

Connecting Children's Mathematical Thinking and Funds of Knowledge in Elementary Methods Courses

Corey Drake

Erin Turner

Alejandro Andreotti

Rodrigo J. Gutiérrez

Tonia Land



Acknowledgements

- Julia Aguirre, Tonya Gau Bartell, Mary Foote, Elham Kazemi, Amy Roth McDuffie, Laura Spielman, Maura Varley
- National Science Foundation (DRL #0736964)



Overview

- Conference and participants
- Goals and theoretical framework
- Two examples of “extended learning activities”
- Preliminary Results
- Discussion



Conference

- May, 2008, in Tucson, Arizona
- 38 participants from 19 institutions
- Conceptual framework and readings, instructional module development, beginnings of research plan



Key Question

- How can we connect children's mathematical thinking and children's community- and family-based mathematical funds of knowledge in elementary methods courses?



Goals of Conference (1)

To work towards the *development of a conceptual framework* for understanding the roles and relationships between children's mathematical thinking and children's cultural, linguistic, community, and family-based mathematical funds of knowledge in elementary mathematics methods courses



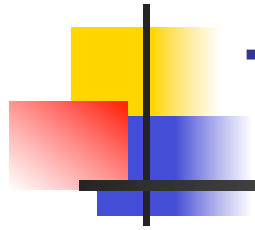
Goals of Conference (2)

To *share current activities* for introducing ideas about children's mathematical thinking and children's family, community, cultural, and linguistic funds of knowledge in elementary mathematics methods courses

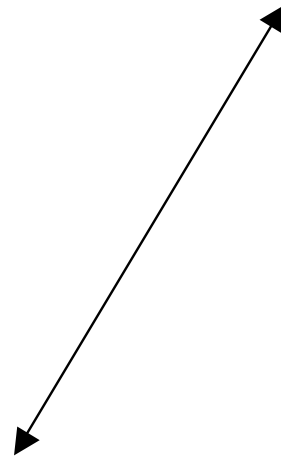


Goals of Conference (3)

- To *develop or adapt “extended learning activities”* (i.e., a set of readings, activities, materials, tasks, and discussion topics) for elementary mathematics methods courses



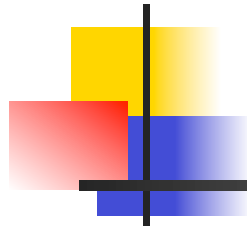
Theoretical Framework





Defining Pre-Service Teacher Learning As:

- Engaging with the mathematical practices and identities of children and families as children move across contexts and spaces
- Reflecting and acting on their own practices and identities as they move across contexts and spaces



Sample Activities



Activity Strands

- Analysis of Critical Cases
 - *Video cases of mathematics teaching/learning*
 - Multi-level case studies of individual students
- Mathematizing
 - *Community Walks and Investigations*
 - Children's Stories and Everyday Activity



Video Cases

- Pre-service teachers view video cases through one of three lenses (focus on the task, on the teacher, on student participation and understanding).
- Analysis focuses on instructional strategies that facilitate mathematical thinking/reasoning and support students with varied cultural and linguistic backgrounds, mathematical experiences and competencies.



Cases Reflect Range of Teaching/Learning Settings

- Sources include:
 - CGI (Cognitively Guided Instruction) books and professional development videotapes
 - Children's Mathematics
 - Thinking Mathematically
 - Annenberg Media's "Teaching Math K-4 Video Library" (available on-line)
 - Text-based Cases (i.e., chapters from Rethinking Mathematics text)



Sample Case: Almeta Hawkins

- 2nd grade, diverse urban elementary classroom
- Whole class lesson on addition and subtraction problem solving
 - Part-Part Whole, Part Unknown Problem
 - **“There are 47 trees in Logan Grove. 31 of them are oak trees. The rest are hickory. How many are hickory?”**



Sample Case: Almeta Hawkins

Related reading/resources:

- Carpenter, T., Fennema, E., Franke, M., Levi, L., & Empson, S. (1999). *Children's Mathematics: Cognitively Guided Instruction*. Portsmouth, NH: Heinemann.
- Garrison, L., Ponce, G., and Amaral O. (2007, August). Ninety percent of the game is half mental. *Teaching Children Mathematics*.



Activity Overview

- Review general discussion guidelines
- Divide into small groups; each assigned one lens
- View video clip
- Individual reflection / small group discussion around lens prompts
- Whole group debriefing (discussion, posters, etc.)



General Discussion Guide

Discussing the video:

- Ground conversation in what you see in the video, talk about the children and teacher in the video rather than children or teachers in general.
- Use examples from the video to ground your comments, questions, or claims.
- Stay focused on the group's questions.
- Assume that students are making sense and that there is knowledge and expertise in what they are saying.



Three-lens Approach

- Focus on Task
- Focus on Student Learning and Participation
- Focus on the Teacher



Community Mathematizing Activity

- Pre-service teachers explore local school and community contexts (parks, businesses, health centers, school playgrounds, etc.)
- Activity includes in-class and out-of-class components
 - Community “walks”
 - Interviews with community members
 - Focused visits to observe, collect data, take pictures



Community Mathematizing

Activity: Goals

- Recognize and begin to understand diverse mathematical practices in the school and local community.
- Pose and investigate (mathematically) questions about contexts/situations in the school or local community.
 - Explicit focus on issues of equity and/or social justice
- Expand ideas about the discipline and about themselves as mathematicians.
- Think about ways to connect community funds of knowledge and children's mathematical thinking.



Community Mathematizing Activity: Resources

For instructors:

- Buck, P. & Sylvester, P.S. (2005) In N. Gonzalez, L. C. Moll & C. Amanti (Eds.), *Funds of knowledge: Theorizing practices in households, communities, and classrooms* (pp. 213-232). Mahway, NJ: Lawrence Erlbaum.

For Pre-service teachers:

- Civil, M., & Kahn, L. (2001). Mathematics instruction developed from a garden theme *Teaching Children Mathematics*, 7(7), 400-405.



Overview of Activity: Option I

Option I: Community Walk

- Phase I: Pre-Activity

- Pre-service teachers reflect on their knowledge/experiences with the community, and discuss articles related to drawing on community-based funds of knowledge in mathematics instruction.



Overview of Activity: Option I

- Phase II: Conduct community walk
 - Pre-service teachers conduct “community walk” in small groups, preferably with elementary students from their internship classroom. (Alternative is to ride bus home with students)
 - Opportunity for elementary students to share knowledge of community, particular focus on contexts/practices that student sees as mathematical.



Overview of Activity: Option I

- Phase III: Develop Lessons/Activity
 - Pre-service teachers develop lesson(s) incorporating knowledge shared by elementary school students, and/or resources that were discussed or observed on the walk.
- Phase IV: Directed Reflection



Overview of Activity: Option II

Option II: Community Investigations

■ Phase I: Brainstorming

- Pre-service teachers brainstorm school or community contexts that could be investigated mathematically AND/OR that evidence mathematical activity.

■ Phase II: Initial Visits

- LOOK for evidence of mathematics (i.e., mathematical practices, relationships, ideas etc..) Often involves talking with people, taking pictures, and making notes.
- FORMULATE questions about the context. Involves generating questions that could be answered using mathematics and questions where the results might be useful or important to someone.



Overview of Activity: Option II

- Phase III: Follow-up Visits
 - Pre-service teachers collect data to help answer questions. Data collection may involve talking to people at the site (interviewing employees, etc., making observations, or collecting information).
 - Discuss and organize data. Decide how to represent the data (graph, table, chart, diagram, etc) to communicate findings to others.



Overview of Activity: Option II

- Phase IV: Group Sharing / Debriefing
 - Pre-service teachers share questions they investigated, including a) why they chose the questions, and b) what data they generated.
 - Share Findings. Discuss what each representation shows and what additional questions it raises.
 - Discuss how to adapt the activity for elementary students, including how to draw on what they have learned about children's mathematical thinking, and how to relate the activity to issues of equity and/or social justice in the school or community.

Community Health Center



- Mathematics used to read and fill prescriptions, measure quantities, calculate payments
- Question: How does the cost of prescription drugs differ for insured versus uninsured patients?

Construction Site next to School



- Mathematics used in planning and constructing buildings, measurement (length, area, volume)
- Questions: How much water does the site use a day if one tank lasts one week? How much water is used throughout the 6 month project? What would we have to do and for how long to use this much water?

Local Raspado Shop

- Mathematics used in determining prices, measuring quantities, ordering supplies
- Questions: Which size raspado is the best deal? What are the prices based on? How does the owner know when to reorder a particular flavor?



Raspados	
Small 2.00 Med. 2.50 Lg. 3.50	
FRESA	LIMON-LIMA
TAMARINDO	LECHE
PIÑA	CEREZA
DURAZNO	SANDIA
VAINILLA	LIMON-CHILE-SAL
CIRUELA	MANGUYADA
MANGO	EL NIÑO
COCO CON LECHE	NUEZ
CHAMOY CON LIMON	GUAYABA
PIÑA COLADA	
PLATANO	CON NIEVE .50¢ EXTRA

Check Cashing Business

- Mathematics related to ratio, graphing, percents, multi-step calculation
 - How many Quick Cash Loans are there in our neighborhood?
 - How does this compare to the amount of banks present in this same area?
 - If you get a loan for \$320.00, what will it cost to repay?





Pre-service Teacher Reflection

- There was a lot more math within a few blocks of the school than I expected. It was also a good way to get to know the surrounding community. I liked the practice aspect of our investigations: using math to find out what the best deals are, what kind of bus pass to buy, how to win prizes at Peter Piper Pizza. ... An interesting thing that happened while we were coming up with problems was we kept asking more and more questions. We only stopped because we ran out of room on the paper. We kept wondering, how many tickets? How many tokens? How many topping combinations? It goes on and on. Once we got going, we kept wondering more and more.

~ white pre-service bilingual teacher



Pre-service teacher reflection

- An assignment that involves community tells the student that their community is important. It shows that we value where they come from and the community in which they live. It encourages students to become problem solvers within their community as well. Math is all about problem solving, and there is no community that doesn't have problems. All communities could use problem solvers and this is one activity that encourages students to take ownership and leadership.”

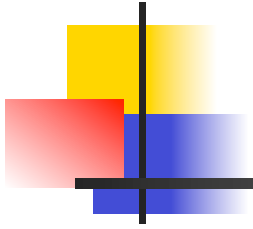
~ African-American pre-service teacher



Beginning of Semester Survey

Questions Related to Funds of Knowledge:

- Elementary teachers should support students understanding how mathematics can help them investigate their own lives.
 - 1% Disagree/Strongly Disagree
 - 99% Agree/Strongly Agree

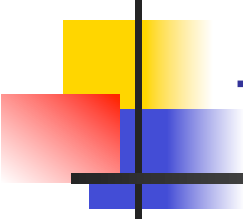


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- The teacher can better support students' development in math if s/he draws on their home/community resources.
 - 6% Disagree/Strongly Disagree
 - 94% Agree/Strongly Agree



In General

- Very strong consensus on questions related to family and community-based funds of knowledge
 - Even at the beginning of the semester
- Not true for questions related to children's mathematical thinking
 - Could be related to nature of questions (easy to identify desired responses) or PSTs' prior experiences, or PSTs' greater willingness to accept ideas about funds of knowledge or...
 - Still not sure how to put these ideas into practice



Pre/Post Results - Questions Related to Children's Mathematical Thinking

- Children need to have many informal experiences solving simple word problems before they are expected to memorize number facts.
 - Pre-Survey: 59% Agree/Strongly Agree
 - Post-Survey: 65% Agree/Strongly Agree
- It is the teacher's job to demonstrate how to solve math problems the right way.
 - Pre-Survey: 43% Disagree/Strongly Disagree
 - Post-Survey: 55% Disagree/Strongly Disagree



Cautions

- Results are preliminary; analyses are continuing
- Still Unanswered:
 - What is the *connection* (for pre-service teachers) between children's mathematical thinking and children's family and community-based mathematical funds of knowledge?



For More Information...

- <http://mathconnect.hs.iastate.edu>