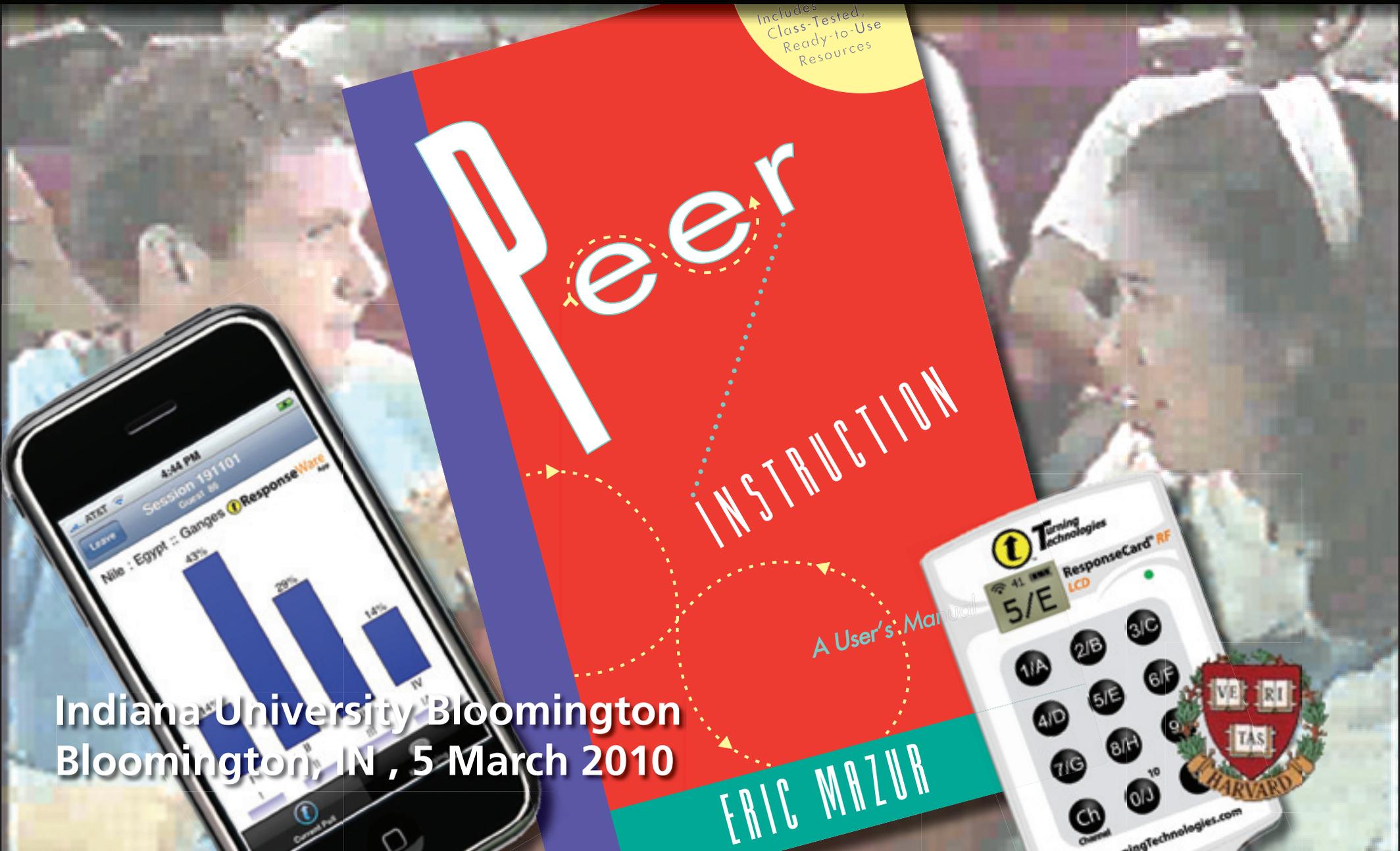


Peer Instruction: a hands-on workshop using clickers



Indiana University Bloomington
Bloomington, IN , 5 March 2010

Get your clickers ready!



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

Consider this

Professors A and B teach the same mechanics class at the same college during different semesters. Professor A uses the traditional approach to teaching and lectures. Professor B uses Peer Instruction and students respond to the questions in using clickers. Each class is evaluated using the traditional end-of-semester questionnaire and using the FCI to measure students' comprehension of mechanics. Both professors are middle-aged and male. The results are as follows.

A: student evaluation: 1.5/5.0; $\langle g \rangle = 0.42$

B: student evaluation: 3.7/5.0; $\langle g \rangle = 0.57$

Consider this

Professor	A	B
pedagogy	traditional	PI with clickers
student evaluation	1.5/5.0	3.7/5.0
FCI <g>	0.42	0.57

What might account for the large difference in evaluation?

I. professor personality

II. technology

III. pedagogy

1. I only

2. II only

3. III only

4. II and III

5. I, II, and III

6. other combination

Consider this

a couple of points worth noting:

Consider this

a couple of points worth noting:

1. you got engaged

Consider this

a couple of points worth noting:

1. you got engaged
2. no "correct" answer

Consider this

a couple of points worth noting:

1. you got engaged
2. no "correct" answer
3. you got engaged

Consider this

a couple of points worth noting:

1. you got engaged
2. no "correct" answer
3. you got engaged
4. you don't *need* a correct answer!

Outline



Outline

- **Setting the stage**
- **Making it happen**
- **Overcoming barriers**

Setting the stage

To set stage for successful implementation, I need to...

Setting the stage

- **convince yourself (and your colleagues)**
- **set learning goals**
- **select approaches**
- **identify resources**

Setting the stage

Use the statement and figure below to answer the next two questions (15 and 16).
A large truck breaks down on the road and receives a push back into town by a car as shown in the figure below.



Pre/post-testing important for:

- justifying approach
- improving implementation

15. While the car is still pushing the truck, is speeding up to get up to cruising speed.

___ 1. the amount of force with which the car pushes on the truck is equal to that with which the truck pushes back on the car.

___ 2. the amount of force with which the car pushes on the truck is smaller than that with which the truck pushes back on the car.

___ 3. the amount of force with which the car pushes on the truck is greater than that with which the truck pushes back on the car.

___ 4. the car's engine is running so the truck cannot push against the car. The truck is pushed forward simply because it is in the way of the car.

___ 5. neither the car nor the truck exerts any force on the other. The truck is pushed forward simply because it is in the way of the car.

16. After the car reaches the constant cruising speed at which its driver wishes to push the truck.

___ 1. the amount of force with which the car pushes on the truck is equal to that with which the truck pushes back on the car.

___ 2. the amount of force with which the car pushes on the truck is smaller than that with which the truck pushes back on the car.

___ 3. the amount of force with which the car pushes on the truck is greater than that with which the truck pushes back on the car.

___ 4. the car's engine is running so the car pushes against the truck, but the truck's engine is not running so the truck cannot push against the car. The truck is pushed forward simply because it is in the way of the car.

___ 5. neither the car nor the truck exerts any force on the other. The truck is pushed forward simply because it is in the way of the car.

Setting the stage

**Evaluate assessment by comparing
student performance on various kinds of problems**

Setting the stage

What constitutes a good problem?

Setting the stage

On a Saturday afternoon, you pull into a parking lot with unmeasured spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

Setting the stage

On a Saturday afternoon, you pull into a parking lot with unmeasured spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

How long do you have to wait before someone frees up a space?

Setting the stage

On a Saturday afternoon, you pull into a parking lot with unmeasured spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

How long do you have to wait before someone frees up a space?

Requires:

Assumptions

Developing a model

Applying that model

Setting the stage

On a Saturday afternoon, you pull into a parking lot with unmeasured spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces. **On average people shop for 2 hours.**

How long do you have to wait before someone frees up a space?

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Applying that model

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Assuming people leave at regularly-spaced intervals, how long do you have to wait before someone frees up a space?

Setting the stage

On a Saturday afternoon, you pull into a parking lot with unmeasured spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces. On average people shop for 2 hours.

Assuming people leave at regularly-spaced intervals, how long do you have to wait before someone frees up a space?

Requires:

Applying a (new) model

Setting the stage

On a Saturday afternoon, you pull into a parking lot with unmeasured spaces near a shopping area, where people are known to shop, on average, for 2 hours. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

How long do you have to wait before someone frees up a space?

Setting the stage

On a Saturday afternoon, you pull into a parking lot with unmeasured spaces near a shopping area, where people are known to shop, on average, for 2 hours. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

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$$t_{wait} = \frac{T_{shop}}{N_{spaces}}$$

Setting the stage

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How long do you have to wait before someone frees up a space?

Requires:

Using a calculator

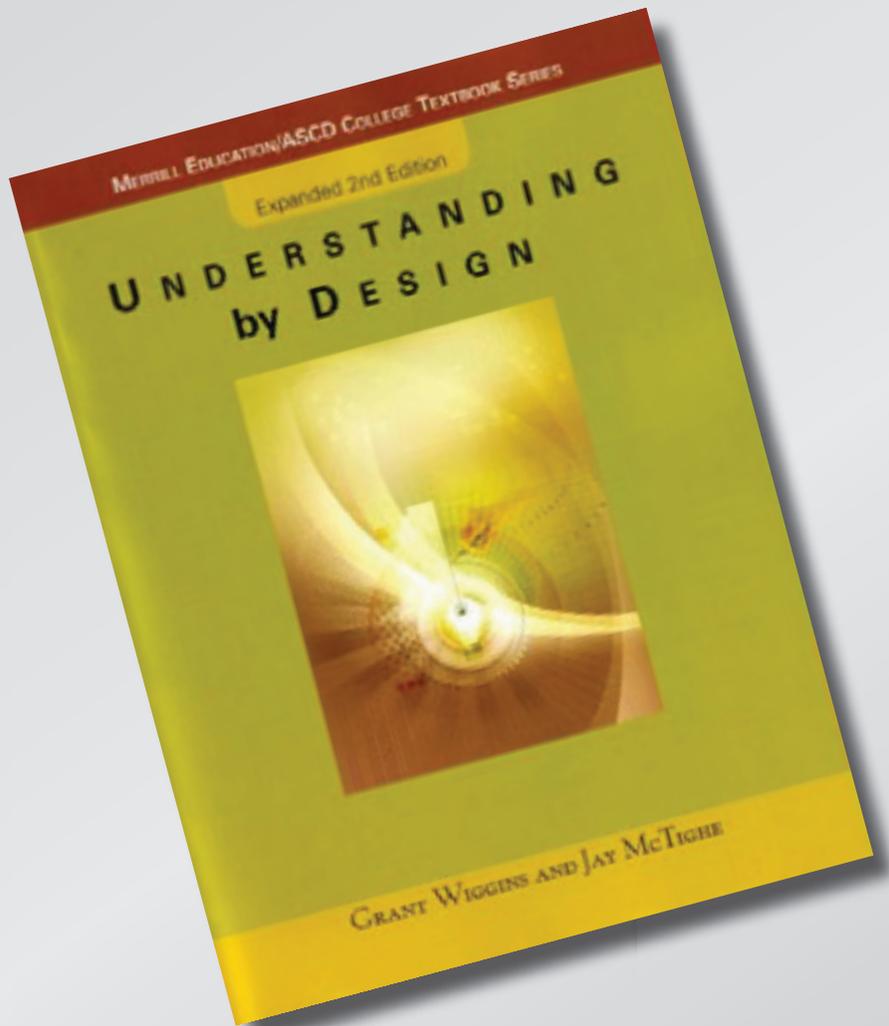
$$t_{wait} = \frac{T_{shop}}{N_{spaces}}$$

Setting the stage

Need to test meaningful skills!

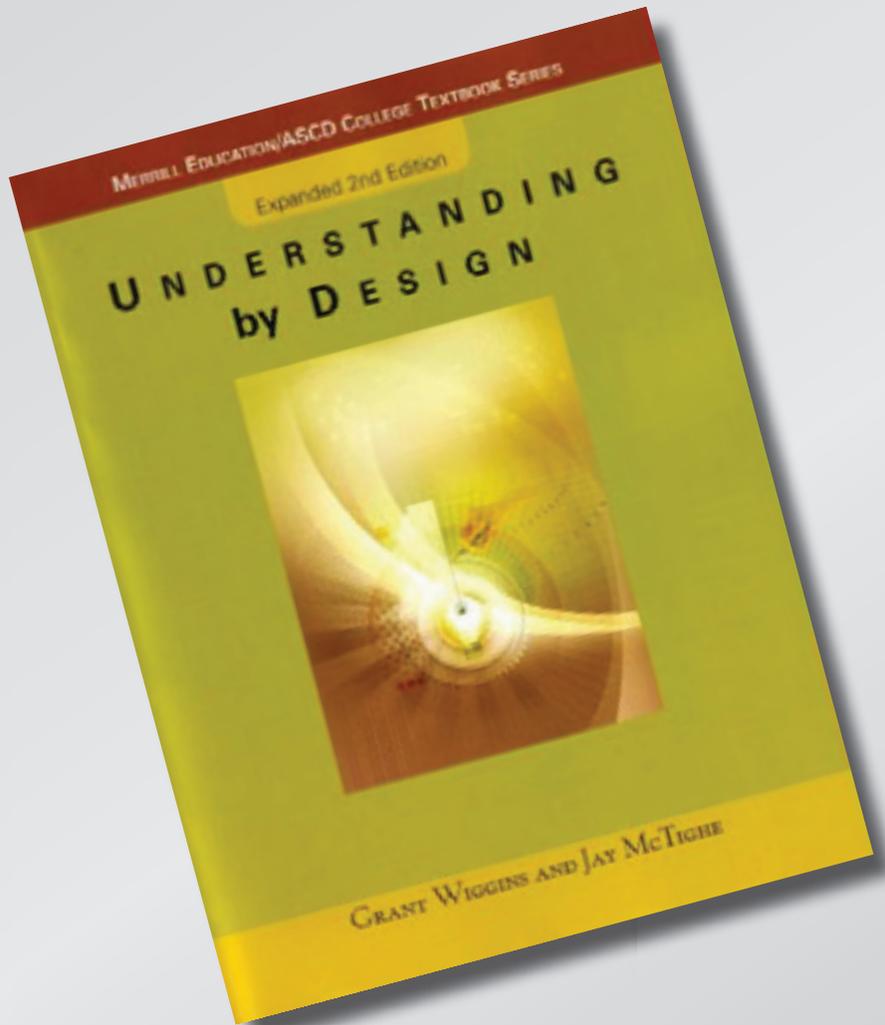
Setting the stage

Setting learning goals



Setting the stage

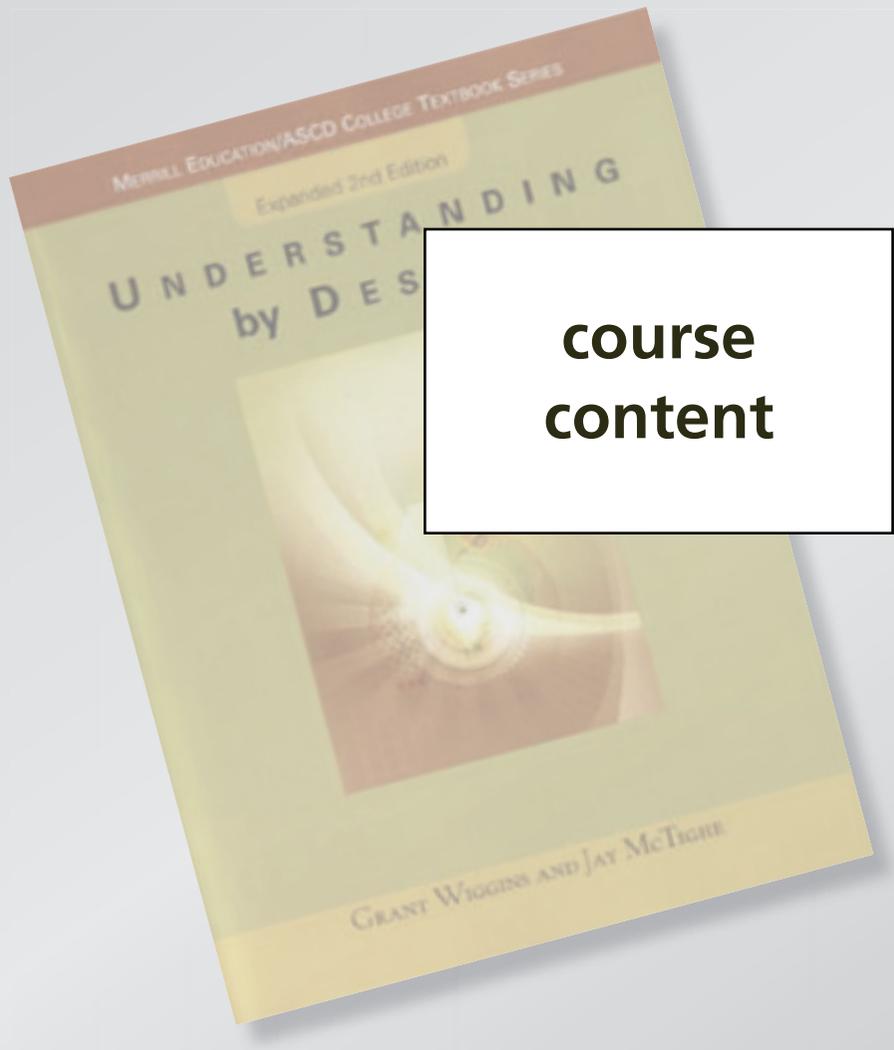
Setting learning goals



- approach, not content
- focus on understanding
- backward design

Setting the stage

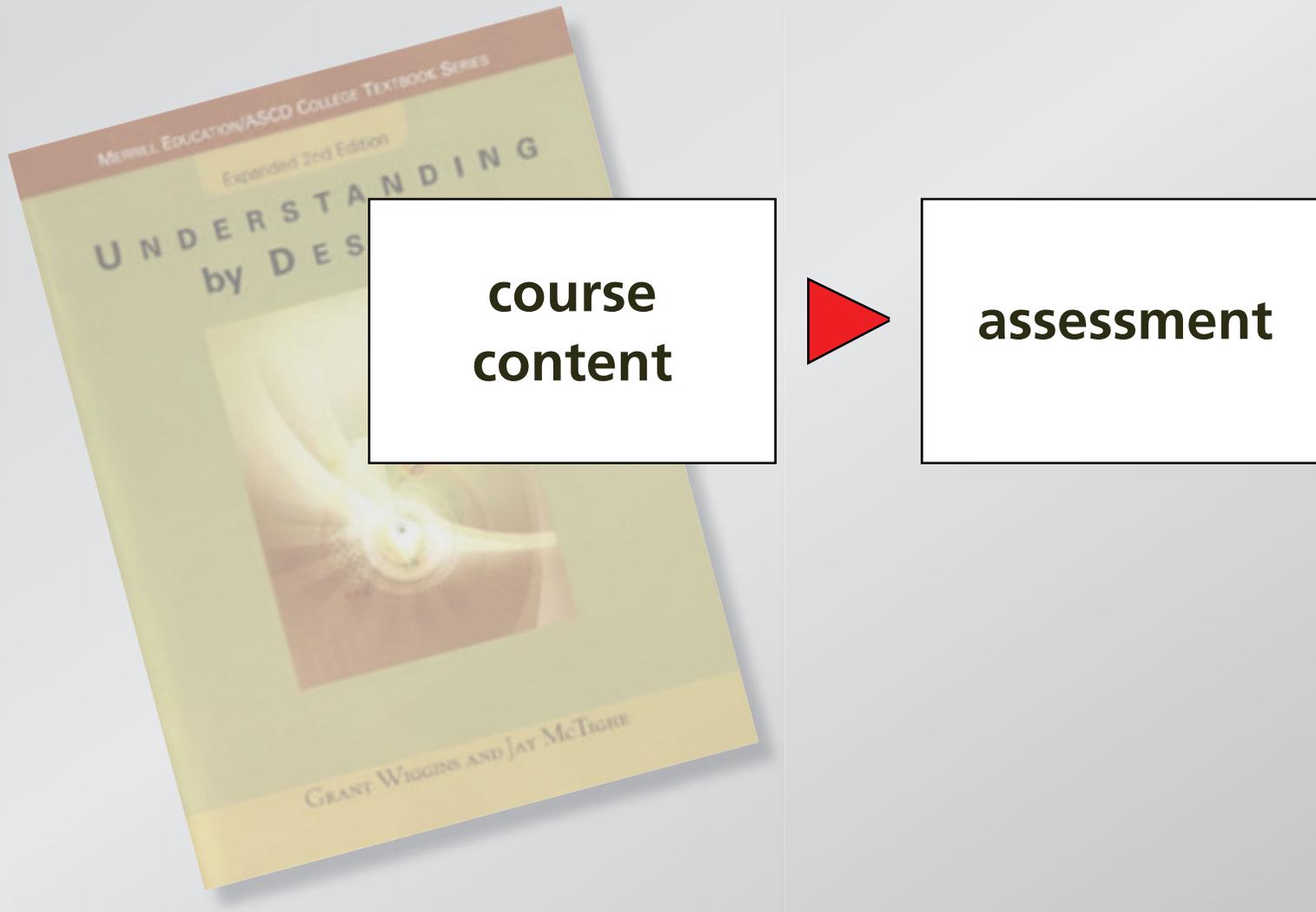
Traditional approach to course planning



**course
content**

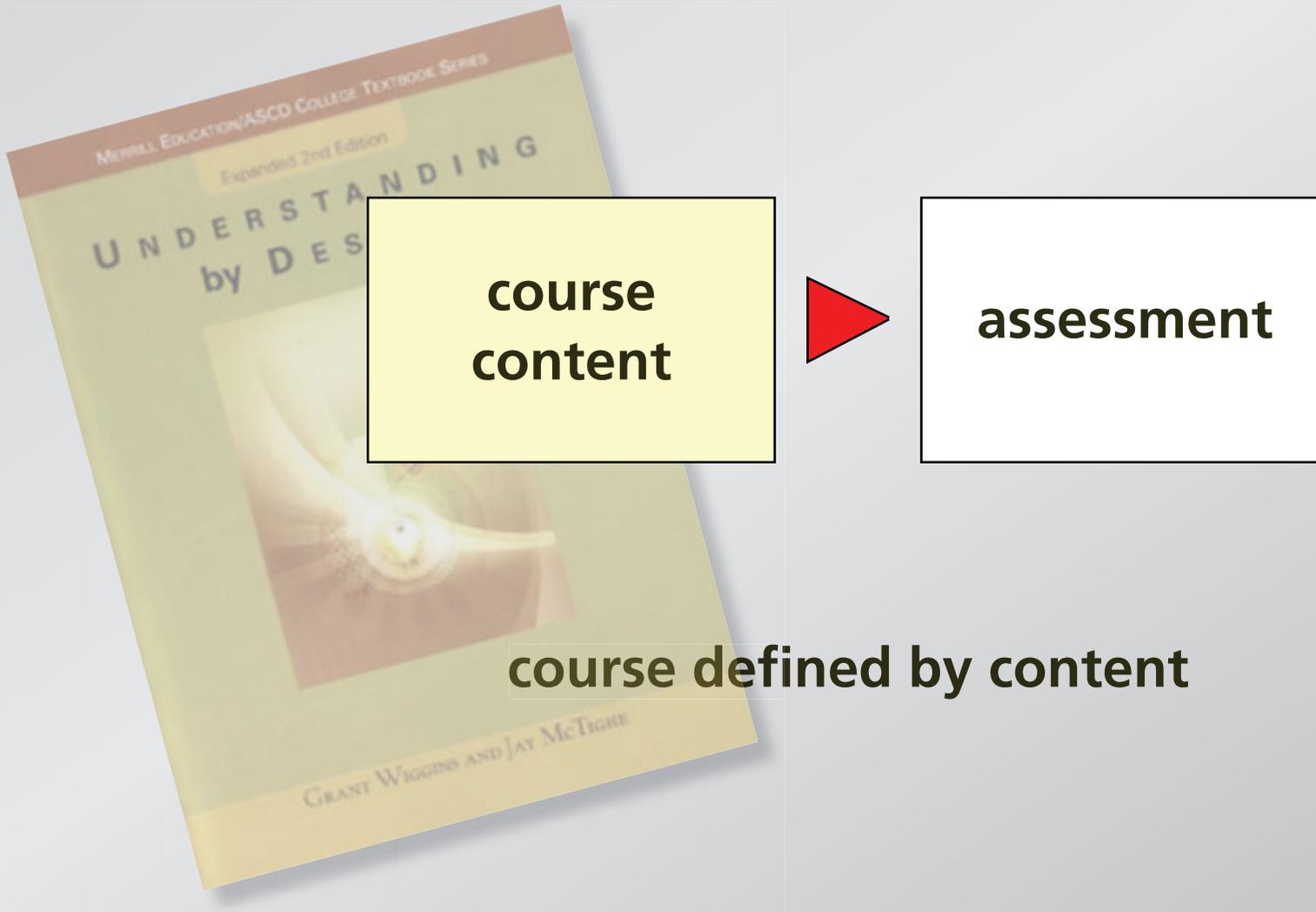
Setting the stage

Traditional approach to course planning



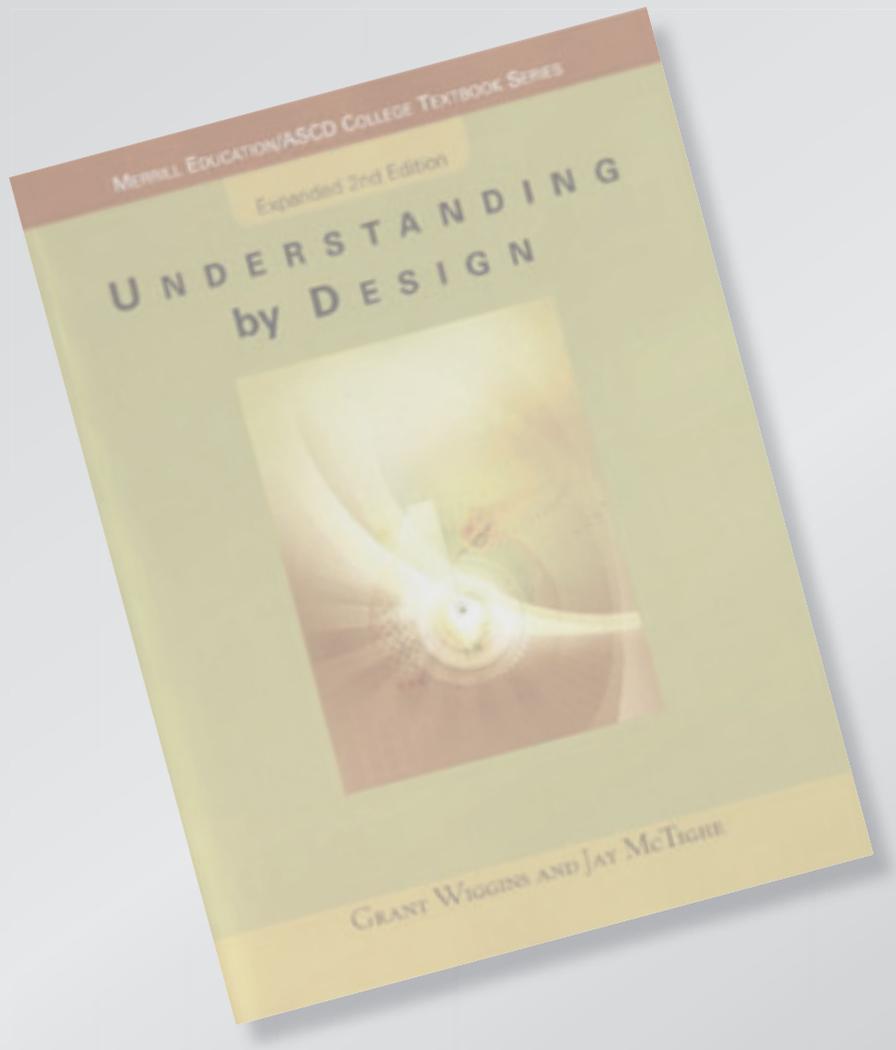
Setting the stage

Traditional approach to course planning



Setting the stage

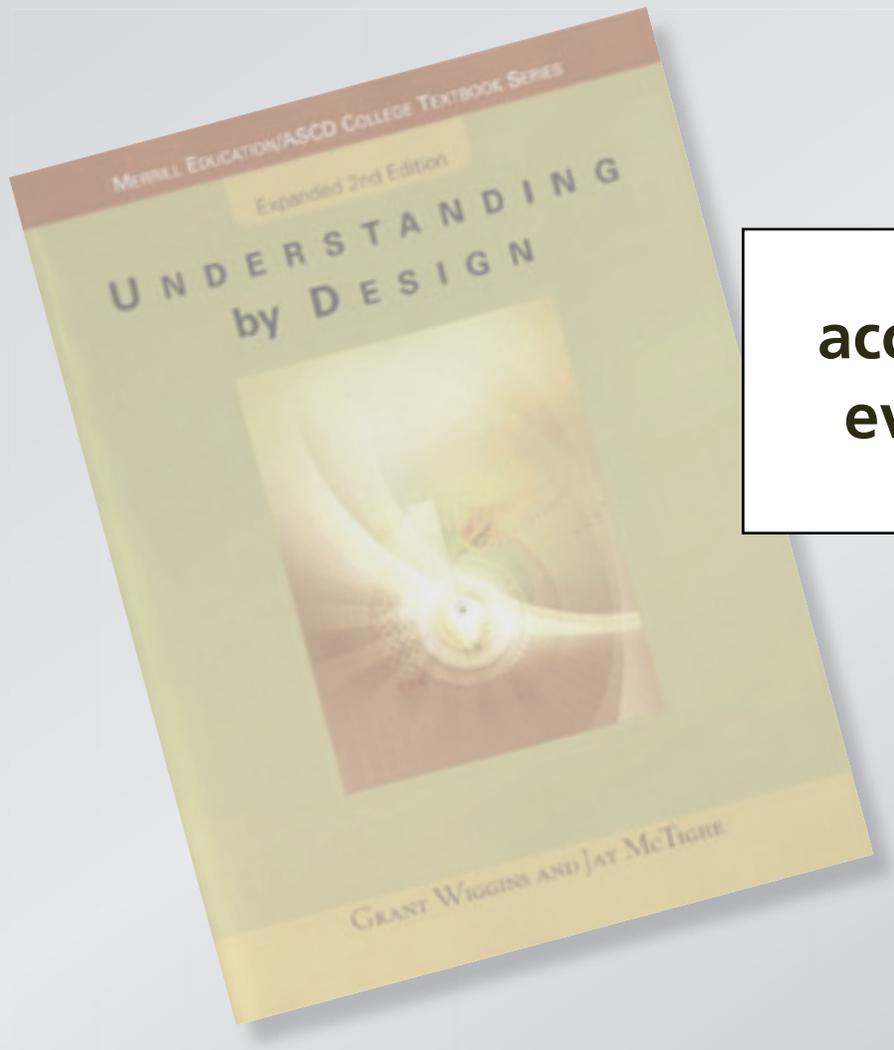
Backward design



**desired
outcomes**

Setting the stage

Backward design



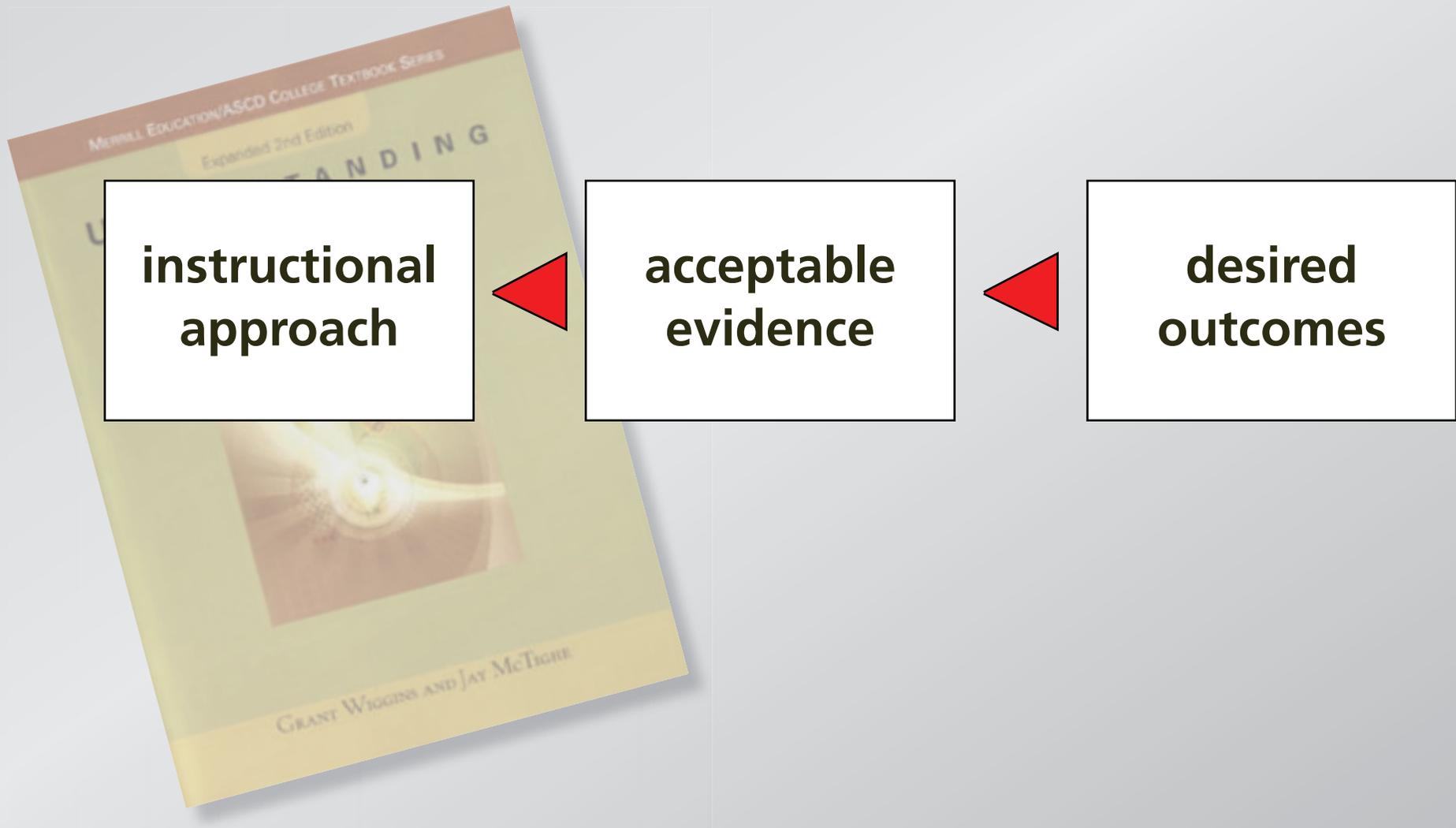
**acceptable
evidence**



**desired
outcomes**

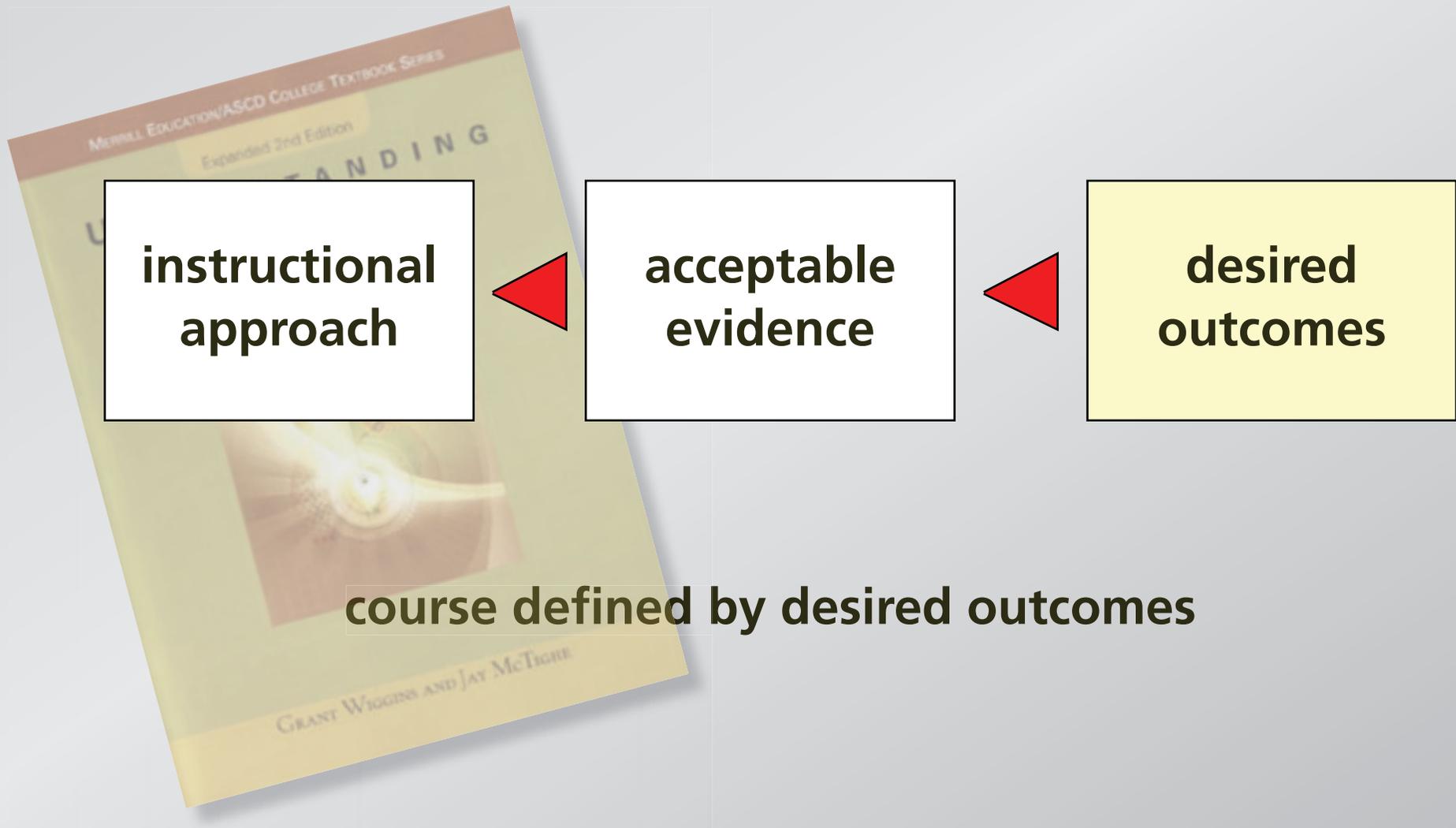
Setting the stage

Backward design



Setting the stage

Backward design



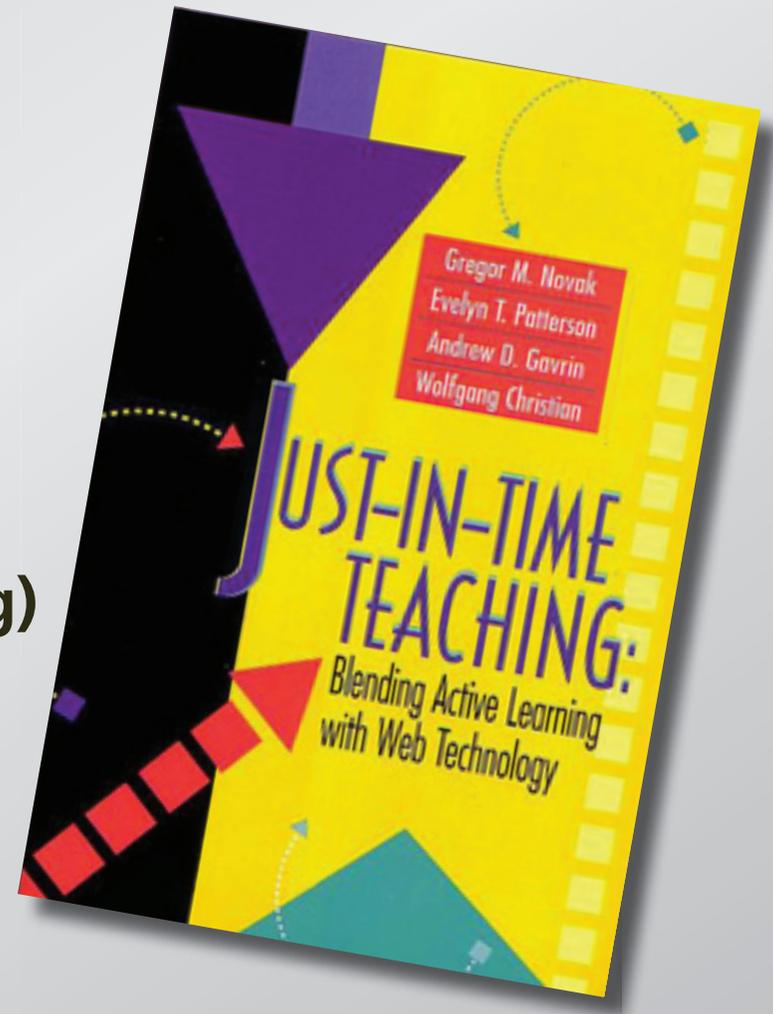
Setting the stage

How to move information transfer out of classroom?

Setting the stage

Approaches for reading:

- Reading quizzes
- Summaries
- Just-in-time-Teaching (www.jitt.org)

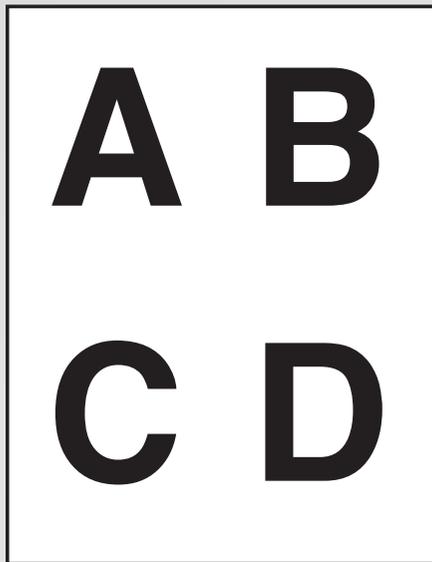


Setting the stage

Are clickers a required resource?

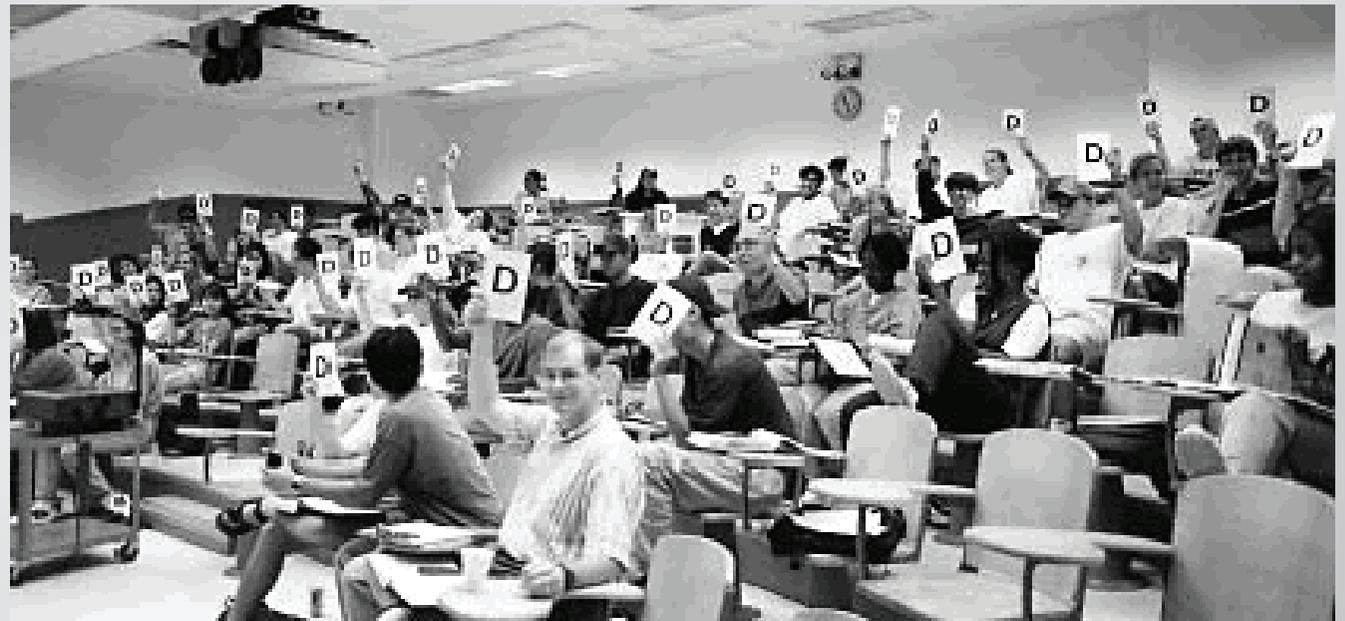
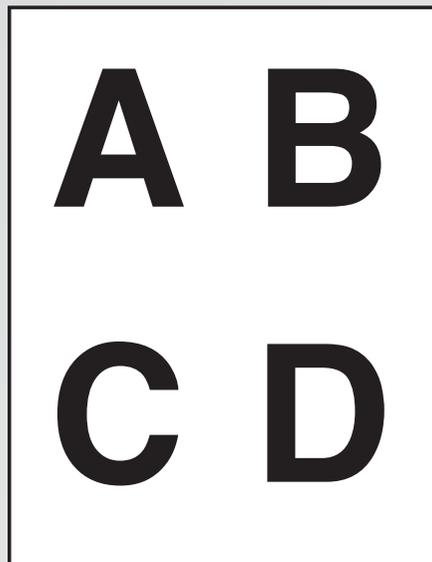
Setting the stage

Flashcards: simple and effective



Setting the stage

Flashcards: simple and effective



Meltzer and Mannivanan, South Eastern Louisiana University

Setting the stage

Imagine a rope that fits snugly along the equator.



Setting the stage

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



Setting the stage

circumference at equator:

$$2\pi R_E$$

Setting the stage

circumference at equator:

$$2\pi R_E$$

new circumference:

$$2\pi R_E + 1 \text{ m}$$

Setting the stage

circumference at equator:

$$2\pi R_E$$

new circumference:

$$2\pi R_E + 1 \text{ m}$$

radius of circle with new circumference:

$$2\pi R = 2\pi R_E + 1 \text{ m}, \quad \text{and so} \quad R = R_E + \frac{1 \text{ m}}{2\pi}.$$

Setting the stage

You all got fired up!

Setting the stage

You all got fired up!

(WITHOUT CLICKERS!)

Setting the stage

It's not the technology, but the pedagogy!

Setting the stage

It's not the technology, but the pedagogy!

(but clickers do offer advantages)

Outline

- **Setting the stage**
- **Making it happen**
- **Overcoming barriers**

Making it happen

To make it happen, I need to...

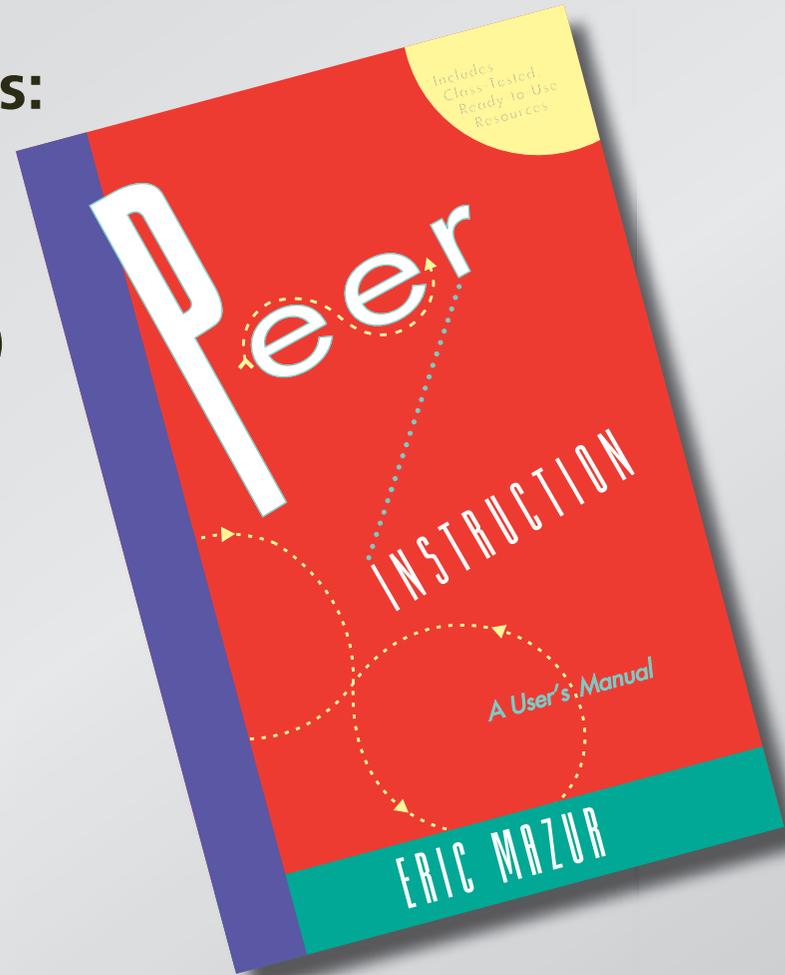
Making it happen

- **find or develop good questions**
- **know how to manage time**

Making it happen

Books with ConcepTests:

- Physics (Prentice Hall)



Making it happen

Books with ConcepTests:

- Physics (Prentice Hall)
- Chemistry (Prentice Hall)



Making it happen

Books with ConcepTests:

- Physics (Prentice Hall)
- Chemistry (Prentice Hall)
- Astronomy (Prentice Hall)



Making it happen

Books with ConcepTests:

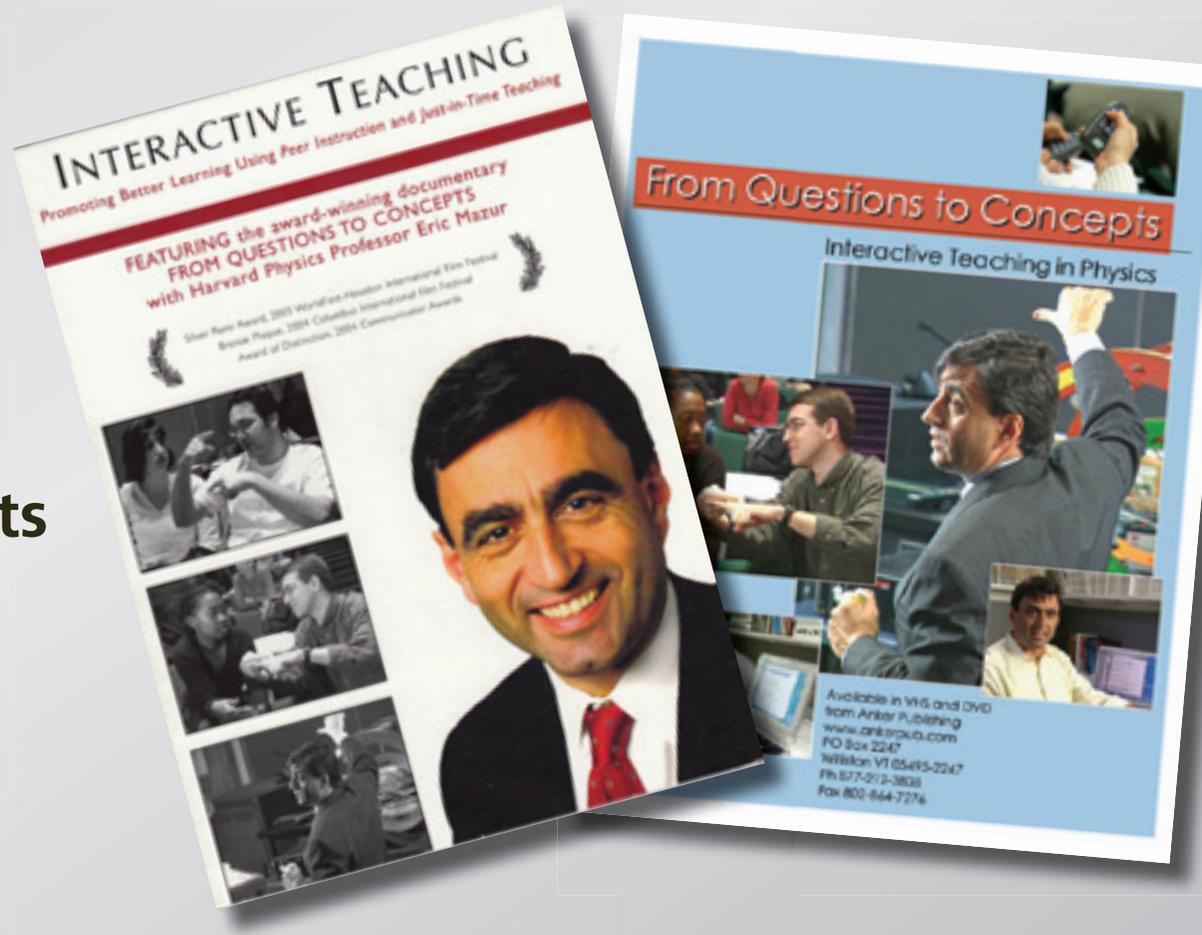
- Physics (Prentice Hall)
- Chemistry (Prentice Hall)
- Astronomy (Prentice Hall)
- Calculus (Wiley)



Making it happen

Videos:

- Interactive Teaching DVD
- From questions to concepts



Making it happen

Types of questions

- **survey**
- **discussion**
- **model testing**
- **select from list**

Making it happen

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.

Making it happen

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

1. Delta Airlines
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- 3. All Nippon Airways**
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Making it happen

hole in plate/circumference

model

Professor A/B

discussion

airline

fact

Making it happen

hole in plate/circumference

model

Professor A/B

discussion

airline

fact

fact-recall not engaging

Making it happen

Good conceptual questions (ConceptTests):

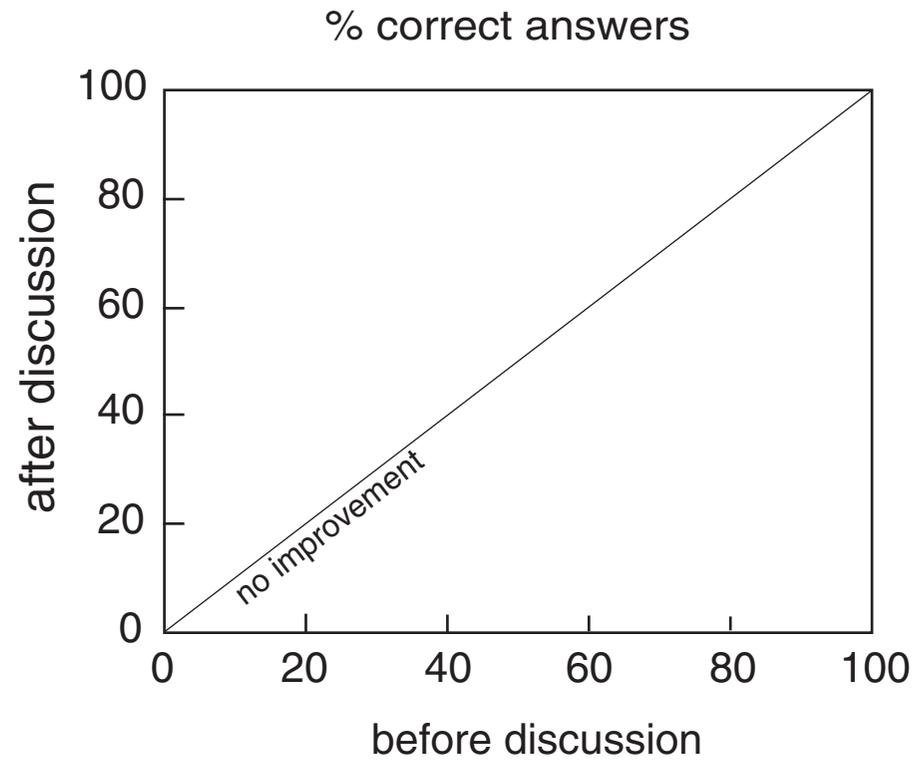
- are based on student difficulties
- focus on single concept
- cannot be solved by “plug and chug”
- are clear and concise
- are of manageable difficulty

Making it happen

must adjust level to audience

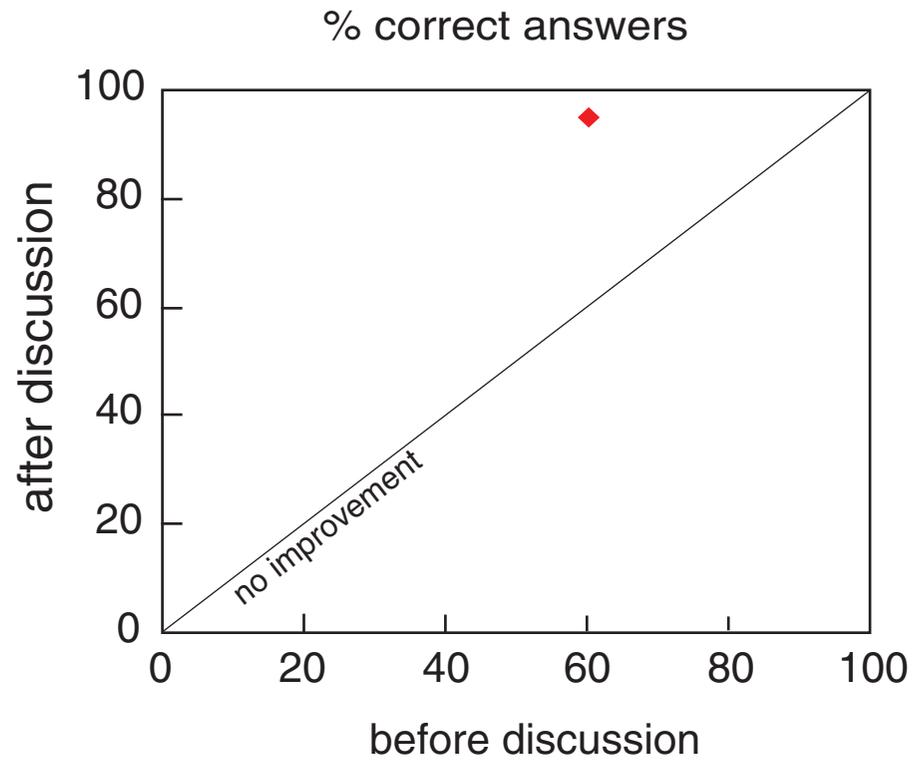
Making it happen

ConceptTest data



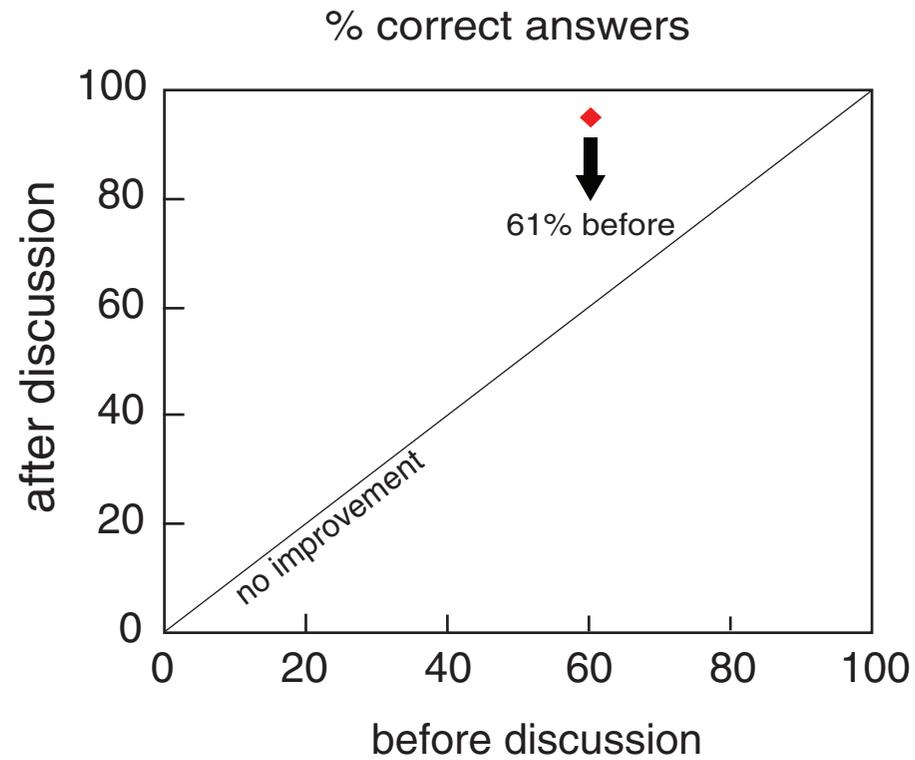
Making it happen

ConceptTest data



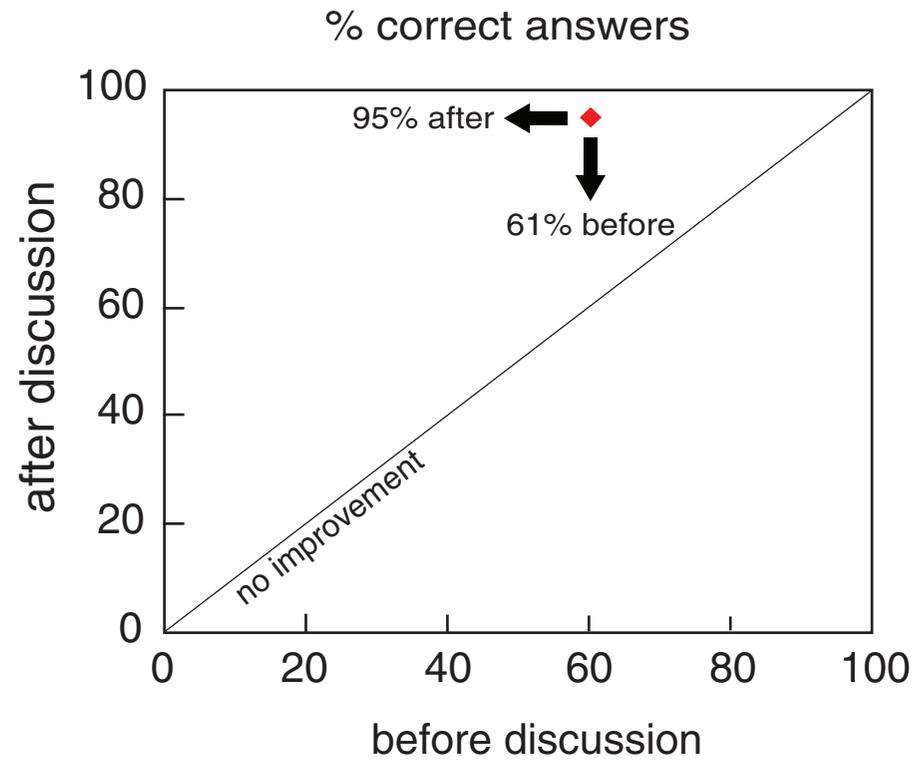
Making it happen

ConceptTest data



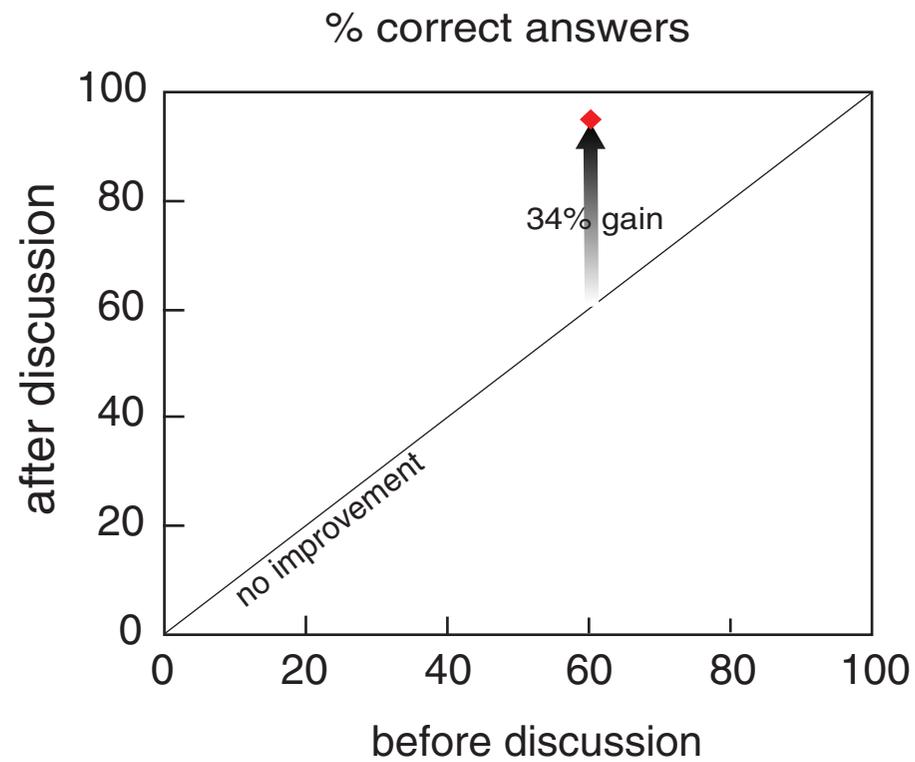
Making it happen

ConceptTest data



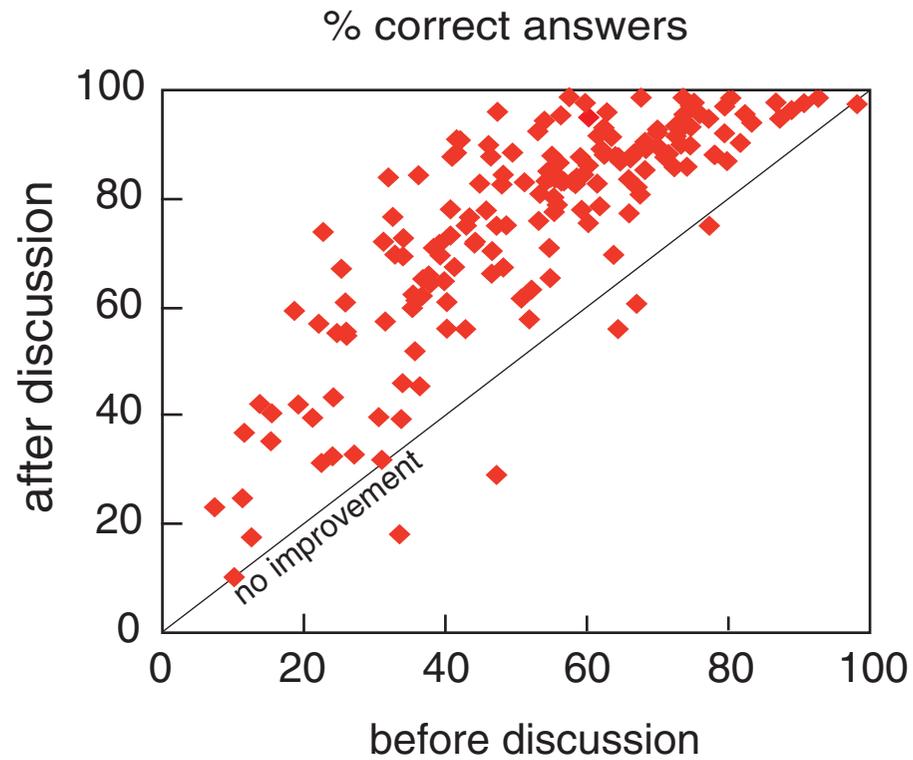
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ConceptTest data



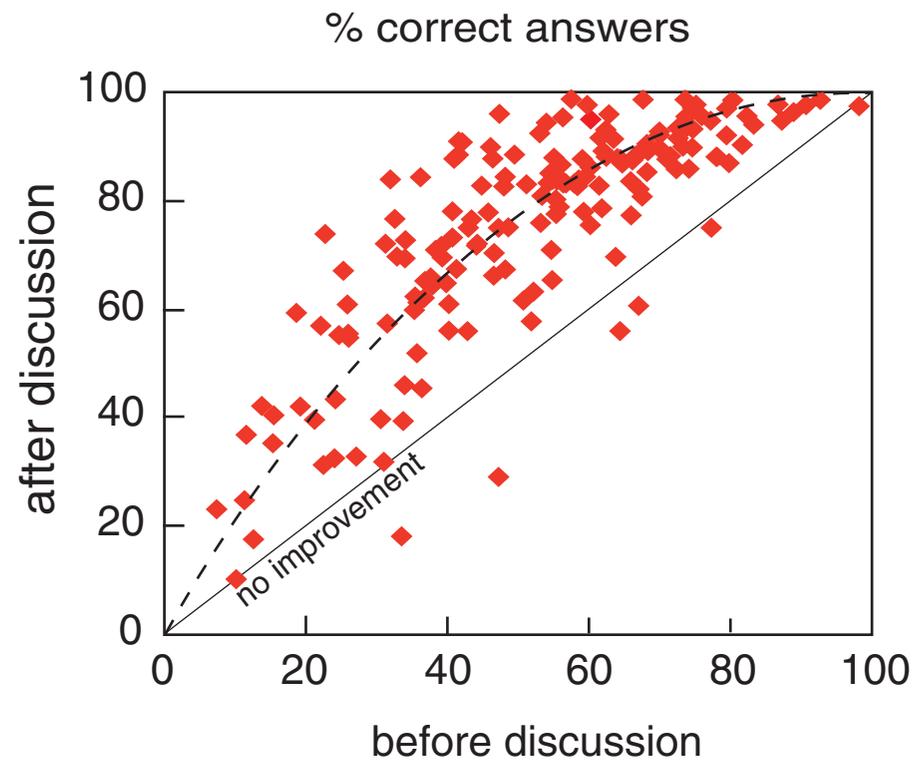
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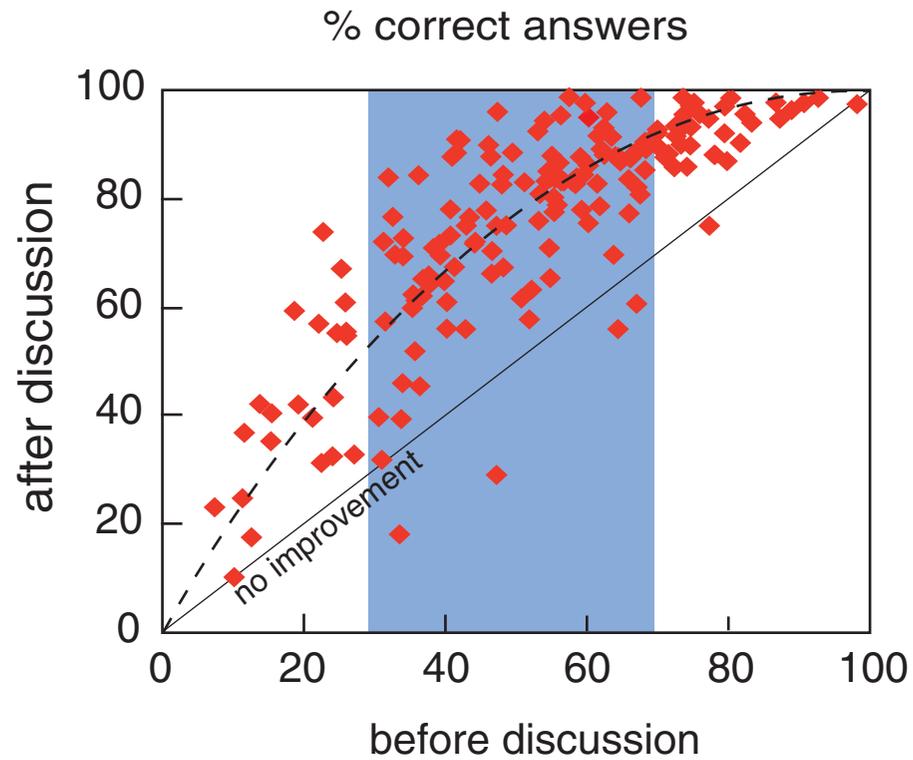
Making it happen

ConceptTest data



Making it happen

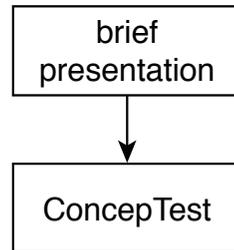
ConcepTest data



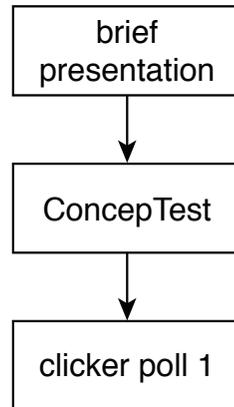
Making it happen

brief
presentation

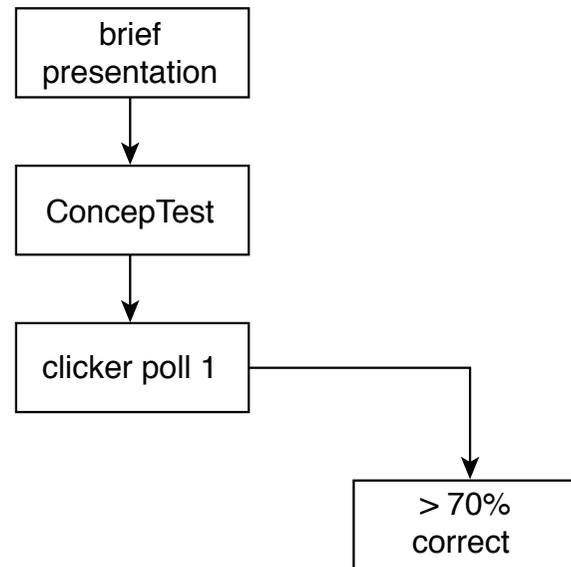
Making it happen



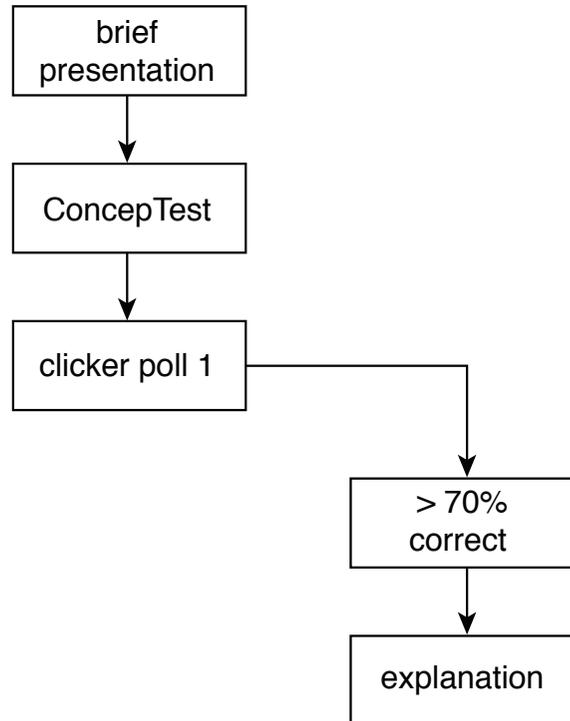
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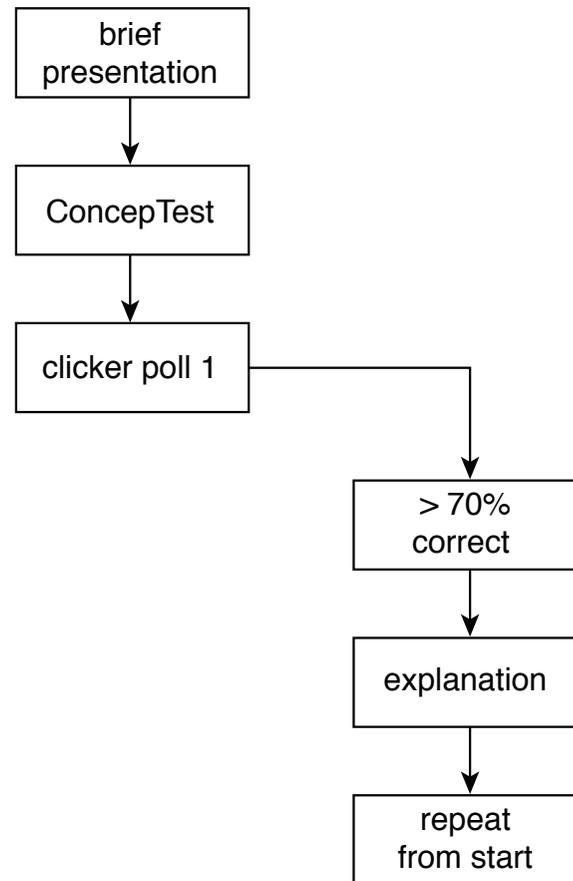
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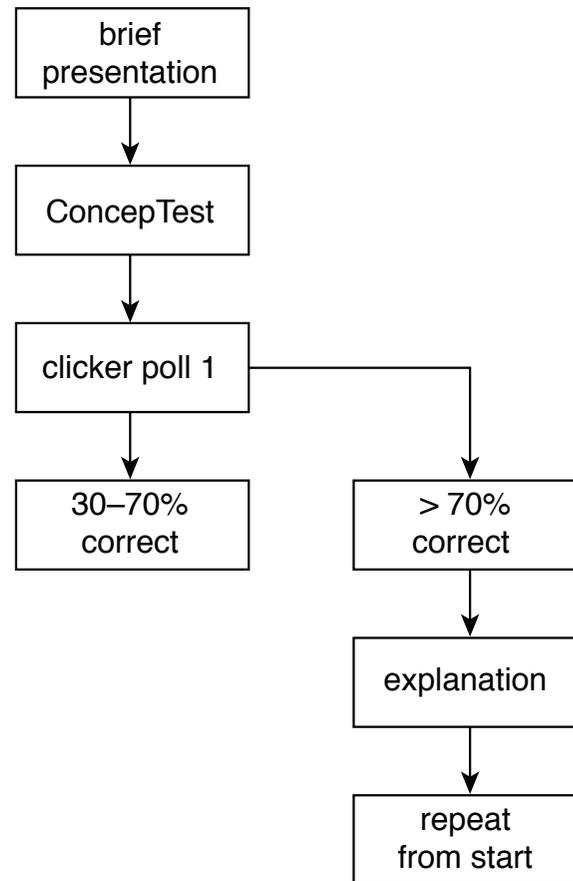
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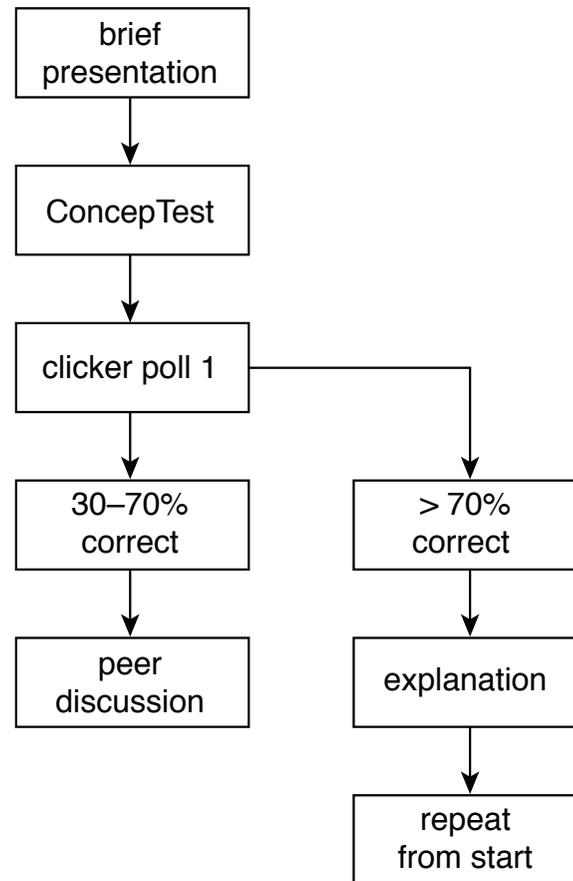
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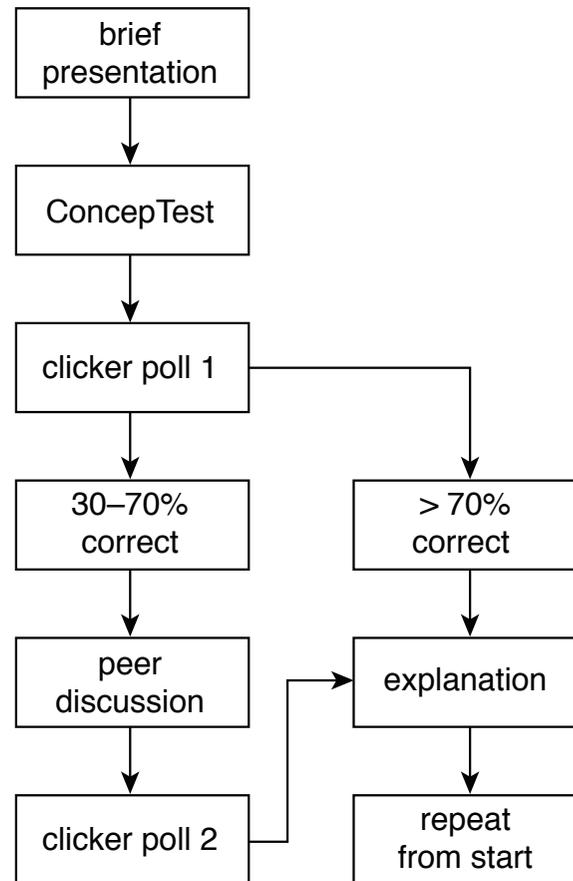
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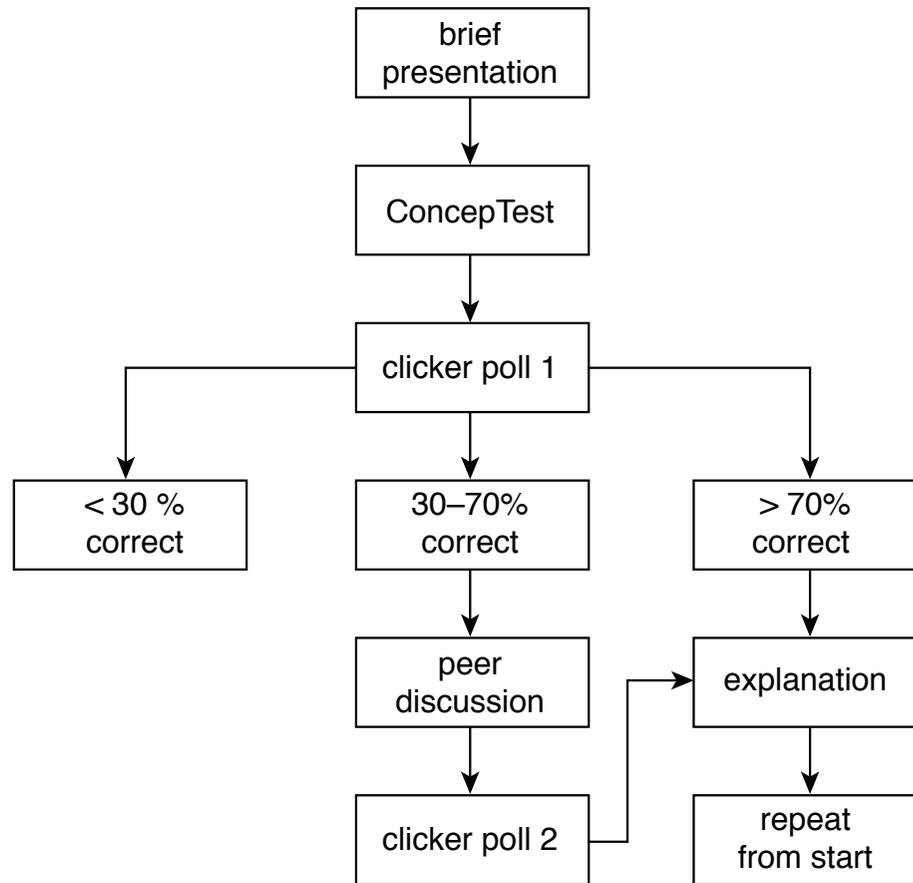
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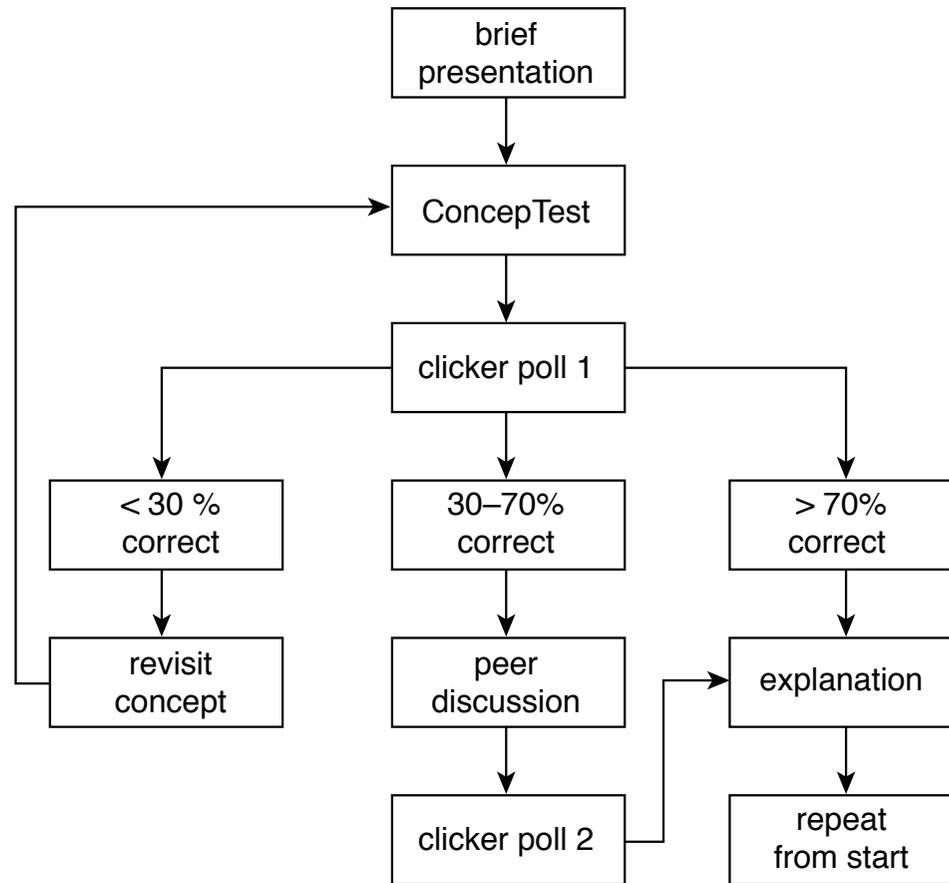
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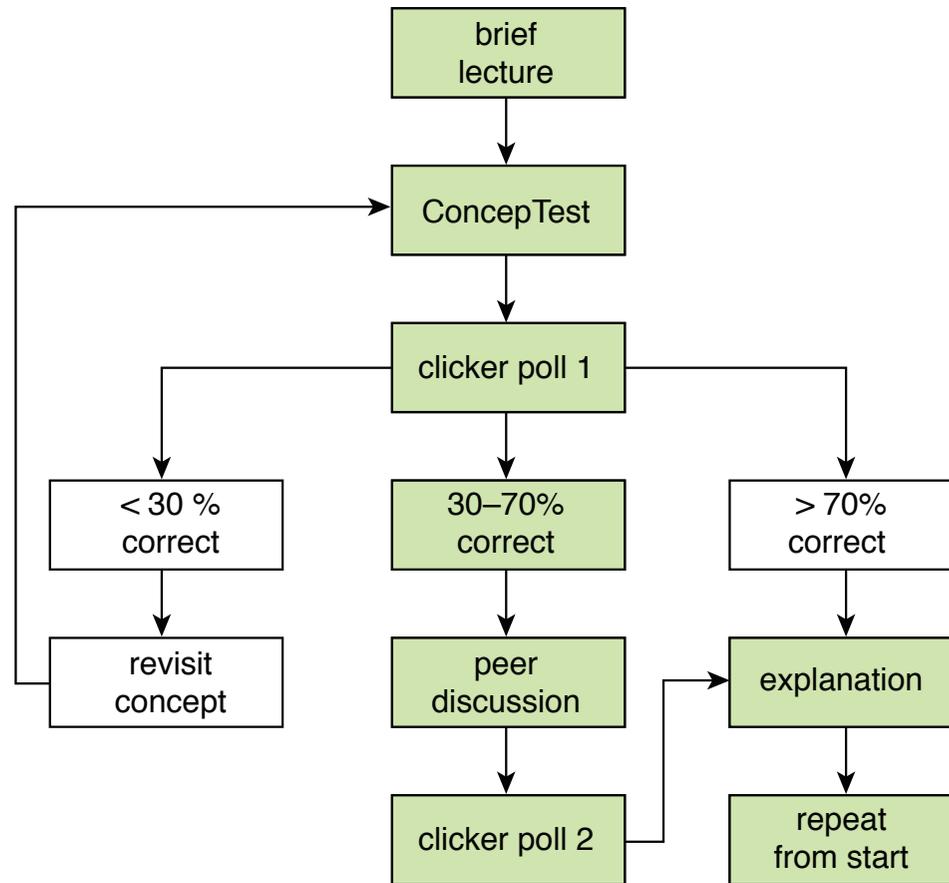
Making it happen



Making it happen



Making it happen



Outline

- **Setting the stage**
- **Making it happen**
- **Overcoming barriers**

Overcoming barriers

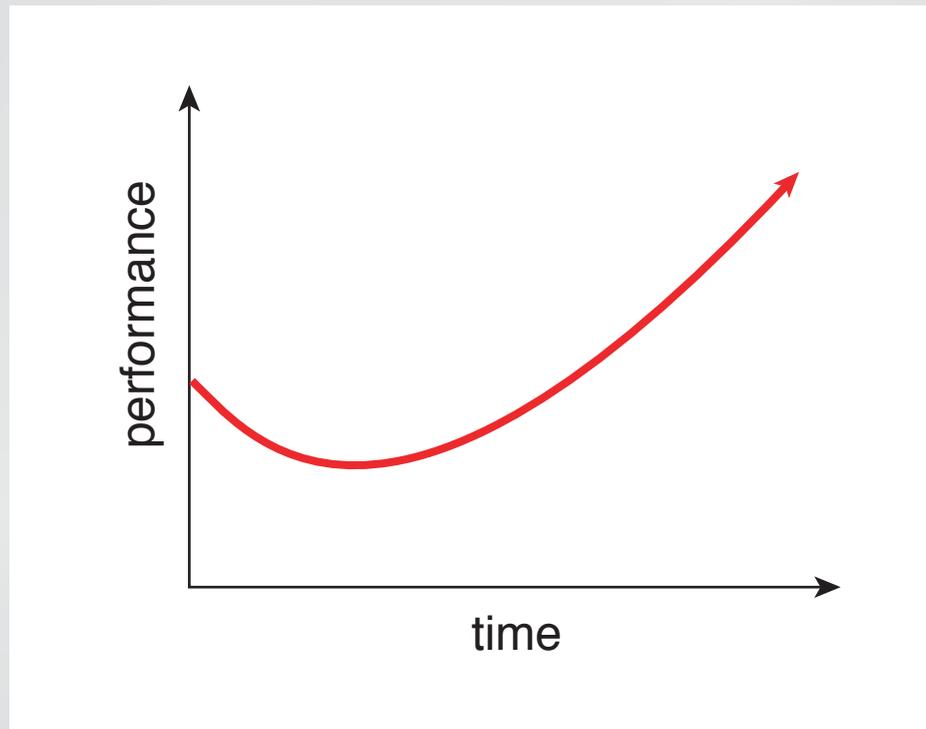
What are some potential barriers?

Overcoming barriers

- **skepticism**
- **growing pains**
- **negative feedback**
- **limited circle of influence**

Overcoming barriers

After changing, things might get *worse* before they get better!



Overcoming barriers

Better understanding leads to *more* — not fewer — questions!

(must recognize confusion as step towards understanding)

Overcoming barriers

Things to do:

- **take data**
- **motivate students**
- **be prepared for initial adjustments**

Overcoming barriers

Why is change so hard?

Overcoming barriers

	"lectures"	PI
coverage	complete	partial
preclass reading	none	cover everything
confusion	little none	substantial
evaluations	known	unknown

Overcoming barriers

	"lectures"	PI	considered
coverage	complete	partial	requirement
preclass reading	none	cover everything	
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Overcoming barriers

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Overcoming barriers

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Overcoming barriers

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Overcoming barriers

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Overcoming barriers

But PI leads to better learning and retention

Overcoming barriers

**But PI leads to better learning and retention
(neither of which is traditionally measured)**

Conclusion



Conclusion

active engagement greatly improves learning gains



Conclusion

active engagement greatly improves learning gains

technology facilitates active engagement



Conclusion

not just a polling tool, but an engagement tool!



Research Funding:

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<http://mazur-www.harvard.edu>

response cards:

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eric_mazur

Let's try it!

The specific heat at constant volume for a monatomic crystal approaches zero at low temperature even though the specific heat for a monatomic gas remains $\frac{3}{2}k$ per atom. Why is this so?

Let's try it!

The specific heat at constant volume for a monatomic crystal approaches zero at low temperature even though the specific heat for a monatomic gas remains $\frac{3}{2}k$ per atom. Why is this so?

1. Potential energy doesn't play a role for the monatomic gas, but it does for the crystal.
2. The particles are indistinguishable in the gas, but not in the crystal.
3. The energy difference between allowed states for the crystal is much larger than it is for the atoms.