Improving Math Education in Nebraska Primary Classrooms through Teacher Professional Development: The NebraskaMATH Project

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Acknowledgments

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- NebraskaMATH is
  - 5-year, $9,235,407, Targeted Math Science Partnership funded by NSF
  - P-16 partnership across the state
- Overall goal of NebraskaMATH: to improve achievement in mathematics for all students and to narrow achievement gaps of at-risk populations
- A main priority of NebraskaMATH is creating a sustainable statewide partnership

Primarily Math Participants

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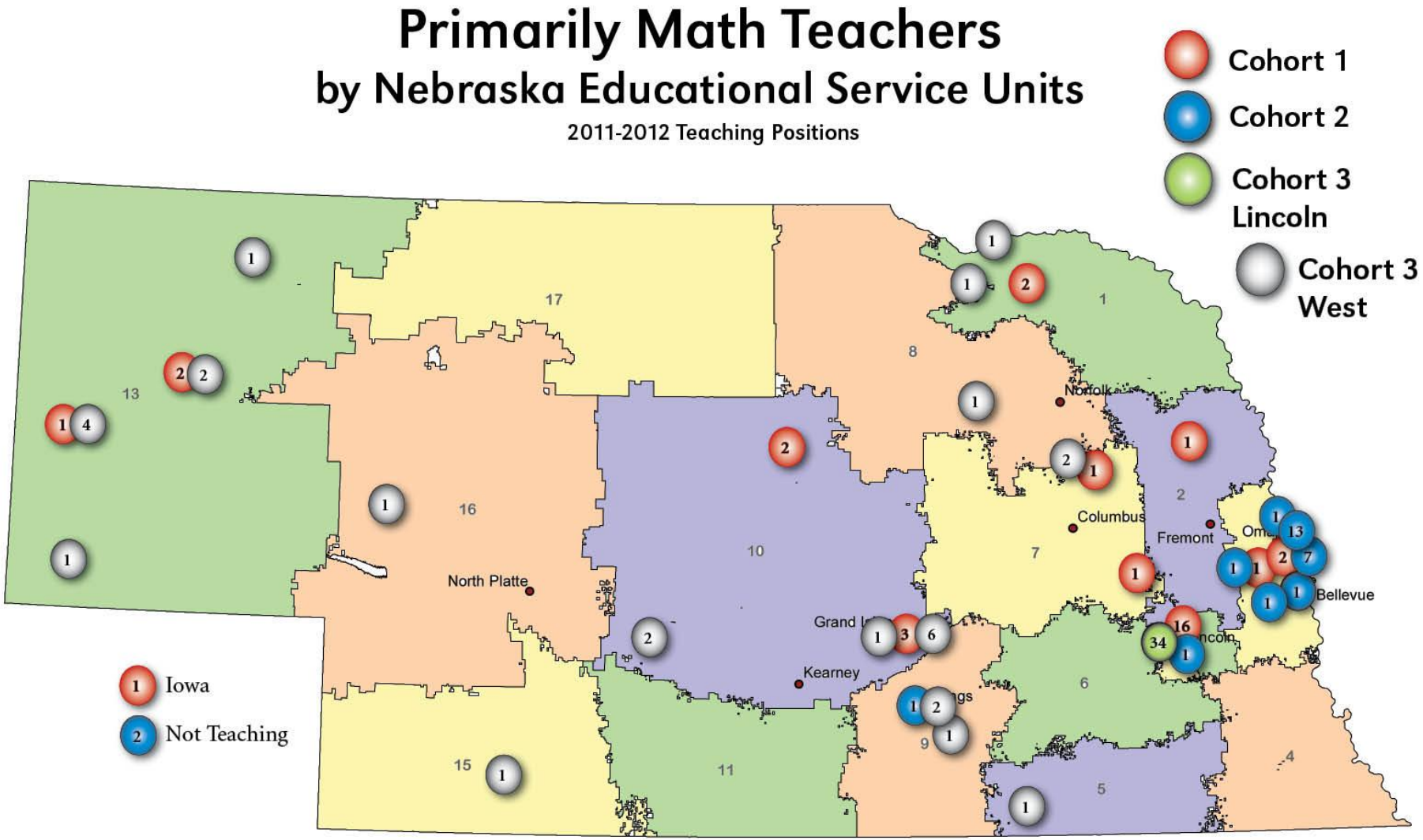

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NebraskaMATH: Primarily Math

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- Focuses on strengthening the teaching & learning of mathematics in grades K-3
- Partnership among mathematics, mathematics education, early childhood, developmental psychology
- Six course, 18-credit hour program leading to a K-3 Mathematics Specialist certificate
  - 3 mathematics courses
  - 3 pedagogy courses
- Optional 7th course focusing on leadership
- On-going support in the form of study groups lasting 2 years after coursework

What do you need to know to become an excellent teacher of mathematics?

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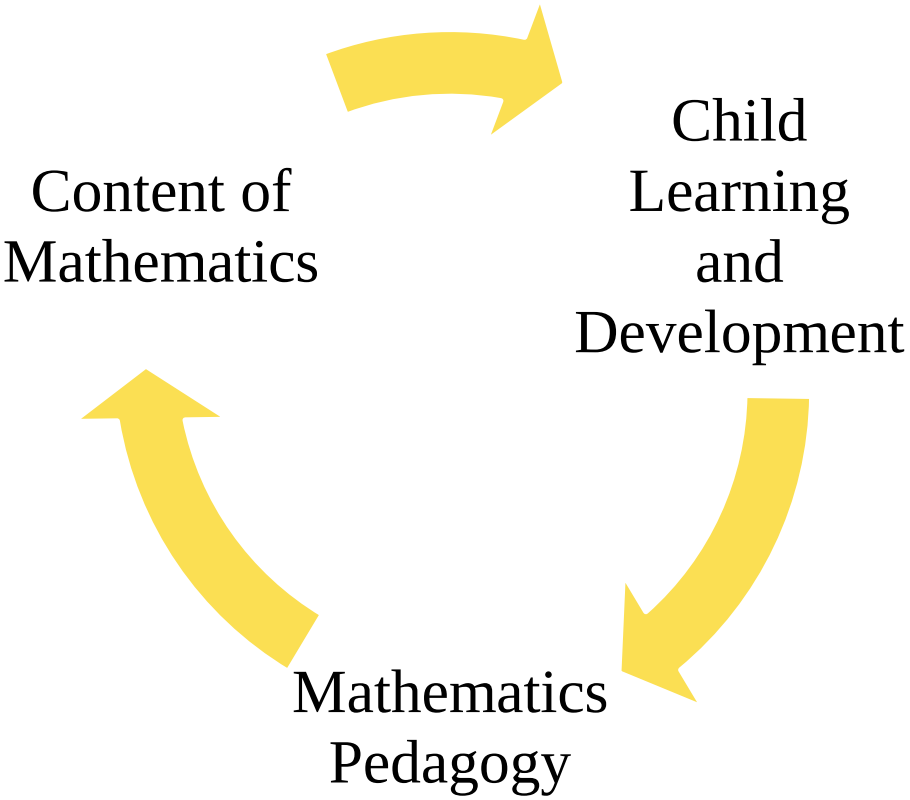

Primarily Math Research Questions

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- How do teachers translate the mathematical attitudes, knowledge, and habits of mind emphasized during the Primarily Math Certification Program into measurable changes in teaching practice?

- How do new structures of leadership in mathematics teaching impact the culture of schools?

Primarily Math Research Questions

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- To what extent does the intervention translate into measurable improvement in students' beliefs and achievement in the areas of math and reading?

Primarily Math Research

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- Research design led us to recruit participants for the first 3 cohorts during 2008-2009
  - First cohort, 35 teachers; classes met in Lincoln June 2009-June 2010; study groups through 2012
  - Second cohort, 35 teachers; classes met in Omaha June 2010-June 2011; study groups through 2013
  - Third cohort, 61 teachers, met in two groups in Lincoln and Grand Island June 2011-June 2012; study groups through 2013
- Collect data from all 3 cohorts beginning summer 2009, continuing through summer 2013

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Primarily Math Research

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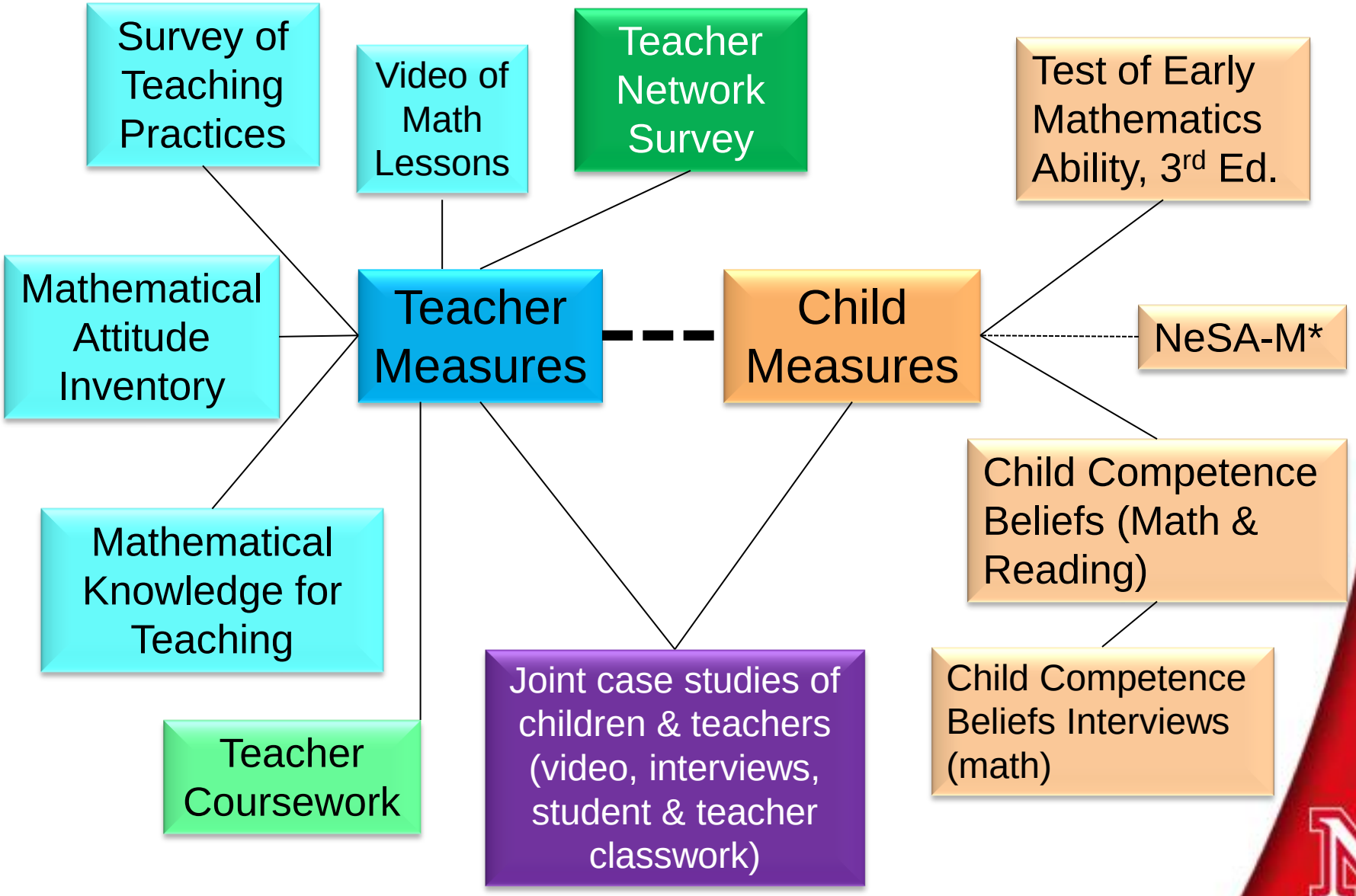

Primarily Math Research

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- School building climate and degree of teacher networking
  - Teacher Network Survey administered to elementary buildings in 4 core partner districts 2010, 2011, 2013
  - Survey allows principals to see where teacher collaboration & isolation are occurring
- This research is in collaboration with a team at Northwestern University led by Jim Spillane

Teacher Network Sociograms

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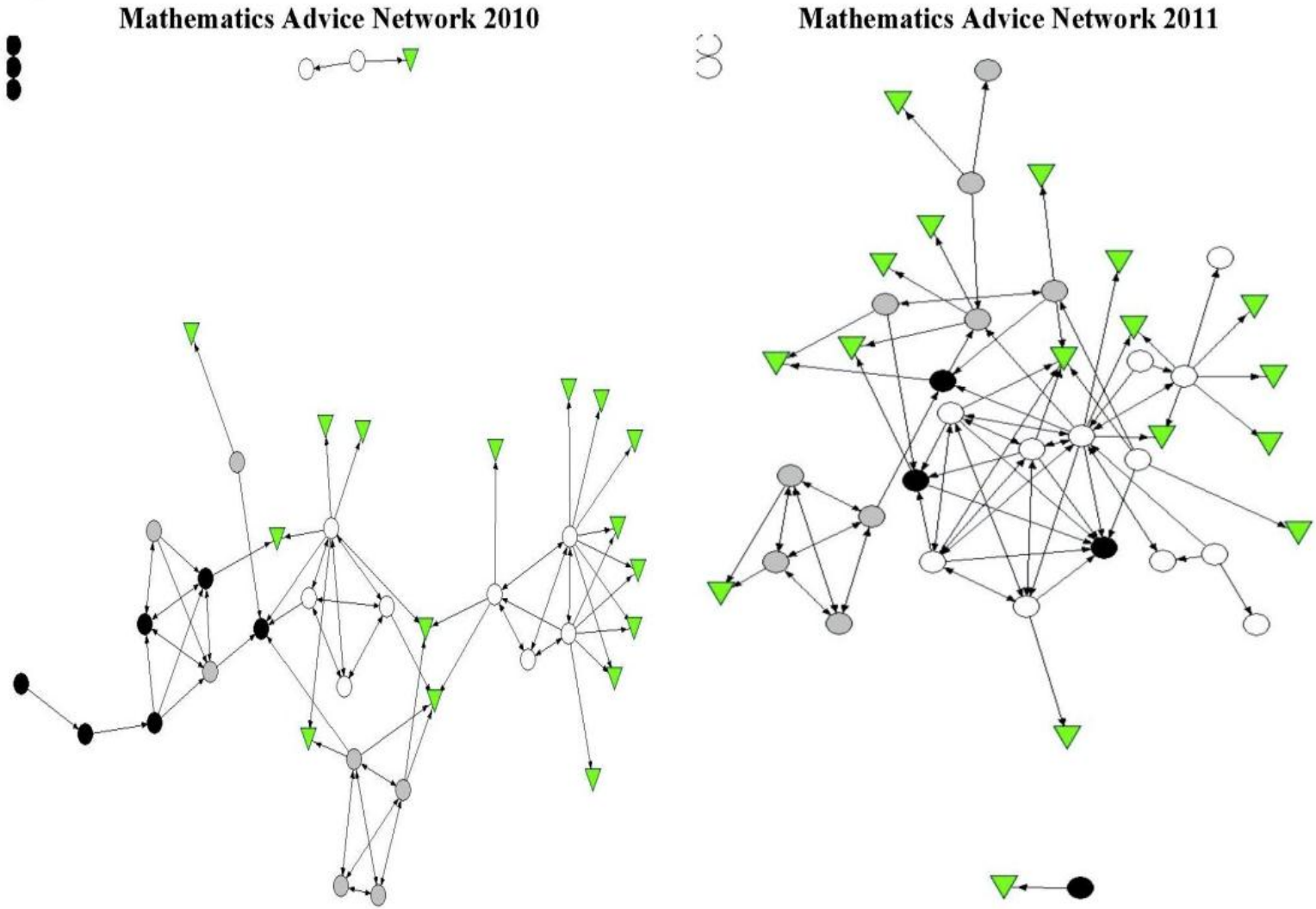

Teacher Network Sociograms

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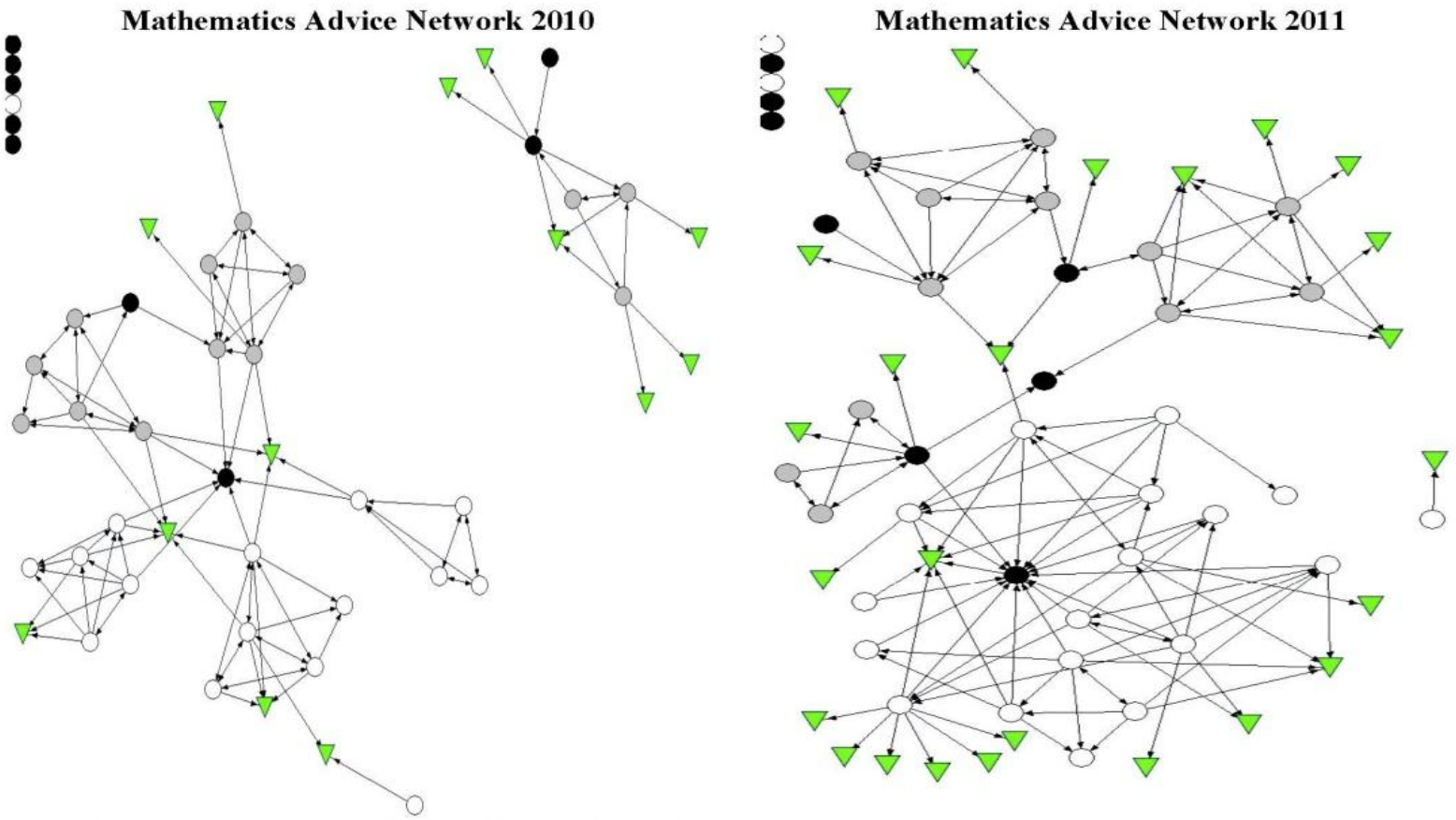

Note: White circles represent lower (K-2) grade level teachers.
Gray circles represent higher (3-5) grade level teachers.
Black circles represent administrators and special teachers.
Green triangles represent teachers who 1) did not respond to survey and 2) were in other schools.

Mathematical Knowledge for Teaching

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- MKT (formerly Learning Mathematics for Teaching instrument) widely used nationwide
- Measures K-6 teachers' knowledge of mathematics as it relates to teaching elementary math
  - Concepts
  - Representations
  - Understanding Student Thinking/Errors
  - Choosing Examples
- Scores are reported as z-scores, based on a large national sample of K-6 teachers

Hill, H.C., Schilling, S.G., & Ball, D.L. (2004) Developing measures of teachers' mathematics knowledge for teaching. *Elementary School Journal, 105*, 11-30.

MKT Example Item

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3. Imagine that you are working with your class on multiplying large numbers. Among your students' papers, you notice that some have displayed their work in the following ways:

Student A	Student B	Student C
35 x 25 125 +75 875	35 x25 175 +700 875	35 x 25 25 150 100 +600 875

Which of these students would you judge to be using a method that could be used to multiply any two whole numbers?

MKT Example Item

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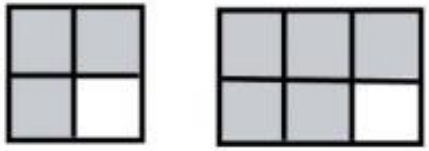
16. Takeem's teacher asks him to make a drawing to compare $\frac{3}{4}$ and $\frac{5}{6}$. He draws the following:



and claims that $\frac{3}{4}$ and $\frac{5}{6}$ are the same amount. What is the <u>most likely</u> explanation for Takeem's answer? (Mark ONE answer.)

a) Takeem is noticing that each figure leaves one square unshaded.

b) Takeem has not yet learned the procedure for finding common denominators.

c) Takeem is adding 2 to both the numerator and denominator of $\frac{3}{4}$, and he sees that that equals $\frac{5}{6}$.

d) All of the above are equally likely.

MKT Example Item

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21. Mr. Foster's class is learning to compare and order fractions. While his students know how to compare fractions using common denominators, Mr. Foster also wants them to develop a variety of other intuitive methods.

Which of the following lists of fractions would be best for helping students learn to develop several different strategies for comparing fractions? (Circle ONE answer.)

a) $\frac{1}{4}$ $\frac{1}{20}$ $\frac{1}{19}$ $\frac{1}{2}$ $\frac{1}{10}$

b) $\frac{4}{13}$ $\frac{3}{11}$ $\frac{6}{20}$ $\frac{1}{3}$ $\frac{2}{5}$

c) $\frac{5}{6}$ $\frac{3}{8}$ $\frac{2}{3}$ $\frac{3}{7}$ $\frac{1}{12}$

d) Any of these would work equally well for this purpose.

MKT Results

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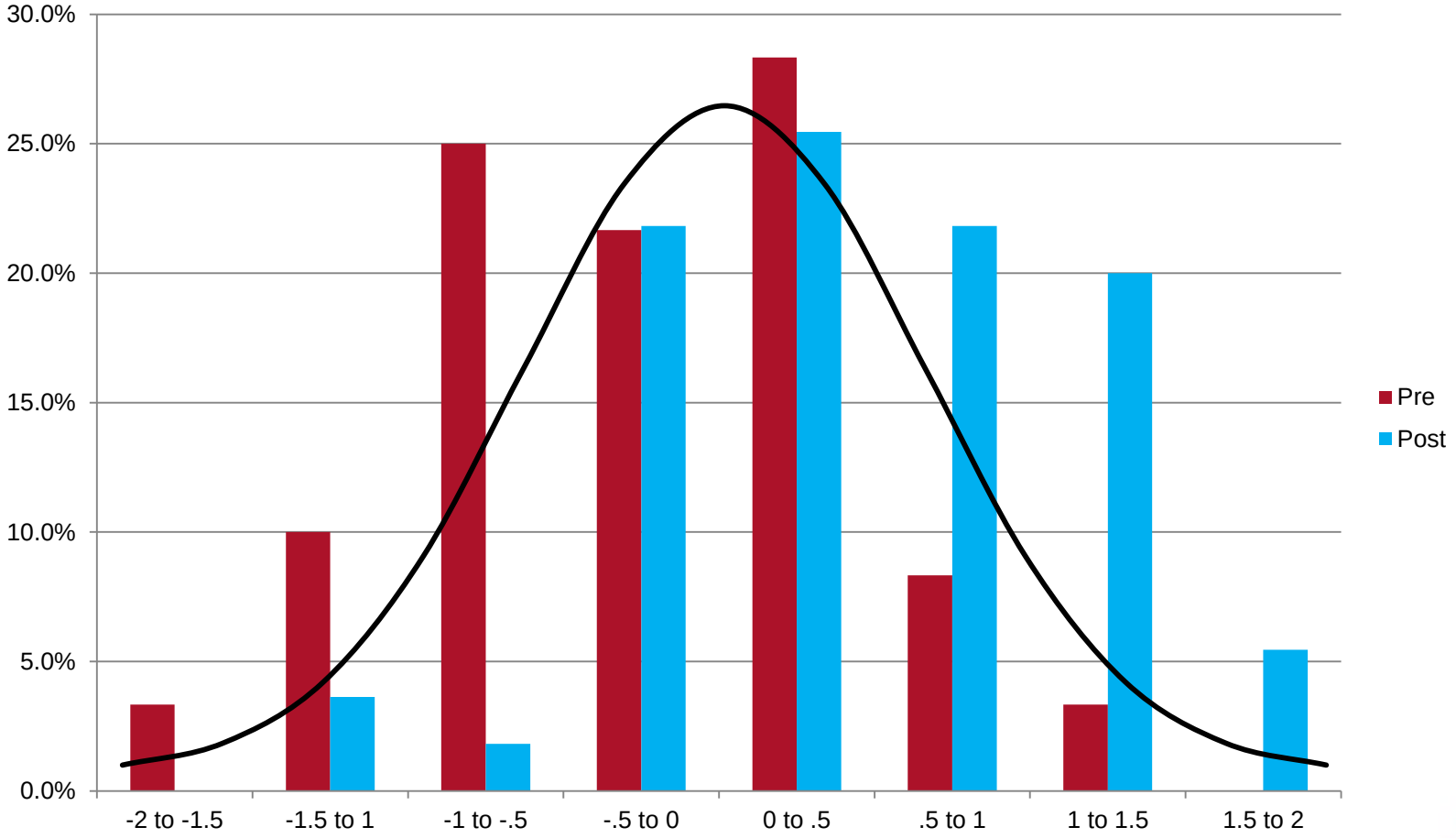
Combining Cohorts 1 & 2 pre- and post/follow-up MKT



Teacher Attitudes

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- We adapted the Fennema-Sherman Mathematical Attitude Inventory (1976) to use with elementary teachers
- Based on goals of Primarily Math, we chose 3 of the 9 subscales: confidence, anxiety and effectance motivation
- 5 point Likert scale response choices
- Latent trait analysis indicated we should break effectance motivation into two factors: persistence and motivation
- Initial analyses confirm our adapted version of the attitude inventory is valid for our population

Attitude Changes

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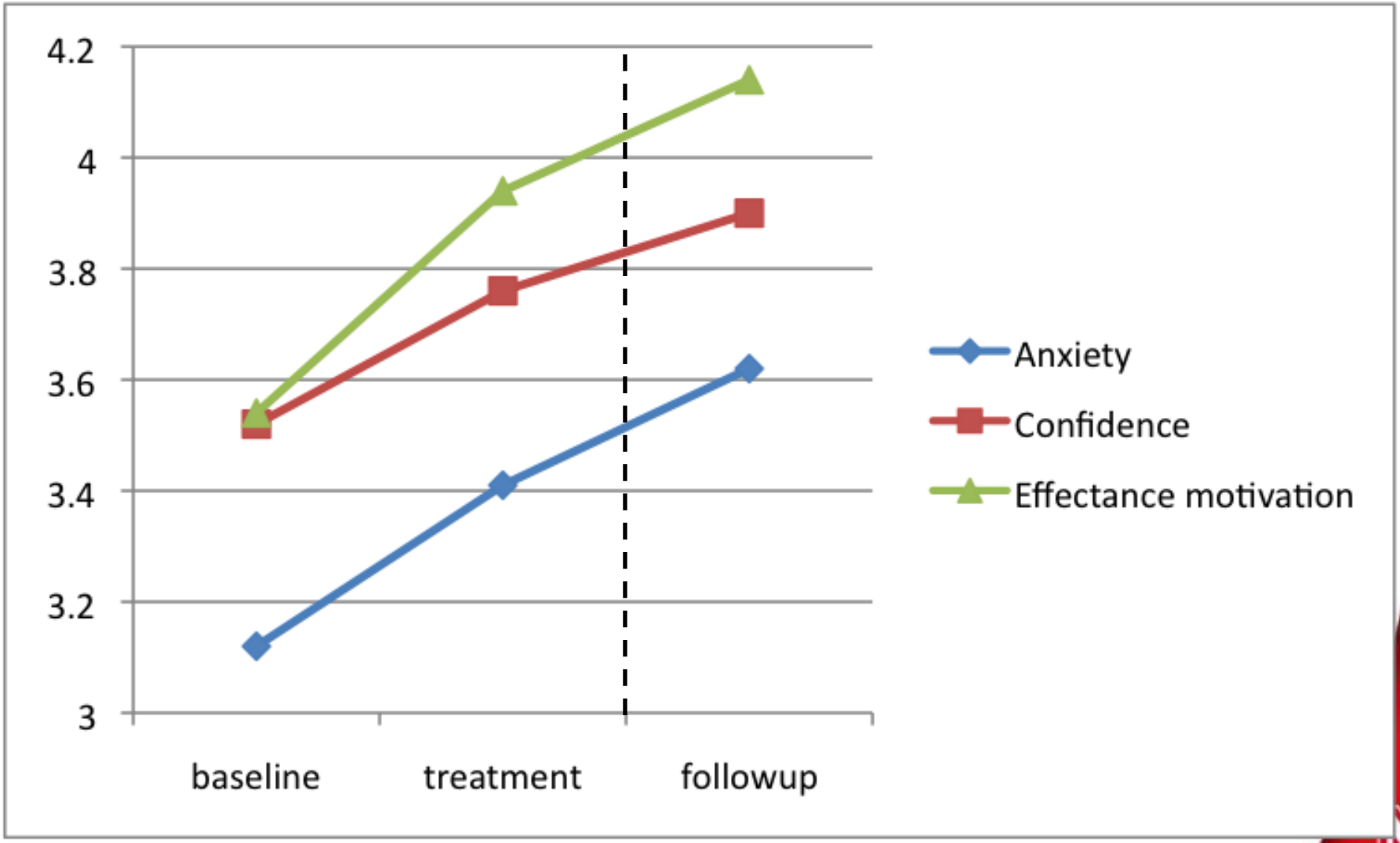

Child Outcomes:
Math Ability & Competence Beliefs, data collected by Traci Kutaka & grad student team

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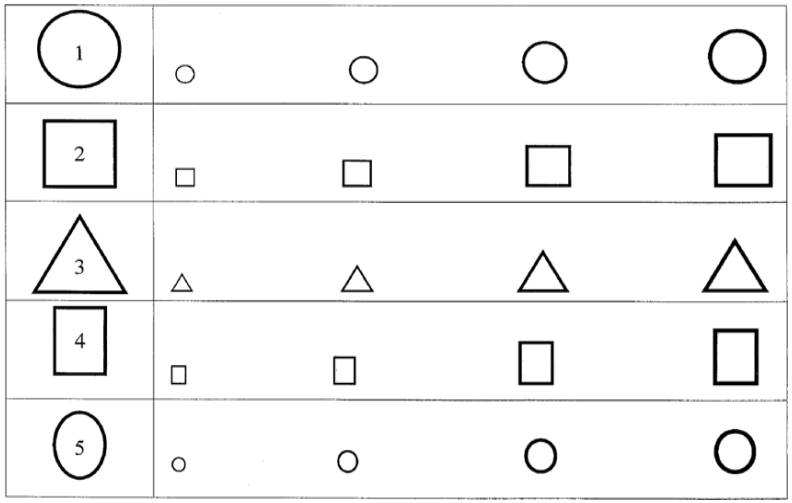
Child Competence Belief Pictorial Survey

Low-Mastery Beliefs ⟷ High-Mastery Beliefs

1 4



Additional Interview Items:

a. **What is math?**

b. How do you become good at math?

Original Items:

1. **How good in math are you?**

2. How good in math are you compared to your classmates?

3. How well do you do in math compared to all your other school subjects?

4. How well do you expect to do in math this year?

5. How good would you be at learning something new in math?

Survey items adapted from Wigfield, Eccles, Yoon, Harold, Arbreton, Freedman-Doan & Blumenfeld (1997).

Method: Semi-Structured Interviews

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Sample

Pilot Study N = 30

Current Study N = 115

- Kindergarten = 30
- First Grade = 40
- Second Grade = 35
- Third Grade = 10

Classroom observation followed by semi-structured interview

Stratified sampling

Coding:

Semi-Structured Interviews

Beliefs as a cognitive and social construct (Items 1 and 2)

Overarching Themes

1. Perceived competence
2. Performance feedback
3. Comparative judgments
4. Strategies for improvement
5. Motivation
6. Behavior & Classroom Norms
7. Future learning

Inter-rater reliability = 90%

Findings: "What is math?"

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Kindergarten (n = 30) & First Grade (n = 40)

"I'm good [at math] because I don't have to go to the safe seat like Tom." (K)

"Math is something you do with a grownup!" (K)

"We don't have a math class…we learn addition and subtraction in our math books. We do new pages to learn about it." (K)

"Math is learning how to use numbers in different ways." (1st)

"We find out stuff about minus and plus…and how those facts help you find other facts." (1st)

"I see my brother practice math!" (1st)

Second (n = 35) & Third Grade (n = 10)

"Like, my mom and dad, when they find something they thought was a lower price but it's a higher price there, they do their math and see how much it would cost if they got two." (2nd)

"Sometimes I ride my bike to the gas station and I have to look at my money and subtract it from the thing I want." (3rd)

"Something you can use for all kinds of things in life. Like if you're an engineer, you have to use geometry." (3rd)

Findings: "How do you know you're good at math?"

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Past Performance

"Everything I do I get it right the first time." (K)

"I almost never get anything wrong. I almost always get a star." (1st)

"Because I go to a challenging math class." (1st)

"Because I only got one problem wrong." (2nd)

"I think I'm okay because I passed the multiplication test." (3rd)

"I get my stuff done really quick." (3rd)

Mathematical Explanation

"Because I know 1-1 = 0, 10-1 = 9, I know 8-1 = 7." (K)

"I know subtract and take-away." (1st)

"I think I can, um, add a lot of numbers together that are bigger." (2nd)

Description of Response Patterns for Item 1: "How good in math are you?"

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		Response Option			
Grade Level	n	1	2	3	**4**
Kindergarten (F)	506	26(5.2%)	30(5.9%)	80(15.8%)	**370(73.1%)**
Kindergarten (S)	489	15(3.1%)	26(5.3%)	106(21.7%)	**342(69.9%)**
1st Grade (F)	357	11(3.1%)	20(5.6%)	77(21.6%)	**249(69.7%)**
1st Grade (S)	305	8(2.6%)	22(7.2%)	77(25.2%)	**198(64.9%)**
2nd Grade (F)	453	14(3.1%)	22(4.9%)	143(31.6%)	**274(60.5%)**
2nd Grade (S)	413	10(2.4%)	28(6.9%)	144(35.1%)	**231(56.3%)**
3rd Grade (F)	256	6(2.3%)	24(9.3%)	108(42.2%)	**118(46.1%)**
3rd Grade (S)	242	6(2.5%)	20(8.3%)	106(43.8%)	**110(45.5%)**

*F indicates Fall scores and S indicates Spring scores

TEMA-3

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- Test of Early Mathematics Ability, 3rd Edition (Ginsburg & Baroody, 2003)
- Individually administered to children in K-3
- We randomly selected 15 students per class among those with signed parental consent forms
- Test yields Math Ability Score, which is expected to remain stable (MAS score is based on both raw score and age at testing)
- Preliminary analyses show we are seeing gains in classes of students with Primarily Math participants as teachers

Family Participation

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"It is essential that parents and community members be involved in mathematics education so that they understand, support, and contribute to the teaching of school mathematics … . All parents who have an interest in our students' mathematical development [should] have a role in which they can meaningfully participate."

--Dominic Peressini, in "What's All the Fuss About Involving Parents in Mathematics Education?" (2002)

Family Projects: Studied in collaboration with Heidi Fleharty

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Many teachers did school-based projects:
Family Math nights
Math and Muffin mornings
Child-Parent teacher conferences
Kindergarten orientation

Family Projects

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But most initiated home-based projects:
Games/activities sent home to all parents at once
Math bags or backpacks
Parent-child homework assignments.

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Discussion

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