UNIVERSITY of NORTHERN COLORADO

Bringing education to life.

Northern Colorado Math Teachers' Circle's Implementation of Common Core State Standards

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NORTHERN COLORADO MATH TEACHERS' CIRCLE

Northern Colorado MTC

- Leadership team formed by March 2011 (2 UNC faculty and 3 district teachers).
- Attended 2011 MTC workshop at AIM in Palo Alto, CA.
- Our sponsors: State Farm, BBVA Compass, MSRI, AIM.
- 2012-2013: Evening sessions, Summer Workshop
- 2013-2014: Evening sessions, 2nd Summer Workshop

1st Summer Workshop (2013)

Monday	Tuesday	Wednesday	Thursday
10:30-11:00 **Welcome participants; Pre-Survey**	8:30-10 **Taxicab Geometry**	8:30-10 **Mathematical Games**	8:30-10 **Number Theory**
11:00- 12:00 **Ice Breaker Problem**	10-10:30 Break 10:30- 12:00 **Taxicab Geometry**	10-10:30 Break 10:30- 12:00 **Mathematical Games**	10-10:30 Break 10:30- 12:00 **Number Theory**
12-1 Lunch	12-1 Lunch	12-1 Lunch	12-1 Lunch
1:00- 2:30 **Intro to Problem Solving**	1-3:00 **Transformational Geometry**	1-2:30 **Mathematical Magic**	1-2:30 **Fractions**
2:30-3:00 Break	3:00-3:30 Break	2:30-3:00 Break	2:30-4:00 **Closing: Overall Wrap-Up & Door prizes**
3:00- 5:00 **Intro to Problem Solving**	3:30- 5:00 **Conway's Rational Tangles**	3:00- 5:00 **Mathematical Magic**	
5:00-6:00 Free	5:00-6:00 Outdoor Dinner (BBQ)	5:00-6:00 Free (Hiking)	
6:00-7:00 Dinner	6:00-7:30 Hiking	6:00-7:00 Dinner	
7:00-8:30 **Games & Refreshments by the campfire**	7:30-9:30 **Games & Refreshments**	7:00-9:00 **Games & Refreshments**	

Invited Speaker, Paul Zeitz, came for Wednesday and Thursday

1st Summer Workshop Sample Problems

- Fraction Problems:

  Find 4 different decimal digits a, b, c, d so that

  $$\frac{a}{b} + \frac{c}{d} < 1$$

  and is as close to 1 as possible. Prove that your answer is the largest such number less than 1.

From Tatiana Shubin's *Fractions, Decimals, Ratios, Rates, Percents, Proportions* Worksheet from mathteacherscircle.org

1st Summer Workshop Sample Problems

- Fraction Problems:

  At sunrise two old women started to walk towards each other. One started from point A and went towards point B while the other started at B and went towards A. They met at noon but did not stop; each one continued to walk maintaining her speed and direction. The first woman came to the point B at 4:00 pm, and the other one came to point A at 9:00 pm. At what time did the sunrise that day?

From Tatiana Shubin's *Fractions, Decimals, Ratios, Rates, Percents, Proportions* Worksheet from mathteacherscircle.org

1st Summer Workshop Sample Problems

- Transformational Geometry Problems:

  Two cities *A* and *B* are on one side of a highway. A company has to build a gas station *G* on the highway and a road from *A* to *B* through *G* that goes straight from *A* to *G* and from *G* to *B*. Design such a road of shortest length. (What if we have three cities instead of two?)

Geometric Transformations I (1962) by I.M. Yaglom (translated from Russian by Allen Shields) –Suggested by Paul Zeitz.

1st Summer Workshop Sample Problems

- Taxicab Geometry Problems:

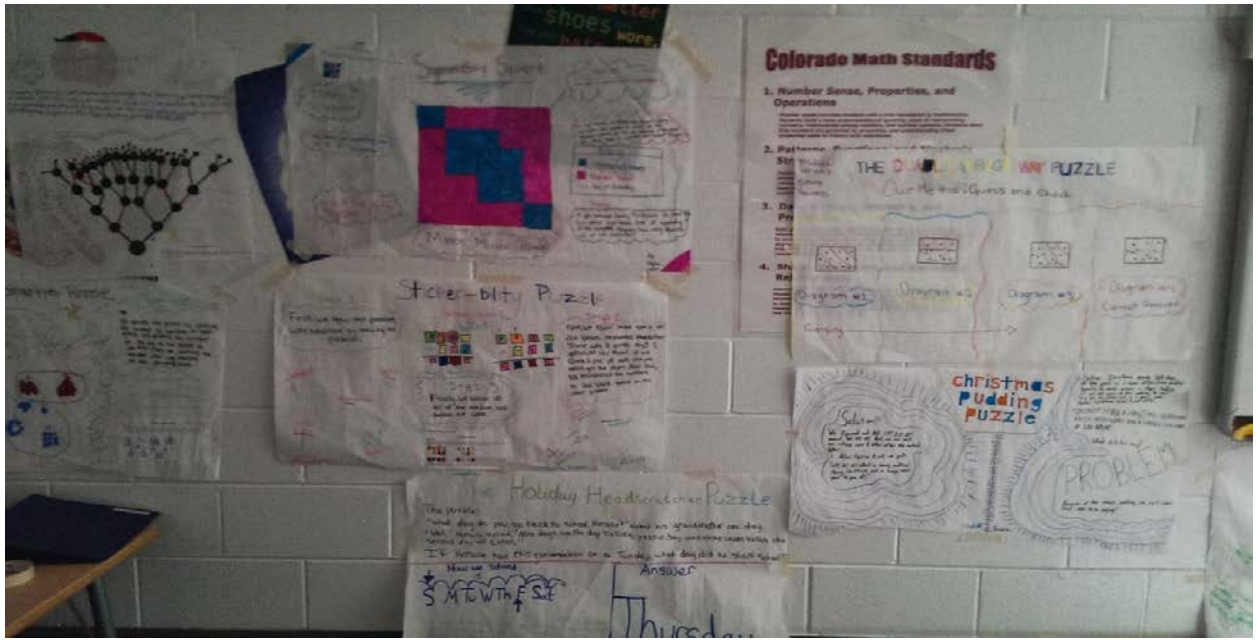
  What do taxicab circles look like? What is the taxicab value of π?

  Which of the triangle congruences (SSS, ASA, AAS, and SAS) are not true in taxicab geometry? For each one that fails, give a counterexample to show it is not true.

From *Taxicab Geometry* by Eugene F. Krause.

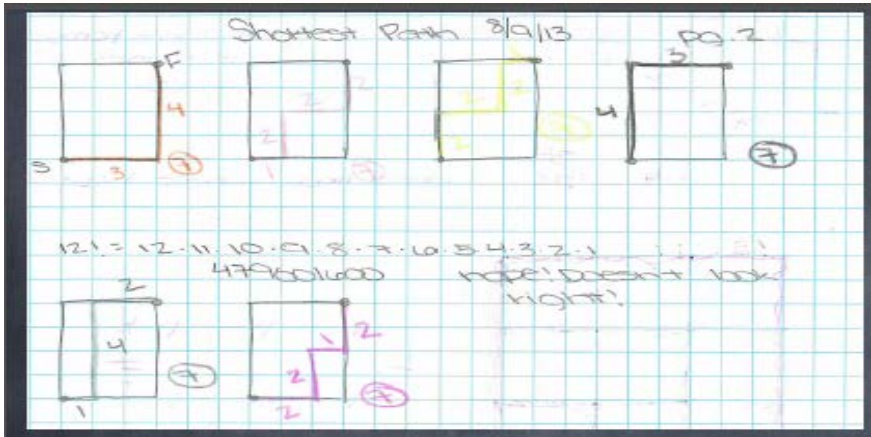
Teacher Changes in Practice After 1st Summer Workshop

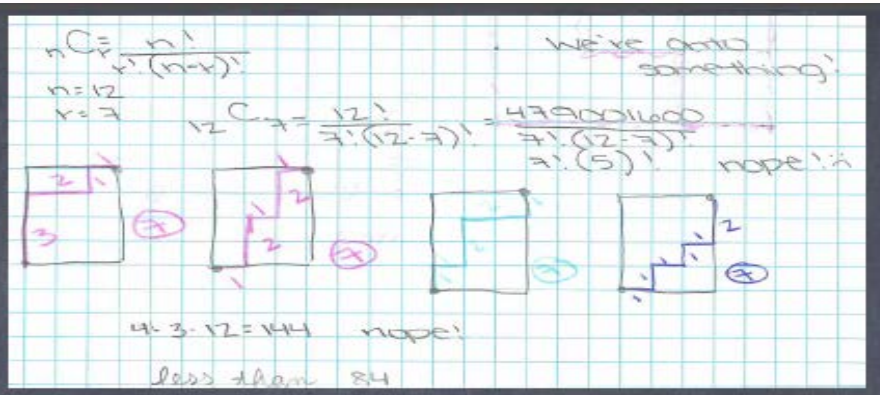
- "Problems in a Bag"
- Weekly "Puzzles and Problems"



- Implementation of Guiding Questions

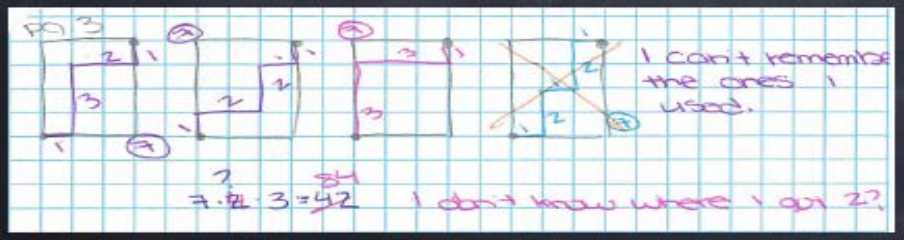
Implemented Problems from 1st Summer Workshop

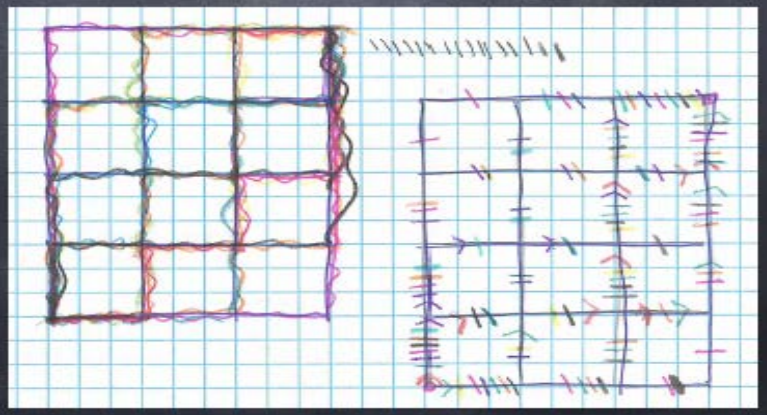




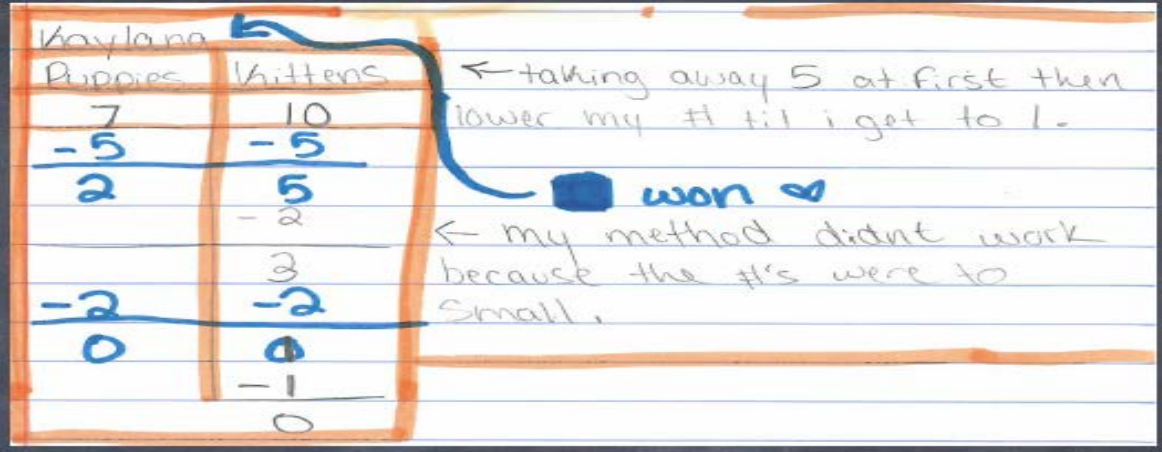
Brandi decided to ditch the idea that combinations were involved after I asked her what she thought a reasonable number of paths would be.

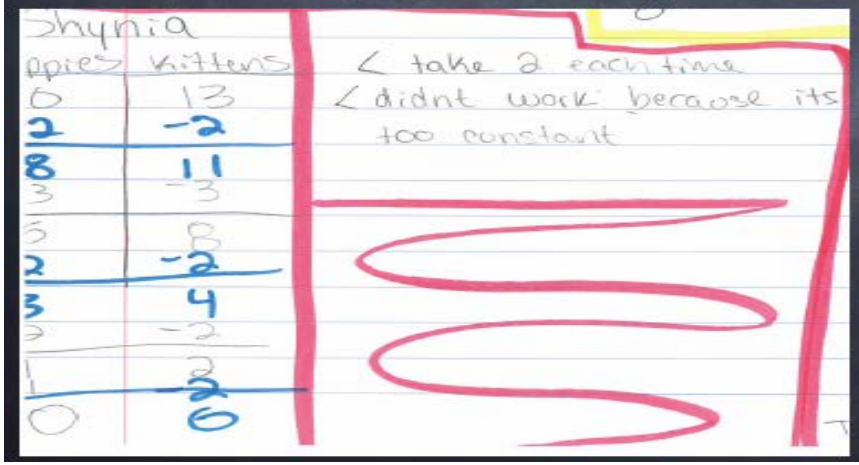
She decided to start drawing all of the different paths.

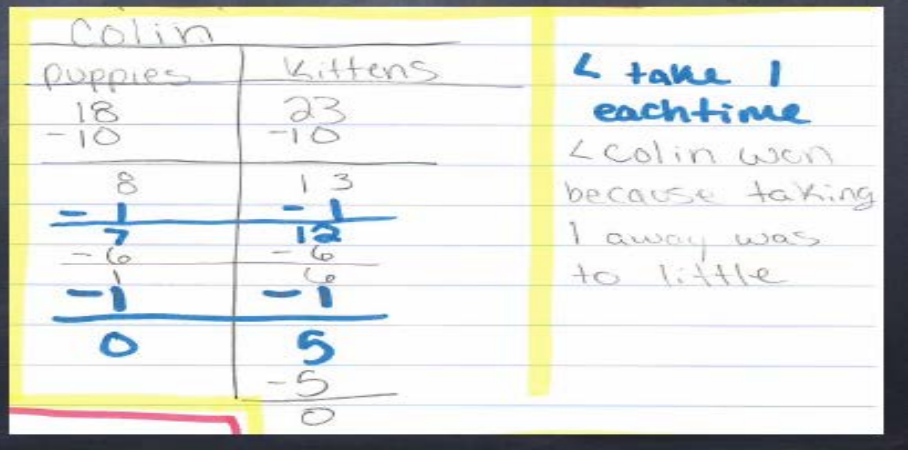




Puppies and Kittens







Starting with a pile of puppies and kittens, two players take turns; a legal move is removing any number of puppies or any number of kittens or an equal number of both puppies and kittens. A player wins by removing the last of the animals. What's a winning strategy?

2nd Summer Workshop: Sessions on Implementation

Monday	Tuesday	Wednesday	Thursday
10:30-11:00 **Welcome participants; Pre-Survey**	8:30-10 **Math Session**	8:30-10 **Math Session**	8:30-10 **Math Session**
	10-10:30 Break	10-10:30 Break	10-10:30 Break
11:00- 12:00 **Math Session**	10:30- 12:00 **Math Session**	10:30- 12:00 **Math Session**	10:30- 12:00 **Math Session**
12-1 Lunch	12-1 Lunch	12-1 Lunch	12-1 Lunch
1:00- 2:30 **Math Session**	1-3:00 **Math Session**	1-2:30 **Math Session**	1-2:30 **Math Session**
2:30-3:00 Break	3:00-3:30 Break	2:30-3:00 Break	2:30-4:00 **Closing: Overall Wrap-Up & Door prizes**
3:00- 5:00 **Math Session**	3:30- 5:00 **Math Session**	3:00- 5:00 **Math Session**	
5:00-6:00 Free	5:00-6:00 Outdoor Dinner (BBQ)	5:00-6:00 Free (Hiking)	
6:00-7:00 Dinner	6:00-7:30 Hiking	6:00-7:00 Dinner	
7:00-8:30 **Experiences of Former Participants**	7:30-9:30 **Task Analysis Of Participants' Curricula**	7:00-9:00 **Implementation Planning and Sharing**	

Task Analysis Framework

Lower-Level Demands	Higher-Level Demands
Memorization • involve either reproducing previously learned facts, rules, formulae or definitions OR committing facts, rules, formulae or definitions to memory. • cannot be solved using procedures because a procedure does not exist or because the time frame in which the task is being completed is too short to use a procedure. • are not ambiguous. Such tasks involve exact reproduction of previously-seen material and what is to be reproduced is clearly and directly stated. • have no connection to the concepts or meaning that underlie the facts, rules, formulae or definitions being learned or reproduced.	**Procedures With Connections** • focus students' attention on the use of procedures for the purpose of developing deeper levels of understanding of mathematical concepts and ideas. • suggest pathways to follow (explicitly or implicitly) that are broad general procedures that have close connections to underlying conceptual ideas as opposed to narrow algorithms that are opaque with respect to underlying concepts. • usually are represented in multiple ways (e.g., visual diagrams, manipulatives, symbols, problem situations). Making connections among multiple representations helps to develop meaning. • require some degree of cognitive effort. Although general procedures may be followed, they cannot be followed mindlessly. Students need to engage with the conceptual ideas that underlie the procedures in order to successfully complete the task and develop understanding.
Procedures Without Connections • are algorithmic. Use of the procedure is either specifically called for or its use is evident based on prior instruction, experience, or placement of the task. • require limited cognitive demand for successful completion. There is little ambiguity about what needs to be done and how to do it. • have no connection to the concepts or meaning that underlie the procedure being used. • are focused on producing correct answers rather than developing mathematical understanding. • require no explanations or explanations that focuses solely on describing the procedure that was used.	**Doing Mathematics** • require complex and non-algorithmic thinking (i.e., there is not a predictable, well-rehearsed approach or pathway explicitly suggested by the task, task instructions, or a worked-out example). • require students to explore and understand the nature of mathematical concepts, processes, or relationships. • demand self-monitoring or self-regulation of one's own cognitive processes. • require students to access relevant knowledge and experiences and make appropriate use of them in working through the task. • require students to analyze the task and actively examine task constraints that may limit possible solution strategies and solutions. • require considerable cognitive effort and may involve some level of anxiety for the student due to the unpredictable nature of the solution process required.

Selecting and Creating Mathematical Tasks: From Research to Practice, Mathematics Teaching in Middle School, vol 3, no.5, February 1998, Margaret Smith and Mary Kay Stein.

Task Analysis Cont'd

- Sample Place Value Problem:

  Mind Reader: For this problem, I will demonstrate my ability to read your mind. You start by choosing a six-digit whole number "n" that repeats the first three digits – e.g. numbers like 725725 or 109109 or 226226. Without knowing what number you chose, I will guess a factor of your number.

  Your goal is to expose my mind-reading scam as just good mathematics. Predict all the possible numbers that I might choose as a factor of your number n. How does my "mind-reading" trick?

MTC Practices that Promote Shifts in Teacher Work

- Content-alignment with Common Core State Standards
- Practice-alignment with Common Core
- General session facilitation characteristics
- Research-based, structured sessions for pedagogical PD

http://www.unco.edu/nhs/mathsci/mtc/