

# Engaging students one-on-one



Includes  
Class-Tested,  
Ready-to-Use  
Resources

# Peer

INSTRUCTION

A User's Manual

## ERIC MAZUR



2015 Transformative Learning Conference  
University of Central Oklahoma  
Oklahoma City, OK, 26 March 2015

# Engaging students one-on-one



@eric\_mazur

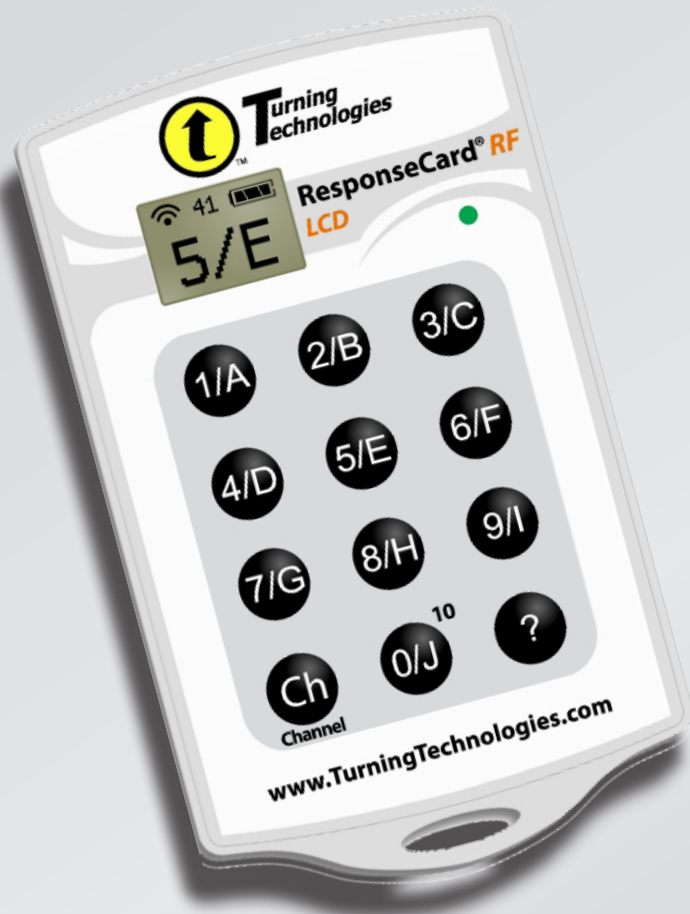


2015 Transformative Learning Conference  
University of Central Oklahoma  
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ERIC MAZUR

# Get your clickers ready!



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



# Get your clickers ready!



[www.TurningTechnologies.com](http://www.TurningTechnologies.com)



# Get your clickers ready!



unique ID on back of clicker

# Quick survey...

## Peer Instruction...

1. Never heard of it.
2. Heard of it, but don't really know what it is.
3. Quite familiar with it.
4. I heard you speak about it so often, I could give your talk

# Quick survey...

## Peer Instruction...

1. Never heard of it.
2. Don't use it in my classes, but I'm open to it.
3. Considering using it in my classes.
4. I have used it it in my classes a few times only.
5. I use it regularly in my classes.



# 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



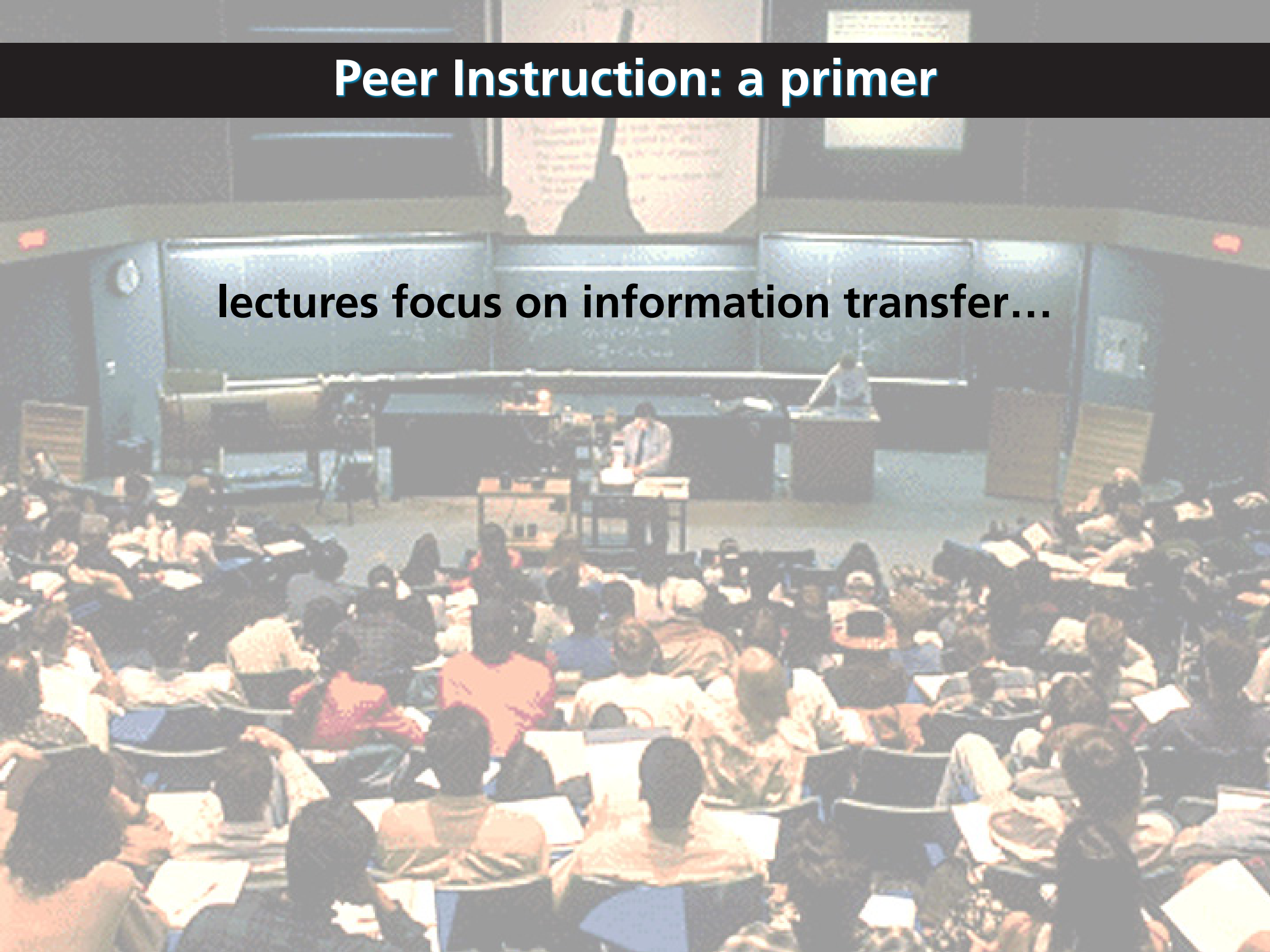


# How we teach...



# Peer Instruction: a primer

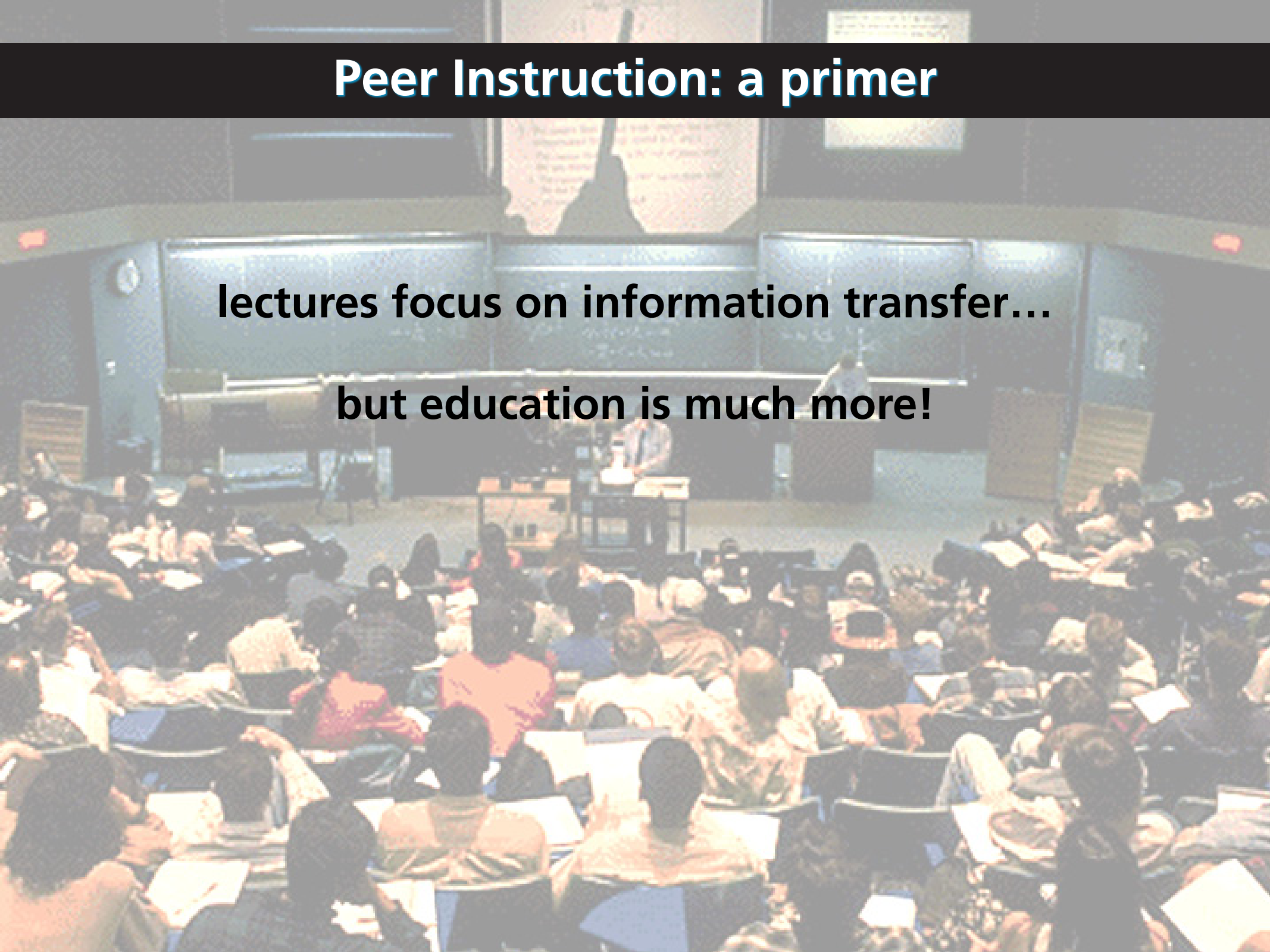
lectures focus on information transfer...



# Peer Instruction: a primer

lectures focus on information transfer...

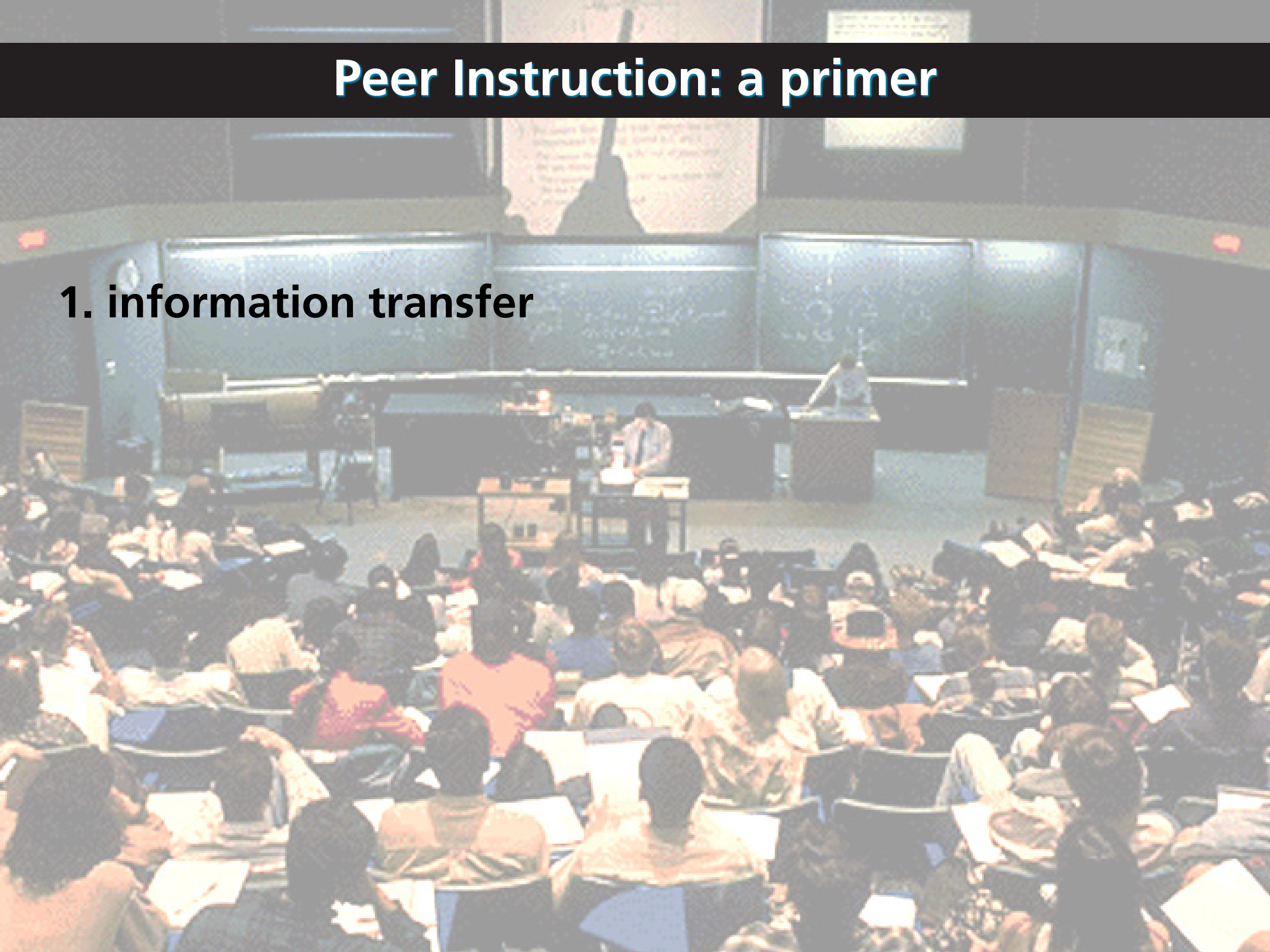
but education is much more!





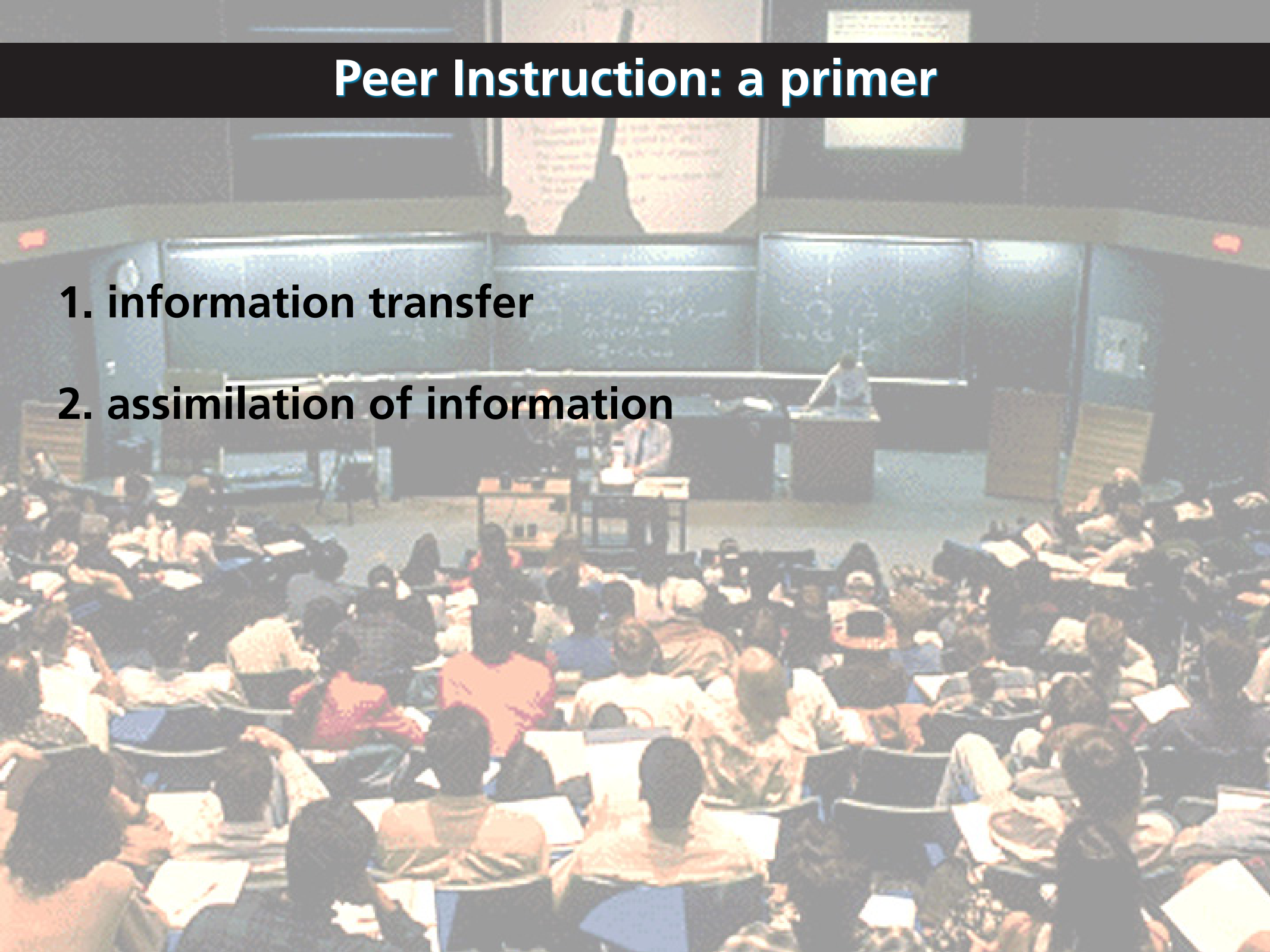
# Peer Instruction: a primer

## 1. information transfer



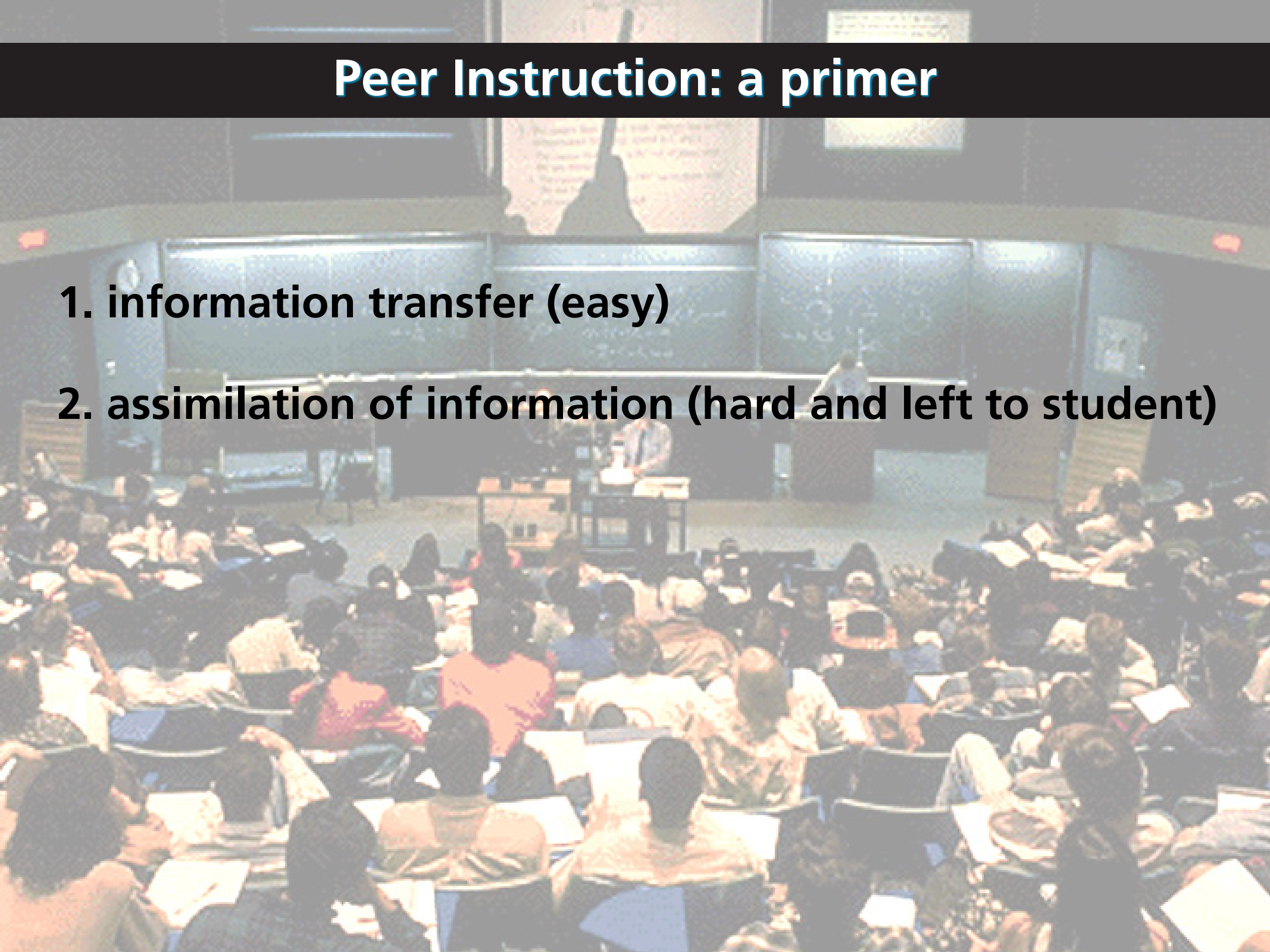
# Peer Instruction: a primer

1. information transfer
2. assimilation of information



# Peer Instruction: a primer

1. information transfer (easy)
2. assimilation of information (hard and left to student)



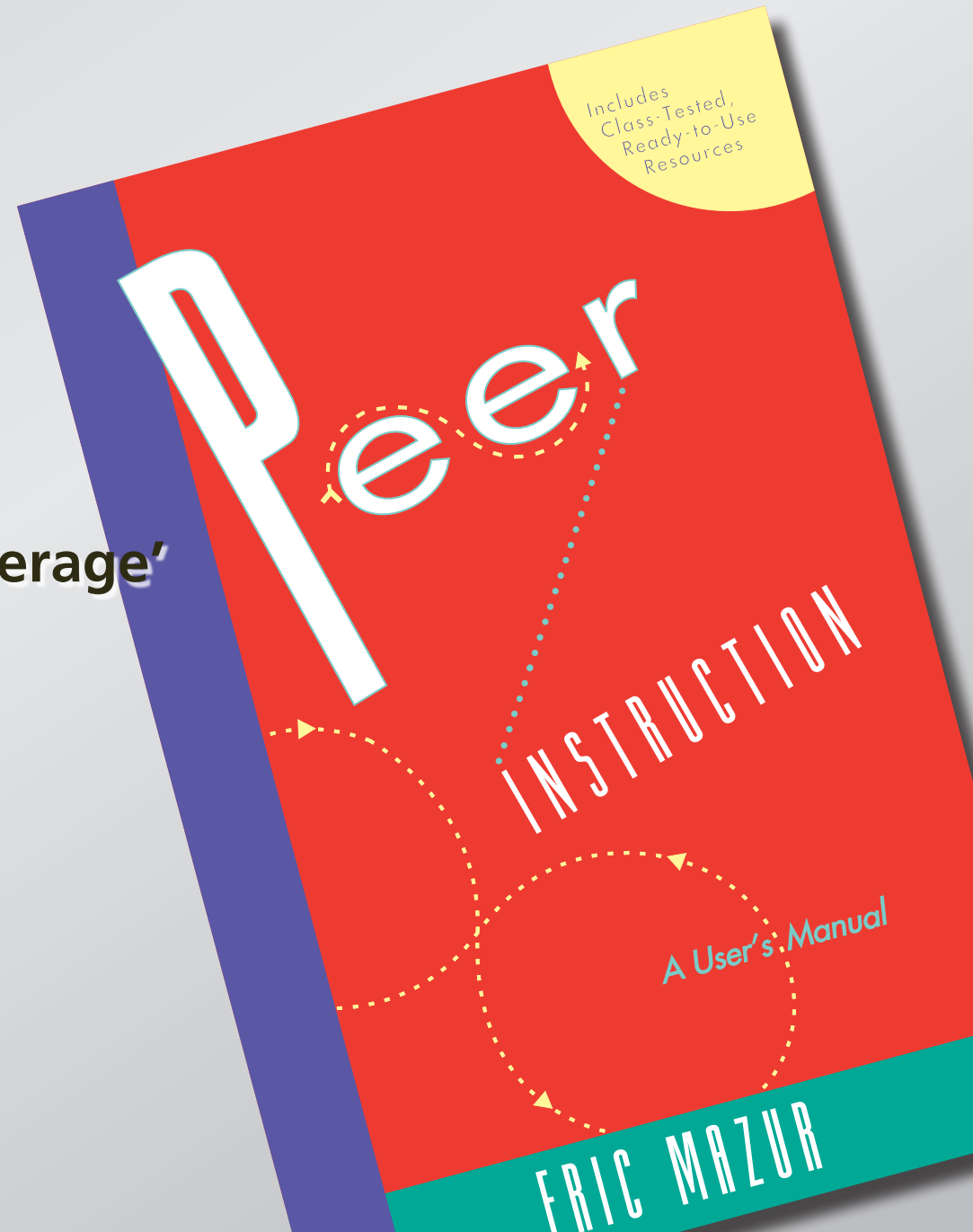
# Peer Instruction: a primer

**Solution: move information transfer out of classroom!**

# Peer Instruction: a primer

## Main features:

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

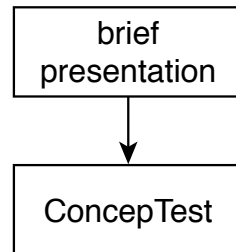




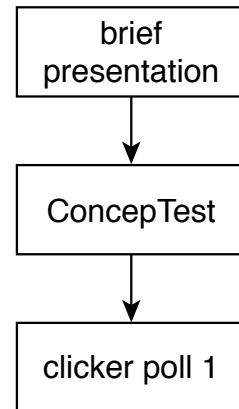
# Peer Instruction: a primer

brief  
presentation

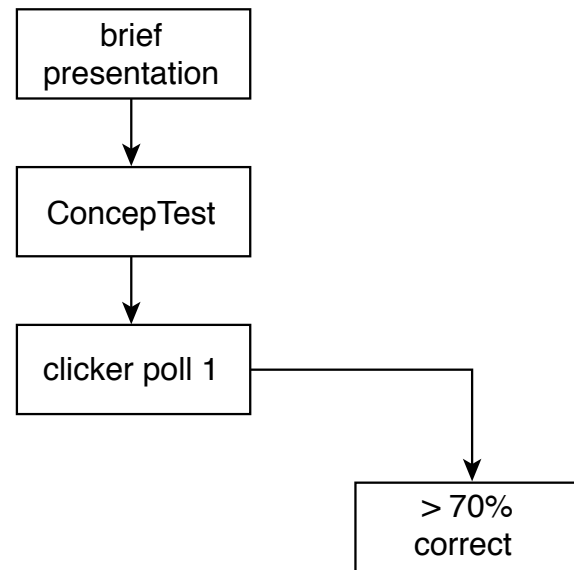
# Peer Instruction: a primer



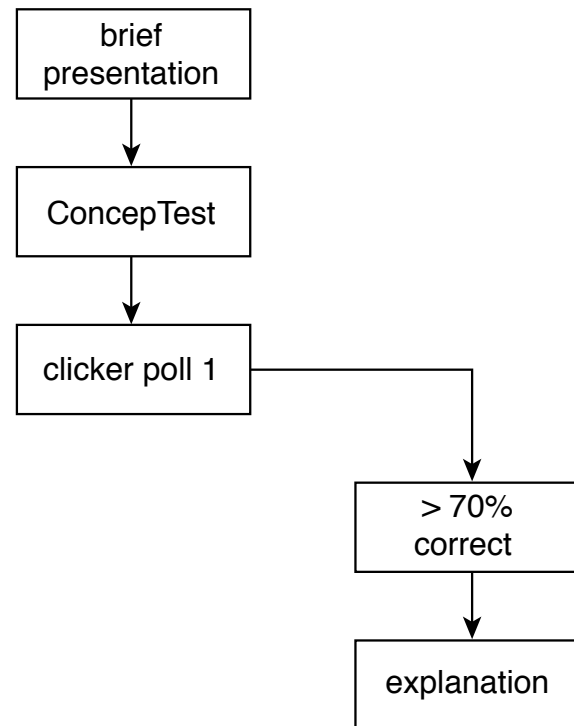
# Peer Instruction: a primer



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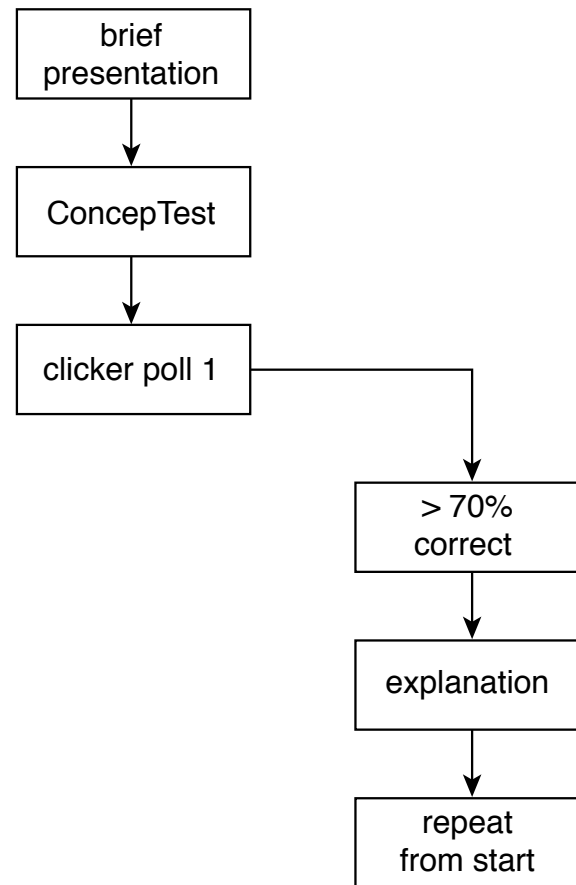


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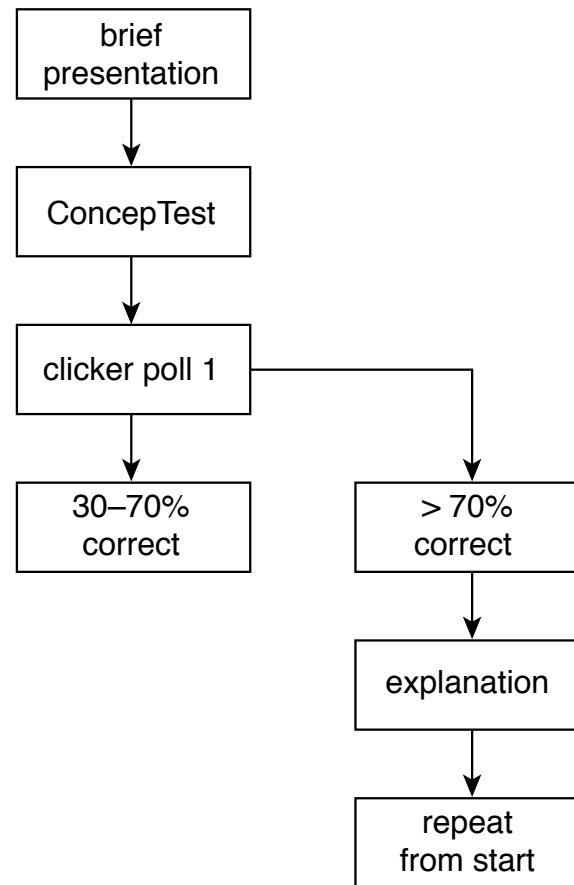




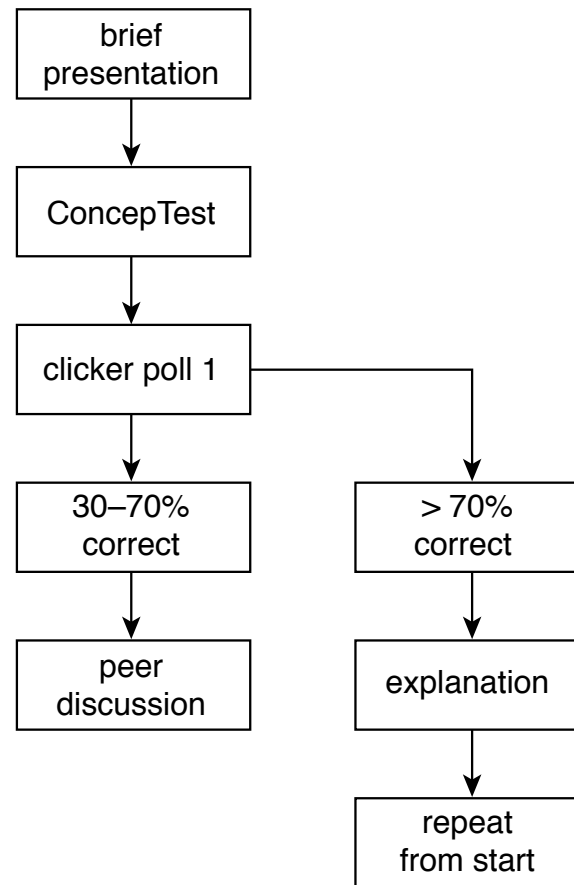
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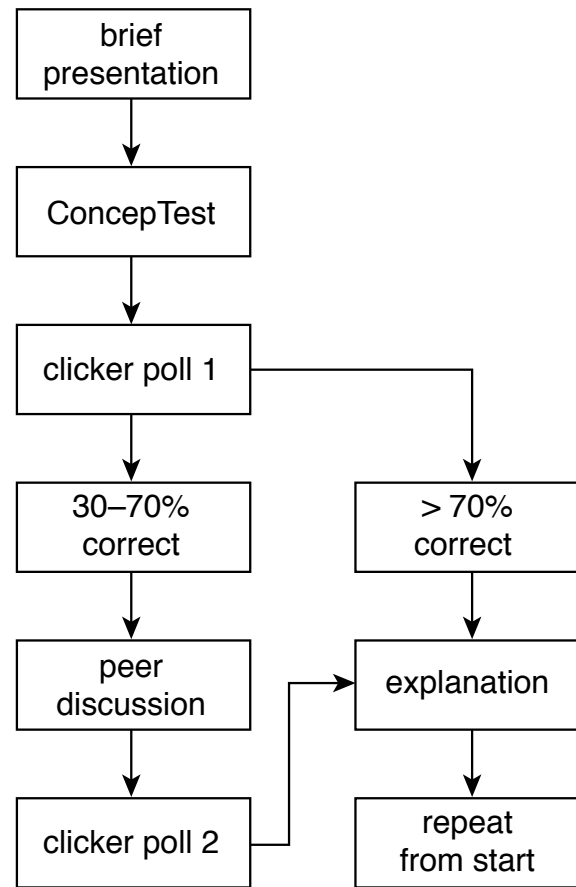
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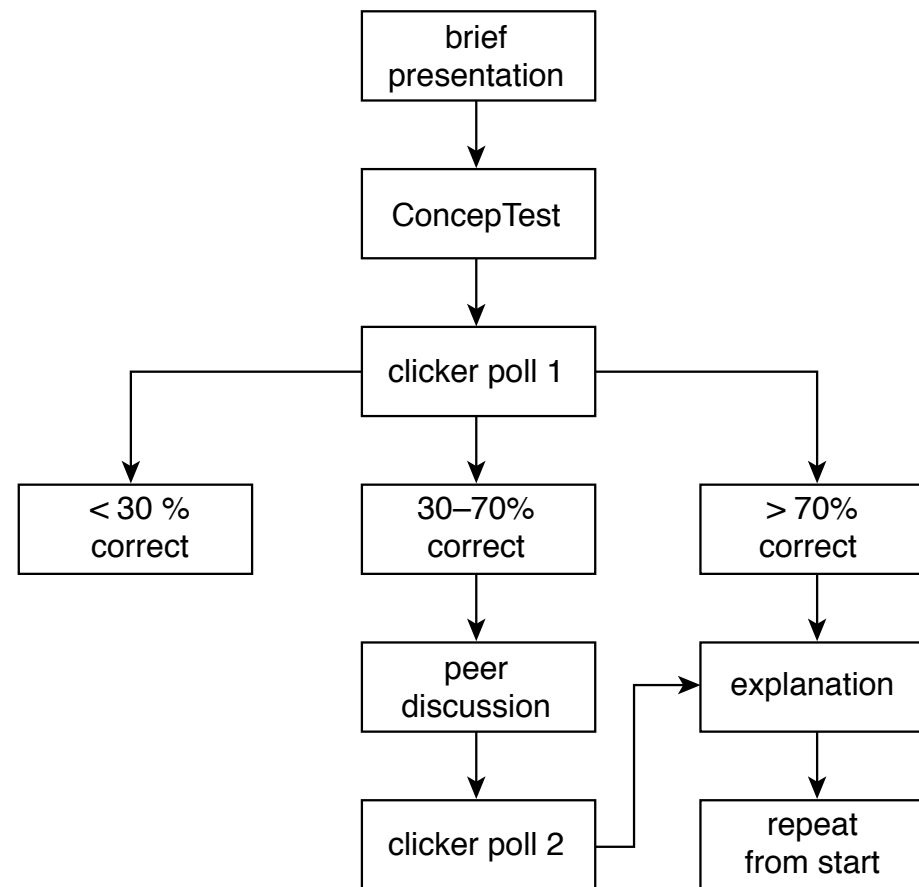
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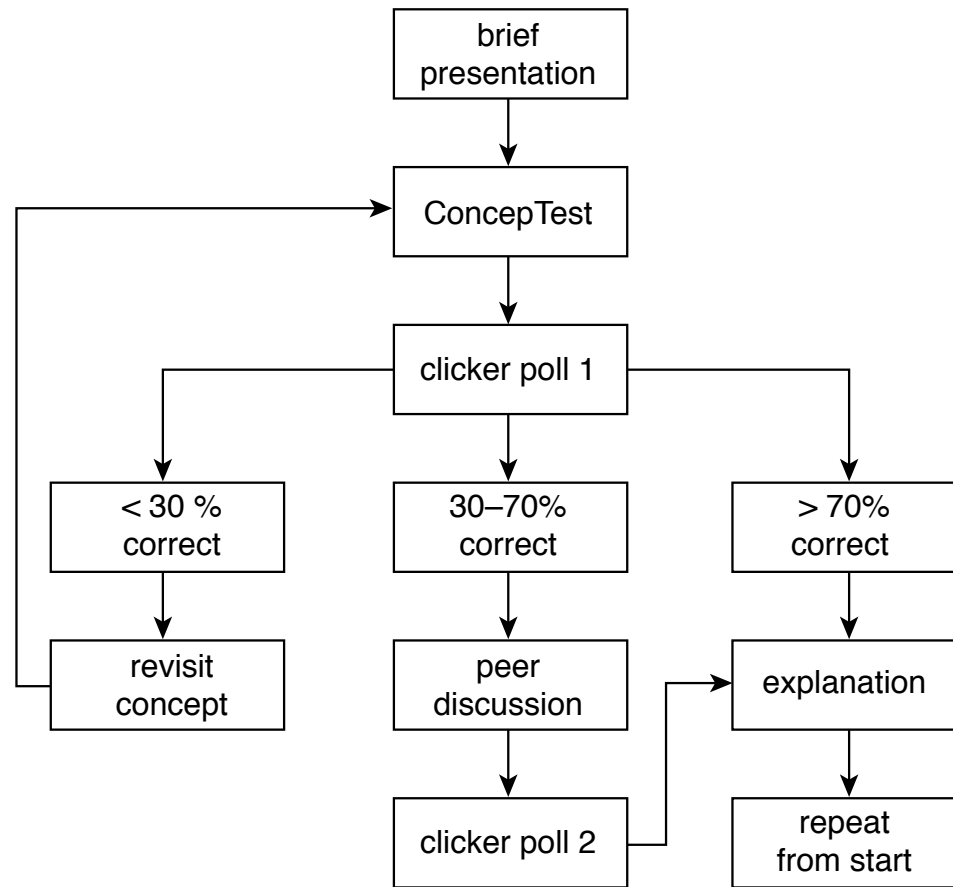


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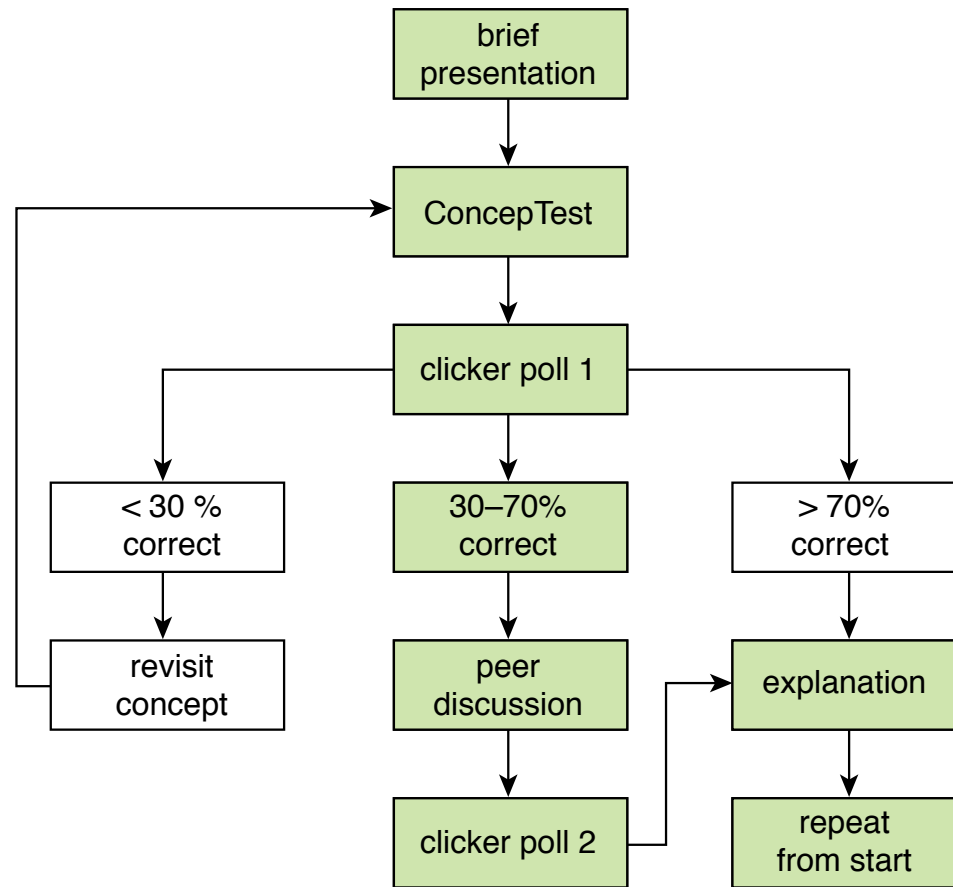




# Peer Instruction: a primer



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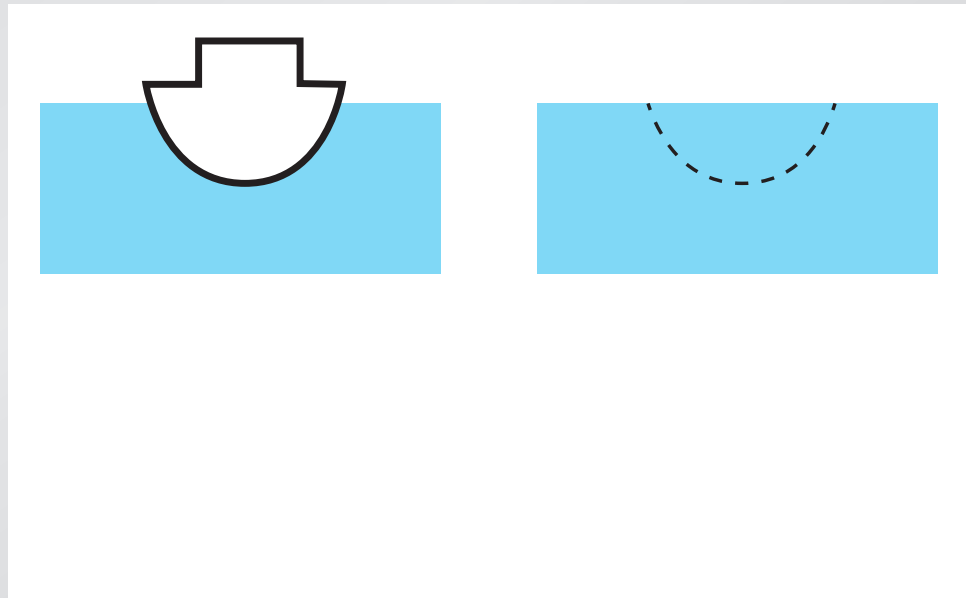


**Let's try it!**

**Archimedes Principle**

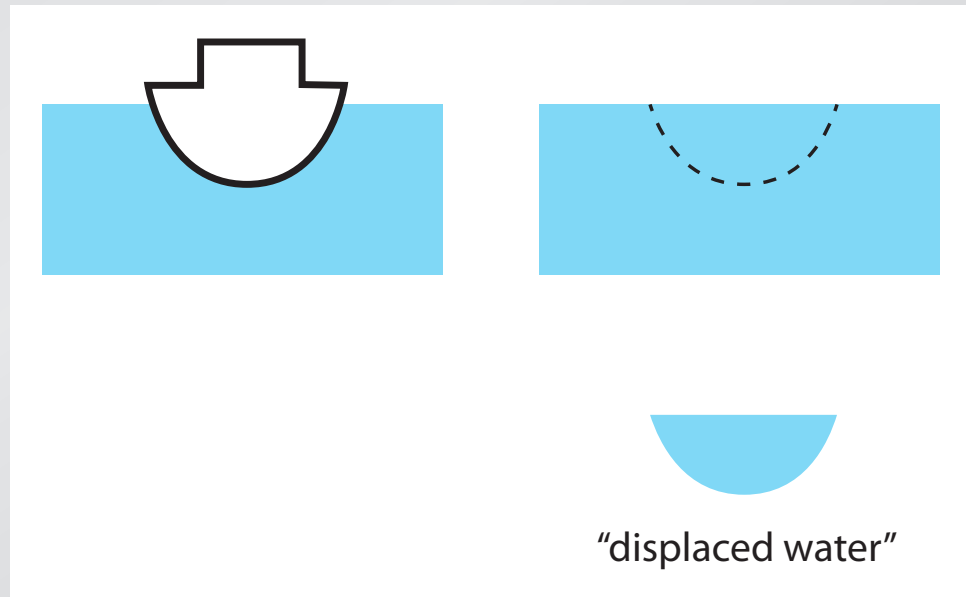
# Let's try it!

An object submerged either fully or partially in a fluid experiences an upward buoyant force the magnitude of which is equal to the magnitude of the force of gravity exerted on the fluid displaced by the object. The volume of displaced fluid is equal to the volume of the submerged portion of the object.



# Let's try it!

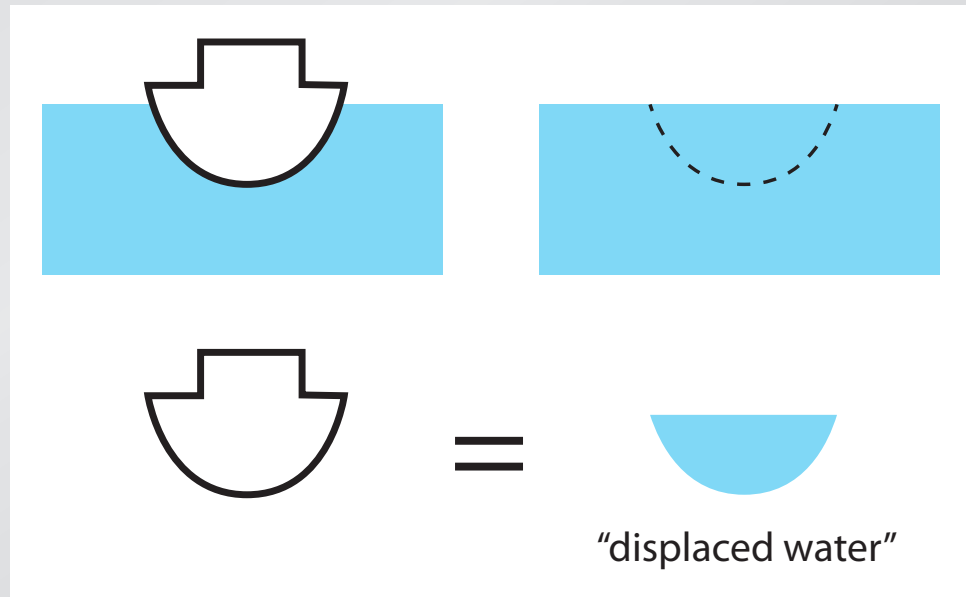
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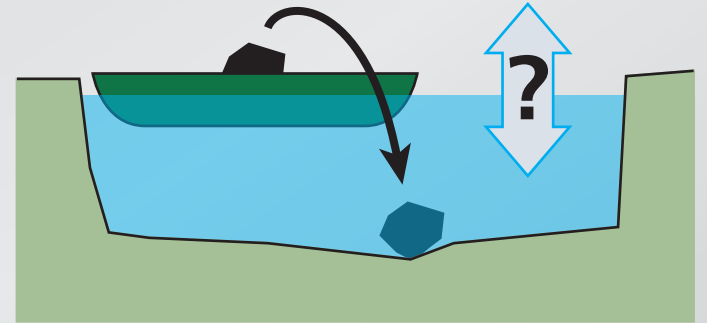
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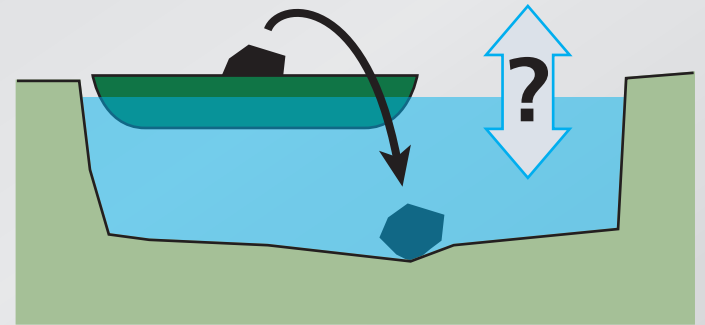
# Let's try it!

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!

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

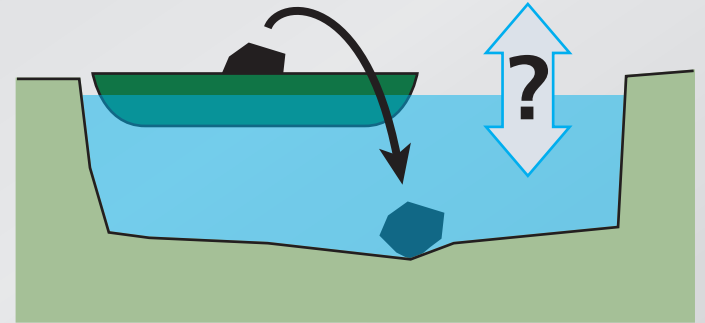
1. higher than
2. the same as
3. lower than

it was when the boulder was in the boat.



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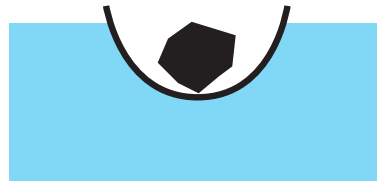
1. higher than
2. the same as
3. lower than ✓

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# Let's try it!

remember: amount of displaced water



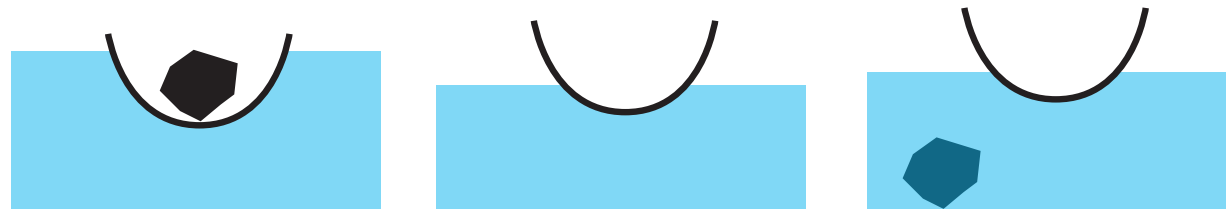
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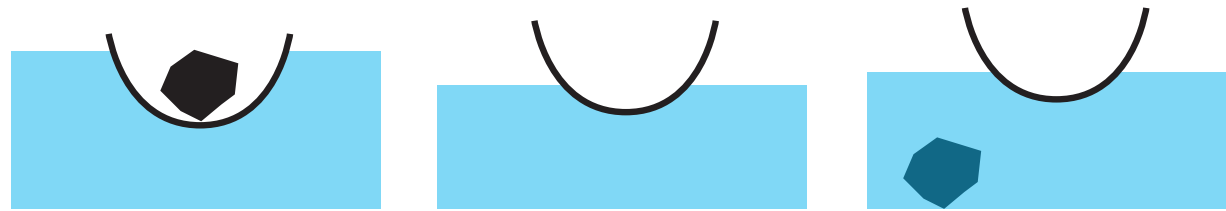
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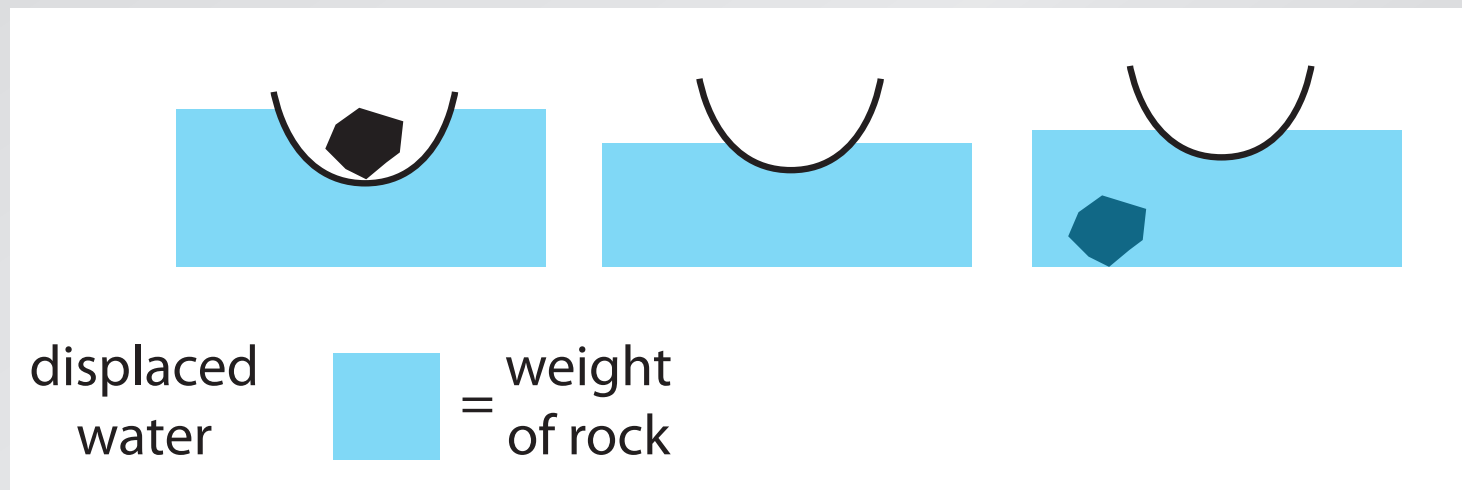


displaced  
water



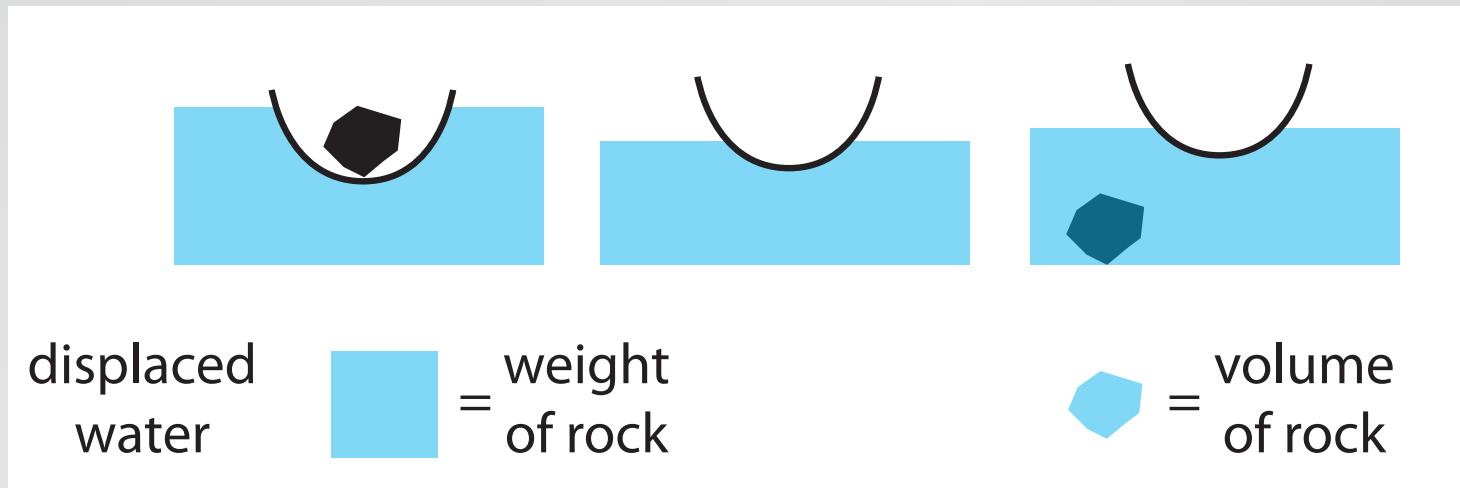
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# Frequently Asked Questions

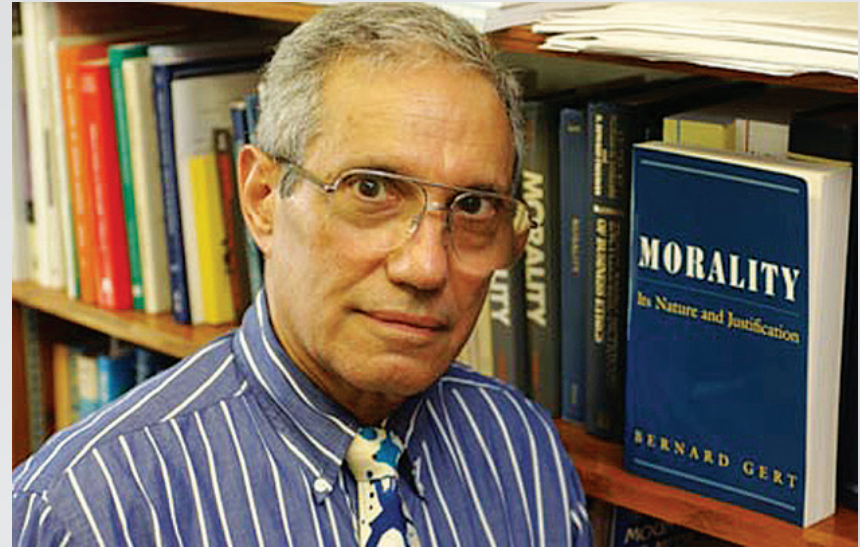
*“Can this method be used in my class,  
where questions don’t necessarily have right answers?”*

# Let's try it!

**Bernard Gert (1934 – 2011)**

**Moral philosopher**

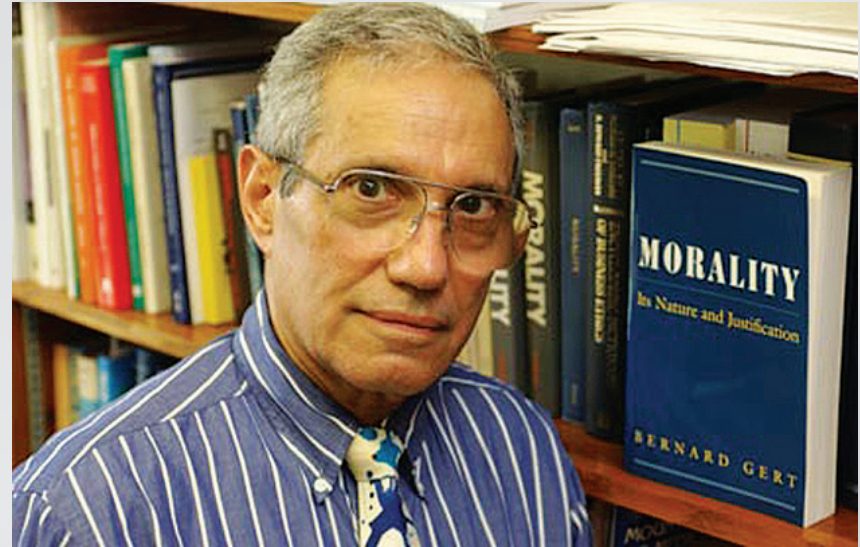
**Professor at Dartmouth**



# Let's try it!

**Bernard Gert (1934 – 2011)**

**Moral philosopher  
Professor at Dartmouth**



**“Morality is an informal public system applying to all rational persons, governing behavior that affects others, and includes what are commonly known as the moral rules, ideals, and virtues and has the lessening of evil or harm as its goal.”**

# Let's try it!

**Bernard Gert's moral system created by 10 rules:**

- 1. Do not kill**
- 2. Do not cause pain**
- 3. Do not disable**
- 4. Do not deprive of freedom**
- 5. Do not deprive of pleasure**
- 6. Do not deceive**
- 7. Keep your promises**
- 8. Do not cheat**
- 9. Obey the law**
- 10. Do your duty (as required by job, circumstances).**

# Let's try it!

Heinz's wife was near death, and her only hope was a drug that had been discovered by a pharmacist who was selling it for an exorbitant price. The drug cost \$20,000 to make, and the pharmacist was selling it for \$200,000. Heinz could only raise \$50,000 and insurance wouldn't make up the difference. He offered what he had to the pharmacist, and when his offer was rejected, Heinz said he would pay the rest later. Still the pharmacist refused. In desperation, Heinz broke into the store and stole the drug.

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Should Heinz have broken into the store to steal the drug for his wife?



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**Should Heinz have broken into the store to steal the drug for his wife?**

- 1. Yes**
- 2. No**



# Let's try it!

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Should Heinz have broken into the store to steal the drug for his wife?

1. Yes
2. No

**you got all engaged!**

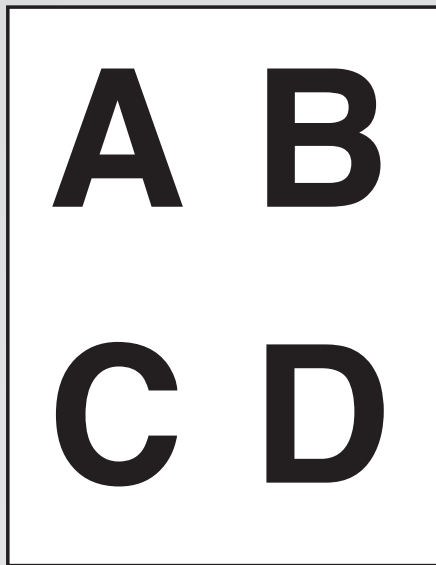


# Frequently Asked Questions

*“Do I need clickers?”*

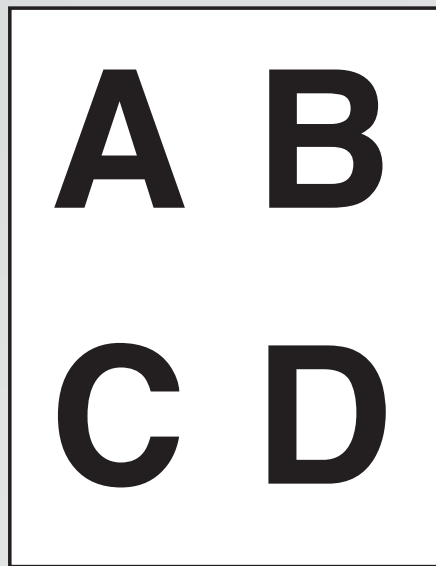
# Clickers necessary?

Flashcards: simple and effective



# Clickers necessary?

Flashcards: simple and effective



Meltzer and Mannivanan, South Eastern Louisiana University

# Clickers necessary?

circumference

# Clickers necessary?

circumference

of a circle of radius  $R$  is  $2\pi R$



# Clickers necessary?

Imagine a rope that fits snugly along the equator.



# Clickers necessary?

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. about 0.15 m
4. exactly 1 m
5. more than 1 m



# Clickers necessary?

*You all got fired up!*

# Clickers necessary?

*You all got fired up!*

**(WITHOUT CLICKERS!)**

# Clickers necessary?

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# Clickers necessary?

circumference at the equator:

$$2\pi R_E$$

# Clickers necessary?

circumference at the equator:

$$2\pi R_E$$

new circumference:

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



# Clickers necessary?

circumference at the equator:

$$2\pi R_E$$

new circumference:

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

radius of circle with new circumference:

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

# Clickers necessary?

**It's not the technology, but the pedagogy!**

# Clickers necessary?

**It's not the technology, but the pedagogy!**

**(but clickers do offer advantages)**

It works here...



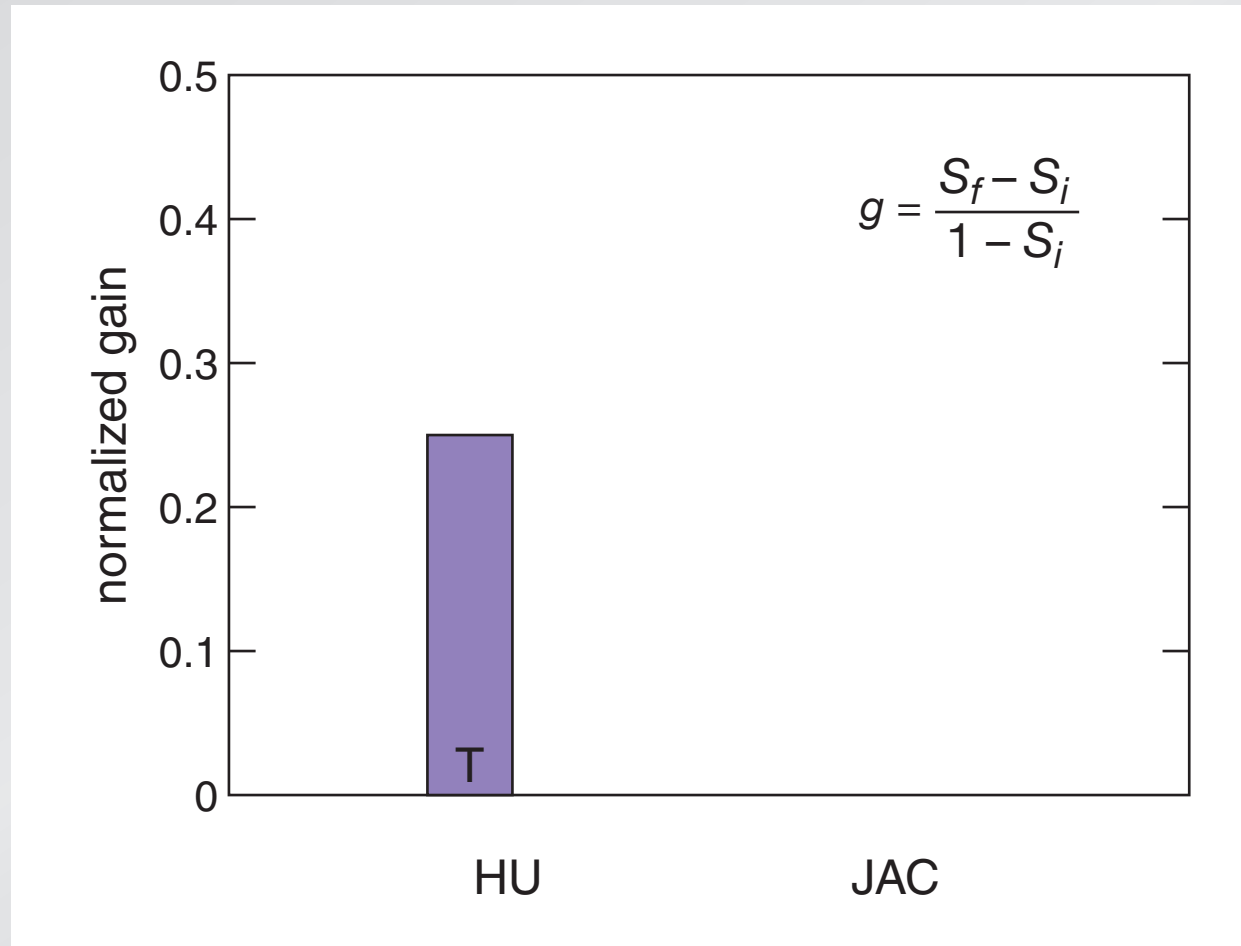


...but will it work here?



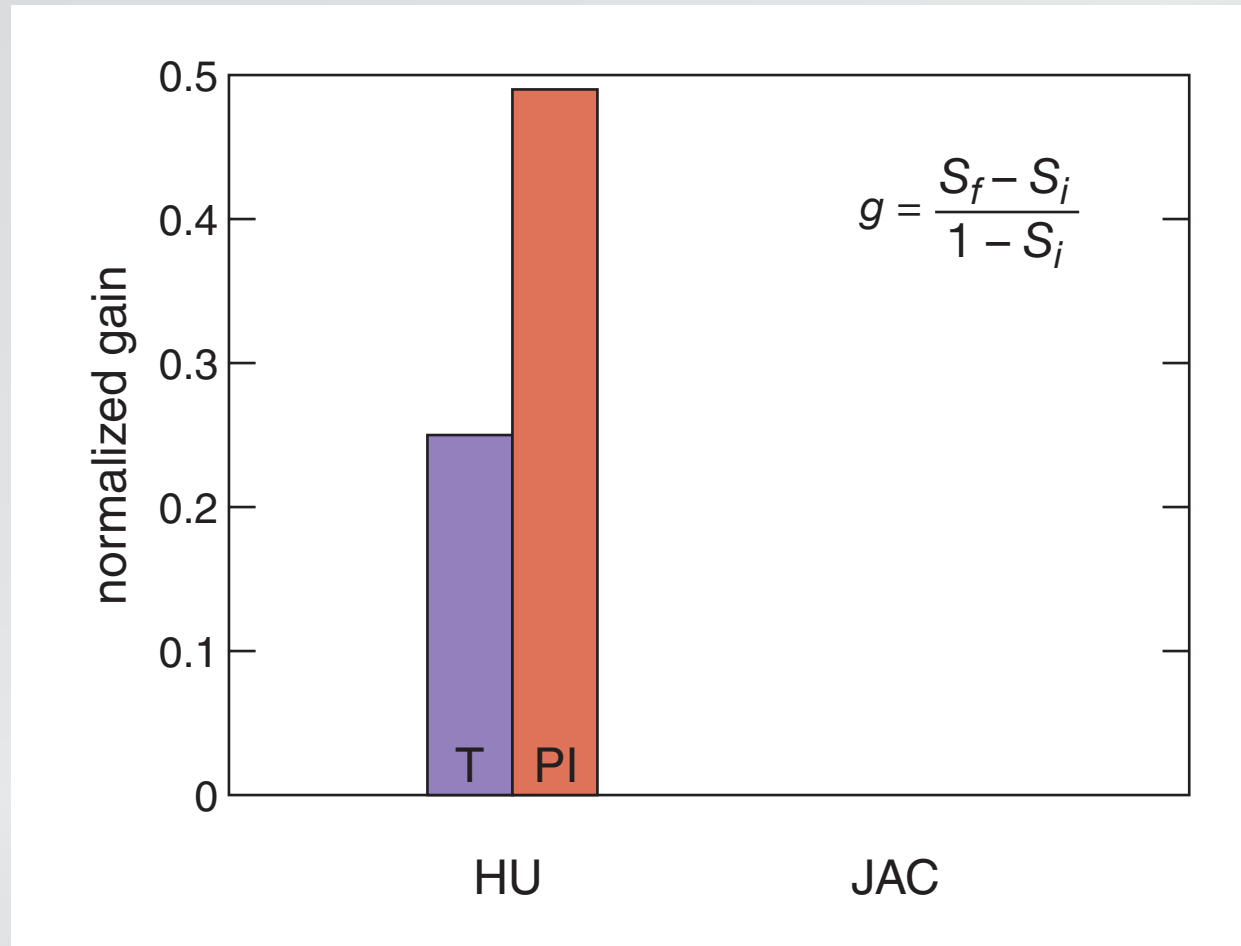
# Will it work at my institution?

## FCI normalized gain



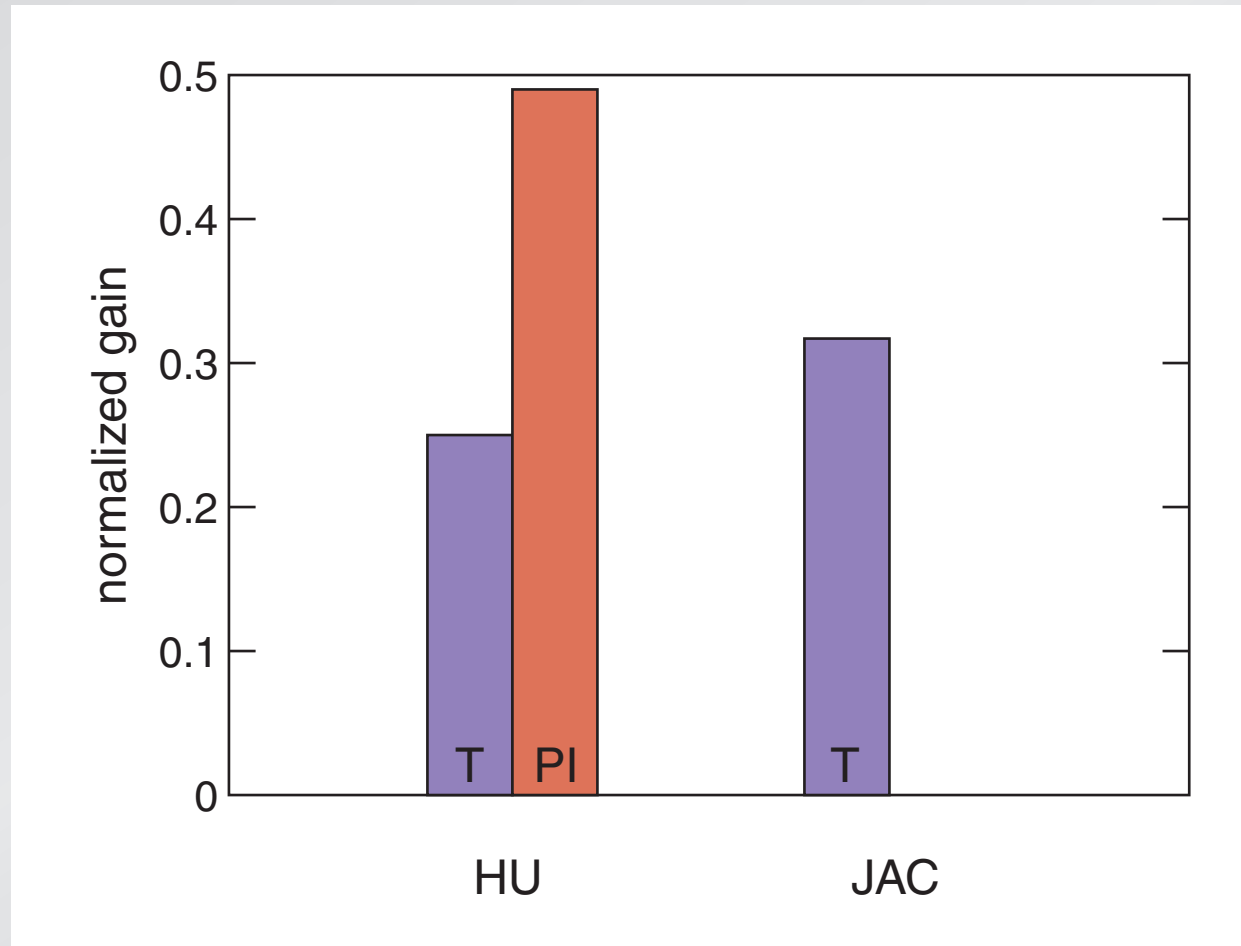
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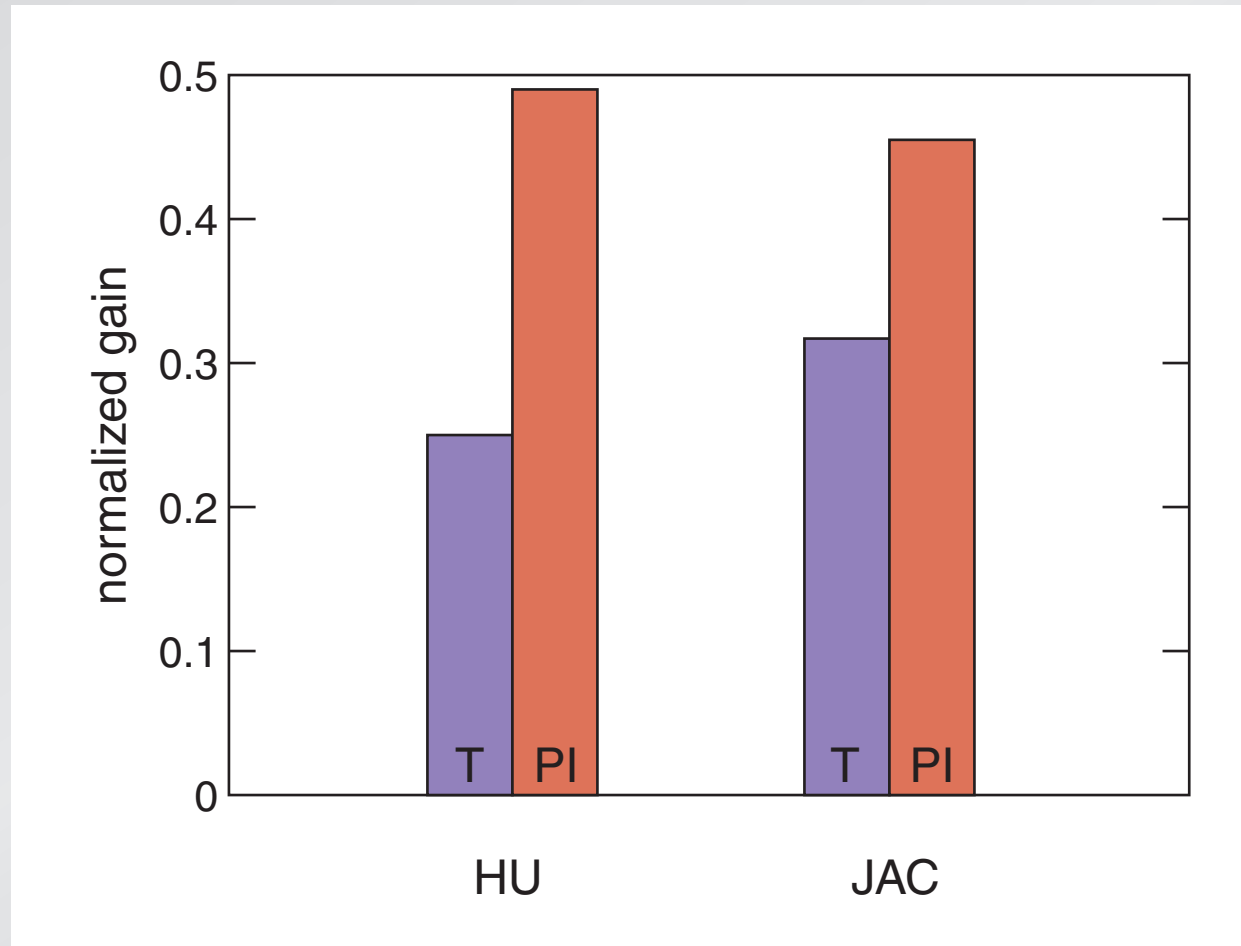
## FCI normalized gain





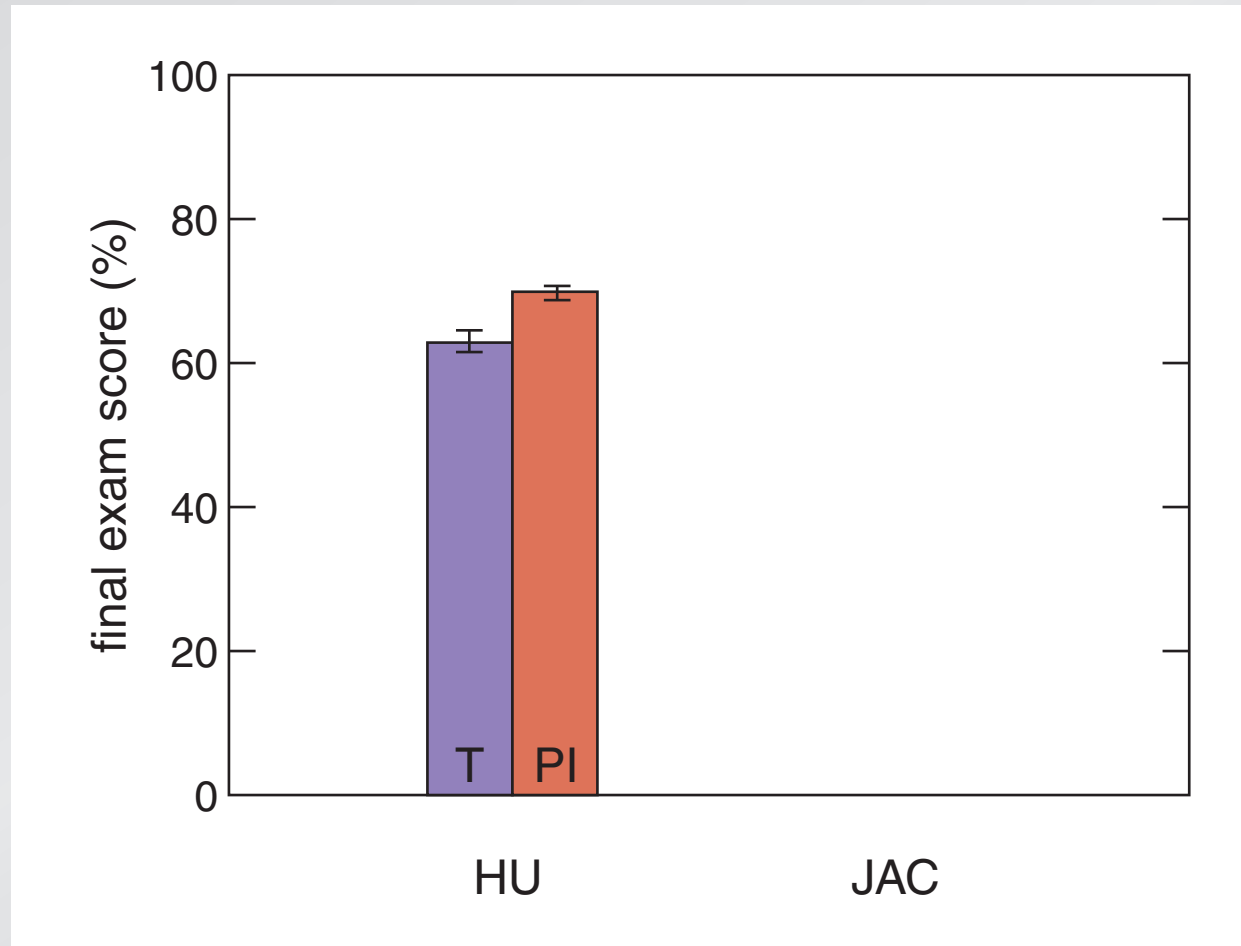
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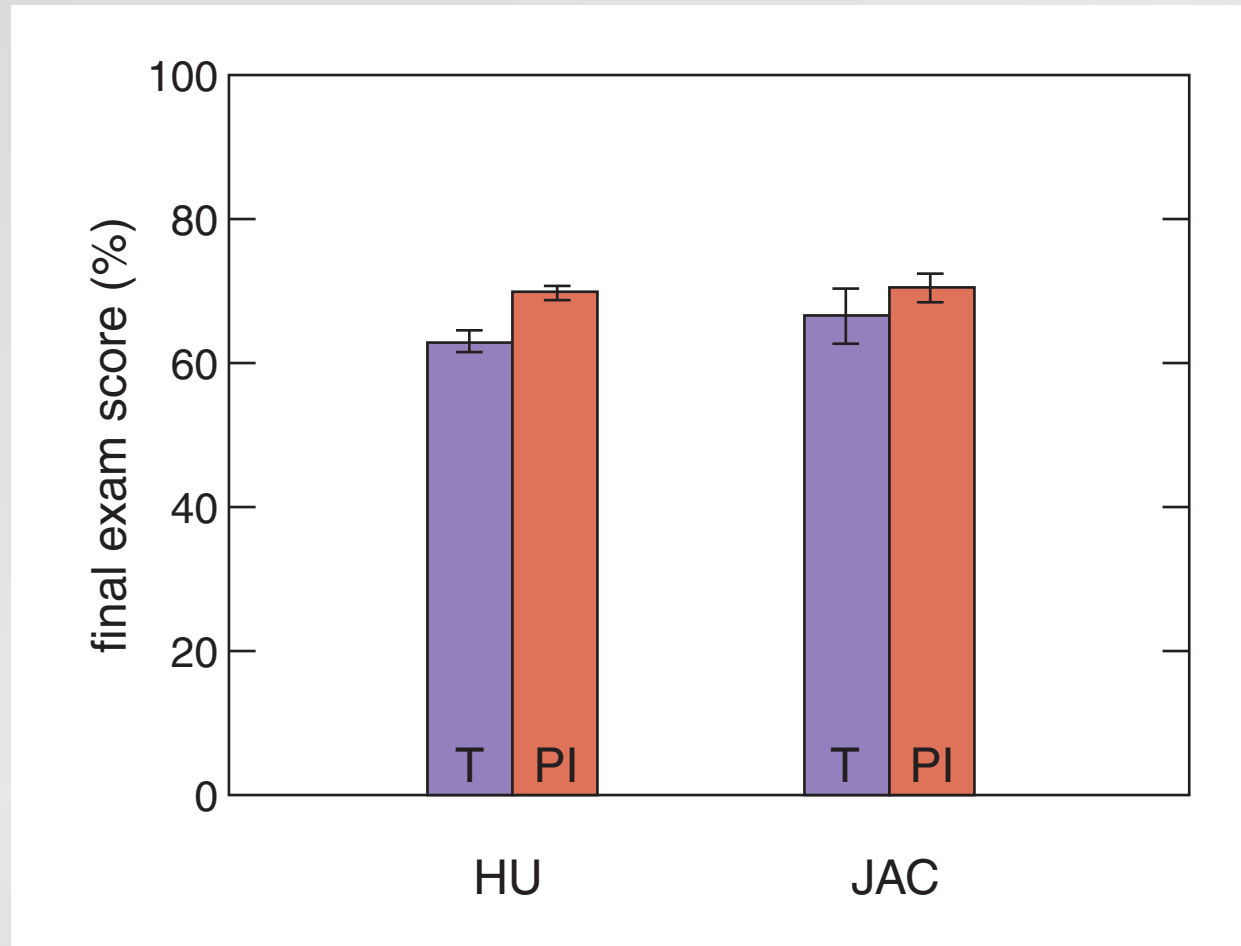
# Will it work at my institution?

exam performance



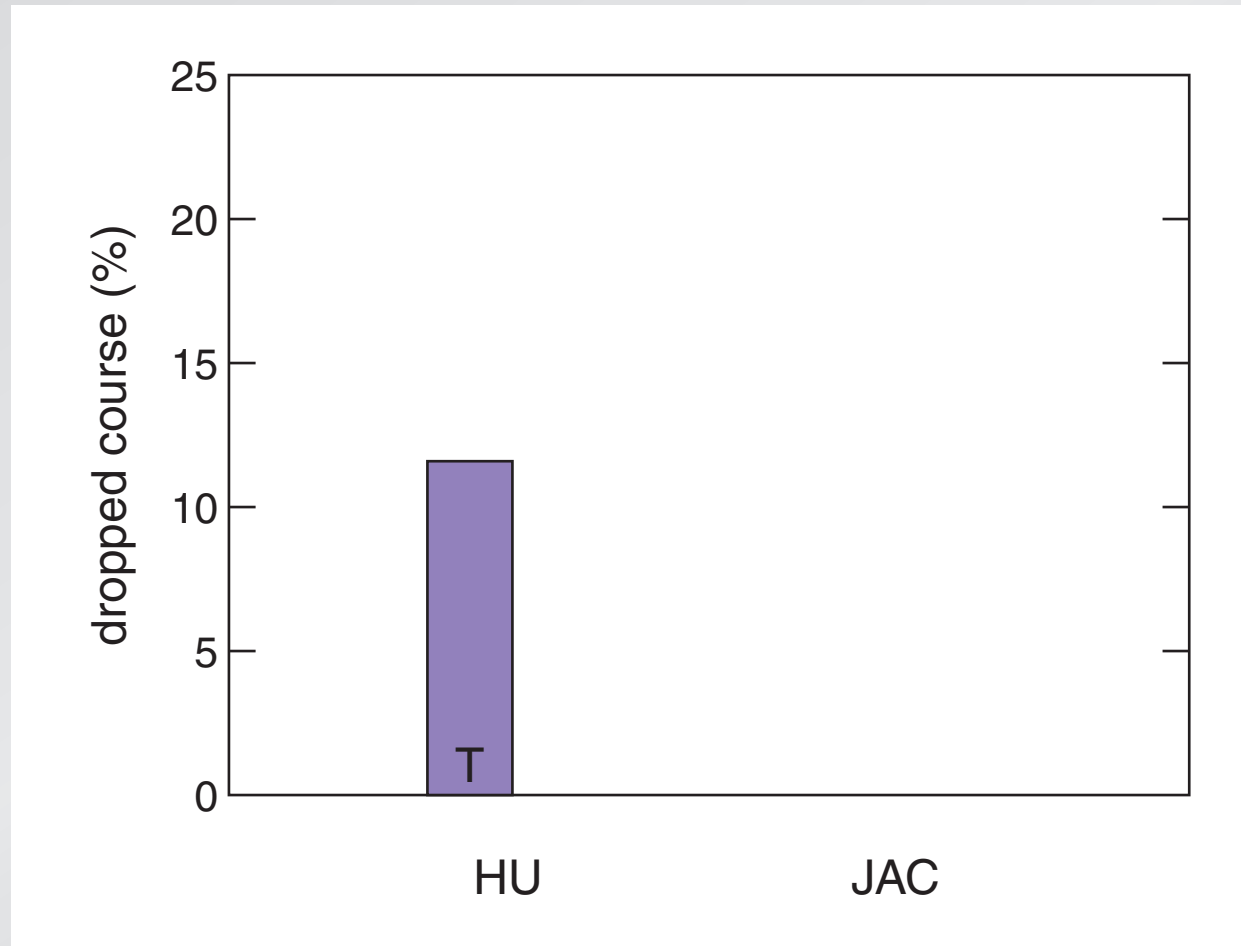
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exam performance



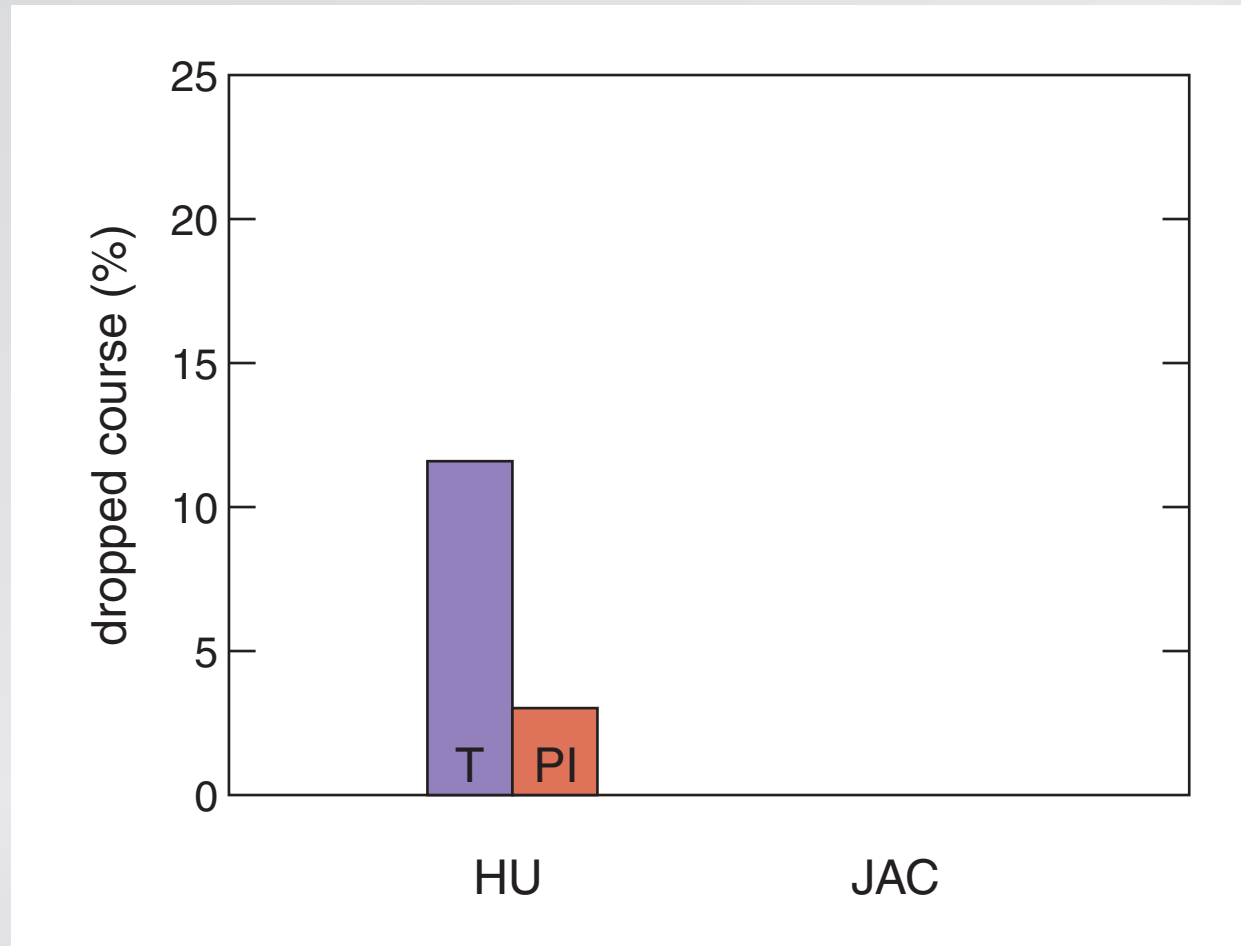
# Will it work at my institution?

## student retention



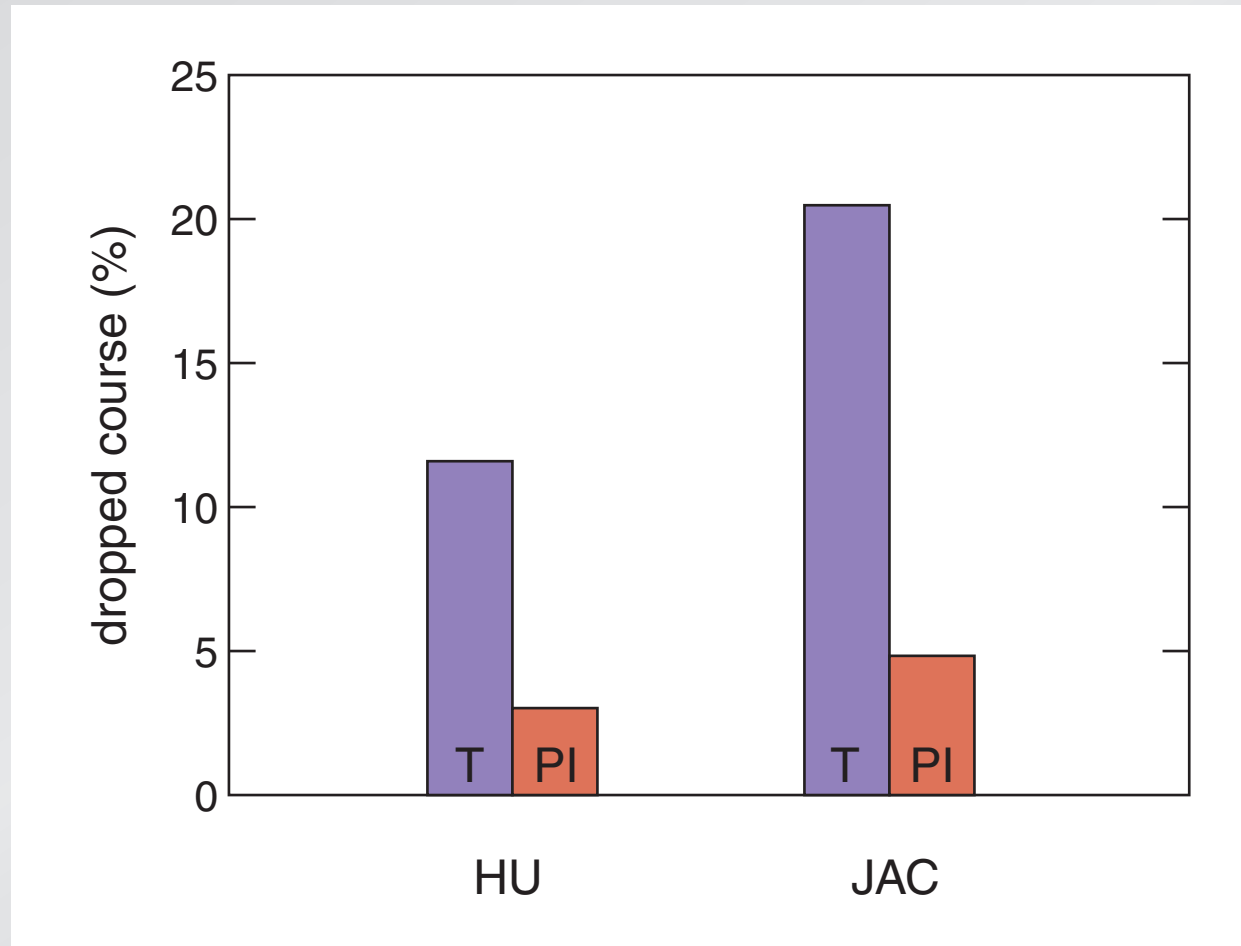
# Will it work at my institution?

## student retention



# Will it work at my institution?

## student retention



# **Will it work at my institution?**

**similar learning gains in different environments**

# Frequently Asked Questions

*“How can I be sure that my students will prepare for class?”*



# Getting students to read

**Students do not come to class prepared, because...**

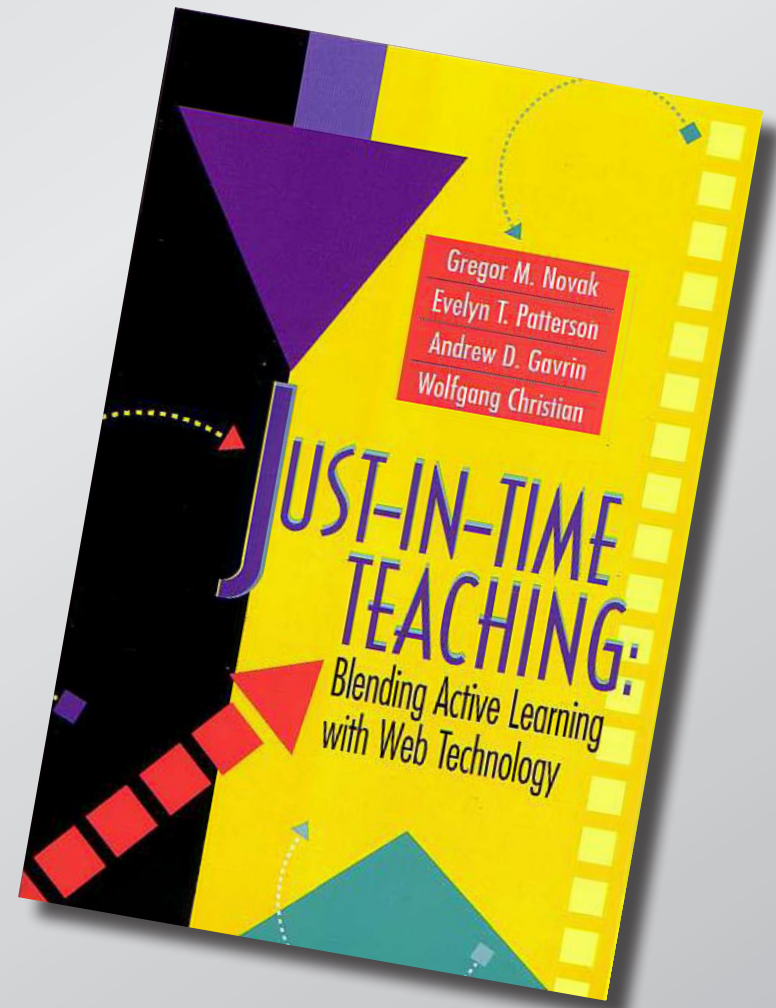
- 1. they don't have time.**
- 2. they are not motivated to learn.**
- 3. their instructors take away the incentive.**
- 4. they do not have the requisite skills.**
- 5. of some other reason.**
- 6. They do come prepared in my class!**

**(select what you consider to be the main reason)**

# Getting students to read

Just-in-time-Teaching (JiTT)

[www.jitt.org](http://www.jitt.org)



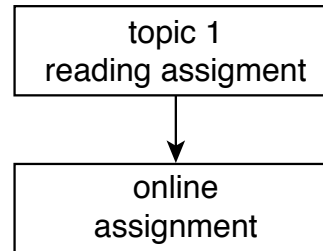
# Getting students to read

## JiTT workflow

topic 1  
reading assignment

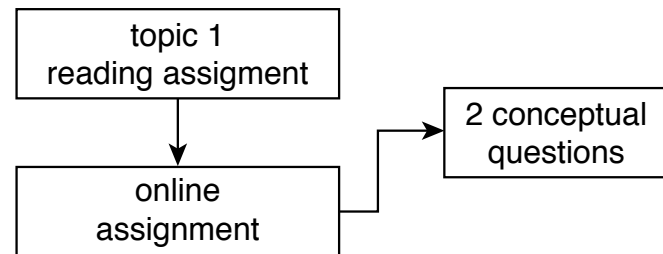
# Getting students to read

## JiTT workflow



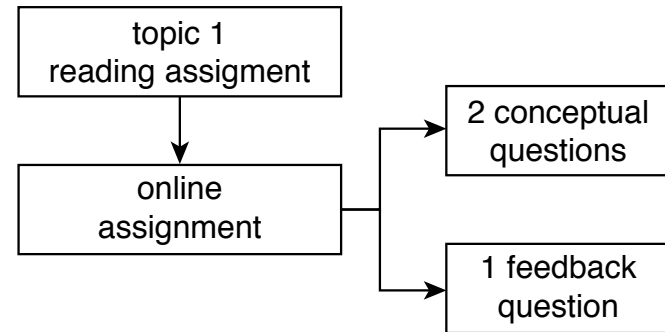
# Getting students to read

## JiTT workflow



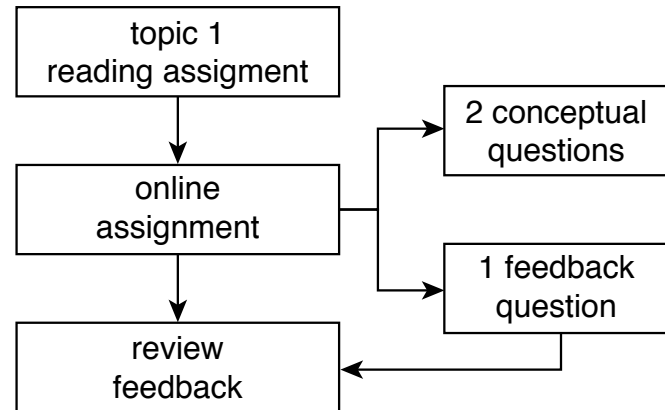
# Getting students to read

## JiTT workflow



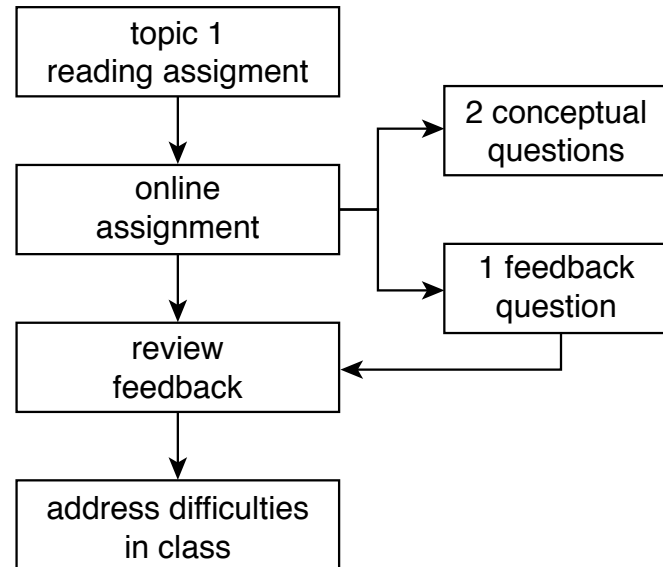
# Getting students to read

## JiTT workflow



# Getting students to read

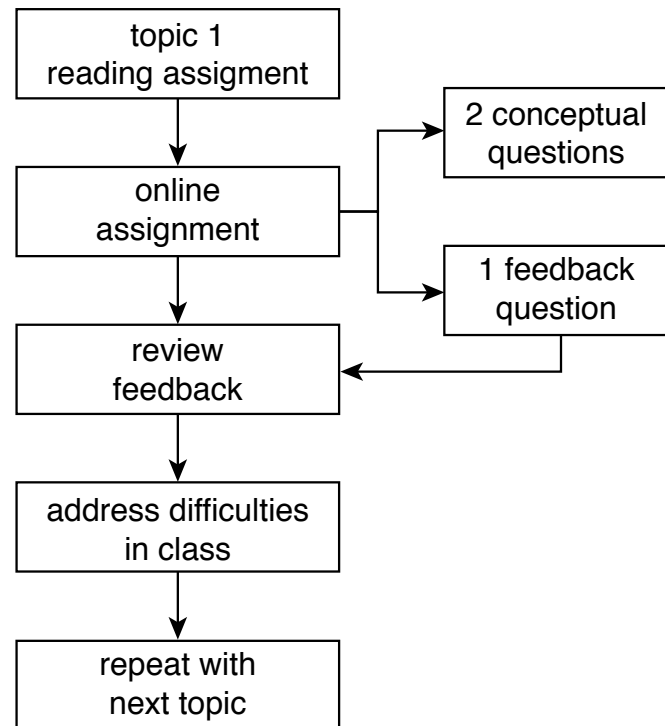
## JiTT workflow





# Getting students to read

## JiTT workflow



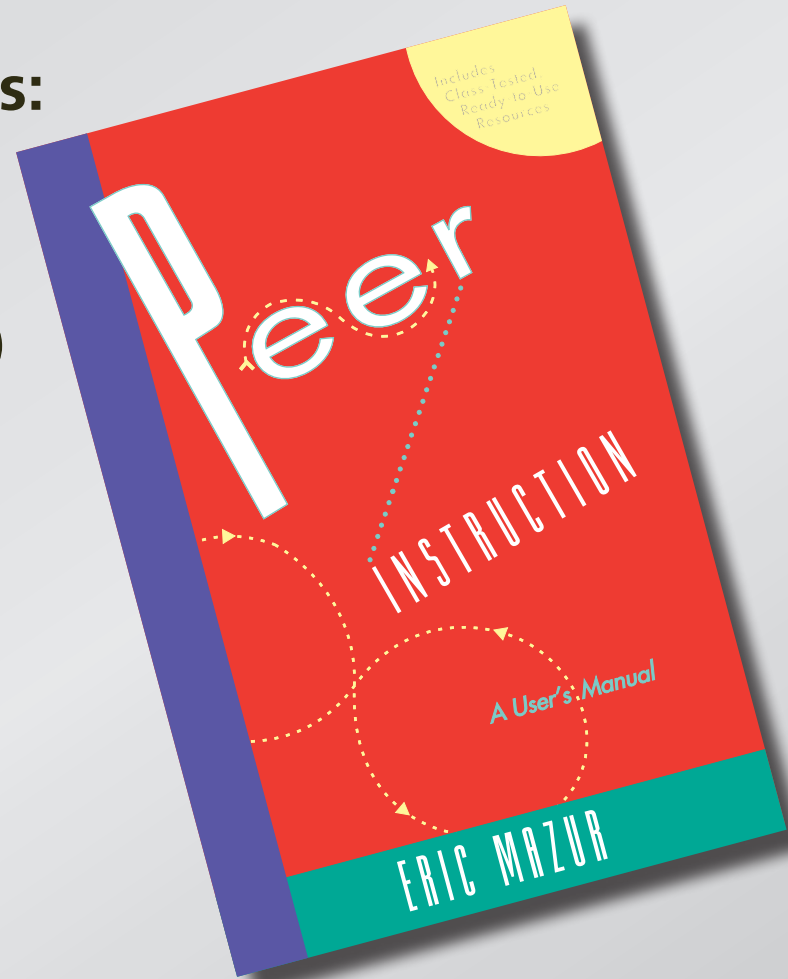
# ConceptTests

*“How do I get examples of good questions?”*

# ConceptTests

## Books with ConceptTests:

- Physics (Prentice Hall)



# ConceptTests

## Books with ConceptTests:

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



# ConceptTests

## Books with ConceptTests:

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





# ConceptTests

## Books with ConceptTests:

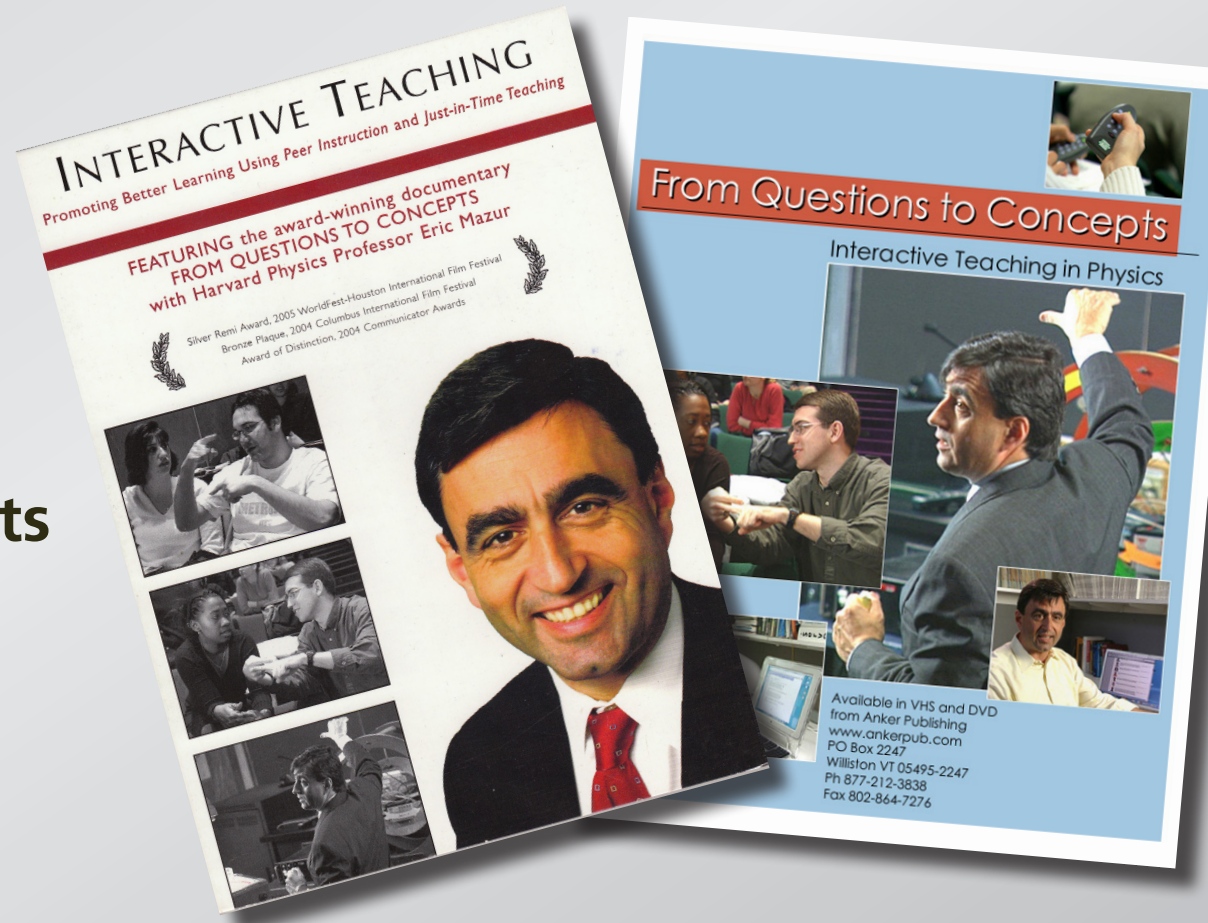
- Physics (Prentice Hall)
- Chemistry (Prentice Hall)
- Astronomy (Prentice Hall)
- Calculus (Wiley)



# ConcepTests

## Videos:

- Interactive Teaching DVD
- From questions to concepts



# ConceptTests

**Google:**

**<your discipline> ConceptTest**

**<your discipline> "Concept Test"**

**<your discipline> "Peer Instruction"**





**Join now!**

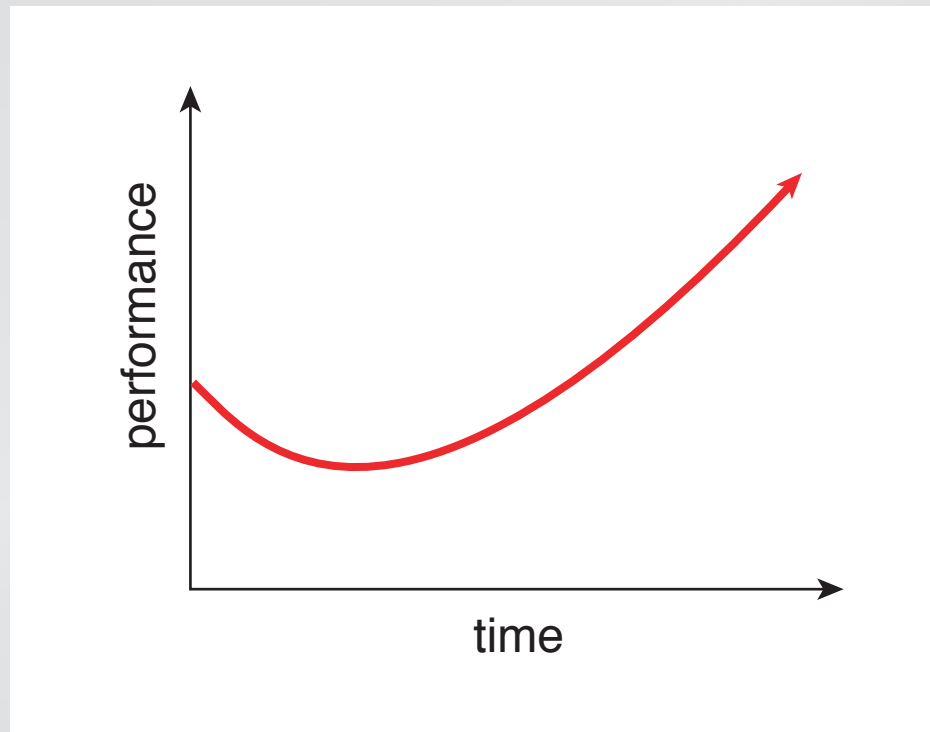
**PeerInstruction.net**

# Frequently Asked Questions

*“How do I deal with students who resist  
this new approach to studying?”*

# Student resistance

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



# Student resistance

Written on Wednesday Feb 16, two weeks into the course:

Subject: concerns

Professor Mazur,

Here are a few concerns. I speak for many of my classmates.

1) You are giving us WAY to much work. After spending multiple hours on the problem set, and not being able to figure out many of the questions, I now see that we have an additional 6 or 7 pages or homework in the workbook. I just spent 4 hours on the lab, and I am not confident on almost half of the questions. This is more work than I have had all semester in all of my other classes combined.

2) If you are going to give us this much work, I would suggest re-structuring the lectures. I find the readings very difficult to understand. I am not a bad student (I got a solid A in physics 1a), but it is very difficult to internalize the readings. You should spend most of the lecture going over, point by point, the readings in their entirety. While the PRS clickers are fun, they do not help me understand the complex material.

I am extremely flustered by the incredibly large amount of work, and my inability to understand it, and I am strongly considering dropping the course.

# Student resistance

Written on Monday May 23, just after the final exam:

Subject: Thanks!

Professor Mazur,

First of all I want to thank you for a great semester. You are an excellent professor, and it is clear that you truly care about each and every student.

The exam went well today. I'm not sure to what extent you will curve the final grades (if at all), but it looks like I may be right around the cutoff point between an A and an A-. I studied as hard as I could and I'm keeping my fingers crossed about the A, but no matter what happens with my grade you should know that you are one of the best professors that I have ever had at Harvard.

Thanks again!

# Student resistance

Hello Prof. Mayer,  
I wanted to hand you this card as  
a token of my deep appreciation of  
how you have helped me throughout  
the semester. You are truly  
an inspiring and have  
changed how I look at  
"learning". I also wanted  
to thank you for  
how understanding  
you were of all  
my circumstances.  
You really made a difference  
in my life. So THANKS  
Thank you!



You made a difference.

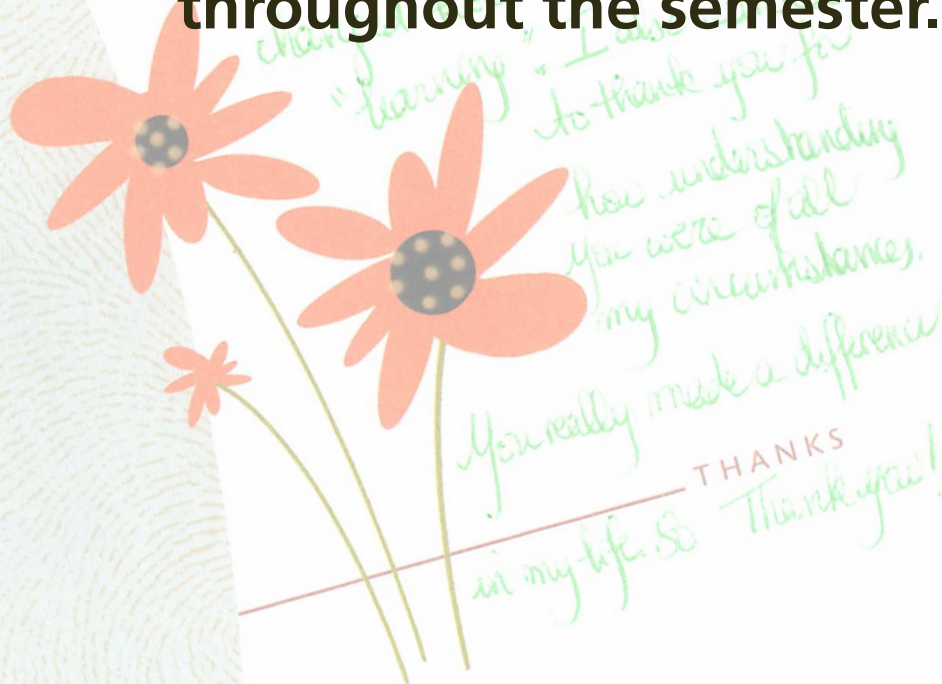
Love, Best



# Student resistance

**"I wanted to hand you this card as a token of my deep appreciation of how you have helped me throughout the semester."**

*You made a difference.*



# Student resistance

**"I wanted to hand you this card as a token of my deep appreciation of how you have helped me throughout the semester. You are truly awe inspiring and have changed how I look at "learning".**

*You made a difference.*





# Student resistance

**"I wanted to hand you this card as a token of my deep appreciation of how you have helped me throughout the semester. You are truly awe inspiring and have changed how I look at "learning". [....] You really made a difference in my life."**

*You made a difference.*

*THANKS  
in my life. So Thank you!*

*Best*

# Student resistance

**and don't forget...**

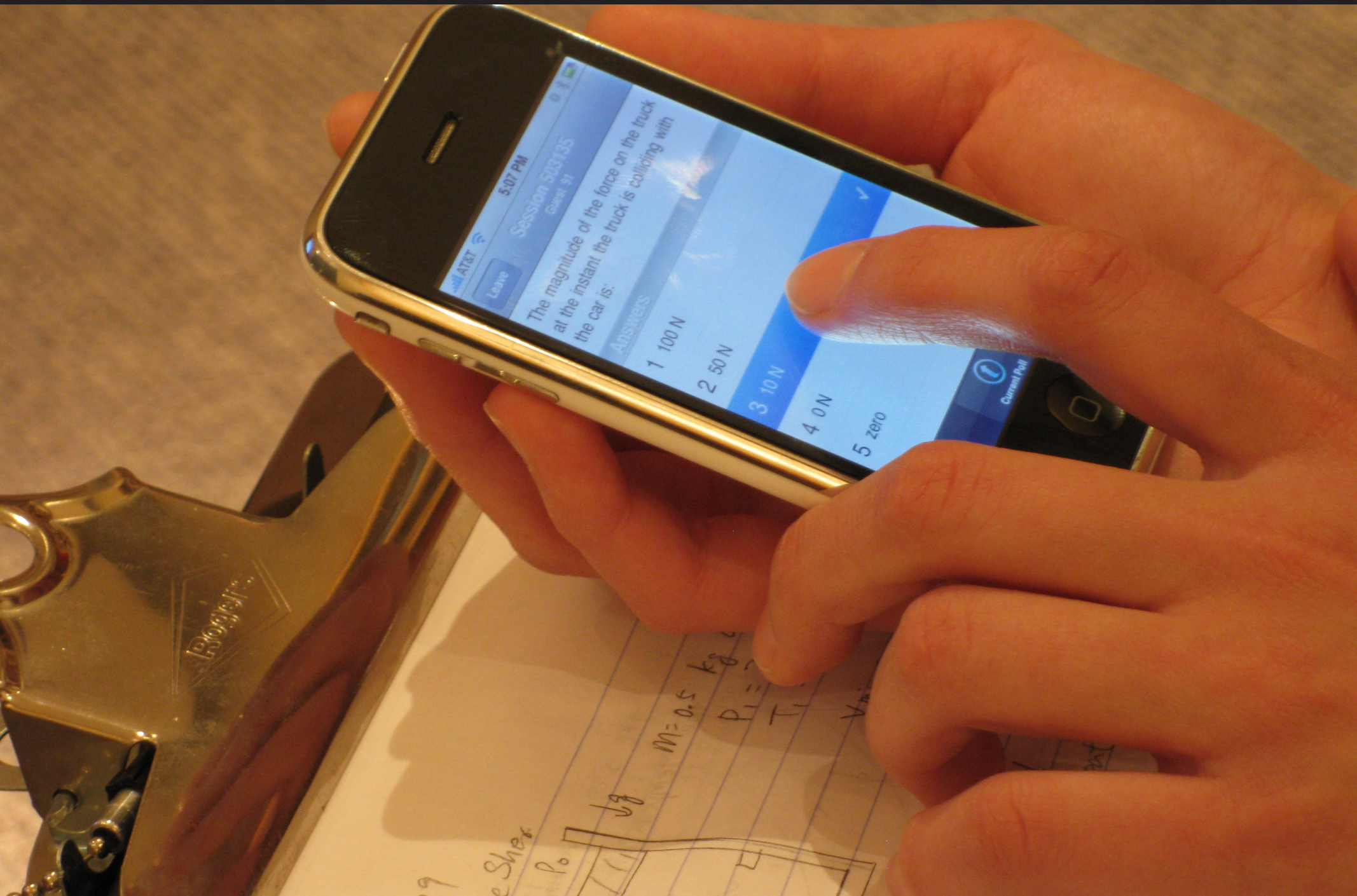
# Student resistance

**and don't forget...**

**PI leads to better learning and retention!**



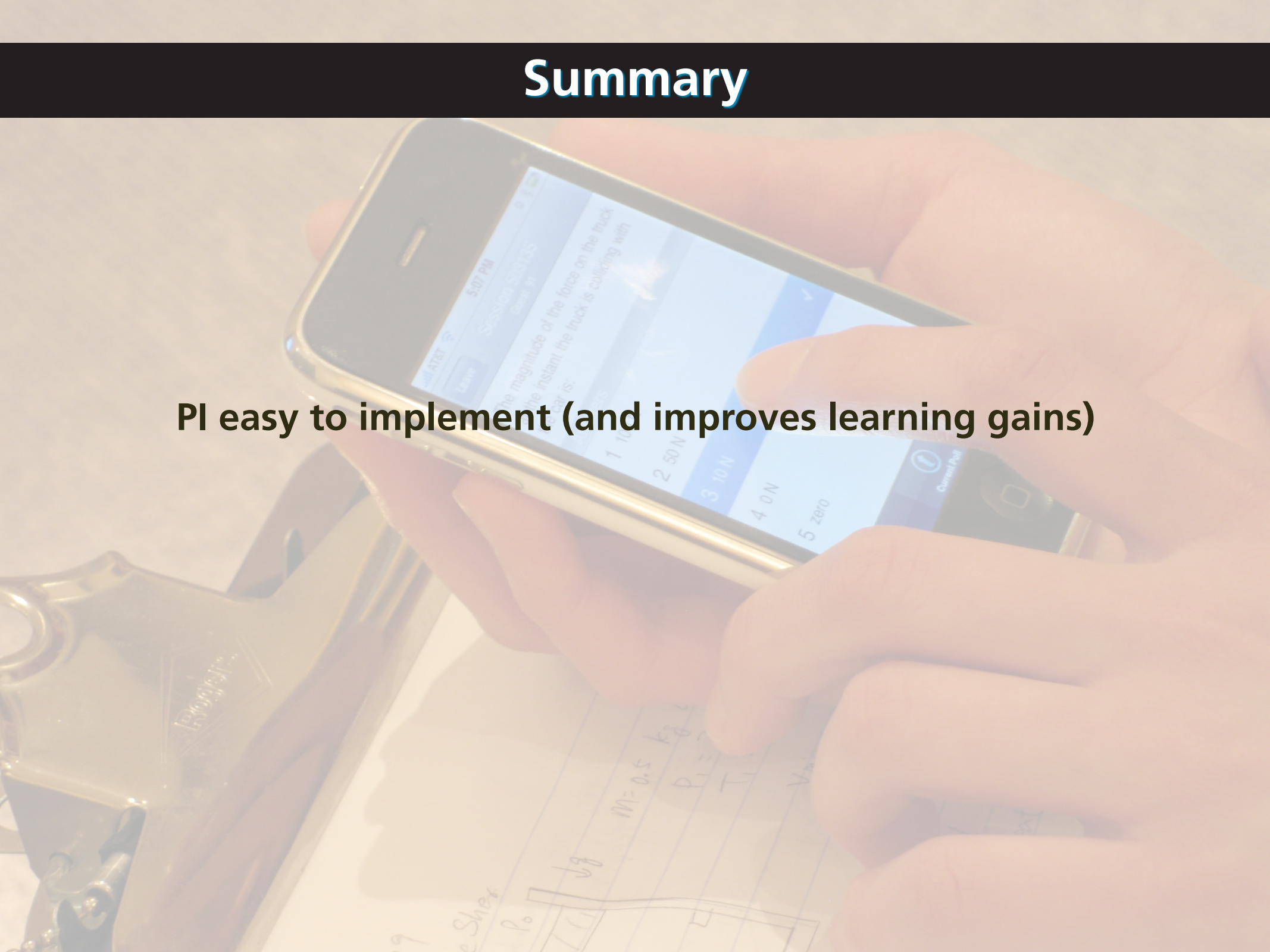
# Summary





# Summary

**PI easy to implement (and improves learning gains)**





# Summary

**PI easy to implement (and improves learning gains)**

**technology facilitates active engagement (but not required)**

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