Nothing Works!

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... not even the ideas
I’m about to share
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... um... What did he say?"

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Following Directions
Knowing your way around

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

Reading a map
Speed and accuracy in computation are no longer legitimate priorities for math education.
Technology can help make math
◊ visual
◊ interactive
◊ creative
What is the area of the small square in terms of x?

What is the area of the rectangle in terms of b and x?

Use the sliders in order.

Explain.
Make Math Interactive

The pyramid has a triangular base, which you can change by moving its vertices.

You can change the location of the yellow vertex within the upper plane, and the height of the pyramid by moving the other yellow point.
Make Math Interactive
Given a point
and a line,
construct a circle through the point,
tangent to the line.
Tools are not magic!
A Tool-Rich Pedagogy

◊ Student-centered classroom
◊ Discussion and reflection, verbalizing
◊ Cooperative learning, group work
◊ Visual bridges to concepts
◊ Microworlds
Multiple Representations

Numeric, symbolic, graphical, geometric, applied, ...
◊ To provide an entry point to more students
◊ To preview or review concepts
◊ To extend exposure
◊ To deepen understanding
◊ To increase variety
Benefits

◊ more motivation
◊ lowers the threshold: access
◊ raises the ceiling: challenge
◊ deeper understanding for all
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
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 and discussion

◊ Then, when appropriate, lecture
Class Discussion

True discussion vs. interactive lecture

Use of open-ended questions
Creating a safe environment

◊ No putdowns

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

◊ "Tell your neighbor..."

◊ "Can you restate what X said?"
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
Homework Choices
Homework

◊ Keep it reasonable
  - most learning happens at school

◊ Keep it separate from class work
  - less rushing, more cooperation
Lagging Homework

Topic 1
- Week 1 class work
- Week 2 homework
- Week 3 quiz
- Week 4 "recycle"

Topic 2
- Week 2 class work
- Week 3 homework
- Week 4 quiz
- Week 5 "recycle"
Curricular Choices
Sequencing within a course

Tackle important and/or difficult topics early

Examples from geometry:
- Inscribed angles at beginning of course
- Pythagorean theorem before congruent triangles
Sequencing within a course

Separate related topics:
◊ tangent / sine and cosine
◊ exponentials / logarithms
◊ sequences / series
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
What is the area of the red square?

Generalize
Navigating a Topic

Concepts to vocabulary and notation, and back.

Example: trig ratios on the ten-centimeter circle ("slope angles")
Navigating a Topic

Difficult to easy, and back.
Pacing

◊ “Covering” vs. uncovering / discovering
◊ Review / View / Preview
◊ When to move on

constant forward motion

eternal review
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"
Assessment Choices
Assessment Alternatives

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

Equity concerns
Keep Assessment Manageable

◊ Give homework a quick look

◊ Don't write extensive comments on tests (do they read them? do they heed them?)

When correcting work, you’re working for one student
When planning, you’re working for the whole class

Love of math and learning is not triggered by assessment
Problem Solving
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
Problems

◊ Problem vs. exercise

◊ Genuine vs. guided-by-the-nose

◊ The curriculum spectrum:
  Problem-based ... problem-rich ... problem-poor ... no problem!
Making Connections

◊ with other representations
◊ with previous knowledge

Nothing transfers
Reasoning and Sense-Making
Skills vs. concepts

Another false choice
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 and parents
◊ 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”.

◊ Don’t throw away or rule out any technique

◊ Constantly broaden your repertoire
Our Own Learning

...about math,

about learning and teaching,

is what makes the job interesting in the long haul
There is no one way
Escape from the Textbook!

Online network:
www.edWeb.net/escape