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Creating Interdisciplinary Collaborations to Support and Understand Mathematics Teaching and Learning

Ruth Heaton

University of Nebraska-Lincoln, rheaton1@unl.edu

Wendy M. Smith

University of Nebraska-Lincoln, wsmith5@unl.edu

Traci Kutaka

University of Nebraska-Lincoln, s-tkutaka1@unl.edu

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Abstract for DBER Group Discussion on 2013-09-19

Presenter(s), Department(s):

Ruth Heaton

Professor

Department of Teaching, Learning, and Teacher Education

Wendy Smith

Research Assistant Professor

Center for Science, Math, and Computer Education

Traci Kutaka

Postdoctoral Research Associate

Center for Science, Math, and Computer Education

Title:

Creating Interdisciplinary Collaborations to Support and Understand Mathematics Teaching and Learning

Abstract:

Teaching mathematics is a complex endeavor and requires a deep understanding of content and pedagogy. Helping teachers learn what they need to know requires the expertise of disciplinary area faculty as well as those with pedagogical expertise. Similarly, understanding the learning of teachers or their students requires complex analyses of messy data by teams of researchers representing differing but complementary perspectives. Cases describing the nature and process of interdisciplinary teaching and research collaborations in mathematics education will be presented and analyzed for lessons learned.



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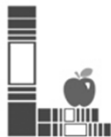
Creating Interdisciplinary Collaborations to Support and Understand Mathematics Teaching and Learning

Ruth M. Heaton

Department of Teaching, Learning and Teacher Education

Wendy Smith & Traci Kutaka

Center for Science, Mathematics, and Computer Education



Interdisciplinary Collaborations

- Math Matters 2000-2003
- Math in the Middle Institute Partnership, 2004-2011
- NebraskaMATH, 2009-2014
 - Primarily Math
 - Nebraska Algebra
 - New Teacher Network
- Nebraska Math and Science Summer Institutes, 2007- present
- NebraskaNOYCE, 2010-2016
- Data Connections, 2011-2014



Future Interdisciplinary Work

- K-12 administrators (principals' learning)
- Preschool teachers and administrators
- Faculty within my own department
- Community organizations
- Arts and Science Department Chairs



Roper-UNL Partnership in Elementary Teacher Education (1996-current)

- Built partnership on existing relationships
- Invested lots of time early
- Observed and listened
- Mentored teachers into my role
- Turned over responsibilities
- Continuous investment in maintaining trust, communication, & support



Math Matters (2000-2003)

- Identified a partner (MSU colleague knew Jim Lewis)
- Invested lots of time early
- Physically present during planning, teaching, and reflection
- Developed understanding of similarities and differences in language and ideas regarding math teaching and learning
- Brokered Jim Lewis' relationship with Roper teachers
- Communication, trust, & support
- Translating collaboration to others—successes and challenges
 - Description of what we did was not enough
 - Clear articulation of principles & reasoning guiding collaborative work (day to day work may vary)



Math in the Middle (2004-2011)

- Faculty: mathematicians, teacher educators, statisticians
- K-12 teachers
- ESUs
- UCARE students and graduate students
- External evaluators
- Master teachers
- Northwestern University researcher
- Professional development & research



Math in the Middle Research

- Differences between research and evaluation
- “Messy” data gathered on teachers and students
- 3 qualitative dissertations (UNL)
- 1 quantitative dissertation (UNL)
- 1 quantitative dissertation (Northwestern)

11 articles and book chapters by 14 different authors



Lessons Learned

- Masters program across two departments—worked within existing structures in new ways
- There is rigor to both pedagogical content and mathematical content
- Willingness to share data
- Many research questions can be asked of the same data
- New methodologies are needed to deal with messy data
- Multiple perspectives lead to richer data analysis
- Scaling up is sometimes scaling down
- Underestimated size of research agenda
- Expectations of quality research vary by discipline
- Some imperfect data by someone's standards is better than no data
- Research is not evaluation, especially important for partnership with school teachers and administrators



NebraskaMATH (2009-2014)

- Faculty: mathematics, teacher education, statistics, early childhood education, psychology, educational psychology, learning and organizational change
- K-12 teachers
- External evaluators
- Graduate students
- Post doctoral fellows
- Master teachers
- Professional development & research & evaluation



Professional Development Lessons Learned

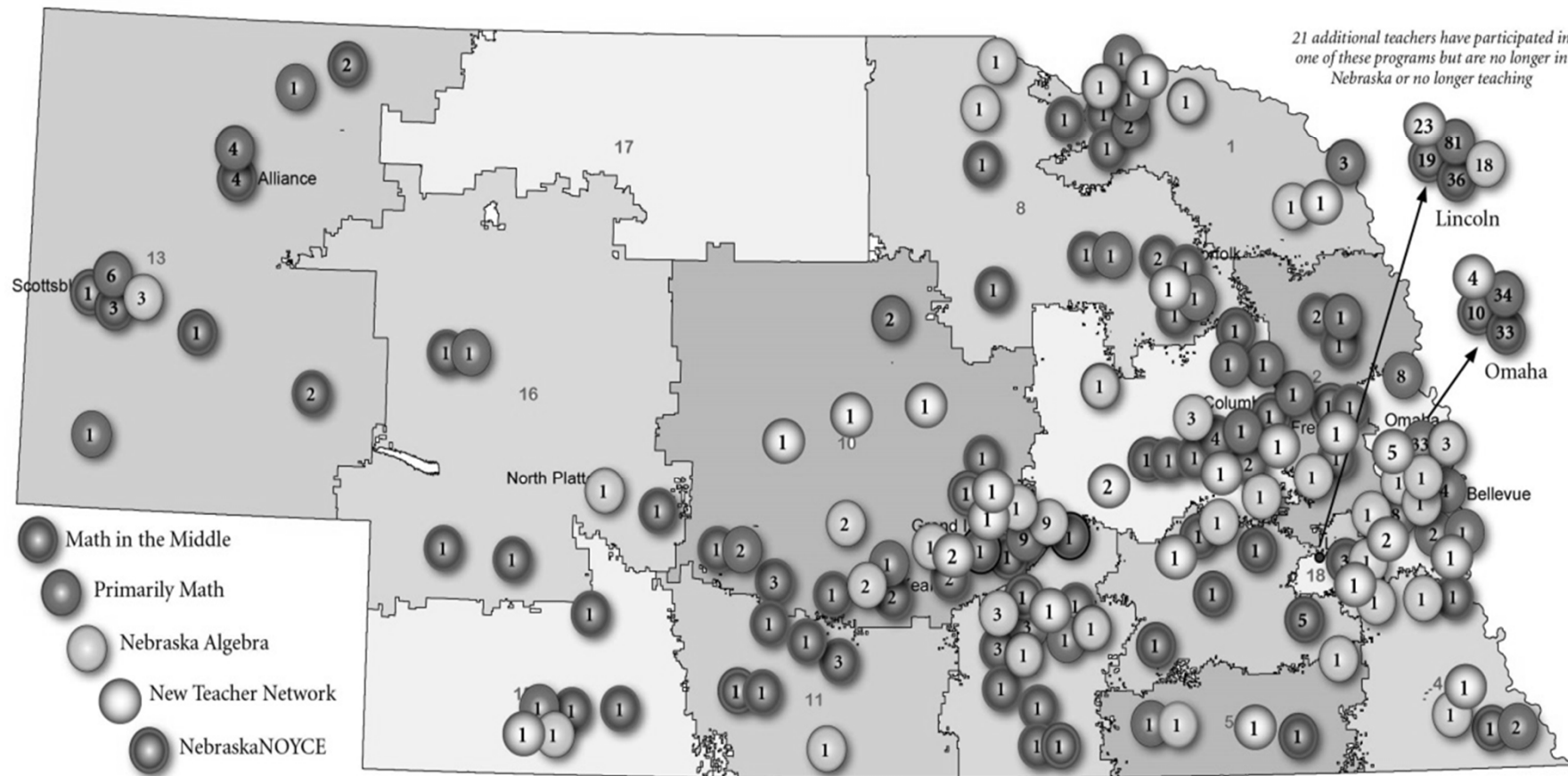
- Not always in agreement on what teachers need to know (disciplinary perspective, pedagogical perspective, K-12 perspective)
- When to persevere and when to back off
 - Family partnership projects
 - Cognition, motivation, and algebra
- Master teachers help negotiate university expectations with K-12 realities
- Relationships are challenging to maintain
- Essential that relationship with J. Lewis already in place



With Whom We Work

Math in the Middle, NebraskaMATH and NebraskaNOYCE Teachers by Nebraska Educational Service Units

2010-2011 Teaching Positions for Math in the Middle, 2012-2013 for NebraskaMATH and Noyce



Research Lessons Learned

- Underestimated size of research agenda
- Willingness to share data
(example: 2012, 5 articles published, 15 different authors, 14 presentations by 16 different presenters)
- Many research questions can be asked of the same data
- New methodologies are needed to deal with messy data
- Multiple perspectives lead to richer data analysis
- Expectations of quality research vary by discipline
- Some imperfect data by someone's standards is better than no data—or is it?
- Time to collaborate is an continual issue
- Differing perspectives, needs, and self interests

Interdisciplinary Partnerships

- Weekly seminar each semester since Fall 2010
- Grad students & postdocs supported by CSMCE grants (NebraskaMATH, Data Connections, NebraskaNOYCE); other interested grad students
 - Mathematics; Teaching, Learning and Teacher Education (math ed); Psychology (child development); Statistics; Educational Psychology (Cognition & Instruction; Psychometricians); Child, Youth and Family Studies (early childhood)
 - Some have teaching backgrounds age 0-5 or grades K-6, 4-8, 7-12 or undergrad; others have no teaching experiences

Interdisciplinary Seminar

- Focus on mathematics education research and better appreciating the issues surrounding mathematics teaching, learning and research
 - Often discussion focuses on discussing an article selected by me or a participant
 - Take turns leading the discussion
 - Participants share ongoing research work (classes, dissertation) & dilemmas
 - Topics informed by current events (standards, testing, teacher evaluation, etc.)
 - Other topics as requested (writing philosophy of research/teaching statements)
- Provides a perspective of “the big picture” sometimes absent from graduate research assistant work



What We've Learned

- Each disciplinary background involves specific language and ways of thinking that are different from each other.
 - Some of the biggest differences were between Psych and Ed Psych, which initially surprised us
 - It takes time and intention to learn to “speak each others’ languages” —sometimes we would have arguments that turned out to be semantic and not substantive
 - Those with more diverse background experiences had the easier times in learning to speak other languages (e.g., teacher before becoming a grad student; pursued masters in one dept and PhD in another)



What We've Learned

- Important to develop a level of rapport and respect for each other and their disciplines/experiences
 - Personal respect helped bridge instances when disciplines have varying value systems (e.g., what counts as high-quality research methodology, what counts as evidence, what questions are worth studying)
- Considering others' perspectives adds richness to our own perspectives on mathematics teaching, learning and research.
 - Some grad students took courses in other depts to deepen their own understanding
 - Some grad students worked on research projects that went far beyond the scope of their home discipline



What We've Learned

- Seminars served to nurture a community of reflective practitioners—reinforce the message that there is always more to learn and understand
- Interdisciplinary community among grad students helps provide a stance toward interdisciplinary work and understanding of the issues likely to be encountered as early faculty after they graduate
- Building a community among grad students and postdocs seems to then extend to their faculty mentors/committee
- Reinforces “the sum is greater than the parts” —we have richer discussions & experiences when we collaborate





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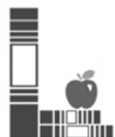
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Young Children's Beliefs about the Self as
a Learner and Producer of Mathematics:
A Mixed Methods Study

Traci Shizu Kutaka

University of Nebraska – Lincoln

April 11, 2013 Burnett #233



Sequential Explanatory Mixed Method Design

1. **To what extent do K-3 students have stable math self-competence beliefs from fall to spring?**
 - Descriptive frequency analysis via SAS
 - Cumulative probit model for repeated measures via Mplus
2. **What is the underlying factor structure of these beliefs (as measured by the Child Beliefs Pictorial Survey adapted from Wigfield et al., 1997) and to what extent is the same construct seen across grade levels?**
 - Item Factor Analysis (IFA) for ordinal outcomes via Mplus
3. **What meaning do students ascribe to the symbols on the belief survey and how do these meaning systems change over the K-3 years (if at all)?**
 - Stratified sampling
 - Grounded theory analysis techniques
 - Cross-thematic matrix by grade level via MAXQDA 10

Dissertation Committee

Member	Department	Background/ Expertise	Role
Carolyn Pope Edwards	CYAF/Psychology	Early childhood education	Primary advisor
Lesa Hoffman	Psychology	Statistics; psychometrics	Quantitative rigor
Brian Wilcox	Psychology/Child, Family, & Law	Program evaluation; policy; mixed methods	Methodological coherence
Ruth Heaton	TLTE	Qualitative methods	Qualitative authenticity
Wendy Smith	Math Education	Qualitative methods; Mixed methods	Methodological coherence



Lessons Learned about the Process of Interviewing Young Children: What to Expect, How to Prepare, and What to Accept

1. Question quality
2. Comprehension of questions
3. (Mis)Interpretation of questions
4. Motivation for participating in interview
5. “I don’t know”
6. “I don’t care”
7. [silence]
8. The distracted child
9. The shy child
10. The flow of conversation



	The Role of the Interviewer:	What Can Be Prepared:	What Cannot Be Prepared:
(Mis)Interpretation of Questions (Demands of Question)	Consider the demands, or mental actions required by the question (e.g., item 5 requires evaluation of a future, imagined self) and what the actions might produce at different levels of development.	Pilot your questions and show them to people with different kinds of expertise. If a child doesn't answer in way that makes you confident he/she understands, use another probe. Anticipate misunderstanding and prepare accordingly.	You will see a lot of within-grade variability in the extent to which a child is capable of or motivated to engage in the mental actions necessary to answer demands of questions
Reception of Question (Motivation)	Authentic sharing and listening can only occur at a certain threshold of affect and motivation; this threshold cannot be anticipated, but intuited during interaction.	In the beginning of the interview, express your serious interest in their point of view and personal experiences. You can also model this attitude by asking questions about them as a person not related to the topic you will be discussing ("What is something you like to do with your family after school?").	Some questions may make individuals uneasy; other might be baffled. As the interviewer you are the architect of the emotional context in which you interact. Sitting next to the child creates a different atmosphere from the interviewer who sits across the table.
"I don't know"	"I don't know" carries more than one meaning. Sometimes it means "I don't understand that question you are asking" or "I don't know right now unless you provide me with a follow-up question" or sometimes it means "I don't care." But this is also a phrase that carries a lot of information. It might reveal something about the comprehensibility of a question for a child or for a grade level;	Observe the natural physical response children have to the question. Did they scrunch their nose or squint their eyes, wiggle in their seat, when they heard a word? Invite the child to comment upon the question itself -- Does it sound funny? Is it confusing? Is the question too long and have too many words? This is helpful reconnaissance for potential item revision.	It's hard to know when to push forward with follow-up questions or when to abandon the item in the interest of maintaining momentum in the conversation. You can always invite the child to answer a different question and come back to it later.

Lessons Learned about Interdisciplinary Work

- Listening as a skill, value, & ethical stance
- Work on relationships outside of work (for the sake of the work)
- Go “island hopping”
- Read outside of your discipline
- Perceptions of others



Questions

- What questions do you have for us about our interdisciplinary work?
- What point are you at in building interdisciplinary partnerships?
- What are you learning?



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Nebraska MATH

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