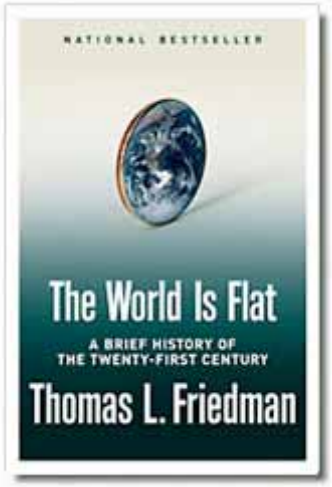
Supporting Teachers in their Classrooms to Increase Student Achievement

David Foster, Director
Silicon Valley Math Initiative
CMC-N Admin. Conference
Asilomar, Dec. 2006

Why Can’t Johnny Add?

Quest for Improving Math Instruction

- 1957 Sputnik
- 1960’s New Math
- 1970’s Individualized Instruction
- 1983 A Nation at Risk
- 1989 NCTM Standards
- 1995 Math Wars
- 1999 TIMSS
- 2001 NCLB
- 2006 National Math Panel



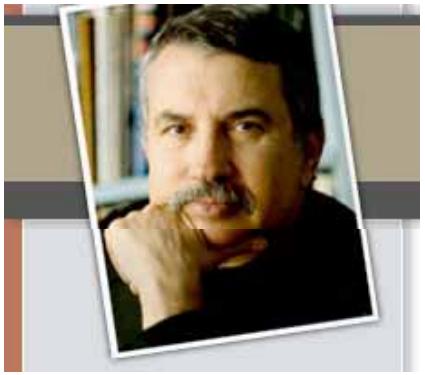
The world has been flattened.

The number of jobs requiring science and engineering skills in the US labor force is growing almost 5 percent per year.

Two-thirds of the nation's mathematics and science teaching force will retire by 2010.

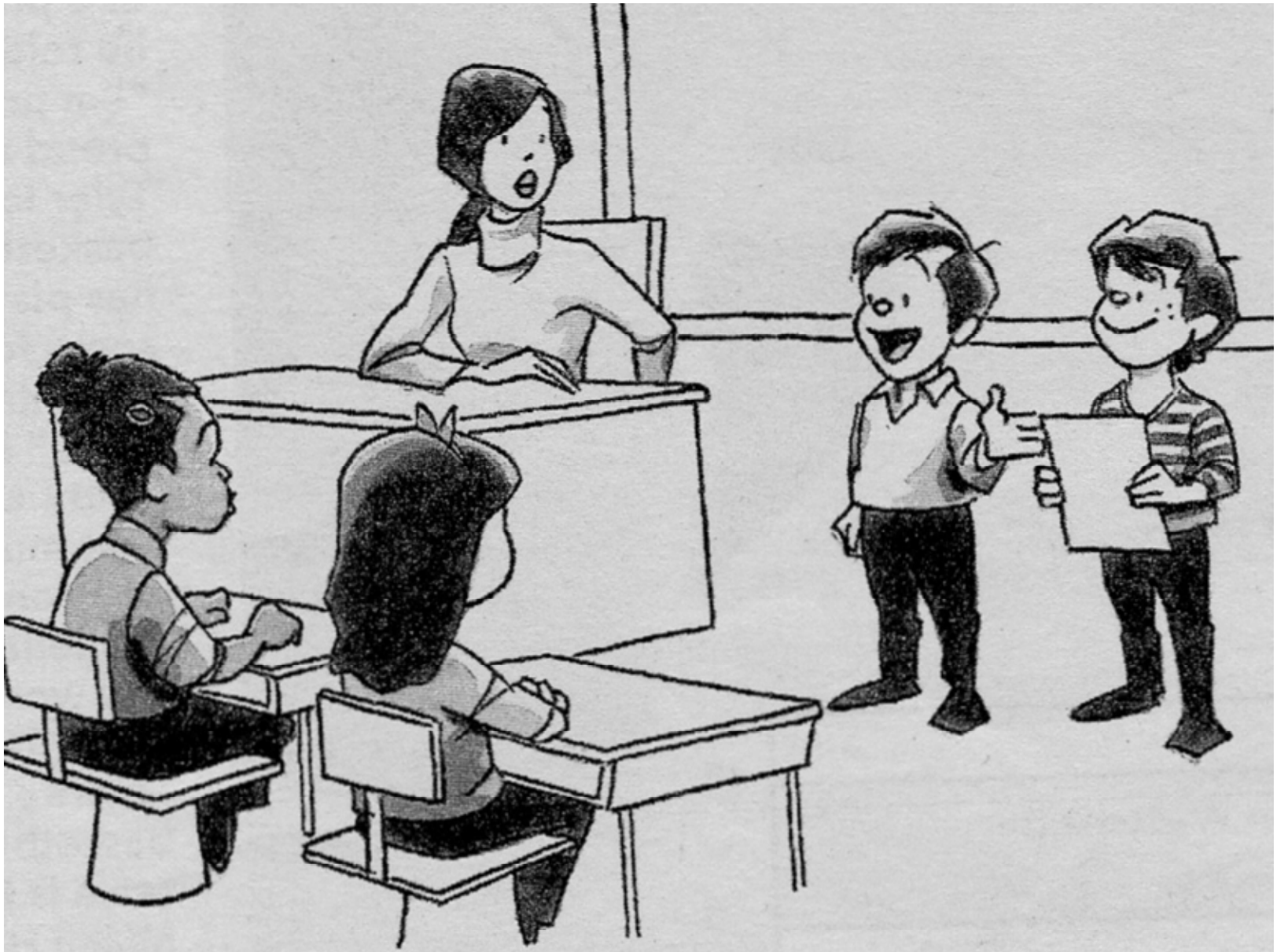
The number of Americans who graduate with just engineering degrees is 5 percent, as compared to 25 percent in Russia and 46 percent in China.

In the fiscal 2005 budget passed by the Republican Congress in November 2004, the budget for the National Science Foundation was actually cut by 1.9 percent.



The brain gain started to go to brain drain around the year 2000.

It is a truism, but the more educated you are, the more options you will have in the flat world



"Kevin will be giving my report on outsourcing."

Response from the Business Community

Competing successfully in this new global environment is essential for our national and economic security and to ensure that the U.S. is able to create high-value jobs and maintain a vital national engineering capability.

Institute of Electrical and Electronics Engineers, Inc.

Response from the Current Administration

To compete in the global economy of the 21st century, knowledge of math is critical. Today's high school graduates need to have solid math skills whether they are proceeding directly to college, or going straight into the workforce. In today's changing world, employers seek critical thinkers and practical problem-solvers fluent in today's technology.

Secretary of Education Margaret Spellings

Comparing Mathematics Instruction between the USA and other High Performing Countries

Student Achievement on 8th Grade TIMSS (math)

Country	Average scores	
	1995[1]	1999[2]
Australia[3] (AU)	519	525
Czech Republic (CZ)	546	520
Hong Kong SAR (HK)	569	582
Japan (JP)	581	579
Netherlands[3] (NL)	529	540
Switzerland (SW)	534	—
United States (US)	492	502
International average[4]	—	487

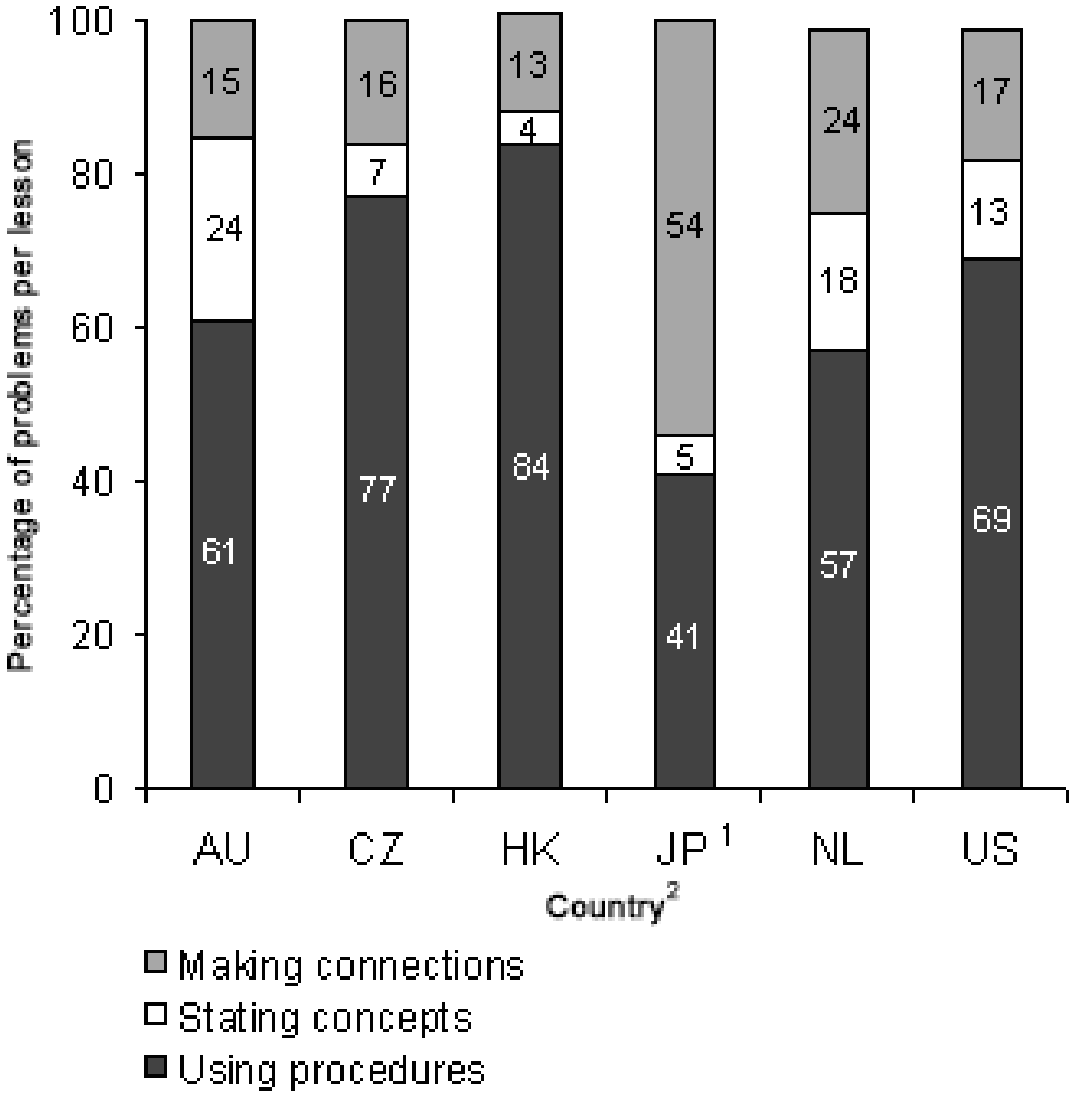
Mathematics Teaching in the United States Today (and Tomorrow): Results from the TIMSS 1999 Video Study, Hiebert, et. al

Absence of Mathematical Reasoning

…the U.S. was the only country in which no lessons contained instances of developing a mathematical justification or generalizing from individual cases.”

Mathematics Teaching in the United States Today (and Tomorrow): Results from the TIMSS 1999 Video Study, Hiebert, et. al

Problem Type Presented
Average Percent of Problems



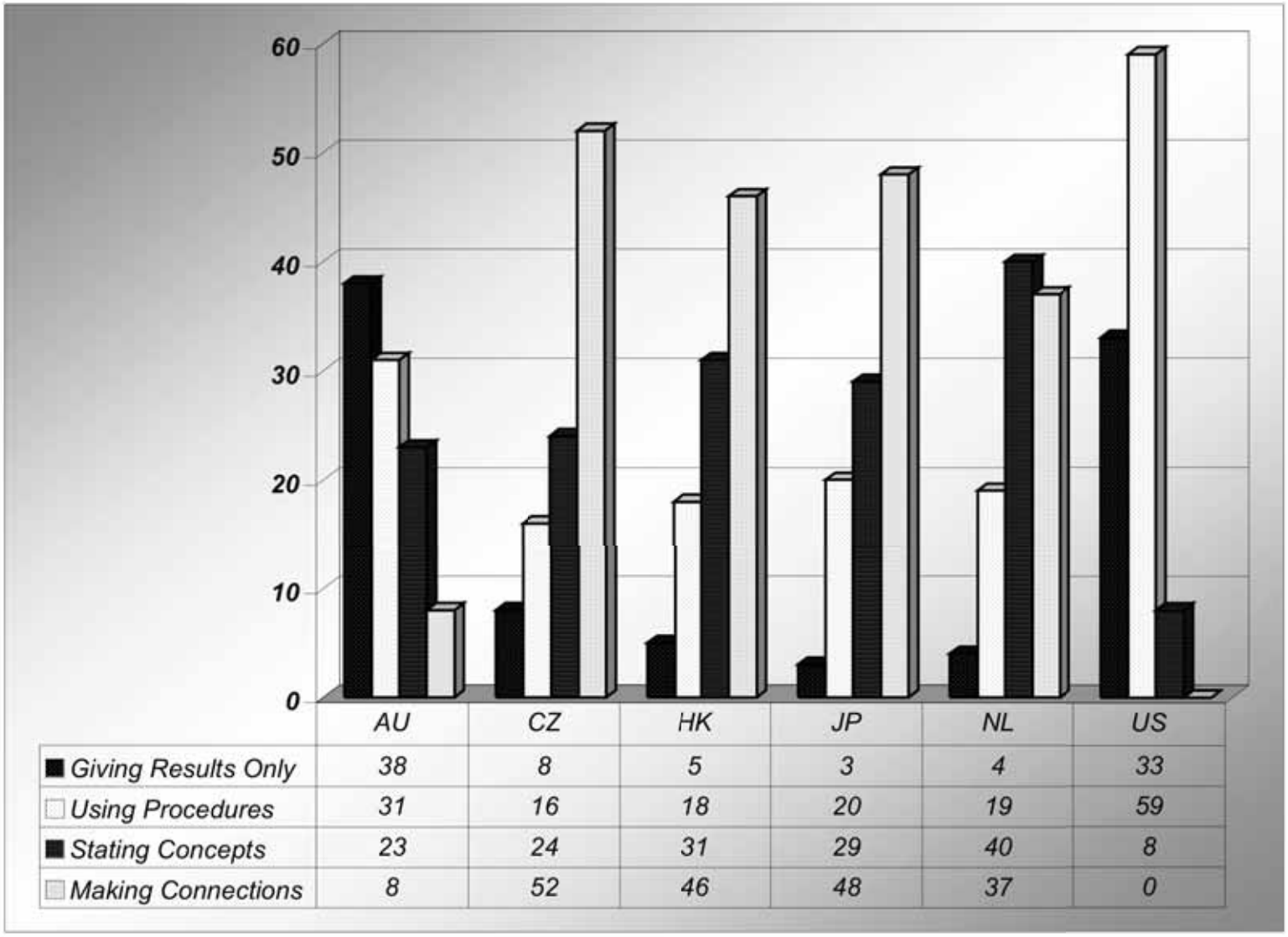
How U.S. Lessons are Different

That although the U.S. doesn't look that different in types of problems worked on (or their frequency), in the U.S., none of the problems maintained cognitive demand or relationships".

James Hiebert

Making Connections

Problems Solved by Explicitly Using Processes



	AU	CZ	HK	JP	NL	US
Giving Results Only	38	8	5	3	4	33
Using Procedures	31	16	18	20	19	59
Stating Concepts	23	24	31	29	40	8
Making Connections	8	52	46	48	37	0

Lowering the Cognitive Demand

In the U.S., none of the connections problems maintained a high level of cognitive demand in their enactment during the lesson.

Summary

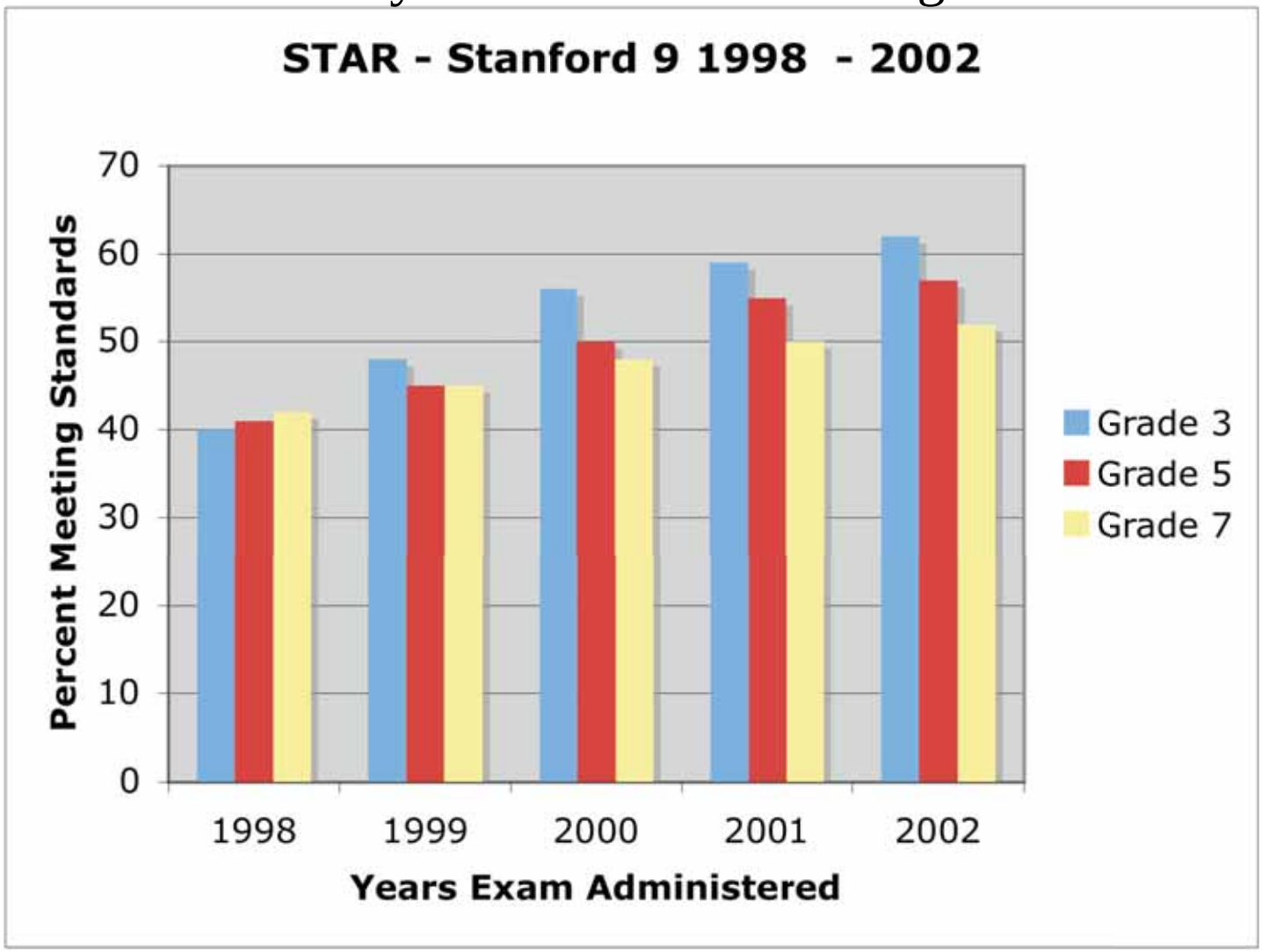
The individual findings relating to mathematical challenge accumulate to portray U.S. lessons as presenting less of a challenge than lessons in other countries.

Mathematics Teaching in the United States Today (and Tomorrow): Results from the TIMSS 1999 Video Study, Hiebert, et. al


ONE CHILD LEFT BEHIND
CONGRESS
STOP
NCLB
The Poor

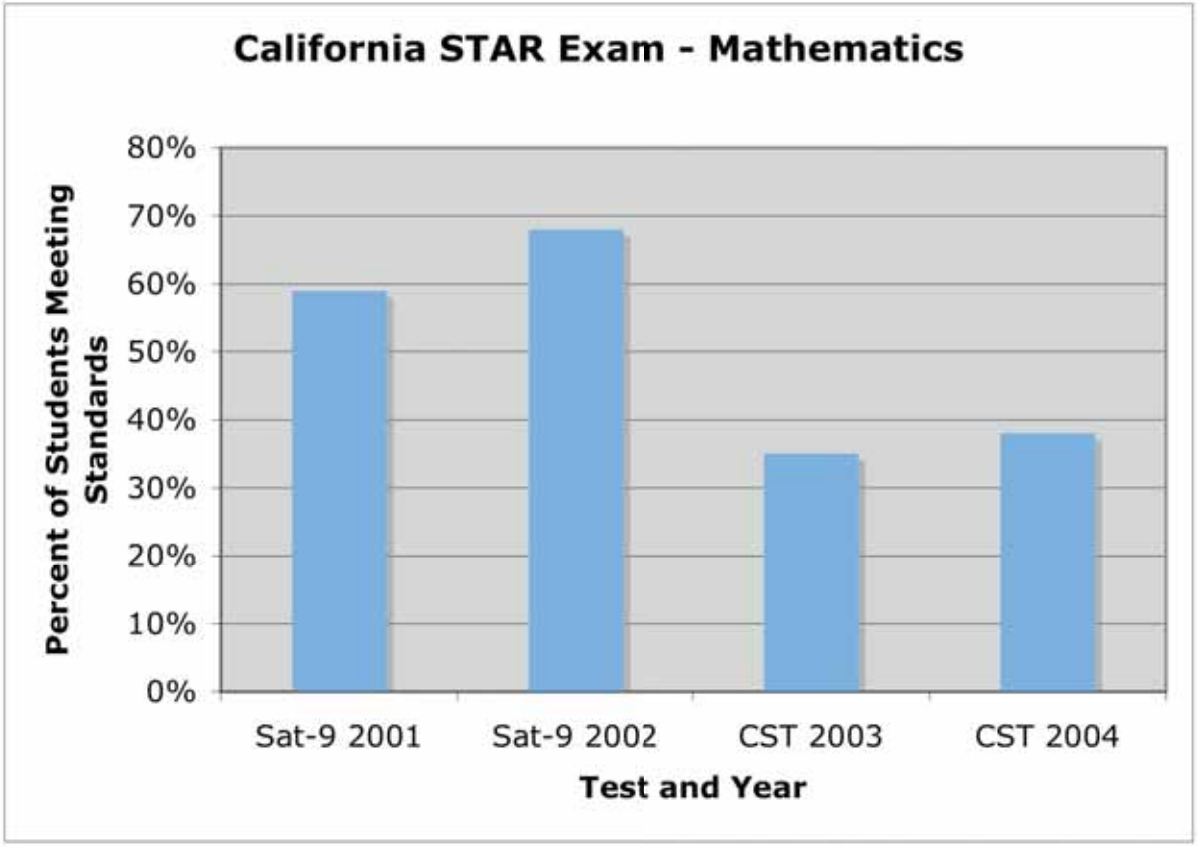
Examination of the California's STAR Program and Accountability System

Student Achievement increased on the SAT-9 during the first 5 years of the STAR Program



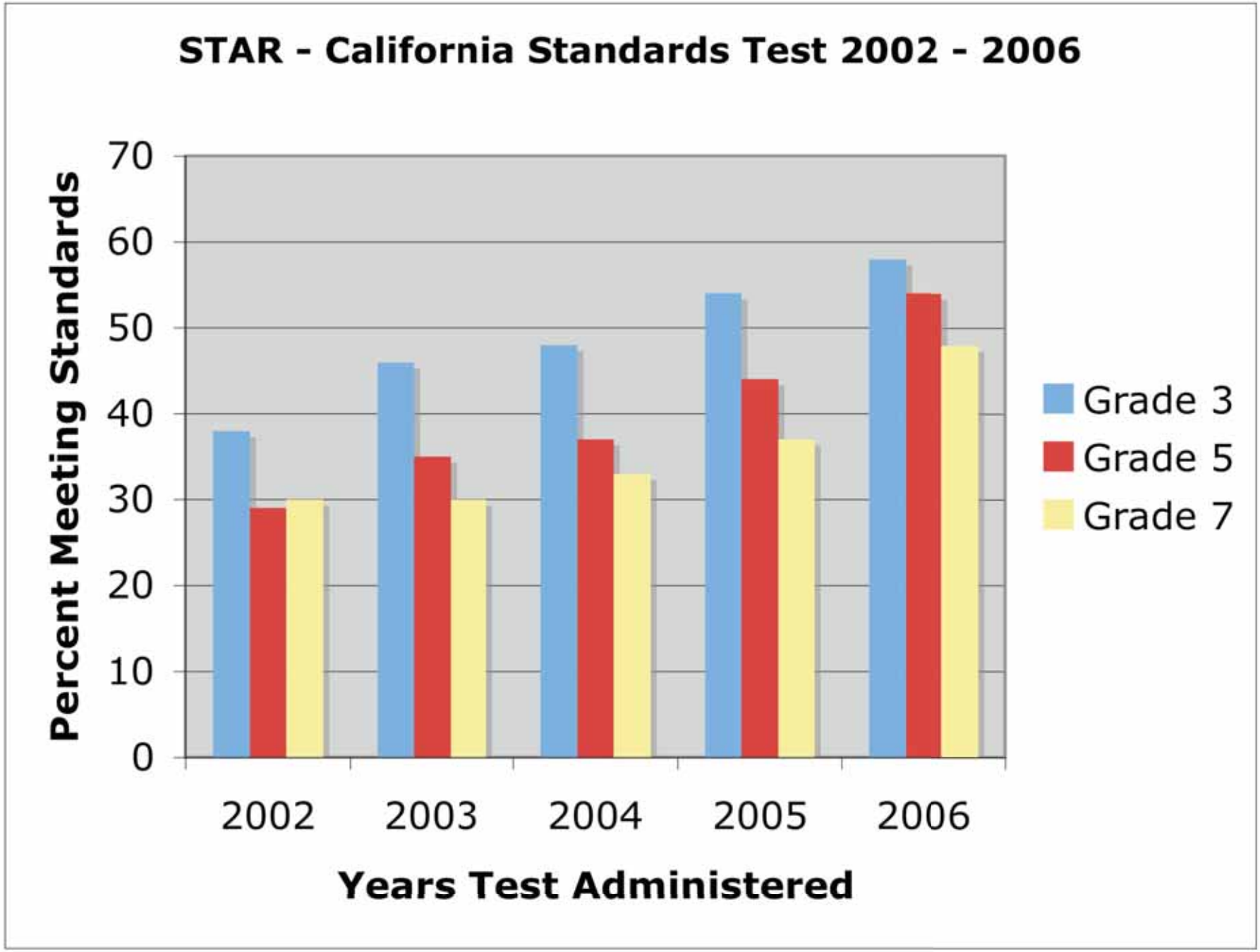
Students, no matter which county or even over the entire state, demonstrate dramatic growth (10%-20% increase) over the five years.

But, when the test was changed between 2002 and 2003, all the student achievement gains were lost.



Comparison of California's Fifth Grade 2001 SAT-9 Math, 2002 SAT-9 Math, 2003 CST Math,2 004 CST Math

So the gains were about test-taking not learning


STAR - California Standards Test 2002 - 2006
Percent Meeting Standards
70
60
50
40
30
20
10
0
2002
2003
2004
2005
2006
Years Test Administered
Grade 3
Grade 5
Grade 7

Gap in Performance

In 2005, nearly 30% of the fourth grade students who were proficient or advanced on the CST Math Test, did not meet standards on NAEP. Passing standardized test does not necessarily equate to learning.

For the 2005-06 school year, 121 schools exited Program Improvement and 320 California schools were newly identified for a net increase of 199 schools. The number of PI schools keep rising.

Mathematics Performance Discrepancies in 2005: State Test Performances Versus NAEP Performances

- There were only three states in which the NAEP[1] performance percentage was higher than the state performance percentage: Hawaii (1 percent); Massachusetts (9 percent); and Wyoming (4 percent).

- For the remaining 42 states, the discrepancies in the two percentages, with the state percentages being equal to or greater than the NAEP percentages, ranged from 0 percent (Maine) to 60 percent (Colorado and Mississippi). The grade 4 performance discrepancy gaps were grouped as follows.
    - 0 to 10 percent: 2 states (ME, SC)
    - 11 to 20 percent: 7 states (AR, KY, MO, MT, NM, RI, WA)
    - 21 to 30 percent: 5 states (CA, FL, NV, OH, PA)
    - 31 to 40 percent: 10 states (AK, CT, IN, KS, LA, MD, MI, MN, NJ, WI)
    - 41 to 50 percent: 14 states (AZ, DE, GA, ID, IL, IA, NE, NY, OK, OR, SD, TX, VA, WV)
    - 51 to 60 percent: 4 states (AL, CO, MS, NC)

1 NAEP 2005 4th Grade

Primary Progress, Secondary Challenge:
A State-by-State Look at Student Achievement Patterns
The Education Trust American Association for Higher Education, 2006

The Drop-Out Disaster

1. Nationally, about one-third of all high school students fail to graduate with their class.
2. For whites and Asian students, the graduation rate is about 75 percent; for minority students (African-American, Hispanic, Native American), the rate is about 50 percent.
3. In 2003, there were 3.5 million Americans aged 16 to 25 who had not graduated from high school and who were not enrolled in school.

College Prep Math and World Class Standards

In 1998, California defined Algebra 1 as the math content for all 8th Graders. Under the pressure of high-stakes testing and severe sanctions the experiment is failing.

Despite the State push toward 8th grade Algebra, only 44.7% of 8th graders took the Algebra I CST in 2005 and only 15% of the 8th graders met standard on the exam.

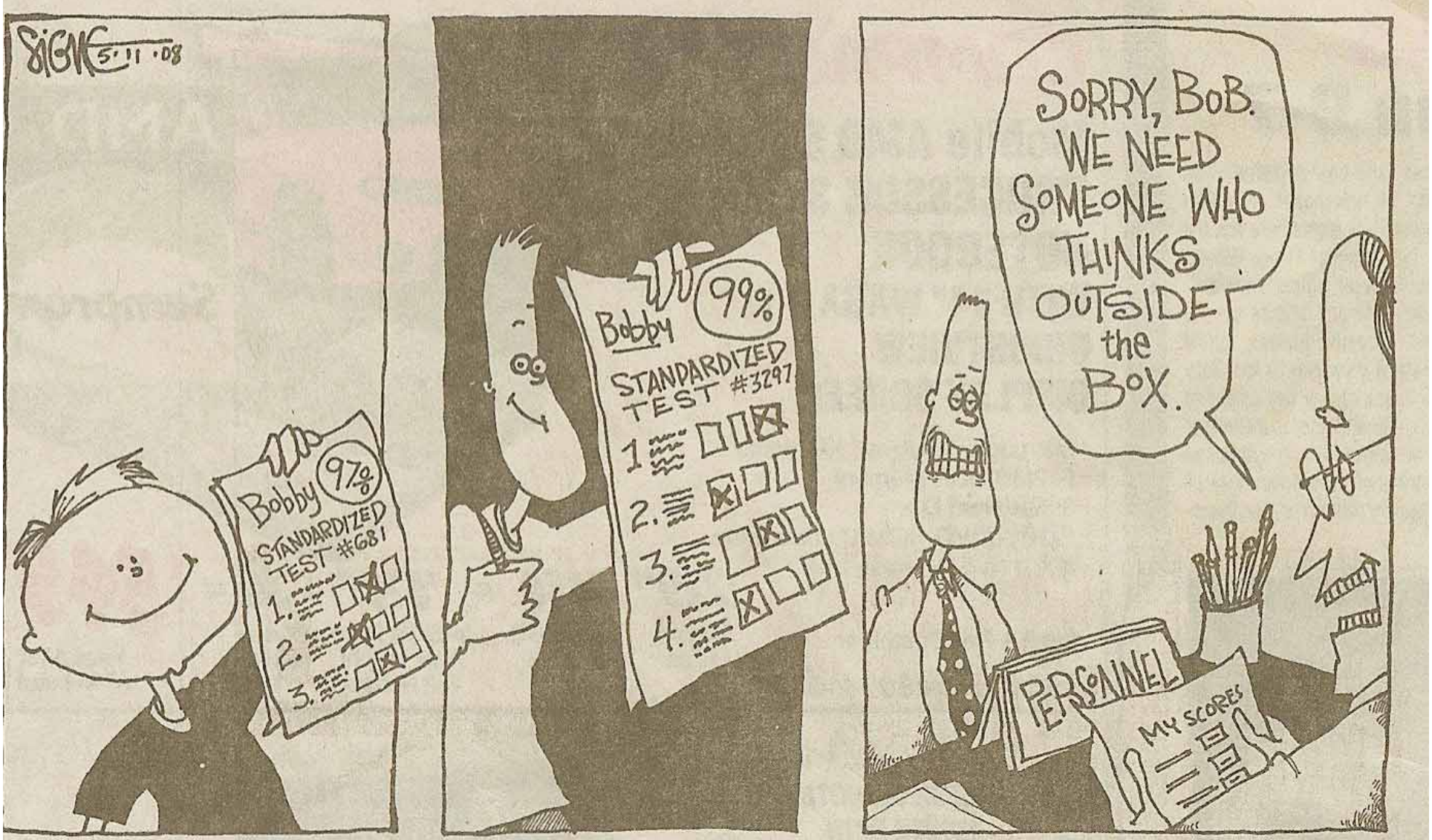
Then in 2006, 49% of 9th graders were enrolled in a beginning algebra course and 21% took geometry. At the end of that year, only 9% met standard in algebra and 9% in geometry. The failure rate is clearly very high.

College Prep Mathematics in California

Year	Course Enrolled	Alg 1	Geom	Alg 2	Total
2003	Eighth Grade	32%	2%		34%
2004	Ninth Grade	43%	17%	3%	63%
2005	Tenth Grade	28%	29%	17%	74%
2006	Eleventh Grade	16%	18%	23%	57%
	Total	119%	66%	43%	

Accumulated Results over 4 Years

Class of 2007	% of Std
Met Standard Alg 1	21%
Met Standard Geom	14%
Met Standard Alg 2	10%

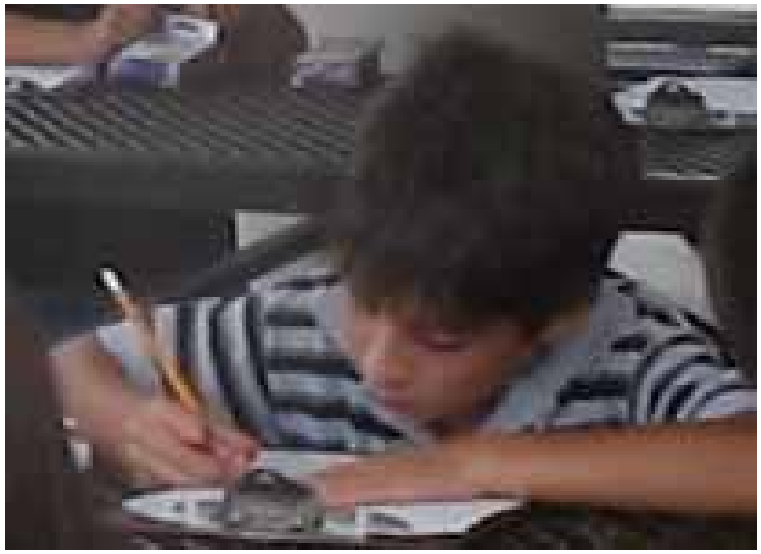


SIGNE WILKINSON — KNIGHT RIDDER

The Solution to Improving Student Achievement?

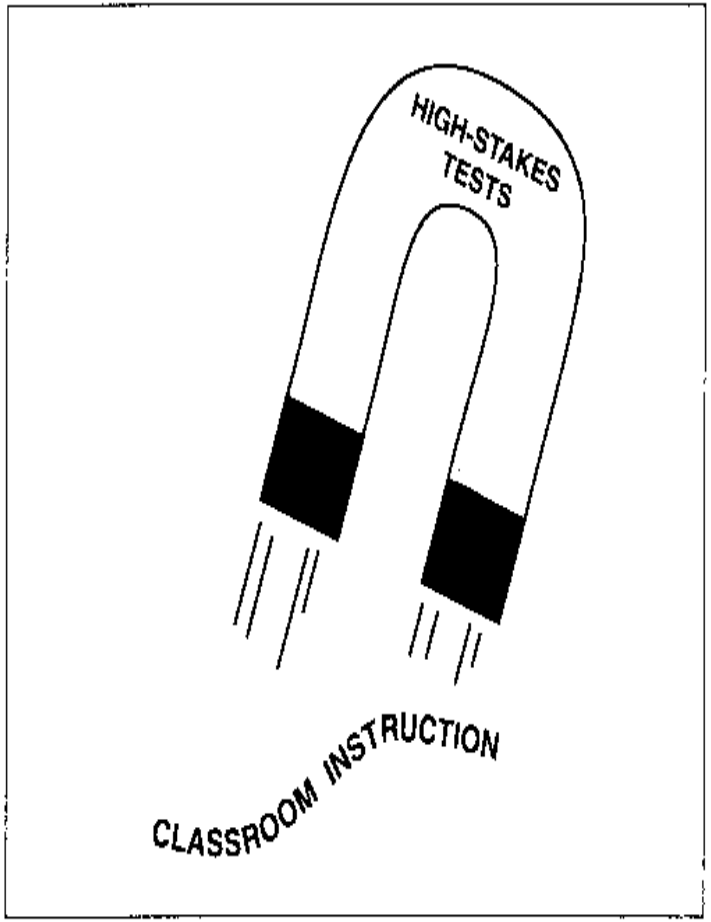
Teacher Proofing Instruction

The Deficit Model of Intervention for Teachers



Unfortunately state and federal approaches to improving instruction centers on a belief that too many teachers can't teach well, so the aim is to neutralize poor instruction by limiting curriculum/textbook options, providing scripts and pacing guides, assigning benchmark tests, focusing on merely basic procedures and skills, and punishing low test scores.

Teaching to the Test



"The drill and kill curriculum that accompanies high-stakes, one-size-fits-all testing programs undermines rather than improves the quality of education. Intensified testing has especially hurt education for low-income, African American and Latino students."

Monty Neill, Ed.D., National Center for Fair & Open Testing.

Comparison student performance on the MARS and CST 2006

Seventh Grade	MARS Below Standards	MARS Above Standards
CST Below Standards	**42.8%**	**4.6%**
CST Above Standards	**20.0%**	**32.6%**

Eighth Grade	MARS Below Standards	MARS Above Standards
CST Below Standards	**52.1%**	**10.1%**
CST Above Standards	**12.4%**	**25.5%**

Algebra One	MARS Below Standards	MARS Above Standards
CST Below Standards	**48.5%**	**6.2%**
CST Above Standards	**10.1%**	**35.2%**

Testing ≠ Learning

“Once again, independent data demonstrate that the nation cannot test its way to educational quality. It's time to abandon the failed test-and-punish quick fix and get on with the hard work of identifying the real causes of student learning problems, then addressing them effectively. "

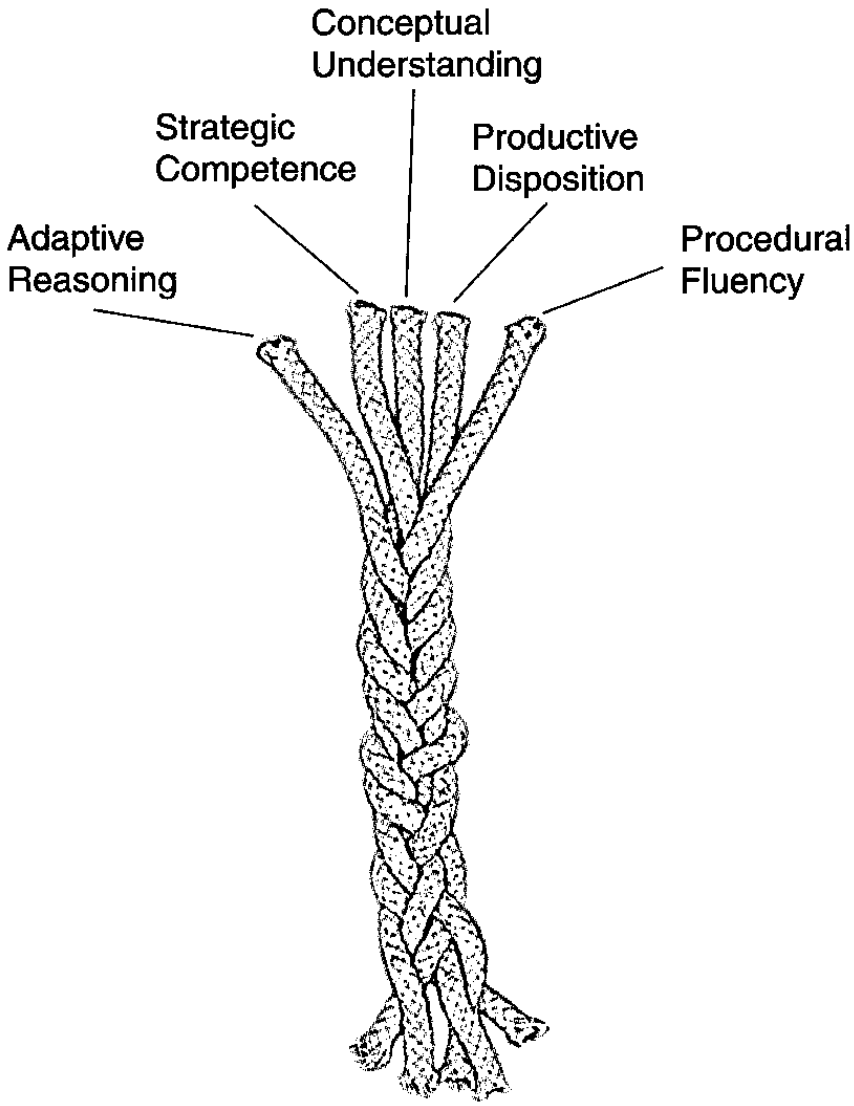
Monty Neill, Ed.D., National Center for Fair & Open Testing.

Video of our Teacher's Dilemma

Teaching Matters

To Really Improve Student Learning - Invest in Teachers

Intertwined Strands of Proficiency



Adding It Up: Helping Children Learn Mathematics, **NRC**, 2001

Depth of Knowledge

Level 1: Recalling and Recognizing:
Student is able to recall routine facts of knowledge and can recognize shape, symbols, attributes or other qualities.

Level 2: Using Procedures:
Student uses or applies procedures and techniques to arrive at solutions or answers.

Level 3: Explaining and Concluding:
Student reasons and derives conclusions. Student explains reasoning and processes. Student communicates procedures and findings.

Level 4: Making Connections, Extending and Justifying:
Student makes connections between different concepts and strands of mathematics. Student extends and builds on knowledge to a situation to arrive at a conclusion. Students use reason and logic to prove and justify conclusions.

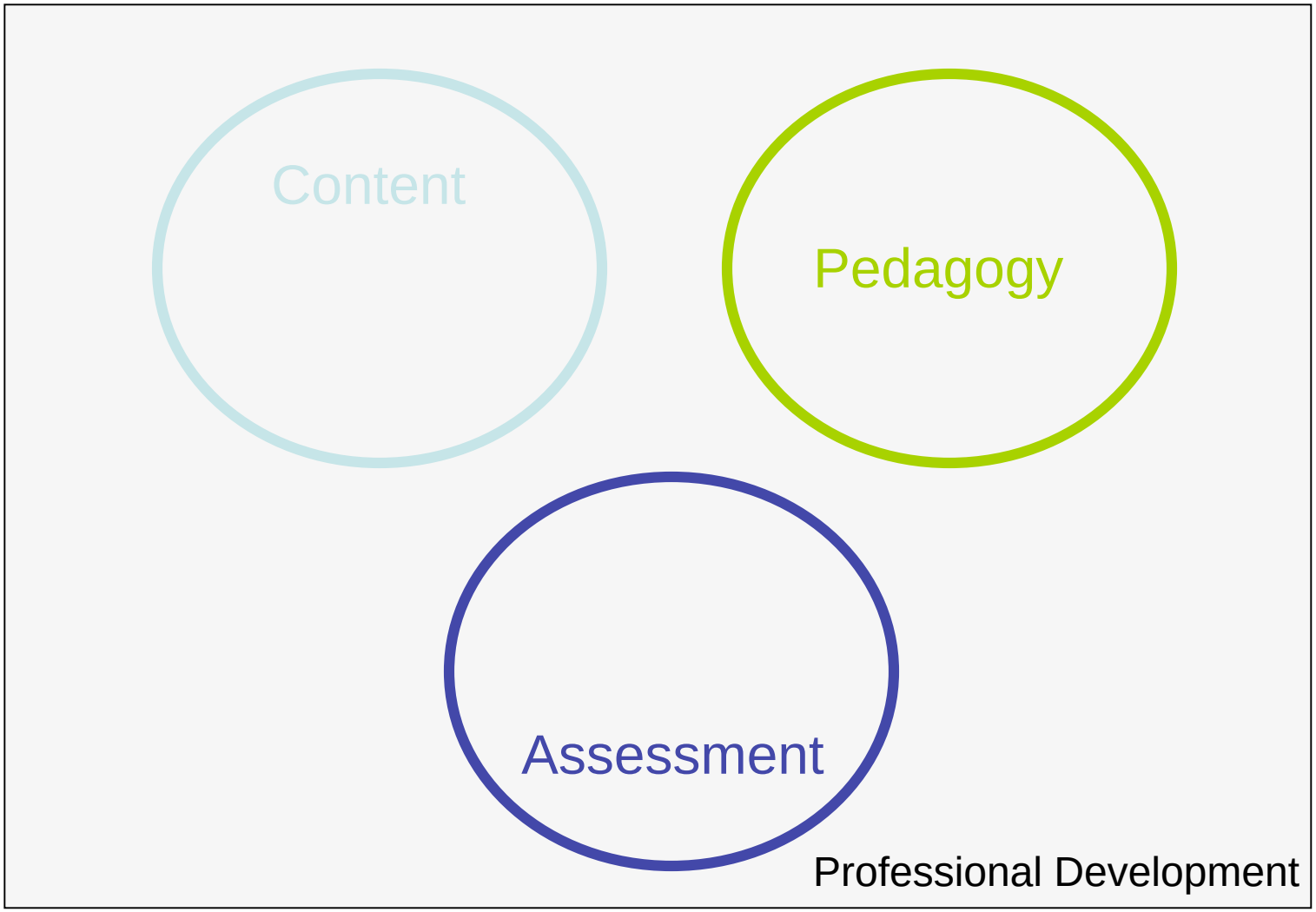
Adapted from the work of Norman L. Webb

Grappling with Teacher Knowledge

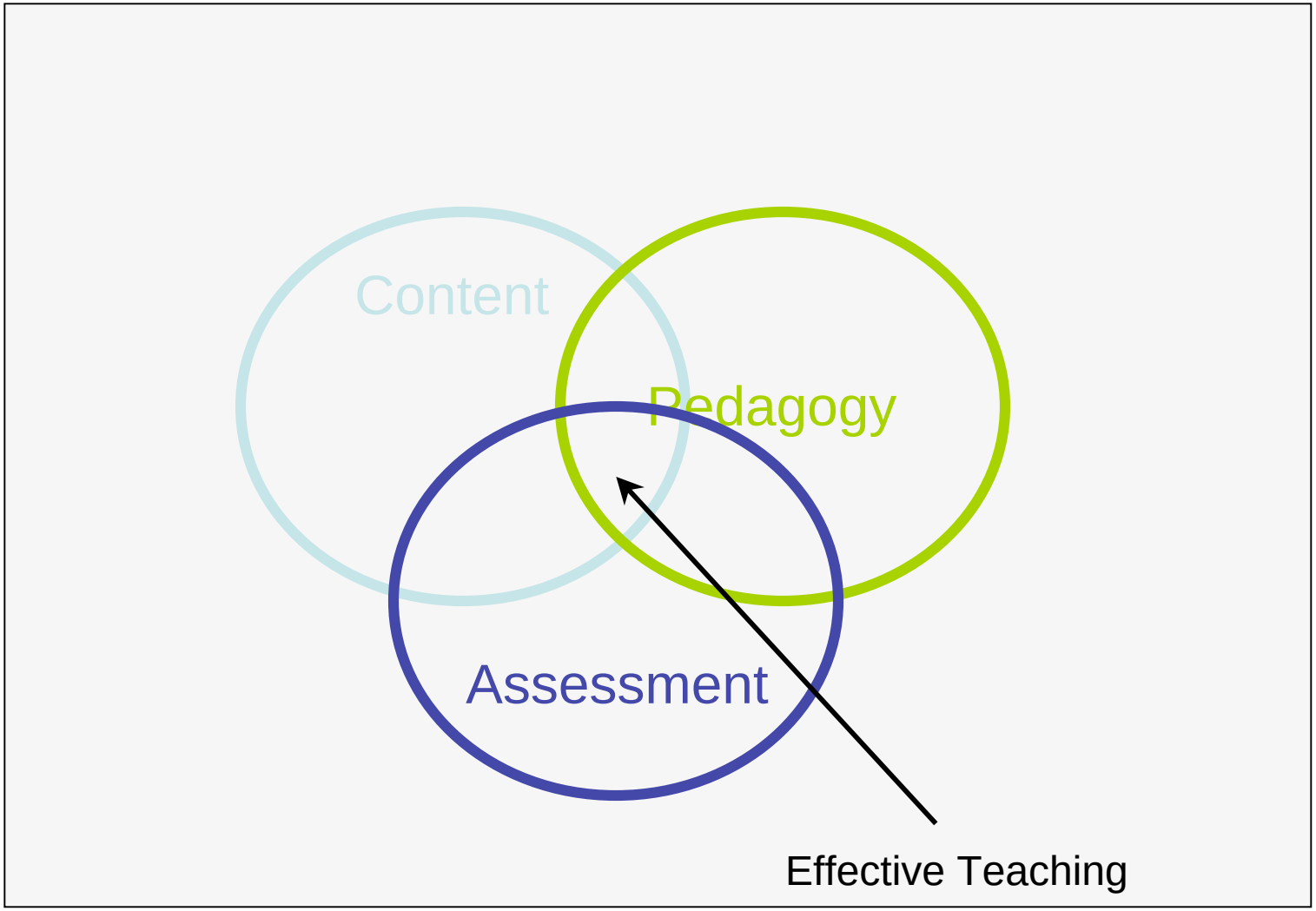
“Teaching mathematics requires an appreciation of mathematical reasoning, understanding the meaning of mathematical ideas and procedures, and knowing how ideas and procedures connect.”

Ball, 1990

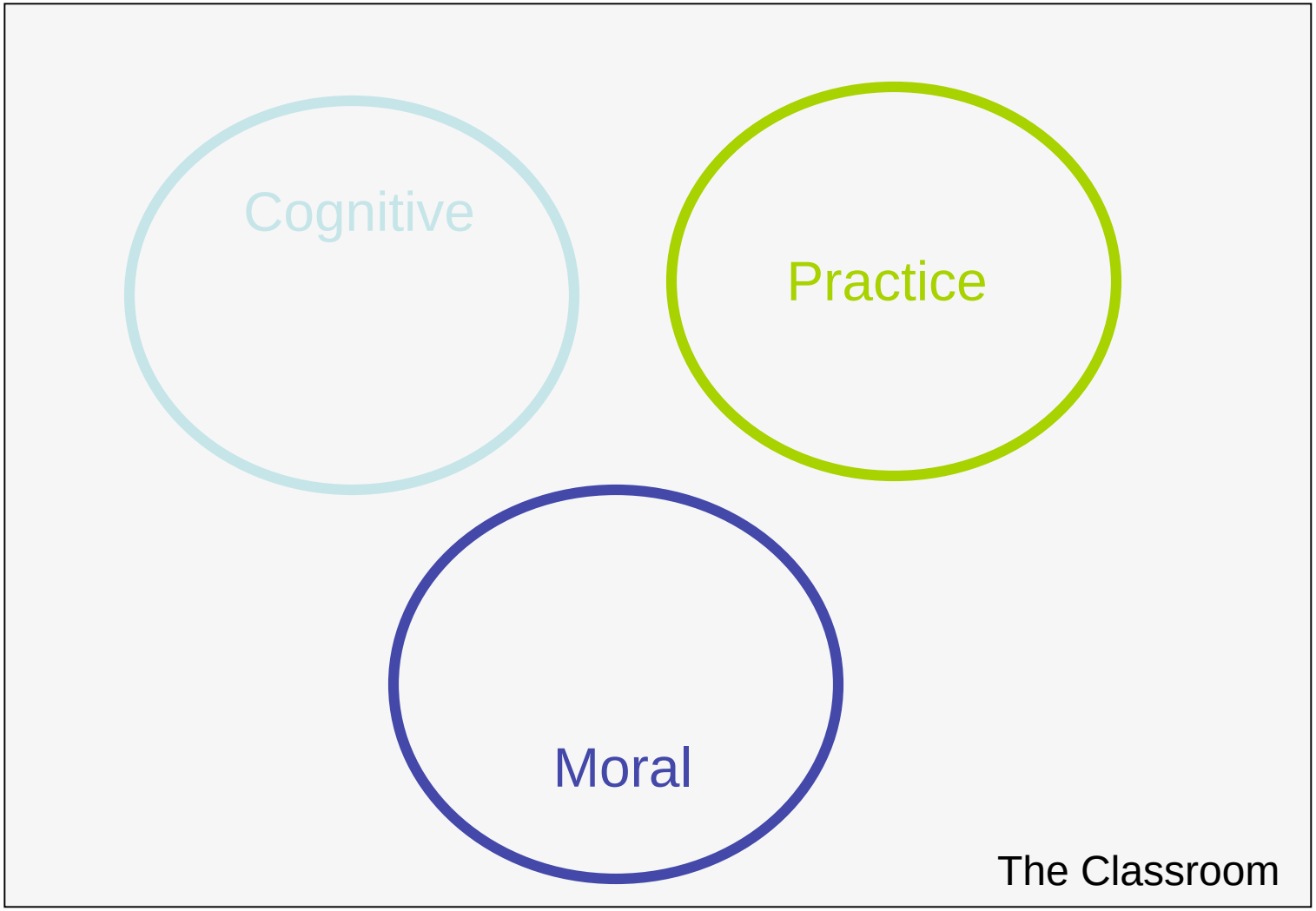
Traditional Approach to Preparing Teachers



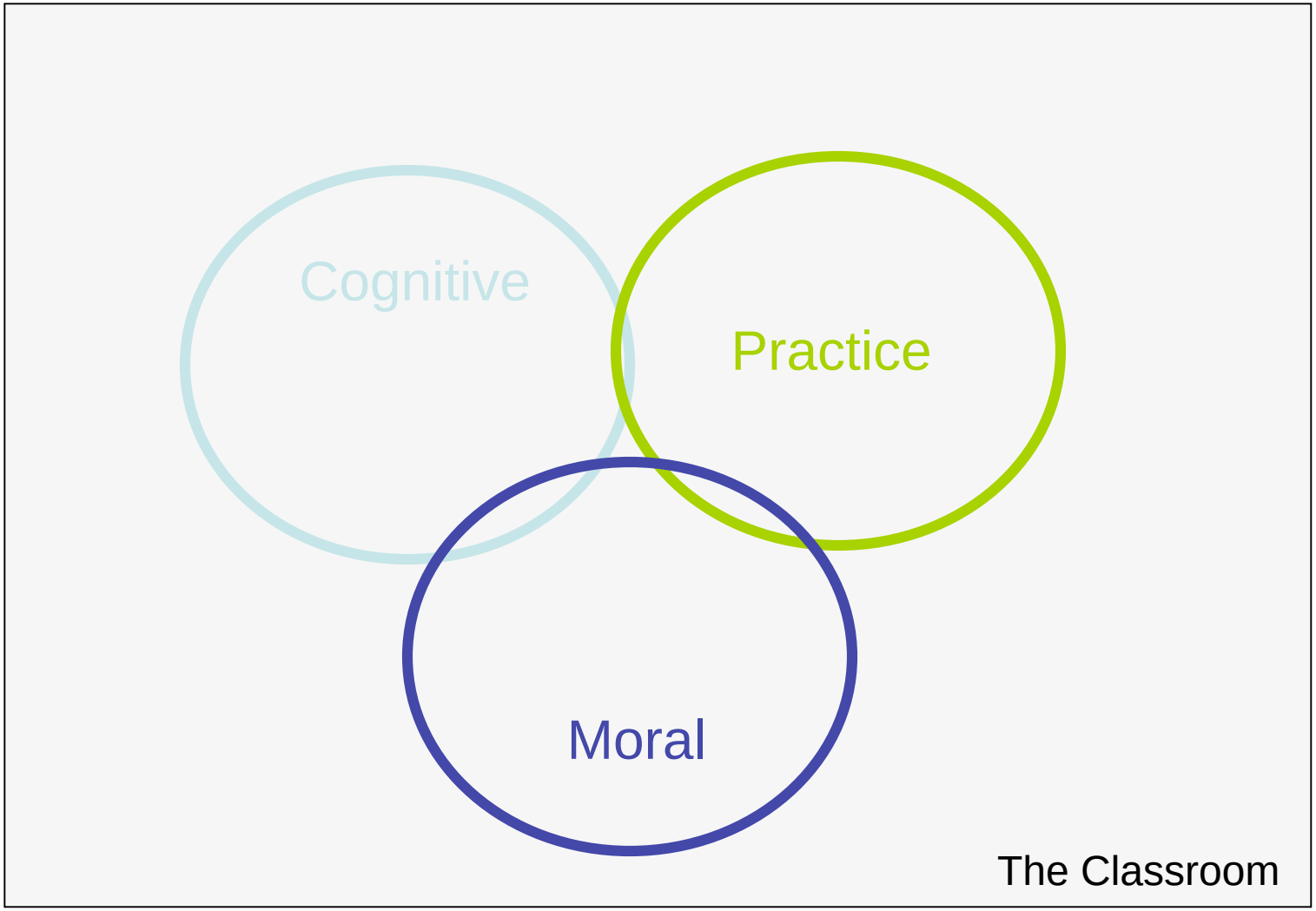
Effective Teaching is at the Intersection



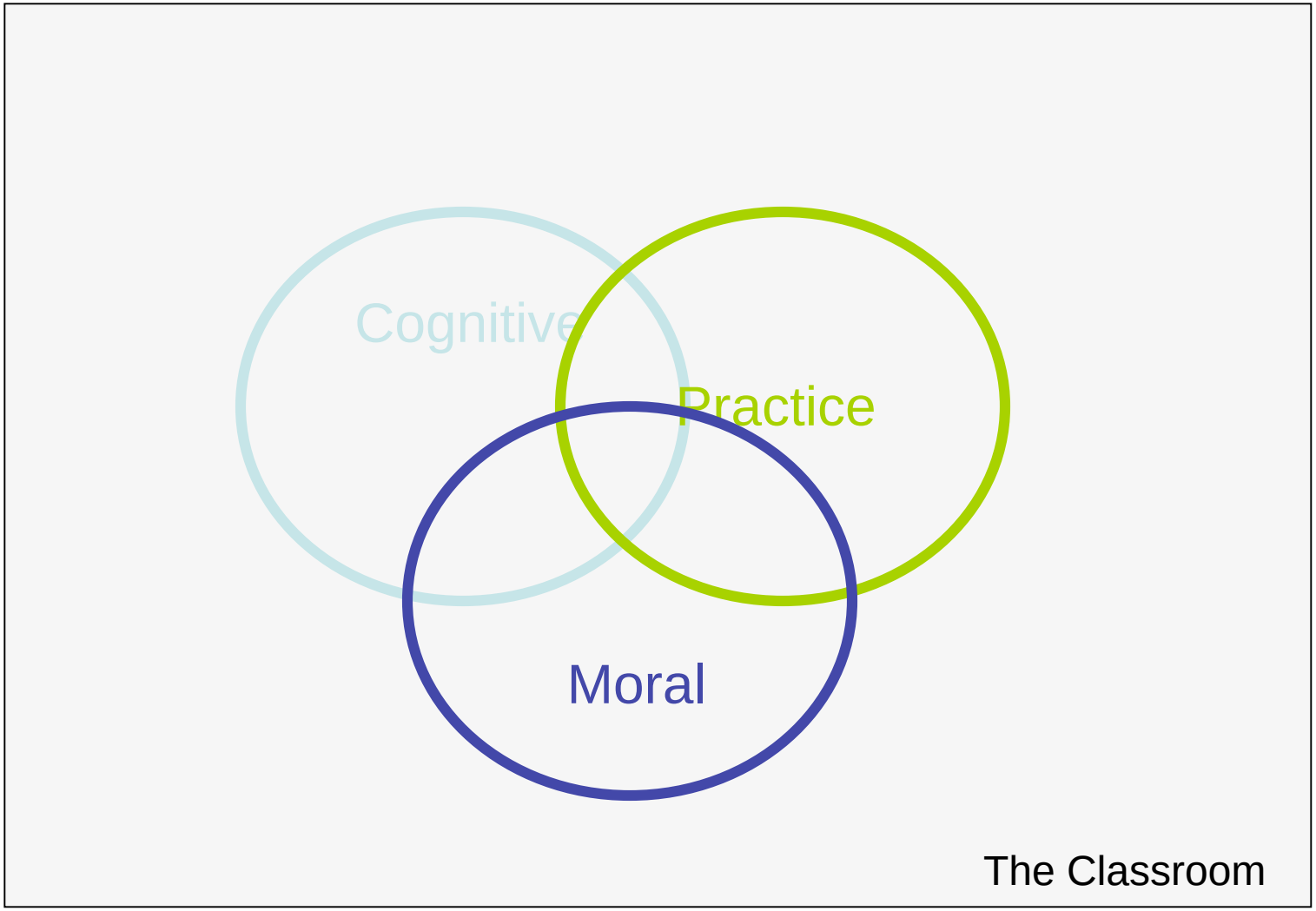
Teacher Knowledge



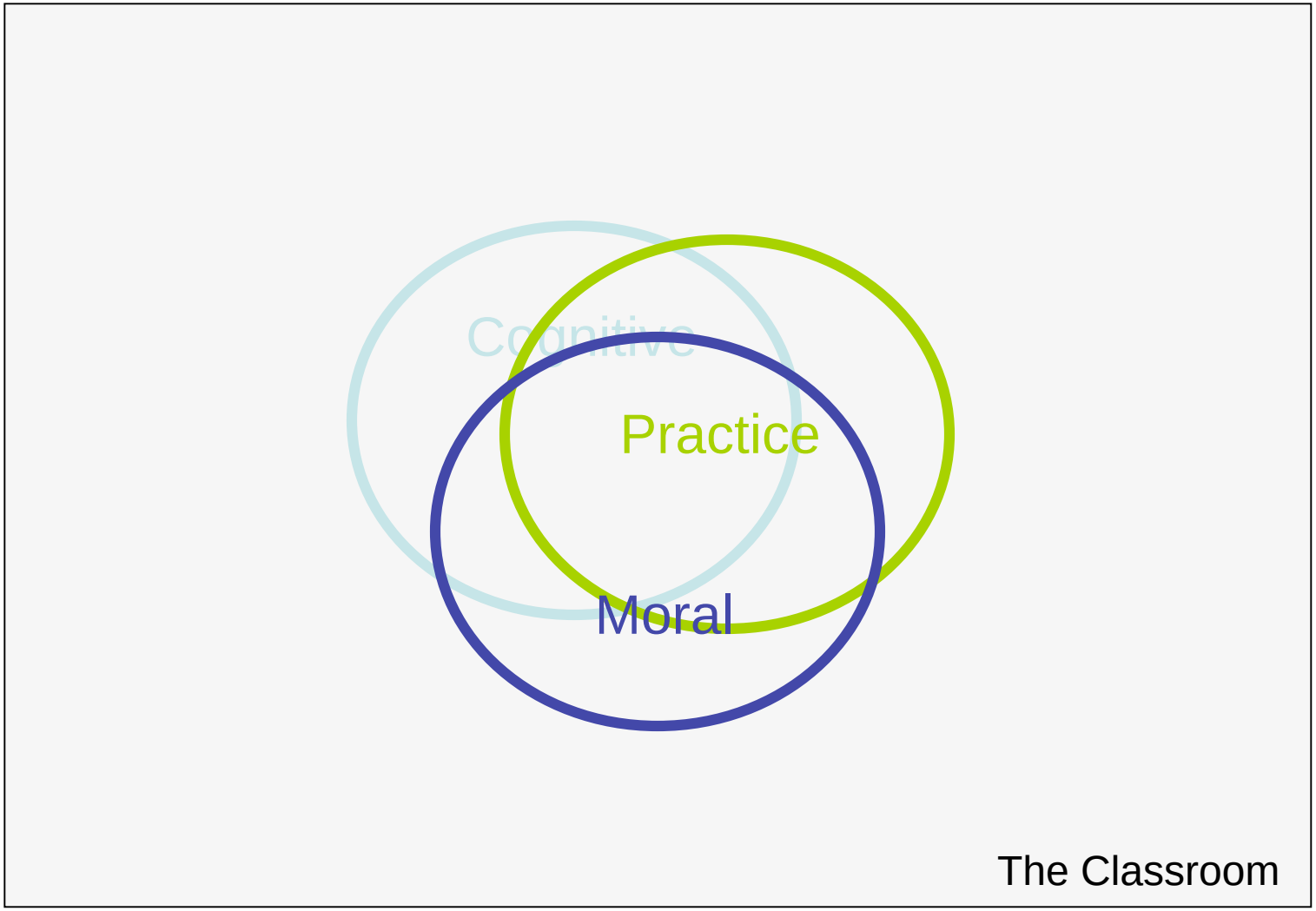
Teacher Knowledge



Teacher Knowledge



Teacher Knowledge



Teacher Knowledge

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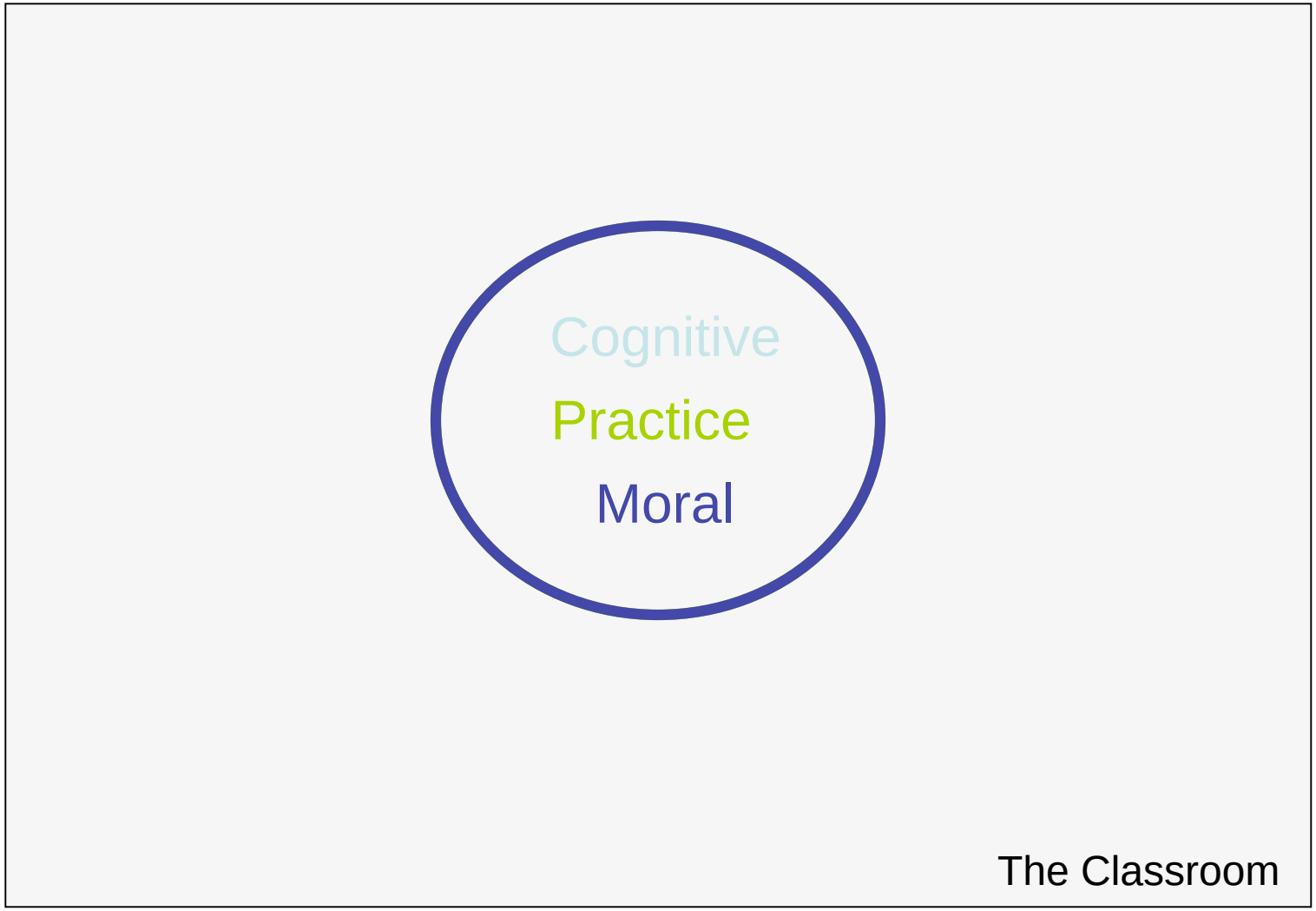


The Challenge of Teaching

Mathematics is perceived as a body of knowledge.

Yet,

Mathematics is a practice of problem solving.

A central practice of teaching is also problem solving.

Paraphrase Hy Bass

Sixth Grade Math Class

- Students are working on making sense of decimals.
- The class has in the past used benchmark numbers to make sense of other numbers; such whether a number is greater than or less than a benchmark such as 1/2 or 0.5.
- The class has found the decimal $0.1\overline{6}$ to represent 1/6.
- Their task is to determine decimal equivalence for 2/6, 3/6, 4/6 and 5/6.

What knowledge does a teacher need in making real time decisions?

Cognitive

- Did the students make valid math argument?
- What is correct and what is incorrect in students understanding?
- How might 6th grade students understand repeating decimals?
- How does that student's explanation relate to the math goals of the lesson?

Practice

- Was the student's explanation clear to the class?
- Should I repeat it, correct it, or comment about it?
- Should I ask another student to clarify?
- Should I ask another student for a different explanation?
- Should I ask the groups to discuss it?

Moral

- Which students understand?
- What should I do for the students that don't?
- How do I get Dylan to engage?
- If I asked Juanita to present, would that cause embarrassment?
- Am I honoring everyone's ideas?

“One thing is to study whom you are teaching, the other thing is to study the knowledge you are teaching. If you can interweave the two things together nicely, you will succeed…Believe me, it seems to be simple when I talk about it, but when you really do it, it is very complicated, subtle, and takes a lot of time. It is easy to be an elementary school teacher, but it is difficult to be a good elementary school teacher.”

Quote from Tr. Wang, Ma 1999

Strategies to Improving Teaching

- Using Student Thinking to Inform Instruction.
- Maintaining Cognitive Demand in Mathematics Lessons.
- Addressing Access and Status for Students.
- Enhancing Teacher Knowledge.
- Engaging Teachers in Productive Professional Development.
- Supporting Collegial Professional Learning Communities.

Using Student Thinking to Inform Instruction.

Focusing on students' thinking is the key to teaching for understanding.

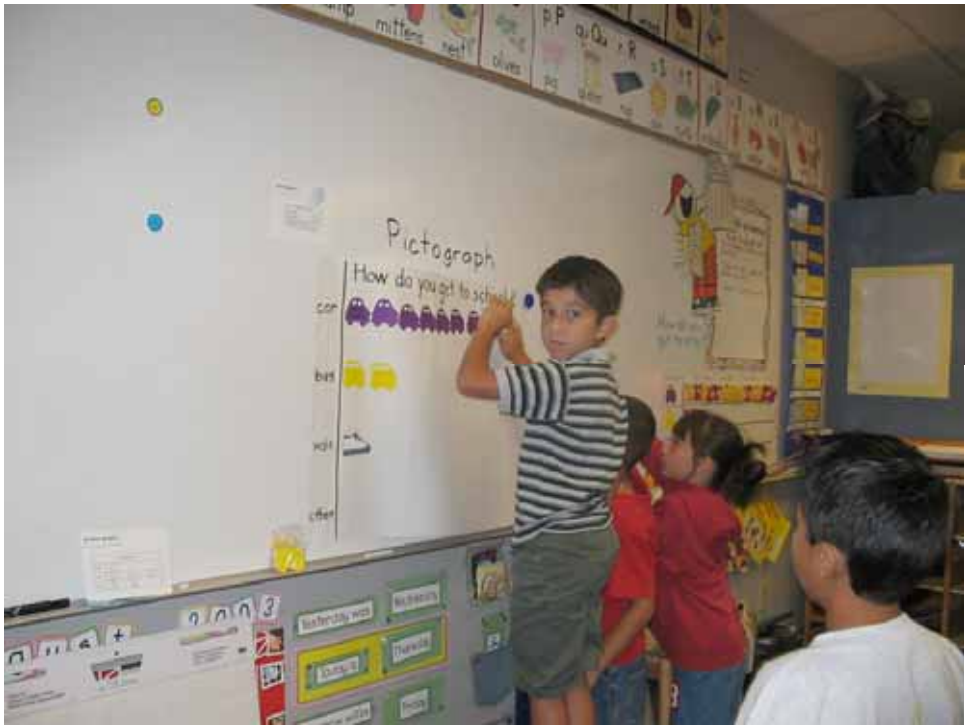
Teachers need to use student work, thinking, understanding and misconceptions to tailor instruction and improve student learning

Maintaining Cognitive Demand in Mathematics Lessons.

The results of the TIMSS Video Study showed that although U.S. teachers used many tasks that could have required a high cognitive demand from students, the actual implementation always lowered the cognitive demand of the tasks.

Addressing Access and Status for Students

"All students can learn mathematics" has to be more than a nice slogan. Teachers must employ strategies to provide access and equity for all students. This includes paying attention to the role of status in the classroom and creating a community of learners.



Engaging Teachers in Productive Professional Development

Engage teachers in experiences that build teachers' content knowledge, confidence and instructional strategies while developing a mutual relationship of trust and collaboration.

Enhancing Teacher Knowledge

It is widely accepted that we must support teachers in gaining mathematical content knowledge, pedagogical content knowledge, and developing an ongoing cycle of reflective learning.

Supporting Collegial Professional Learning Communities

Teachers must work together and learn from one another in a professional learning community. This requires a structured program of reflection and attention to students' thinking and their work.

Summary Thoughts

- Unfortunately K-12 math instruction has a well too recognized *Signature Pedagogy…* that needs to be changed.
- Teacher Knowledge involves more than content -- cognitive,practice and moral.
- Teacher Knowledge should be measured by *flexibility* (reactive to concepts, responsive to students' thought, sensitive to students' needs).
- Building Teacher Knowledge is a life-time, ongoing process of growth and learning - which is a dramatic shift in thinking, policy and resource allocation.

For a copy of the PowerPoint,

download from:

www.noycefdn.org/math/resources.html