Memorization or understanding: are we teaching the right thing?

Institute of Laser Engineering
Beijing University of Technology
Beijing, China, 5 August 2013

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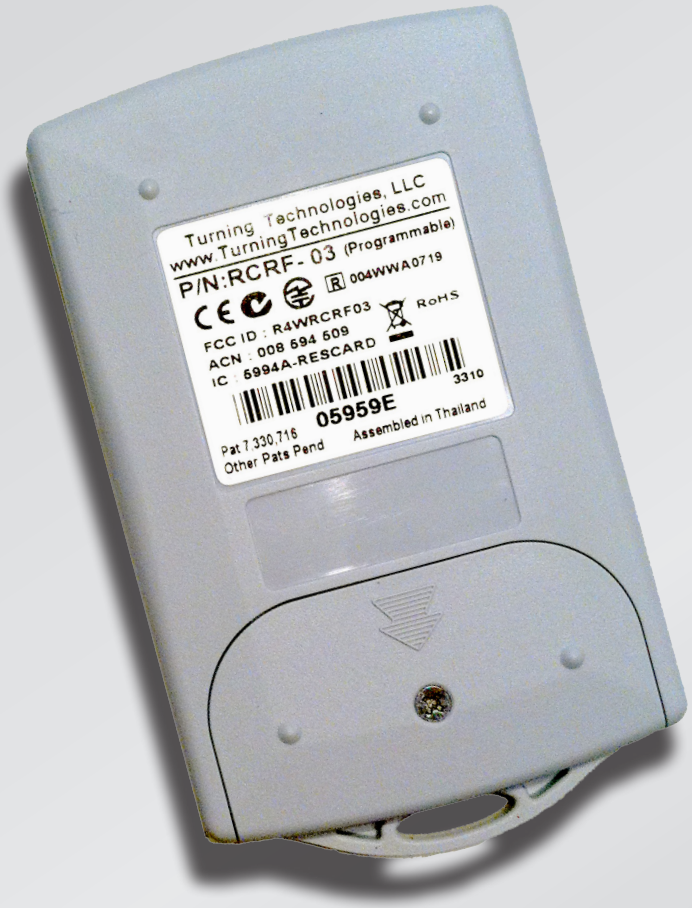

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How do we learn?

Think of something you are good at — something that you know you do well.

How do we learn?

Think of something you are good at — something that you know you do well.

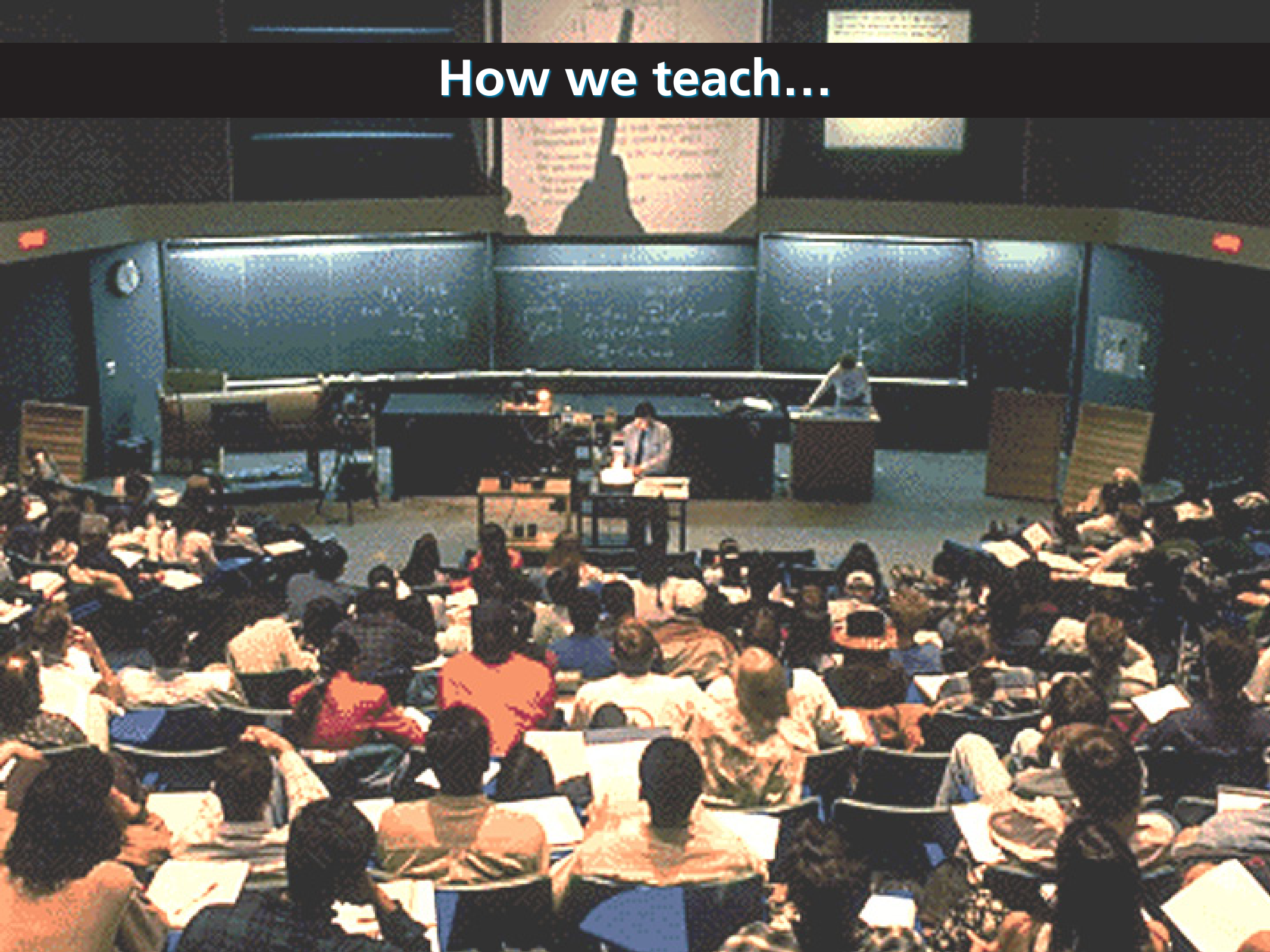
***How* did you become good at this?**

How do we learn?

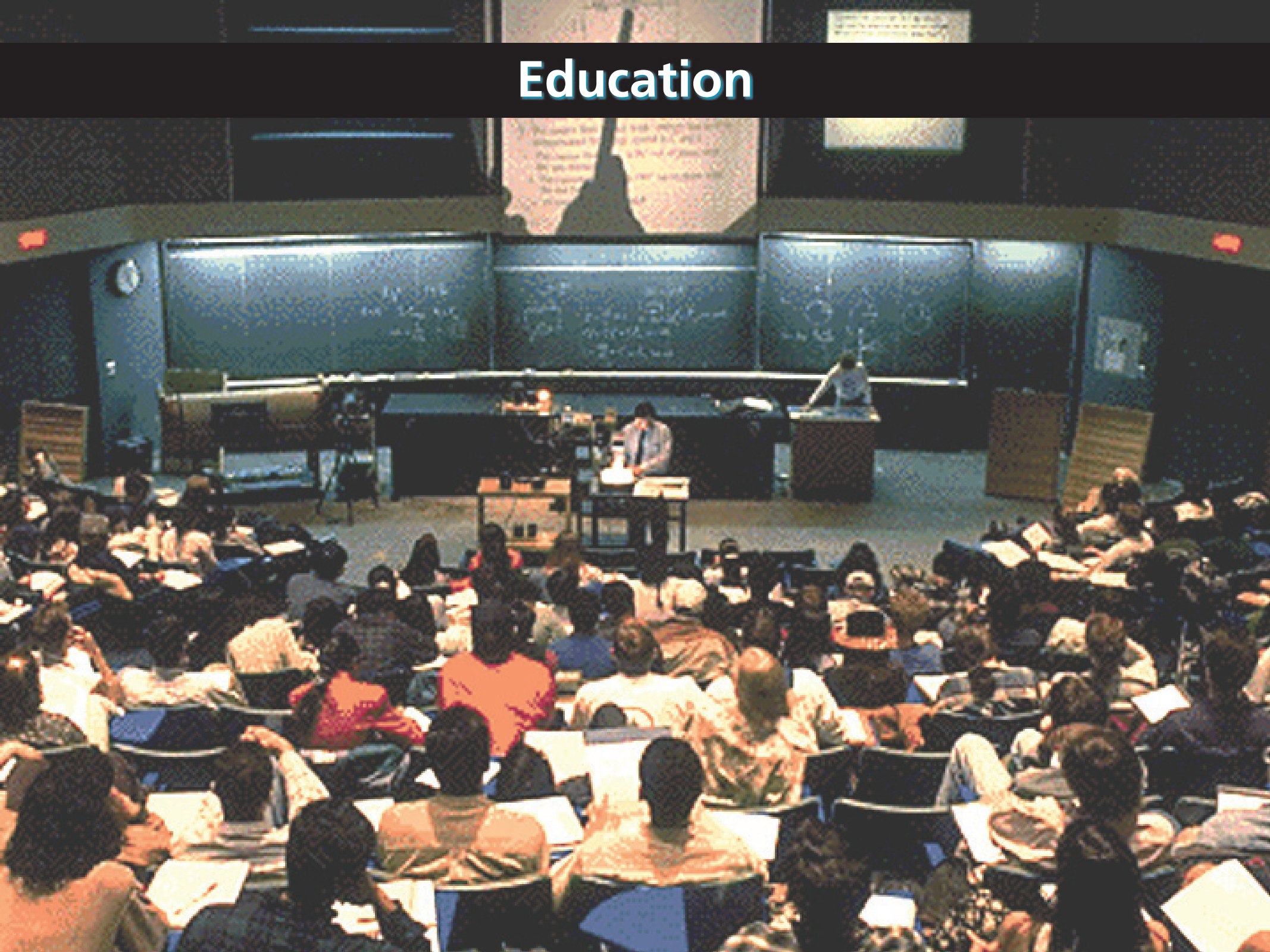
Became good at it by:

1. trial and error
2. lectures
3. practicing
4. apprenticeship
5. other

How we teach…

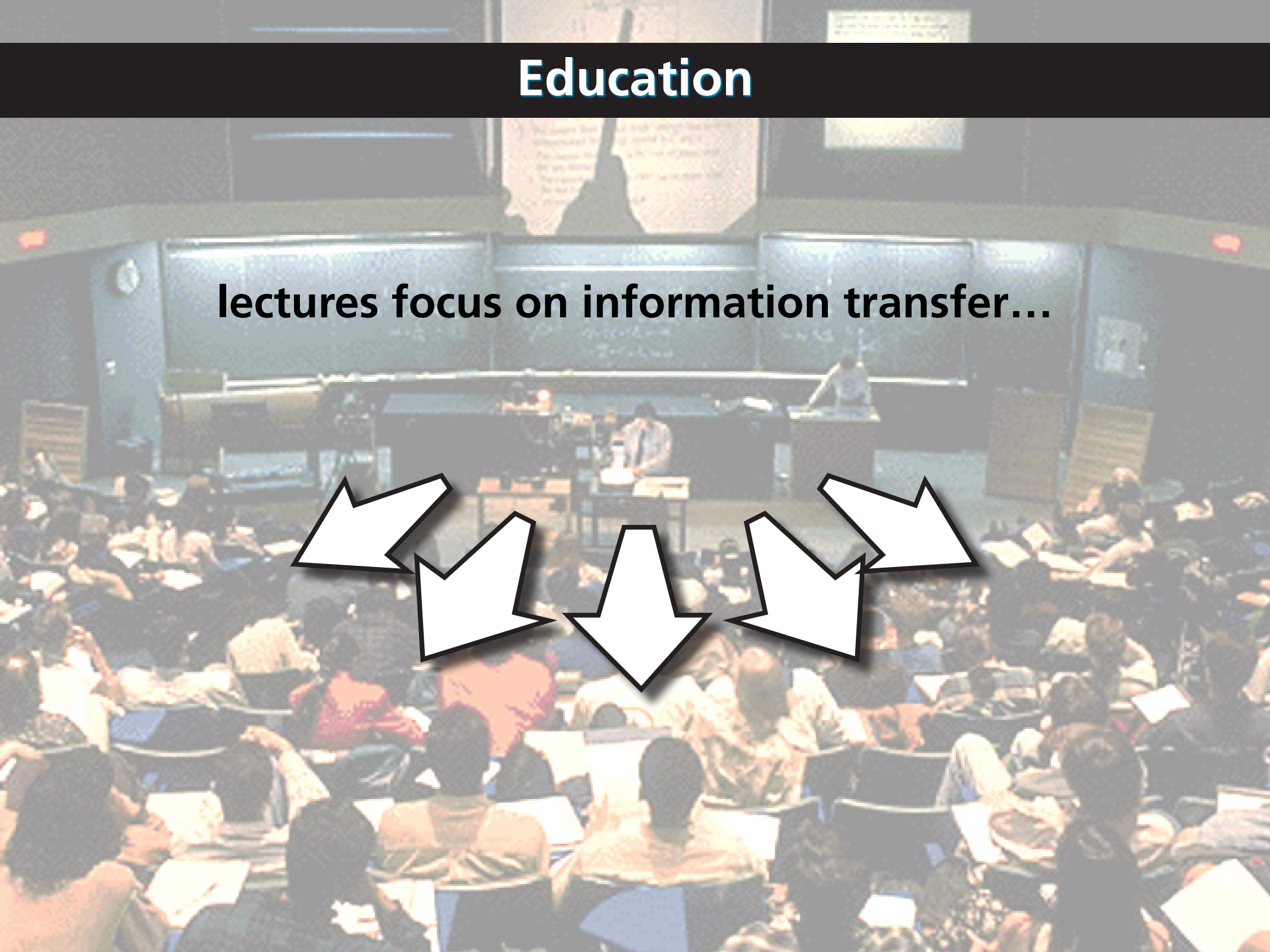


Education



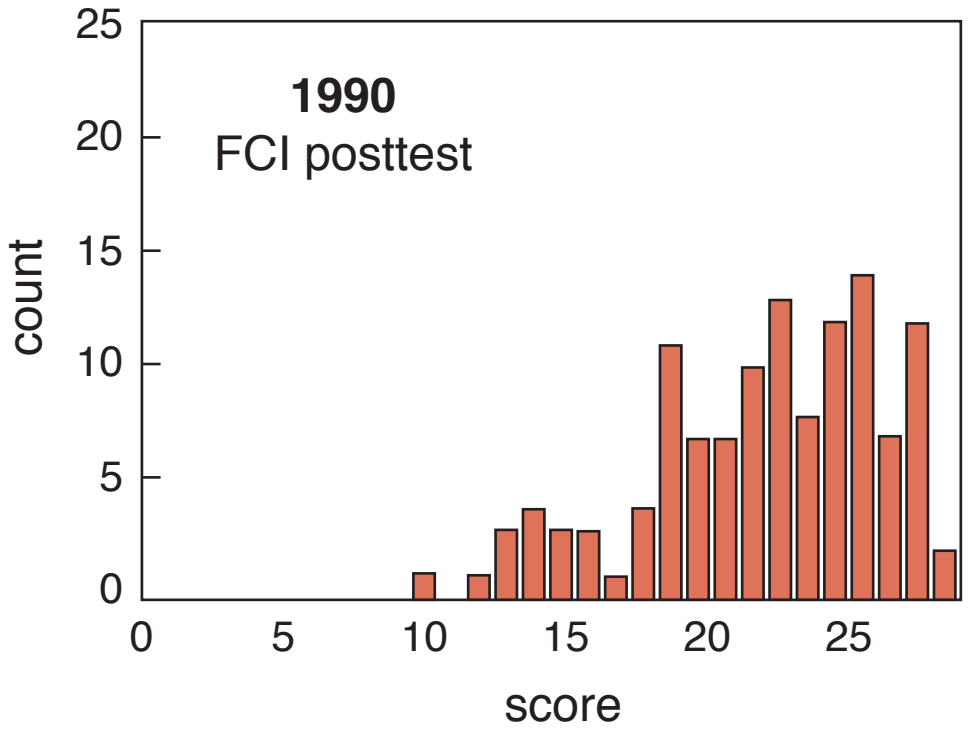
Education

lectures focus on information transfer…



Education

education is not just information transfer



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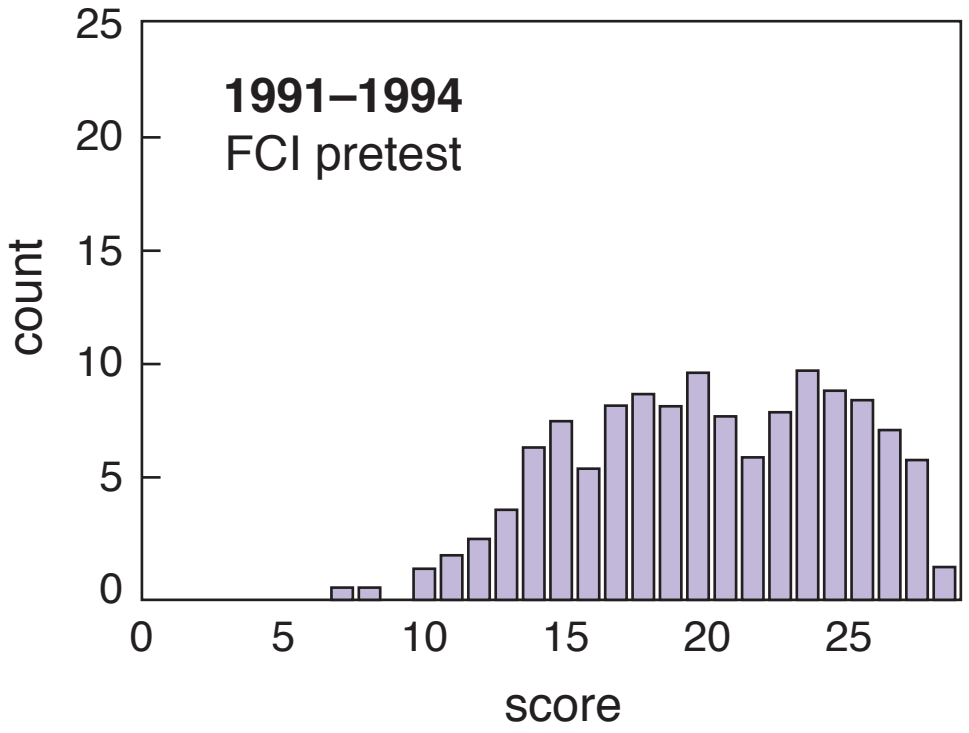

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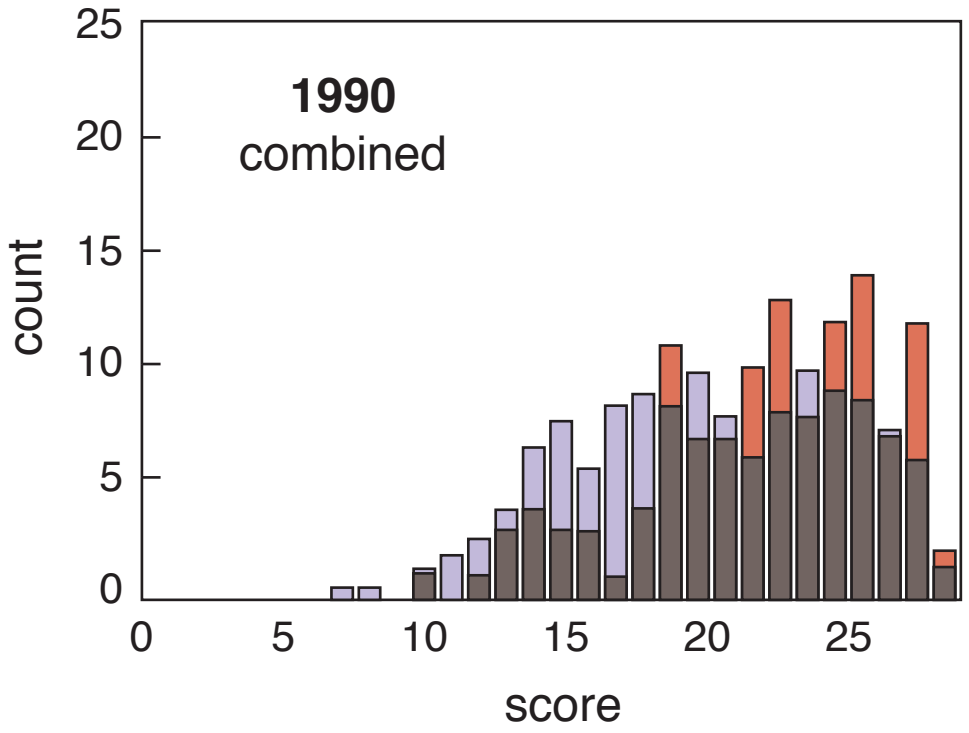
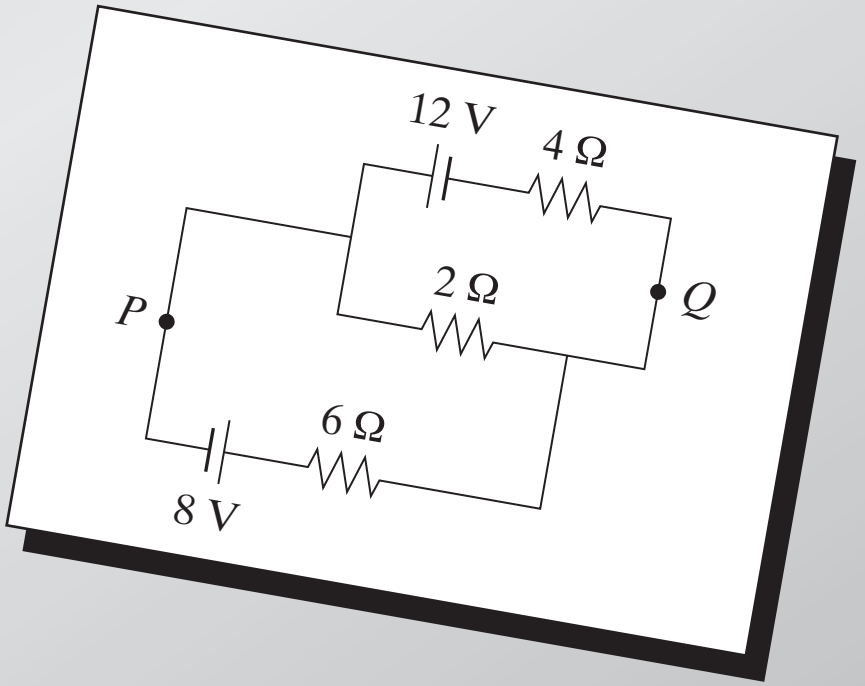


Education

conventional problems misleading



Education

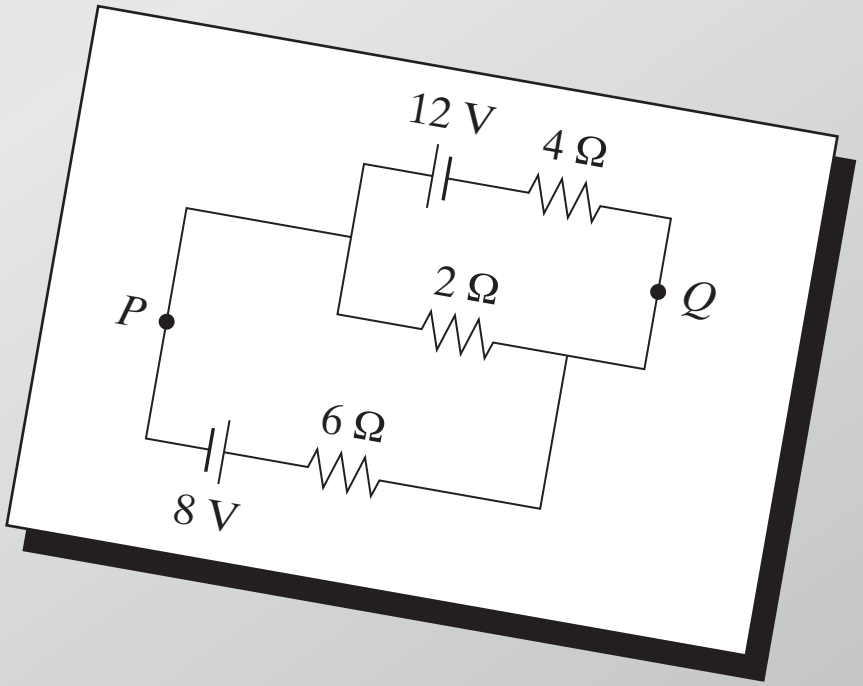
conventional problems misleading

Calculate:

(*a*) current in 2-Ω resistor

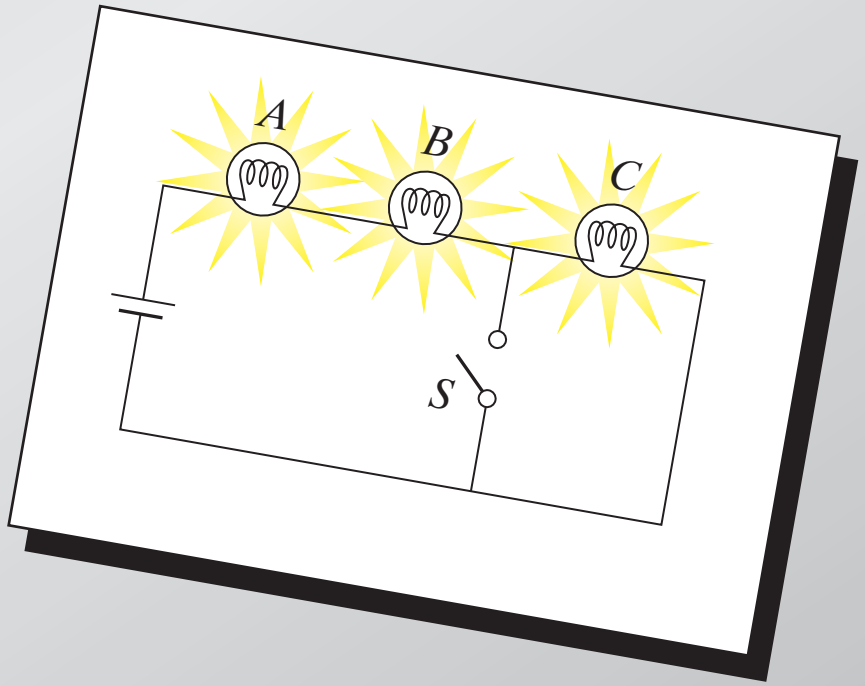
(*b*) potential difference

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?

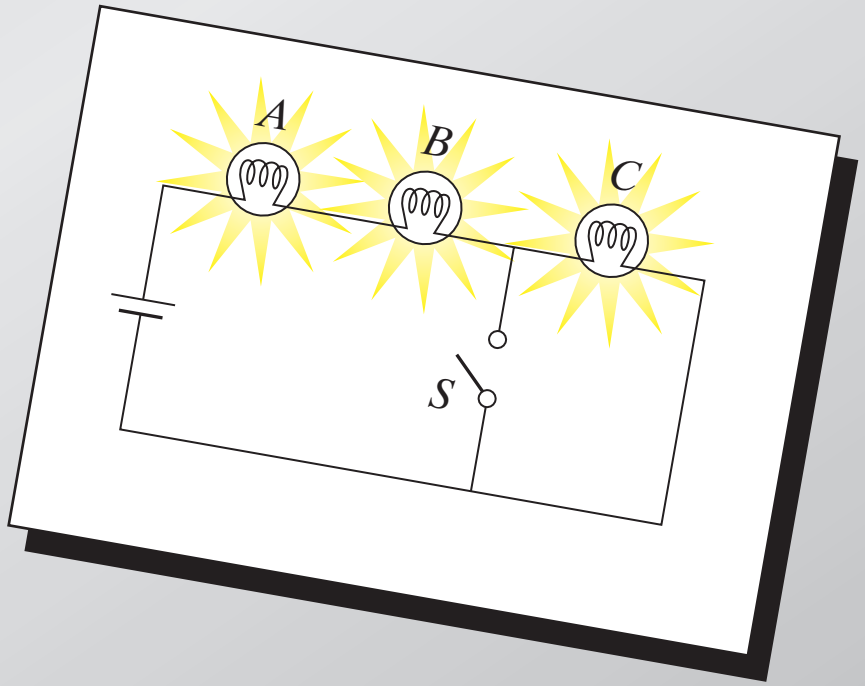
(*b*) intensity of C?

(*c*) current through battery?

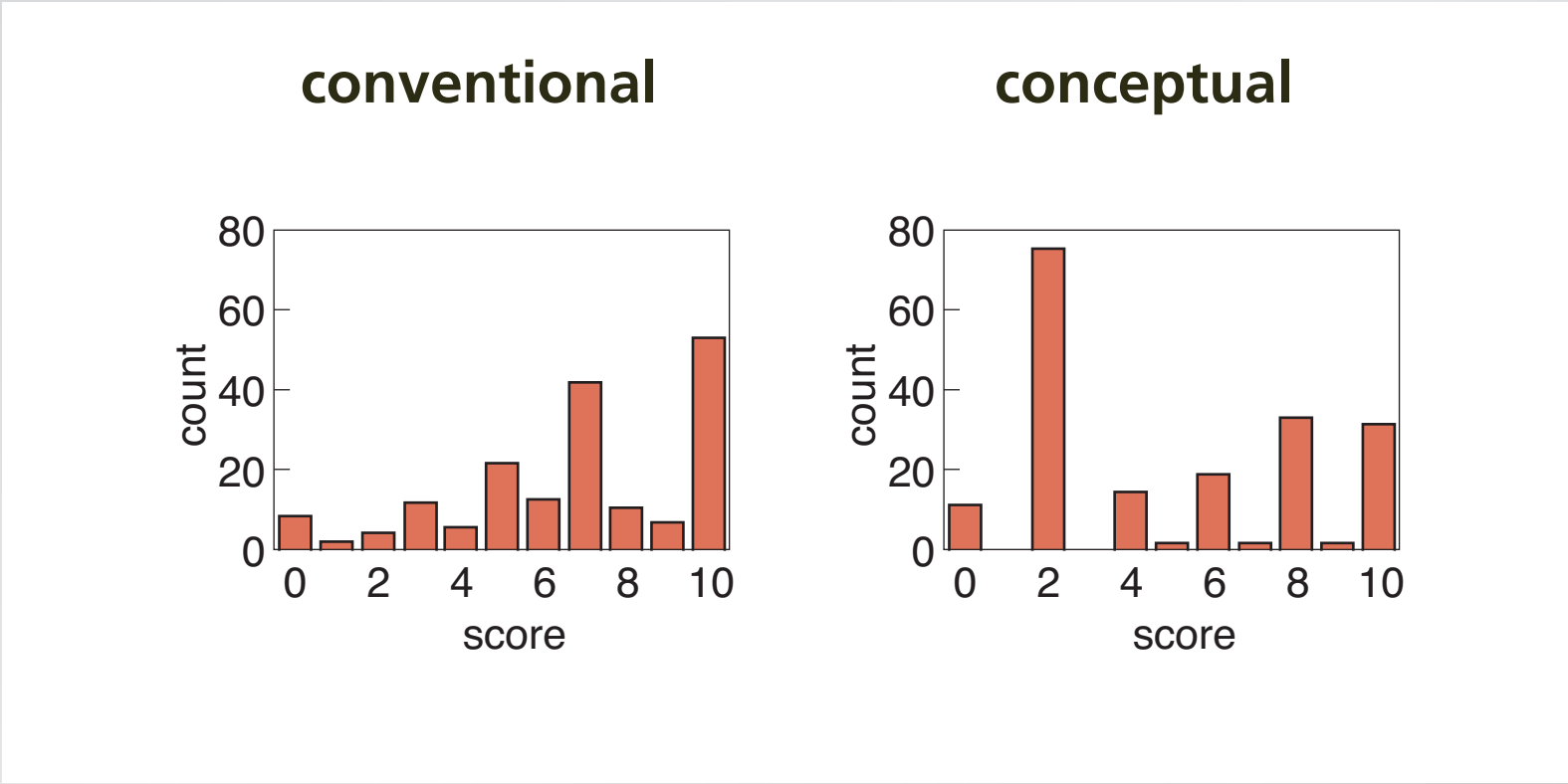
(*d*) potential difference across

A, *B*, and *C*?

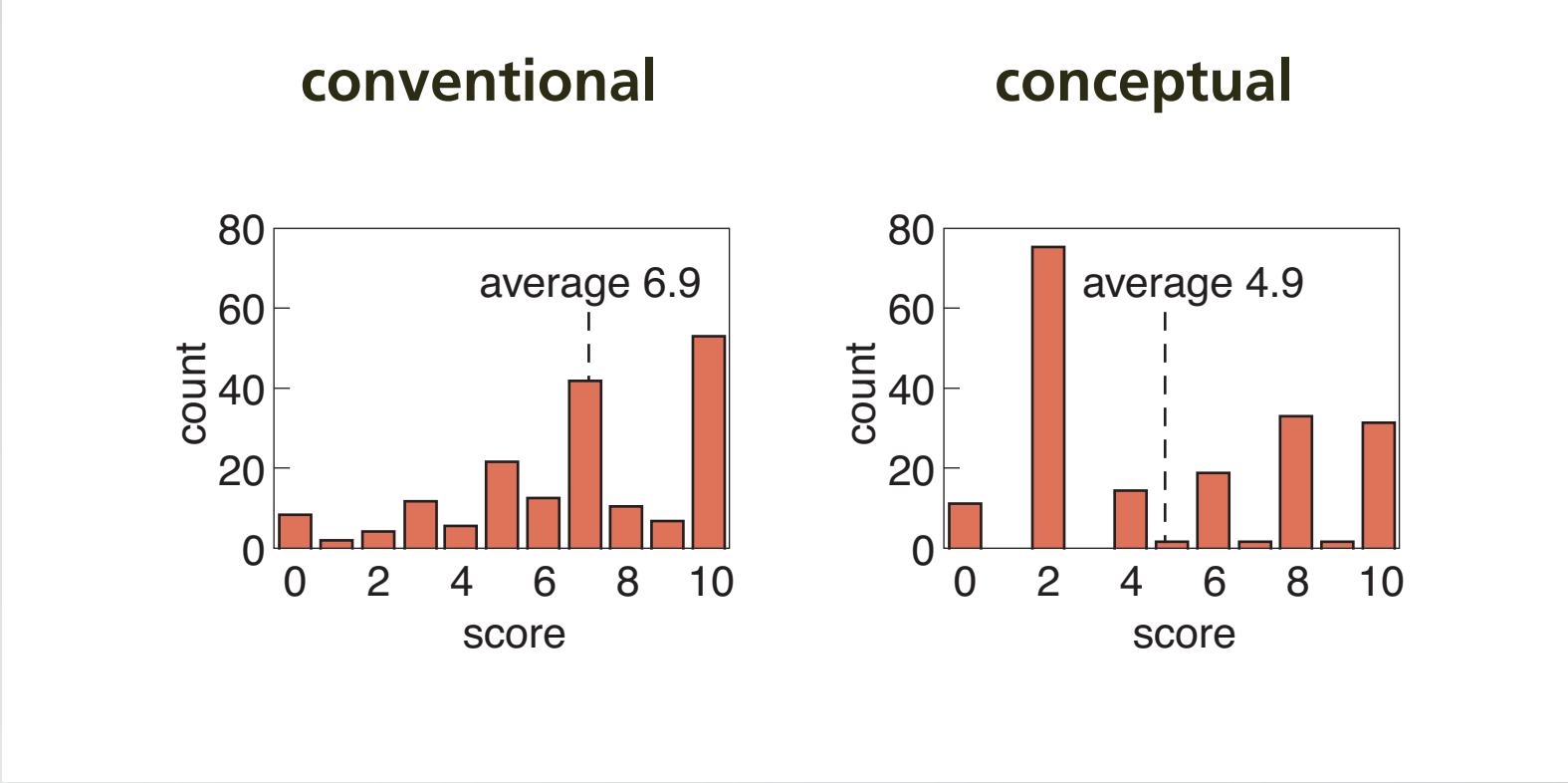
(*e*) the total power dissipated?



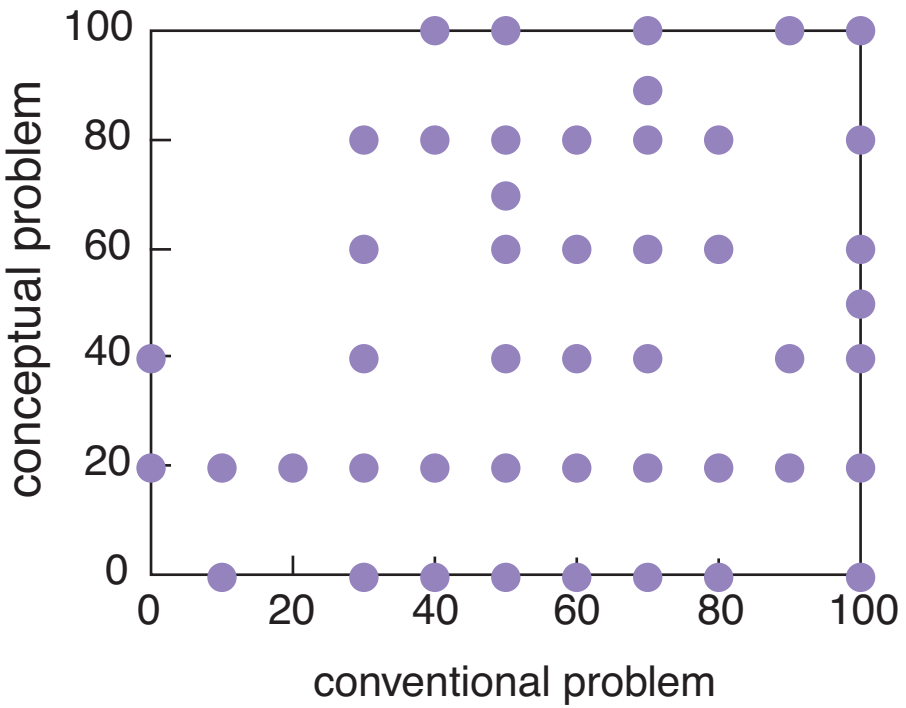
Education



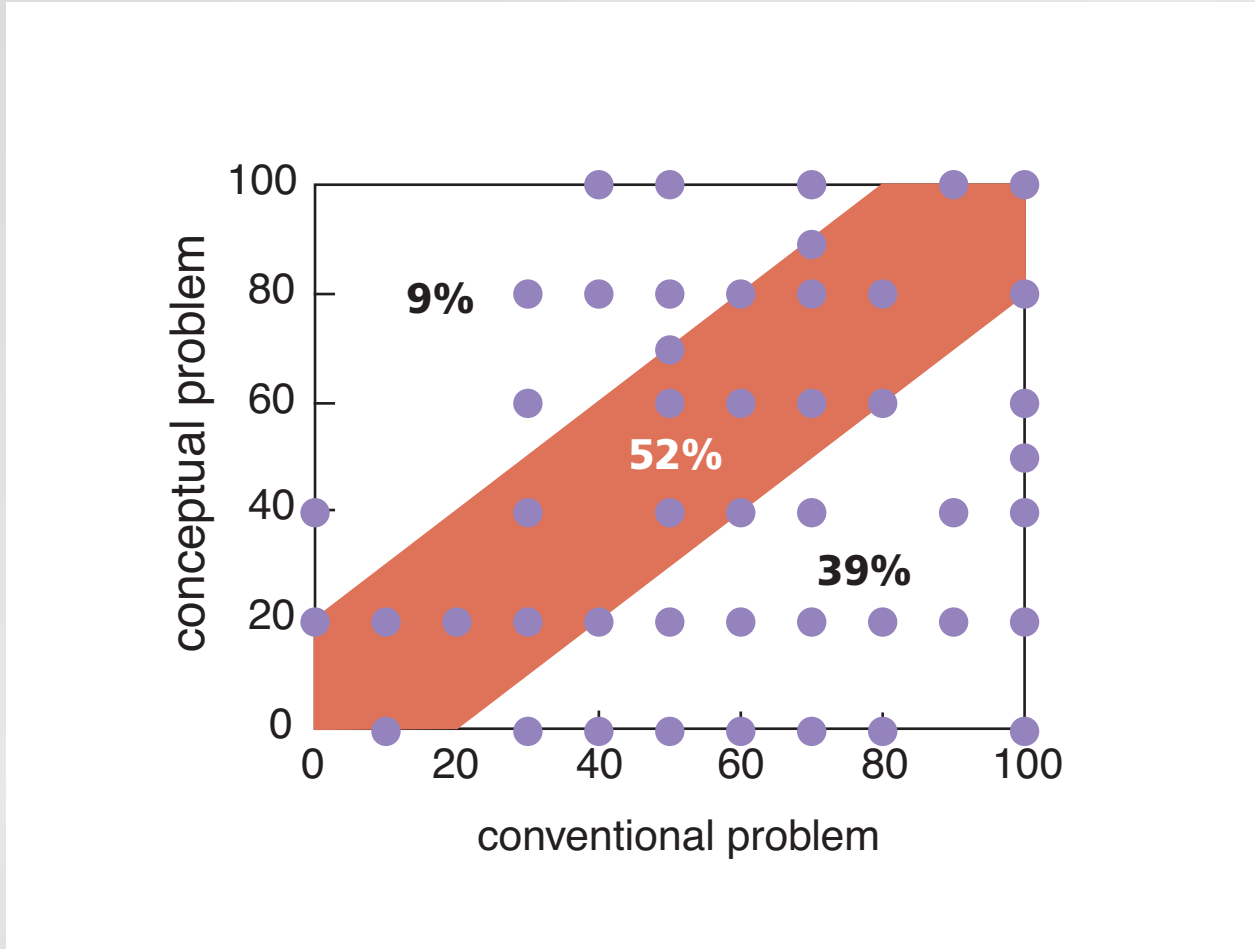
Education


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

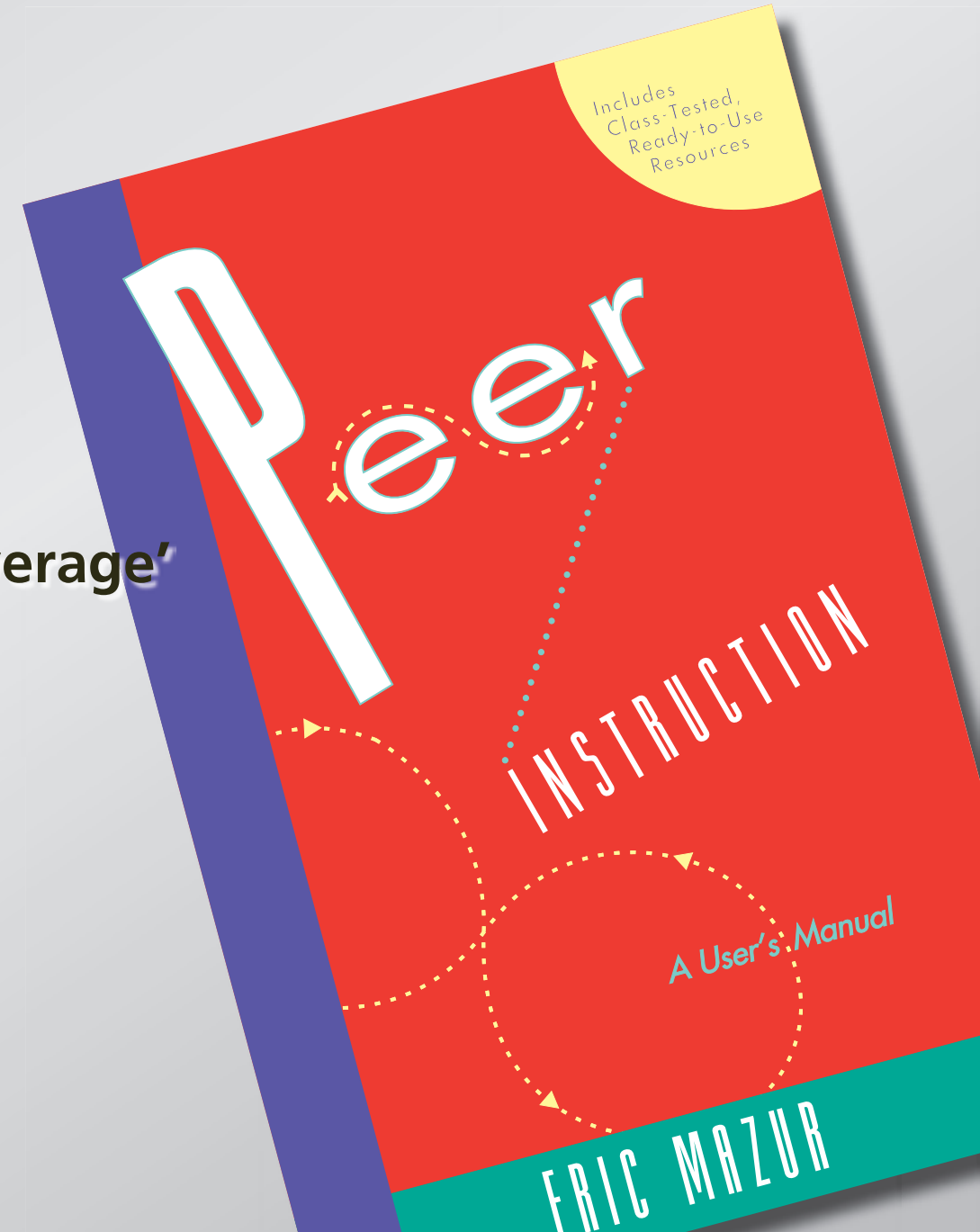
Peer Instruction

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

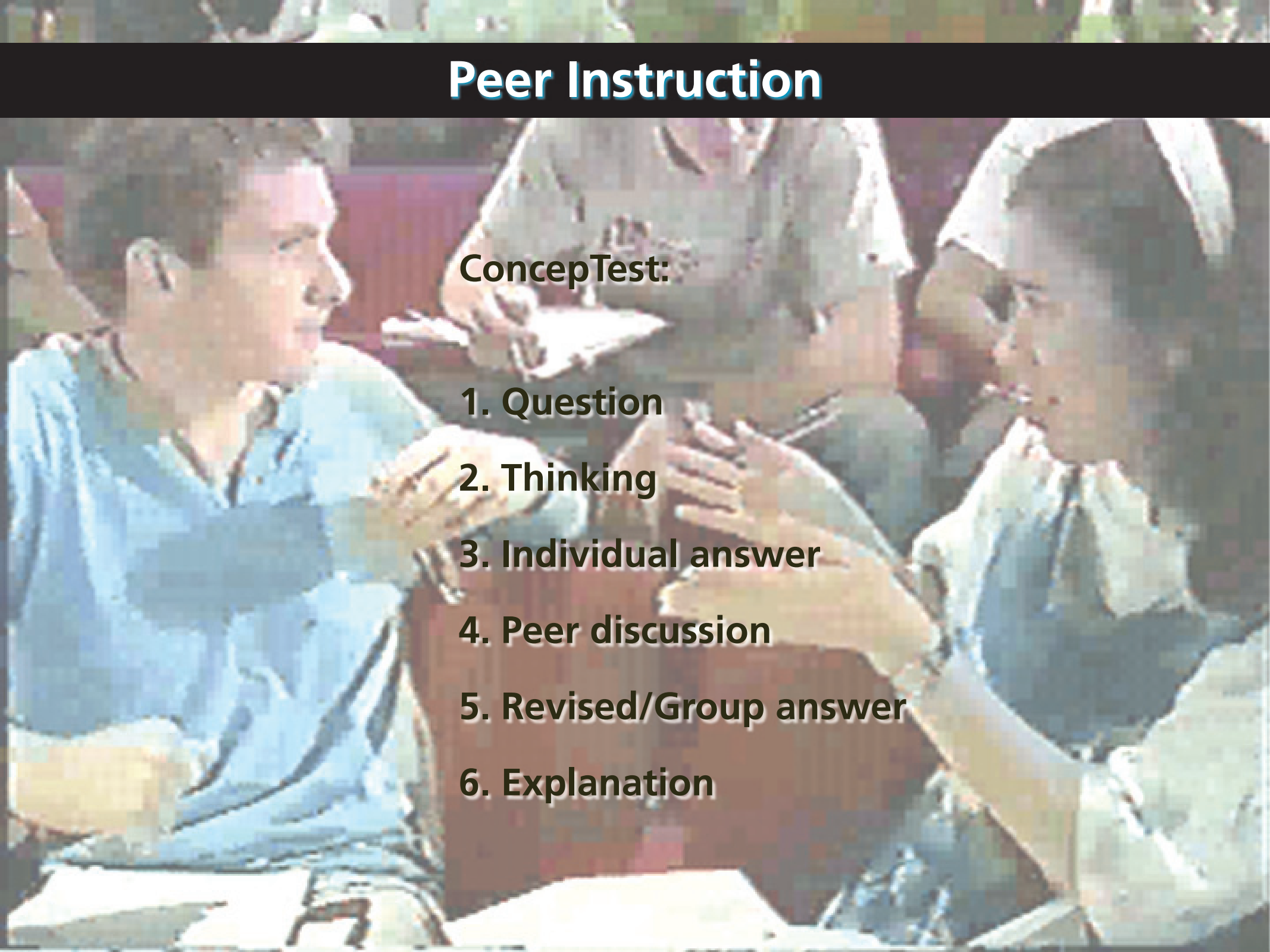
Peer Instruction

Main features:

- pre-class reading
- in-class: depth, not 'coverage'
- ConcepTests



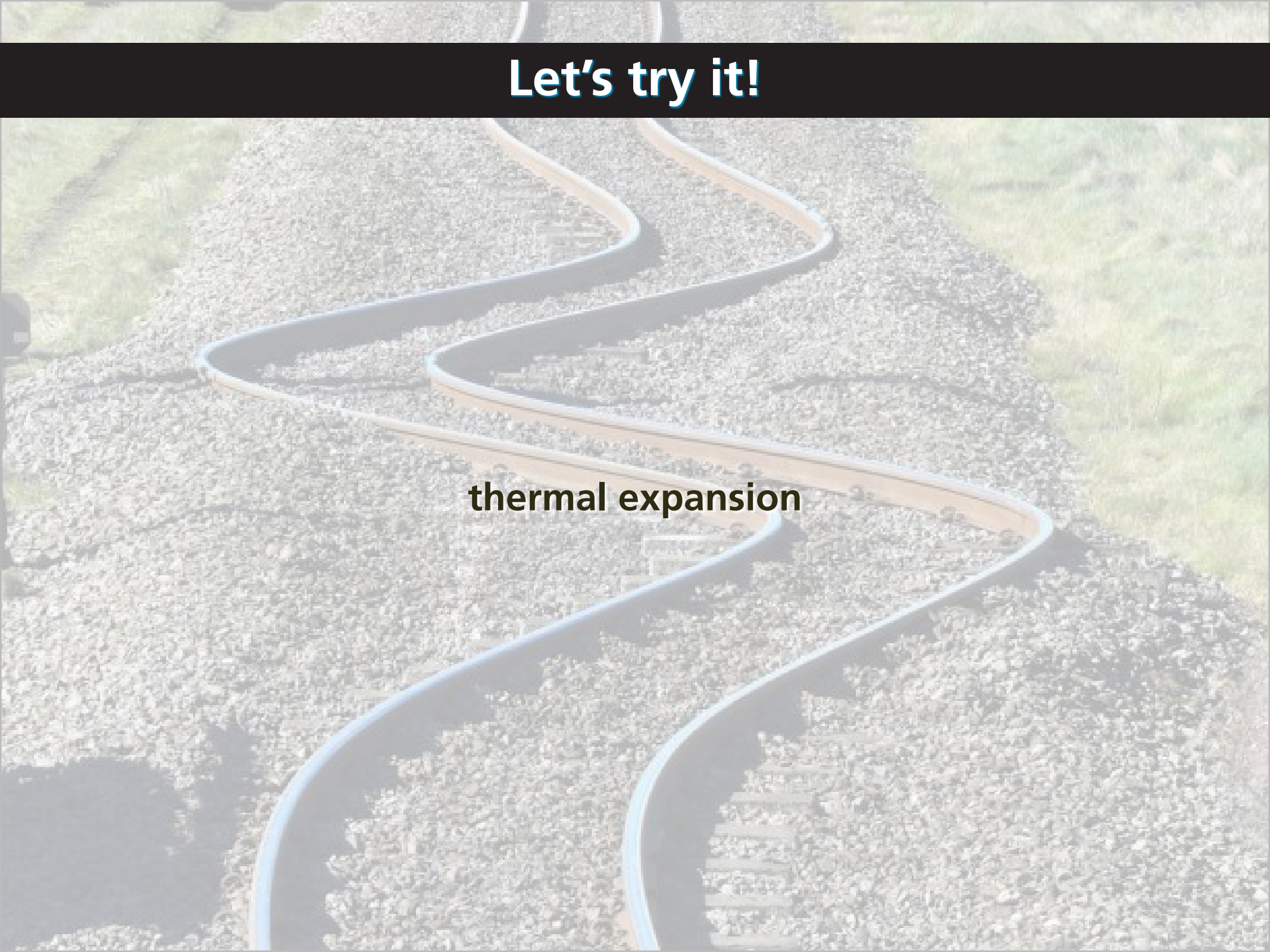
Peer Instruction



ConcepTest:

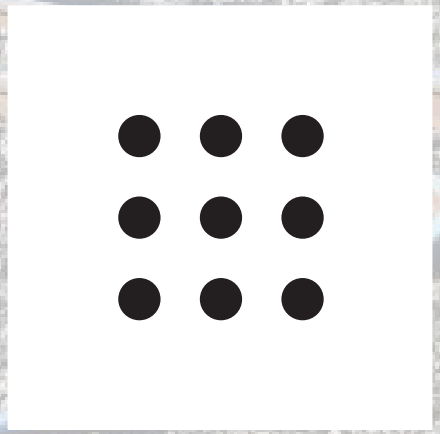
1. Question
2. Thinking
3. Individual answer
4. Peer discussion
5. Revised/Group answer
6. Explanation

Let's try it!



Let's try it!

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



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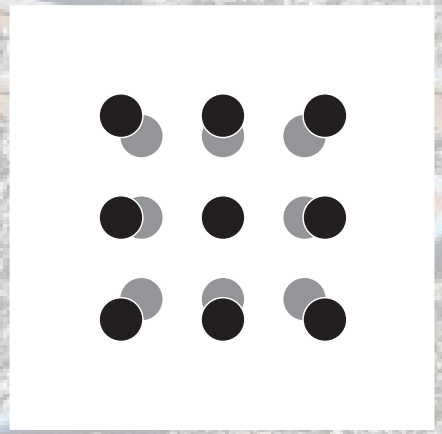
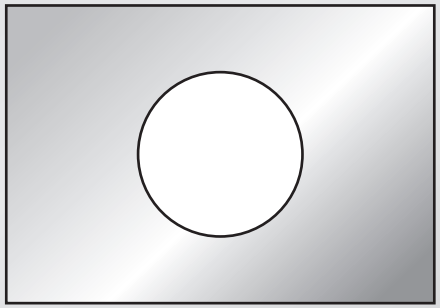


Let's try it!

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

Let's try it!

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



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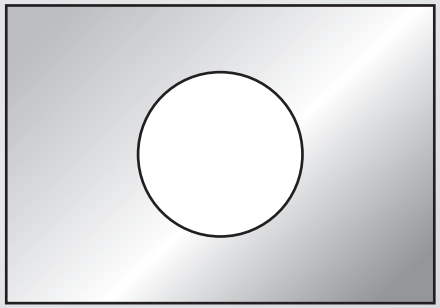


When the plate is uniformly heated, the diameter of the hole

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

Let's try it!

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

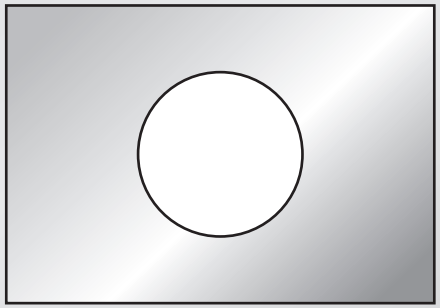
When the plate is uniformly heated, the diameter of the hole

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

you got all fired up!

Let's try it!

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



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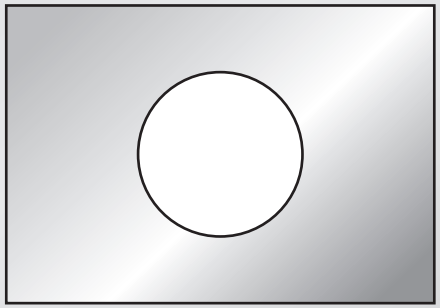

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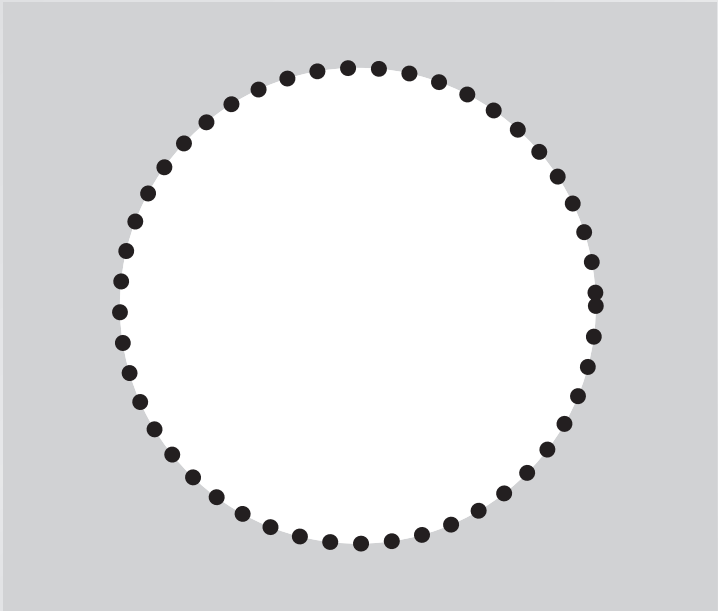
Let's try it!

consider the atoms at the rim of the hole



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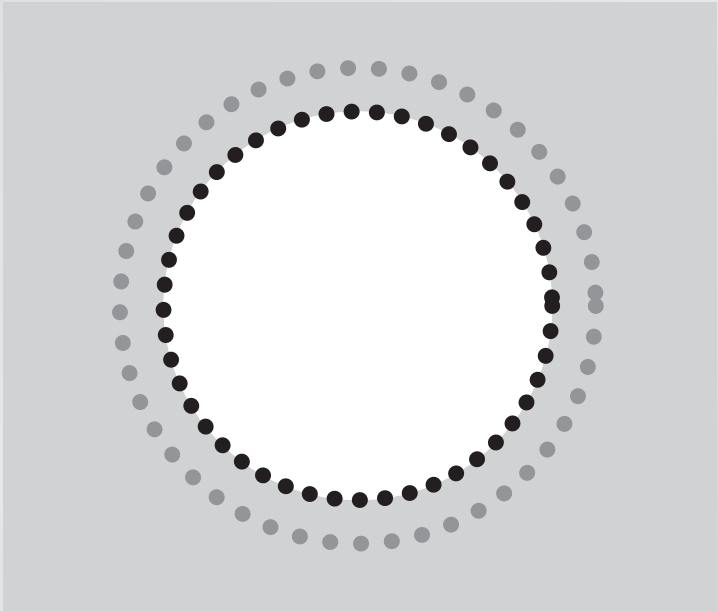

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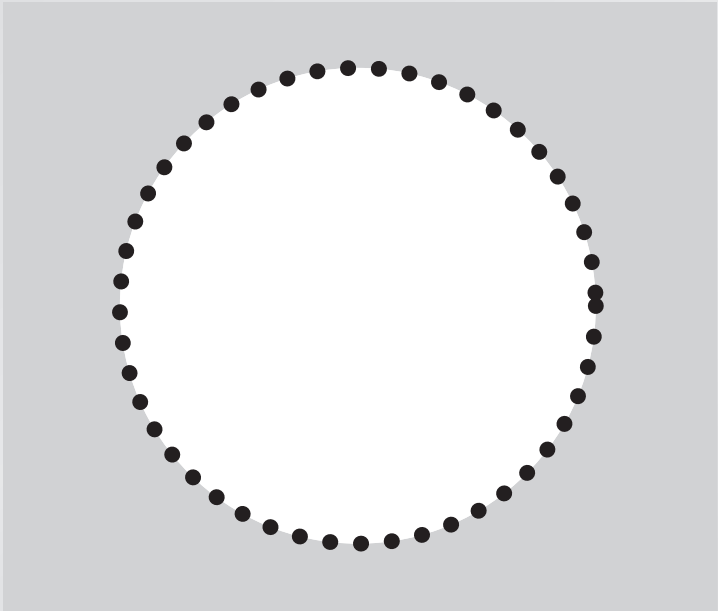

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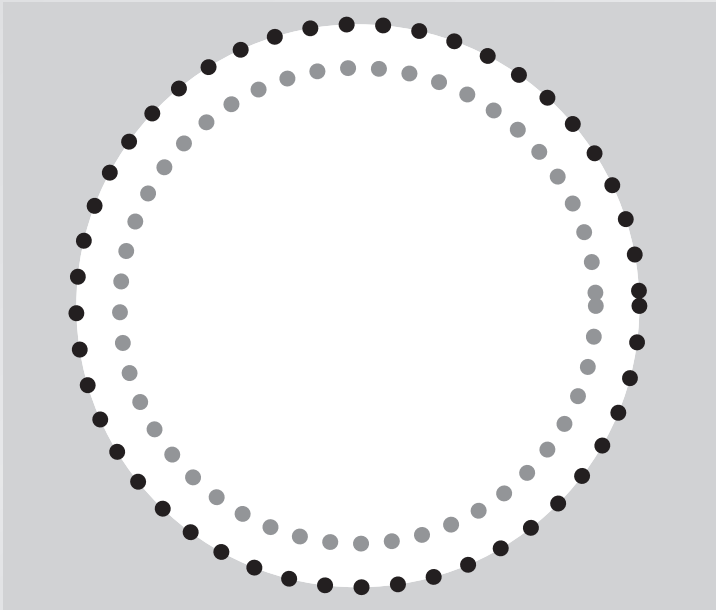


Let's try it!

consider the atoms at the rim of the hole

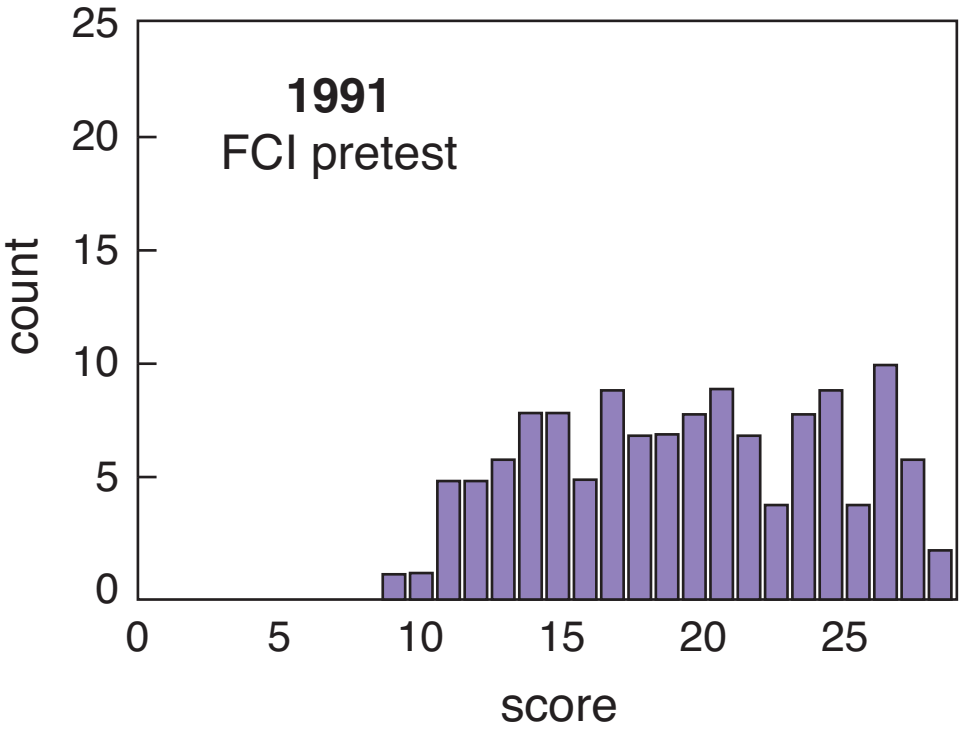
you won't forget this

Results

is it any good?

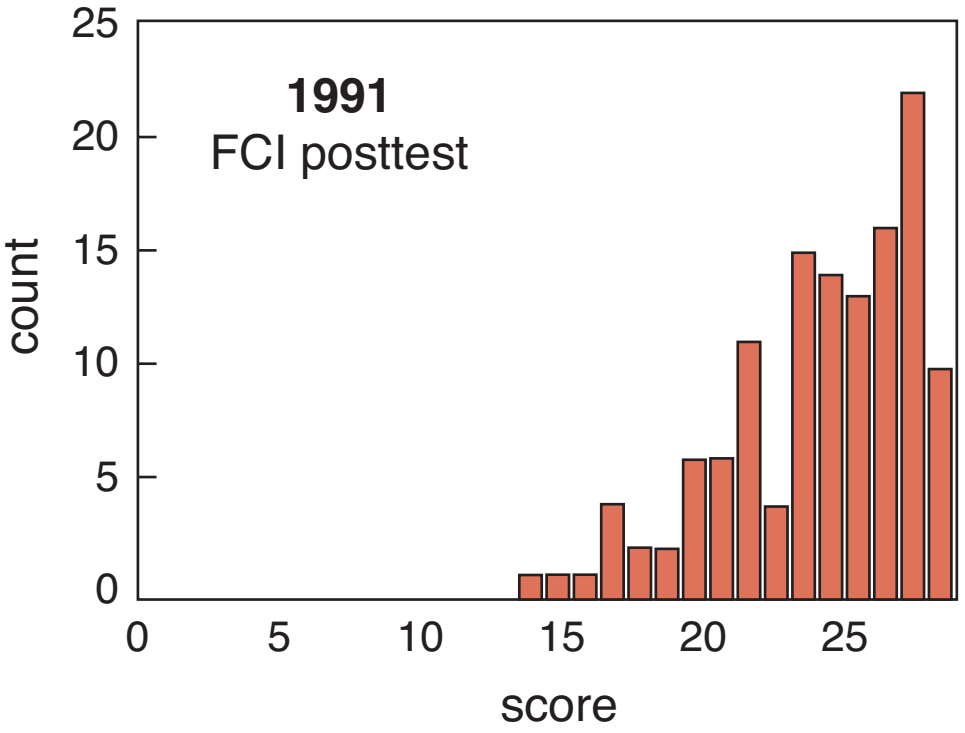
Results

first year of implementing PI



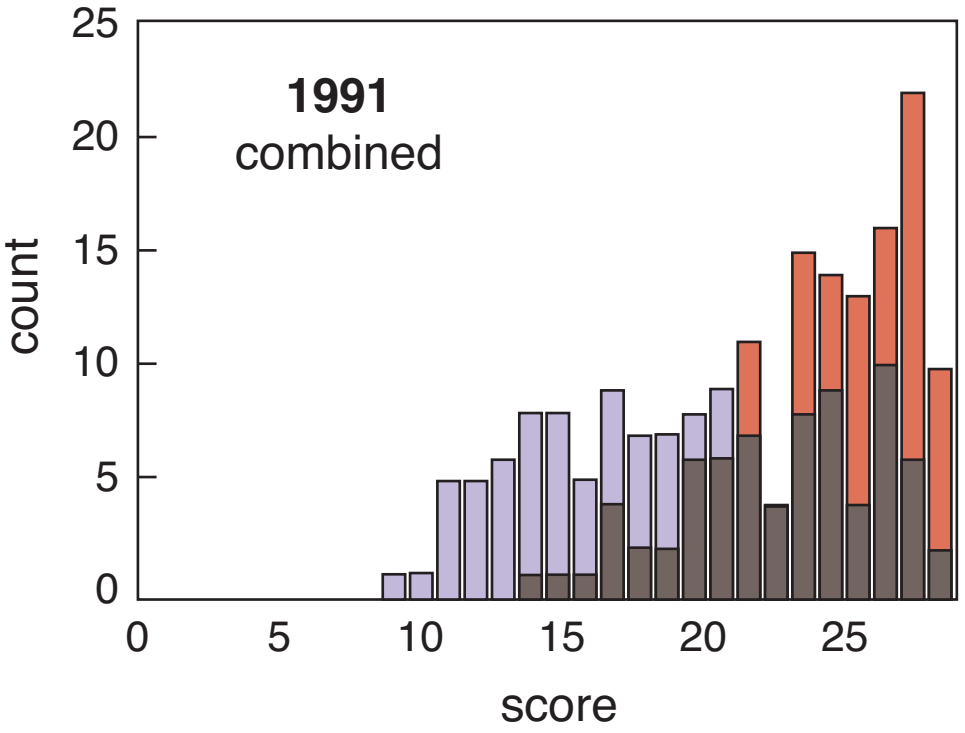
Results

first year of implementing PI



Results

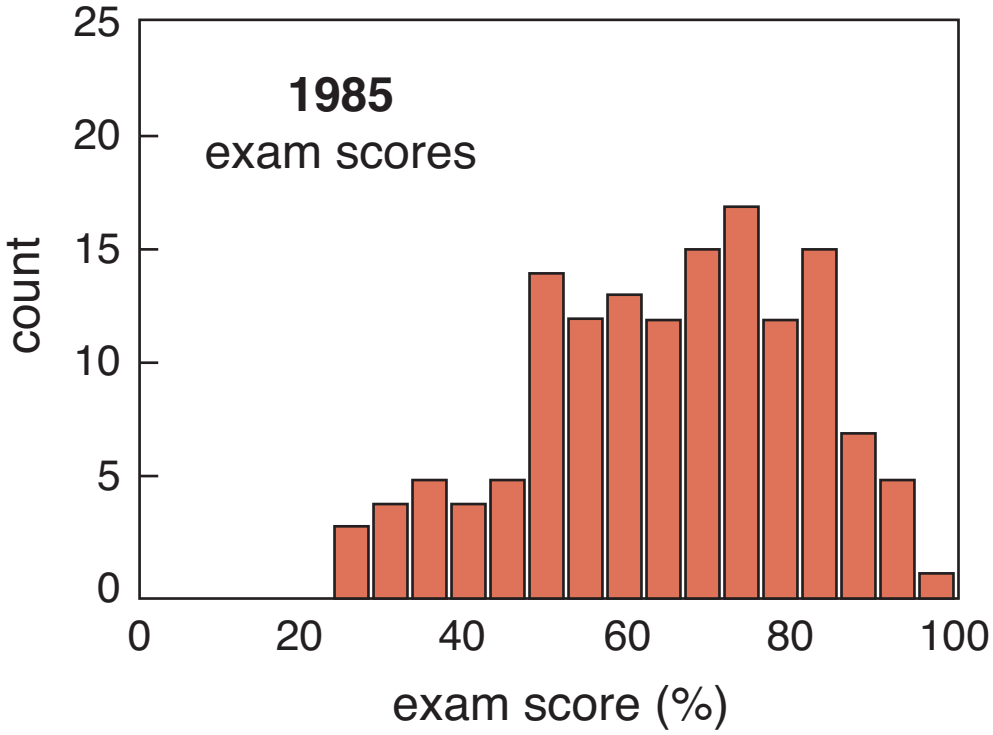
first year of implementing PI



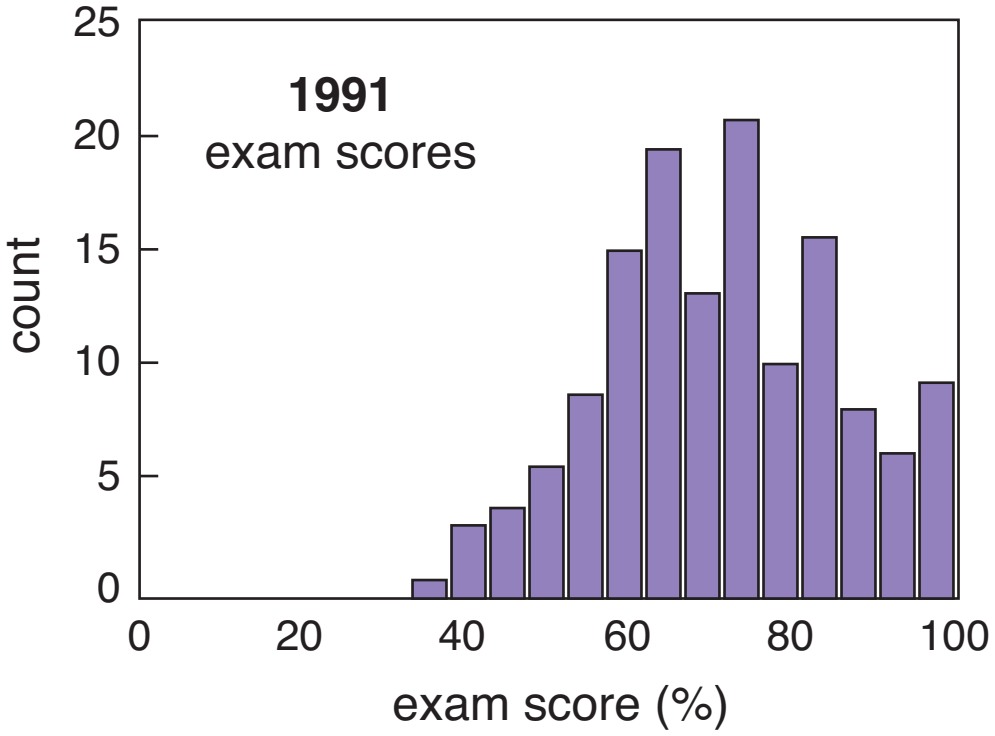
Results

what about problem solving?

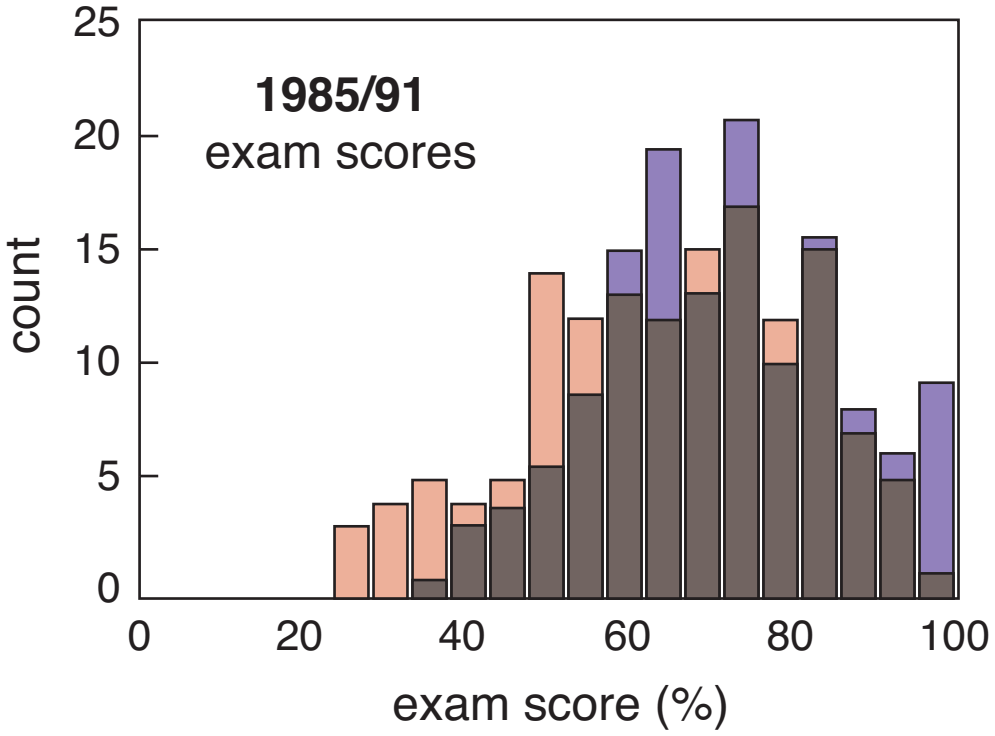
Results


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!)

Funding:

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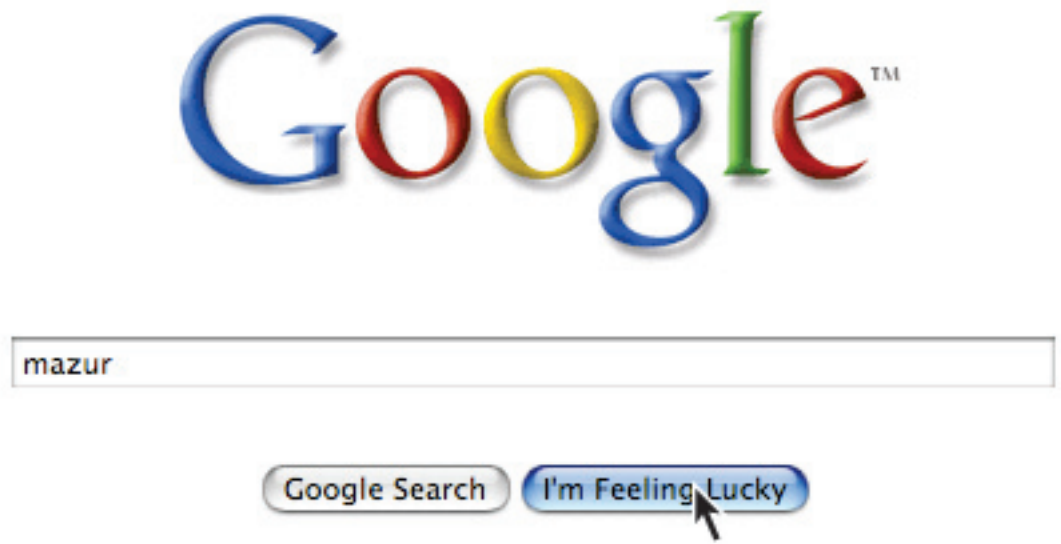
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