to be asked to teach the same course two summers ago on campus. I was able to reconnect with the content in a different way as the instructor and share my excitement for the subject with my peers in the class.”

A more recent initiative is to offer these courses online for teachers both in Nebraska and across the country in partnership with Nebraska Online, allowing the degree to be earned entirely online.

Jason’s advice for teachers who are interested in earning a MAT is simple: “Do it now,” he said. “Don’t wait another year; get started. Take one class, then take another. Make it work. It will change you and your teaching forever.” ▣

Online courses

The Department has created 17 graduate courses for math teachers; the following list highlights some that are currently offered online:

MATH 802T: Functions, Algebra and Geometry

MATH 804T: Experimentation, Conjecture and Reasoning

MATH 805T: Discrete Mathematics

MATH 807T: Using Mathematics to Understand our World

MATH 810T: Algebra for Algebra Teachers

MATH 811T: Functions for High School Teachers

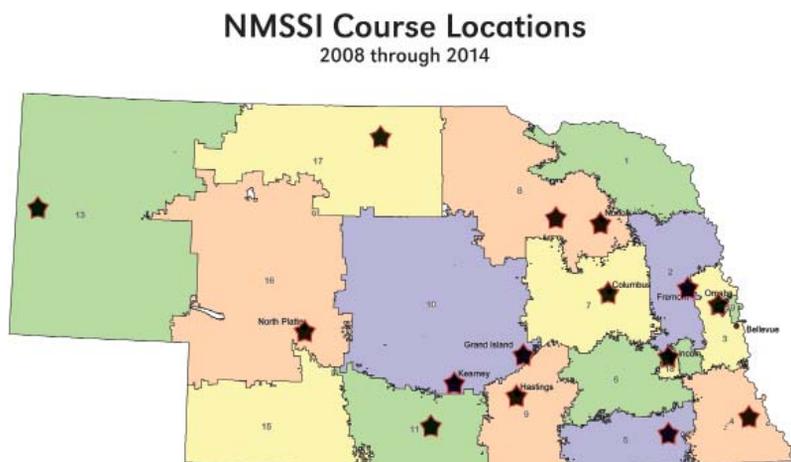
MATH 812T: Geometry for Geometry Teachers

Nebraska Math & Science Summer Institutes: Increasing capacity to serve teachers

The Nebraska Math and Science Summer Institutes (NMSSI) is a key component of the Center for Science, Mathematics and Computer Education's (CSMCE) long-term commitment to provide professional development opportunities for K-12 Nebraska math and science teachers. The philosophy of the NMSSI program is to improve mathematics education in Nebraska by investing in the education of teachers. Thus, the program offers courses designed to strengthen teachers' mathematical content knowledge in addition to courses that aim to deepen teachers' pedagogical skills.

Starting in the early 2000s, mathematics education leaders at Lincoln Public Schools and the CSMCE supported summer mathematics workshops for teachers, meeting an increased demand for this type of professional development. In 2004, Math in the Middle, a \$5.9 million grant that created a new master's degree program for middle-level teachers and a significant program of research in mathematics education, was funded by the National Science Foundation and administered by the CSMCE. By the end of this grant in Summer 2011, 156 Nebraska teachers had earned a master's degree from UNL. The grant also served as a foundation for developing a K-12-University partnership with LPS, the Omaha Public Schools and Nebraska's Educational Service Units.

The opportunity to work with so many dedicated math teachers convinced Jim Lewis, the Princi-



Courses have been held in Ainsworth, Auburn, Beatrice, Columbus, Fremont, Grand Island, Hastings, Holdrege, Kearney, Lincoln, Neligh, Norfolk, North Platte, Omaha and Scottsbluff.

pal Investigator for Math in the Middle and CSMCE director, that the program must find local funds to continue offering graduate education to mathematics teachers and to extend the program to science teachers. In 2007, UNL agreed to discount tuition in the summer for math and science teachers, and the NMSSI was created. The courses taught as part of the Math in the Middle curriculum were adapted for NMSSI courses that could be offered across the state.

NebraskaMATH, awarded in 2009, pledged a major commitment to developing a statewide partnership to support mathematics teachers and to the growth of the NMSSI. From just four courses in 2008 and 56 total course registrations to 33 courses in 2014 and 392 total course registrations, the program has grown substantially over the past few years as it has reached out to 15 different locations.

To help ensure that the courses are of the highest quality and of the highest benefit to teachers, most of the courses are taught with teams of instructors. These teams generally include a faculty member, a graduate student in the discipline or a master teacher. The master teacher is typically an individual whom the program knows to be an exemplary K-12 teacher and from the area in which the course is being taught.

Research has shown that for professional development to have an impact on teaching practices, teachers must be engaged in the professional development for 80 hours. NMSSI courses use a concentrated immersion approach developed by Math in the Middle and continued in NebraskaMATH. Classes meet from 8 a.m. – 5 p.m. daily (Monday-Friday) for either one or two weeks (one week for a single course, two weeks for a pair of courses) with nightly home-

work. At the end of each course, teachers are assigned an end-of-course assignment designed to support the long-term retention of material studied in the course. Thus, teachers are able to earn up to 12 graduate credits during a single summer, while being in class for a short, focused period of time.

While this approach is intense, support for participants from the instructional teams is substantial. This approach has proved to be quite popular with teachers because it protects most of the summer for other activities. The NMSSI's intense 40-hour-per-week summer courses provide the kind of professional development teachers need to increase student learning and academic success.

Traditionally, the costs of graduate education have been enormously prohibitive, especially for the teachers who have recently begun their teaching career. Both the funding of and the time commitment required for taking graduate courses are significant obstacles for teachers; thus, the NMSSI seeks to minimize these obstacles by: offering courses during a condensed time period; bringing quality graduate education to the teachers' communities to reduce travel; and reducing tuition and providing lunch for all teachers.

Because the need is so great (teaching is the largest occupation in the U.S.), the nation is focused on the importance of supporting professional development for math and science teachers. The recent adoption of the revised Nebraska mathematics standards, along with the first implementation of a statewide assessment of student achievement in mathematics, represents a special and immediate challenge for mathematics teachers, and it is essential to increase capacity to serve mathematics teachers in Nebraska. □

NMSSI BY THE NUMBERS

Year	Number of Courses	Number of Cities	Total People	Total Registrations
2008	4	1	35	56
2009	11	4	72	108
2010	19	4	101	147
2011	24	8	141	197
2012	18	10	174	261
2013	30	10	217	358
2014	33	8	194	392

Math Teachers Circles

One of the more informal means by which professional development opportunities for Nebraska teachers are continuing is through Math Teachers Circles (MTC): <http://scimath.unl.edu/mathteacherscircle> or [/gnmtc](http://gnmtc). MTCs are designed to bring together teachers of mathematics (primarily grades 6-12) and mathematicians with a goal of discovering and sharing with students the excitement and richness of problem solving in deep yet accessible mathematical topics.

The longest running MTC in Nebraska is the Lincoln area circle, which began in 2007 and is still organized by three of its original founders. The group meets five evenings per academic year for a dinner and math problem. The problems are intended to challenge teachers but be adaptable to teachers' classrooms. The Lincoln circle resulted in the establishment of the Central Nebraska Math Teachers Circle in 2009. The University of Nebraska at Kearney's Pari Ford, a UNL graduate, leads the central circle. Through strengthened connections with the University of Nebraska at Omaha, NebraskaMATH provided initial support in 2011 to begin the Omaha Area Math Teachers Circle, led by Angie Hodge of UNO. Omaha circles meet monthly at UNO for hands-on sessions.

To extend the benefits of Math Teachers Circles to teachers in rural locations, the Greater Nebraska Math Teachers Circle (GNMTC) grant began in 2012 with a seed grant from the MSRI and is led by Michelle Homp at UNL. The goal of the GNMTC is to bring these enriching networking opportunities to teachers from rural communities, who might otherwise not have access to participation in a teachers circle. An annual September event, scheduled prior to the Nebraska Association of Teachers of Mathematics Fall Conference in Kearney, kicks off the GNMTC at the beginning of the school year. Participants are treated to dinner and an engaging mathematical task and then invited to lead the same presentation in their home communities, with all of the materials (slides, handouts, plans) provided. GNMTC allows teachers otherwise isolated to network around mathematics and communicate more easily. □

NMSSI's school of rock:

Field course turns teachers into geology stars

This is how you turn science teachers into rock stars: Take them on a road trip. Get them dirty. Show them a stadium of mountains and rivers and open sky and pose questions about the geologic world around them. But don't make it easy. Hand them a shovel.

Make them dig deep to uncover the answers for themselves.

Frustrate them.

Then watch them return to their classrooms squeezed and heated and changed like a metamorphic rock.

This transformation happens each summer during a two-week graduate-level class at UNL called GEOS 898: Methods in Geoscience Field Instruction, a field course for science teachers, which is part of the Nebraska Math and Science Summer Institutes (NMSSI). The NMSSI offers science courses for teachers as well as mathematics and pedagogy courses. GEOS 898 is a unique and valuable course that is a highlight of the NMSSI.

"It was the most incredible journey I have ever been on so far," says Anica Brown, who teaches science to seventh- and eighth-graders at Lincoln Public Schools' Pound Middle School. "Had I not had that opportunity, I would not be able to do the things I do now in my classroom."

The teachers start out in Lincoln and then follow the Platte River through Nebraska and into the Rocky Mountains of Wyoming, where they study the history of the Rockies, and then travel on to South Dakota and back home.

The teachers learn together in



KEITH LEVY | UNL EARTH AND ATMOSPHERIC SCIENCES

Students in GEOS 898: Methods in Geoscience Field Instruction enjoy their trip.

the field, irritated at first by the course's "inquiry-based" method of teaching in which the facts aren't just given to them to memorize. They eat around the campfire and sleep under the stars. They bond.

They absorb the enormity of the Earth and its geologic history and come away humbled by it, and with a whole different outlook and a drive to solve problems on their own based on curiosity.

"I'd taken other courses before about rocks and minerals and different things like that," says Brown, who went on the trip two years ago. "But never have I really been exposed to and thrust into the real rocks."

A rock star professor, David Harwood, leads the course.

"It's not something that I have to teach," he says. "In GEOS 898, I teach by allowing the students who are teachers to discover this. By immersing these teachers in a discovery process, they get to feel like they are students, and they get

to feel the value of the process of learning, which is a lifelong skill."

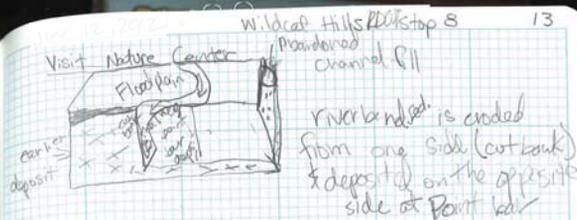
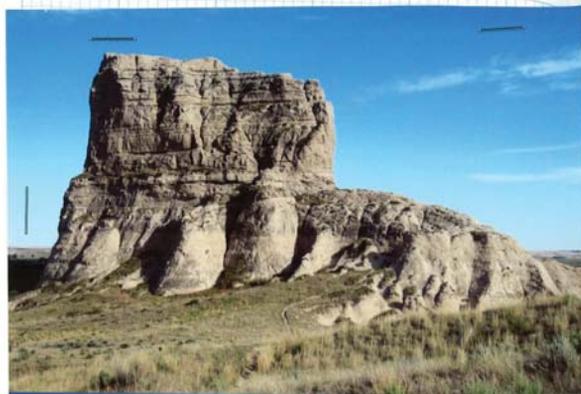
Harwood, the Stout Chair in Stratigraphy in UNL's Department of Earth and Atmospheric Sciences, had this past summer's class "going from sunup to sundown every day," says David Peters, a social studies teacher at Lincoln Southeast High School.

"It was a very challenging and very rewarding course," Peters says. "I think at times, we were overwhelmed and even became frustrated or fatigued. But I think that is the idea. I think that is what you want to get out of your education. I guess you want to challenge the students."

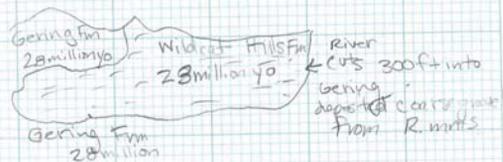
Peters says Harwood was like the Energizer Bunny: "And he had us at or near the breaking point for most of the two weeks."

Says Brown: "Being infused with the inquiry method that David does, when he takes you out on this trip, is just incredible.

"I mean, you understand it



Wildcat Hills River



Wright Cap dipping gravel beds indicate the channel depth of over 20ft high water events
 granite pebbles found in bottom of the channel indicate a major fluvial flow river w/ R. bank source

LINDSAY AUGUSTYN | UNL CSMCE

Photos and diagrams fill this field book from a teacher in David Harwood's *Methods in Geoscience Field Instruction* course in 2012.

when you come back and you just want to put it to use and bring it back to your classroom and your kids. You just want to do that.”

The course has been offered each summer for the past decade. Eight to 12 teachers take it each time. Most of their expenses – food, travel, lodging – are covered by private donors.

Harwood is pleased with that broad financial support for the program. The money, he says, makes this course possible.

The students are grateful, too.

“Had I not had the opportunity to have someone provide funds for me to do this, I wouldn’t have done it,” Brown says. “I wouldn’t have been able to do it. I could not have afforded that 15-day trip on my own.”

Says Peters: “I would say a tremendous thank you to anyone

who has donated toward this course. It was the most rewarding grad class I have ever taken. It was extremely challenging, also enjoyable. I would say that on behalf of everyone who has taken the class, this year or in the past, we have lots of students to share these ideas with. And in terms of the investment, I can’t stress how long-lasting and how beneficial that will be to so many different communities across the state of Nebraska.”

If you would like to help support graduate students like teachers David Peters and Anica Brown, please consider giving online to the Chris and Marlys Christensen Geosciences Teaching Fund at UNL. ■

– Colleen Fleischer, University of Nebraska Foundation

Rock video

GEOS 898: Methods in Geoscience Field Instruction is an innovative field course for science teachers created by Professor David Harwood in UNL’s Department of Earth and Atmospheric Sciences that is offered as part of the Nebraska Math and Science Summer Institutes. The course was featured on Nebraska Educational Television, as a segment of the “Nebraska Stories” program and was titled “Rockin’ in a Big Red Van.” A link to this video can be found on YouTube at: https://www.youtube.com/watch?v=tul018X0_HI. ■



LINDSAY AUGUSTYN | UNL CSMCE

LPS Scott Middle School teacher Alicia Davis (left) visits with fellow Noyce Master Teacher Shelby Aaberg of Scottsbluff High School. Aaberg, the 2015 Nebraska Teacher of the Year, brought some of his students to observe Davis' class on a trip in February 2015.

Robert Noyce Teacher Scholarship: Supporting math teachers in high-need districts

NebraskaNOYCE: NSF Mathematics Teaching and Master Teaching Fellows began in 2010 and represents an effort to build on the NebraskaMATH partnership.

This project includes UNL, OPS, LPS, GIPS, Nebraska's Educational Service Units Coordinating Council (ESUCC), and the University of Nebraska Foundation with a focused effort to strengthen mathematics teaching and learning in high-need Nebraska schools.

OPS, LPS and GIPS are three high-need school districts that serve the largest number of students in Nebraska who qualify for free or reduced lunch. These districts also serve a significant percentage of Nebraska's underrep-

resented ethnic minority students. The ESUCC offers a vehicle for extending our partnership to smaller rural high-need school districts. The original leadership team for NebraskaNOYCE included Jim Lewis, Wendy Smith, Steve Swidler, Ira Papick, David Fowler and Doug Kauffman. The project currently is led by Smith, Swidler, Yvonne Lai and Lorraine Males.

The purpose of NebraskaNOYCE is to focus on increasing the number of, and strengthen the quality of, mathematics teachers in Nebraska's high-need districts. NebraskaNOYCE includes funding for both Master Teaching Fellows and Teaching Fellows.

The goals of NebraskaNOYCE include creating the master's

degree plus certification program for Teaching Fellows; recruiting Teaching Fellows and Master Teaching Fellows; supporting the Teaching Fellows and Master Teaching Fellows as they teach in high-need Nebraska schools; and bringing NebraskaNOYCE to sustainability.

Five years into the grant, it's having an impact:

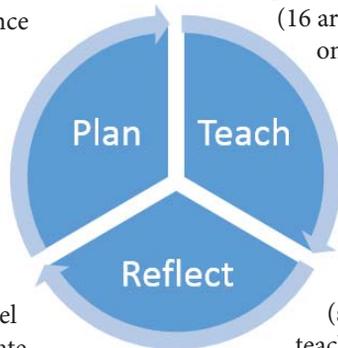
- With support from NebraskaNOYCE, the Department of Teaching, Learning and Teacher Education created the MAMt program, a 14-month program that leads to a master's degree with certification to teach high school mathematics. NSF funds supported two cohorts of Teaching Fellows (2011-12 and 2012-13),

and TLTE institutionalized the program. Two additional cohorts have participated (2013-14 and 2014-15). All of the graduates have secured teaching jobs after graduating. TLTE also created a science degree plus certification, supporting four years of teachers in the science Noyce grant. These two programs for secondary teachers, along with an elementary certification program, have become UNL's model for post-baccalaureate teaching certification; UNL now offers similar 14-month master's plus certification for secondary English and foreign language programs.

- NebraskaNOYCE recruited and works with 13 Teaching Fellows and 30 Master Teaching Fellows. All continue to teach in high-need Nebraska schools and are active in mathematics education leadership in the state.

Although the 13 Teaching Fellows are currently second- and third-year teachers, they have been involved in the following leadership activities already:

- taking additional graduate courses
- sharing their knowledge and skills in building- and district-level professional development sessions
- serving on instructional teams to teach courses to other Nebraska teachers
- mentoring new(er) teachers
- serving on building and district committees (including textbook adoption)
- creating and teaching an introductory computer science course
- one Teaching Fellow has become her school's mathematics liaison, the middle school version



of department chair

NebraskaNOYCE's 30 Master Teaching Fellows (learn more about them at <http://scimath.unl.edu/noyce/meet-master-teachers>) have been busy making an impact, including:

- pursuing advanced degrees (16 are pursuing doctorates; one earned a second master's degree)
 - 11 MTFs are department chairs/middle school liaisons and nine are mathematics coaches
 - mentoring (serving as cooperating teachers for Teaching Fellows and other student teachers or helping new teachers in their building or district)

- 29 have served on or led instructional teams offering math and math education courses for K-12 Nebraska teachers

- leading professional development activities for peers at the building, district, ESU, statewide, and national level
- publishing (seven MTFs have had four articles accepted/published in *Mathematics Teacher*)
- pursuing National Professional Board Certification (nine MTFs have earned NPBC in mathematics, and eight more have pending applications).

Building on NebraskaNOYCE, NebraskaNOYCE Phase II is a new Monitoring and Evaluation grant led by Smith, with Lai and Males. The purpose of the project is to examine the efficacy of NebraskaNOYCE as a program for pre-service Teaching Fellows and in-service MTFs.

A cornerstone of the research efforts involves understanding what mathematical knowledge for teaching looks like in action. Teaching Fellows and MTFs will plan specific lessons while the UNL team observes them

teaching and asks them to reflect upon the lessons. Semi-structured interviews will help to uncover the mathematical knowledge for teaching invoked in these instantiations of teaching.

Another part of the Phase II efforts is to work with MTFs to develop specific mathematical examples that can be used to support selected K-12 mathematical trajectories, such as the trajectory from multiplications to exponentiation to exponential functions. Such examples would be suitable to share with novice teachers or with preservice teachers. In this way, the Phase II findings can have an impact on the undergraduate teacher preparation mathematics classes at UNL. □

What is Noyce?

The Robert Noyce Teacher Scholarship Fund is a program from the National Science Foundation that includes funding for people to become secondary mathematics or science teachers, and also salary supplements for teacher leaders with a focus on improving mathematics and science instruction in high-need districts. UNL had both science (\$1.2 million) and mathematics (\$3 million) Noyce grants funded in 2010, as well as a Noyce Conference grant (\$800,000) and Noyce Phase II (\$300,000) funded in 2014. The original \$3 million mathematics Noyce grant also involves \$1.5 million of matching fundings provided by UNL and partner school districts. More about the Noyce grants can be found online at: <http://scimath.unl.edu/noyce>. □

Deepening an understanding of math



CRAIG CHANDLER | UNIVERSITY COMMUNICATIONS
LPS district K-2 math coordinator Susie Katt is working on her doctorate at UNL.

Susie Katt tried to leave her options open when she started at the University of Nebraska-Lincoln, but all of the signs pointed to teaching.

“My involvement as a classroom teacher in a curriculum study allowed me to experience district leadership. I was fortunate to be hired the next year for a K-2 mathematics coaching position at the district level,” Katt said.

Through her work for the district, Katt learned about Primarily Math and thought it would be an excellent opportunity.

“I knew of many Math in the Middle graduates who spoke very highly of their experience, and I was envious of their deep knowledge of the subject and pedagogical practices,” Katt said.

Katt’s primary responsibility as K-2 mathematics coordinator is working with kindergarten, first grade and second grade. Katt works with teachers in all of the 38 elementary buildings in LPS.

“My role as K-2 math coordinator also allows me to interact with building administrators, support building instructional coaches,

coordinate efforts with other district coaches, work on initiatives and projects that affect LPS elementary students in mathematics, and promote mathematics with various groups within the community,” Katt said.

“Due to my experiences in Primarily Math, I feel I’m better equipped to be an effective teacher and coach of mathematics,” she added.

“Participation in Primarily Math has given Susie an opportunity to deepen her content knowledge, consider alternative instructional strategies,

and grow as a leader. She is an invaluable member of the LPS math leadership team in no small part due to her involvement with Primarily Math,” said Matt Larson, mathematics curriculum specialist at LPS and president-elect of the National Council of Teachers of Mathematics.

Katt has been an instructor for a number of courses for Primarily Math since completing the program. She is a lead instructor of the first two mathematics courses for Primarily Math and the program’s leadership course, TEAC 836B, which she helped create. Katt also teaches and mentors other master teachers to become instructors for the leadership course.

“As a participant, I never would have imagined that I would have been asked to serve in an instructional role for future cohorts. It has been a pleasure to share my love and passion for teaching mathematics to young children with Primarily Math teachers from across the state.”

Originally from Valentine, Nebraska, Katt also completed a master’s degree in Educational Administration from UNL. She is a Noyce Master Teaching Fellow and is currently working on her doctorate of education from UNL, to deepen her understanding of mathematics.

Her husband, Jason, is a certified public accountant, and they have two children, Tenley and Huxton.

“I cherish the relationships I’ve built with the other participants of Primarily Math, and I consider this program to be one of the most influential experiences of my career,” Katt said. □

LINCOLN PUBLIC SCHOOLS

Susie Katt

Her parents both began their careers as teachers. Her favorite make-believe game as a child was school. She taught swimming lessons during high school. Then, after a practicum experience her sophomore year at UNL, she “fell in love with young children all over again” and changed her major from General Studies to Human Development and the Family, with an emphasis in Early Childhood and Elementary Education.

After teaching for Lincoln Public Schools for 10 years, Katt has spent the past eight years as a math coach and K-2 math coordinator for the district.

Sustaining NebraskaMATH momentum

Efforts to sustain the most beneficial components of NebraskaMATH beyond the end of its NSF funding continue for NebraskaMATH leaders who are seeking support from private institutions and Nebraska school districts and ESUs. Programs have been brought to districts from a variety of effective models, using funding from:

- private foundations,
- state grants,
- districts' Title I professional development funds and
- other district professional development funds.

Omaha Public Schools Teacher Leader Academy

In 2013, The Sherwood Foundation® and Lozier Foundation awarded \$5.5 million to NebraskaMATH to work with the Omaha Public Schools and bring NebraskaMATH programs to OPS teachers at no cost to the teachers.

This three-year grant includes funds for graduate courses for teachers, for district elementary and middle-level mathematics coaches, and for the study of the impact of these courses on classrooms.

In the summer of 2013, groups of teachers began Primarily Math and Math in the Middle courses, while other teachers, including many high school teachers, received fellowships to take courses through the Nebraska Math and Science Summer Institutes (NMSSI).

A second round of cohorts of teachers began Primarily Math and Math in the Middle in 2014, and a New Teacher Network program was established, where novice



LINDSAY AUGUSTYN | UNL CSMCE

OPS Primarily Math teacher Angela Holdren of King Elementary leads her first-grade students in a math lesson.

high school teachers were invited to register for up to four courses across the summer. Additional teachers received fellowships to take either NMSSI courses during the summer or online academic-year courses.

OPS also has hired nine mathematics coaches. These coaches work with teachers on improving mathematics instruction by providing on-the-job professional development. Part of this project also includes Math Studio (see page 23).

To demonstrate the positive impact on teachers and students by the investment of this grant, the research project asks teachers to take annual surveys of attitudes, teaching practices, and mathematical knowledge for teaching and tests a subset of these teachers' students. Teachers and math coaches are being interviewed and observed to further document the impact of the program on desired outcomes.

Thus far, earlier NebraskaMATH findings of the strong positive impact of

participating in Primarily Math on all teacher outcomes have been confirmed. Classroom observations and student data collection efforts got under way in the fall of 2014; therefore, findings on student outcomes should be available in late 2015.

UNL-Lincoln Public Schools Title I Professional Development Program

In 2014, in an effort initiated by a LPS middle school principal and supported by the district's director of curriculum and instruction, LPS designated over half a million dollars of Title I professional development funds for teachers in Title I buildings to begin participating in Primarily Math and Math in the Middle. The funding also covers an evaluation of the impacts of these programs.

The Title I funds are being used not only to cover the full cost of teacher tuition and fees, but also to pay teachers a stipend to participate in the summer courses. Primarily Math teachers will complete the program in Summer 2015. Math in the Middle participants are on track to complete Math in the Middle in Summer 2016, earning master's degrees in the process.

The teachers take surveys and a math assessment at the beginning and end of each summer to document their growth in mathematical knowledge for teaching, attitudes toward mathematics, confidence and pedagogical skills. Data from the beginning to the end of Summer 2014 show large growth in all of these areas for the 79 teachers participating.



LINDSAY AUGUSTYN | UNL CSMCE

ESU 3 Primarily Math participants create a group poster during Math 801P in the summer of 2014 in La Vista, Nebraska.

Strengthening Upper Elementary Mathematics Instruction in the Nebraska Panhandle

In 2014, UNL, ESU 13 and the Scottsbluff Public Schools received a collaborative grant from the Nebraska Coordinating Commission for Postsecondary Education's Improving Teacher Quality State Grants Program, which is funded by the U.S. Department of Education's Improving Teacher Quality program.

The Strengthening Mathematics Instruction project is a professional development program for teachers of grades 4-6 designed to strengthen knowledge of mathematics curriculum and the pedagogical knowledge needed to offer challenging but accessible mathematics courses. Bringing aspects of both Primarily Math and Math in the Middle to ESU

13 teachers, the workshops are held in multiple locations in ESU 13 and also online to focus on improving teachers' mathematical knowledge for teaching and their mathematical pedagogical skills. In 2015, the SMI program is focusing on a program for K-3 teachers.

ESU 3 and ESU 5 Primarily Math Partnerships

Districts in ESU 3 and ESU 5 each found resources in 2014 to provide full or partial fellowships for teachers to take Primarily Math courses. The investment by districts and ESUs to date is nearly \$25,000. UNL allocated additional tuition fellowships for the participants to further lower their costs. The ESU 3 group is on track to complete Primarily Math in Summer 2015. The ESU 5 group took the first Primarily Math course in Summer 2014 and will take the second in Summer 2015.

Donations welcome

The cost for graduate courses can be a significant barrier for teachers. To this end, the Center for Science, Mathematics and Computer Education asks for private donations to help teachers cover the costs of tuition and fees for courses through the Nebraska Math and Science Summer Institutes. It is important to provide Nebraska math teachers with continued opportunities for professional growth. In turn, great teachers will inspire their students to learn — and love — mathematics. To donate to the CSMCE via the University Foundation, visit: <http://scimath.unl.edu/giving> or use the enclosed card.

Nebraska **MATH** TEACHERS

2014-15 Teaching Positions

(Nebraska unless otherwise noted)

The teachers identified below have completed
Primarily Math, Nebraska Algebra or New
Teacher Network between 2010 and 2014.

* denotes also in the New Teacher Network

Nebraska Algebra Cohort 1 (2009-2010)

*Danielle Buhrman, Grand Island Public
Schools, Grand Island Senior High

Darla Berks, Lincoln Public Schools,
District Math Coach

*Aaron Burgoa, formerly Lincoln Public
Schools, North Star High School

Kim Busby, Gering Public Schools, Gering
High School

*Jeff Depue, Gretna Public Schools,
Gretna High School

Daniel Dougherty, Lincoln Public
Schools, Lincoln Southeast High School

Jane Dougherty, Lincoln Public Schools,
Lincoln East High School

Spencer Duncan, Lincoln Public Schools,
Lincoln Southeast High School

*Emily Dvorak, Lincoln Public Schools,
Lincoln High School

Steve Eckman, Lincoln Public Schools,
Lincoln Northeast High School

*Tammy Gallagher, formerly Lincoln
Public Schools, Lincoln Northeast High
School

Carol Goans, Lincoln Public Schools,
Lincoln Southeast High School

*Kelly Gomez Johnson, University of
Nebraska at Omaha

Teri Gum, formerly Boys Town High
School

Tami Heiser, Niobrara Public Schools,
Niobrara Secondary School

Trina Hellbusch, Boone Central Schools,
Boone Central Middle School

Tony Hoffman, Crofton Community
Schools, Crofton High School

Lindsay Hollman, Columbus Public
Schools, Columbus Middle School

Denise Hunzeker, Humboldt Table Rock
Steinauer, HTRS High School

Karey Killion, High Plains Community
Schools, High Plains Community High
School

Julie Kreizel, Lincoln Public Schools,
District Math Coach

Christy Kreutzer, Hastings Public
Schools, Hastings Senior High School

Jon Ladehoff, Sutton Public Schools,
Sutton Secondary School

Holly Liibbe, Lincoln Public Schools,
Culler Middle School

Andrew Loch, Papillion-La Vista School
District, La Vista Junior High School

Eric Lockert, Lincoln Public Schools,
North Star High School

Chris Lodes, retired, Lincoln Public
Schools, Lincoln Northeast High School

Julie Lodes, Springfield Platteview
Community Schools, Platteview Senior
High School

Jeremy Long, Westside Community
Schools, Westside High School

John Matzke, Lincoln Public Schools,
Lincoln East High School

*Todd McQuistan, formerly Lincoln
Public Schools, Lincoln Southeast High
School

*Jennifer Mercer, Lincoln Public Schools,
Lefler Middle School

Angela Mosier, Westside Community
Schools, Westside High School

Kathryn Mousel, Kenesaw Public
Schools, Kenesaw Secondary School

Amy Nebesniak, University of Nebraska
at Kearney

Rick Nordhues, Syracuse-Dunbar-Avoca
Schools, Syracuse Middle School

*Katherine Norman, Lincoln Public
Schools, Lincoln Southeast High School

*Tiffany Ogden, Lincoln Public Schools,
Lincoln High School

Jill Phipps, formerly Lincoln Public
Schools, Lincoln Southwest High School

*Bryan Pilakowski, Bennington Public
Schools, Bennington Secondary School

*Jennifer Powell, Bellevue Public Schools,
Bellevue Mission Middle School

Kelli Roeber Schoening, Lincoln Public
Schools, Lincoln Southeast High School

Charlot Schlake, Lincoln Public Schools,
Lincoln High School

Josh Severin, Lincoln Public Schools,
Lincoln Southeast High School

Wendy Shotkoski, Columbus Public
Schools, Columbus High School

Ryan Shuman, Lincoln Public Schools,
Pound Middle School

Reetu Singh, formerly Lincoln Public
Schools, North Star High School

Gary Smith, Gering Public Schools,
Gering High School

*Meagan Stobel, Gering Public Schools,
Gering High School

Jennifer Stutheit, formerly Lincoln Public
Schools, North Star High School

Christin Sutter, Lincoln Public Schools,
Lincoln Southwest High School

*Arnold Talero, Norris School District
160, Norris High School

Jared Vitosh, Norris School District 160,
Norris High School

Nebraska Algebra Cohort 2 (2010-2011)

Steve Bahrij, St. Mary's Schools, St.
Mary's High School

Angela Blank, Northwest Public Schools,
Cedar Hollow

Julie Blaser, Scotus Central Catholic

Deb Bulin, Thayer Central Community
Schools, Thayer Central High School

Alicia Davis, Lincoln Public Schools, Scott
Middle School

Wanda DeKay, Niobrara Public Schools,
Niobrara Secondary School

Marcus Donner, Shelton Public Schools,
Shelton High School

*Stefanie Edwards, Broken Bow Public Schools, Broken Bow High School

Cody Franzen, Litchfield Public Schools, Litchfield High School

*Neil Hammond, Gretna Public Schools, Gretna High School

*Lindsey Harders, Northwest Public Schools, Northwest High School

Kathleen Klein, Kearney Public Schools, Horizon Middle School

Dee Krolikowski, Grand Island Public Schools, Grand Island Senior High

Kelli Larson, Gering Public Schools, Gering High School

Ken Mathine, Grand Island Public Schools, Grand Island Senior High

*Kathy Niedbalski, Kearney Catholic Schools, Kearney Catholic Middle and High School

Terri Rech, Kearney Public Schools, Kearney Senior High School

Lisa Schmidt, Elmwood-Murdock Public Schools, Elmwood-Murdock Jr/Sr High School

Keith Schroetlin, Wisner-Pilger Public Schools, Wisner-Pilger High School

Kyle Schumann, Lincoln Public Schools, Southwest High School

Audrey Smalley, Grand Island Public Schools, Grand Island Senior High

Dan Vahle, Grand Island Public Schools, Grand Island Senior High

Sharon Witt, Hastings Public Schools, Hastings Senior High School

Nebraska Algebra Cohort 3 (2011-2012)

Sarah Benzel, Gretna Public Schools, Gretna High School

Iris Borg, Wakefield Public Schools, Wakefield High School

Jason Cochran, McCook Public Schools, McCook Senior High School

Elizabeth Crabtree, Milford Public Schools, Milford High School

*Chara Eckery, Lincoln Pius X High School

*Bailey Feit, Lincoln Public Schools, North Star High School

*Casey Fries, Lincoln Public Schools, Lincoln East High School

Brian Johnson, Nebraska City Public Schools, Nebraska City Middle School

*James Jordan, Omaha Public Schools, Central High School

*Mandy Kehm, Omaha Marian High School

*Carrie Kopf, Norfolk Public Schools, Norfolk Senior High School

*Tahma Kuck, Ord Public Schools, Ord Jr/Sr High School

*Heather Lander, South Sioux City Community Schools, South Sioux City Middle School

*Megan Lund, formerly Lincoln Christian Jr/Sr High School

*Julianne Meier, Lincoln Public Schools, Lincoln Southeast High School

*Dan Meyer, Millard Public Schools, Harry Andersen Middle School

*Danielle Niss, Educational Service Unit #4, formerly Lewiston High School

Mary Nuckolls, Wahoo Public Schools, Wahoo High School

*Heather Peters, Riverside High School

Amanda Pfeil, Alma Public Schools, Alma High School

Susan Poland, Litchfield Public Schools, Litchfield High School

*Angela Schroetlin, formerly York Public Schools, York Middle School

*Sarah Scofield, Lincoln Public Schools, Southwest High School

*Brian Stevens, Westside Community Schools, Westside High School

Theron Troxel, Freeman Public Schools, Freeman High School

*Gina Vifquain, Lincoln Public Schools, Southwest High School

*Amber Vlasnik, Lincoln Public Schools, Lincoln High School

Mary Wright, North Platte Public Schools, Adams Middle School

New Teacher Network 2012

Staci Applegarth, McCook Public Schools, McCook Senior High School

Courtney Beach, Hastings Public Schools, Hastings Middle School

Jeanette Broxterman, Lincoln Public Schools, Lefler Middle School

Karen Clinch, Fremont Public Schools, Fremont Senior High School

Sarah Fischbein, Lincoln Public Schools, Goodrich Middle School

Mitchell Fricke, Millard Public Schools, Millard North High School

Alan Holdorf, Lincoln Public Schools, Lincoln Southeast High School

Tony Jacobsen, Crete Public Schools, Crete High School

Charles James, Schuyler Community Schools, Schuyler Central High School

Matt James, Lincoln Public Schools, Southwest High School

Laura Janssen, South Sioux City Community Schools, South Sioux City Middle School

Molly Jensen, Omaha Public Schools, Central High School

Daniel Martin, Kearney Public Schools, Kearney Senior High School

Jeff Meyer, Lincoln Public Schools, Lincoln High School

Brianna Pinguoch, Omaha Public Schools, Central High School

Lee Plath, Lincoln Public Schools, Culler Middle School

Tiffany Powers, Lincoln Public Schools, Southwest High School

Sam Robb, Twin River Public Schools, Twin River Senior High School

Emily Romkema, Santee Community Schools, Santee High School

Kyle Schwaninger, Lincoln Public Schools, North Star High School

April Sypal, Aquinas St. Mary's Catholic Schools, Aquinas High School

Shannon Wiig, Lincoln Public Schools, Lincoln High School

New Teacher Network 2013

Lauren Beitel, Omaha Public Schools, Bryan High School

Jamison Goodell, Omaha Public Schools, Bryan High School

Collin Holmquist, Omaha Public Schools, Bryan High School

Jeremy Jank, Lincoln Public Schools, North Star High School

Sonja Ann Kalkwarf, Cedar Bluffs Public Schools, Cedar Bluffs High School

Patrick Spieler, Omaha Public Schools, Central High School

Joseph Steele, Omaha Public Schools, Northwest High School

Primarily Math Cohort 1 (2009-2010)

Shannon Allard, Alliance Public Schools,
Emerson Elementary School

Kelli Anderson, Lincoln Public Schools,
Campbell Elementary School

Jeane Anderson, Scottsbluff Public
Schools, Roosevelt Elementary School

Diann Barnes, Grand Island Public
Schools, Engleman Elementary School

Cindy Beaman, Grand Island Public
Schools, District Math Coach

Jodi Chapek, East Butler Public Schools,
Brainard Elementary School

Stacy Chapek, Lincoln Public Schools,
Adams Elementary School

Jo Conrad, Howells-Dodge Consolidated
Schools, Dodge Elementary School

Jessica Dickes, Gretna Public Schools,
Thomas Elementary

Kelly Dockweiler, Loup County Public
Schools, Loup County Elementary School

Rita Ehly, Lincoln Public Schools, Everett
Elementary School

Amy Fiedler, Bloomfield Community
Schools, Bloomfield Elementary School

Megan Fleischman, Lincoln Public
Schools, Kloefkorn Elementary School

Lynn Fuller, Lincoln Public Schools, West
Lincoln Elementary School

Tabitha Gilsdorf, Bloomfield Community
Schools, Bloomfield Elementary School

Bev Grueber, North Bend Public Schools,
North Bend Elementary School

Janis Hiatt, retired, Lincoln Public
Schools, Rousseau Elementary School

Danielle Inserra, Papillion-La Vista
School District, Patriot Elementary
School

Brittany Jenkins Pinegar, West Point
Public Schools, Beemer Elementary
School

Kellie Joy, Lincoln Public Schools, Clinton
Elementary School

Susie Katt, Lincoln Public Schools,
District K-2 Math Coach

Annie Kennedy, Lincoln Public Schools,
Sheridan Elementary School

Keri Lewandowski, Lincoln Public
Schools, Kooser Elementary School

Lisa Mason-D'Croze, Lincoln Public
Schools, Elliott Elementary School

Jane McGill, Papillion-La Vista School
District, Carriage Hill and G Stanley Hall
Elementary Schools

Cynthia Mracek, Alliance Public Schools,
Grandview Elementary School

Molly Orton, Lincoln Public Schools,
Adams Elementary School

Jana Rowe, Gretna Public Schools,
Gretna Elementary School

Sy Settell, Lincoln Public Schools,
Belmont Elementary School

Cindy Settje, Leigh Community Schools,
Leigh Elementary School

Kathy Simpson, Lincoln Public Schools,
Belmont Elementary School

Kina Stefka, Sargent Public Schools,
Sargent Elementary School

Deb Watchorn, Lincoln Public Schools,
Belmont Elementary School

Linda Woitaszewski, Grand Island Public
Schools, Shoemaker Elementary School

Tara Zuspan, Lincoln Public Schools,
Brownell Elementary School

Primarily Math Cohort 2 (2010-2011)

Alysia Augustus, Papillion-La Vista
School District, Anderson Grove
Elementary School

Wendy Badders, Omaha Public Schools,
Bancroft Elementary School

Kathleen Bilek, Omaha Public Schools,
Bancroft Elementary School

Rebecca Brown, Lincoln Public Schools,
Holmes Elementary School

Heather Bryan, Omaha Public Schools,
Ashland Park/Robbins Elementary
School

Nadene Chavet, formerly Santee
Community Schools

Tracy Custer, Blair Community Schools,
Blair North Elementary School

Marni Driessen, Omaha Public Schools,
Mount View and Wakonda Elementary
Schools Math Coach

Mary Duffy, Omaha Public Schools,
Dundee Elementary

Jeani Guenther, Papillion-La Vista School
District, La Vista Junior High School

Megan Harding, Papillion-La Vista
School District, G Stanley Hall
Elementary School

Meeghan Hartfield, Omaha Public
Schools, Highland Elementary School

Jill House, Omaha Public Schools

Cynthia Hudson, Bellevue Public Schools,
Betz Elementary School

Alycia Hughes, Hastings Public Schools,
Alcott Elementary School

Melissa Jankowski, Omaha Public
Schools, Benson West Elementary School

Sherri Johnson, Plattsmouth Community
Schools, Plattsmouth Middle School

Leah Kastrup, Omaha Public Schools,
Math Coach

Kerri Kratina, Omaha Public Schools,
Benson West Elementary School

Caterina Noll, formerly Papillion-La
Vista School District, Parkview Heights
Elementary School

Christine Olsen, Omaha Public Schools,
Hartman Elementary School

Kelli Roehrig, formerly Papillion-La Vista
School District, Golden Hills Elementary
School

Elizabeth Scheppers, Papillion-La Vista
School District, Parkview Heights and La
Vista West Elementary Schools

Carrie Schnell, Gretna Public Schools,
Palisades Elementary School

Laura Topf, formerly Omaha Public
Schools, Ashland Park/Robbins
Elementary School

Jimmi Watts, Omaha Public Schools,
Belle Ryan Elementary School

Meredith Whiley, Omaha Public Schools,
King and Kennedy Elementary Schools

Primarily Math Cohort 3 LPS (2011-2012)

Mary Abebe, Lincoln Public Schools,
Saratoga Elementary School

Jill Allen, Lincoln Public Schools, Hartley
Elementary School

Sara Andersson, Lincoln Public Schools,
Pyrrtle Elementary School

Amy Barton, Lincoln Public Schools,
Lakeview Elementary School

Tessie Beaver, Lincoln Public Schools,
Everett Elementary School

Amanda Christensen, Lincoln Public
Schools, Fredstrom Elementary School

Tina Cruickshank, Lincoln Public Schools,
Arnold Elementary School

Amy Davidson, Lincoln Public Schools,
Fredstrom Elementary School

Laura Deans, Lincoln Public Schools,
Kloefkorn Elementary School

Chris Dinneen, Lincoln Public Schools,
Maxey Elementary School

Allyn Fujan, Lincoln Public Schools,
Brownell Elementary School

Kristi Green, Lincoln Public Schools,
Campbell Elementary School

Whitney Hobbs, Lincoln Public Schools,
Clinton Elementary School

Carol Hovey, retired, Lincoln Public
Schools, Campbell Elementary School

Jamie Hoyle, Lincoln Public Schools,
Lakeview Elementary School

Sarah Ideus, Lincoln Public Schools,
Adams Elementary School

Carol Jozsa, Lincoln Public Schools,
Morley Elementary School

Kristy Kennedy, Lincoln Public Schools,
Kloefkorn Elementary School

Heather Kramer, Lincoln Public Schools,
Roper Elementary School

Cassie Krueger, Lincoln Public Schools,
Adams Elementary School

Shelly Muggy, Lincoln Public Schools,
Everett Elementary School

Stephanie Nantkes, Lincoln Public
Schools, Arnold Elementary School

Angela Penner, Lincoln Public Schools,
Sheridan Elementary School

Erin Pfister, Lincoln Public Schools,
Belmont Elementary School

Tiffany Reynolds, Lincoln Public Schools,
Kooser Elementary School

Jamie Ritchey, Lincoln Public Schools,
Belmont Elementary School

Michelle Stephens, Lincoln Public
Schools, Prescott Elementary School

Becky Unterseher, Lincoln Public Schools,
Arnold Elementary School

Darcy Vercellino, Lincoln Public Schools,
Beattie Elementary School

Deirdre Walton, Lincoln Public Schools,
Morley Elementary School

Krista Wells, Lincoln Public Schools,
Kooser Elementary School

Kimberly Zetterman, Lincoln Public
Schools, Adams Elementary School

Dawn Ziegelmann, formerly Lincoln
Public Schools, Clinton Elementary
School

Primarily Math Cohort 3 West (2011-2012)

Jessie Anderson, Hay Springs Public
Schools, Hay Springs Elementary School

Vanessa Bartels, Grand Island Public
Schools, Knickrehm Elementary School

Tawnya Bass, Alliance Public Schools,
Grandview Elementary School

Mary Carriker, South Central NE Unified
System 5, Sandy Creek Elementary
School

Cynthia Crick, Cozad Community
Schools, Cozad Elementary School

Jane Dewey, McCook Public Schools,
McCook Elementary School

Michelle Dubbert, Deshler Public
Schools, Deshler Elementary School

Michelle Dutcher, Kearney Public
Schools, Sunrise Middle School

Merri Ann Elliott, formerly Cozad
Community Schools, Cozad Elementary
School

Jackie Fitzgerald, St. Paul Public Schools,
St. Paul Elementary School

Whitney Flower, Grand Island Public
Schools, Lincoln Elementary School

Stephanie Hamilton, Elkhorn Valley
Schools, Elkhorn Valley Elementary
School

Dana Henry, St. Paul Public Schools, St.
Paul Elementary School

Penny Hilzer, Scottsbluff Public Schools,
Lincoln Heights Elementary School

Nanette Kissler, Scottsbluff Public
Schools, Lincoln Heights Elementary
School

Vicki Klein, Scottsbluff Public Schools,
Lake Minatare School

Bobbi Middleton, Madison Public
Schools, Madison Middle School

Melanie Moore, formerly Northwest
Public Schools, Cedar Hollow School

Monica Munter, Hastings Public Schools,
Longfellow Elementary School

Linda Paesl, Nebraska Unified District 1,
Verdigre Elementary School

Patty Powers, Arthur County Schools,
Arthur Elementary School

Nora Robinson, Kimball Public Schools,
Mary Lynch Elementary School

Trudy Schnell, Scottsbluff Public Schools,
Lake Minatare School

Tammy Sorensen, Santee Community
Schools, Santee Elementary School

Penny Wickham, Alliance Public Schools,
Grandview Elementary School

Suzanne Wissing, St. Michael's
Elementary School, Hastings

Amber Waitaszewski, Grand Island
Public Schools, Knickrehm Elementary
School

Primarily Math Cohort 4 ESU 3 (2012-2013)

Andrew Boone, Gretna Public Schools,
Thomas Elementary School

Michelle Brown, Bellevue Public Schools,
Fort Crook Elementary School

Erin Case, Papillion-La Vista School
District, Patriot Elementary

Danielle Cassell, Douglas County West
Community Schools, Douglas Co West
Elementary School

Liz Cook, Gretna Public Schools,
Palisades Elementary School

Melissa Croom, Millard Public Schools,
Norris Elementary School

Laura Darling, Papillion-La Vista School
District, Portal Elementary School

Allie Elsasser, Papillion-La Vista School
District, Patriot Elementary School

Diane Finney, Papillion-La Vista School
District, Carriage Hill Elementary School

Mindi Fowler, Springfield Platteview
Community Schools, Westmont
Elementary School

Brittany Fulton, Gretna Public Schools,
Whitetail Creek Elementary School

Nichole Hallquist, Papillion-La Vista
School District, Trumble Park Elementary
School

Christine Hanke, Papillion-La Vista
School District, La Vista West
Elementary School

Abby Hansen, Papillion-La Vista School
District, Parkview Heights Elementary
School

Melissa Hawley, Falls City Public
Schools, Falls City North Elementary

Gretchen Kalkowski, Louisville Public
Schools, Louisville Elementary School

Bethany Klone, Bellevue Public Schools,
Two Springs Elementary School

Brittini Konrad, Papillion-La Vista School District, Rumsey Station Elementary School

Danielle Koory, Papillion-La Vista School District, Walnut Creek Elementary

Kelly Krings, formerly Papillion-La Vista School District, Portal Elementary

Chris Miller, Papillion-La Vista School District, Rumsey Station Elementary School

Brooke Morehead, Papillion-La Vista School District, Walnut Creek Elementary School

Krista Morrison, Millard Public Schools, Reagan Elementary School

Kimberly Norblade, Papillion-La Vista School District, Tara Heights Elementary School

Kimberly Oliver, Falls City Public Schools, Falls City North Elementary

Marilyn Opitz, Millard Public Schools, Norris Elementary School

Linda Poole, Papillion-La Vista School District, Portal Elementary School

Carter Pratt, Gretna Public Schools, Thomas Elementary School

Britni Putnam, formerly Papillion-La Vista School District, Walnut Creek Elementary School

Scott Simpson, Gretna Public Schools, Thomas Elementary School

Betsy Smith, Papillion-La Vista School District, Rumsey Station Elementary School

Sarah Smith, Kearney Public Schools, Sunrise Middle School

Julia Soto, Elkhorn Public Schools, Spring Ridge Elementary

Mary Bridget Stork, Springfield Platteview Community Schools, Westmont Elementary School

Christine Synowiecki, Papillion-La Vista School District, La Vista West Elementary

Jamie Toelle, Louisville Public Schools, Louisville Elementary School

Jon Trede, Gretna Public Schools, Whitetail Creek Elementary School

Rhonda Wiebers, Bellevue Public Schools, Fort Crook Elementary School

Primarily Math Cohort 4 Lincoln (2012-2013)

Tiffany Anderson, Auburn Public Schools, Calvert Elementary School

Angela Blanco, Scottsbluff Public Schools, Lincoln Heights Elementary School

Teresa Calafiore, Lincoln Public Schools, Kooser Elementary School

Tracy Clements, Lincoln Public Schools, Beattie Elementary School

Amy Emanuel, Lincoln Public Schools, Roper Elementary School

Rachel Frank, Lincoln Public Schools, Prescott Elementary School

Theresa Haack, Lincoln Public Schools, Elliott Elementary School

Sarah Hoglund, Lincoln Public Schools District Office

Andrea Holtgrewe, Lincoln Public Schools, Clinton Elementary School

Jennifer Jenkins, Lincoln Public Schools, Pershing Elementary School

Sherri Key, Lincoln Public Schools, Rousseau Elementary School

Lacey Konwinski, Lincoln Public Schools, Beattie Elementary School

Megan Kooima, formerly Lincoln Public Schools, West Lincoln Elementary School

Megan Miller, Lincoln Public Schools, Adams Elementary School

Nancy Mosier, Lincoln Public Schools, Lakeview Elementary School

Alison Nickolaus Bowder, Lincoln Public Schools, Prescott Elementary School

Tricia Phillips, Lincoln Public Schools District Office

Jessi Potter, Lincoln Public Schools, Kooser Elementary School

Elizabeth Pruett, Lincoln Public Schools, Hartley Elementary School

Kristine Ray, Lincoln Public Schools, West Lincoln Elementary School

Chantelle Schroeder, Lincoln Public Schools, Meadow Lane Elementary School

Katie Songster, Lincoln Public Schools, Randolph Elementary School

Holly Southwick, Lincoln Public Schools, Maxey Elementary School

Lisa Sparks, Lincoln Public Schools, West Lincoln Elementary School

Jessica Tewalt, Lincoln Public Schools, Cavett Elementary School

Sarah Timmer, formerly Grand Island Public Schools, Jefferson Elementary School

Elizabeth Topp, Lincoln Public Schools, Kooser Elementary School

Sara Tracy, Lincoln Public Schools, Campbell Elementary School

Karen Vontz, Lincoln Public Schools, McPhee Elementary School

Barb Wallingford, Lincoln Public Schools, Eastridge Elementary School

Ashley Wergin, Lincoln Public Schools, Sheridan Elementary School

Jennifer Woelber, formerly Lincoln Public Schools, Beattie Elementary School

Andrea Woita, Lincoln Public Schools, Meadow Lane Elementary School

Primarily Math Cohort 4 Omaha (2012-2013)

Rebecca Barber, South Sioux City Community Schools, Covington Elementary School

Hollie Booth, Blair Community Schools, Blair North Elementary School

Angela Brodine, Omaha Public Schools, Spring Lake Magnet Center

Meghan Daigh, Omaha Public Schools, Kennedy Elementary School

Ann Dirks, Omaha Public Schools, Western Hills Magnet Center

Erica Flynn, Omaha Public Schools, Bancroft Elementary School

Christina Free, Omaha Public Schools, Jefferson Elementary School

Mandy Farrage, formerly Omaha Public Schools, Highland Elementary School

Mike Heller, Omaha Public Schools, Standing Bear Elementary School

Heather Herman, Blair Community Schools, Blair North Elementary School

Jenna Hoelsing, formerly Blair Community Schools, Blair North Elementary School

Lisa Holland, Omaha Public Schools, District Math Coach

Jim Hubbard, South Sioux City Community Schools, Covington Elementary School

Tracie Johnson, Blair Community Schools, Blair North Elementary School

Joana Kimmel, Omaha Public Schools,
Bancroft Elementary School

Lisa Kleen, Omaha Public Schools,
Bancroft Elementary School

Kelle Lawrence, Omaha Public Schools,
Sunny Slope Elementary School

Frances Merica, Omaha Public Schools,
Beals Elementary School

Michelle Meyer, Omaha Public Schools,
Belle Ryan Elementary School

Carey Mogensen, South Sioux
City Community Schools, Cardinal
Elementary School

Karen Overland, Omaha Public Schools,
Spring Lake Magnet Center

Suzanne Pike, Omaha Public Schools,
Liberty Elementary School

Mary Schubert, Blair Community
Schools, Blair North Elementary School

Jennifer Streeter, Papillion-La Vista
School District, G Stanley Hall
Elementary School

Maris Taylor, Blair Community Schools,
Blair South Elementary School

Angela Thiemann, Omaha Public
Schools, Bancroft Elementary School

Shirley Tipler, Omaha Public Schools,
Sherman Elementary School

Kristin Wiese, Omaha Public Schools,
Picotte Elementary School

Megan Zitek, Omaha Public Schools,
Western Hills Magnet Center

Primarily Math Cohort 5 (2013-2014)

Mallory Cacy, Northwest Public Schools,
1R Elementary School

Tammy Chohon, Northwest Public
Schools, 1R Elementary School

Brenda Cochran, Grand Island Public
Schools, Wasmer Elementary School

Danielle Dudo, Grand Island Public
Schools, Newell Elementary School

Shelley Eickhoff, Grand Island Public
Schools, Newell Elementary School

Angela Harder, Grand Island Public
Schools, Dodge Elementary School

Lauren Henry, Hastings Public Schools,
Morton Elementary School

Danie Hilton, Grand Island Public
Schools, Lincoln Elementary School

Katie Keasling, Grand Island Public
Schools, Stolley Park Elementary School

Lori Keslar, Grand Island Public Schools,
Stolley Park Elementary School

Selena Laughlin, Adams Central Public
Schools, East Elementary School

Rita Leininger, Sidney Public Schools,
South Ward Elementary School

Deborah Lewis, Malcolm Public Schools,
Westfall Elementary

Kelli Long, Omaha Public Schools, Rose
Hill Elementary School

Becky Maul, Adams Central Public
Schools, Juniata Elementary School

Andrea May, Northwest Public Schools,
Cedar Hollow School

Connie Meyer, St. John Lutheran
Elementary School, Seward

Heather Negus, Central City Public
Schools, Central City Elementary School

Candice Nordby, Adams Central Public
Schools, Wallace Elementary School

Marsha Pawley, Aurora Public Schools,
Aurora Elementary School

Carissa Phillips, Aurora Public Schools,
Aurora Elementary School

Kayla Reutzel, Adams Central Public
Schools, Juniata Elementary School

Angie Roby, Grand Island Public Schools,
Knickrehm Elementary School

Sandra Royuk, St. John Lutheran
Elementary School, Seward

Dani Ryan, Grand Island Public Schools,
Starr Elementary School

Lindsey Schademann, Seward Public
Schools, Seward Elementary School

Cassey Schaefer, Gibbon Public Schools,
Gibbon Elementary School

Jessica Schroeder, Grand Island Public
Schools, Engleman Elementary School

Gwen Schultz, Shickley Public Schools,
Shickley Elementary School

Melanie Stepp, O'Neill Public Schools,
O'Neill Elementary School

Hannah Vacek, Hastings Public Schools,
Morton Elementary School

Donnette Van Pelt, Central City Public
Schools, Central City Elementary

Kelli Wemhoff, Northwest Public Schools,
1R Elementary School

Shelley Wilcynski, Lincoln Public Schools,
Campbell Elementary School

Omaha Public Schools Teacher Leader Academy Primarily Math Cohort 1 (2013-2014)

Lacey Allen, Indian Hill Elementary
School

Katie Almgren, Indian Hill Elementary
School

Meagan Bakhit, Belle Ryan Elementary
School

Dana Berstler, Mount View Elementary
School

Amy Burns, King Elementary School

Laura Chan, Fullerton Magnet Center

Kristine Clark, Ashland Park/Robbins
Elementary School

Katie Grant, Miller Park Elementary
School

Jennifer Grimes, Ashland Park/Robbins
Elementary School

Angela Holdren, King Elementary School

Jennifer Kaminski, Benson West
Elementary School

Terry Killian, Mount View Elementary
School

Alicia Knudsen, Ashland Park/Robbins
Elementary School

Miranda McAreavey, Wakonda
Elementary School

Jennifer Miller, Dundee Elementary
School

Kristine Murray, Gomez Heritage
Elementary School

Katie Omer, Saddlebrook Elementary
School

Angela Rosenthal, Masters Elementary
School

Arlicia Shaw, Springville Elementary
School

Natalie Suhr, Saddlebrook Elementary
School

Melissa Sullivan, Fullerton Magnet
Center

Julie Trimble, Saddlebrook Elementary
School

Nebraska **MATH** LEADERSHIP

Principal Investigators

Ruth Heaton, Gilmartin Professor of Mathematics Education, UNL Department of Teaching, Learning and Teacher Education (co-PI 2009-2014; PI 2015)

Jim Lewis, Aaron Douglas Professor, Department of Mathematics and Director, UNL Center for Science, Mathematics and Computer Education (PI 2009-2014)

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Barbara Jacobson, former Director of Curriculum, Lincoln Public Schools (co-PI 2009-2012)

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Jadi Miller, Director of Curriculum, Lincoln Public Schools (co-PI 2012-2015)

Ira Papick, Professor Emeritus, UNL Department of Mathematics (co-PI 2009-2013)

Wendy Smith, Research Coordinator and Assistant Director, UNL Center for Science, Mathematics and Computer Education (co-PI 2015)

Walt Stroup, Professor, UNL Department of Statistics (co-PI 2009-2015)



Ruth Heaton



Jim Lewis



Carolyn Edwards



Barbara Jacobson



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Jadi Miller



Ira Papick



Wendy Smith



Walt Stroup



Lindsay Augustyn



Deb Harder



James Harrington



Michelle Homp



Matt Larson



Deb Rodenburg



Deb Wragge

Leadership Team

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Michelle Homp, NebraskaMATH Program Manager, UNL Center for Science, Mathematics and Computer Education

Matt Larson, Mathematics Curriculum Specialist, Lincoln Public Schools, President-elect of the National Council of Teachers of Mathematics

Deb Rodenburg, Director of Assessment and School Improvement, Papillion-La Vista School District

Deb Wragge, ESU 8 Mathematics Curriculum Specialist

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Glenda Lappan, Michigan State University

Joan Leitzel, President Emerita, University of New Hampshire

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Collegiate Faculty

Erin Blankenship, UNL Statistics

Roger Bruning, UNL Educational Psychology

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David Fowler, retired, UNL TLTE

Chuck Friesen, UNL TLTE

Jennifer Green, UNL Statistics (Montana State University*)

Brian Harbourne, UNL Mathematics

Stephen Hartke, UNL Mathematics

Ruth Heaton, UNL TLTE

Angela Hodge, UNO Mathematics

Michelle Homp, UNL Center for Science, Mathematics and Computer Education

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Tom Marley, UNL Mathematics

Michael Matthews, UNO Mathematics

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Kendra Schmid, UNMC Statistics

Wendy Smith, UNL Center for Science, Mathematics and Computer Education

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Witawas Srisa-An, UNL Computer Science and Engineering

Jane Strawhecker, UNK Education

Judy Walker, UNL Mathematics

Jake Weiss, UNK Mathematics

Gordon Woodward, retired, UNL Mathematics

Tami Worner, Wayne State College

Master Teachers and Administrators

Shelby Aaberg, Scottsbluff Public Schools

Anna Anderson, Holdrege Public Schools

Delise Andrews, Lincoln Public Schools

Tanya Archie, Omaha Public Schools

Ali Arndt, Lincoln Public Schools

Amy Barton, Lincoln Public Schools

Cindy Beaman, Grand Island Public Schools

Darla Berks, Lincoln Public Schools

Kathy Bohac, East Butler Public Schools

Andrew Boone, Gretna Public Schools

Myrna Bornemeier, Lincoln Public Schools

Danielle Buhrman, Grand Island Public Schools

Deb Bulin, Thayer Central Community Schools

Connie Colton, Omaha Public Schools

Tracy Custer, Blair Community Schools

Alicia Davis, Lincoln Public Schools

Wanda DeKay, Niobrara Secondary School

Shana Dick, Scottsbluff Public Schools

Marni Driessen, Omaha Public Schools

Michelle Dutcher, Kearney Public Schools

Jill Edgren, Wood River Rural Schools

Rachel Fellows, Lincoln Public Schools

Megan Fleischman, Lincoln Public Schools

Whitney Flower, Grand Island Public Schools

Gary Furse, Lincoln Public Schools

Katie Garcia, Omaha Public Schools

Doug Glasshoff, East Butler Public Schools

Susan Graupner Kilmer, retired, Lincoln Public Schools

Marlene Grayer, Omaha Public Schools

Shauna Green, Lincoln Public Schools

Kyla Hall, Lincoln Public Schools

Megan Harding, Papillion-La Vista School District

Tom Harrington, Madison Public Schools

David Hartman, Lincoln Public Schools

Linda Hayek, retired, Papillion-La Vista School District

Cole Hilker, O'Neill Public Schools

Karen Hillen, Leigh Community Schools

Julie Hoaglund, Brady Public Schools

Jill House, Omaha Public Schools

Danielle Inserra, Papillion-La Vista School District

Paula Jakopovic, Omaha Public Schools

Pat Janike, Lincoln Public Schools

Kristin Johnson, Lincoln Public Schools

Kellie Joy, Lincoln Public Schools

Susie Katt, Lincoln Public Schools

Karey Killion, High Plains Community Schools

Heather Kramer, Lincoln Public Schools

Kerri Kratina, Omaha Public Schools

Julie Kreizel, Lincoln Public Schools

Brent Larson, Omaha Public Schools

Matt Larson, Lincoln Public Schools
 Stacie Leffer, Gordon-Rushville Public Schools
 Jill Luschen, Omaha Public Schools
 Josh Males, Lincoln Public Schools
 Jane McGill, Papillion-La Vista School District
 Carmen Melliger, Aquinas St. Mary's Catholic Schools
 Linda Moore, retired, Lexington Public Schools
 Anne Munksgaard, Lincoln Public Schools
 Kathy Niedbalski, Kearney Catholic
 Molly Orton, Lincoln Public Schools
 Laura Parn, Lincoln Public Schools (Wentzille, Mo., Public Schools*)
 Kristine Ray, Lincoln Public Schools
 Deb Rodenburg, Papillion-La Vista School District
 Kelli Roehrig, formerly Papillion-La Vista School District
 Edie Ronhovde, Fremont Public Schools
 Greg Sand, Omaha Public Schools
 Daniel Schaben, Arapahoe Public Schools
 Elizabeth Scheppers, Papillion-La Vista School District
 Anne Schmidt, Lincoln Public Schools
 Lisa Schmidt, Elmwood-Murdock Public Schools
 Valerie Schovanec, Omaha Public Schools
 JaLena Slack, Crete Public Schools
 Katie Soto, Grand Island Public Schools
 Meagan Stobel, Gering Public Schools
 Jessica Tewalt, Lincoln Public Schools
 Lindsey Thompson, Lincoln Public Schools
 Beth Topp, Lincoln Public Schools
 Lisa Vavra, Omaha Public Schools
 Jason Vitosh, Falls City Public Schools
 Amber Vlasnik, Lincoln Public Schools
 Jerel Welker, Lincoln Public Schools
 Sherry West, Lincoln Public Schools
 Keri Witherell, Omaha Public Schools
 Tara Zuspan, Lincoln Public Schools

UNL Graduate Students

Sarah Behrens, Mathematics
 Derek Boeckner, Mathematics
 Jessalyn Bolkema, Mathematics
 Mary Alice Carlson, TLTE (Montana State University*)
 Oscar Castillo, UNO Mathematics
 Ela Celikbas, Mathematics (University of Missouri Columbia*)
 Kristen Chockley, Mathematics
 Tom Clark, Mathematics (Dordt College*)
 Nathan Corwin, Mathematics (Rutgers University*)
 Julie Couton, Statistics
 Amanda Croll, Mathematics (Concordia University Irvine*)
 Elizabeth Cunningham, TLTE
 Doug Dailey, Mathematics
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Nebraska **MATH** DISSERTATIONS

A QUALITATIVE STUDY OF RESPONSIVE TEACHING IN THE PRIMARY MATHEMATICS CLASSROOM

Mary Alice Carlson, Ph.D., 2014
Advisor: Ruth Heaton

Mathematics education reforms suggest that good teaching requires attention to students' reasoning. However, taking students' mathematical conceptions seriously multiplies complexities of teaching because teachers must navigate relationships among mathematical content, students, and students as they are learning content. Choices regarding the best course of action may arise in the form of dilemmas to be managed rather than either-or decisions to be made. Thus teacher learning is a matter of developing knowledge of content and pedagogy and of developing a stance that enables teachers to make productive use of student conceptions. In this qualitative case study I analyze the practice of two first-grade Primarily Math teachers who are seeking to be responsive to students' mathematical ideas. A central component of pedagogy coursework was cultivating teacher characteristics thought to be important when teaching in ways that are responsive to students' mathematical ideas. The central question of this study is: What does it mean to engage in a teaching practice that gives students access to meaningful mathematical content while being responsive to students' mathematical ideas? Data analyzed include videotaped classroom observations, post-observation conversations between the teacher and researcher, teacher lesson plans and notes, and written coursework. Analysis suggests that teachers find ways to navigate particular tensions while being responsive to students' ideas. First, teachers allow space for student thinking while providing classroom structure. Second, teachers draw on their existing knowledge while building new conceptions based on unfolding classroom events. Third, teachers work with individuals while simultaneously shaping the entire lesson. Finally, I find that learning while teaching is in fact a task of teaching that is critical to

eliciting, understanding, and responding to students' mathematical ideas in productive ways.

VALUE-ADDED METHODOLOGY FOR ESTIMATING PROFESSIONAL DEVELOPMENT PROGRAM EFFECTS

Pamela S. Fellers, Ph.D., 2014
Advisors: Walter W. Stroup and Erin. E Blankenship

This dissertation studied the use of value-added methodology to estimate the effect of a Professional Development program on student achievement focusing on the sensitivity of model estimates to violations of assumptions and model specification. Specifically, the non-random assignment of students to classrooms, assessment ceiling effects, and student-specific growth trajectories were addressed via simulation. Results from the investigations illuminate the vulnerability of program effect estimates and standard errors from the presented model applied to data generated to mimic these features commonly observed in student achievement data.

PLANNING AND ENACTING MATHEMATICAL TASKS OF HIGH COGNITIVE DEMAND IN THE PRIMARY CLASSROOM

Kelly Grinnell, Ph.D., 2013
Advisor: Ruth Heaton

This study offers an examination of two primary-grades teachers as they learn to transfer knowledge from professional development into their classrooms. I engaged in planning sessions with each teacher to help plan tasks of high cognitive demand, including anticipating and planning for classroom discourse that would occur around the task. A detailed description of the planning and teaching that took place during the study provides information about how a teacher can learn and what a teacher learns to consider in order to plan and implement meaningful mathematical lessons. This design experiment describes the work of two teachers who participated in Primarily Math. The overarching

questions studied were about the transfer of knowledge from professional development to classroom practice and how teachers plan and implement tasks of high cognitive demand. Within the study, I examined the role of the curriculum and the understanding of student conceptions of mathematics in planning and teaching. I found that weak mathematical knowledge for teaching can be overcome by learning to deeply understand students. Additionally, the intentional use of talk moves can help teachers improve classroom discourse, sustain press for justification and minimize the routinizing of math problems. I suggest guidelines for planning tasks of high cognitive demand and questions that teachers can use to reflect upon and learn from implementing tasks of high cognitive demand.

YOUNG CHILDREN'S BELIEFS ABOUT THE SELF AS A LEARNER AND PRODUCER OF MATHEMATICS: A MIXED METHODS STUDY

Traci Kutaka, Ph.D., 2013
Advisor: Carolyn Pope Edwards

The purpose of my mixed methods dissertation was to study how K-3 children develop productive learning dispositions in mathematics. I did this using the quantitative Primarily Math pictorial survey data and by conducting qualitative interviews with children who completed the survey at each grade level. Quantitative Results: I learned that children's beliefs about their mathematical competence were more statistically stable from fall to spring for second- and third-grade children (relative to their younger peers), suggesting that kindergarten and first-grade children's beliefs are more malleable. This is a surprising finding for the research community, since we expect that beliefs about competence and aptitude would not begin to solidify until the latter elementary grade levels (fifth grade and beyond). Qualitative Findings: My colleagues and I interviewed 115 children about what they were thinking or feeling as they selected

the pictorial symbol that represented their beliefs about their present and future mathematical competence. I learned that children's responses were grounded in rich memories that ranged from winning and losing math games, having conversations about cost in grocery stores while shopping with their mothers, and the speed at which they were able to complete worksheets. I came to the conclusion that children's responses were meaningful and that teachers are uniquely positioned to help children develop healthy self-beliefs by simply asking children what evidence they use to construct their self-beliefs.

ELEMENTARY SCHOOL TEACHERS' INTERPRETATION AND PROMOTION OF CREATIVITY IN THE LEARNING OF MATHEMATICS: A GROUNDED THEORY STUDY

Yinjing Shen, Ph. D., 2014
Advisor: Carolyn Pope Edwards

Creativity is important for young children learning mathematics. Comparing the investment theory of creativity and national standards and principles for early mathematics shows that doing mathematics is more than applying rules and procedures; rather, learning mathematics takes a lot of creativity. However, people often claim that creativity for young children learning of mathematics is not adequately supported by teachers in the classroom due to teachers' poor college preparation in mathematics content knowledge, teachers' negativity toward creative students, teachers' occupational pressure, or low quality curriculum. The purpose of this grounded theory study was to generate a model that explains how teachers make sense of creativity in the learning of mathematics and how teachers promote or fail to promote it in the classroom. In-depth interviews with 30 Kindergarten to Grade-3 Primarily Math teachers were conducted. These teachers were also asked to draw a picture to represent their understanding of creativity for young students in the learning of mathematics. A theoretical model was developed describing: 1) the central phenomenon of how teachers interpret mathematical creativity; 2) the strategies teachers use to promote creativity in the learning of mathematics; and 3) the consequences of how different aspects of mathematical creativity are promoted by different strategies in different degrees. The findings challenge

the popular notion that teachers do not view mathematics in early grades as requiring creativity and that teachers are not supporting enough creativity in the learning of mathematics in the classroom. Instead, this study finds that Primarily Math teachers have a well-developed concept of mathematical creativity and that they are also resourceful about how to promote creativity in the learning of mathematics.

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