Notes from March 27, 2014 Parallel Session 7C
Space Science Addition Conference Room

Jim Madden, Robert Perlis, Scott Baldrich, LSU
Mathematics dept involvement in K-12 math ed at LSU: A half century of growth

Robert: LSU Math Dept Chair
Efforts to have the math dept work in education started in 1958. Carnes Institute was an academic year cohort experience for teachers, started by Dick Anderson (see current MAA newsletter for an article about him [died in 2008]).
Robert got involved in 1985 with teaching inservice courses for middle school, then elementary, and then high school. He was just supposed to teach mathematics, and didn't get any directions for how to go about this. He learned you can teach elementary teachers all the same math you teach high school teachers, as long as you don't call it algebra, calculus, etc. Also, stay away from variables.

□
□□ (multiply by 2)
□□ . . . . . (add 6)
□ . . . (divide by 2)
. . . (subtract original)
Always end with 3. But ((2x+6)/2)-x=3 is not so easy to understand

Ten years ago, Robert switched more to service learning rather than teacher education.
How do you read 133? One-hundred-thirty-three or One-hundred-and-thirty-three? Is it misunderstood if "and" is included? Allowing for ambiguity is sometimes useful for connections to the "real world."

Jim Madden: Cain Center was created in 1992 but intended director became ill and could not begin. In 1998, a chemistry educator was hired as director, and started working on projects to enhance undergrad STEM education.
1998-2000, LSU Community of Scholars involved depts. Of education and math, and created an interdisciplinary research group. This really helped the STEM faculty get into education research; this was led by Dick Anderson.
Also in 1999, Madden got a CCLI grant with Frank Neubrander (2000-2001), which really got involved in math ed research.
In 2000, the Cain Center was endowed, and was able to expand the education work
See slides for Cain Center activities in early 2000s. Includes STEM-CP grant and GeauxTeach (UTeach replication). This also includes the Math Vision Lab (2002-ongoing) that funds research and outreach.
Some key learnings from the Math Vision Lab are that cultures are extremely hard to change, meaningful math education research is very hard to do, and that if the university doesn't understand the school authority structure, problems will ensue.
Another key finding: it is rewarding for mathematicians to work directly with teachers, but the impact is far greater when teachers are enabled to provide professional development to peers.
Some of the best research has been done by teachers working on master's degrees as part of LaMSTI.
Cain has made money for LSU by offering online dual-enrollment courses for high school teachers.

Scott Baldridge: Teacher Preparation at LSU
Scott has written textbooks for elementary math courses, which had grown out of this work at LSU, focused on self-study for teacher professional development.

EngageNY is curriculum that is free, and online. There is a commercial version called Eureka Math. The professional development needs to be embedded since there is not much in the way of time or funding for out-of-school teacher professional development. So, the curriculum design embeds mathematical knowledge for teaching, first through a focus on definitions. There is one single set of definitions they use for all of PK-12. The curriculum uses descriptions in place of definitions if the students do not yet need full definitions. The second key is "basic facts" (axioms & theorems). Ratios and rates should be understood through geometry and geometry axioms, as the foundation and coherence, going from manipulating units, ratios, proportional relationships, and modeling with functions. Finally, there is a focus on what terms a given term inherits ("object oriented school mathematics"). Thus, determine what a term is, what is the formal definition, what is the initial description, and what other terms are connected to this one. For instance, the writers at one point wanted to say that linear functions had slopes. This is not actually correct. Linear Functions have rates. Lines in the coordinate plane have slopes. What the teachers see, that encourage self-study. There are a small number of models (only 10 per grade) so that the kids and teachers rely on the model over time as the mathematics deepens (geometric figures). Secondly, Immersion in a story (coherence): need to keep the coherent storyline of the mathematics over time. Thinking of a storyline makes more sense especially to elementary teachers, for keeping mathematics coherence. Thirdly, there are teacher vignettes of questions/responses (standards for mathematical practices) to give examples of how teacher-student interactions can look like in the classroom. Fourth: Teaching sequences (Progressions) that support the storyline. Last, teacher solutions (classroom artifacts) to help teachers think about student thinking and how that can look in writing. This whole curriculum grew out of decades of work with teachers.

Davida Fischman: Adventures of Mathematicians in School Education
CSU San Bernadino has a Center for Enhancement of Mathematics Education. This CEME partners with lots of local districts, as well as multiple departments and faculty in the university, with other universities, and the education offices at the county level. Education work is rewarded in math promotion & tenure.
The Department has 26 mathematicians and 1 math educator, but many mathematicians working in education. The Dept has four areas of focus: Preservice, inservice, assessment, and math education research.

Mathematical ACES is an MSP in its fourth year. This project focuses on algebra in 4^{th}-8^{th} to build a foundation for success in algebra. There are summer institutes for teachers, monthly seminars, monthly lesson study, and 2 hrs/month of un-facilitated collaboration time with just the teachers and no university personnel.

Over 20 years working with teachers, this has overcome the barrier that the mathematician and K-12 language sound similar (same words) but can have very different meanings. E.g., professional development as "make-and-take" versus graduate courses of in-depth math learning. By starting with mutual respect, and continuing monthly meetings over years, the partnerships grow and have substantive conversations.

When looking at student work, Davida tries to get teachers to focus on what students DO understand, to build on their understanding. Davida also asks the teachers to think about the whys of her decisions, such as why to provide or withhold manipulatives, why group presentations are sequenced a certain way, how errors are turned into learning opportunities, etc.

Preservice programs and inservice programs are connected by strong mathematical problems that are thought-provoking, reveal structure, elicit common misconceptions, and think about what questions should be asked that do not lower the cognitive complexity of a task.

Mathematicians are involved in the mentoring of Noyce scholars, along with the mentor teachers (cooperating teachers).

Math education research is hard to get started, and is better with collaborations with math education researchers. Davida found some of these in the partner universities. A focus now is on the habits of mind for teaching mathematics. They have developed an instrument for measuring this that is just now ready to share. Habits of mind that are being published about are both general learning and mathematical learning, but what is lacking is teacher habits of mind. The literature tends to have beliefs, knowledge and dispositions that lead to enactment of ambitious instruction. But Davida adds a middle step of proclivities to do the work. For instance, teacher proclivities to actually DO math, to think about student thinking in math, and to decide on student habits of mind to develop. Persistence is a huge part of this. The focus was on the second one: teacher thinking about student thinking, hoping that this would correlate with student outcomes. When they tried a likert-scale, it was too "obvious" for what the "right" answer would be. So, they went with a set of scenarios and potential student responses. Currently the project is analyzing video of classroom to support the self-report survey data. Teachers had to rate the likelihood they would use each of the potential responses (each response is reasonable in given situtations). This instrument has turned out to have nice scale factors, which very much correlate to the California (Procedural) state test.

One activity to focus on mathematical practice standards is to ask teachers to write down the top three characteristics of strong mathematics students.

How did Davida get into education focus? Curiosity about how people think about mathematics. She loves teaching and seeing the lightbulb go on for understanding. This makes her feel she is making a difference in the world.