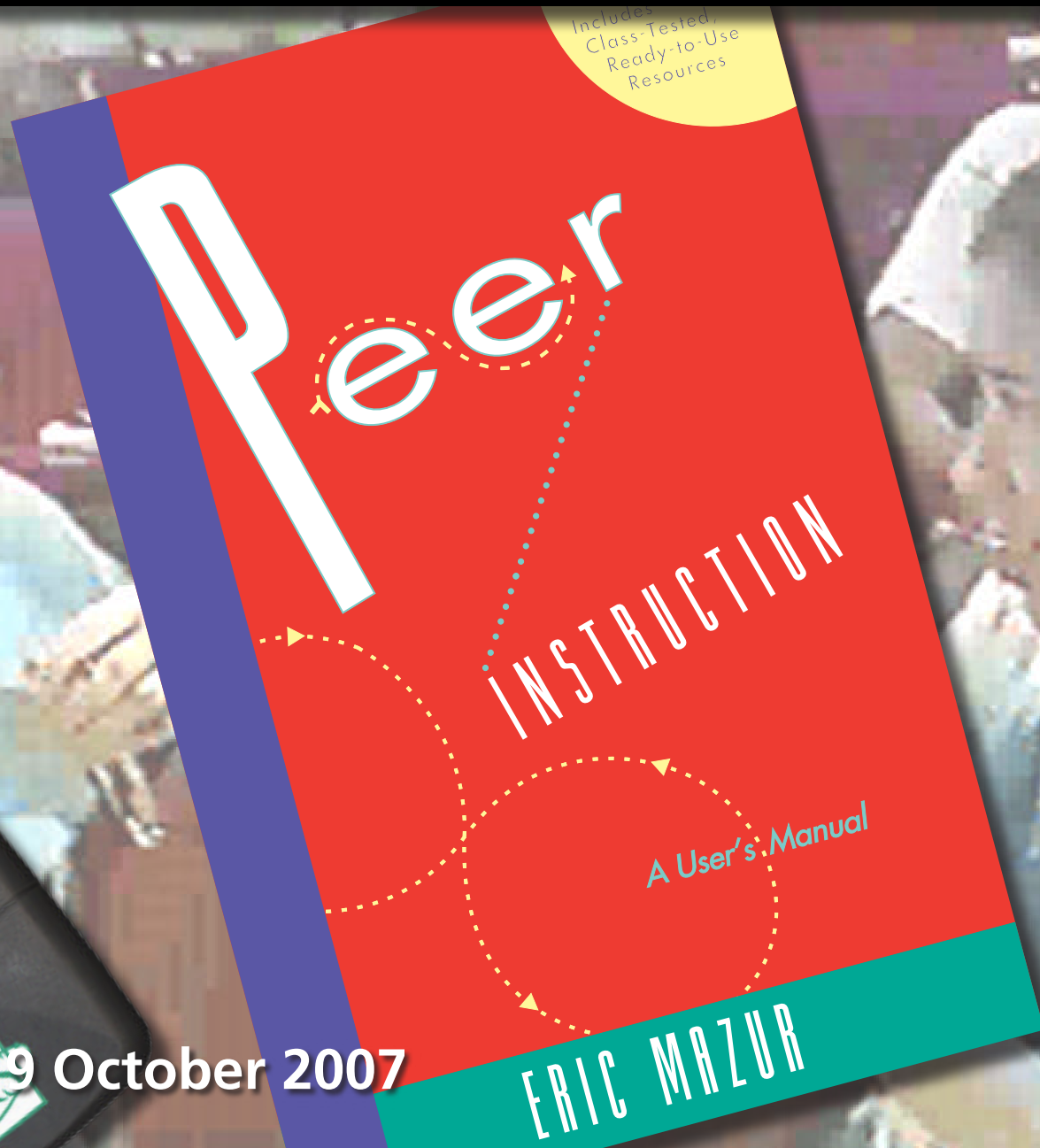
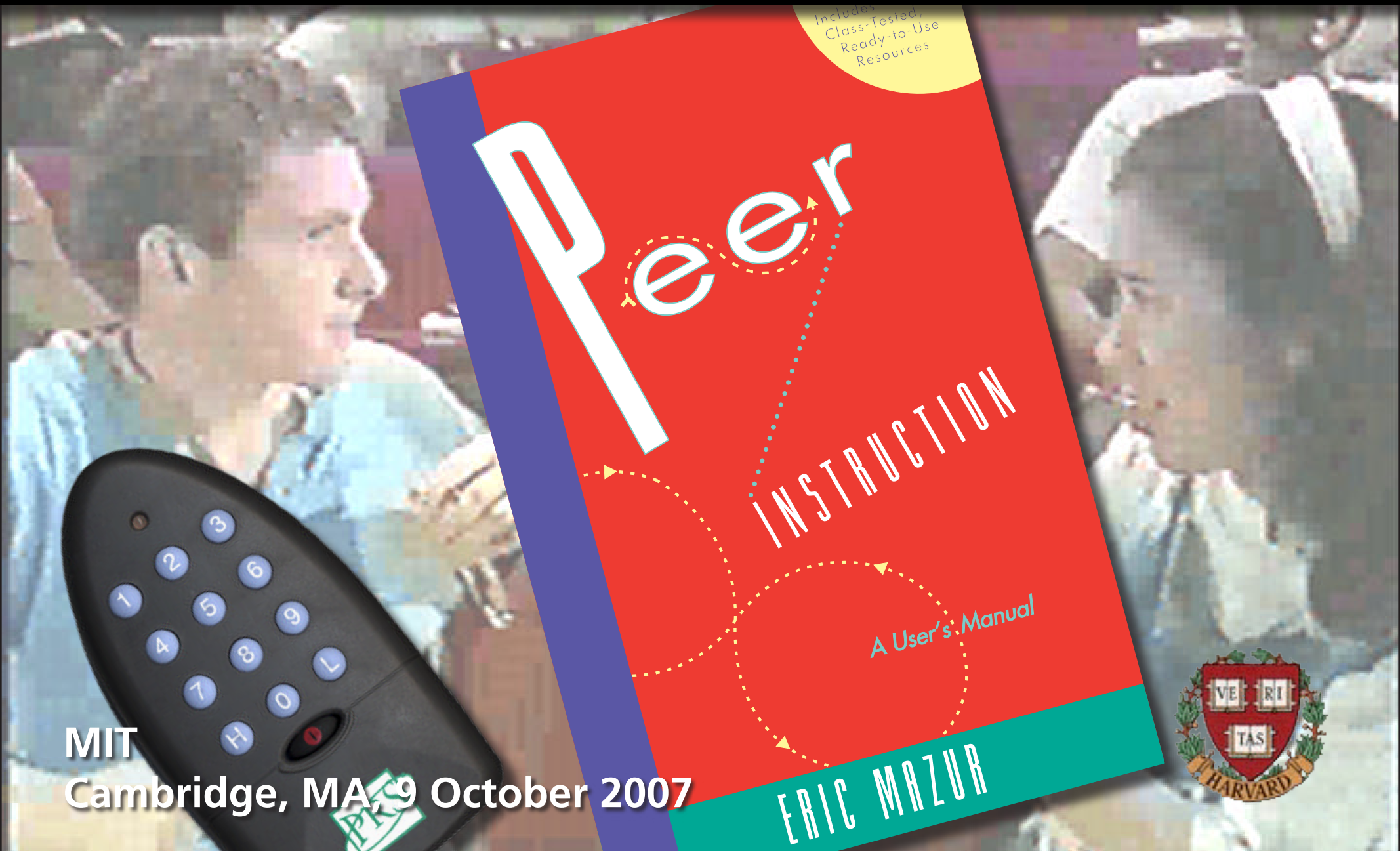
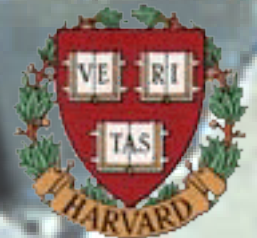


# Peer Instruction: 'brains-on' demo and discussion



MIT

Cambridge, MA, 9 October 2007



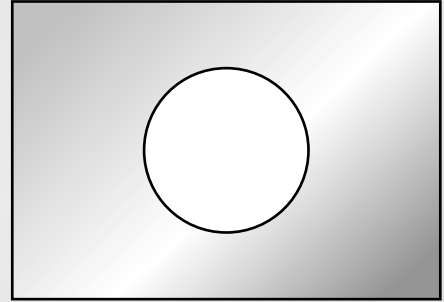
# Outline

**Some options:**

- **Let's try it!**
- **Feedback methods**
- **Research: providing the basis for change**
- **Problems with problems**
- **Resources**
- **Barriers to reform**

# Let's try it!

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

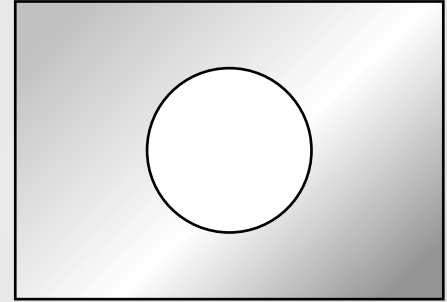


# Let's try it!

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.

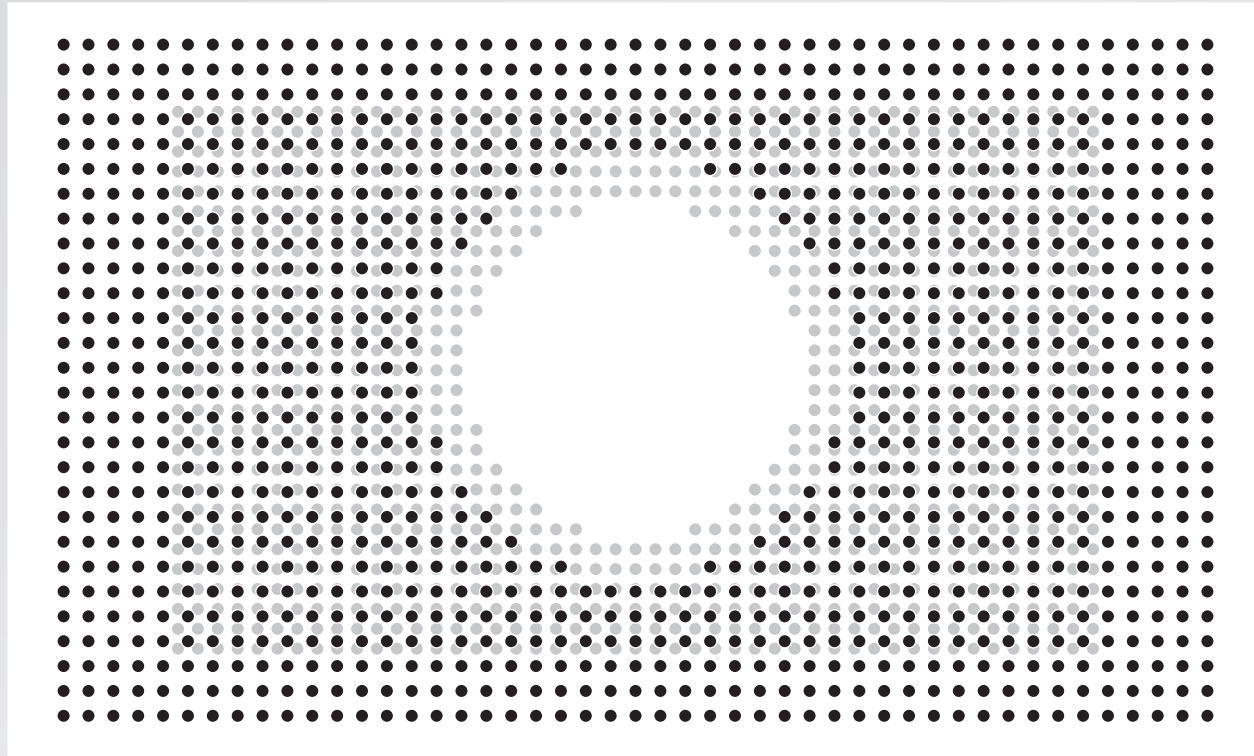


**Let's try it!**

*It's easy to fire up the audience!*

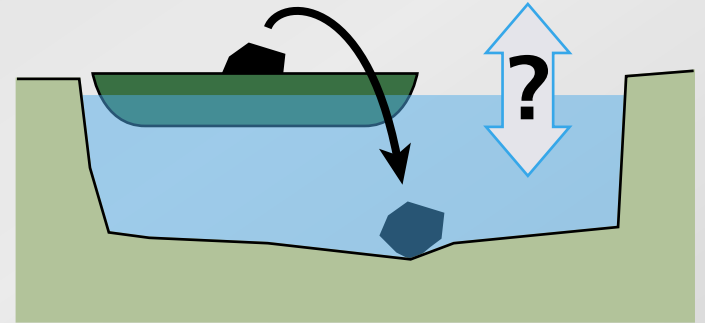
# Let's try it!

The distance between the atoms increases uniformly



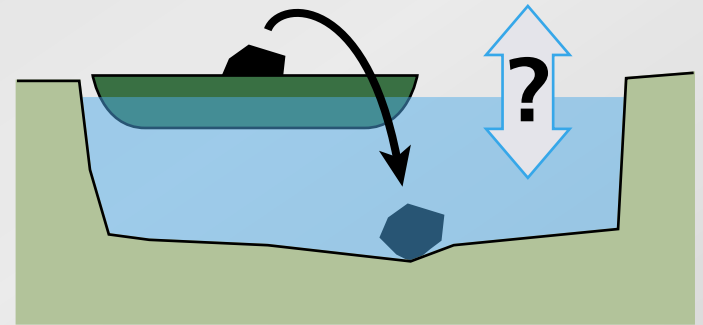
# Let's try it!

A boat carrying a large boulder is floating on a small pond. The boulder is thrown overboard and sinks to the bottom of the pond.



# Let's try it!

A boat carrying a large boulder is floating on a small pond. The boulder is thrown overboard and sinks to the bottom of the pond.



After the boulder sinks to the bottom of the pond, the level of the water in the pond is

1. higher than
2. the same as
3. lower than

it was when the boulder was in the boat.



**Let's try it!**

***We all make mistakes!***

# Let's try it!

When we hold a page of printed text in front of a mirror, the text on the image in the mirror runs from right to left:

**The New York Times**

# Let's try it!

When we hold a page of printed text in front of a mirror, the text on the image in the mirror runs from right to left:

**The New York Times**

Why is it that right and left are interchanged and not top and bottom? Because:

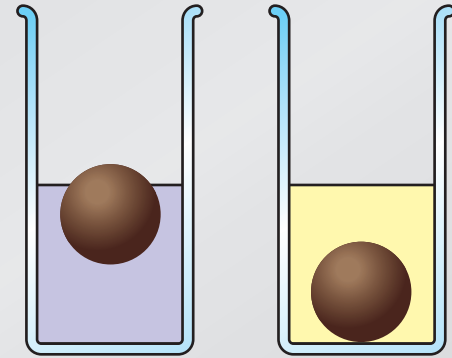
1. the mirror is oriented vertically.
2. we have two eyes in the horizontal plane.
3. the Earth's gravitation is directed downward.
4. a habit we have when looking at images in a mirror.
5. It only *appears* to run from left to right.

**Let's try it!**

*It's "simple" only if you know the answer*

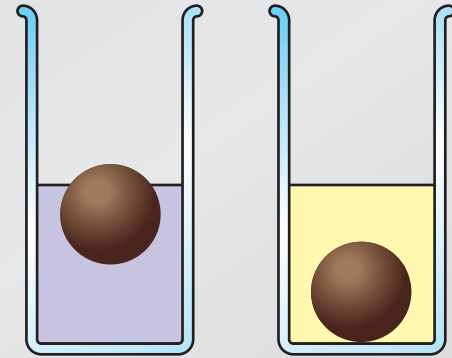
# Let's try it!

Consider an object that floats in water, but sinks in oil. When the object floats in water, most of it is submerged.



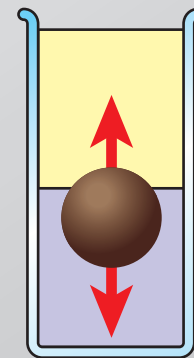
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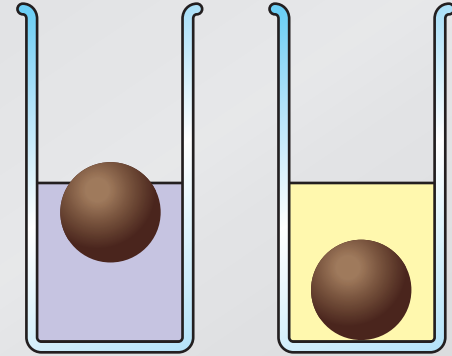
If we slowly pour the oil on top of the water so it completely covers the object, the object

1. moves up.
2. stays in the same place.
3. moves down.



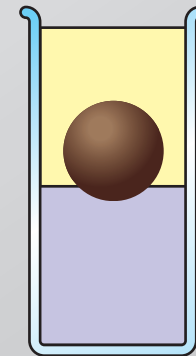
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**Let's try it!**

*It's easy to make simple demonstrations fascinating!*



# Developing ConceptTests

## Good 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

# Developing ConceptTests

**Try writing a ConceptTests on the following topic:**

**The acceleration due to gravity is constant**

# Developing ConceptTests

A ball is thrown downward (not dropped) from the top of a tower.

After being released, its downward acceleration is:

1. greater than  $g$
2. exactly  $g$
3. smaller than  $g$

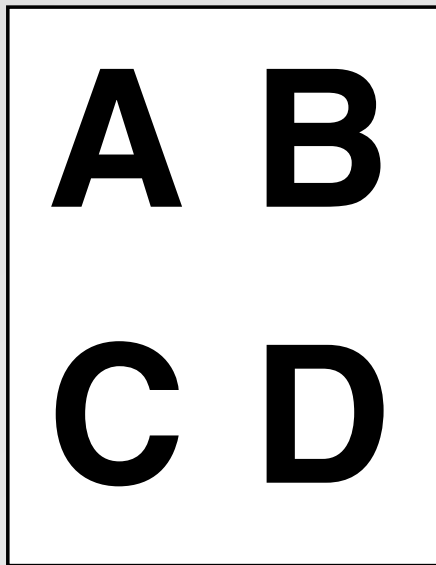
# Feedback methods

**Show of hands:**

**easy, but only moderately effective**

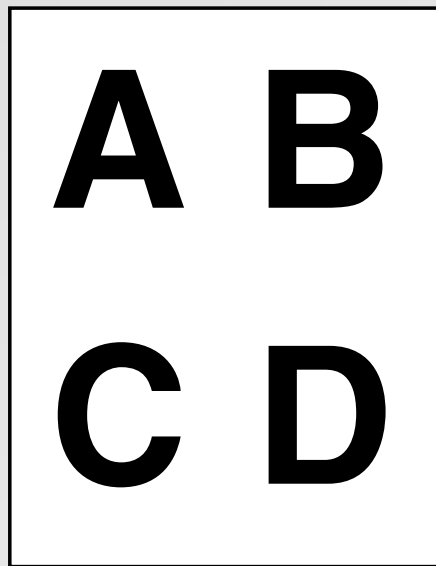
# Feedback methods

Flashcards: simple and effective



# Feedback methods

Flashcards: simple and effective



Meltzer and Mannivanan, South Eastern Louisiana University

# Feedback methods

Infrared transmitters (PRS): easy collection of data



# Feedback methods

Infrared transmitters (PRS): easy collection of data



Kristy Beauvais, Concord Carlisle High School



# Feedback methods

near future: wireless classroom



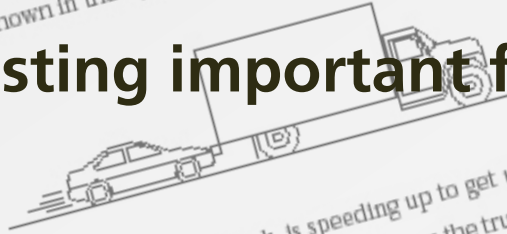
# Research: providing the basis for change

## Pre/post-testing important for:

- justifying approach
- improving implementation

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 compact car as shown in the figure below.



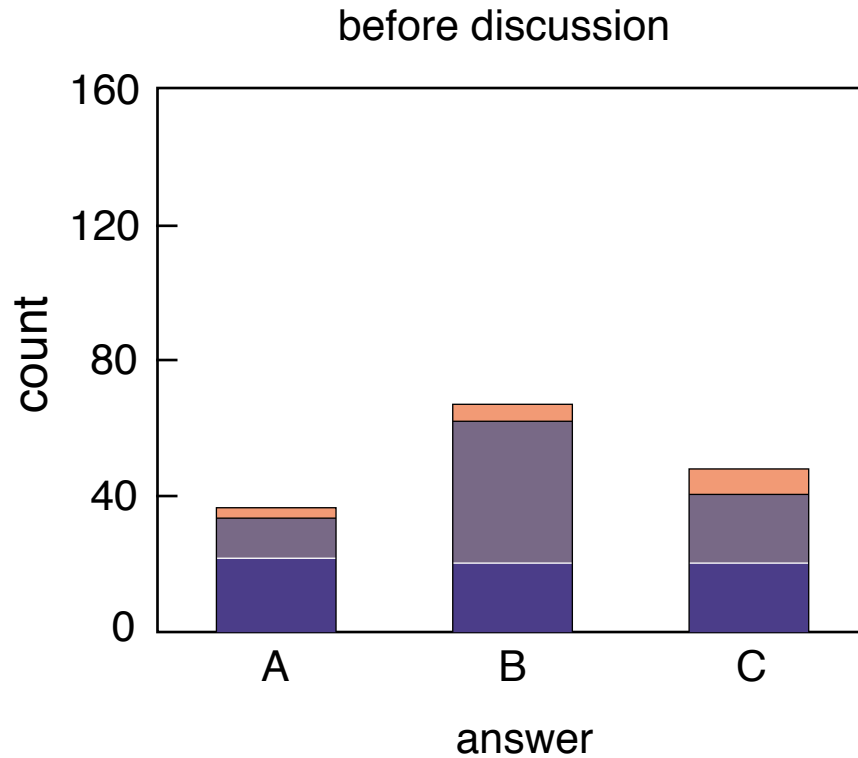
15. While the car, still pushing the truck, is speeding up to get up to cruising speed,
- \_\_\_ 1. the amount of force with which the car pushes on the truck is equal to that with which the truck pushes back on the car.
  - \_\_\_ 2. the amount of force with which the car pushes on the truck is smaller 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 car pushes against the truck, but the truck's engine is not running so the truck cannot push back 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.
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# **Research: providing the basis for change**

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

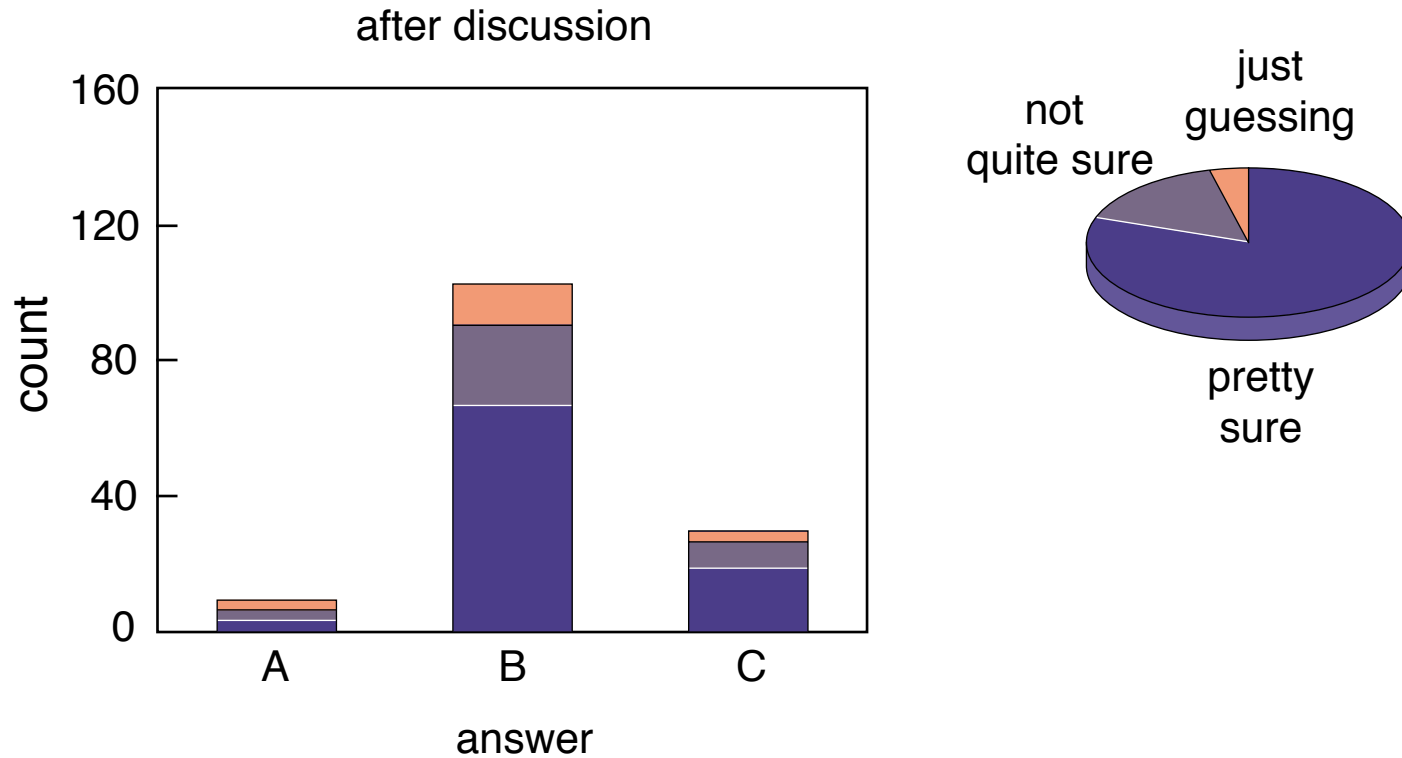
# Research: providing the basis for change

## ConceptTest data



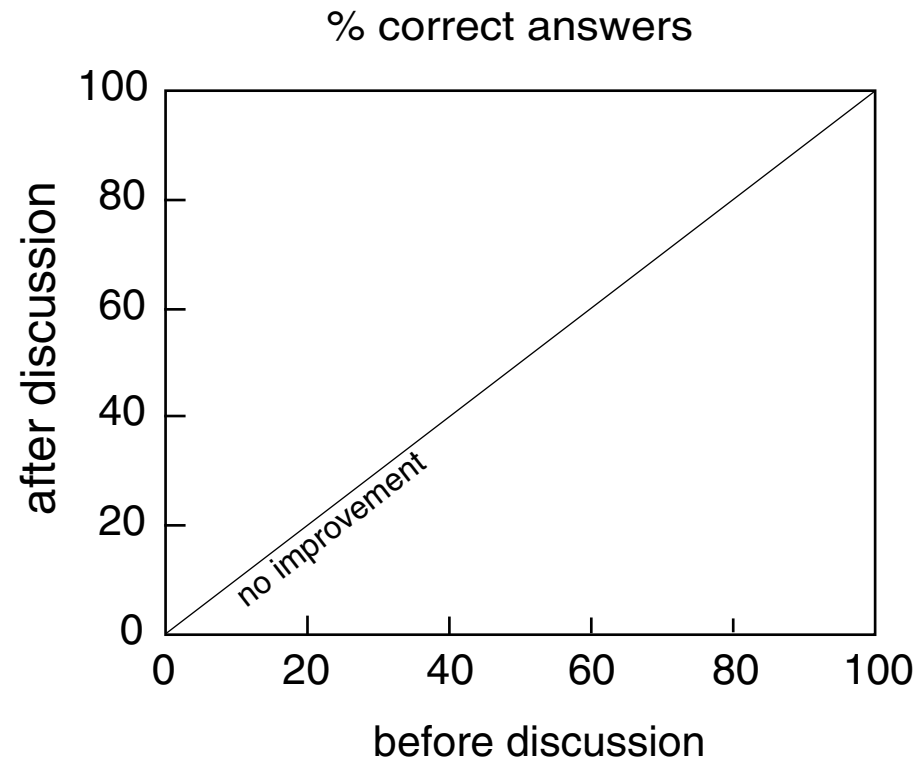
# Research: providing the basis for change

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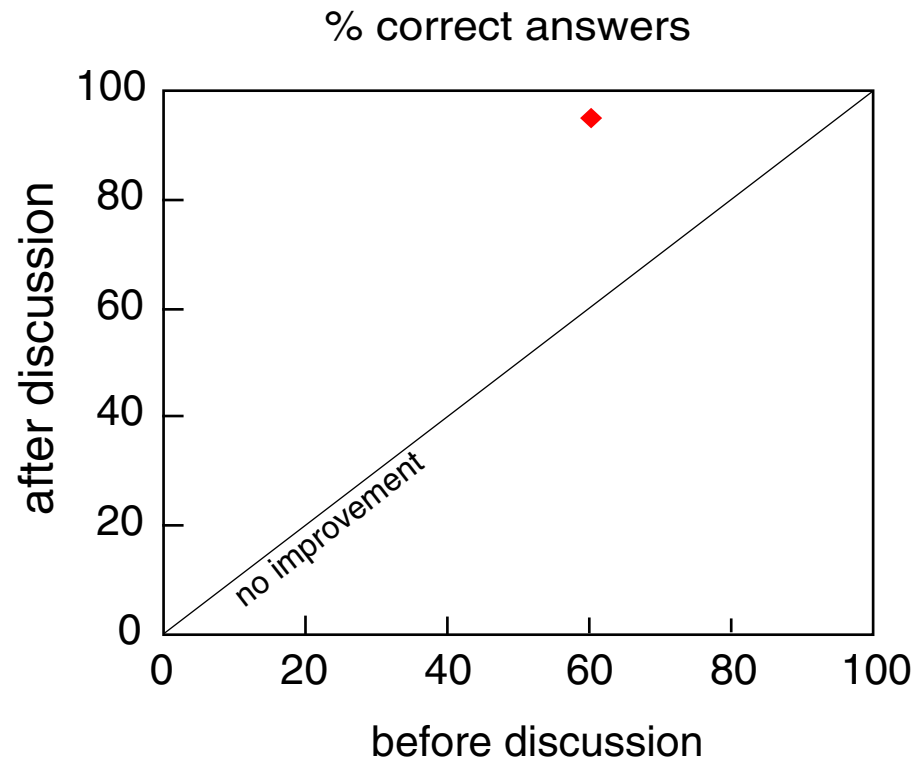
# Research: providing the basis for change

## ConceptTest data



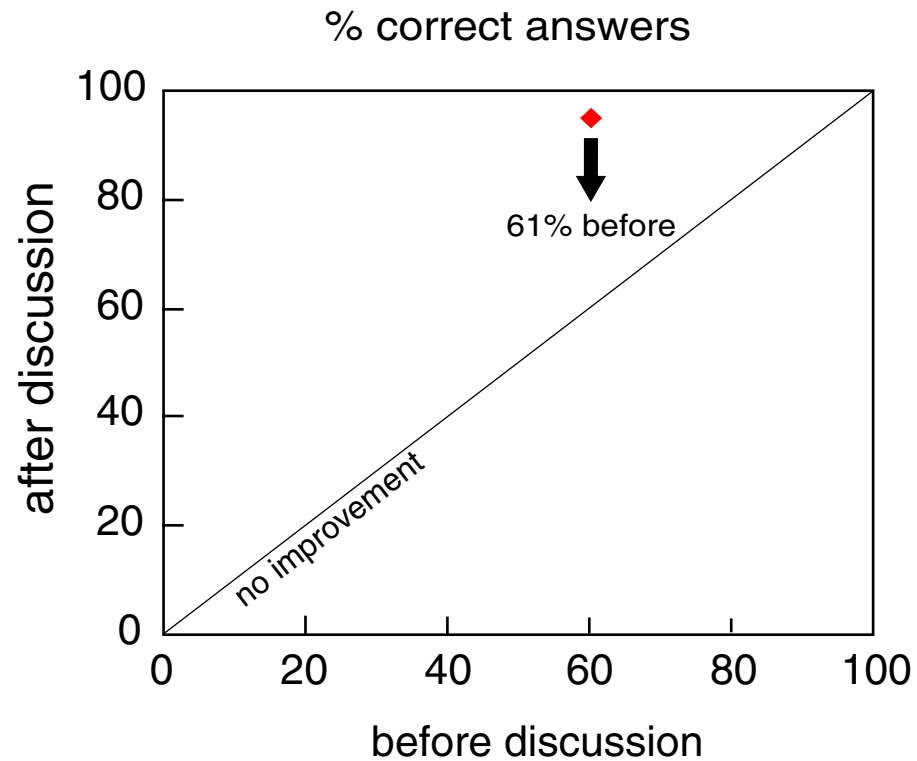
# Research: providing the basis for change

## ConceptTest data



# Research: providing the basis for change

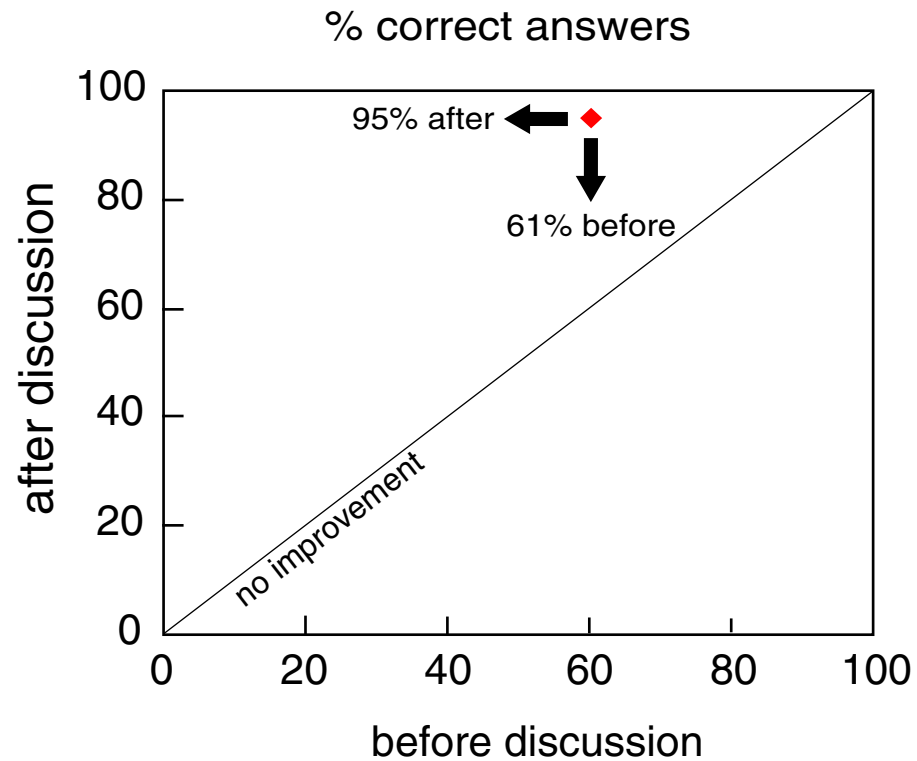
## ConceptTest data





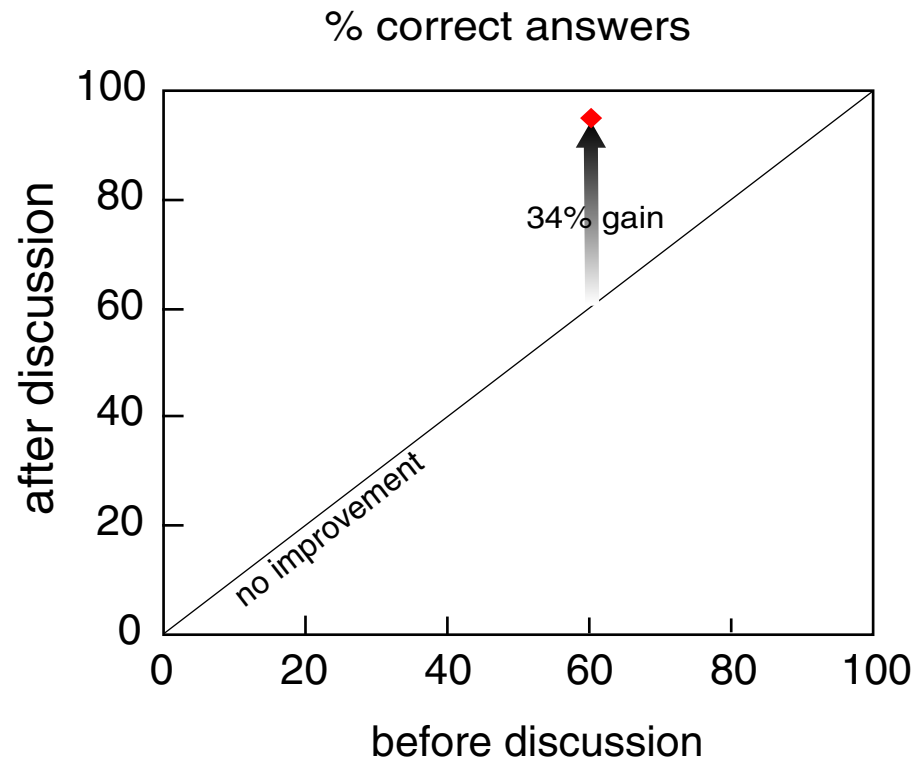
# Research: providing the basis for change

## ConceptTest data



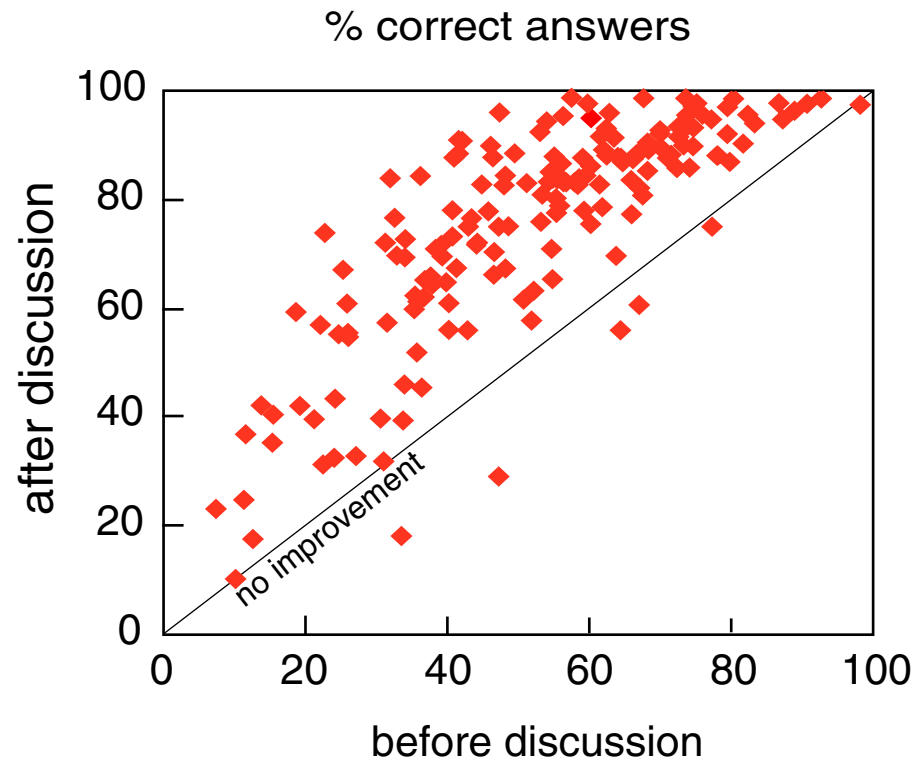
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## ConceptTest data



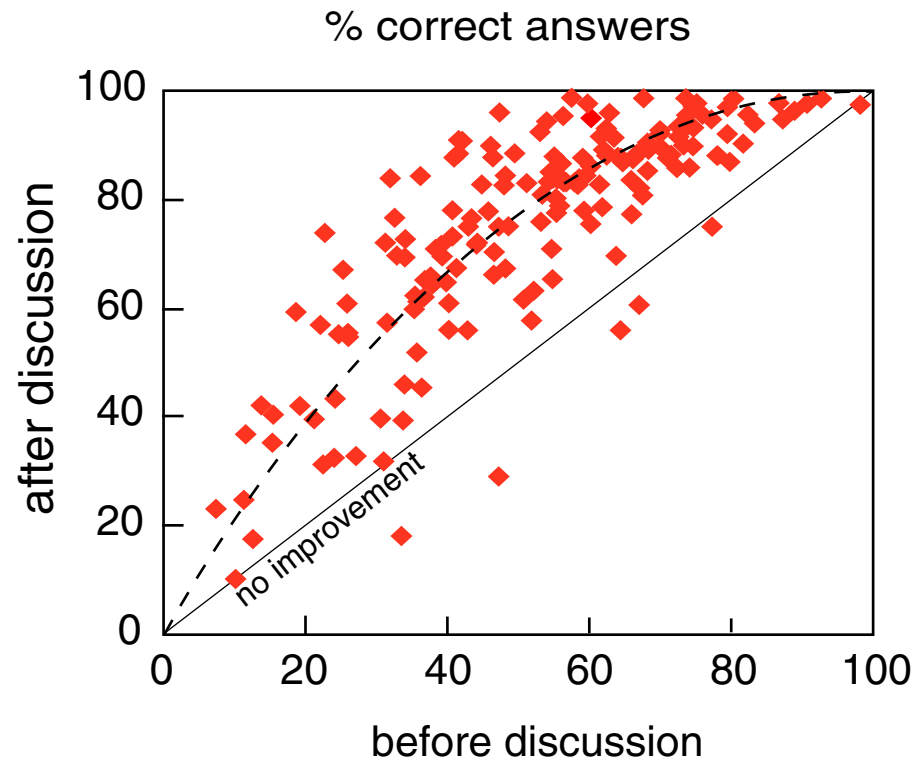
# Research: providing the basis for change

## ConceptTest data



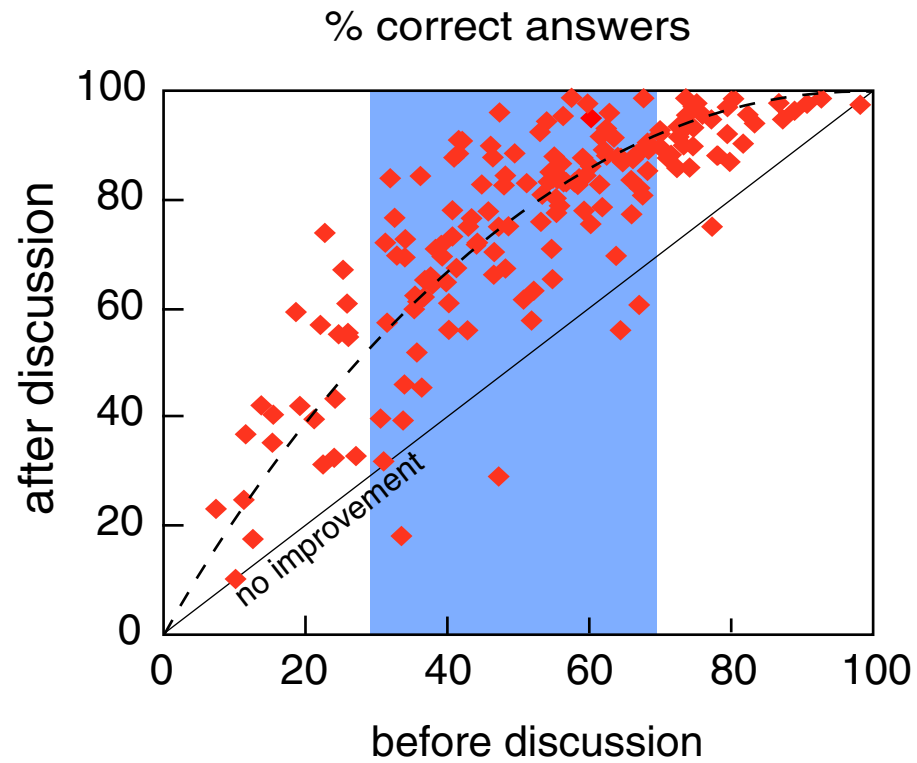
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## ConceptTest data



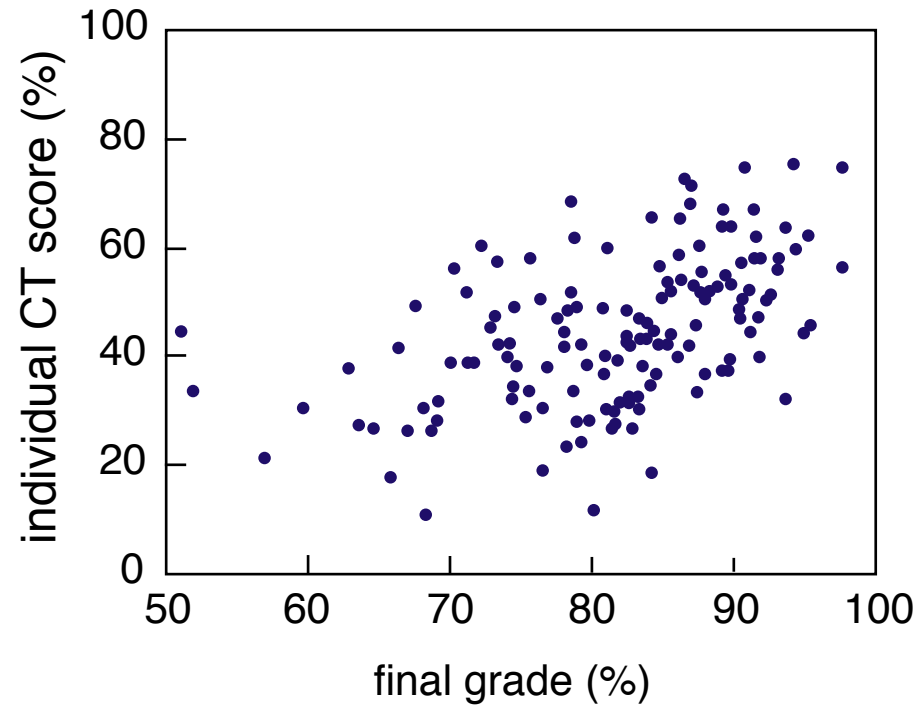
# Research: providing the basis for change

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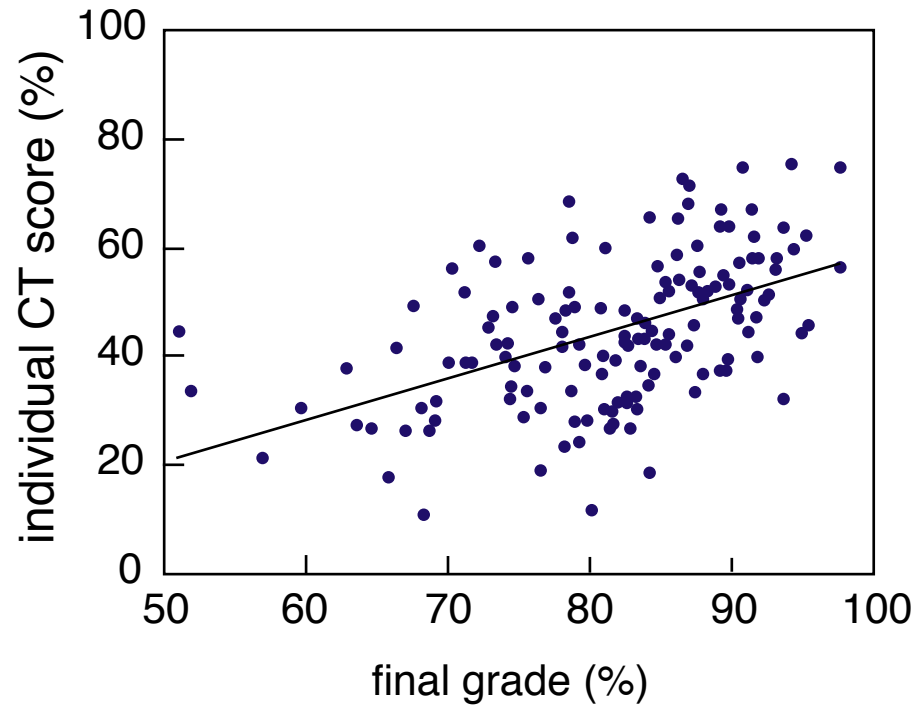
# Research: providing the basis for change

who benefits from the ConcepTests?



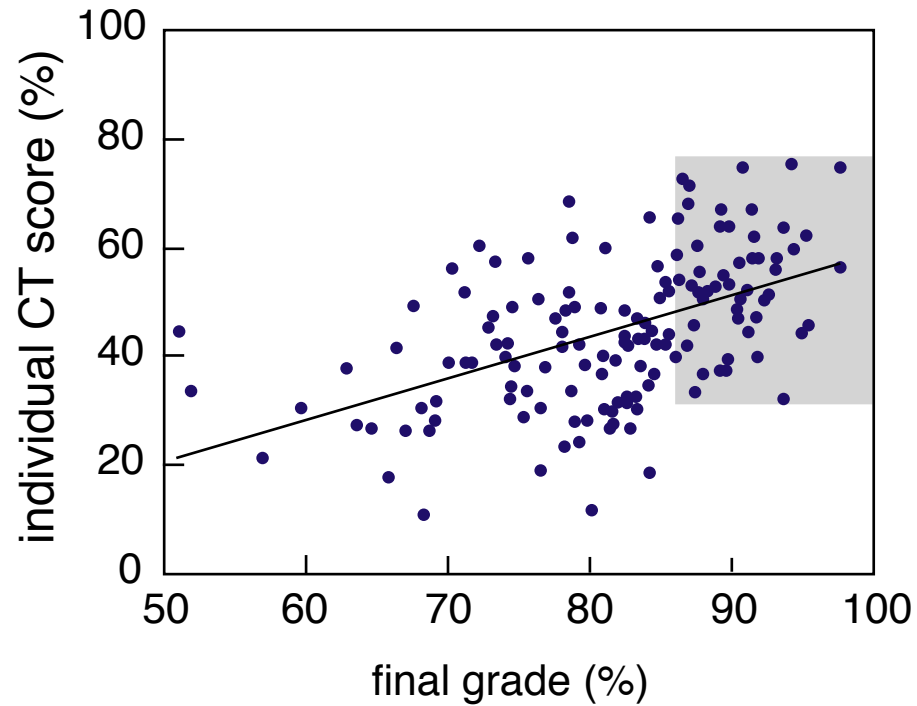
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# Research: providing the basis for change

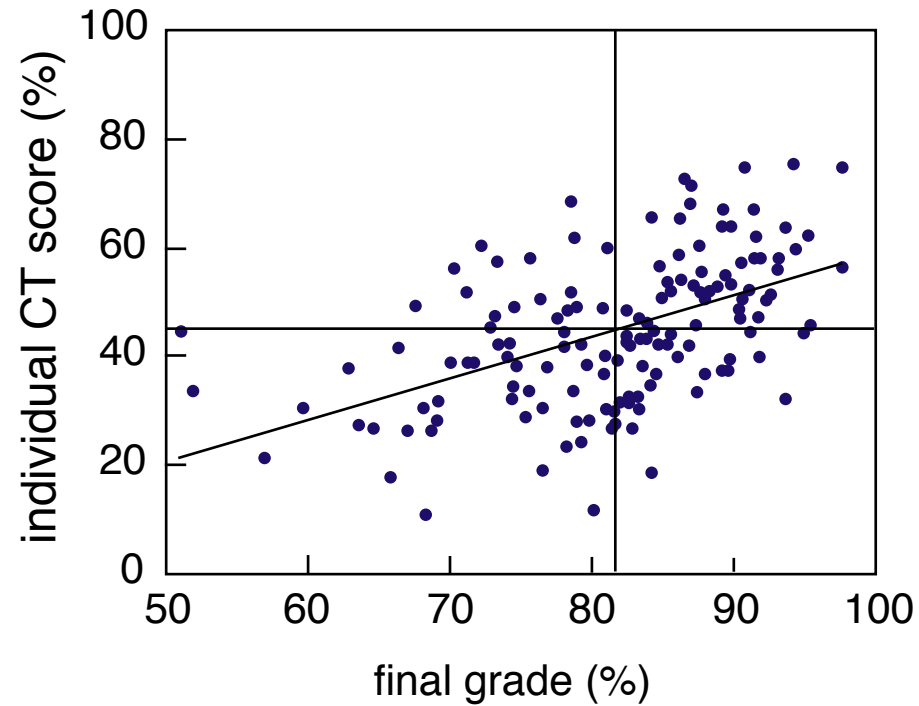
even the best students are challenged





# Research: providing the basis for change

even the best students are challenged



# Problems with problems

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.

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Requires:

Assumptions

Developing a model

Applying that model

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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.**

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

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**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



# Problems with problems

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

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

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Requires:

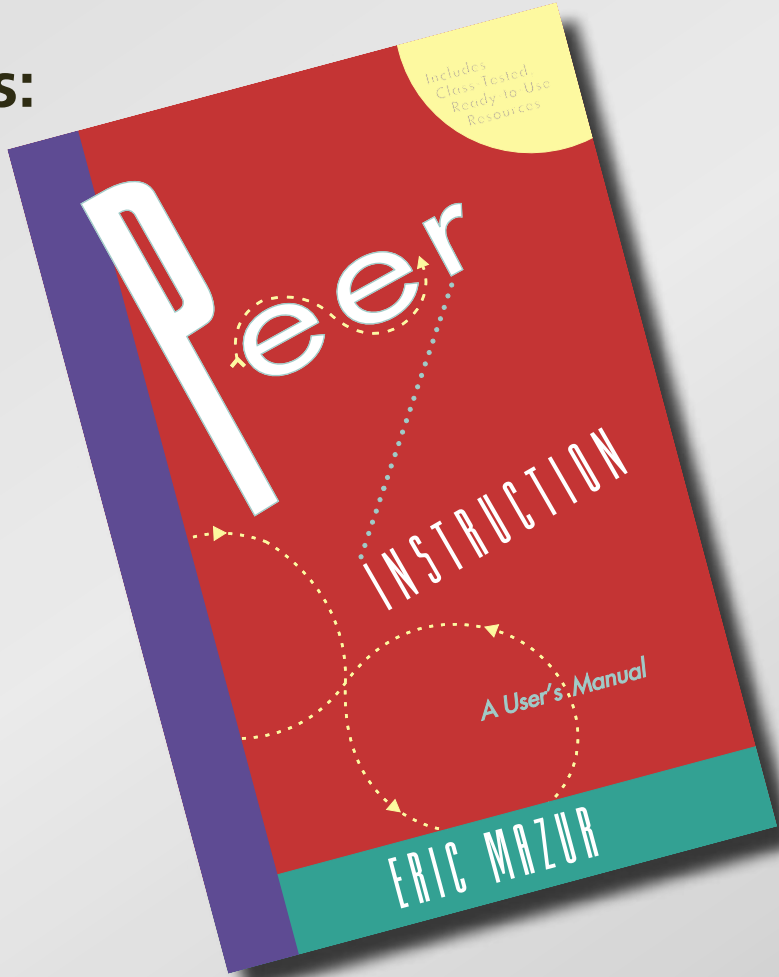
Using a calculator

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

# Resources

## Books with ConcepTests:

- Physics (Prentice Hall)



# Resources

## Books with ConcepTests:

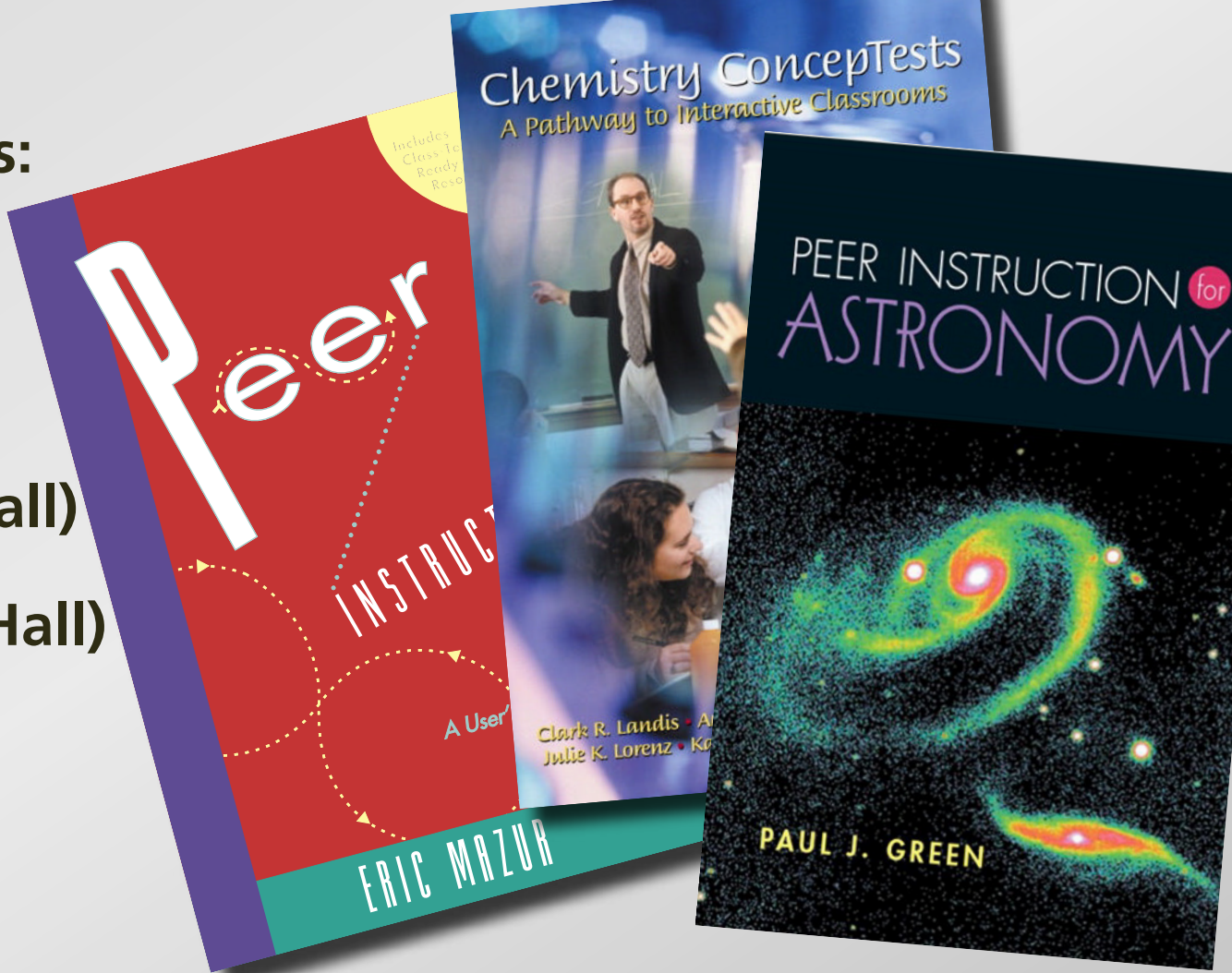
- Physics (Prentice Hall)
- Chemistry (Prentice Hall)



# Resources

## Books with ConcepTests:

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



# Resources

## Books with ConcepTests:

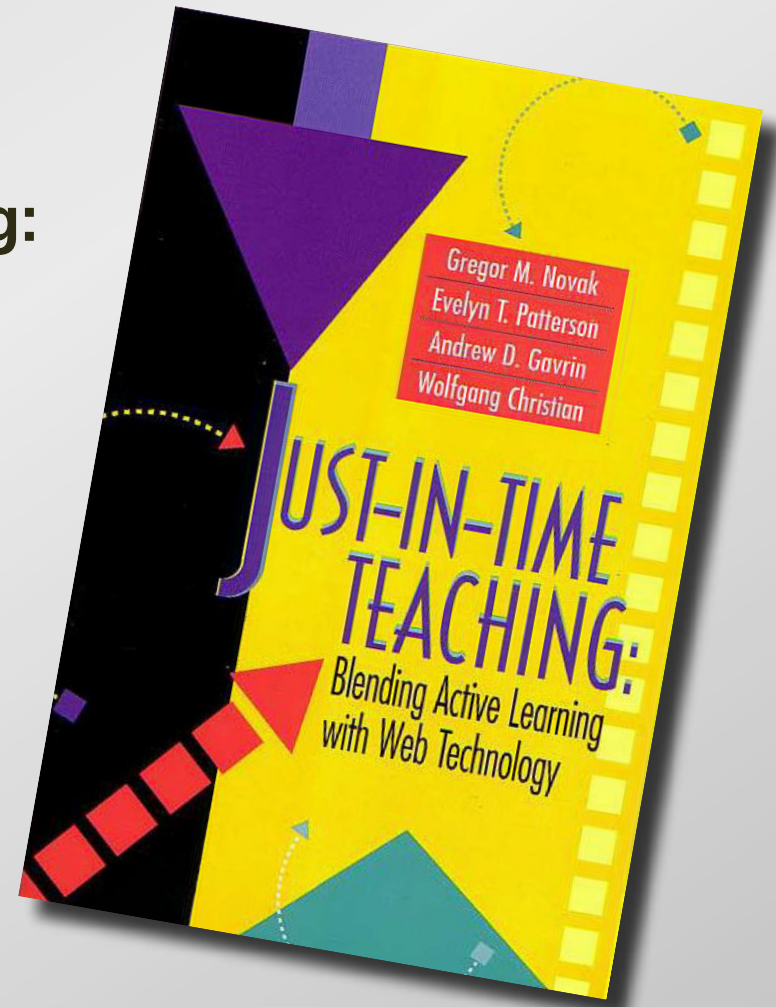
- Physics (Prentice Hall)
- Chemistry (Prentice Hall)
- Astronomy (Prentice Hall)
- Calculus (Wiley)



# Resources

## Information on Just-in-Time-Teaching:

- Prentice Hall book
- <http://www.jitt.org>

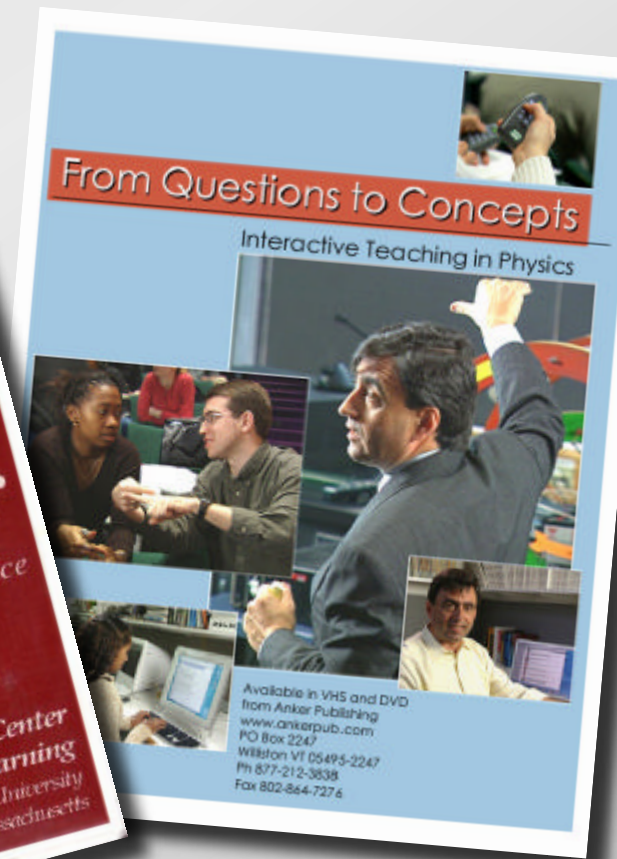




# Resources

## Videos:

- Thinking together
- From questions to concepts



<http://www.ankerpub.com>

# Resources

Course management:

<http://deas.harvard.edu/ilt>

The screenshot shows a web browser window titled "ILT: Manage" with the URL <http://www.conceptest.org>. The page is for "Physics 1b" and is logged in as "Eric Mazur". The navigation menu includes HOME, READING, LECTURES, ASSIGNMENTS, FORUMS, NEWS, and HANDOUTS. The current page is "Physics > Introductory Electromagnetism > Magnetism > CT: 3756" dated October 25, 2001. The problem text reads: "1. A permanent magnet is dropped through a long aluminum tube, as shown. As the magnet drops, electric currents are induced around the tube. Compared to a freely-falling magnet, the magnet through the tube drops". Below the text are two diagrams: the first shows a magnet falling through a tube with a magnetic field vector  $B$  pointing downwards; the second shows the magnet further down the tube with induced current loops. The multiple-choice options are: 1. more slowly, 2. exactly the same way, 3. faster, 4. Need more information. A hint suggests considering induced currents in strips ahead of and behind the magnet. The answer explains that the flux is increasing below the magnet, inducing a counterclockwise current that repels it, while the flux is decreasing above, inducing a clockwise current that attracts it, resulting in a net upward force that slows the magnet. The page footer includes copyright information for 2000 by Eric Mazur and a "Select Section" dropdown menu.

# Barriers to reform

## Challenges:

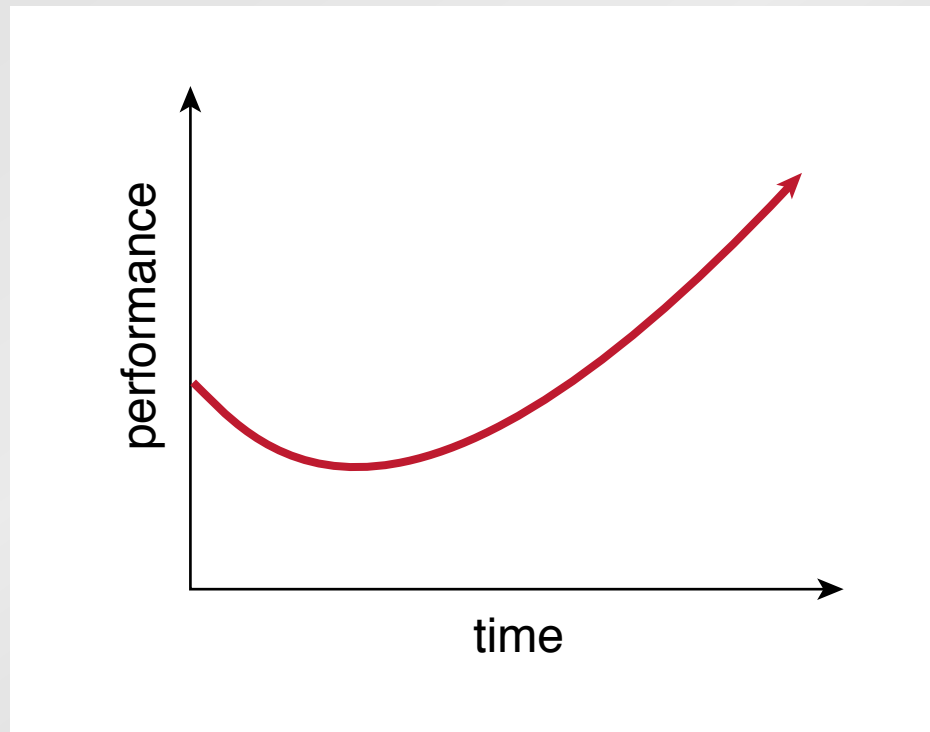
- **skepticism**
- **growing pains**
- **limited circle of influence**

# Barriers to reform

Two things to watch out for

# Barriers to reform

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



# Barriers to reform

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

(must recognize confusion as step towards understanding)

# Barriers to reform

**Things to do:**

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

# Barriers to reform

---

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



# Barriers to reform

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<b>learning</b>	<b>little</b>	<b>better</b>	
<b>retention</b>	<b>little</b>	<b>better</b>	

# Barriers to reform

---

	<b>"lectures"</b>	<b>PI</b>	<b>considered</b>
<b>coverage</b>	<b>complete</b>	<b>partial</b>	<b>requirement</b>
<b>preclass reading</b>	<b>none</b>	<b>cover everything</b>	<b>hurdle</b>
<b>confusion</b>	<b>little none</b>	<b>substantial</b>	<b>problem</b>
<b>evaluations</b>	<b>known</b>	<b>unknown</b>	<b>important</b>
<b>learning</b>	<b>little</b>	<b>better</b>	
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# Barriers to reform

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<b>confusion</b>	<b>little none</b>	<b>substantial</b>	<b>problem</b>
<b>evaluations</b>	<b>known</b>	<b>unknown</b>	<b>important</b>
<b>learning</b>	<b>little</b>	<b>better</b>	<b>not measured</b>
<b>retention</b>	<b>little</b>	<b>better</b>	<b>not part of grade</b>

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