TRIP REPORT: National Council of Teachers of Mathematics Regional Conference
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I attended the NCTM Regional Conference in Reno Nevada, November 5-7, 2008.

SUMMARY

The '60s are alive and well in the math education theory of the '00s. That is, the primary math ed research finding is to teach with passion and compassion, via engaged interaction with problems rather than with symbols. Math without meaning is not even math.

OVERVIEW

More than 250 presentations, half were trying to sell something. Big presence of textbook and calculator salespersons. Many folks sharing their delight in new learning strategies, most of which were closely related to Singapore math. Manipulatives were everywhere, with lots of ways to avoid simplifying and solving algebraic symbol patterns. Here are some representative talk and workshop titles:

General

-- Inspiring Students to Be Problem Solvers

-- Middle Level Mathematics and Real-World Engineering Problems

-- Zero to Infinity: Teaching How Numbers and Notions Evolve and Grow

-- Diversify Instruction by Connecting Mathematics and the Arts

-- Using Literature and Technology to Open Doors to "Aha" Moments
   for Students in Diverse Classrooms

-- Communicating: Speaking, Writing, and Sketching -- About Math!

-- Mathematics in Contemporary Culture: The Comic Strips

-- Oh, My Gosh! I Really Get It! Understanding Math with Highly Interactive Software

-- Math-Magical Arithmetricks

Algebra

-- Patterns in Linear Functions

-- Algebra as a Life Skill: Making Mathematics Make Sense

-- Involve All Students in Algebraic and Logical Thinking
   with Practical, Hands-On Activities

-- Algebra in the Physical Sense

-- Using Tiles and Games to Teach Algebra

-- The Power of Investigative Calculus Projects

HIGHLIGHTS

-- Standardized tests are designed to discriminate between students, that is, to establish *differences*. Thus, they not about assessment, they are about establishing social hierarchies. The majority of low-performing schools in the US are low performing because they have limited the curriculum to what is testable. (Wesson)

-- Students need to be active in the classroom. The best way to achieve that is for the teacher to stop talking. (Burger)

-- Algebra is a way of thinking about the world, that leads to a way of manipulating symbolic structures. (Kaput)

-- Singapore math *is* really good!

-- Classroom math is fundamentally more visual and diagrammatic than symbolic.

KEYNOTE

The Keynote Speaker, Ken Wesson, presented the case for "brain-considerate learning", that is, establishing teaching practices that incorporate the recent rapid advances in knowledge about how the brain works, in particular, how we learn, remember, and think. Some important points (that are actually not very new, but are just emerging from the brain research community into the education community):

-- Brains don't mature until folks are in their thirties.

-- What the brain values is 1) patterns, 2) emotions, 3) relevance, 4) appropriate context, and 5) sense-making.

-- All information is first processed by the emotional system. Attention first requires relevance and involvement. Teachers need to establish emotional bonds with students prior to expecting them to learn.

-- Where the hands go, the brain will follow. Hands-on learning is literal.

-- Hemispheric coordination is a physiological necessity. Content must be multimodal. Not different and separate modes of teaching and learning (visual, audial, tactile, kinesthetic, symbolic, etc), but all of these at the same time. Every individual is multimodal.

-- All academic content areas (particularly and especially math) implicitly incorporate aspects of art, music, language, belief, physical action, cognitive abstraction, and emotion.

-- Never teach more than 20 minutes at one time. Time for integration, discussion, and yes escape, is mandatory if learning is to take place.

-- It's lunacy to expect that a student should be able to learn from listening to a new idea for an hour. Learning takes long-term practice and exploration. What we get from the traditional classroom is pseudo-learning, stuff that stays around for an hour or a day and then goes away.

-- Math education in modern countries (er, not the US) focuses on key concepts that are taught in depth, in careful sequence, and over years. US classrooms focus on huge amounts of forgettable details.

-- Textbooks should be extremely small, and contain only the most powerful ideas.

-- The two most destructive educational ideas (peculiar to the US): 1) with enough training, anyone can achieve excellence in anything, and 2) for individuals, the greatest room for growth is in areas that are their weakest.

-- Brain-considerate learning takes place by 1) physical involvement, 2) emotional engagement, 3) quietness that permits internal dialog and reflection, 4) a non-threatening environment, and 5) conversation focussed on change.

I came away from this presentation with an awkward feeling that took a couple of days to articulate. The issue is simply that American schools and teaching practices have never been concerned with physiological wisdom, otherwise, for example, we would never expect people (especially children and teenagers) to sit in one place for hours every day. Brain cells use glucose for energy; glucose is generated by physical activity.

To incorporate much of the learning research from the last decade, we would need to completely redefine the structure of the classroom, the knowledge of teachers, the organization of schools, the objectives of education, the policies of government, the whole system. And this indeed is what many of the researchers are calling for, and they are saying that half-way measures and gradual change will never get us there. Sounds like every other crisis are currently face.

So the ethical question for me is this: Should we subscribe to impossible expectations about good teaching? Should we just admit that schooling is not really about increasing knowledge, and in effect, end the charade? Should we all just learn to live with the idea that we will always be, due to our educational environment, terrible teachers? Or should we risk everything to change everything? Viva the '60s!

TEACHING IN VIRTUAL ENVIRONMENTS

I thought this would be on virtual worlds, but it was on putting courses online.

-- Teachers are struggling with huge workloads in getting courses online.

-- It's a fundamental error to try to keep coursework academic. There's a mismatch between the teaching model (conventional) and the media model (rapid communication, shorthand texting, chat, deep connectivity, frequent change of focus).

My son's high school solves the problem by banning personal technologies in the classroom. Who needs to live in this century anyway?

SUBTRACTION

-- It is very difficult.

-- The historical aim of teaching arithmetic: to think things through, to think clearly, quickly and accurately (Welch 1889). That's LWTC's "critical thinking", but oops we forgot the goal and got lost in teaching symbol manipulation.

-- Definition of "concept": a picture in your mind of an idea.

-- Arithmetic is a dialog between concrete and verbal. There's no real reason to introduce symbols.

-- Manipulatives aid thinking, algorithms do not.

-- New word: Subitize. To recognize quantity without counting.

-- Avoid teaching vertical addition until at least three digit numbers. One and two digit addition and subtraction should be approached using strategies rather than memorization of facts and algorithms.

-- Strategies: subitize, double, bridge to ten, pair off, compose and decompose, benchmarks.

NUMBER SENSE

-- Focus on meaning, relations, estimation, applications.

-- Some good examples of non-algorithmic questions:
    -- is 4x12 closer to 40 or to 50?
    -- how many paperclips can you hold in your hand?
    -- what tip should you leave if the bill is $199.23?
    -- how long does it take you to drive 50 miles?
    -- if a 10 year-old is 5' tall, how tall will he be at 20?

-- We should always attach meanings to numbers. Don't ask to multiply two three digit numbers unless each number has a meaningful anchor.

-- Be able to explain how the operations (+,−,x,÷) work using diagrams and no numbers or symbols.

-- Ignored concept: number density. How many numbers are between 100 and 1000?

-- Sort fractions in order. Which are close to 0, close to 1?

VISUAL LEARNING

-- 1%-5% of people have dyscalculia, an inability to use numbers clearly.

-- Children are natural visual learners, and can grasp visual abstractions.

-- Use visual models for problem solving: illustrations, photos, diagrams, graphs, icons,...

-- Visual language is cross-cultural, no ESL problem.

-- Ask students to draw the problem and the answer. This is easier than stating the problem in symbols.

-- Ask students to *show* the answer, not to figure it out.

MAKING MATH MEANINGFUL FOR LIVING

-- The (historical) rationale for teaching algebra is to get to calculus. If a student does not take calculus, algebra is not a necessity.

-- If a student asks, "When would we ever use this?", then the teacher has already made a mistake.

-- Invert homework and classwork. The classroom should be where students do math activity. Monotonous activities should be done at home, when students can be multitasking (watch TV, chat with friends, etc.).

-- An experiment: permit only questions in class, no answers (a refrain from Postman and Weingartner, "Teaching as a Subversive Activity" 1969).

-- Emphasize *Show No Work*. Do the problem in your head (for empowerment and for problem solving skill development).

-- Tests are inappropriate to assess thinking. Activities other than thinking are inappropriate for the math classroom.

-- Give 10% of the grade for making mistakes. Without errors, learning does not move forward. Error making needs to be legitimized as a productive activity, worth points. Also helps with math anxiety.

SINGAPORE MATH

-- Main style: careful attention to teaching heuristics, to moving from simple to complex, and from routine to non-routine problems to be solved.

-- Focus on problem solving (not symbol manipulation), use diagrams and models more than symbols.

-- Fourth grade: "Mel has 48 books for sale. She sold 1/3 of them on the first day and 1/4 of the remainder on the second day. How many books were not sold?" Turns out this is a relatively easy problem for the Singapore technique, which focusses on diagrammatic part-part-whole relations.

-- Introduce difficult problems that require non-algorithmic, creative thinking early. Use lots of open-ended and real-world problems.

After seeing this approach working *for teachers*, I left thinking that it would not be difficult to teach the entire Singapore curriculum to LWTC students starting at Math 80. Downside: we need different textbooks.