



Nebraska
MATH

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Lincoln

Developing a Sustainable Statewide Partnership

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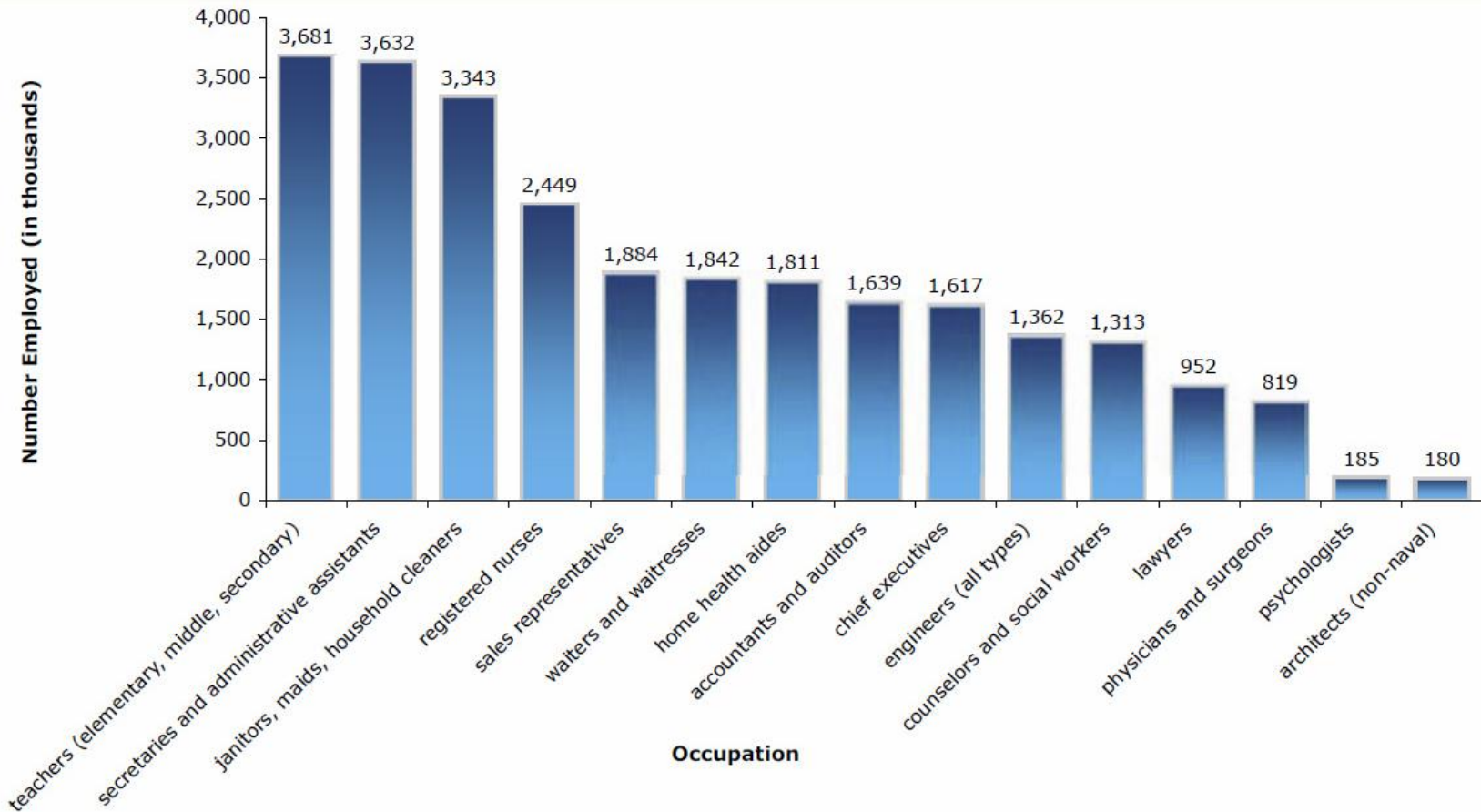


CBMS Forum on Content Based Professional Development for Teachers of Mathematics

- ... an excellent context for the mathematics community to work toward major improvement and scaling up of content-based professional development opportunities for teachers of mathematics.
- Our goal is not only in scaling up, but also in getting these opportunities built into our systems so they are a part of the on-going responsibilities of college and university mathematics departments ...



The realities of scale



Learning to Work Together

- UNL-LPS Professional Development Workshops
 - Growing demand for content-based professional development
 - Sharing resources; building trust
- Mathematics – Teacher Education Departments
 - Math Matters
 - A CCLI grant from NSF to revise how elementary teachers are educated at Nebraska
 - A mathematician – mathematics educator partnership
 - Appreciation for the interdisciplinary nature of teaching and teacher education



University support has been critical

- Center for Science, Mathematics and Computer Education
 - Permanent infrastructure providing staff support
- Math and Science Teachers for the 21st Century Program of Excellence
 - Approximately \$350,000/yr for 13 years (2002-2015)
- Administrative Support
 - Chair, Dean, Vice Chancellor, Chancellor
 - APLU – Science and Mathematics Teacher Imperative
 - Business-Higher Education Forum American Imperative
 - Support for Fund Raising





NSF Support has been critical

- Math Matters – (2000 – 2003)
- Math in the Middle Institute Partnership
(2004 – 2009)
- Nebraska**MATH** Partnership – (2009 – 2013)
- NebraskaNOYCE – (2010 – 2016)





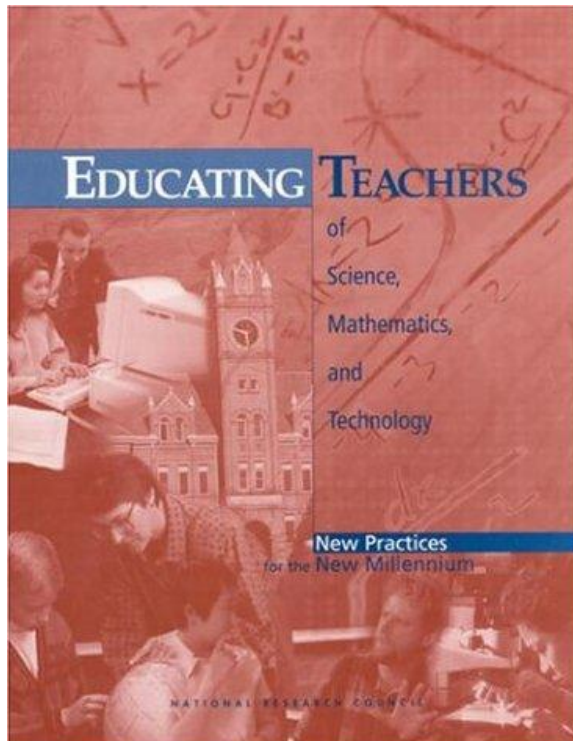
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Professional Development

- Math in the Middle Institute
 - A master's program for middle level (5-8) teachers
- Primarily Math
 - An 18-hour certificate program for K-3 teachers
- Nebraska Algebra
 - A 9-hour program for Algebra 1 teachers
- New Teacher Network
 - A 24-hour PD and mentoring program for new teachers
- Robert Noyce NSF Master Teaching Fellowships
 - A program for extraordinary master teachers
- Robert Noyce NSF Teaching Fellowships
 - A postbac master's and certification program

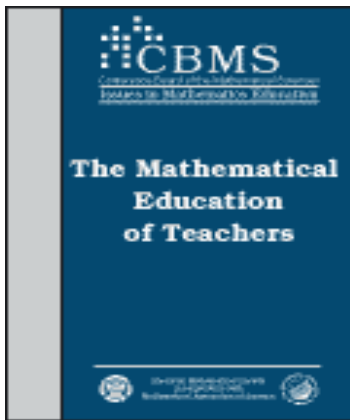


Educating Teachers of Science, Mathematics, and Technology New Practices for the New Millennium



This National Research Council report recommends:

“a new partnership between K-12 schools and the higher education community designed to ensure high-quality teacher education and professional development for teachers.”



The Mathematical Education of Teachers

Recommendations

- Teachers need mathematics courses that develop a deep understanding of the math they teach.
- Mathematics courses should
 - focus on a thorough development of basic mathematical ideas.
 - develop careful reasoning and mathematical ‘common sense’.
 - develop the **habits of mind of a mathematical thinker** and demonstrate flexible, interactive styles of teaching.
- The mathematics education of teachers should be based on
 - partnerships between mathematicians, mathematics education faculty and school mathematics teachers.





Math in the Middle Institute Partnership

A 25-month masters program for outstanding middle level math teachers who will become intellectual leaders in their schools, and districts.

Math in the Middle courses focus on:

- Enhancing mathematical knowledge
- Enabling teachers to transfer mathematics they learn into their classrooms
- Leadership development
- Action research



The habits of mind of a mathematical thinker

Have you observed two people who appear to know the same “facts” but for whom there is a marked difference in their ability to use that information to answer questions or solve problems?

Why?

- Do mathematical thinkers approach problems differently?
- And, if so, how do we develop the “habits of mind of a mathematical thinker” in teachers and assist them in cultivating this knowledge among their students?
- *To study this question, we developed a working definition based on experience and the work of other mathematics educators (e.g., Cuoco, et al., Driscoll)*



All Math in the Middle Math Courses Emphasize Problems to Develop Teachers' Mathematical Habits of Mind

Goals: Give teachers experiences to develop their:

- Strategies for solving problems
- Flexibility in thinking
- An appreciation for the importance of precise mathematical definitions and careful reasoning
- Ability to explain solutions to others
- Persistence and self-efficacy



Math in the Middle Courses

- **Eight new mathematics and statistics courses designed for middle level teachers (Grades 5 – 8) including:**
 - Mathematics as a Second Language
 - Functions, Algebra and Geometry for Middle Level Teachers
 - Experimentation, Conjecture and Reasoning
 - Number Theory and Cryptology for Middle Level Teachers
 - Using Mathematics to Understand our World
 - Statistics for Middle Level Teachers
- **Special math focused sections of three pedagogical courses:**
 - Inquiry into Teaching and Learning
 - Curriculum Inquiry
 - Teacher as Scholarly Practitioner
- **An integrated capstone course:**
 - Integrating the Learning and Teaching of Mathematics





Math in the Middle Instructional Model

SUMMER

- Offer 1 and 2 week classes.
- Class meets from 8:00 a.m. - 5:00 p.m.
- 30-35 teachers – 5 instructors in class at one time.
- Substantial homework each night.
- End-of-Course problem set
 - Purpose – long term retention of knowledge gained.

ACADEMIC YEAR

- Two-day (8:00 – 5:00) on-campus class session.
- Course completed as an on-line, distance education course using Blackboard and Breeze.
 - Major problem sets
 - End-of-Course problem set
 - Substantial support available for teachers



The Triangle Game

(Paul Sally, U. Chicago) Consider an equilateral triangle with points located at each vertex and at each midpoint of a side. The problem uses the set of numbers $\{1, 2, 3, 4, 5, 6\}$. Find a way to put one of the numbers on each point so that the sum of the numbers along any side is equal to the sum of the numbers along each of the two other sides. (Call this an Equal Side Sum Solution.)

- Is it possible to have two different Equal Side Sum Solutions?
- Which Equal Side Sum Solutions are possible?
- How can you generalize this game?



Side Sum Solutions for Hexagons

Side Sum 17: 3, 8, 6, 4, 7, 9, 1, 11, 5, 10, 2, 12

Side Sum 18: None

Side Sum 19: 6, 2, 11, 5, 3, 9, 7, 4, 8, 10, 1, 12

And 4, 10, 5, 8, 6, 2, 11, 1, 7, 9, 3, 12

And 5, 11, 3, 9, 7, 4, 8, 10, 1, 6, 12, 2

And 3, 9, 7, 11, 1, 10, 8, 6, 5, 2, 12, 4

Side Sum 20: 7, 11, 2, 8, 10, 4, 6, 9, 5, 3, 12, 1

And 9, 3, 8, 5, 7, 11, 2, 12, 6, 4, 10, 1

And 8, 2, 10, 4, 6, 9, 5, 3, 12, 7, 1, 11

And 10, 4, 6, 2, 12, 3, 5, 7, 8, 11, 1, 9

Side Sum 21: None

Side Sum 22: 10, 5, 7, 9, 6, 4, 12, 2, 8, 3, 11, 1



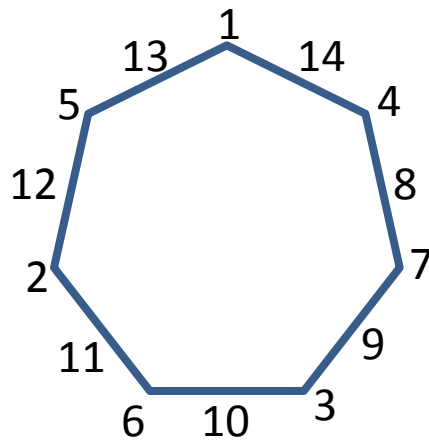
Patterns with Minimums & Maximums

Polygon	Minimum Side Sum	To find the next Minimum	Maximum Side Sum	To find the next Maximum
Triangle	9	+3	12	+3
Square	12	+2	15	+4
Pentagon	14	+3	19	+3
Hexagon	17	+2	22	+4
Heptagon	19	+3	26	+3
Octagon	22		29	



A Solution for an n-sided polygon, n odd

- General solution for an n-gon where $n = 2k + 1$, n odd
- For a Heptagon Solution, $n = 7$; $k = 3$



To find the vertices begin with 1, move clockwise by k each time, and reduce mod n . The midpoints begin with $2n$ between 1 and $1+k$ and move counterclockwise, subtracting 1 each time. For a heptagon, the Side Sum = $5k + 4$.

Making Our Work Public

- Please visit the **Products** section of our web site: <http://scimath.unl.edu/MIM/> for information on Math in the Middle:
- Course Materials
- Teachers' Expository Math Papers
- Teachers' Action Research Papers



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*A partnership to improve
mathematics achievement*



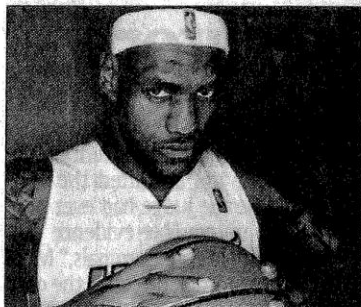
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SPORTS SCORES



By Marc Serota, Getty Images

LeBron James: At Heat media day.

Naysayers light fire for Heat

■ LeBron James says critics will help his work with Dwyane Wade and Chris Bosh, 1, 10C



Tuesday, September 28, 2010

Newsline

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By Joe Raedle, Getty Images

Southwest to buy AirTran

■ Low-cost carrier aims for business-travel market with \$1.4M merger, 1-2B

