Space Science Center Addition Conference Room
3/27/14 Session 5C

RAC collaborations
Using Networked Improvement Communities: Plan-Do-Study-Act; the focus is on staying in context. Have a driver diagram with a target (or targets), with primary drivers that are the problems that are identified as crucial to overcoming in order to reach the target, and secondary drivers that are the hypothesized solutions to the primary drivers.

Auburn has 14 years now of biweekly math ed seminars to bring together discussions

Clinical Experiences RAC: Gary Martin
A critical need is recruiting more mentor teachers
Mentor teachers need knowledge of CCSSM, and how to mentor
The group is trying out new models for clinical experiences (triad=2 student teachers with one cooperating teacher)

Cynthia: Marketing for Attracting Teacher Hopefuls
Problem is not enough secondary teachers being trained to meet demands; about 1/3 of secondary math teachers right now do not have math certification
Image of teaching profession for attracting a diverse population is an issue under discussion
Need more of a marketing plan for diverse programs, coupled with retention programs to keep recruits
S Carolina @ Dicky has employed an advertising firm to have better marketing imagery
Need to build an infrastructure to collect data for admission, progression, graduation, as well as background & interests. Analyze by institution.
FIU/AZ developing recruitment materials for STEM majors to teaching
Boise State doing surveys to ID high-impact recruitment strategies

1-5-25 (1-n-n^2): the idea of trying something once, then scaling up to a few, then scaling up to a lot
RAC to MTEP to the universe

Building Communities & Courses: Mike Mays
Developing courses for teachers based on METII (math and stat). Need integrated learning strategies of math + pedagogy (such as in a capstone course). Collaborative work among stakeholders is critical. Each of the partners are developing a different unit (modeling, congruence/transformations, etc)

Actively Learning Mathematics: Jim Lewis
Freshman math courses can be critical to recruitment of potential teachers. Low success rates and low persistence are big problems at the freshman level. Forces beyond clear exposition of mathematics are involved in failure rates. So all of the groups are using active learning strategies: group work, technology, concepts, problem solving, communication, mathematical habits of mind. Most sites are using a version of learning assistants: undergrads who are successful in math serving as course assistants during group work time.
Productive perseverance: students need skills to succeed in college; need to believe they are capable of learning math; need to see math courses as having value; need to have a sense of belonging—socially tied to peers, faculty, institution; need to promote growth mindsets.
Most of the RAC is calculus I & II; UNL focusing on precalculus. UNL is following the Michigan model of structured lesson plans. Success went down the first semester of changes. So the group revised the

lesson plans, created an "entry" exam, have WeBWork homework, team quizzes (outside of class); professional development for graduate teaching assistants (GTAs); substantial faculty mentoring. Next: improve the GTA training (weeklong before seminar, plus ongoing teaching seminar); improve lesson plans; renovated classrooms with tables; time for longer classes (75 min, 3x/week instead of 50 min); understanding how to motivate students; tracking students over time.

Auburn has found that attendance is crucial to active learning, through community building. The students with lower attendance mostly drop the class.

Three dimensions of course design for Preservice secondary teachers
Cody Patterson

Secondary math teacher prep is all run through the math dept, including methods (including 4 courses for teachers and 2 methods). The math courses are open to anyone, but designed for teachers. The last of the courses is called Synthesis of Mathematical Concepts (capstone).

Tried to create a capstone course that didn't duplicate past courses, benefited secondary teachers, and will have knowledge that will be retained.

Wanted to look deep (understand central secondary math topics), wide (connecting different topics in mathematics) and far (seeing where K-12 math can solve real world problems; also developing the persistence needed).

Isomorphism between $(\mathbb{R}, +)$ and $(\mathbb{R}^+, \cdot)$

Quadratic equations: algebraic and geometric points of view

Modeling: using unseen quantities and structures.

Decided to work on understanding that the graphs of any two quadratic functions are similar. ($y=kx^2$ is similar to $y=x^2$). This is hard because algebraic representations of transformations are difficult for students. It is not obvious how to prove this for quadratics in general. Also, Cody realized that students didn't understand enough about graph transformations in general.

Created an activity called "Point Checker". Each group gets a set of cards. The Checker (has an equation); The Transformer (has a transformation like a reflection); The Point Person (check if the following 3 points are on the graph of the transformed graph); The Generalizer (write a rule for checking whether (x,y) is on the transformed graph). Each person can only see their own card and have their own task.

Uses equations that are hard to picture in their head, then consider: What would it mean for a point to be on the transformed graph?

The purpose of the generalization is to see that a point is on the transformation if and only if the invers transformation applied to the point is on the original. This is hard because you have to sort of do transformations in reverse to think about these. This helps give students meaning to why transformation rules tend to work "backwards" (e.g., slide to the right by subtracting).

This then connects to the horizon using transformation matrices.

Then there is a homework assignment with a single parameter to investigate the effects of changing the graph.

Thus, in this example, one goal is deep understanding of transformations—this is a high school topic. Another goal is connecting the algebraic and geometric views of conic sections, and connecting transformations and coordinate geometry. The other goal is looking far: transformations that are not the "usual" ones. A less explicit goal was the role of precise definitions—the definition of similar needs to work for more than just polygons. Also, when there are multiple definitions, it is useful to connect them (such as defining a parabola with focus & directrix, vs looking at $ax^2 + bx + c = y$)

Technology gives power to investigate lots of cases quickly. But, sometimes this is too concrete to get at understanding the abstraction. So, there is also value in figuring out "by hand."

Techniques for task design need to get around the procedural knowledge that students bring to the class. Jamming is to pose a task that won't fit with the known procedures. Crashing: you can use a procedure but you'll get the wrong answer (either really tricky, or the task doesn't actually meet the requirements of the procedure).

PreService Teacher Task Study Project: preservice teachers produce tasks for Illustrative Mathematics, and critique those of others (from other institutions)

If a connection is made in a math class and no one notices, does it make an impact? Need to be more explicit to maximize the payoff.
Last slide has one main idea: can use this as a summary.