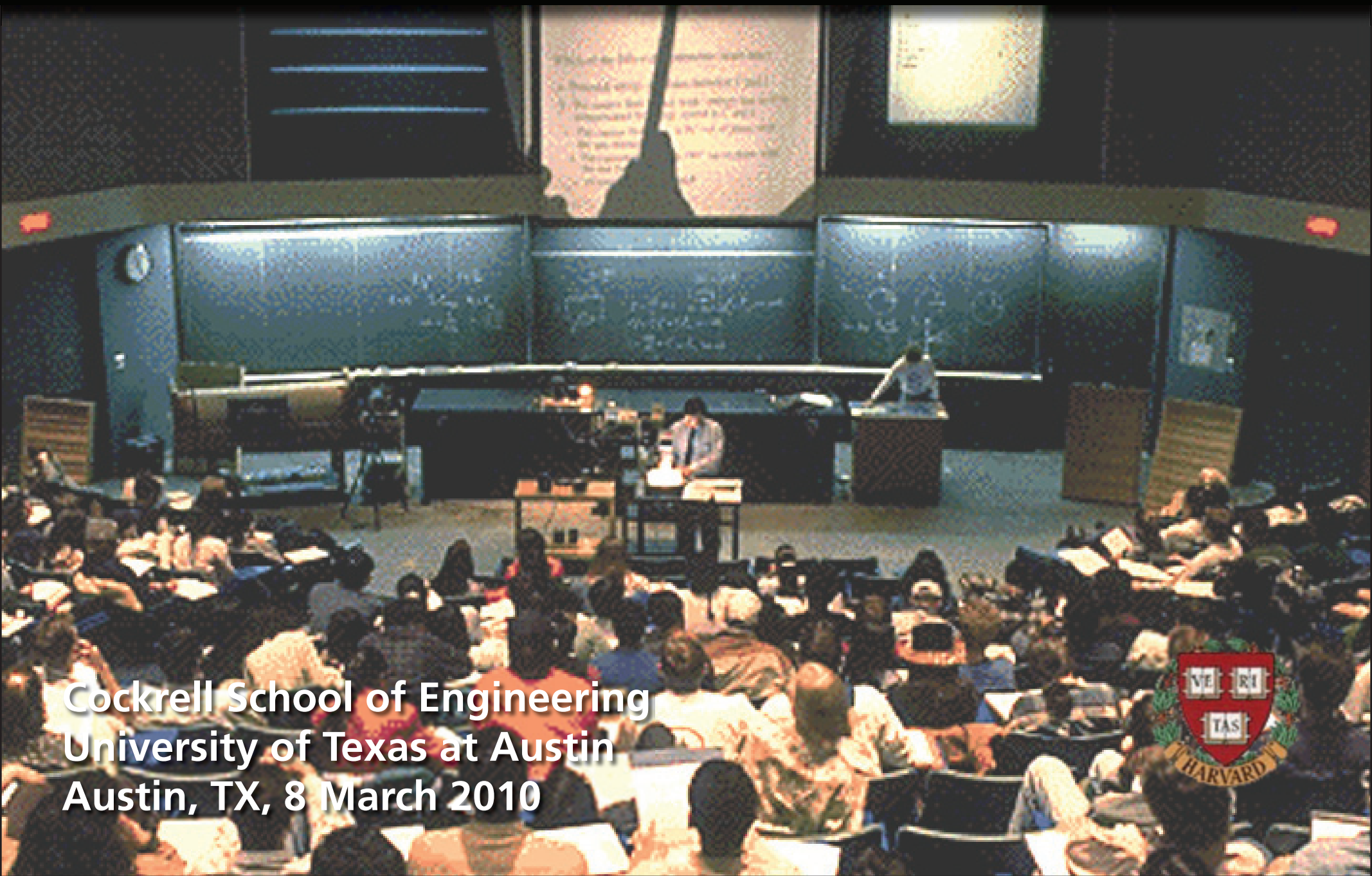
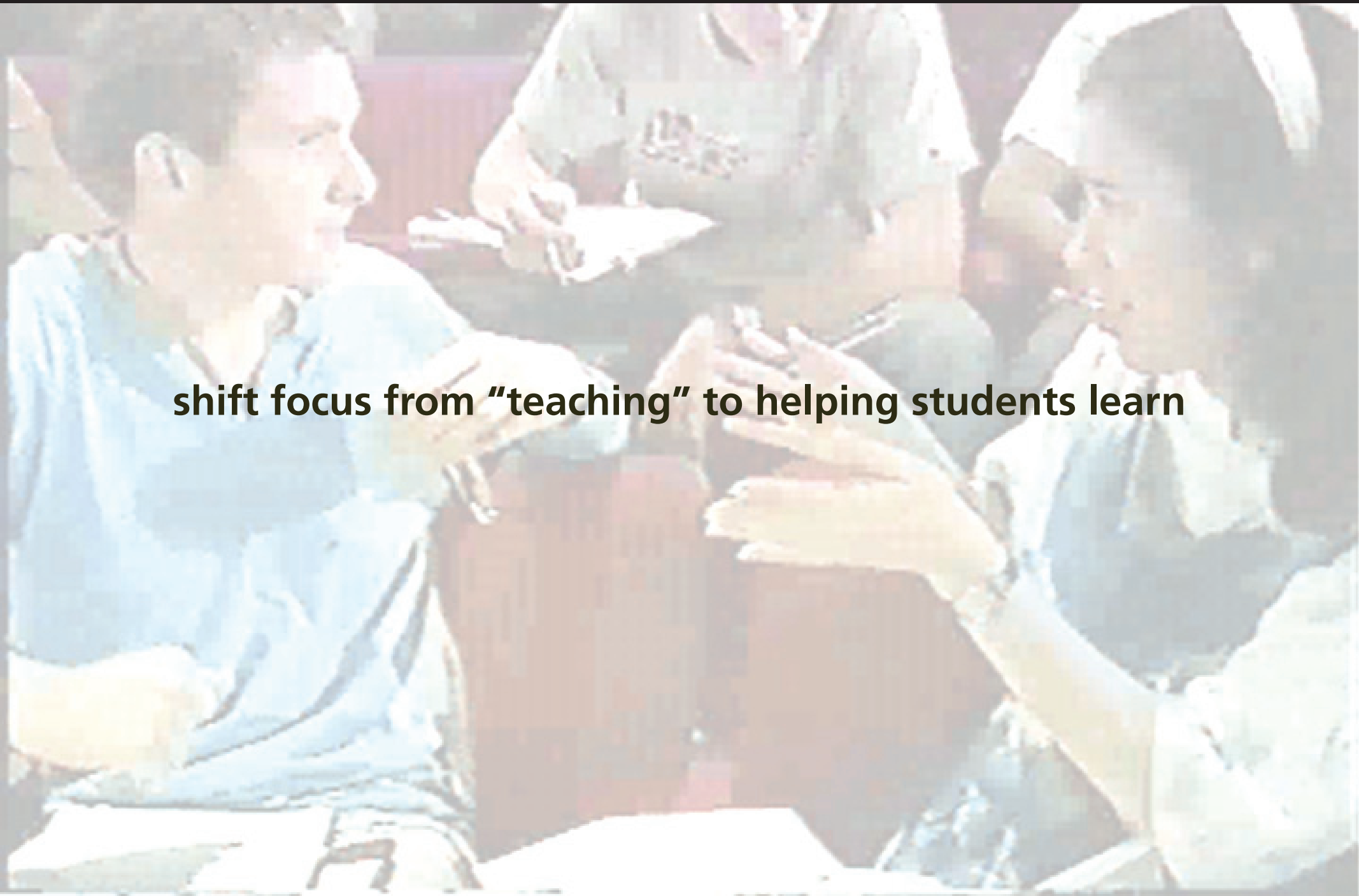
Memorization or understanding: are we teaching the right thing?



Cockrell School of Engineering
University of Texas at Austin
Austin, TX, 8 March 2010

My message



shift focus from “teaching” to helping students learn

Outline

- Education

Outline

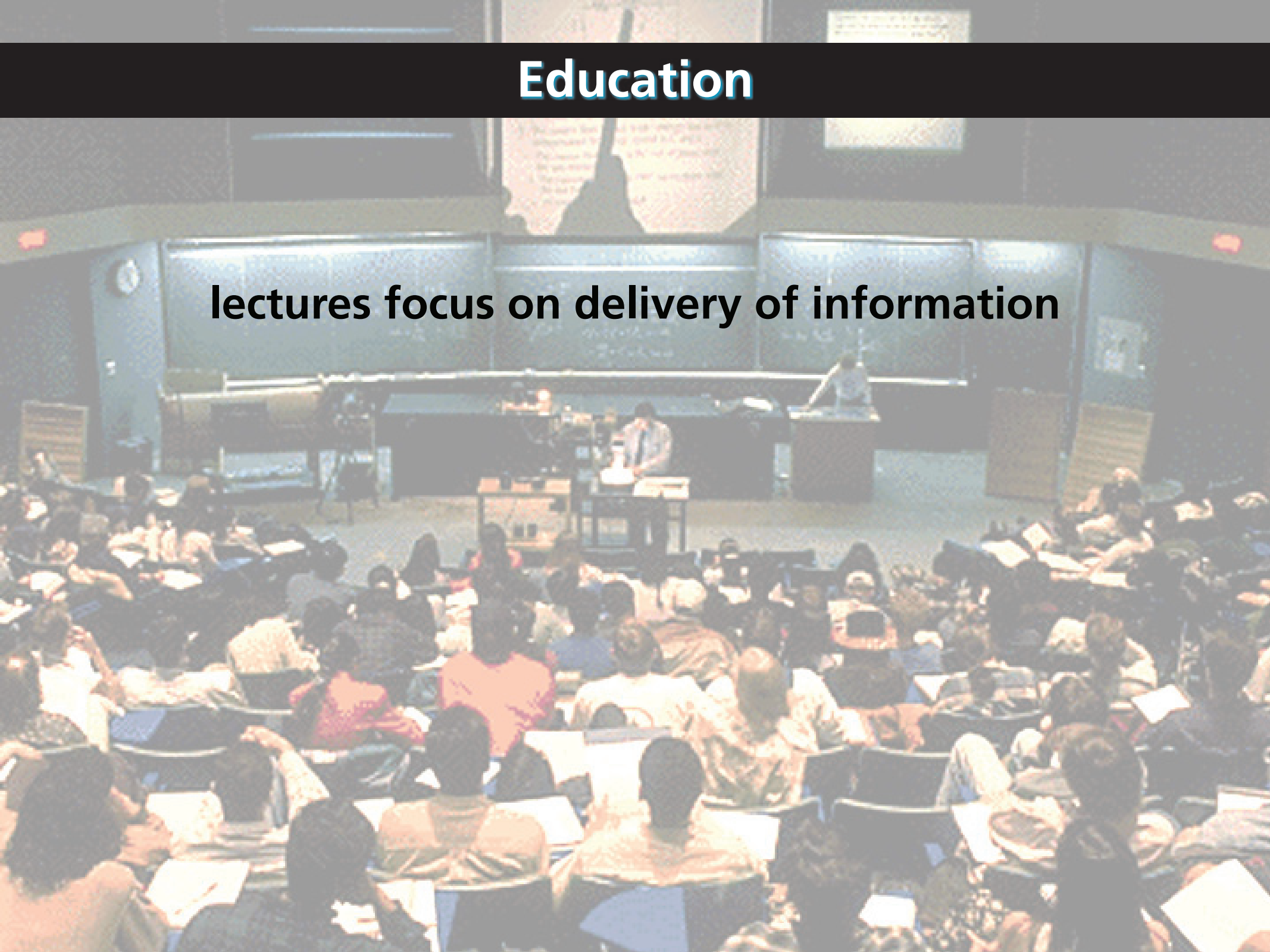
- Education
- Peer Instruction

Outline

- Education
- Peer Instruction
- Results

Education

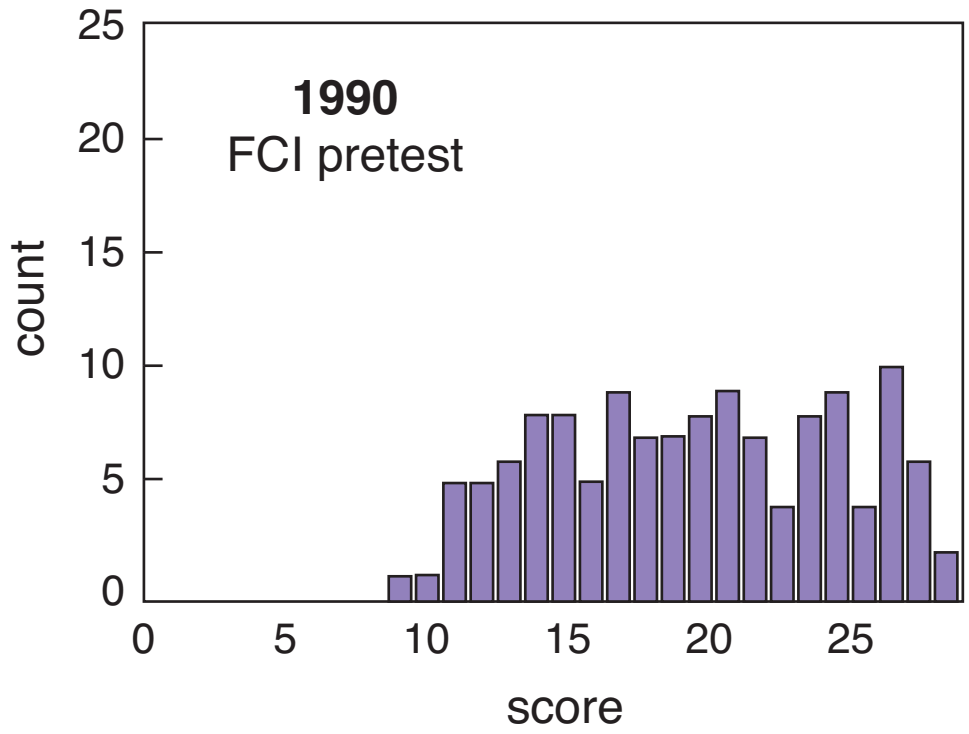
Education



lectures focus on delivery of information

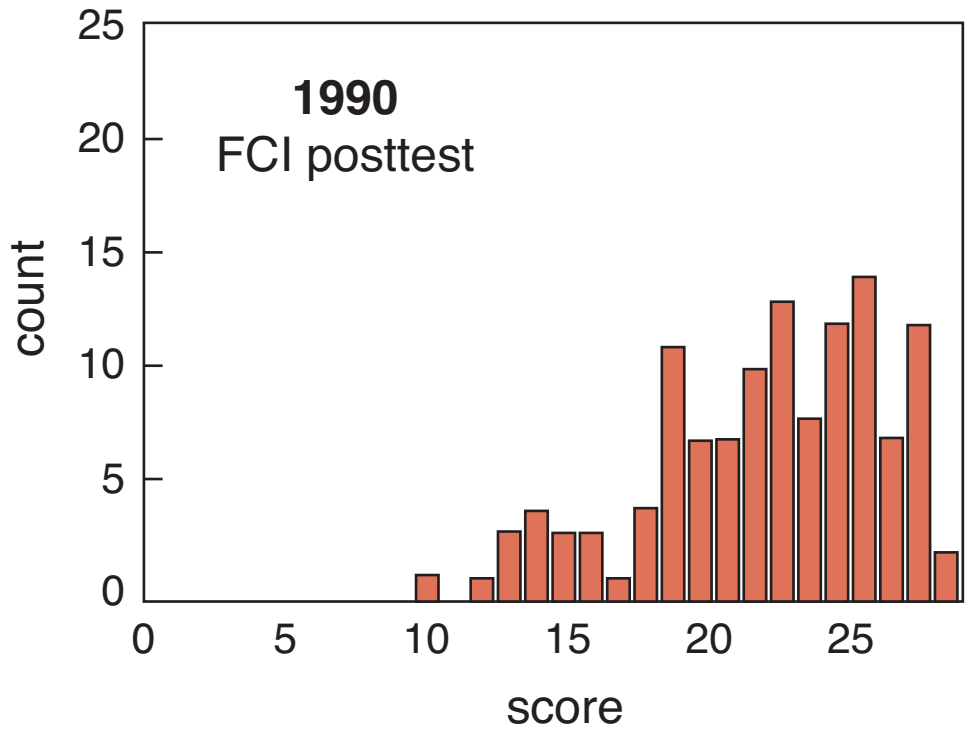
Education

education is not just information transfer



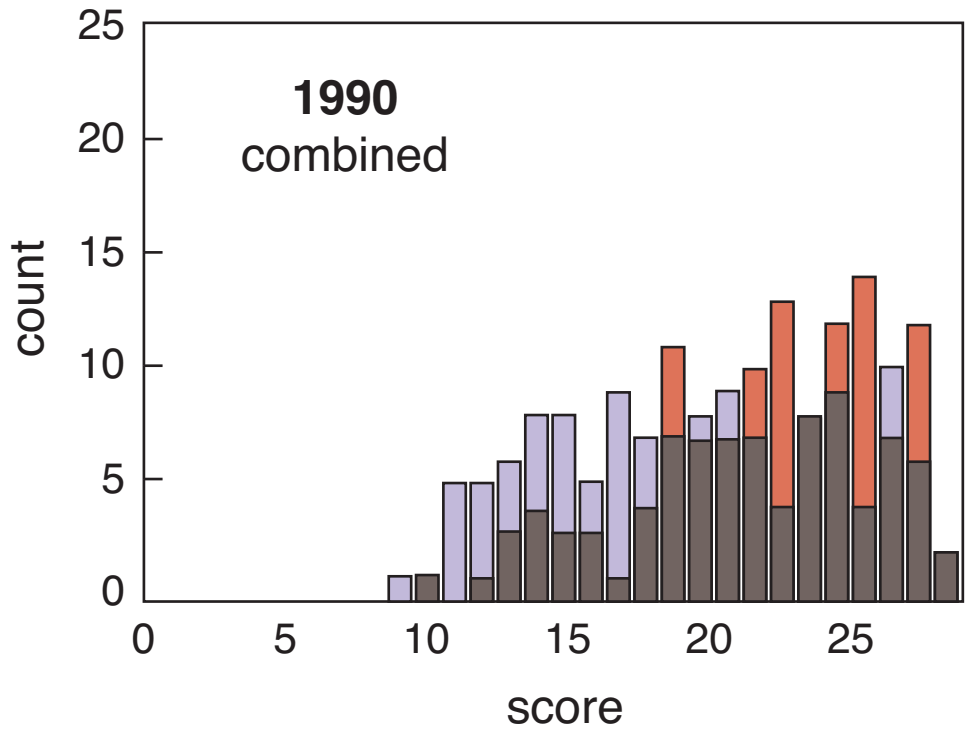
Education

education is not just information transfer

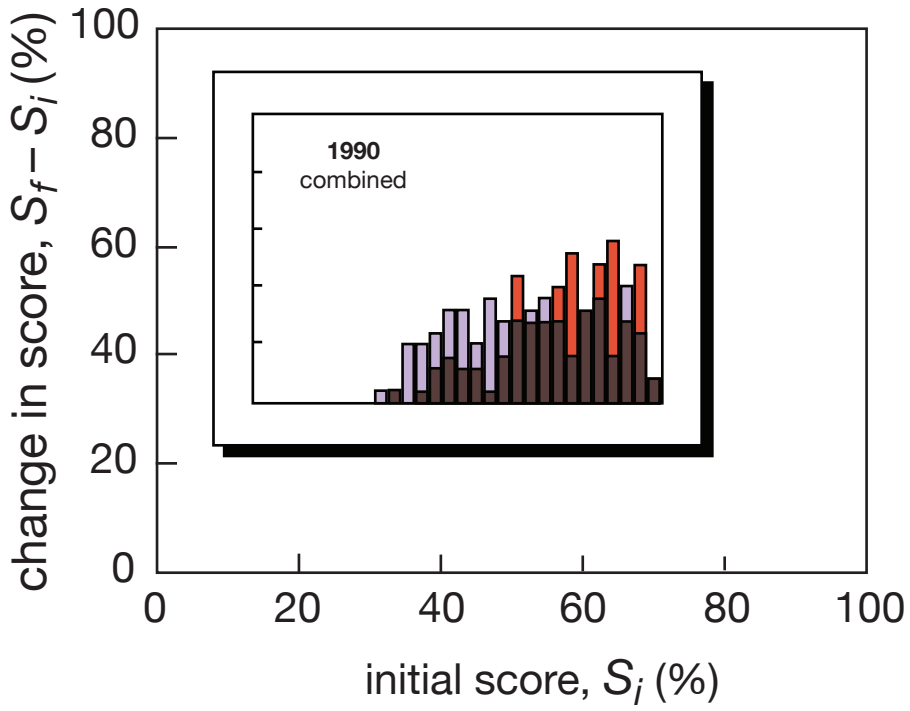


Education

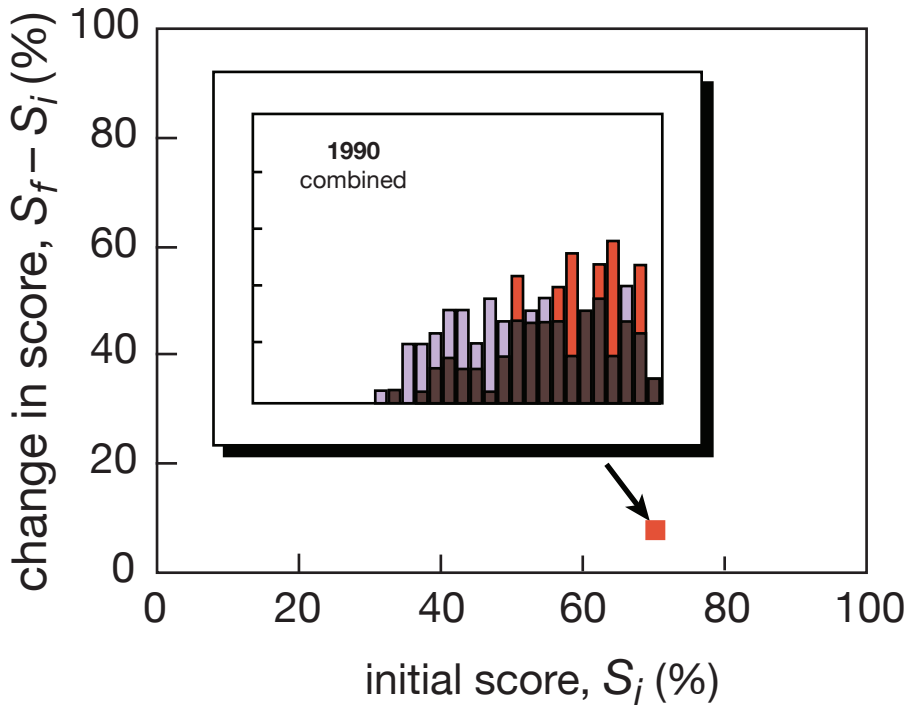
education is not just information transfer



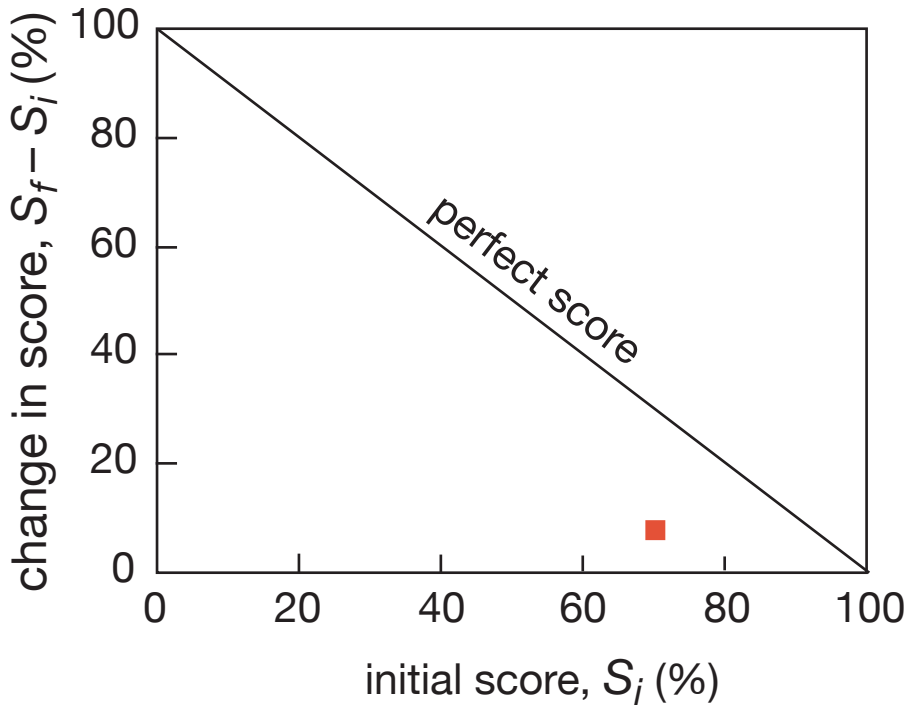
Education


1990
combined
change in score, $S_f - S_i$ (%)
initial score, S_i (%)
0
20
40
60
80
100

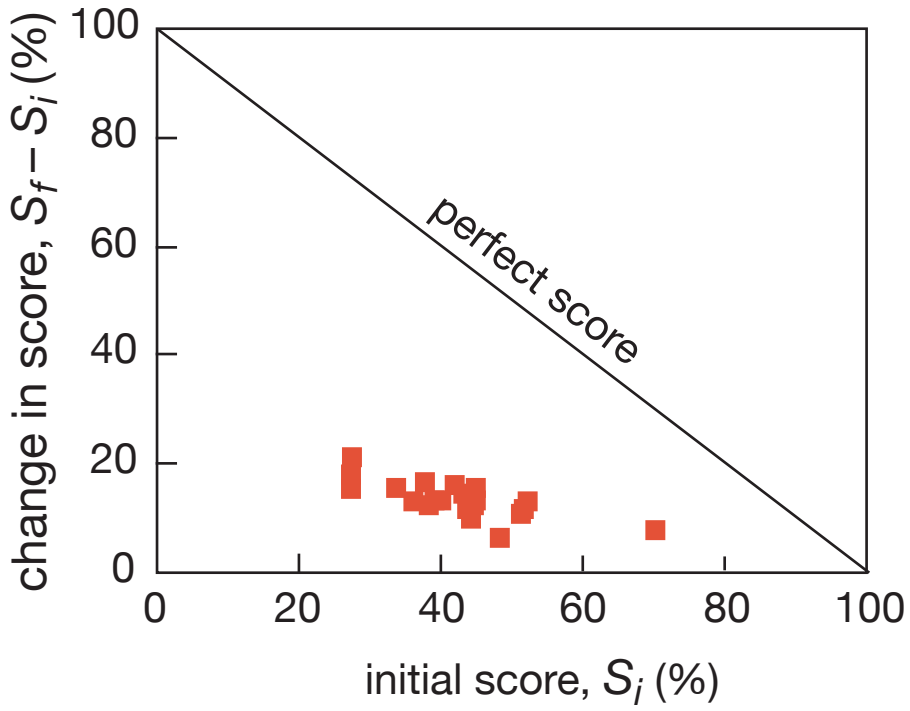
Education


1990
combined
change in score, $S_f - S_i$ (%)
initial score, S_i (%)
0
20
40
60
80
100

Education


100
80
60
40
20
0
0
20
40
60
80
100
perfect score
change in score, $S_f - S_i$ (%)
initial score, S_i (%)

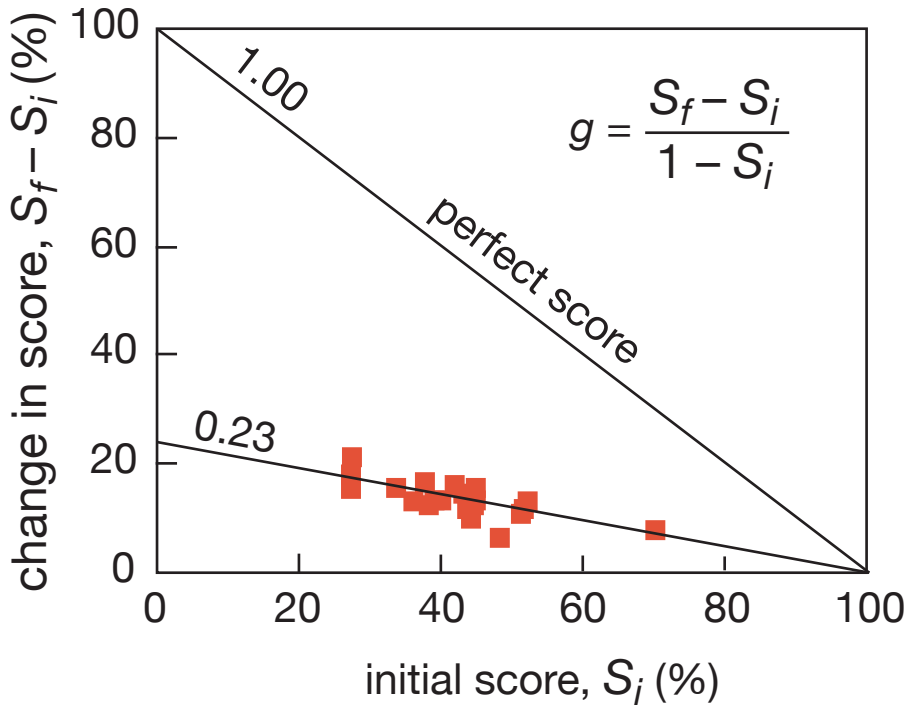
Education



R.R. Hake, *Am. J. Phys.* 66, 64 (1998)

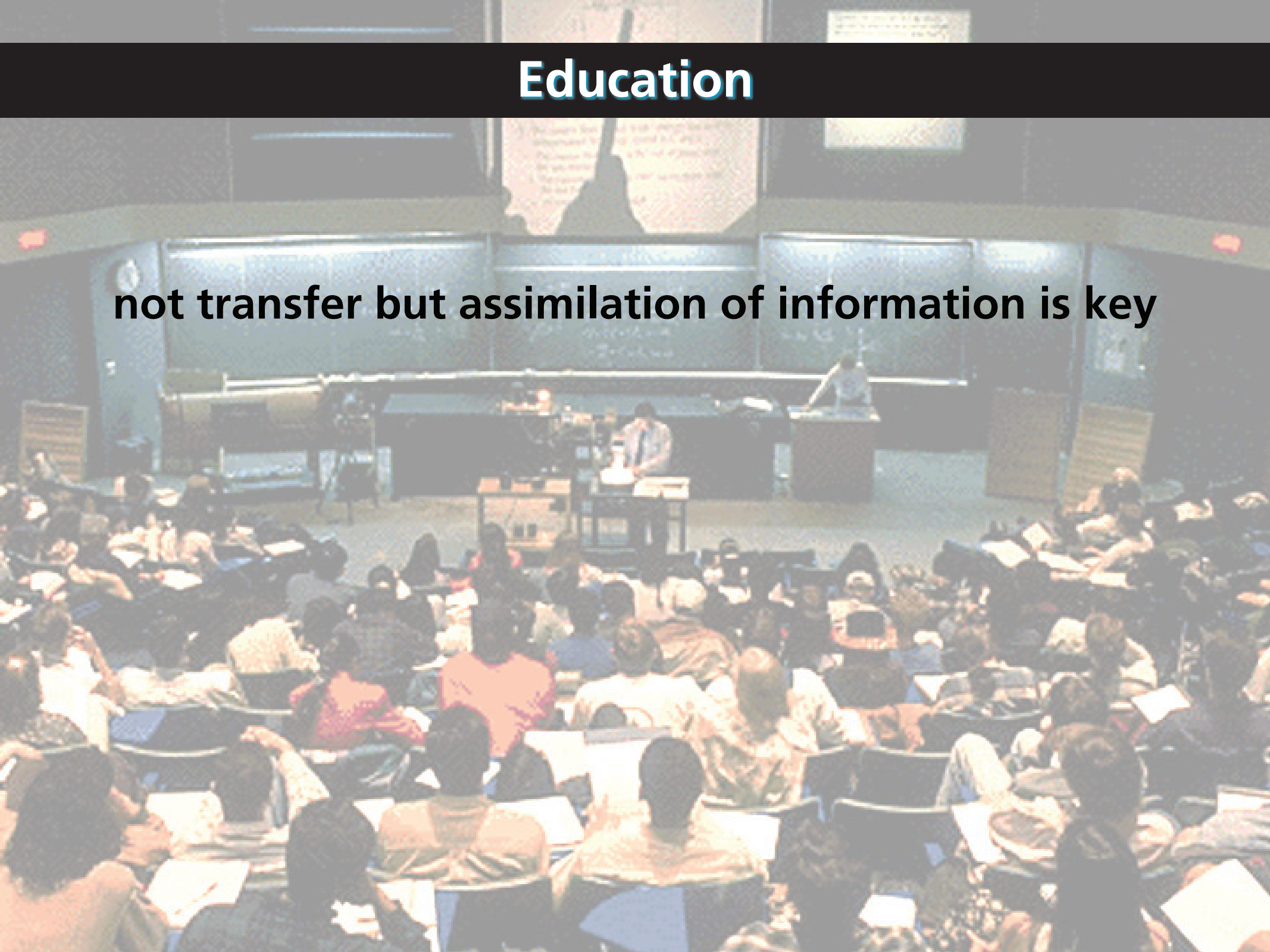
Education

only one quarter of maximum gain realized



R.R. Hake, *Am. J. Phys.* 66, 64 (1998)

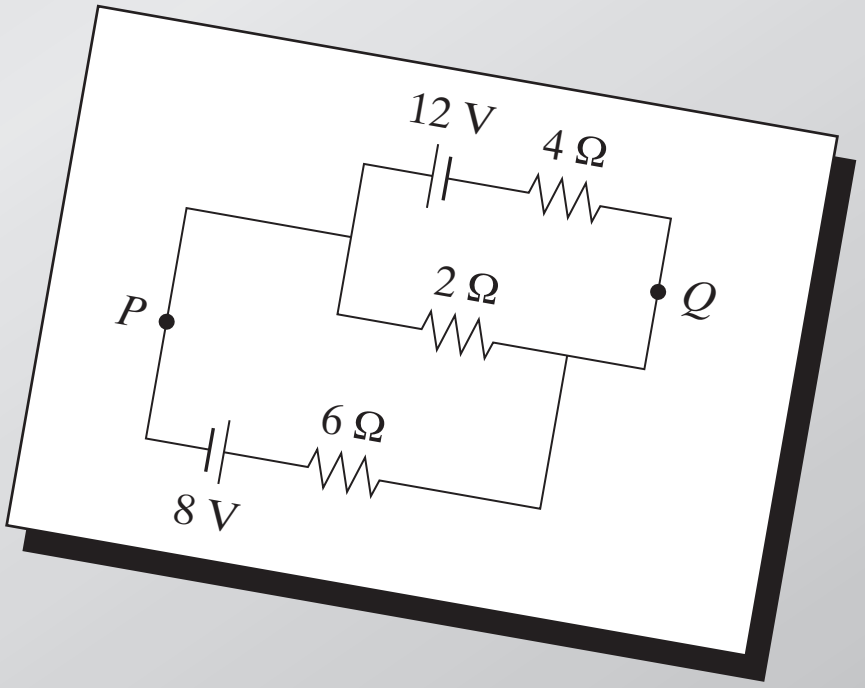
Education



not transfer but assimilation of information is key

Education

conventional problems misleading



Education

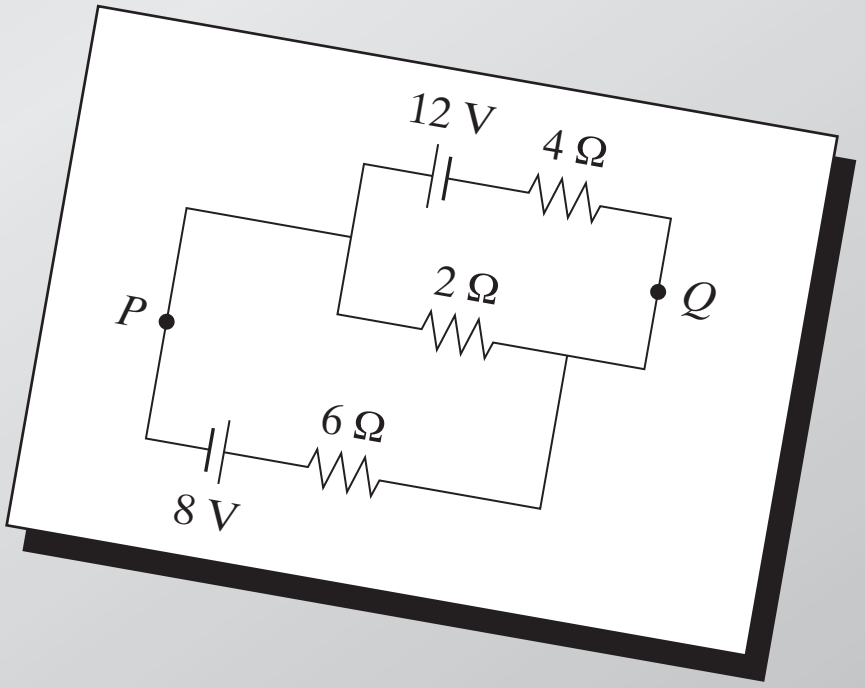
conventional problems misleading

Calculate:

(*a*) current in 2-Ω resistor

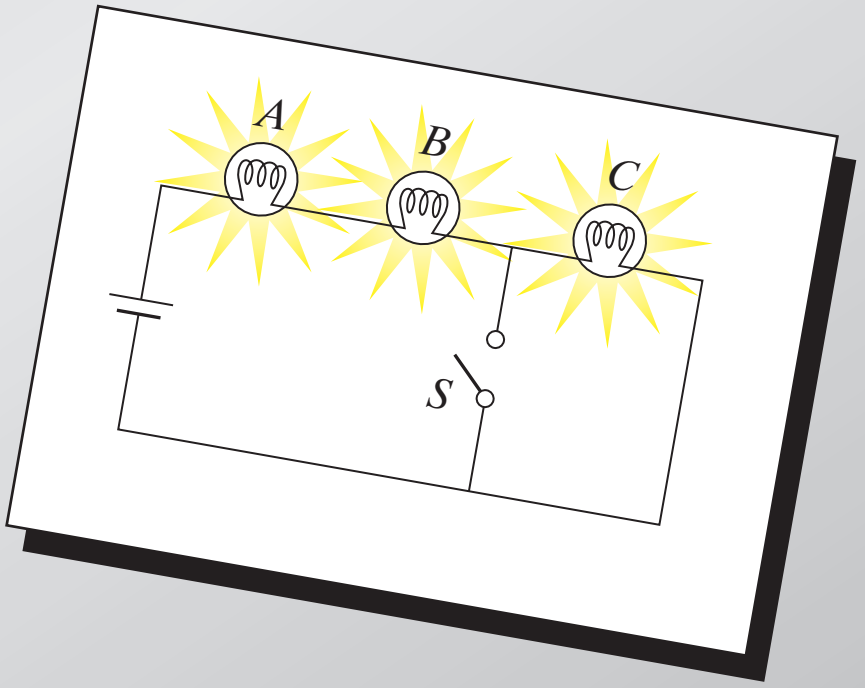
(*b*) potential difference

between *P* and *Q*



Education

are the basic principles understood?



Education

are the basic principles understood?

When *S* is closed, what happens to:

(*a*) intensities of A and B?

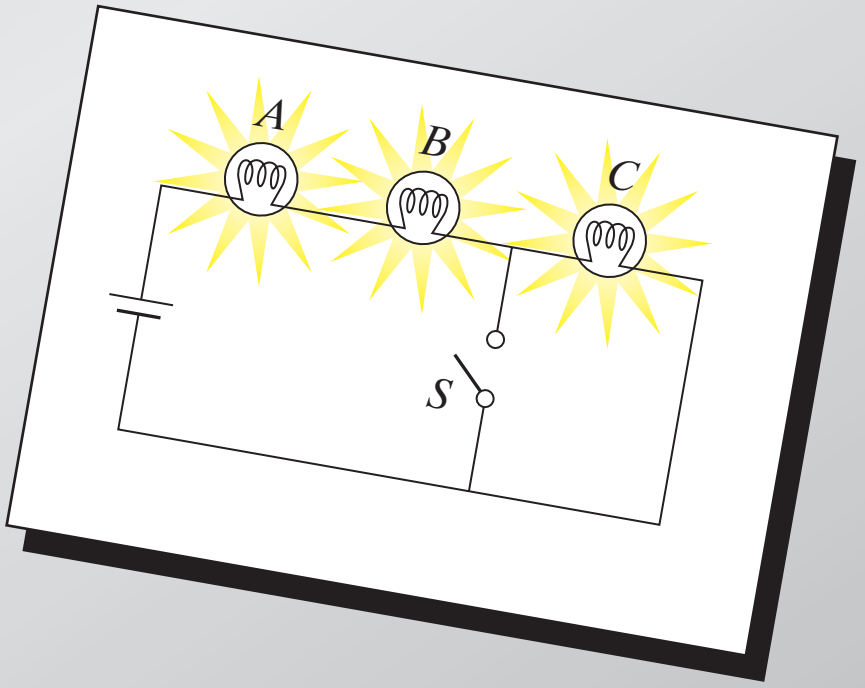
(*b*) intensity of C?

(*c*) current through battery?

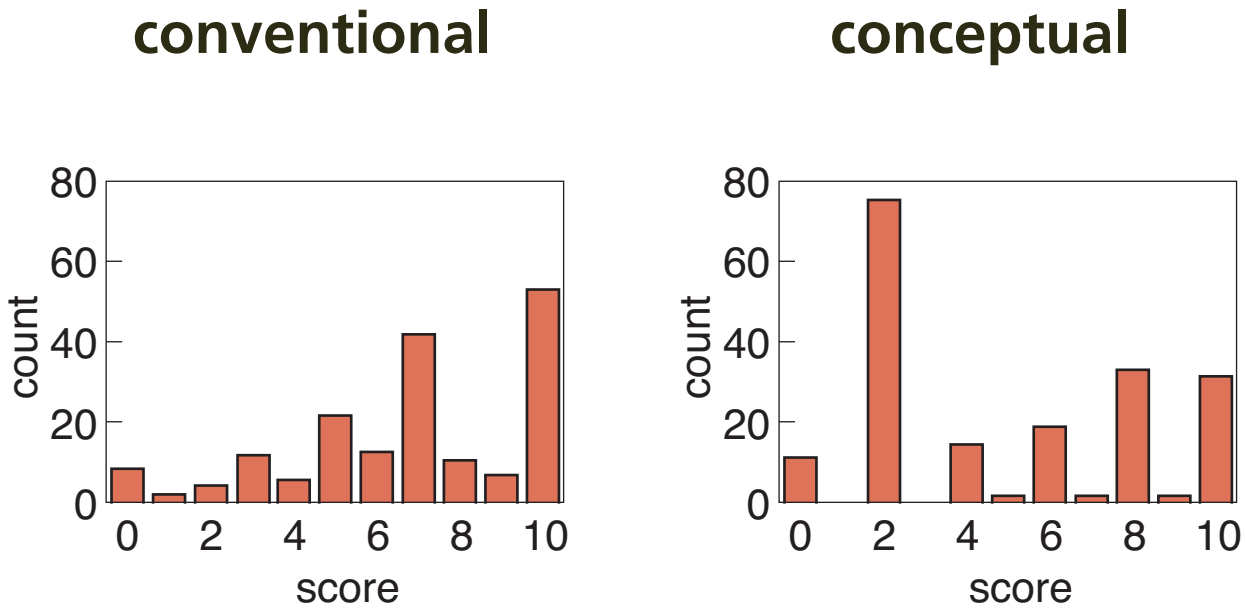
(*d*) potential difference across

A, *B*, and *C*?

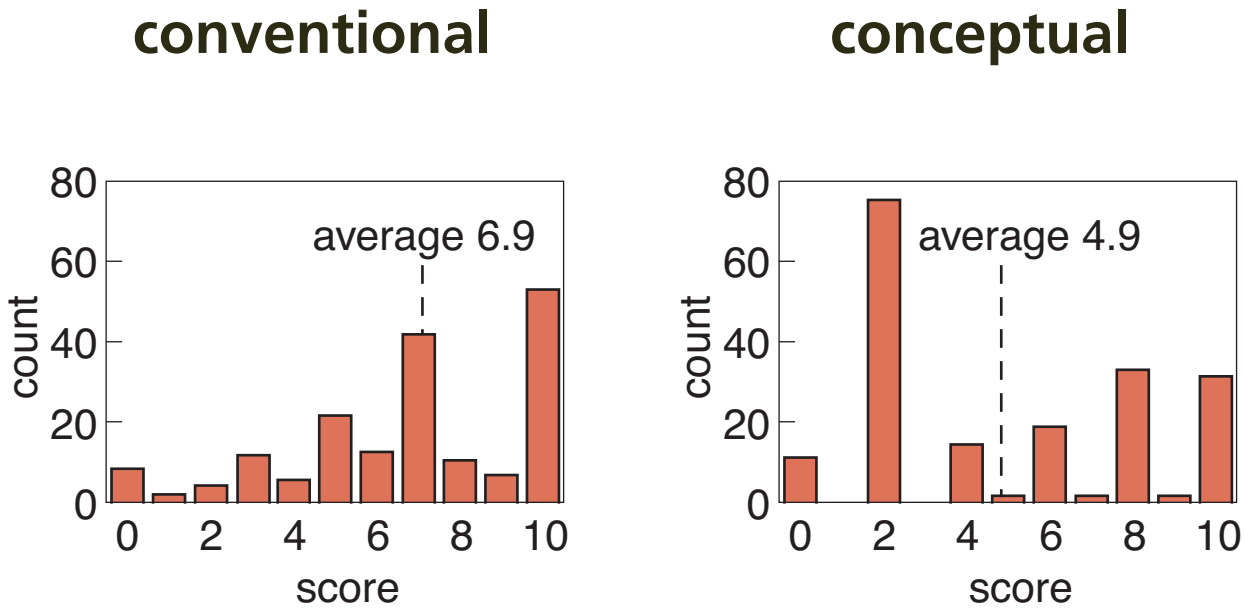
(*e*) the total power dissipated?



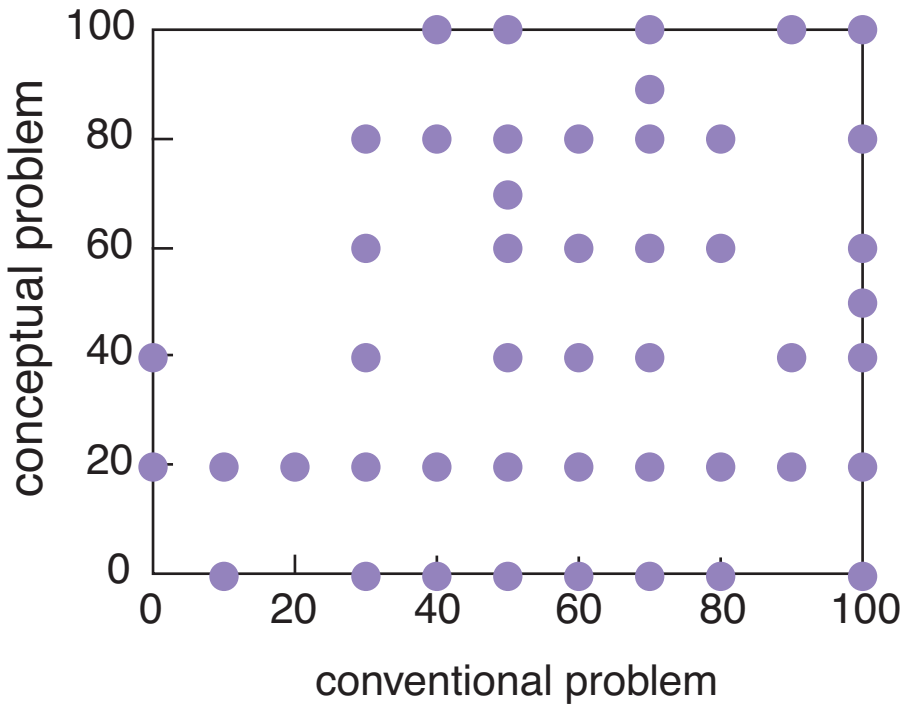
Education



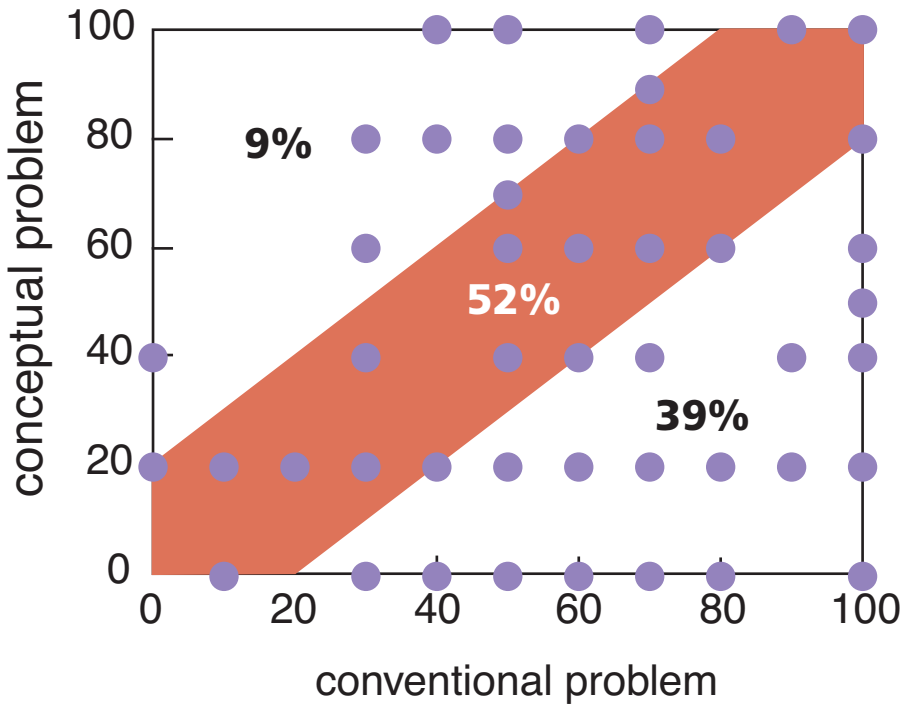
Education


conventional
conceptual
average 6.9
average 4.9
count
score
0
20
40
60
80
0
2
4
6
8
10

Education


100
80
60
40
20
0
conceptual problem
0
20
40
60
80
100
conventional problem

Education


100
80
60
40
20
0
conceptual problem
9%
52%
39%
0
20
40
60
80
100
conventional problem


So what should we do?

Peer Instruction

Give students more responsibility for gathering information…

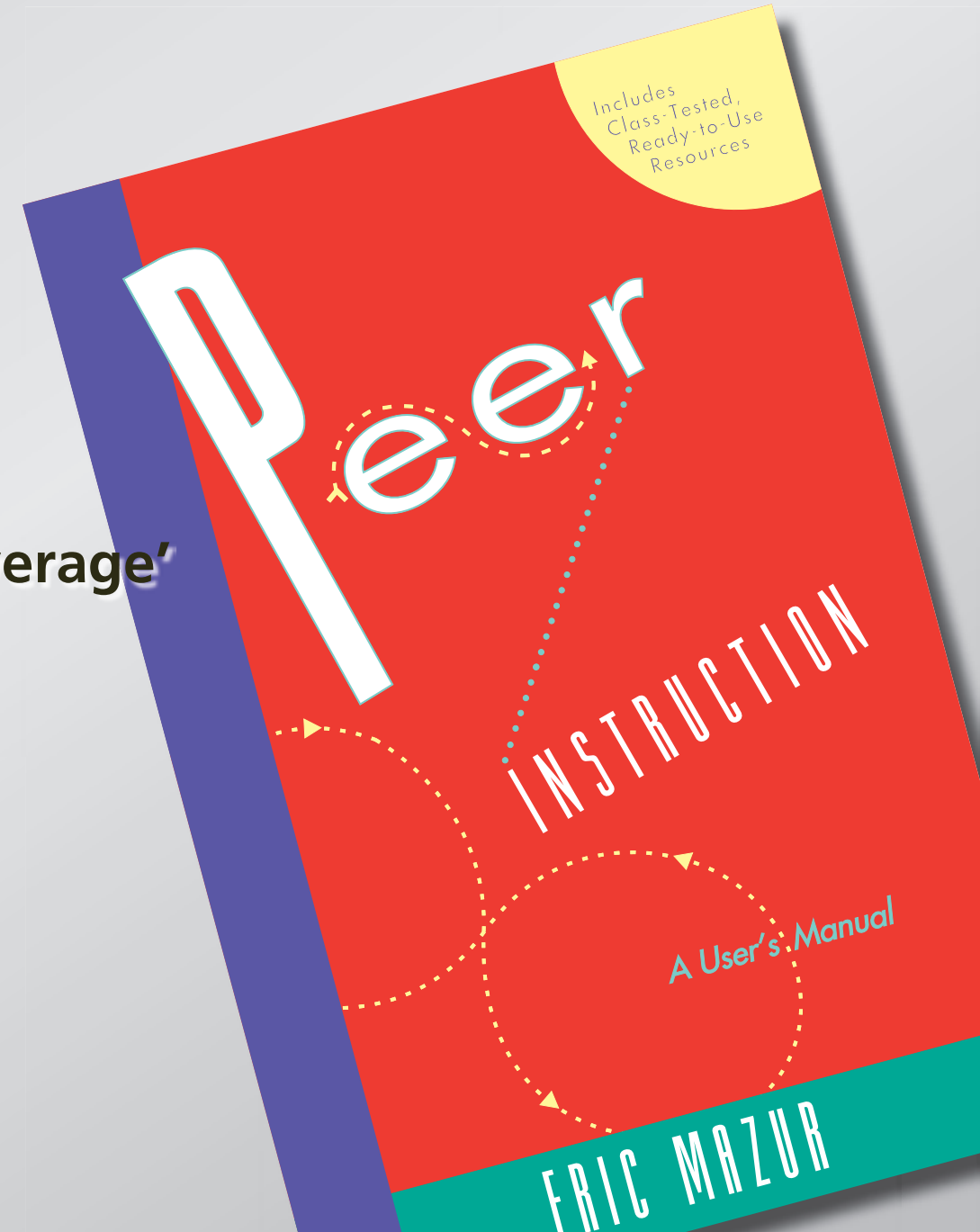
Peer Instruction

Give students more responsibility for gathering information…
so we can better help them assimilate it.

Peer Instruction

Main features:

- pre-class reading
- in-class: depth, not ‘coverage’
- ConcepTests



Peer Instruction

ConcepTest:

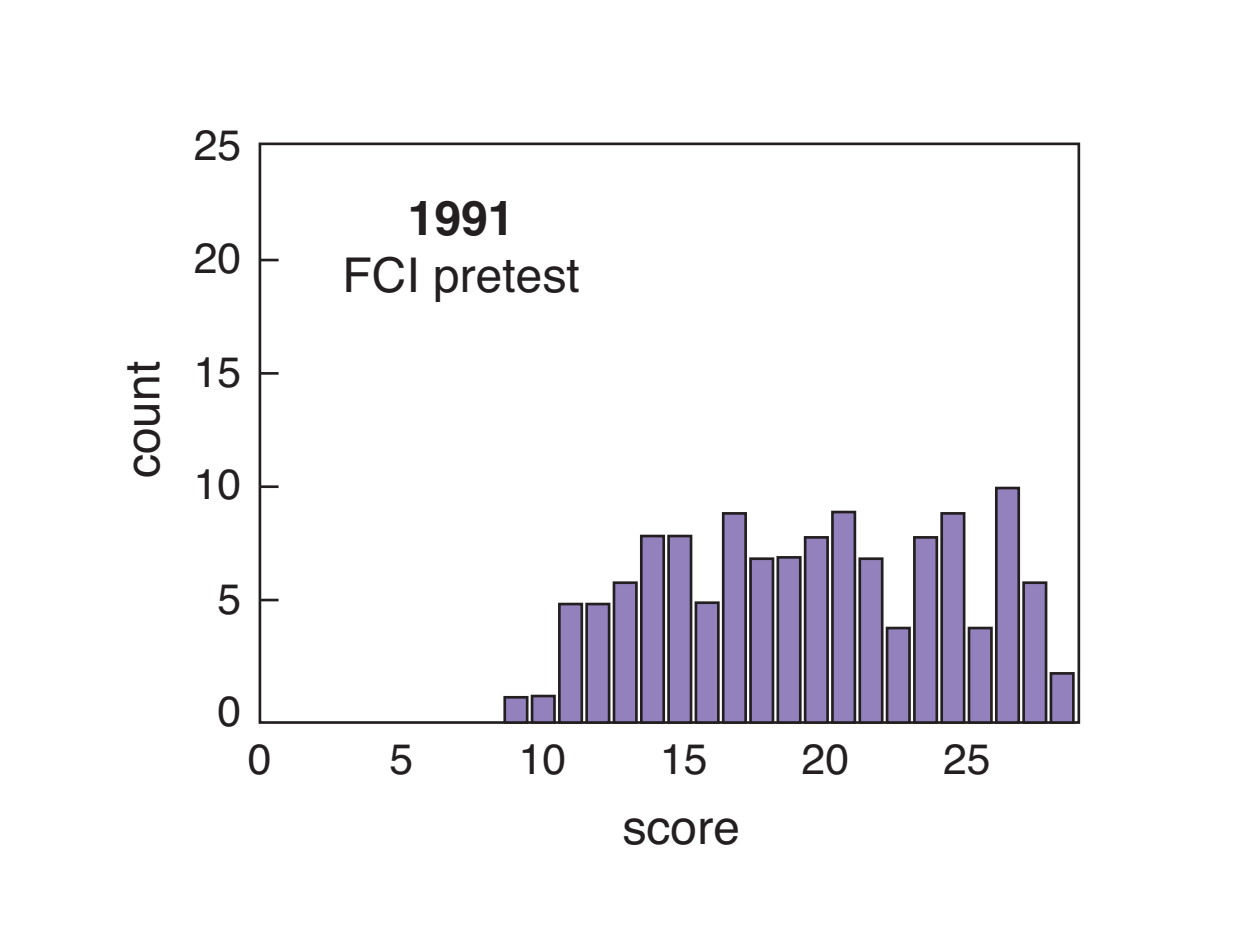
1. Question
2. Thinking
3. Individual answer
4. Peer discussion
5. Revised/Group answer
6. Explanation

Results

is it any good?

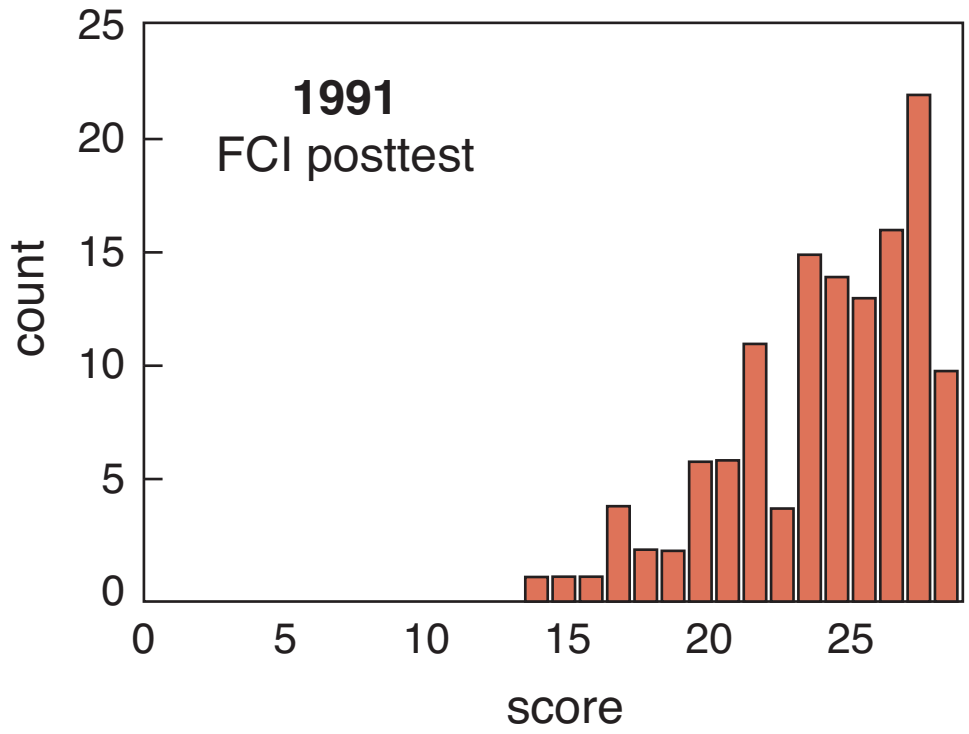
Results

first year of implementing PI



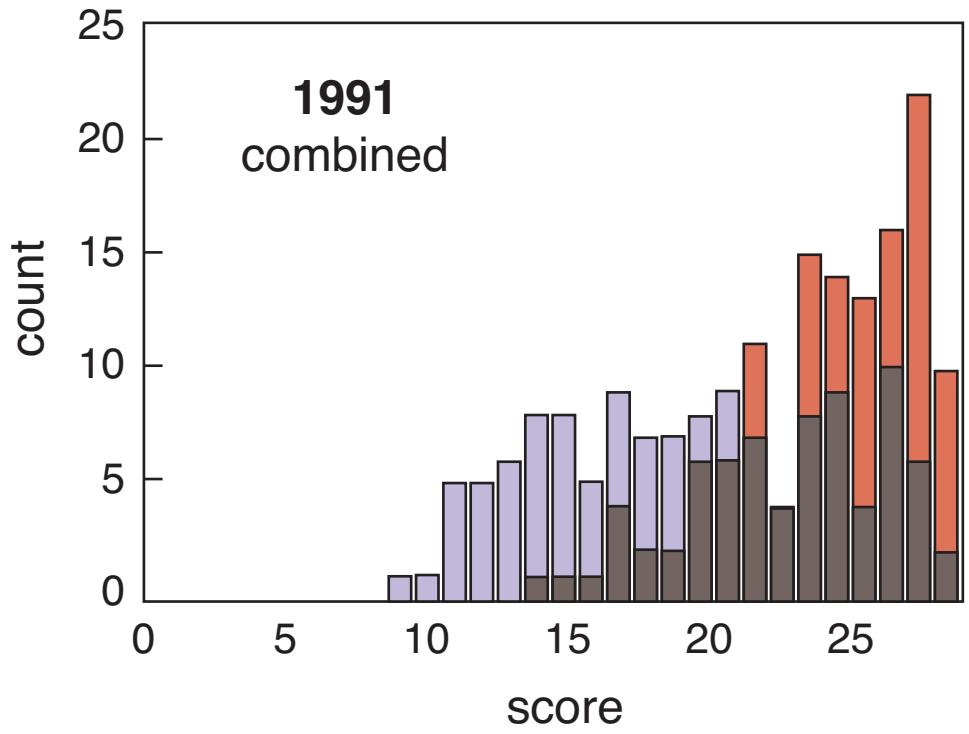
Results

first year of implementing PI

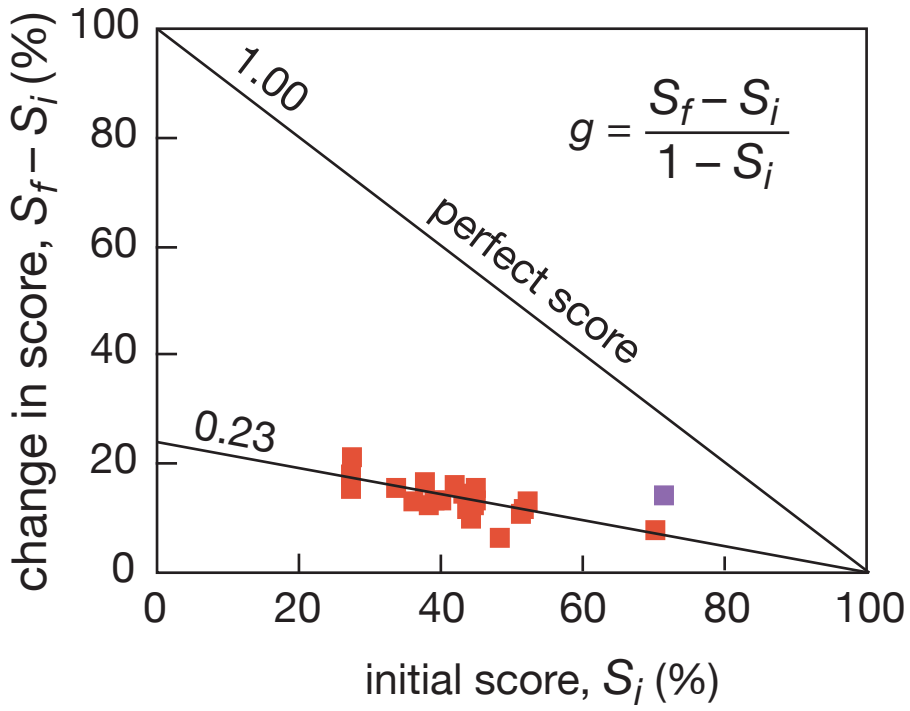


Results

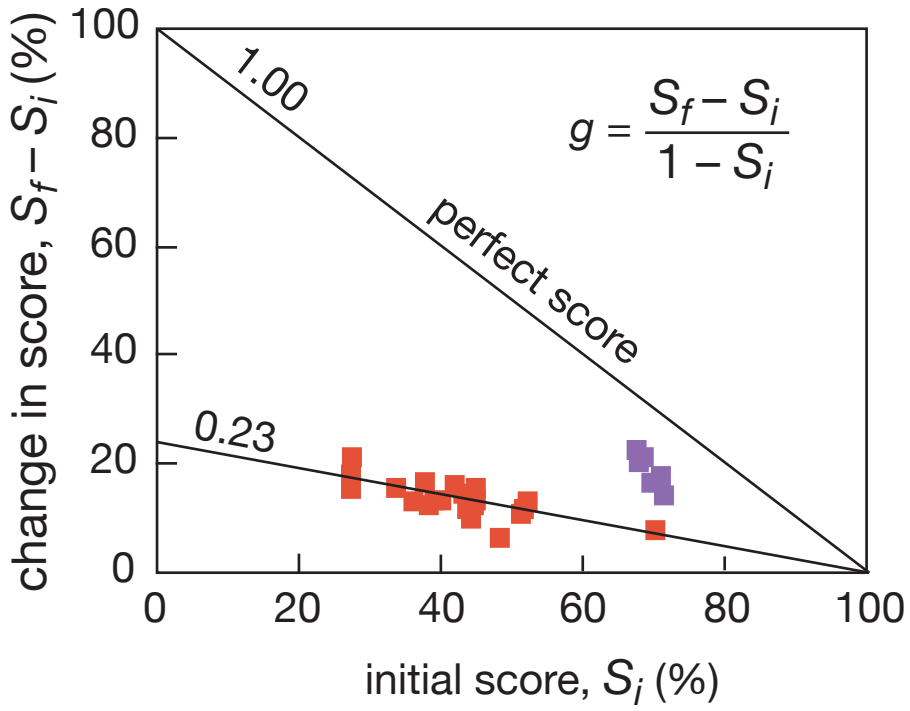
first year of implementing PI



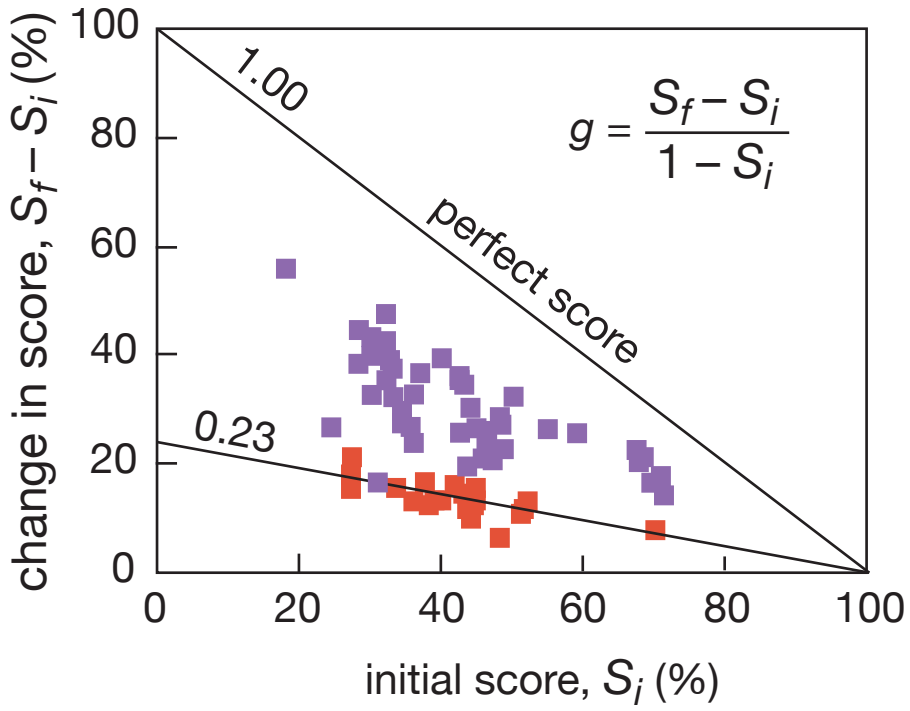
Results


100
80
60
40
20
0
0
20
40
60
80
100
1.00
perfect score
0.23
$g = \frac{S_f - S_i}{1 - S_i}$
change in score, $S_f - S_i$ (%)
initial score, S_i (%)

Results

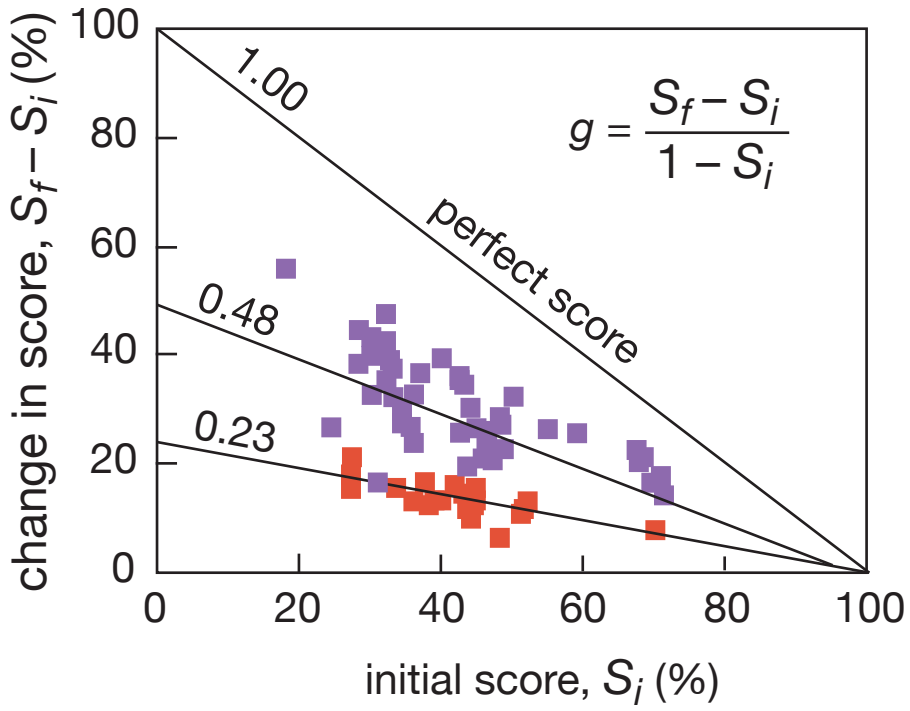

100
80
60
40
20
0
0
20
40
60
80
100
1.00
perfect score
0.23
$g = \frac{S_f - S_i}{1 - S_i}$
change in score, $S_f - S_i$ (%)
initial score, S_i (%)

Results



R.R. Hake, *Am. J. Phys.* 66, 64 (1998)

Results

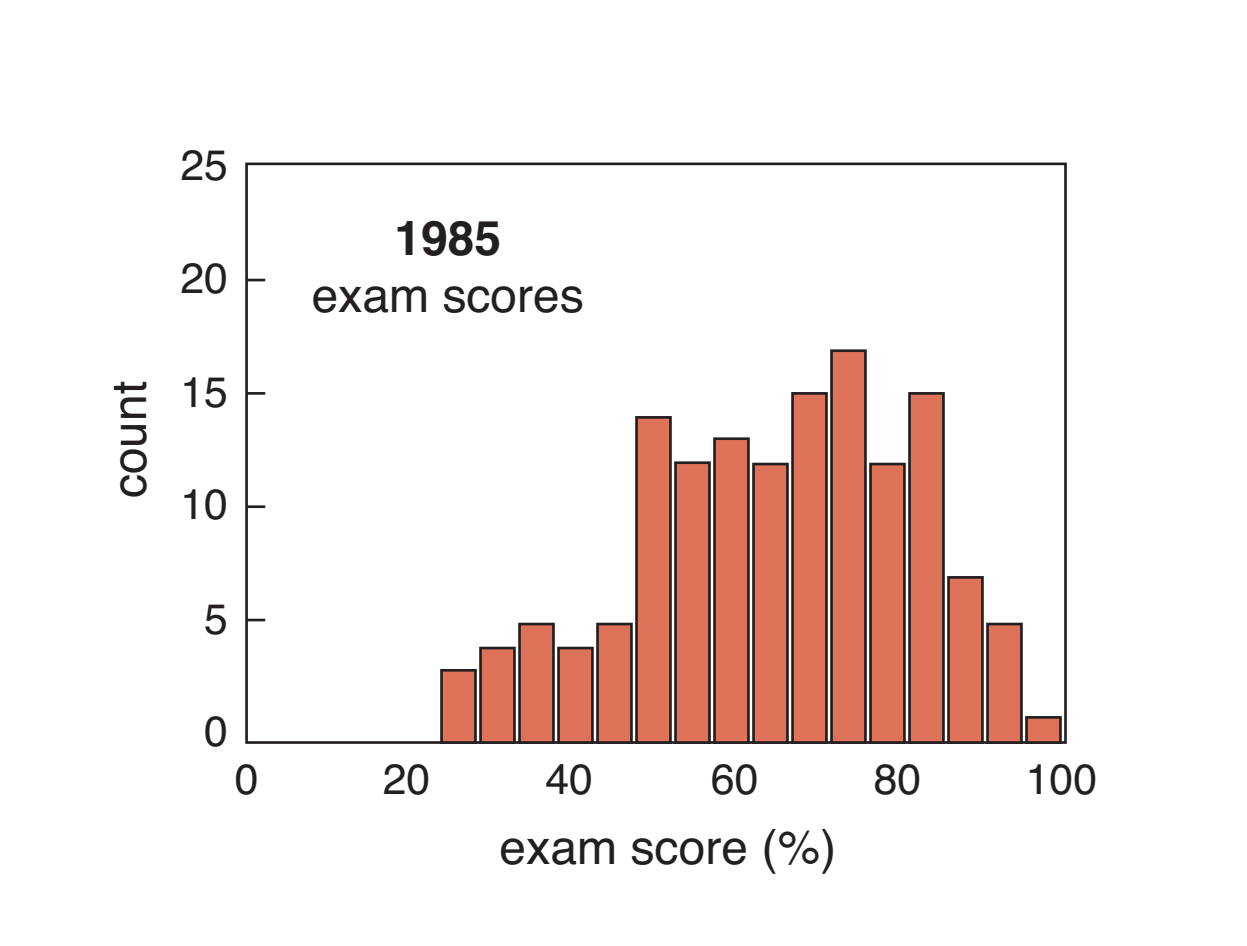


R.R. Hake, *Am. J. Phys.* 66, 64 (1998)

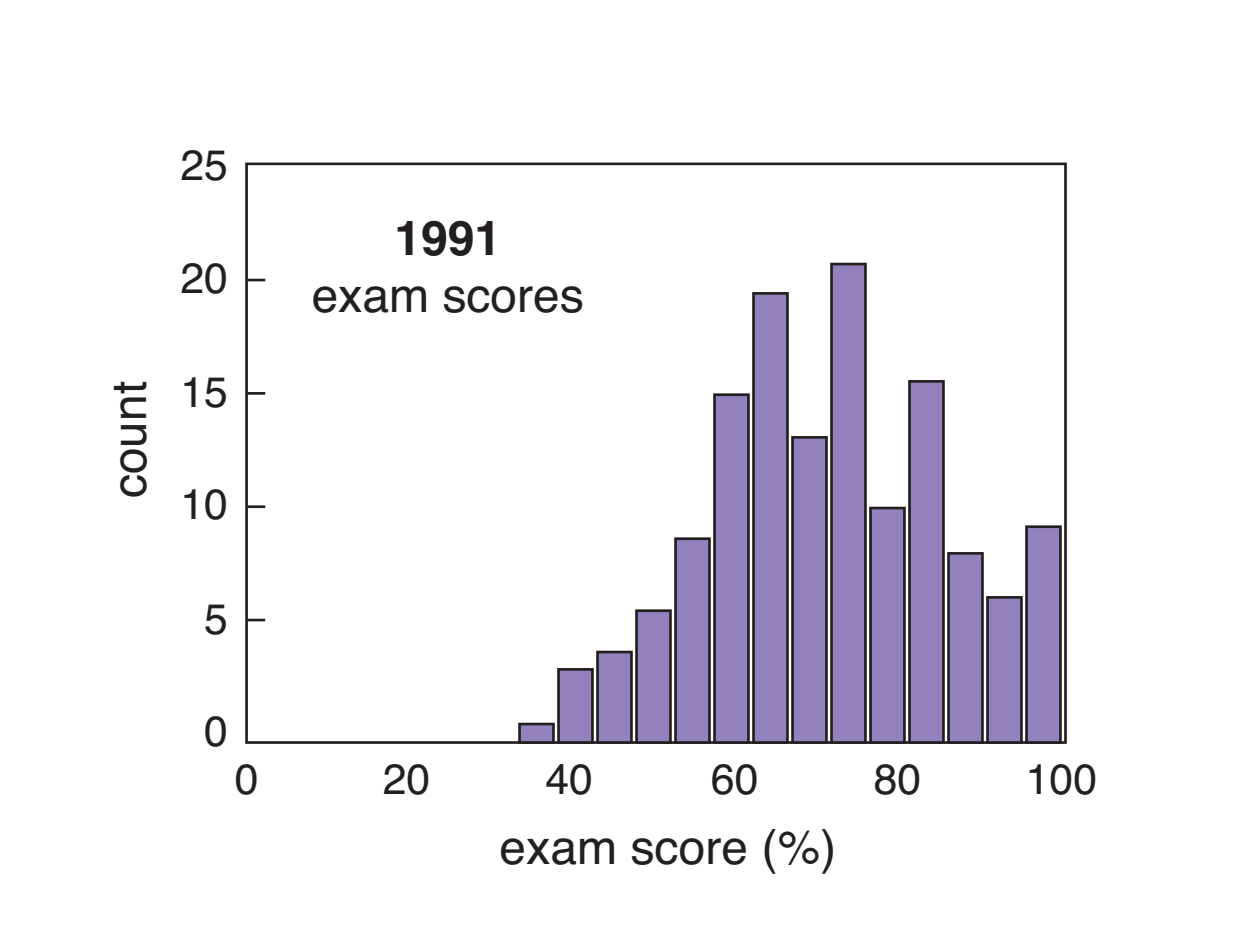
Results

what about problem solving?

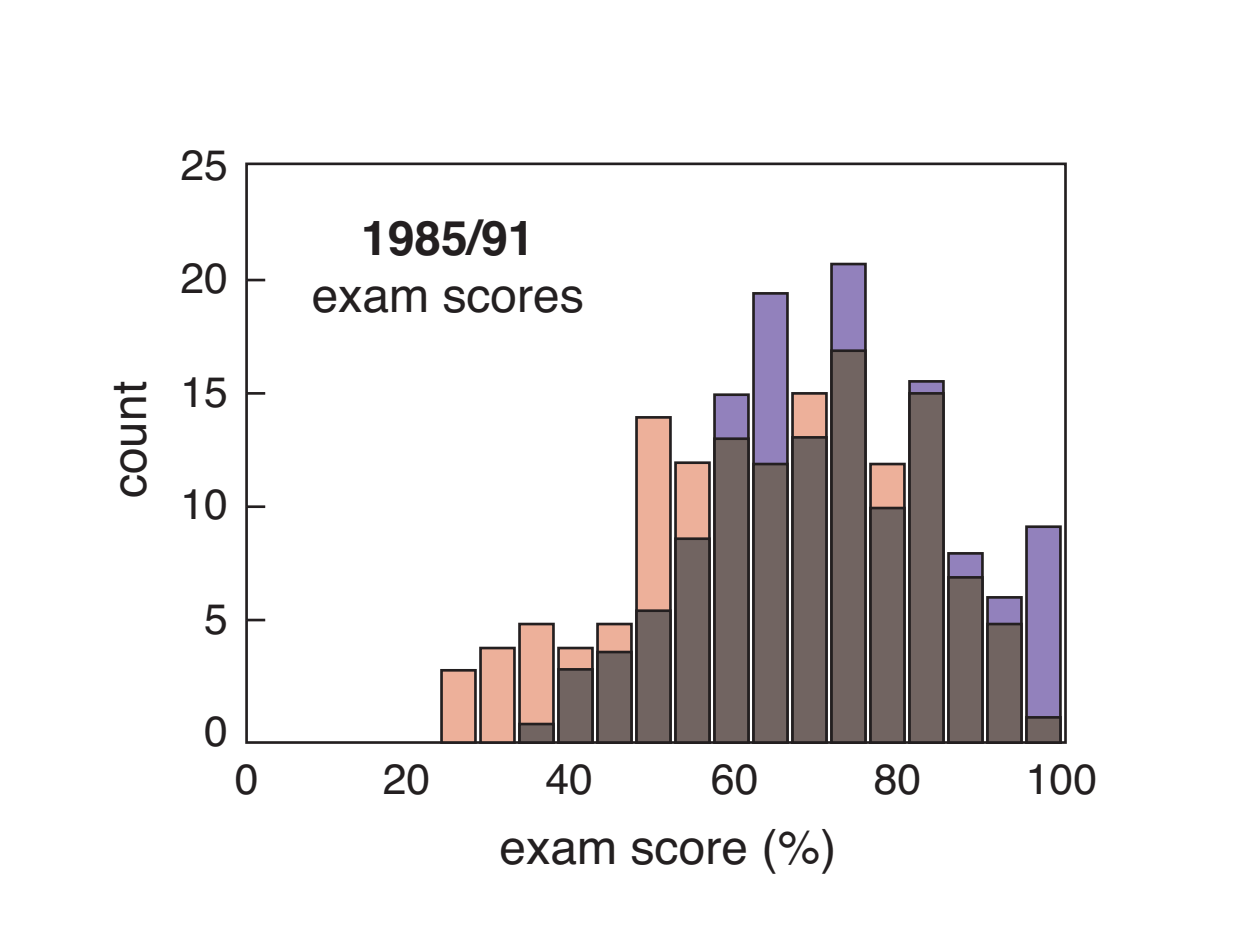
Results


1985
exam scores
count
25
20
15
10
5
0
0
20
40
60
80
100
exam score (%)

Results


1991
exam scores
count
25
20
15
10
5
0
0
20
40
60
80
100
exam score (%)

Results


1985/91
exam scores
count
25
20
15
10
5
0
0
20
40
60
80
100
exam score (%)

Conclusion

So better understanding leads to better problem solving!

Conclusion

So better understanding leads to better problem solving!

(but “good” problem solving doesn’t always indicate understanding!)

Why does it work?

Students:

- promotes thinking
- helps uncover and address misunderstanding
- boosts confidence

Why does it work?

Students:

- promotes thinking
- helps uncover and address misunderstanding
- boosts confidence

Faculty:

- change of format, not content
- with existing questions, little effort
- adaptable

Summary

Traditional indicators of success misleading

Summary

Traditional indicators of success misleading

Education is no longer about information

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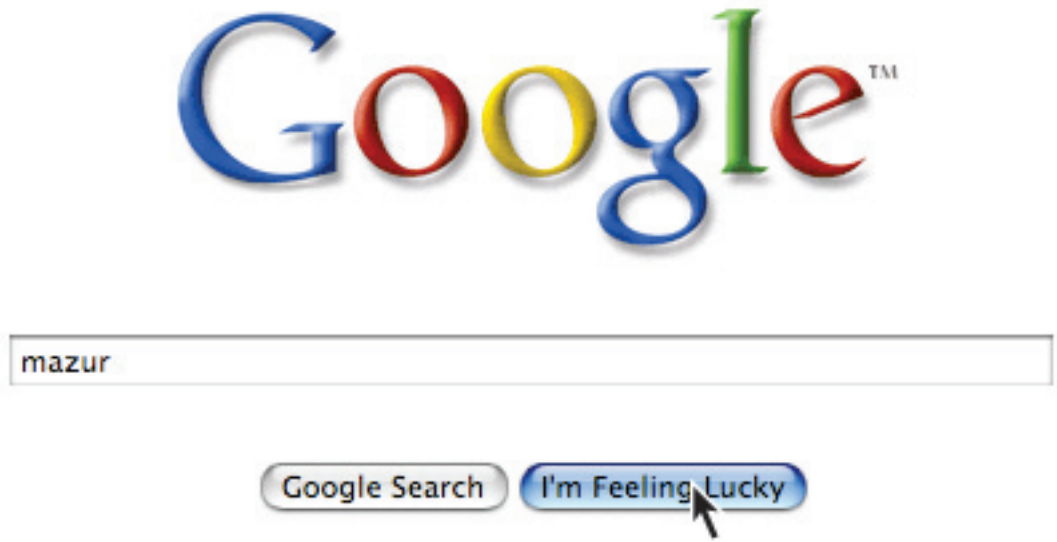
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