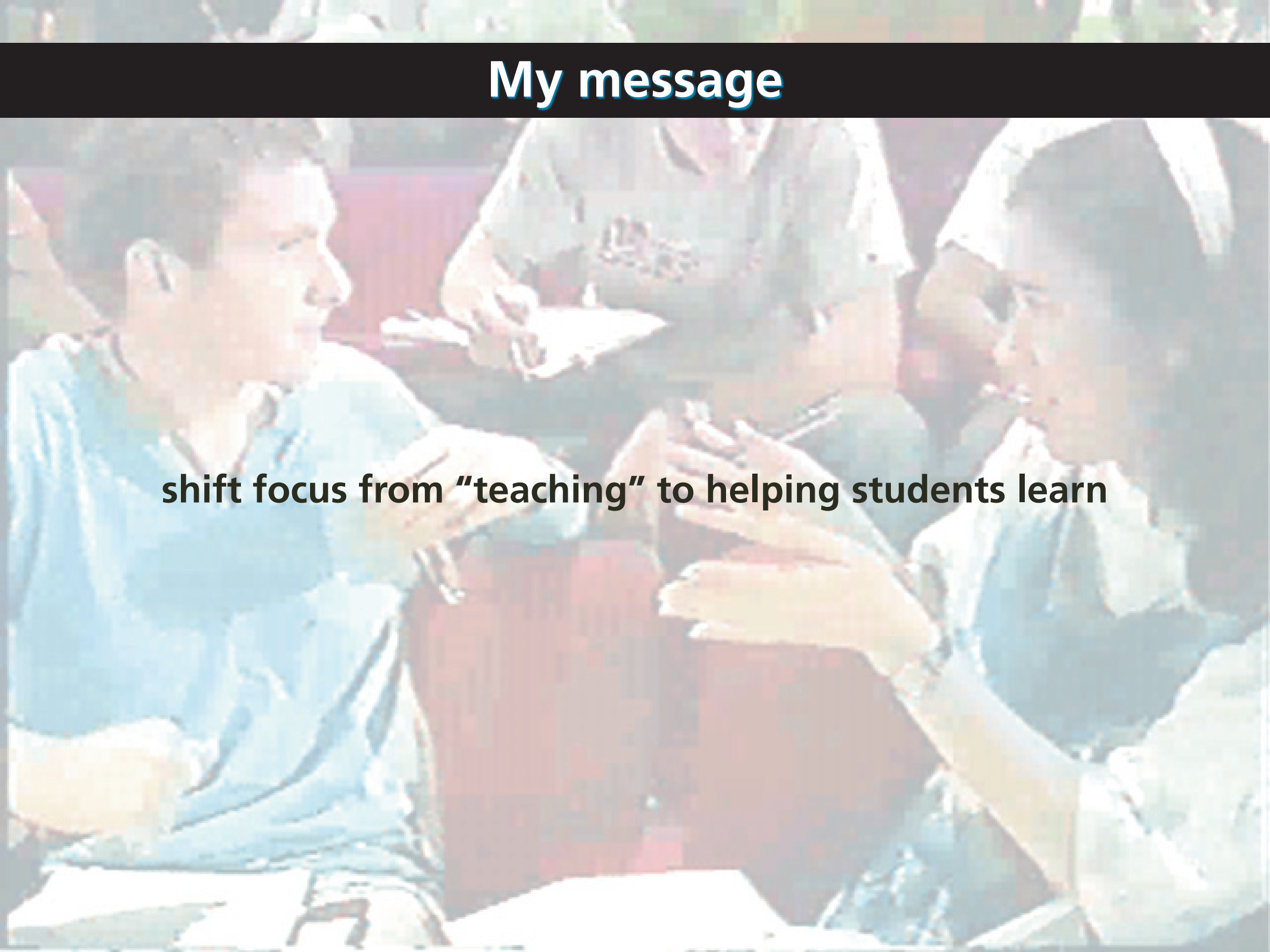
Confessions of a converted lecturer

Active Learning in Engineering Education 2011 Meeting
Universidad de Chile
Santiago, Chile, 11 January 2011

My message

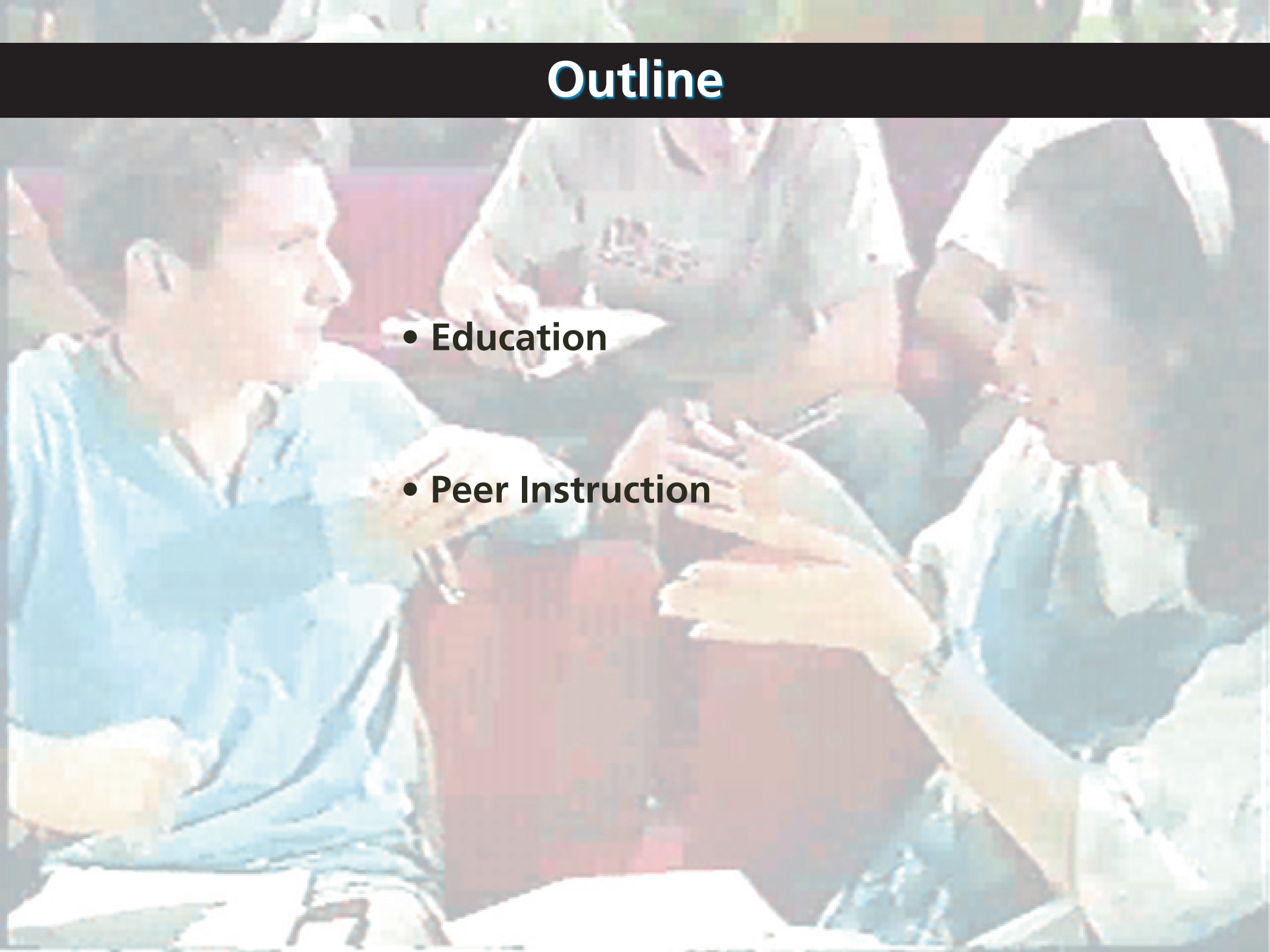


shift focus from “teaching” to helping students learn

Outline

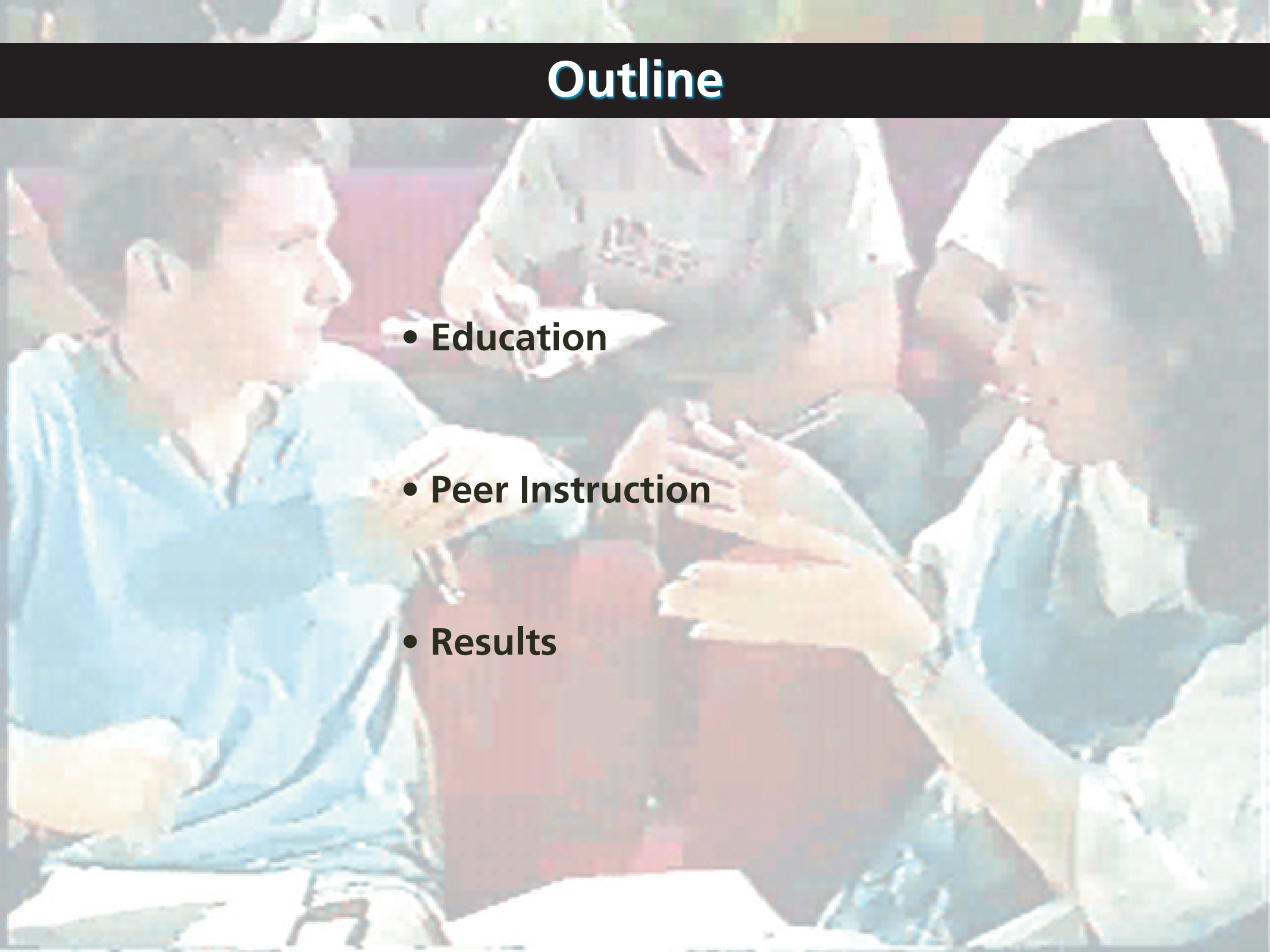
- Education

Outline



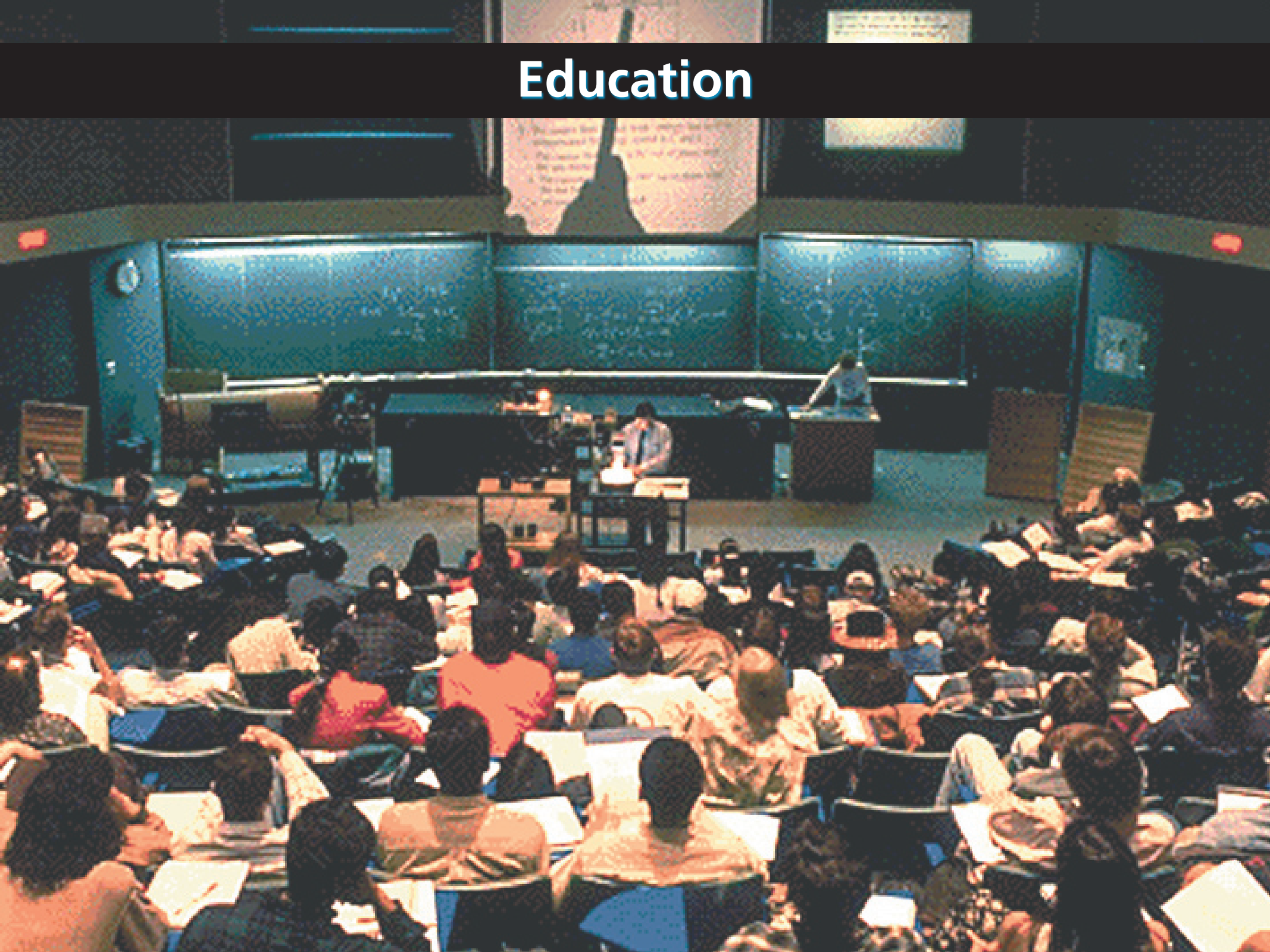
- Education
- Peer Instruction

Outline

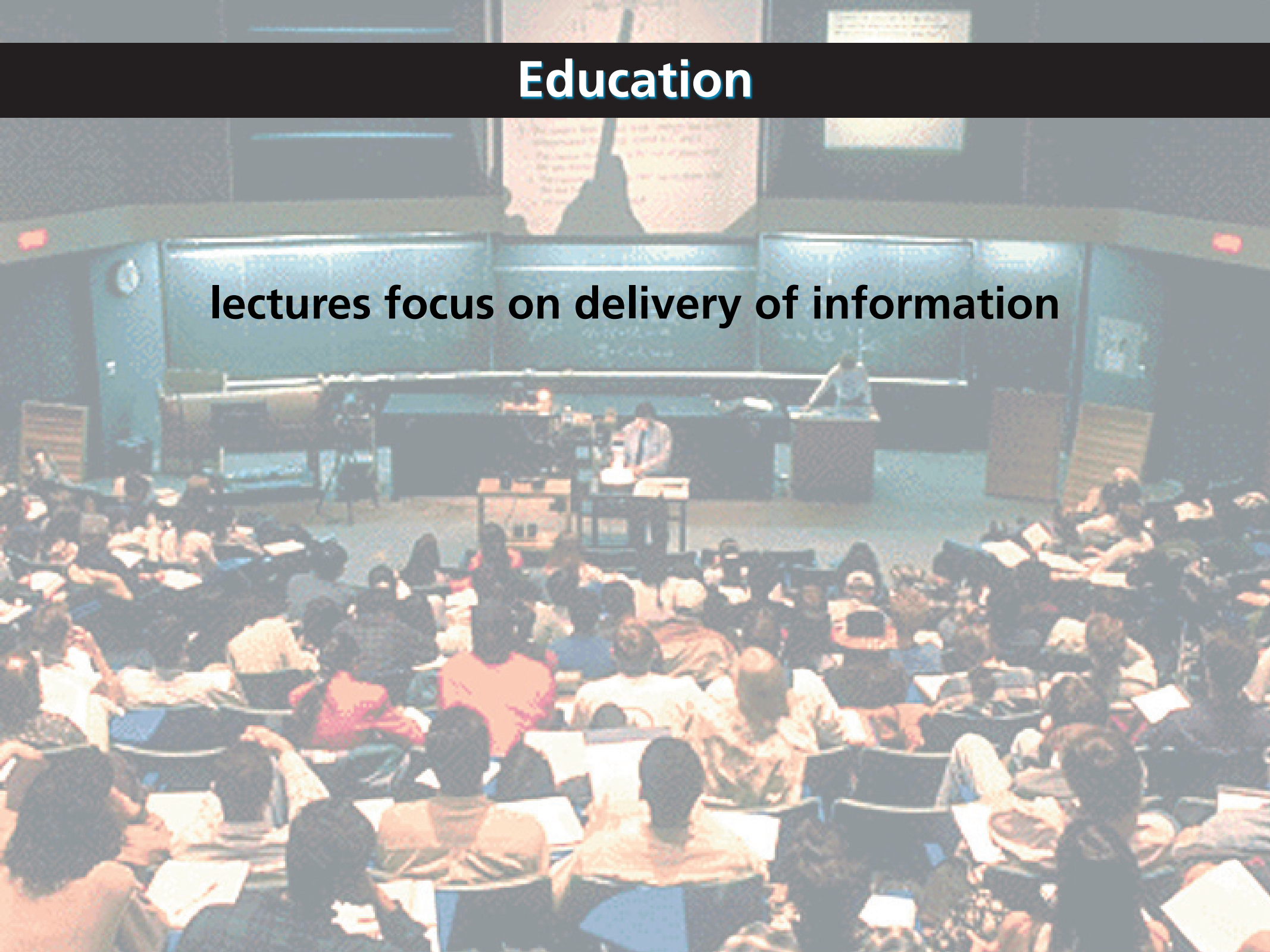


- Education
- Peer Instruction
- Results

Education



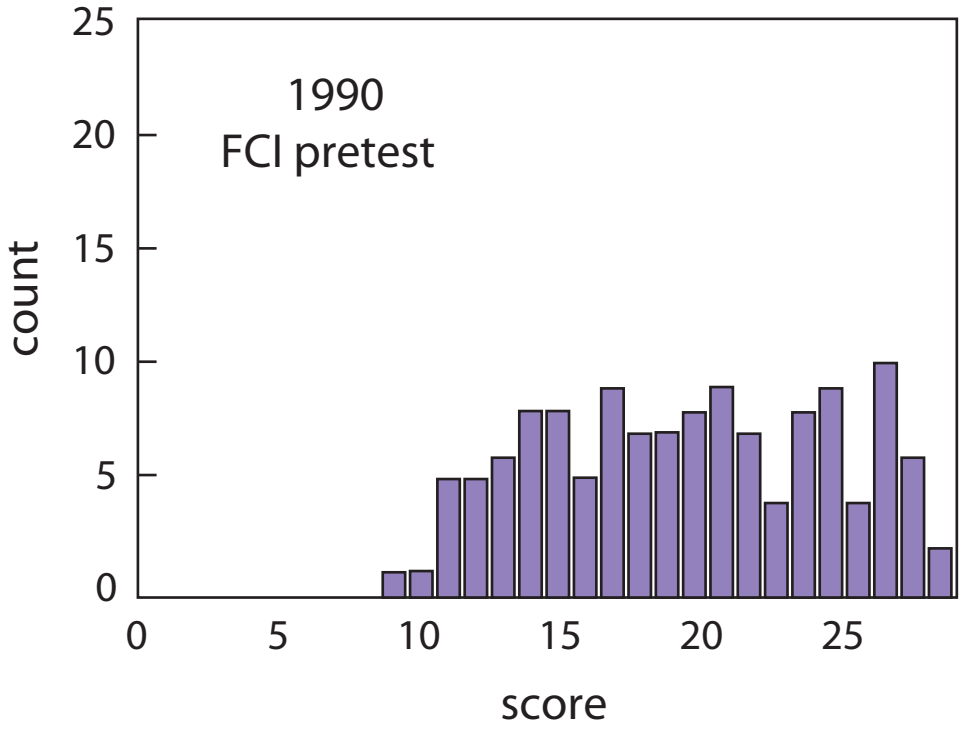
Education



lectures focus on delivery of information

Education

education is not just information transfer



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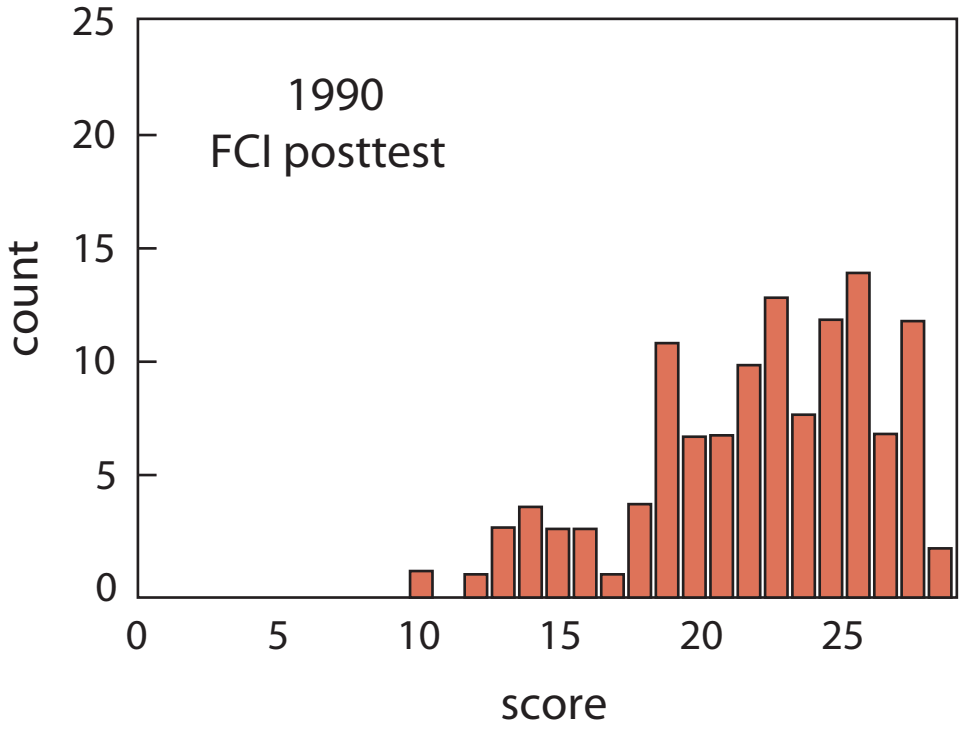

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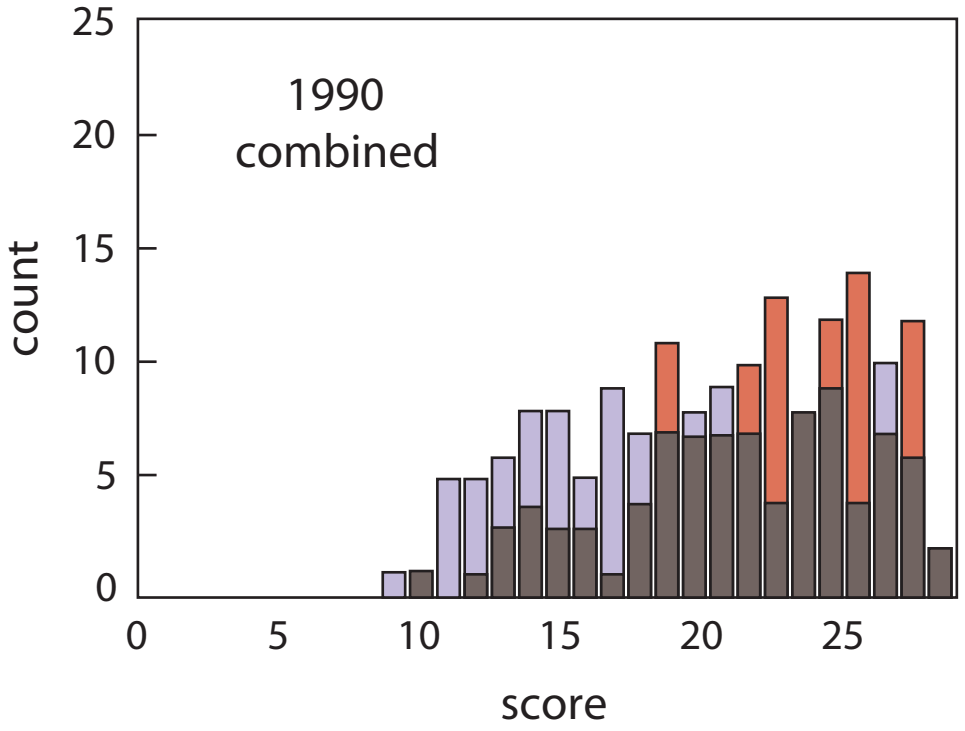
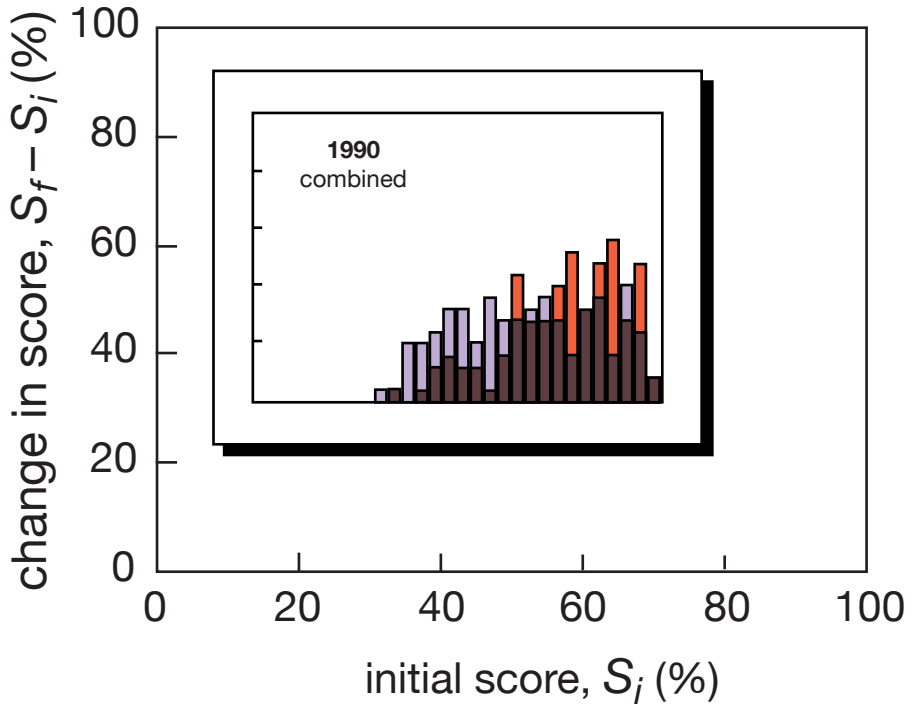
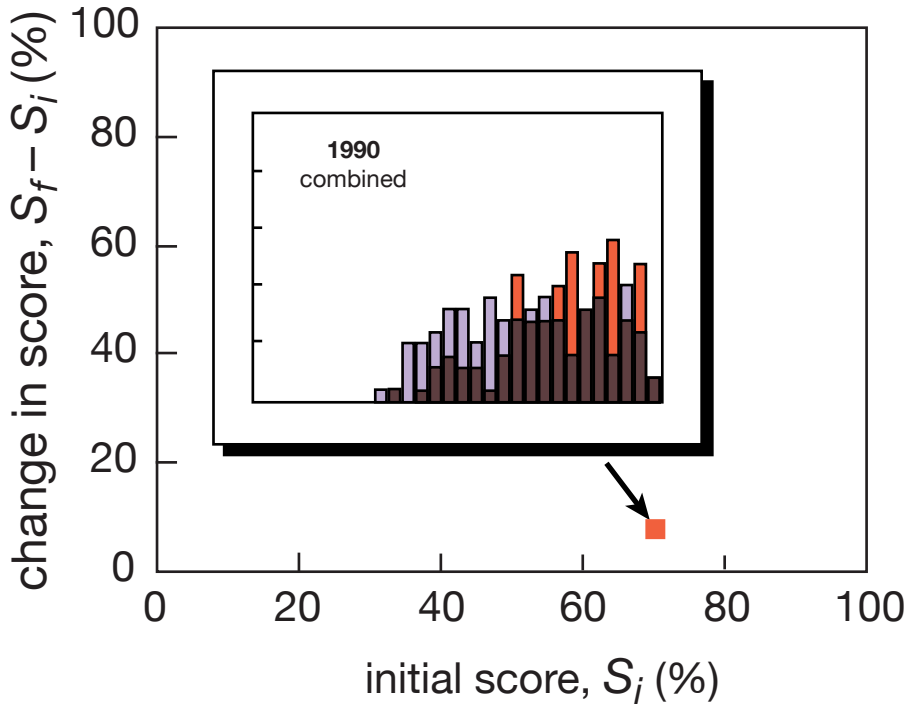


Education


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

Education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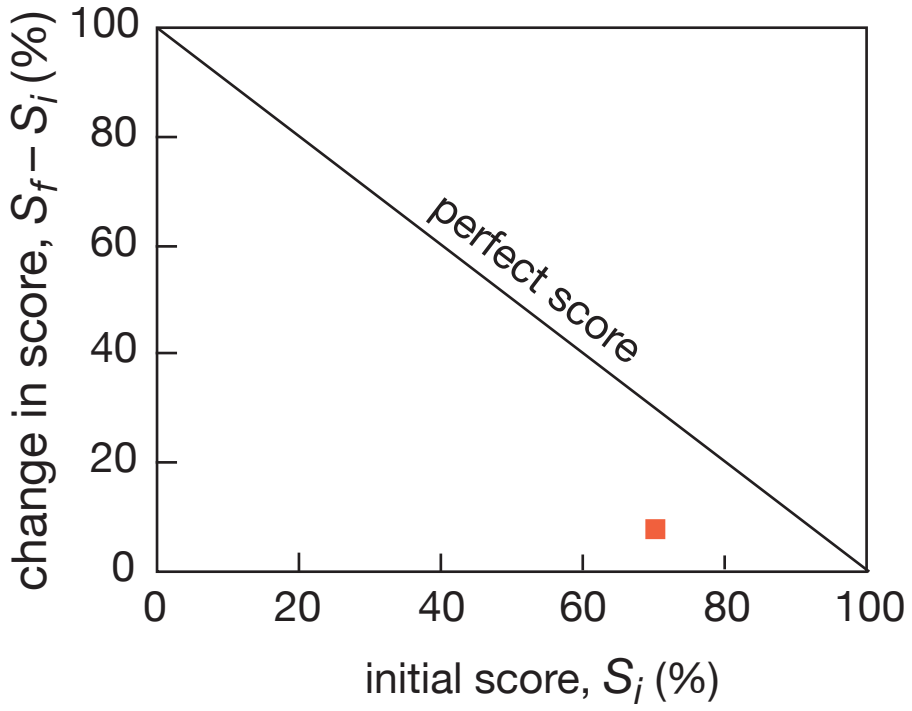
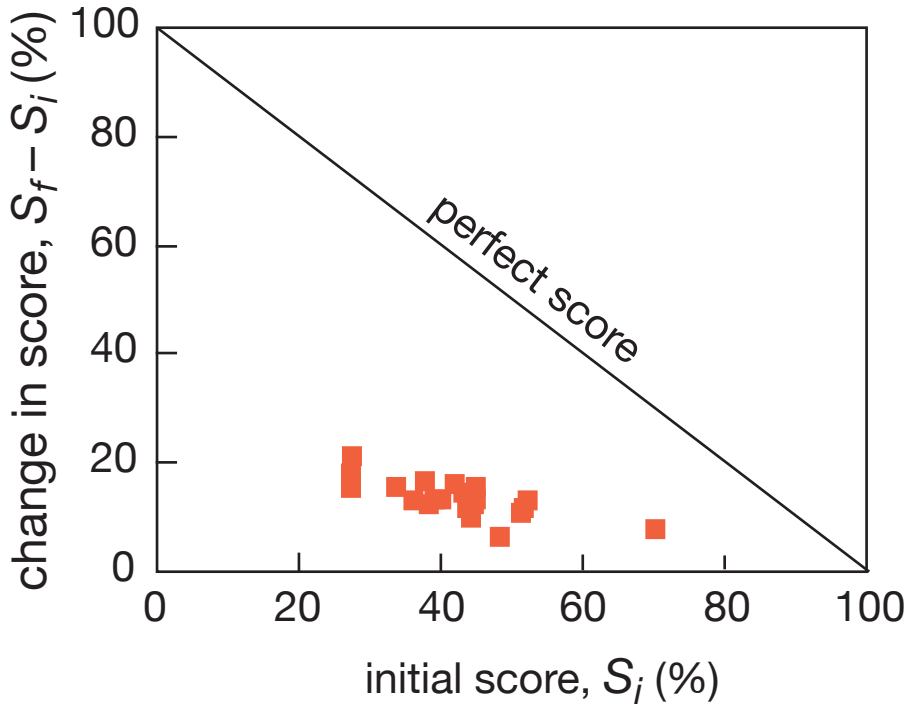

change in score, $S_f - S_i$ (%)
100
80
60
40
20
0
0
20
40
60
80
100
initial score, S_i (%)
perfect score

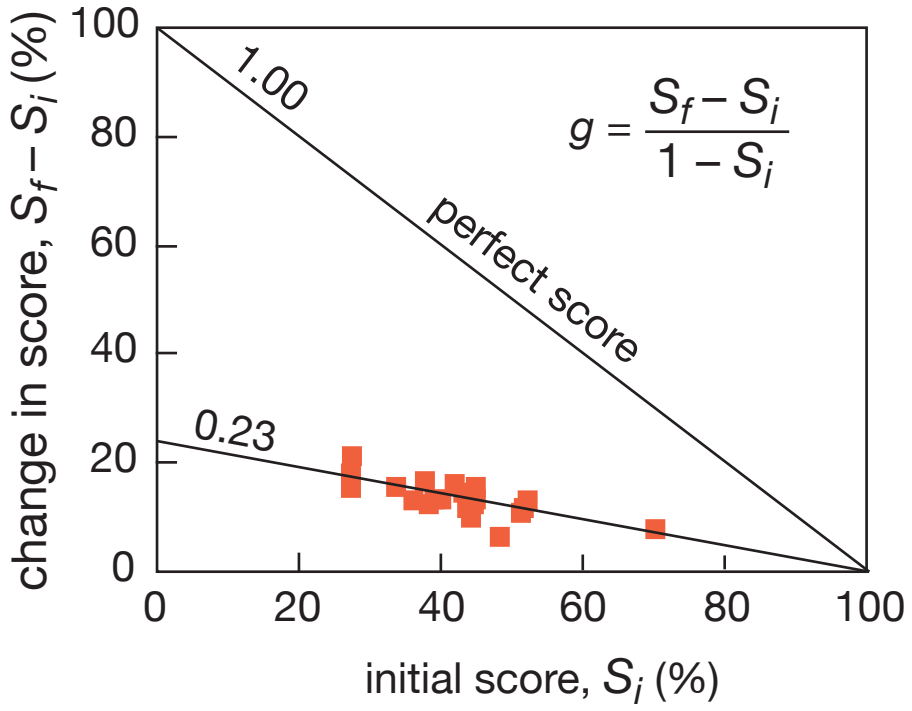
Education



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

Education

only one quarter of maximum gain realized



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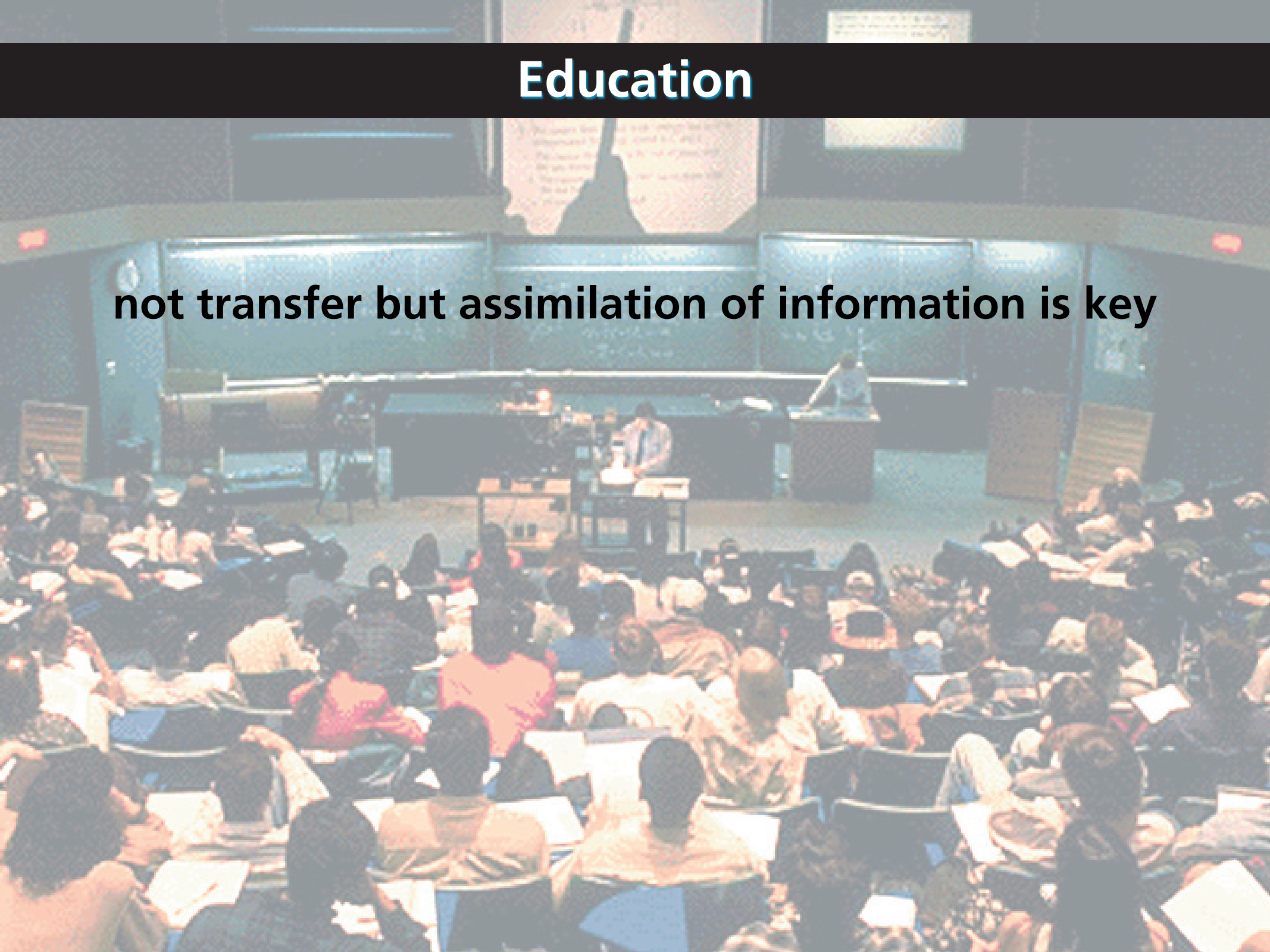
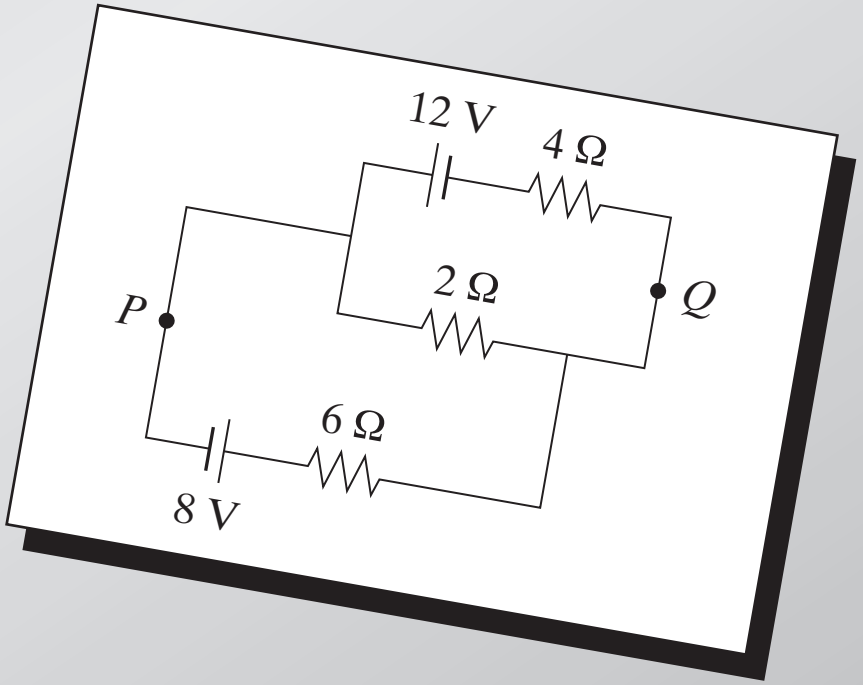
Education



not transfer but assimilation of information is key

Education

conventional problems misleading



Education

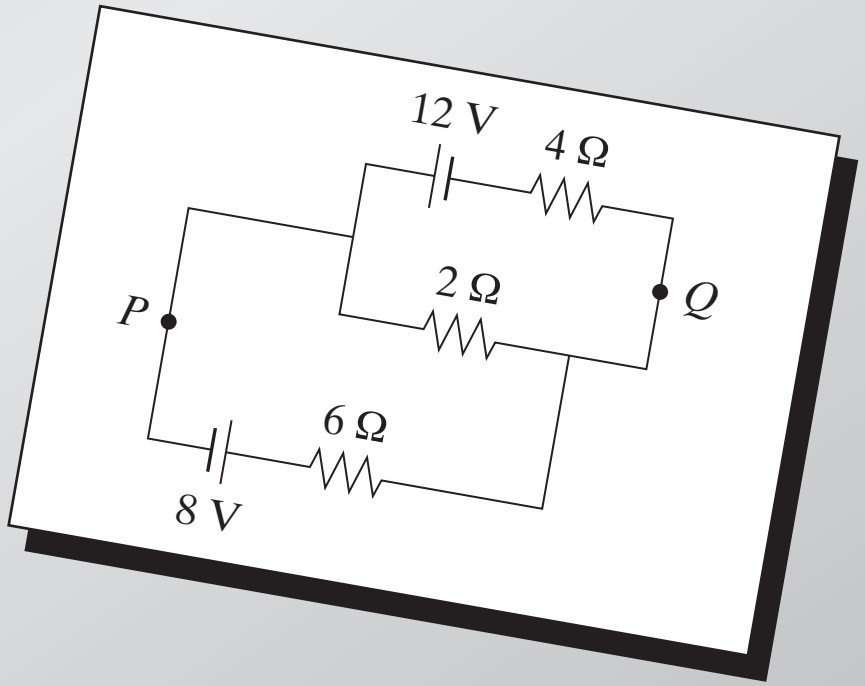
conventional problems misleading

Calculate:

(*a*) current in 2-Ω resistor

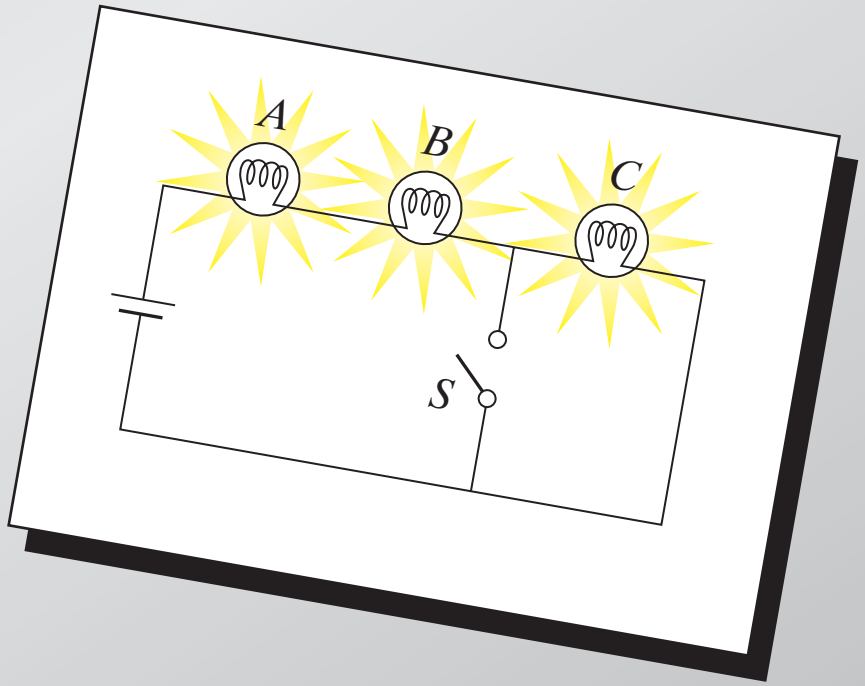
(*b*) potential difference

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?

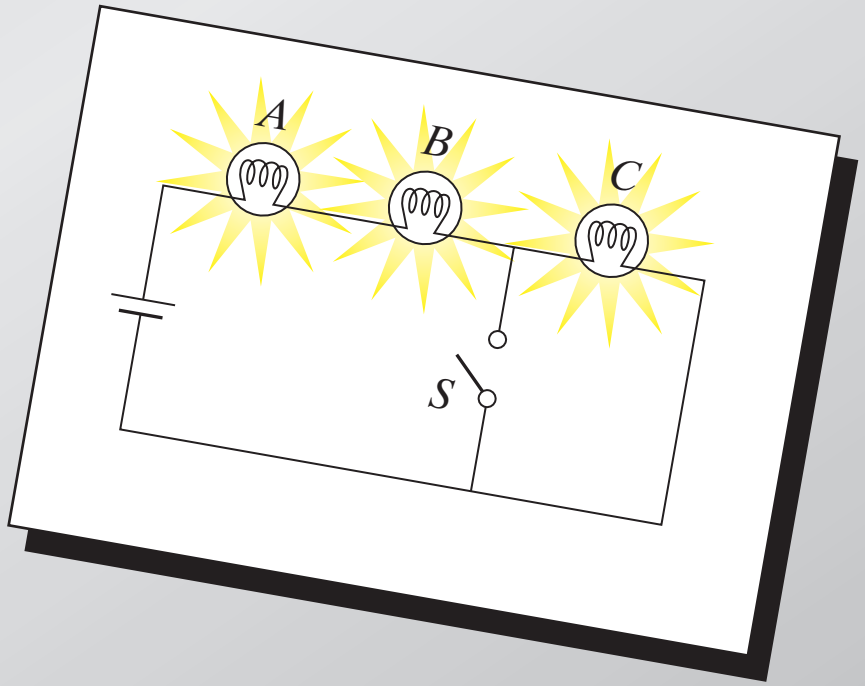
(*b*) intensity of C?

(*c*) current through battery?

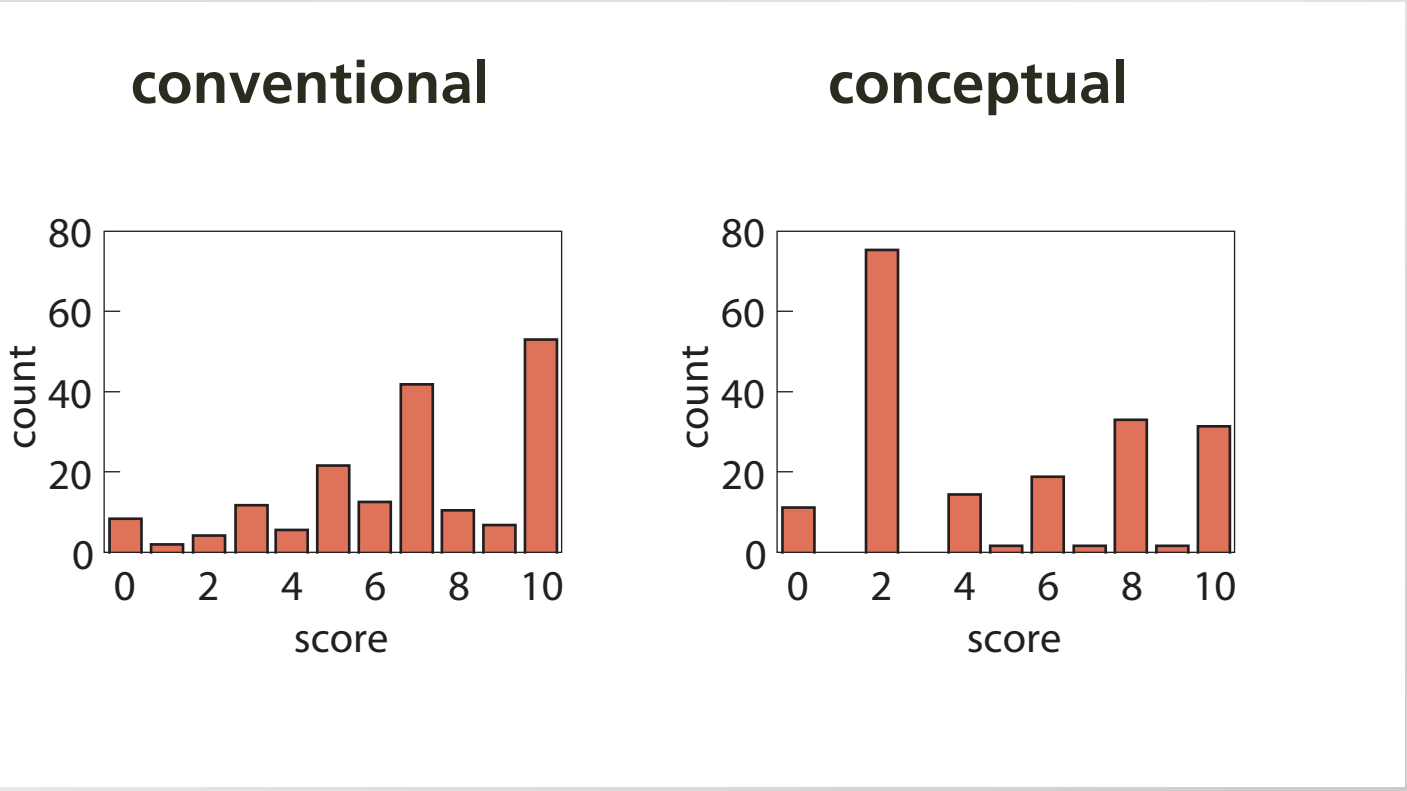
(*d*) potential difference across

A, *B*, and *C*?

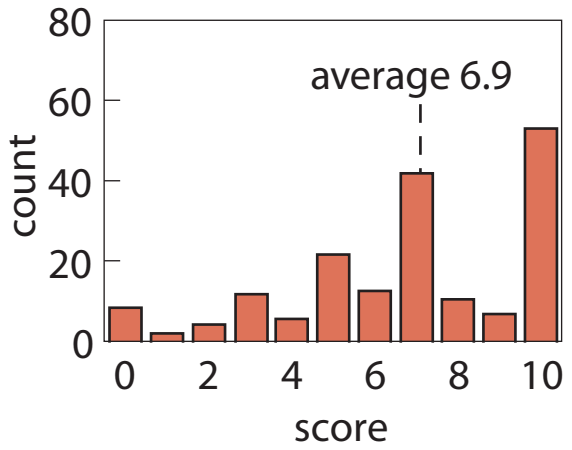
(*e*) the total power dissipated?

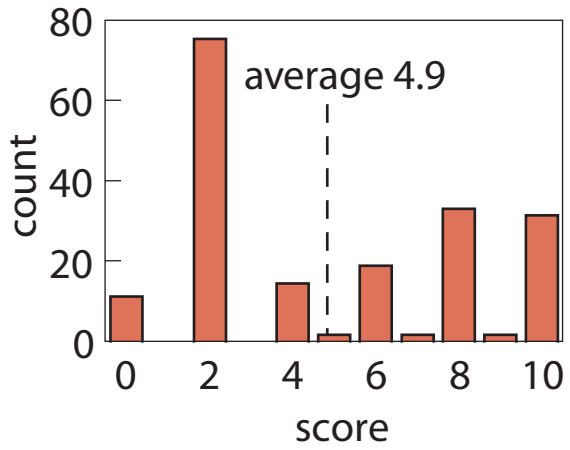


Education



Education


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


conceptual
80
60
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20
0
count
average 4.9
0
2
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6
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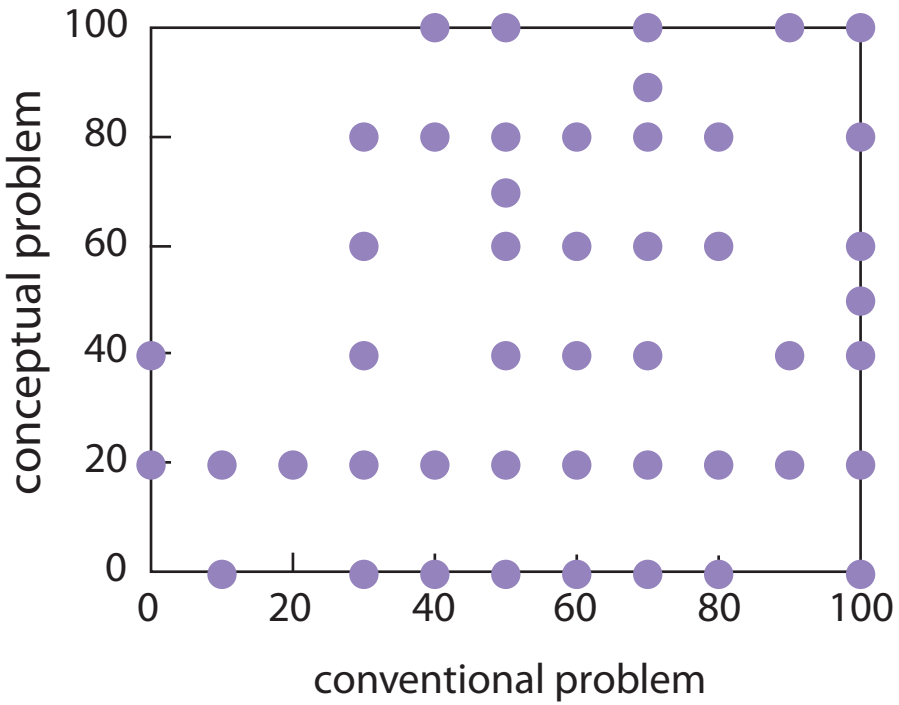
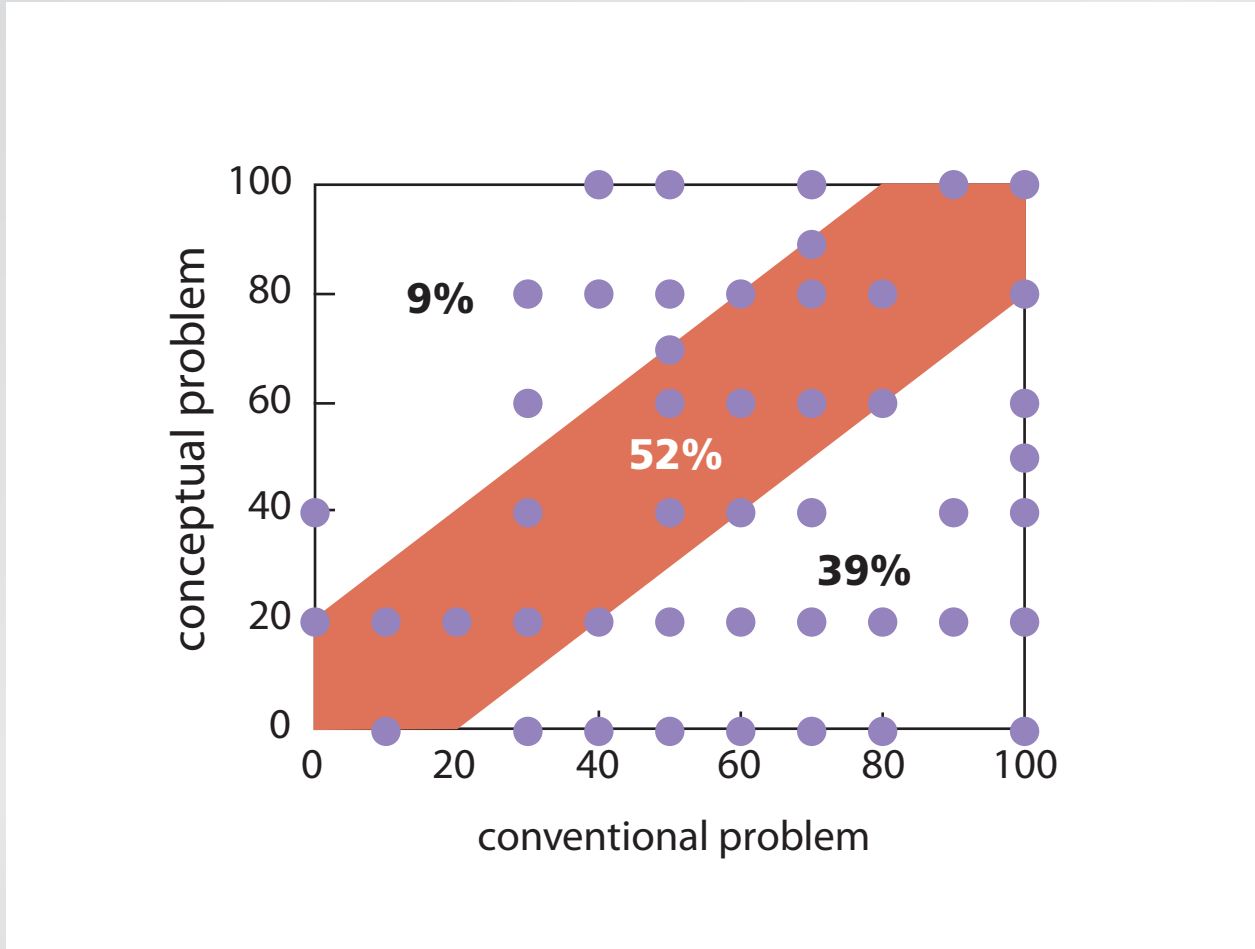
10
score

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…

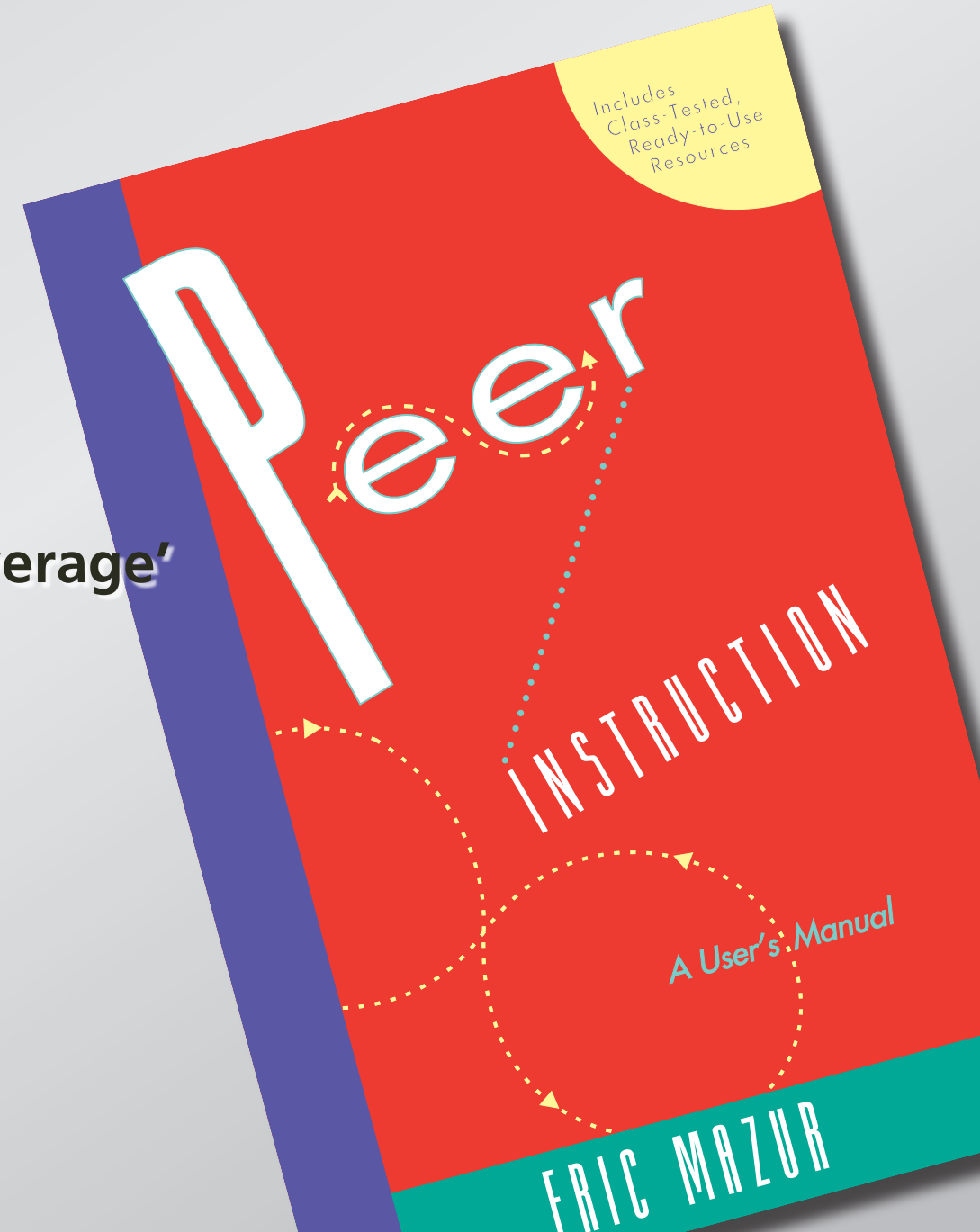
Peer Instruction

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

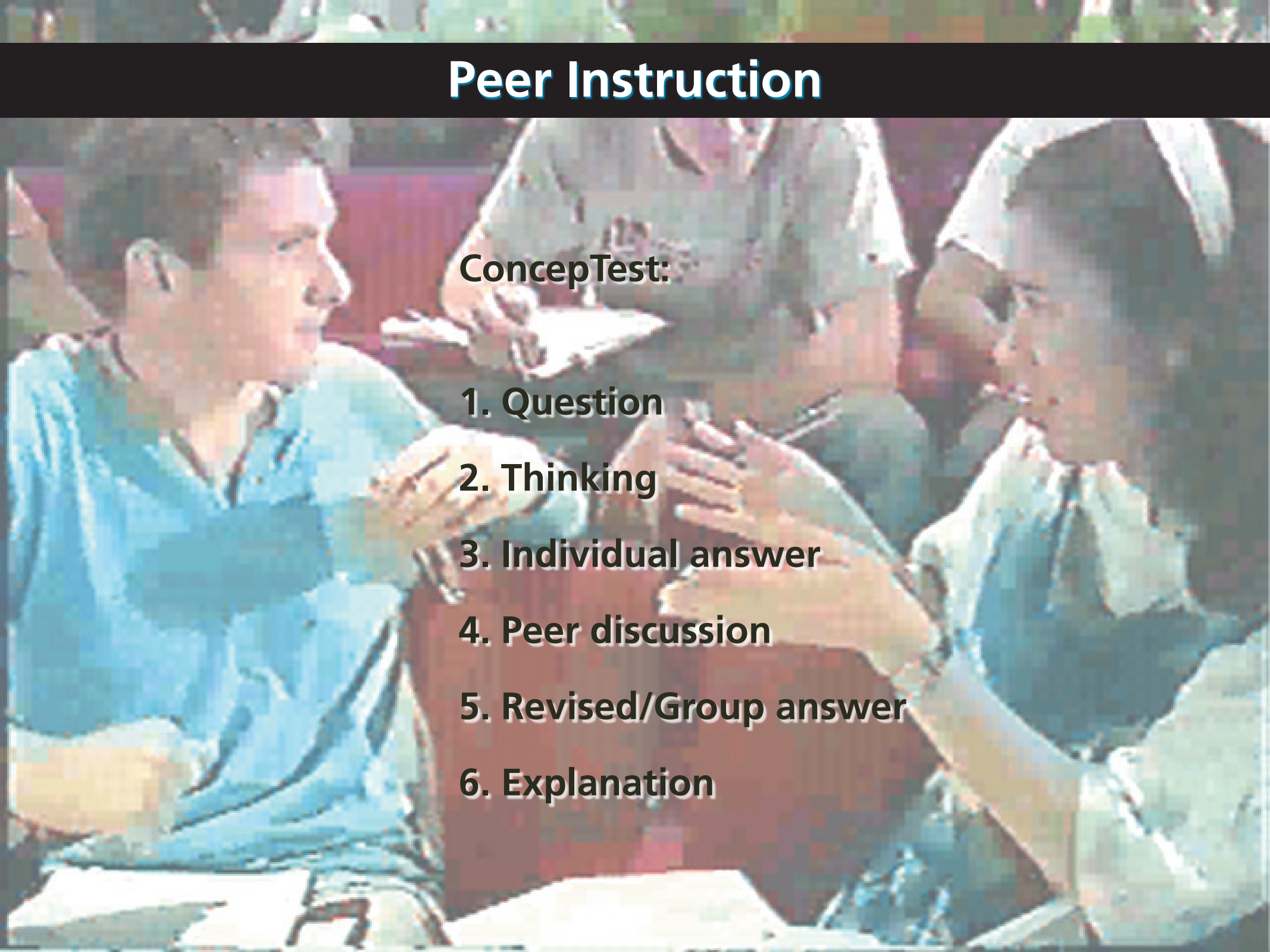
Peer Instruction

Main features:

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



Peer Instruction



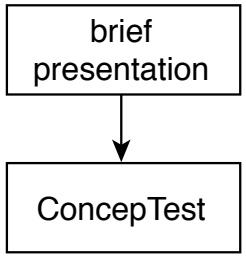
ConcepTest:

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

Peer Instruction: a primer

brief
presentation

Peer Instruction: a primer



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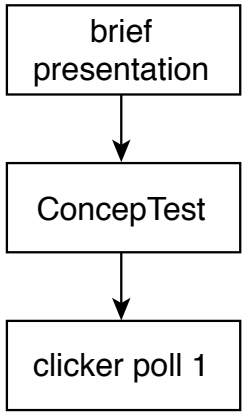

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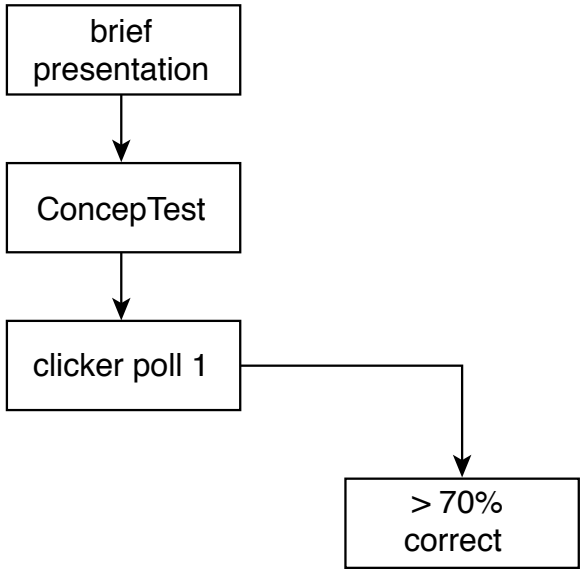

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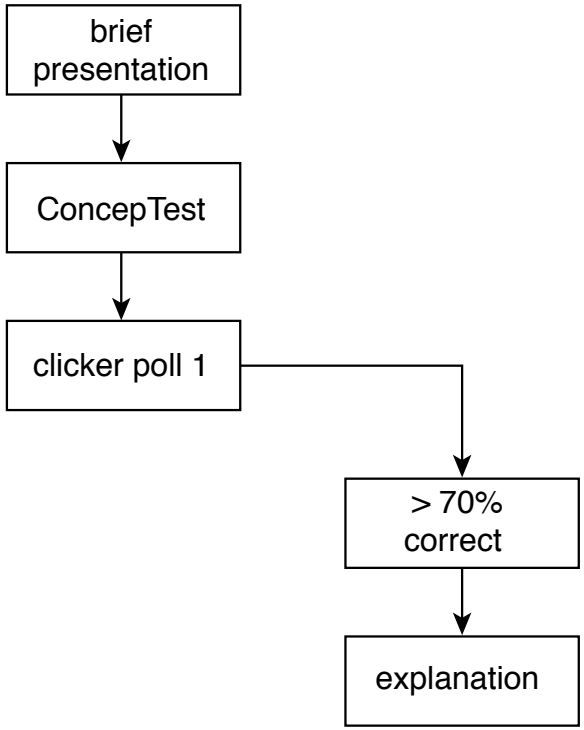

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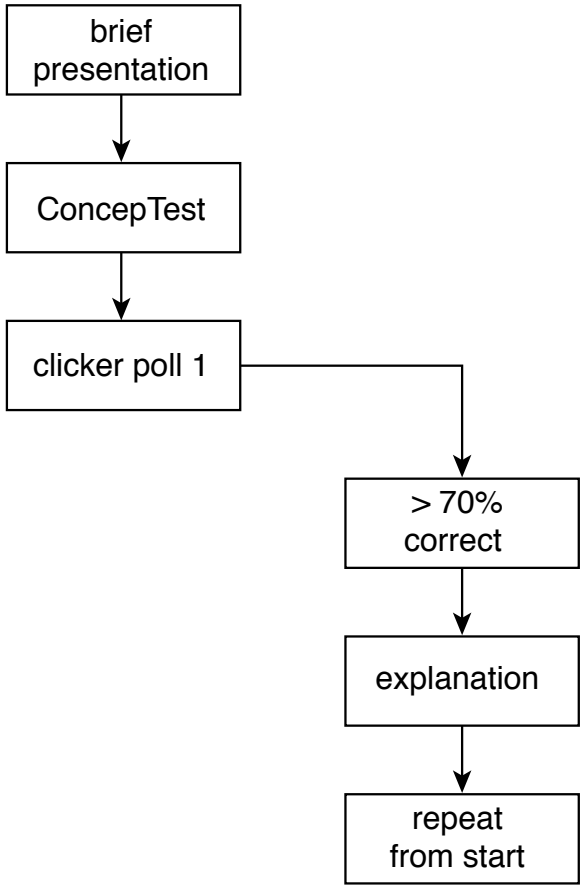

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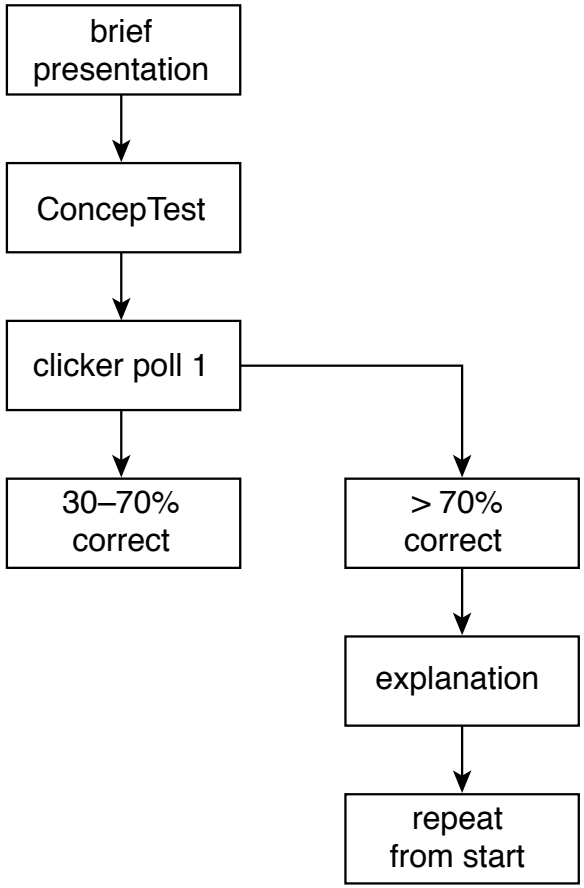

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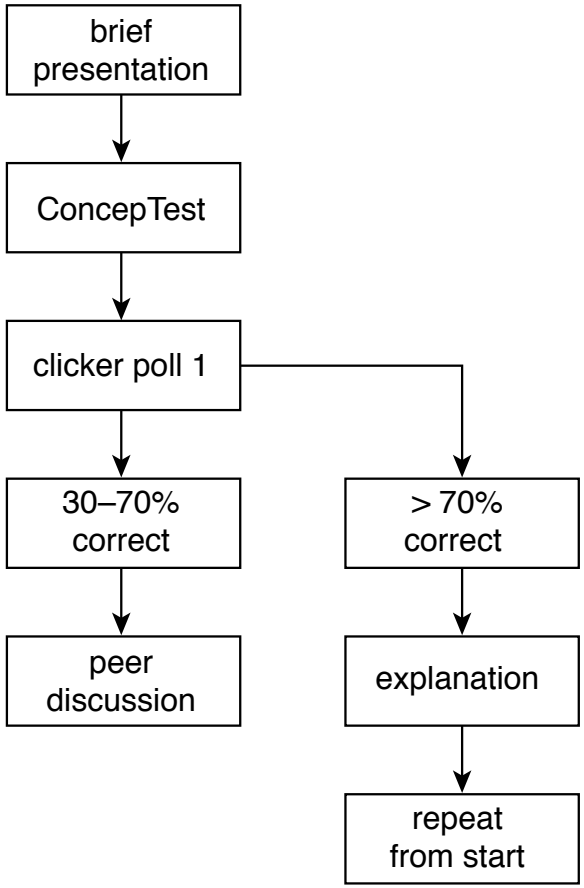

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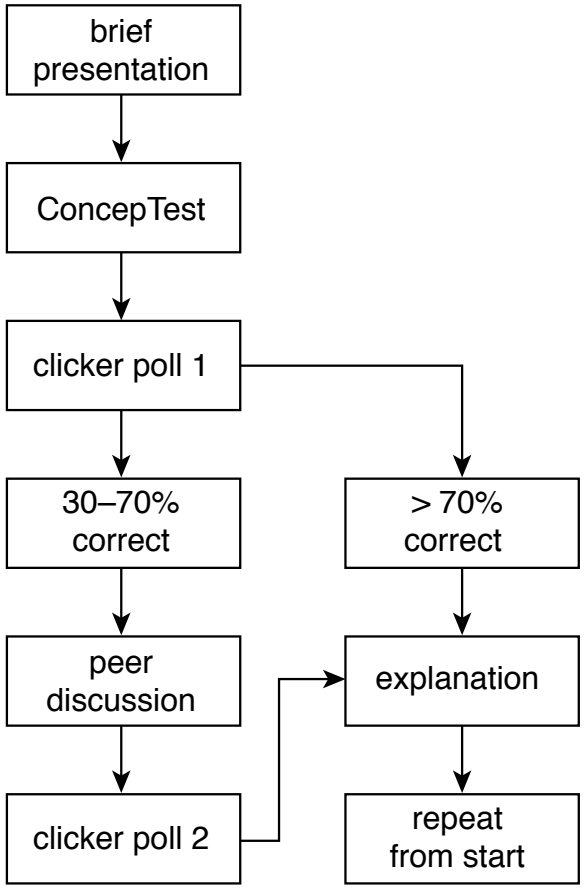

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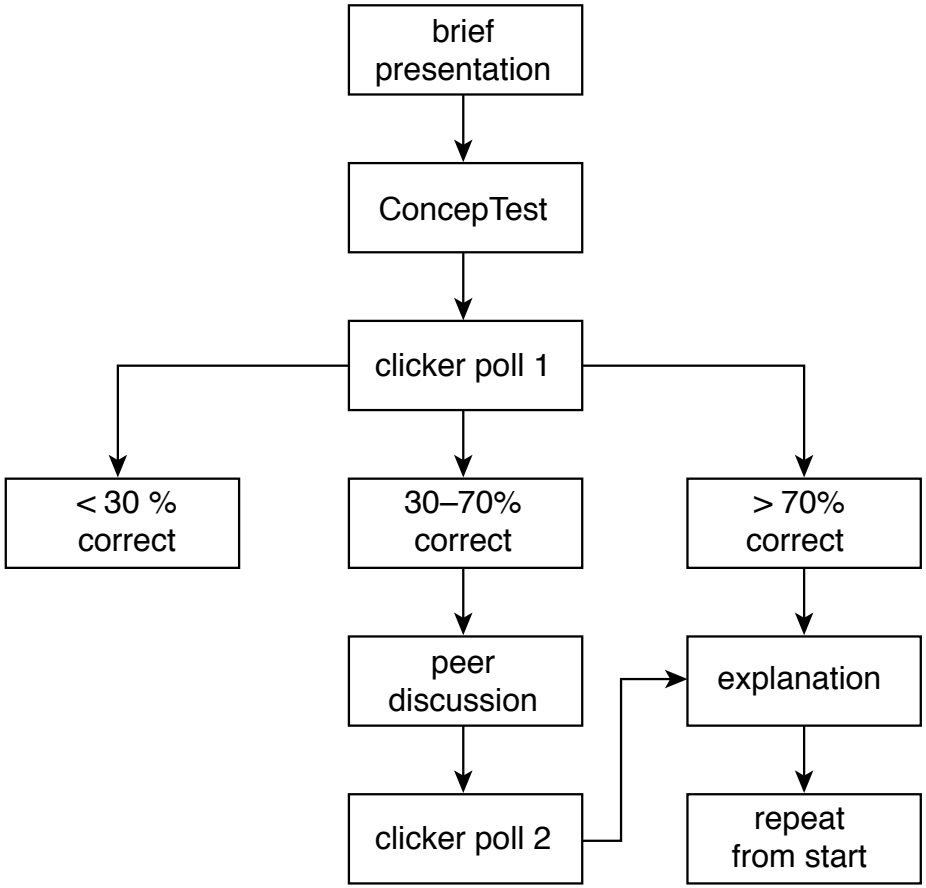

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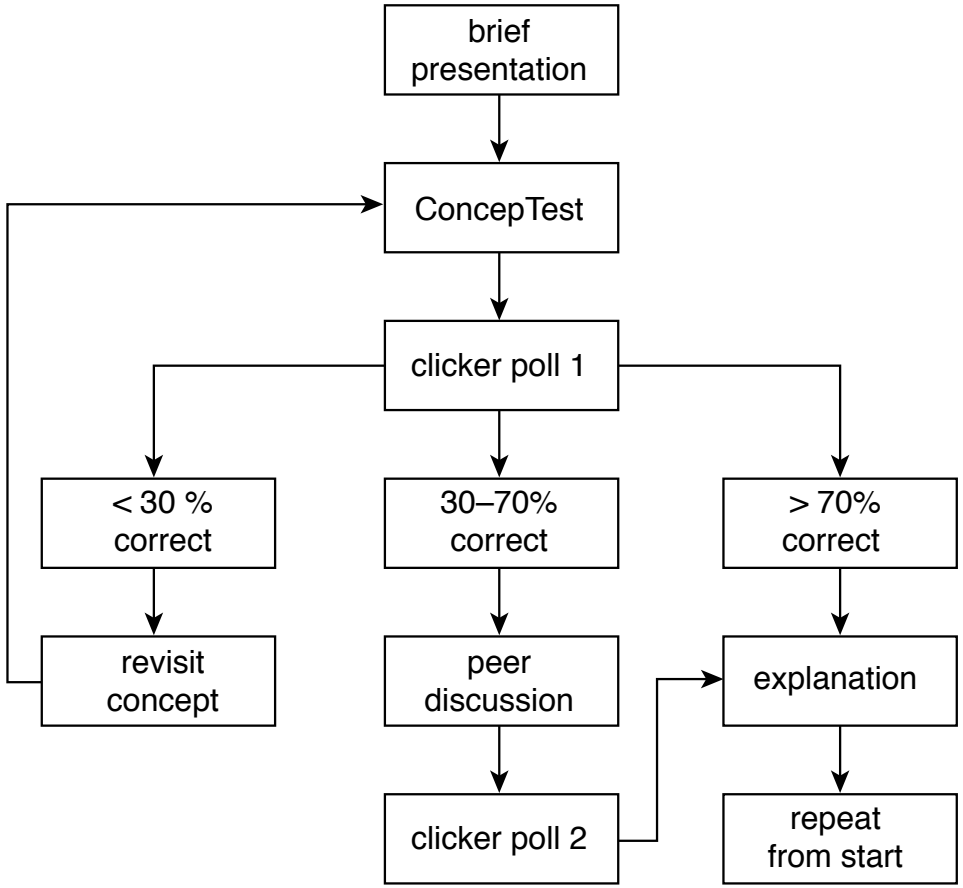

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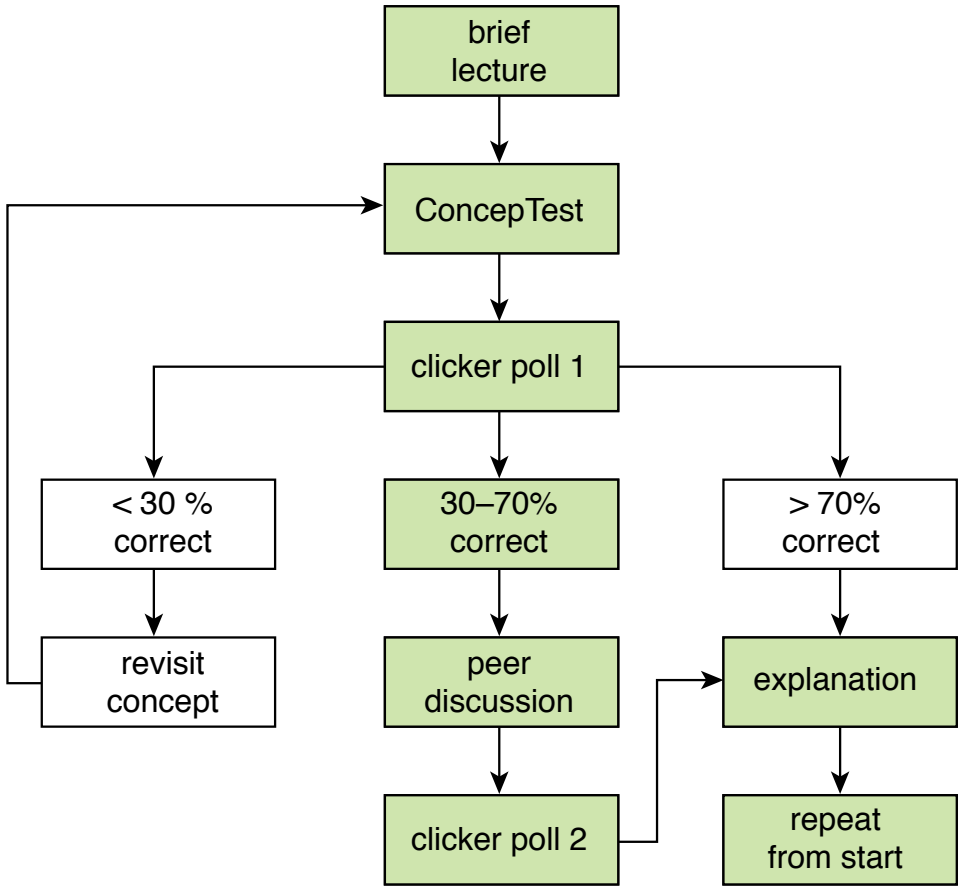

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- no ON/OFF button
- only last “click” counts
- display shows recorded answer

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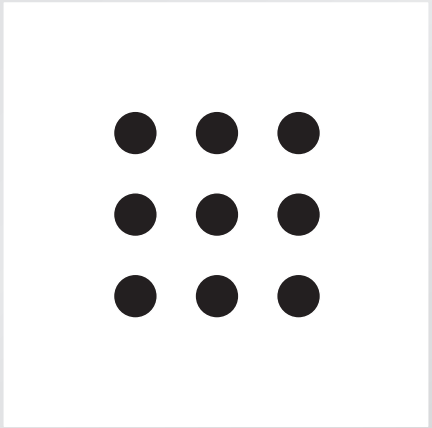
Let's try it!

When metals heat up, they expand because all atoms get farther away from each other.



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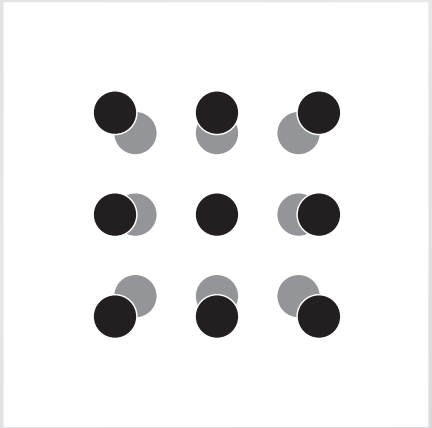
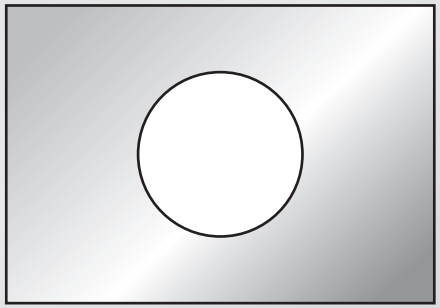


Let's try it!

Consider a rectangular metal plate with a circular hole in it.



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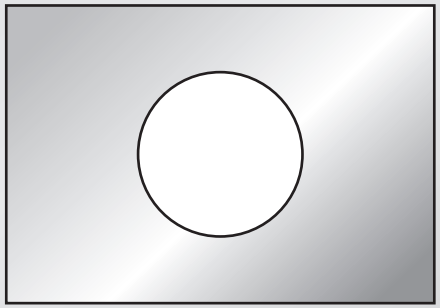


When the plate is uniformly heated, the diameter of the hole

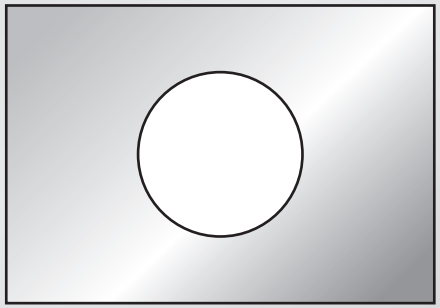
1. increases.
2. stays the same.
3. decreases.

Let's try it!

It's easy to fire up the audience!

Let's try it!

Consider a rectangular metal plate with a circular hole in it.



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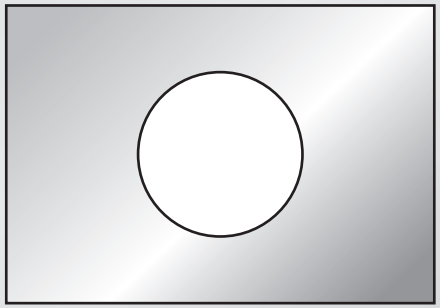

When the plate is uniformly heated, the diameter of the hole

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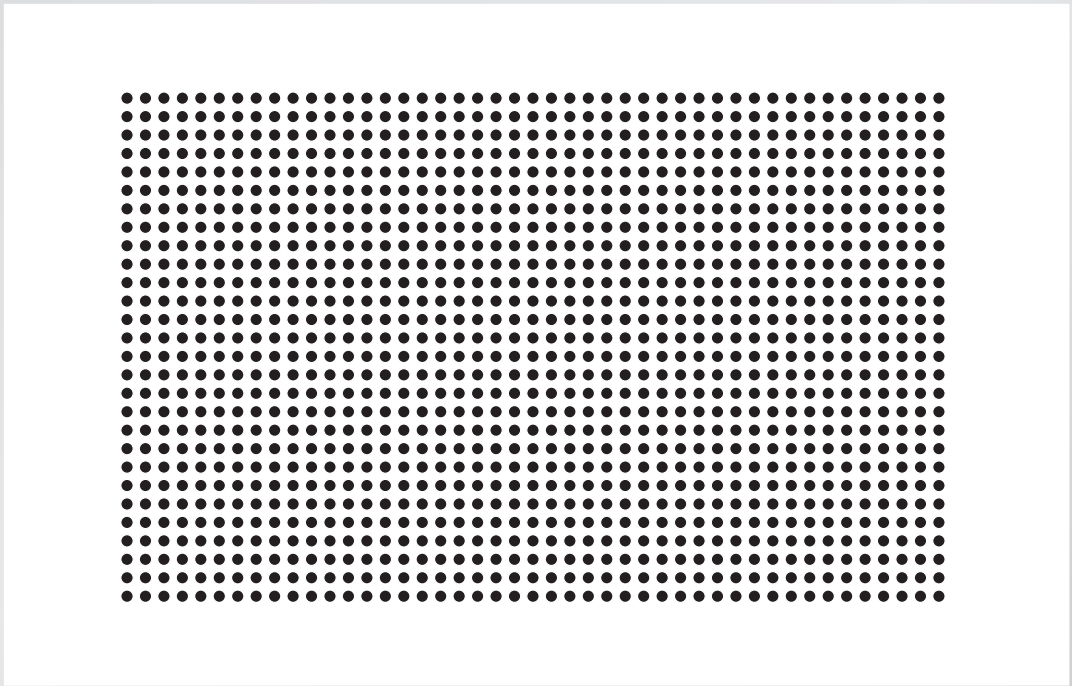
2. stays the same.
3. decreases.

Let's try it!

remember: all atoms must get farther away from each other!



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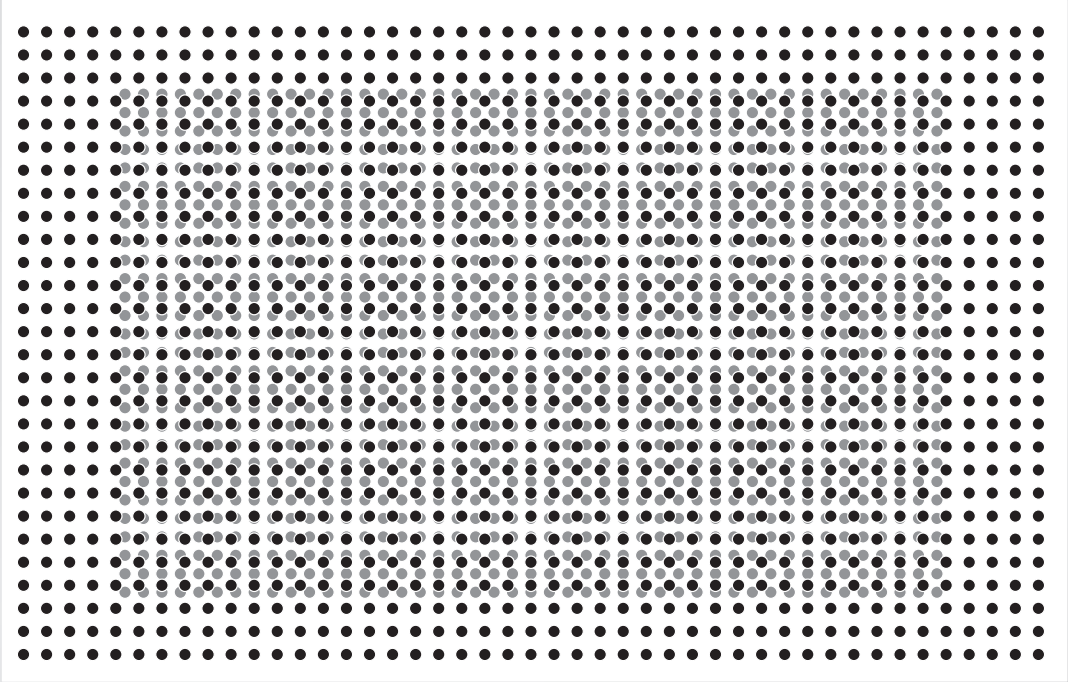
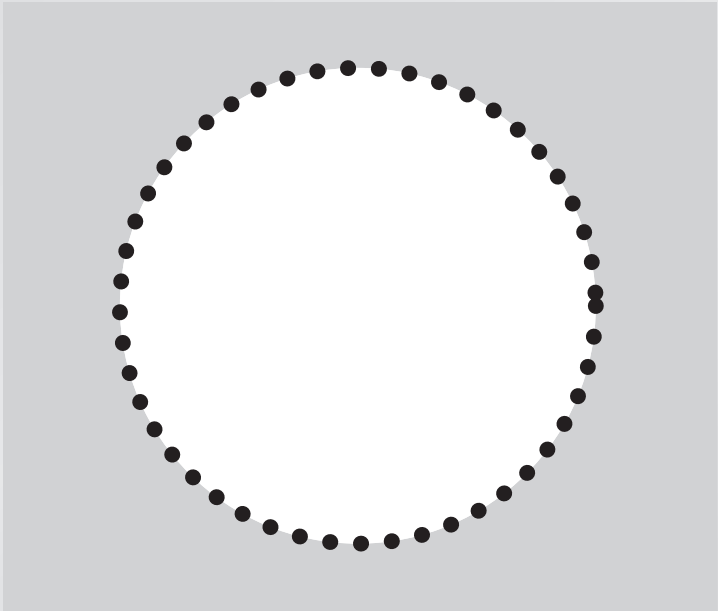


Let's try it!

consider the atoms at the rim of the hole



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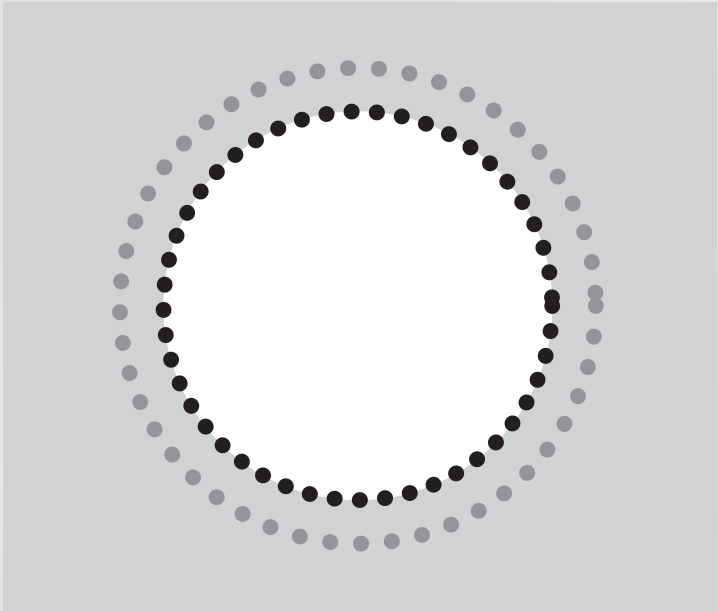

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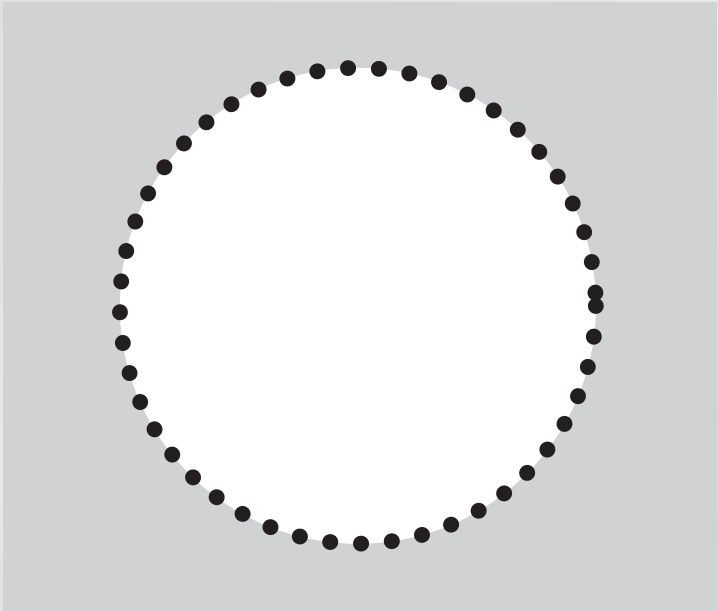

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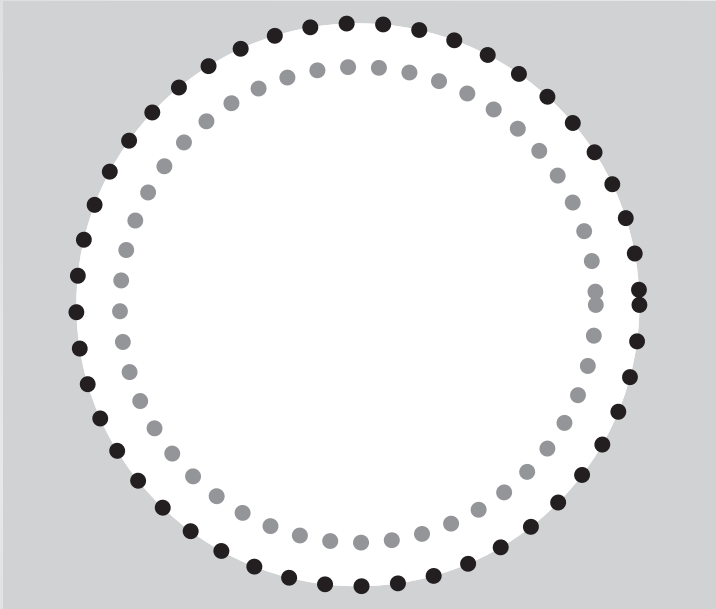

Setting the stage

What constitutes a good problem?

Let's try it!

Imagine a rope that fits snugly along the equator.

Let's try it!

Imagine a rope that fits snugly along the equator.

Suppose the rope is cut and 1 m of rope is inserted between the cut ends. If the rope were to maintain a circular shape, how far off the surface of the Earth would it float?

1. the width of a few atoms
2. the width of a few hairs
3. the height of a curb
4. exactly 1 m
5. more than 1 m

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Let's try it!

circumference at equator:

$$2\pi R_{\mathrm{E}}$$

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new circumference:

$$2\pi R_{\mathrm{E}} + 1\ \mathrm{m}$$

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new circumference:

$$2\pi R_{\mathrm{E}} + 1\ \mathrm{m}$$

radius of circle with new circumference:

$$2\pi R = 2\pi R_{\mathrm{E}} + 1\ \mathrm{m}, \quad \textbf{and so} \quad R = R_{\mathrm{E}} + \frac{1\ \mathrm{m}}{2\pi}.$$

Let's try it

Which of the following airlines tries to save fuel by suggesting that its passengers use the bathroom before boarding?

1. Delta Airlines
2. Lufthansa
3. All Nippon Airways
4. British Midland Airways
5. Air France
6. JAL
7. Aboriginal Air Services
8. Aeroflot
9. Are you kidding me? None of the above.

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Let's try it!

hole in plate	model
circumference	model
airline	fact

Let's try it!

hole in plate	model
circumference	model
airline	fact

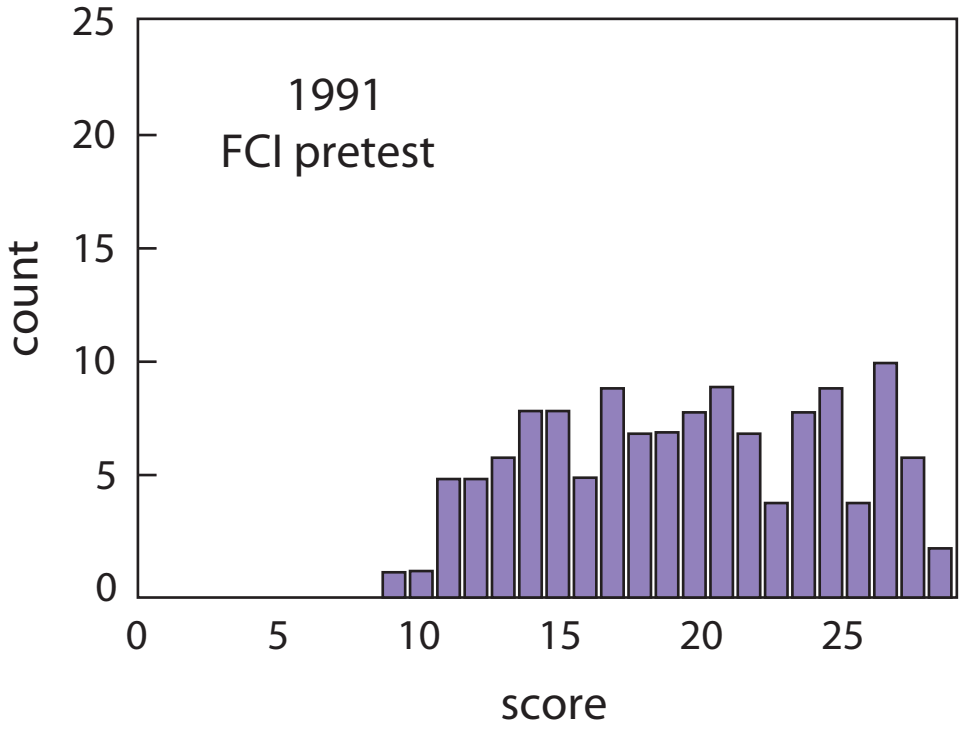
need to test mental model!

Results

is it any good?

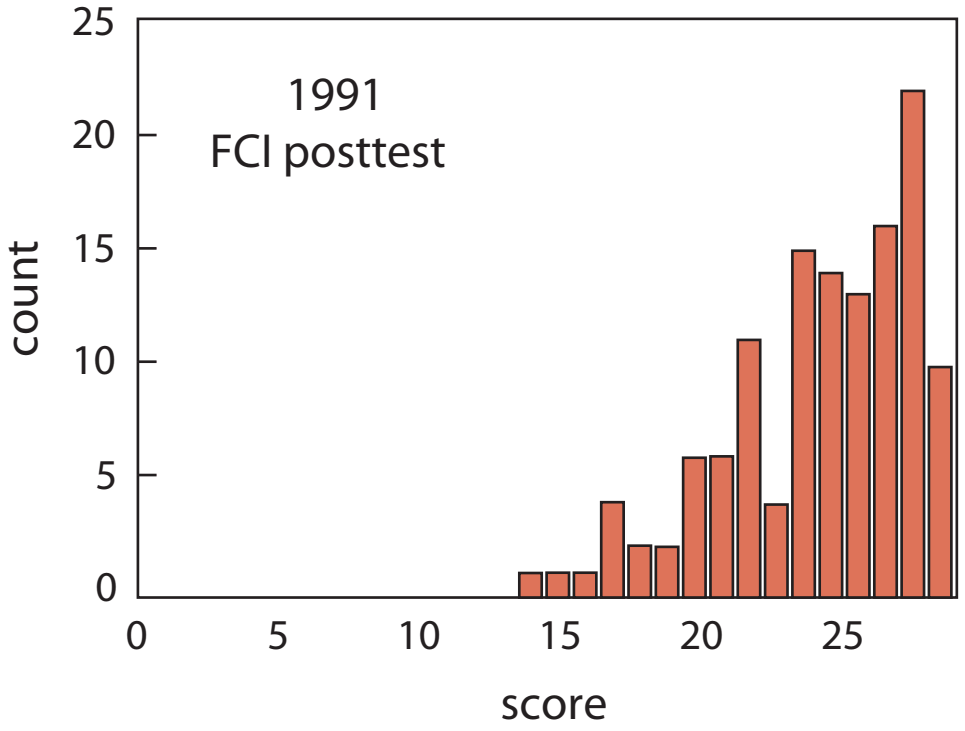
Results

first year of implementing PI



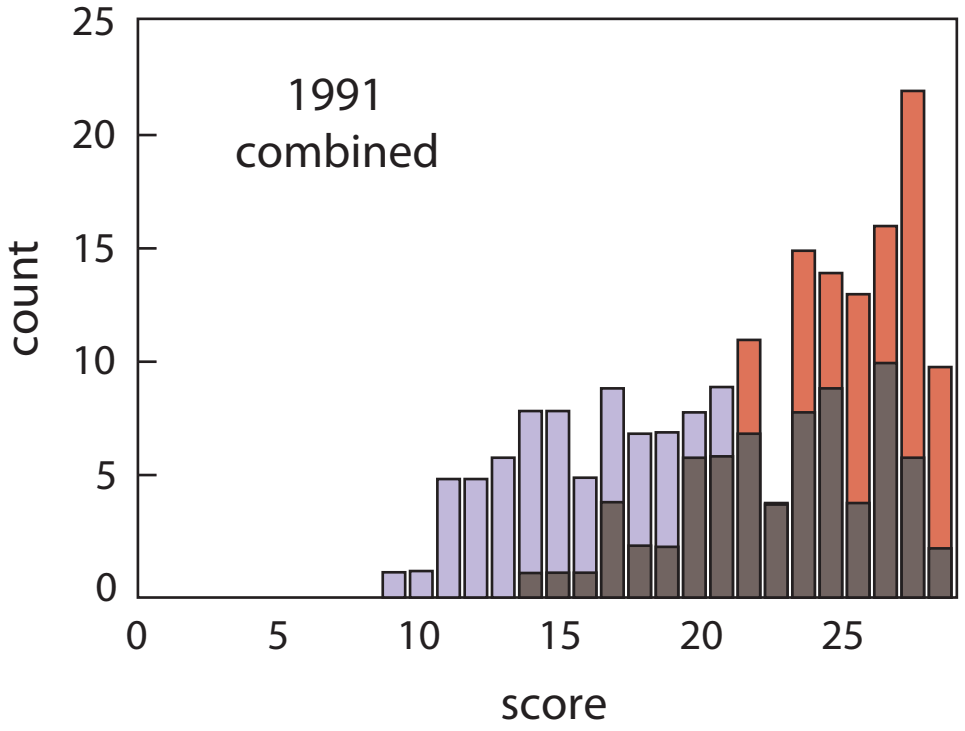
Results

first year of implementing PI

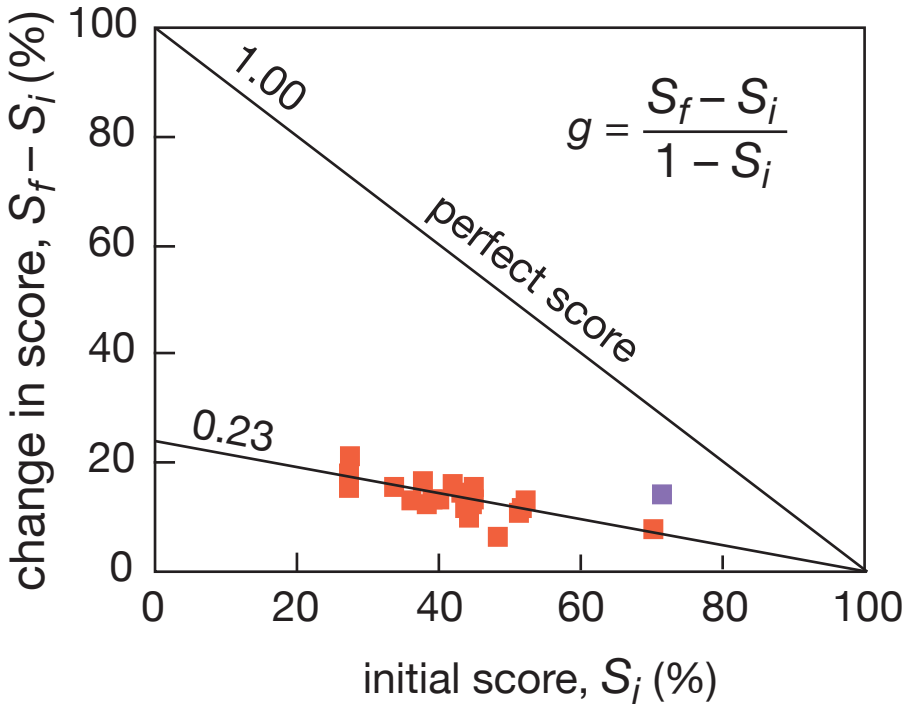


Results

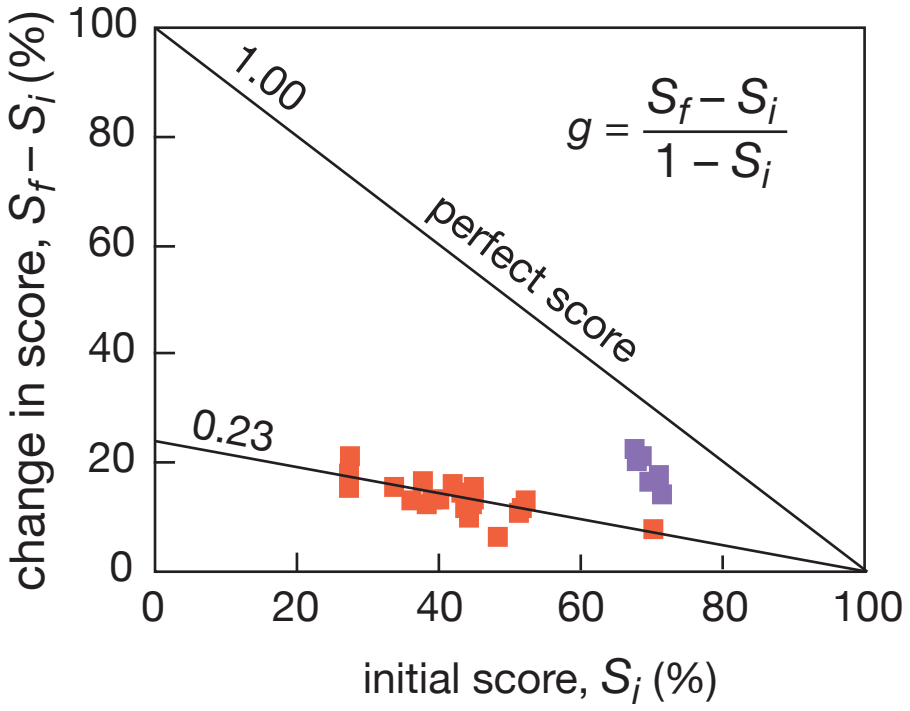
first year of implementing PI



Results


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

Results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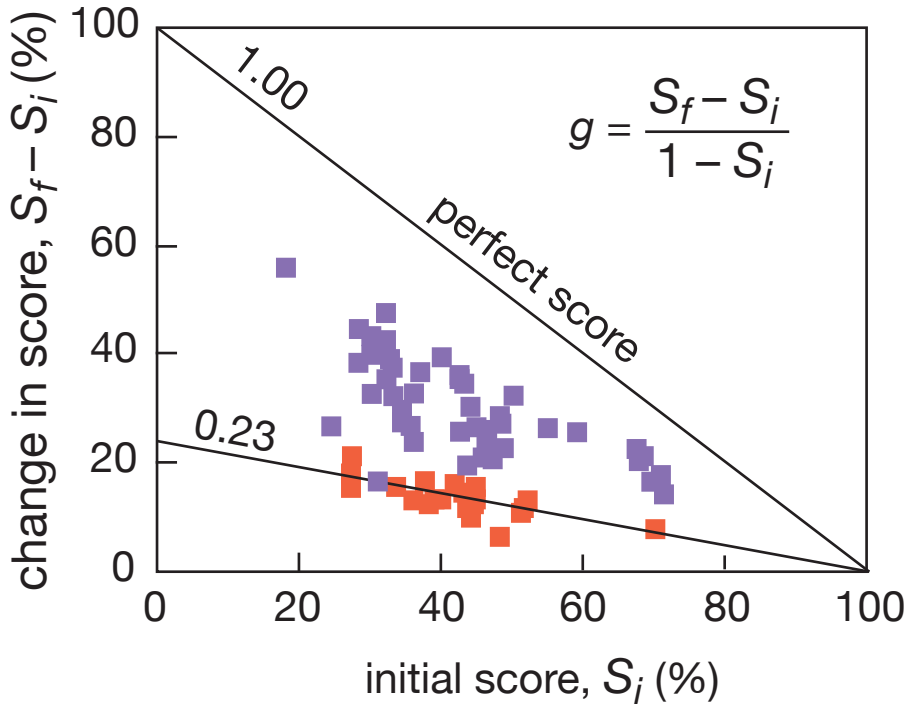
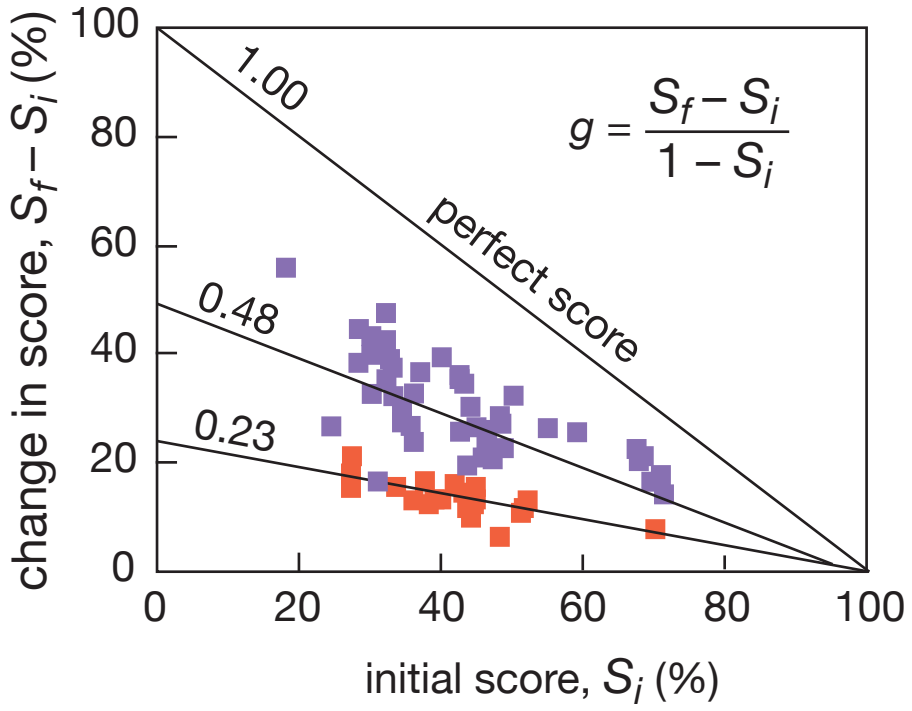


R.R. Hake, *Am. J. Phys.* 66, 64 (1998)

Results

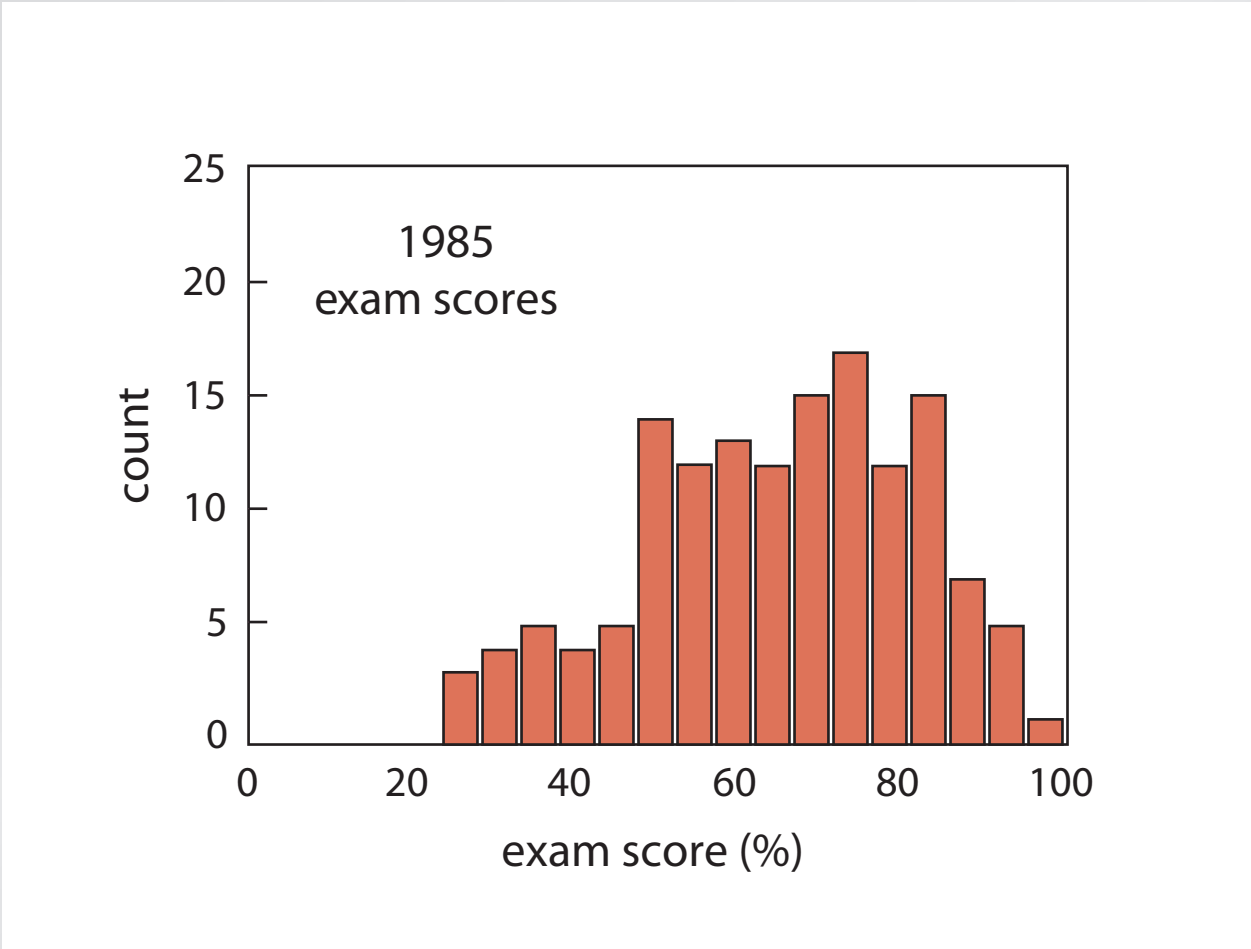


R.R. Hake, *Am. J. Phys.* 66, 64 (1998)

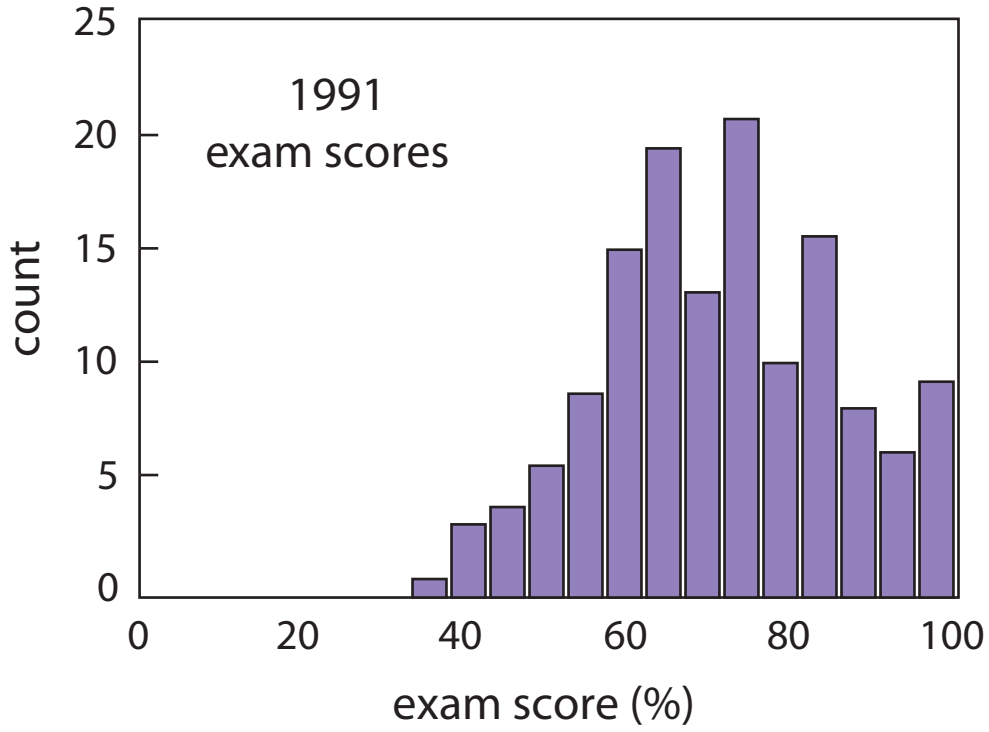
Results

what about problem solving?

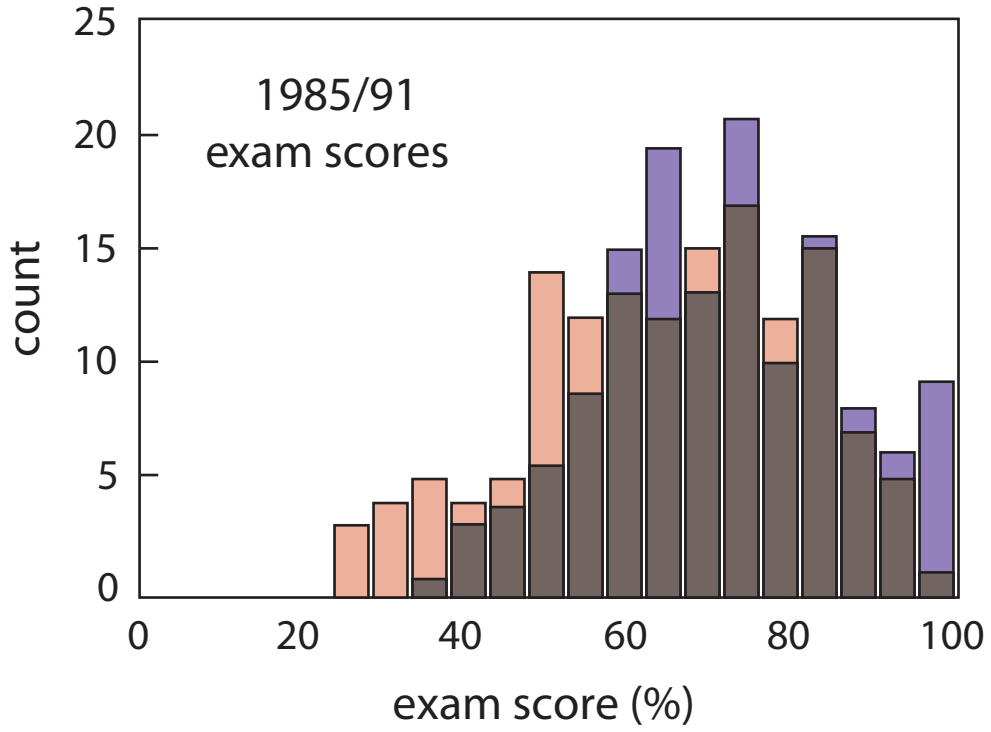
Results


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 (%)

Summary

So better understanding leads to better problem solving!

Summary

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

Summary

Traditional indicators of success misleading

Summary

Traditional indicators of success misleading

Education is no longer about information

Many thanks to:

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Learning Technologies Interactive and Turning Technologies

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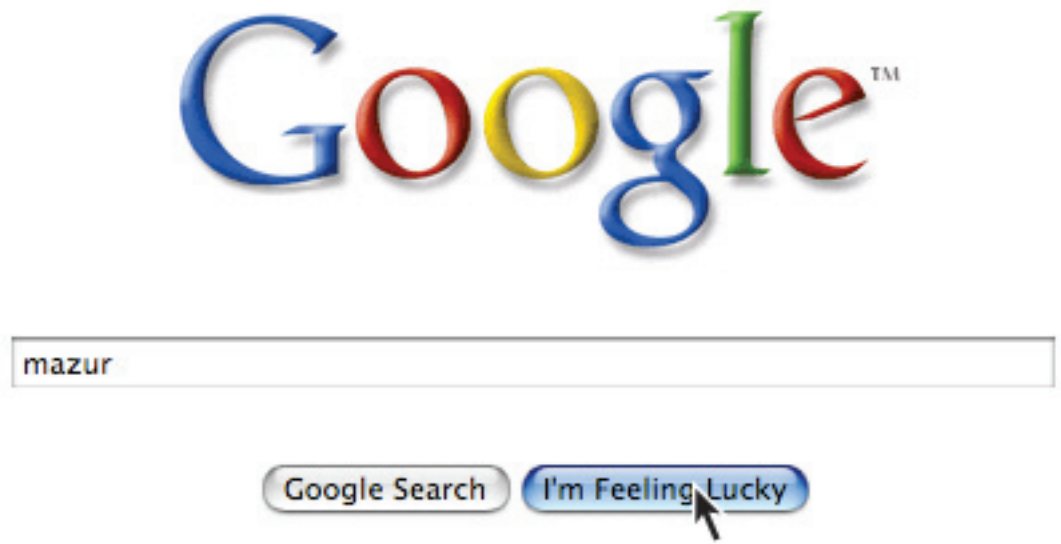
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