Nothing Works!

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Tools: Manipulatives
Make a Rectangle

\[ 2x^2 + 4x = 2x \cdot (x+2) \]
He said:

"Go South on Martin Luther King Junior Way (Old Grove Street). Left on Alcatraz. Right on College. Left on Keith. You'll get to a stop sign, then a stop light. Make a left onto Broadway, but get into the right lane. When you see the overpass... er... when you see the freeway... u m... What did he say?"

**Following Directions**
Knowing your way around

It's at Temescal!
Oh, here's another route...

Reading a map
Tools: Technology
Speed and accuracy in computation are no longer legitimate priorities for math education.
Technology can help make math
◊ visual
◊ interactive
◊ creative
Make Math Visual
Make Math Interactive
Make Math Creative
Technology complements...
...does not replace hands-on and paper-pencil work
Unfortunately:

Tools are not magic!
A Tool-Rich Pedagogy

◊ Student-centered classroom
◊ Discussion and reflection, verbalizing
◊ Cooperative learning, group work
◊ Visual bridges to concepts
◊ Microworlds
Classroom Choices
Group Work

◊ Random groups
   - new groups every 2 weeks

◊ Students mostly work independently
   - are expected to help each other

◊ If a group does not function well
   - intervene directly to get the behaviors you want

◊ If more than one group is stuck
   - stop them all for a class discussion
More on group work:
Complex Instruction

◊ Prof. Elizabeth Cohen (Stanford)

◊ Mathematics for Equity
   (Carlos Cabana and other Bay Area public school teachers)

◊ Also search my blog for more titles
Verbalizing

Putting things in words is crucial to understanding

◊ Encourage talking

◊ Require writing
Don’t answer questions they don’t have

They cannot hear you!

◊ Seed with questions, problems, discussion
◊ Lecture in small doses when appropriate
Class Discussion

True discussion vs. interactive lecture

Use of open-ended questions
Creating a safe environment

◊ No putdowns
◊ "Tell your neighbor..."
◊ "Can you restate what X said?"
Growth Mindset

◊ Praise participation and risk-taking
  - rather than correct answers

◊ Backed by research: Prof. Carol Dweck, Stanford
Handling wrong answers

◊ write down many answers
◊ poker face vs. telling
◊ "Choose someone to help you"
◊ making 'mistakes' myself
Feedback from all

◊ votes
◊ gestures
◊ writing
Variety

◊ Fanfare vs. total silence
◊ New problems, not same as on paper
◊ Move around the room
◊ Give the right answer, or a probably popular wrong answer up front
Heterogeneous Classes
All classes are heterogeneous

Alliance with the strongest students

Support for the weakest
The Goldilocks Strategy

◊ Something too difficult
◊ Something too easy
◊ Something "just right"
Curricular Choices
Sequencing within a course

Tackle important and/or difficult topics early
Sequencing within a course

Separate related topics:
◊ Proportional relationships / Dilations
◊ Linear functions / Systems
◊ Exponents / Scientific Notation
Navigating a Topic

Concrete to abstract, and back
positive whole numbers to rational numbers
numbers to variables
discrete to continuous

Example:
the Pythagorean theorem on the geoboard
Navigating a Topic

Difficult to easy, and back.
Assessment Choices
Assessment: Purpose

1. To improve learning
   
   Let students know where they are
   
   Provide learning opportunities
Assessment: Purpose

2. To improve teaching

Diagnose student understanding and skills

Figure out next steps

Fine-tune the course
Assessment: Purpose

3. Also...

- Manipulate student motivation
- Prepare students for future assessments (!)
- Rank students / assign grades
- Justify the grades
- Satisfy parents, administrators, and politicians
Assessment Alternatives

◊ Participation quiz
◊ Quiz / test corrections
◊ "Recycle extra"
◊ Other take-home assignments
  - projects
  - reports
  - problem sets

Equity concerns
Reasoning and Sense-Making
“Be less helpful” — Dan Meyer

but keep it interactive
Discovery vs. Direct Instruction

◊ A false choice: neither works well without the other

◊ After exploration, "institutionalization"

- Make key concepts explicit

- Clarify what is important and worth remembering and thus worth writing down
Skills vs. concepts

Another false choice
Memorization

◊ as a substitute for understanding, *does not work*

◊ as a complement to understanding, can help
Teach for understanding!

Understanding...

◊ is difficult to encapsulate in a checklist
◊ cannot be easily conferred by explanations
◊ is difficult to assess
◊ is not always valued by students, parents, and administrators
◊ is the most important part of our job
Nothing Works

for every student

every class

every teacher

every day
Be skeptical and eclectic

Do not believe claims that some particular approach or curriculum is “the answer”.

Constantly broaden your repertoire
Our Own Learning

...about math,

about learning and teaching,

is what makes the job interesting in the long haul
The Art of Teaching

◊ Don’t blame the students
◊ Learn from your successes and mistakes
◊ Teacher collaboration is key
There is no one way