Singapore's Conceptual Approach to Learning Math

~Kathleen Jalalpour

1. What is a Conceptual Approach to Math?

Traditional Approach to Teaching Math	A Conceptual Approach to Teaching Math
Knowledge exists outside the child, and is imparted by adults through direct instruction.	Knowledge exists within the child. Students can construct conceptual meaning through hands-on experiences and observation.
The student role is passive and receptive.	The student is expected to engage actively in investigations, based on their natural curiosity.
Learning is primarily done with pencil and paper.	Much of the learning evolves from hands-on concrete investigations, reflection and discussion.
Math is about learning to find correct answers.	Math is about observing patterns, deducing rules, and distilling problem-solving processes.
Focus is on memorization of facts, vocabulary and formulas.	Focus is on the construction of a large conceptual foundation.
The adult's role is to talk, the child's role is to listen.	The child's role is to talk, the adult's role is to listen.

The column at right above summarizes our beliefs. Most of us adults were educated in the traditional system on the left. Some of our classmates exceled, others did not.

Traditional instruction was successful at preparing a small group of students for professional careers and giving a large majority the skills they needed for factory jobs.
This has all changed. The *recognized educational priorities* for the 21st century include critical thinking, communication and collaboration, creativity, and technology skills.

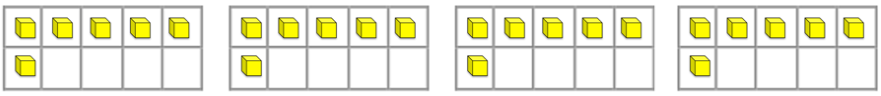
If we expect the citizen of the future to be foremost a *creative, flexible problem solver with good communication skills,* then it is our duty to align education with that goal.

It is our firm belief that one of the best places to build these vital 21st Century skills is in the math classroom. More specifically, in a thinking math classroom.

2. What does this look like in the classroom?

- "Ask, Don't Tell" – We keep our own *telling* to a minimum, and instead ask questions. "What if?" questions with overtones of curiosity and wondering. "What if we moved this block here? What if we had twice as many blocks? What if a mouse stole some of the blocks at nighttime? What if you and I shared them equally? What if we built a bunch of houses with 6 blocks each?" Open-ended wonderings and stories that feed a child's natural interest in how the world works.

- "Let's Ask the Blocks" – Students don't need to be *told* how to understand math if they trust their own ability to deduce math truths by exploration. A first grader might remark that these 4 *sixes* are easier to see as **4** ***fives*** plus **4** ones (therefore 20 + 4) .



She is benefitting from having used ten-frames so often that she sees TEN blocks on the ten frame as "The Quantity that Does Not Need to Be Counted", and FIVE as "No Way Do I Need to Count That Row". She is now well on her way to a conceptually-based understanding of multiplication. The blocks give way to drawings, then to visualization, and finally to mental math with confidence.

DATA POINT LINK

- "Can You Prove That?" – We use this sentence or its twin "Can you show me why that works?" to encourage students to think critically about facts they think they know. I feign surprise at their new insight, and ask them to explain it to me. If they can use blocks to show me *why* their answer works, they have solid, conceptual understanding.

> *Evidence from the 13 million students who took the 2012 PISA test showed that the lowest achieving students in math were those who used memorization as their main math strategy. The highest achieving students were those who thought of math as a set of*

- "Speed Is Not Intelligence" – We avoid games based on speed and competition. We don't use timed tests or flash cards.

Here's the thing: Thinking is hard. And good thinking is often slow. Actually, good thinking probably alternates between a fumbling slowness and sudden flashes of insight. But memorization is a shortcut that builds *neither number sense nor thinking skills.*
Yes, fluency is necessary for later math subjects, but there are many roads to fluency, and memorization is the dullest.

⇒ Note – Like Stanford professor Jo Boaler? Read her take on *speed in math learning here*.

3. Doesn't this take a long time?

Why yes, it does. Especially at the beginning, in the first 2 or 3 years of school. But we're looking at a *long game.*
Young children need to build a ***huge*** foundation of number sense, mental math, conceptual understanding and problem-solving experience.

- There are many ways to make 5, and many ways to make 7, and so on. That means there are many ways to make 50, and 70, too. And 0.5 and 0.7. And 5*x* and 7*x*. These relationships are visually developed by a child's internal sense-making process, and the pay-off is a long-term comfort and efficiency with mental math, word problems and number relationships.
- Children repeatedly bundle 10 ones to make a ten, and then pick up some more ones and start counting over again, ("10…1, 10…2... *I mean eleven, twelve...*) And one ten can be *unbundled* again, into 10 ones, if you want to subtract something and need some ones. Time spent at this level is the prerequisite to all future computational proficiency.

- Children might surprise us with their observances! "10 tens bundle to 100, and unbundle again, too. It's always ten of this equals one of that, unless we're learning fractions, and then *five* fifths bundle to one... and $1\frac{2}{5}$ unbundles to 7."
- They notice things like "5 – 0 is five, unless we're counting all the trees placed at five intervals along a street, and then it's six."
- Or "If you're multiplying 2 numbers, you can double one of them and halve the other, and get the same answer, if it's easier. But not if you're dividing. Then you have to double or halve *both* of them."

This sounds confusing, but with *BLOCKS,* it's not. With blocks, all of this makes perfect sense to children. And the important win for educators is the outcome of all this conceptual work *in the long run.*

We have been using Singapore Math for 16 years, and have followed our own elementary students through middle and high school. We see an increase in confidence, equity, problem-solving ability, ease with word problems, and a better understanding of algebra. The investment in a strong conceptual foundation of number sense pays off!