

# Peer Instruction



Interactive Teaching and Learning  
Taibah University  
Medinah, Saudi Arabia, 9 December 2013

# Peer Instruction



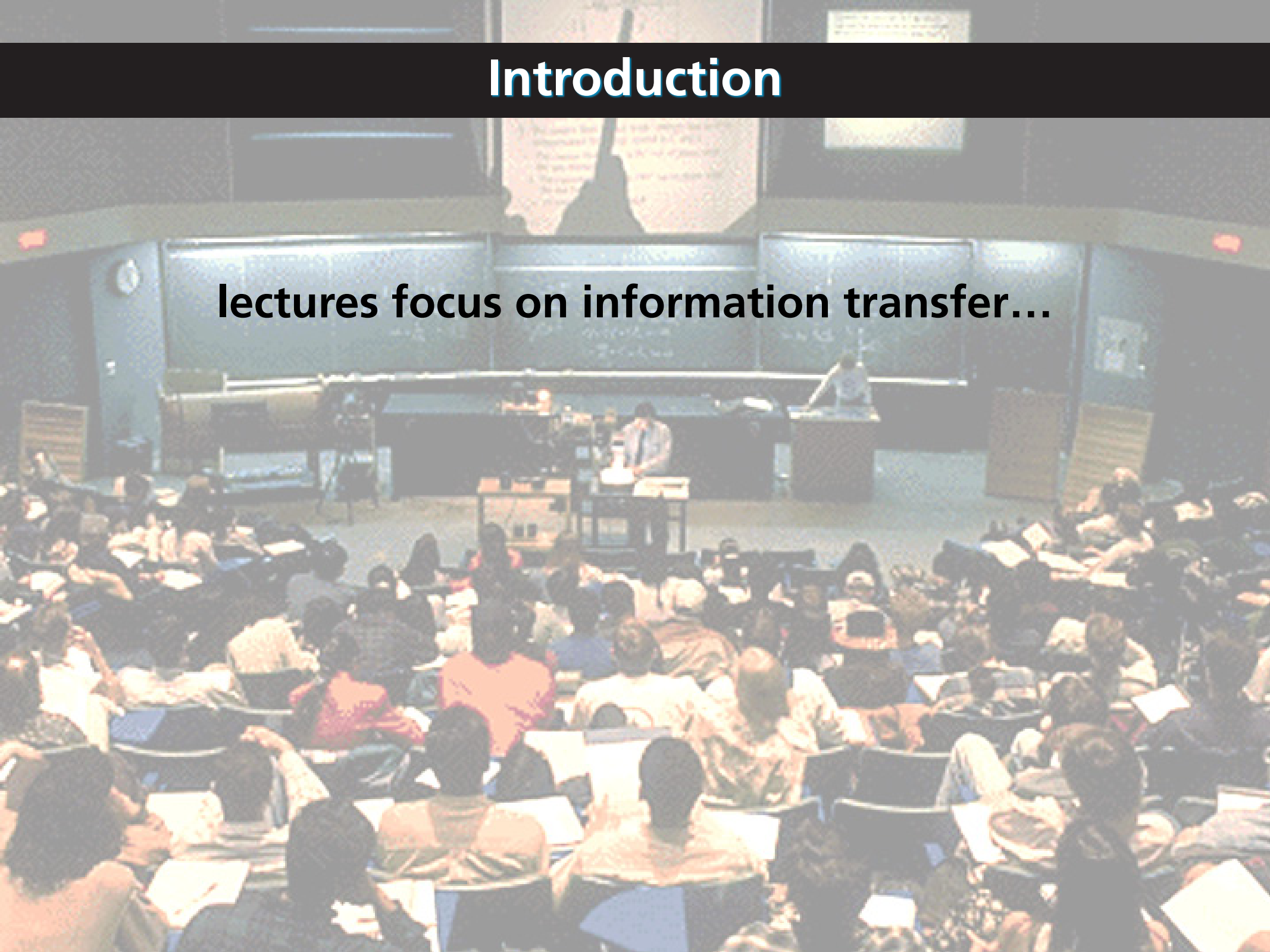
@eric\_mazur

Interactive Teaching and Learning  
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# Introduction

**lectures focus on information transfer...**

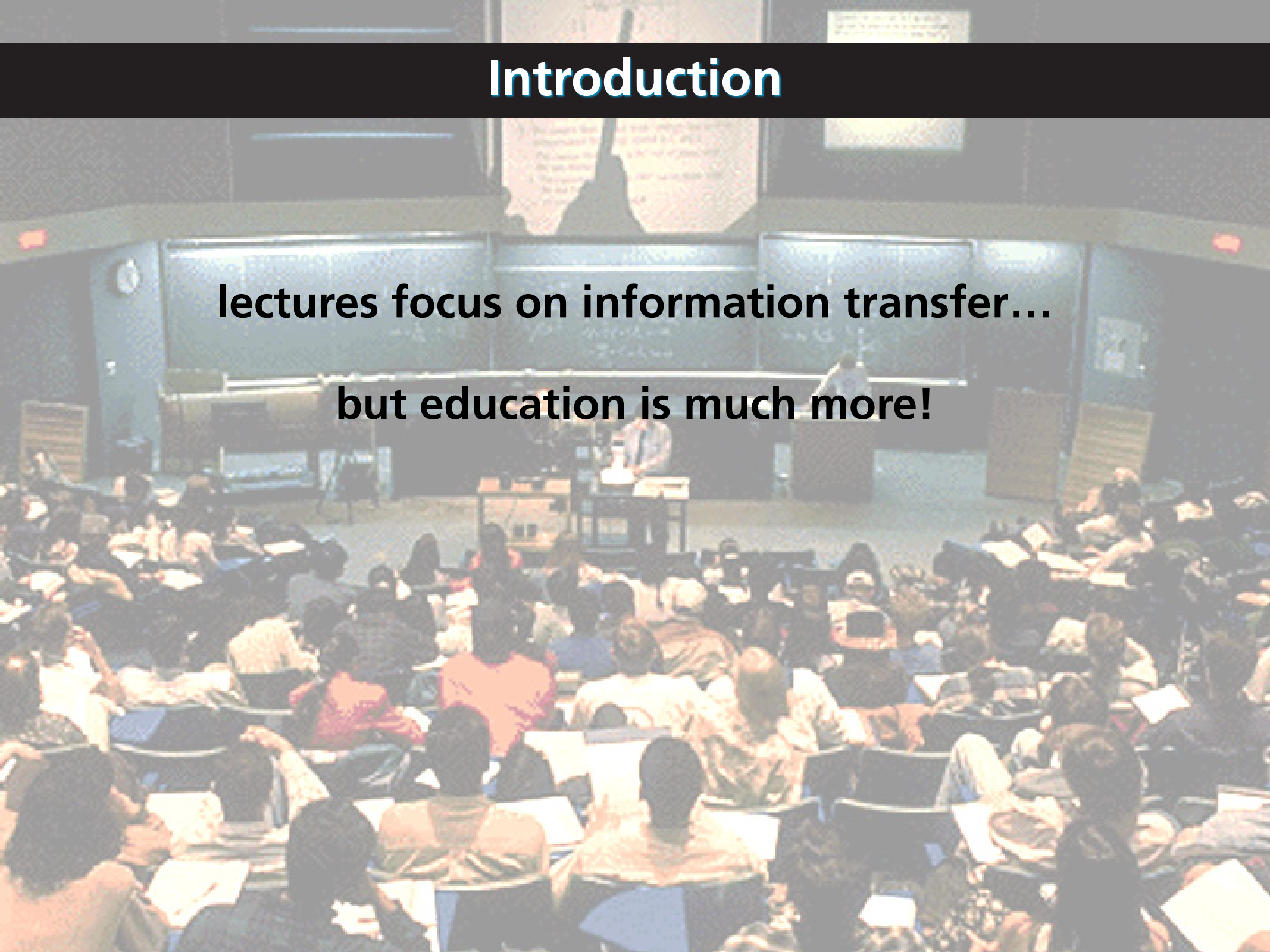




# Introduction

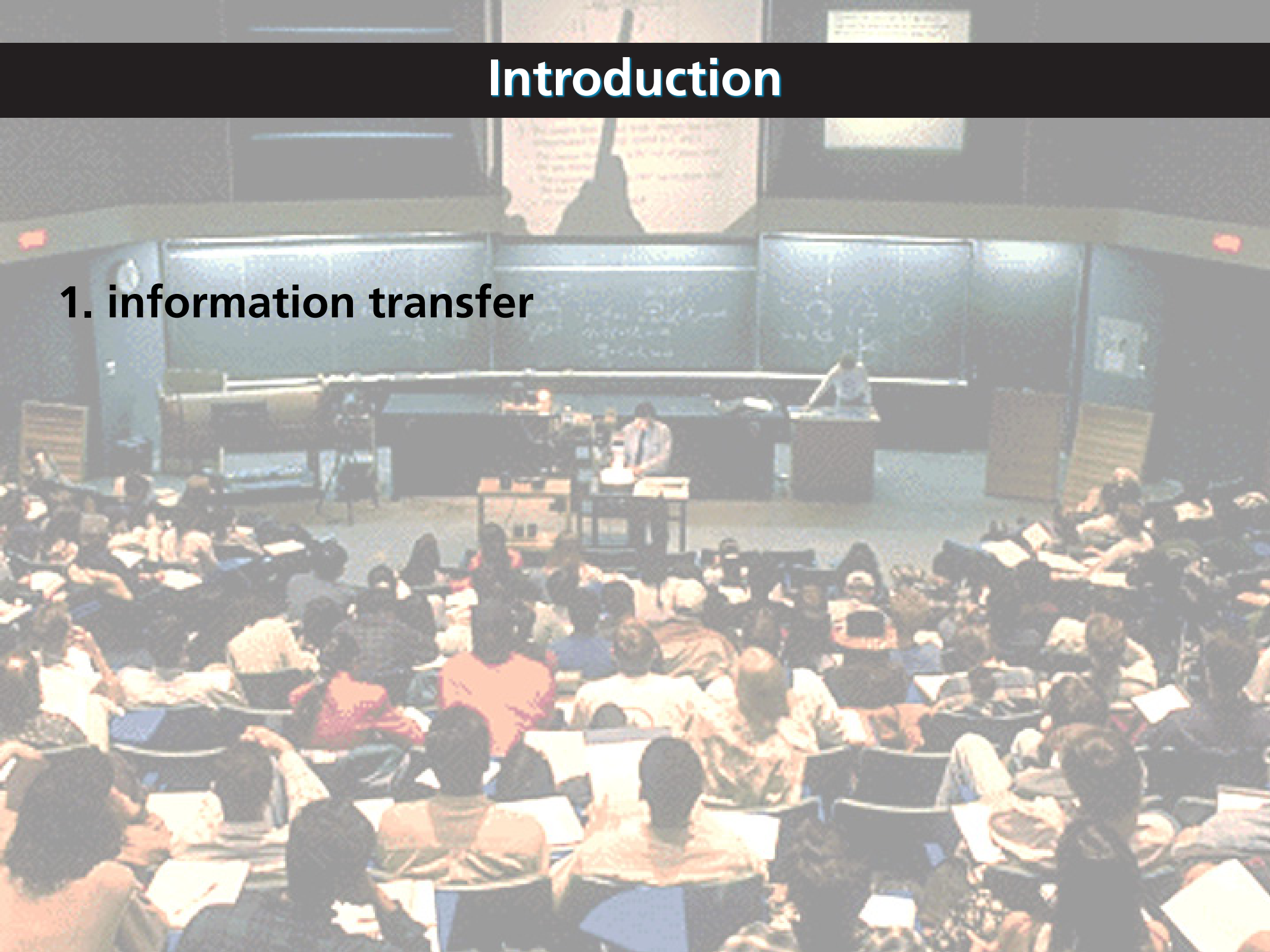
**lectures focus on information transfer...**

**but education is much more!**



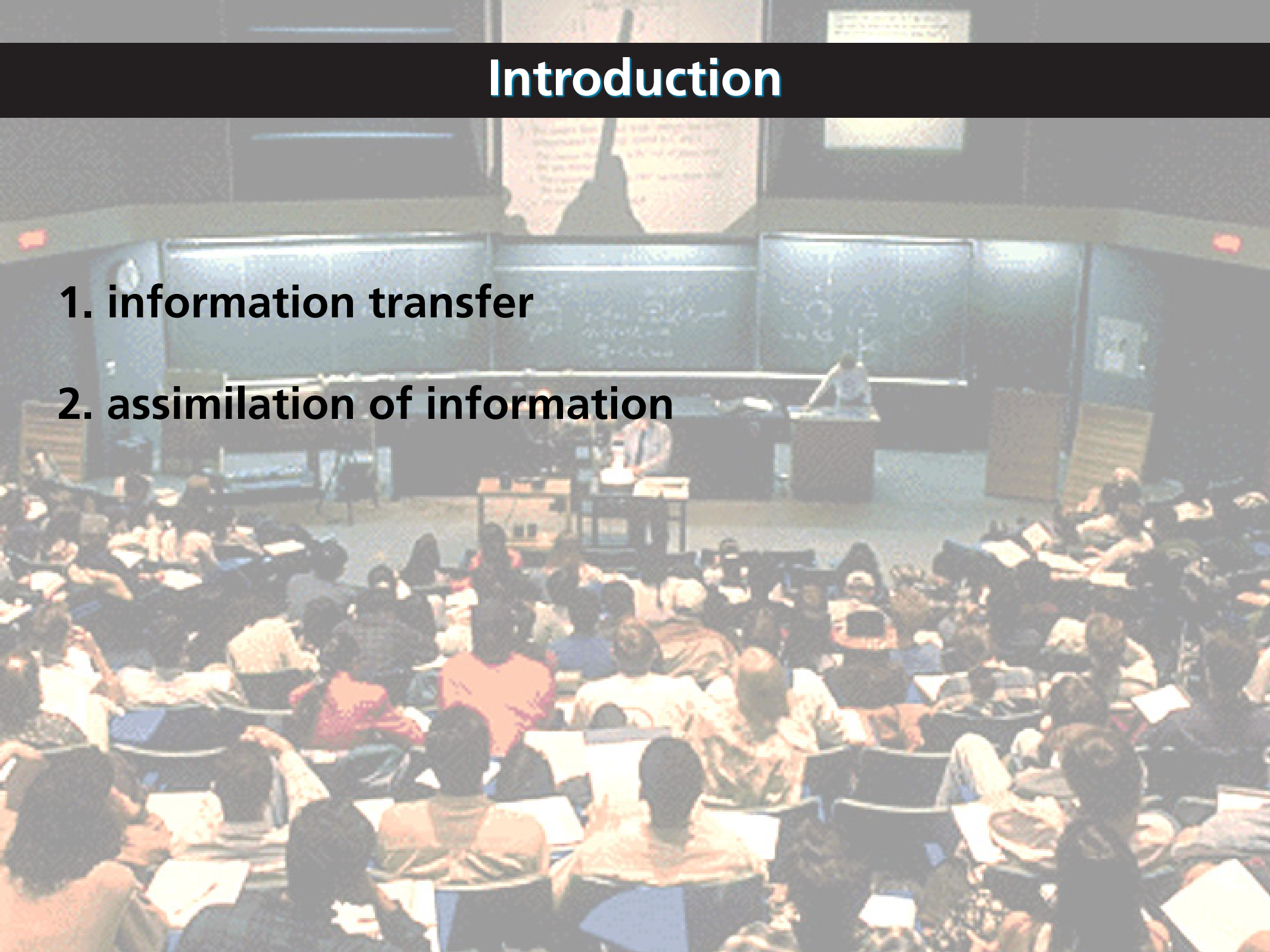
# Introduction

## 1. information transfer



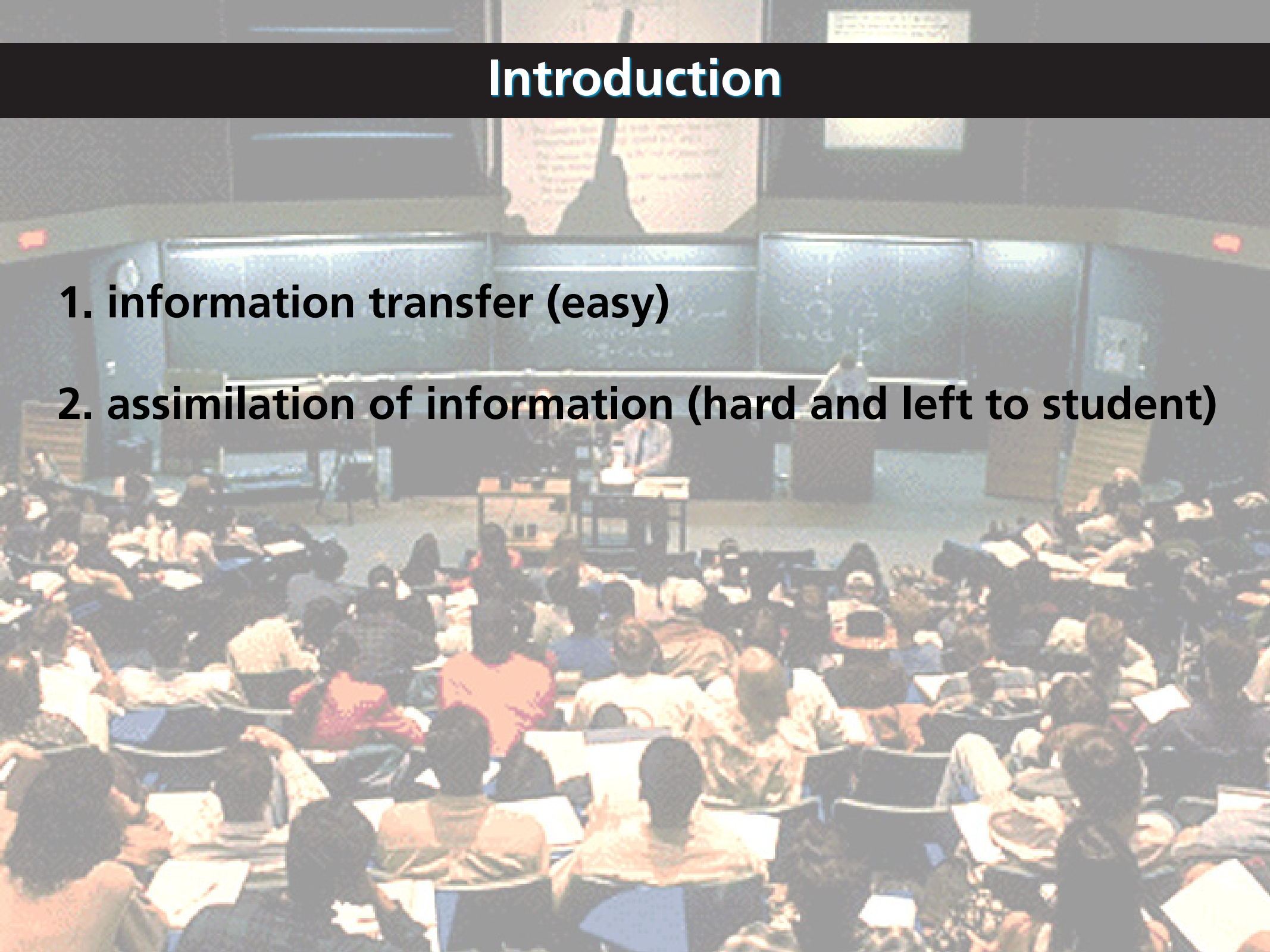
# Introduction

1. information transfer
2. assimilation of information



# Introduction

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



# Introduction

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



# Introduction

**How to move information transfer out of classroom?**

# Introduction

**How to move information transfer out of classroom?**

**Use JiTT (before class) and PI (in class)!**

# Outline



# Outline

- **PI & JiTT Overview**
- **Implementing PI & JiTT**
- **ConceptTests**



# PI & JiTT Overview

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

# PI & JiTT Overview

**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!**

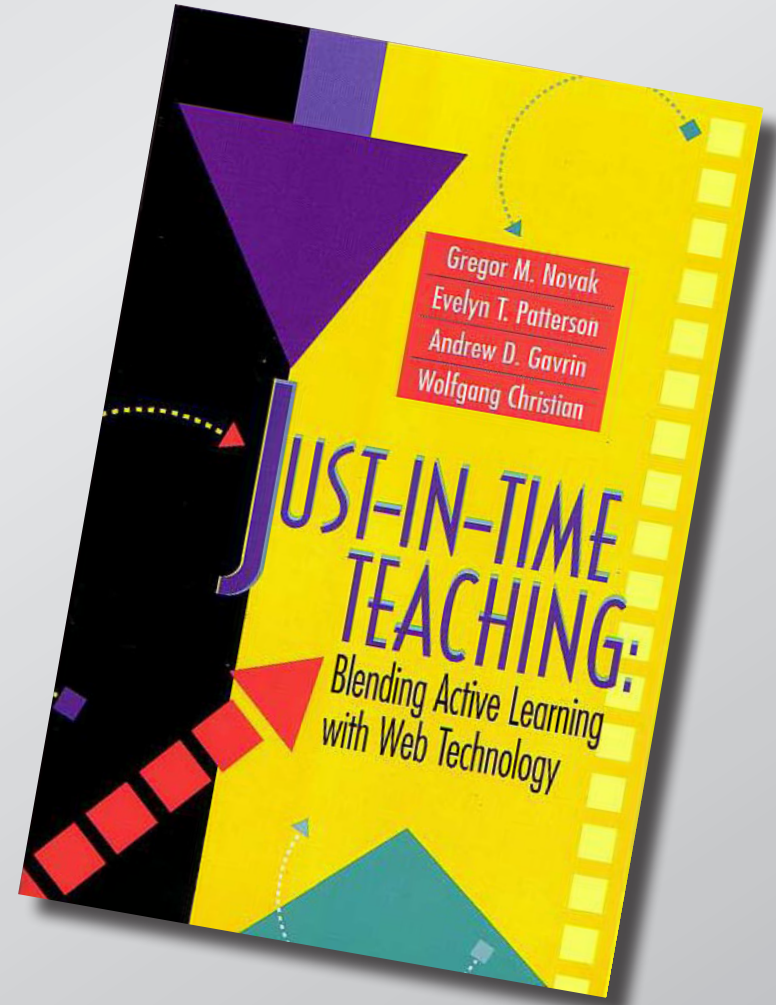
**(select what you consider to be the main reason)**



# PI & JiTT Overview

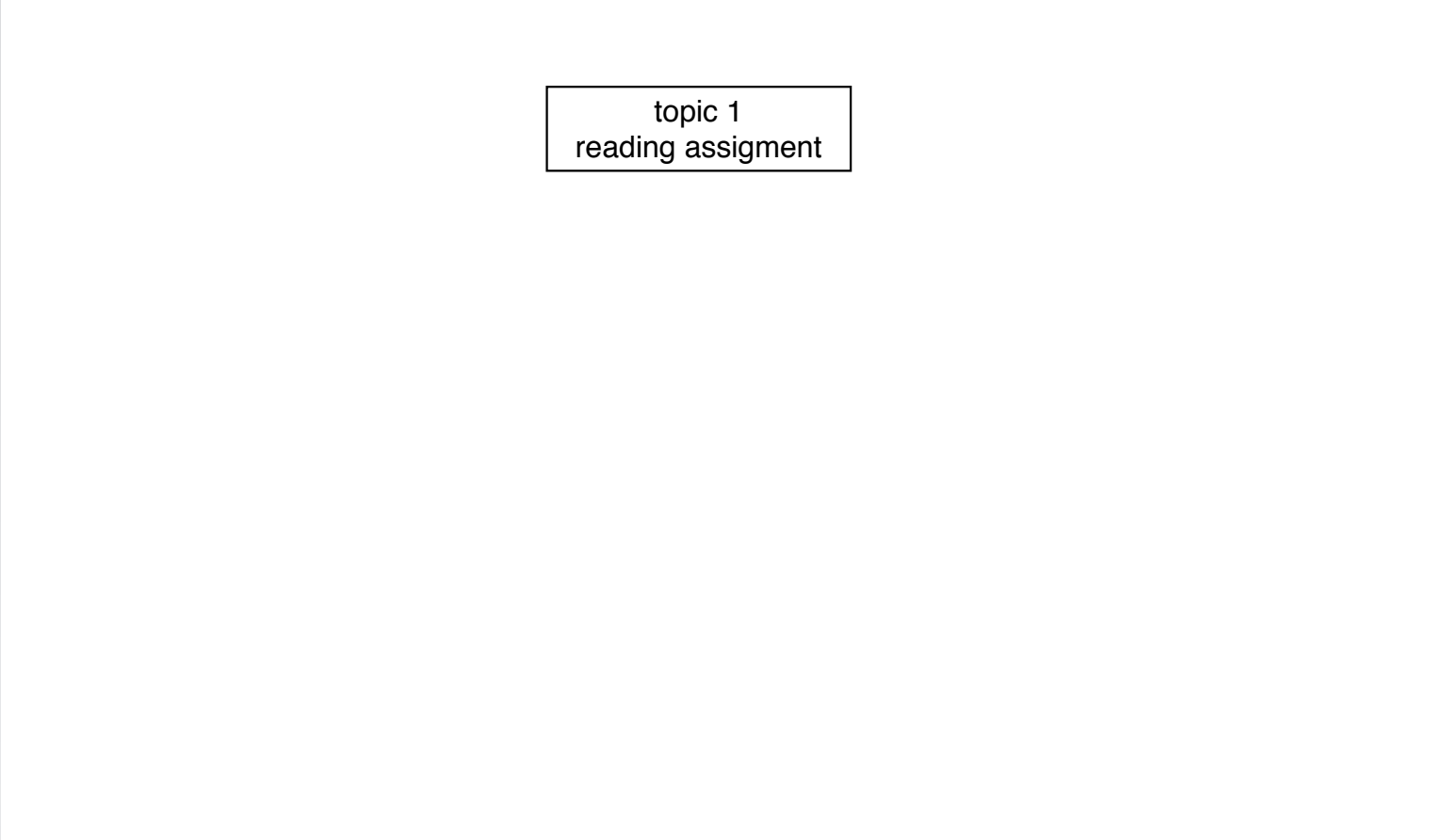
Just-in-time-Teaching (JiTT)

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



# PI & JiTT Overview

## JiTT workflow

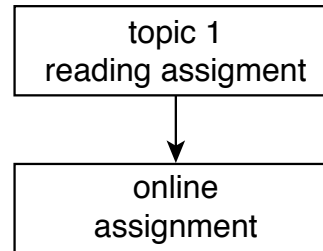


topic 1  
reading assignment



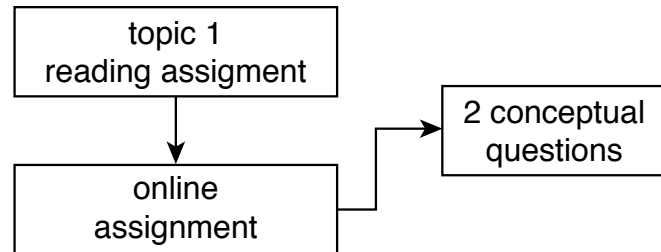
# PI & JiTT Overview

## JiTT workflow



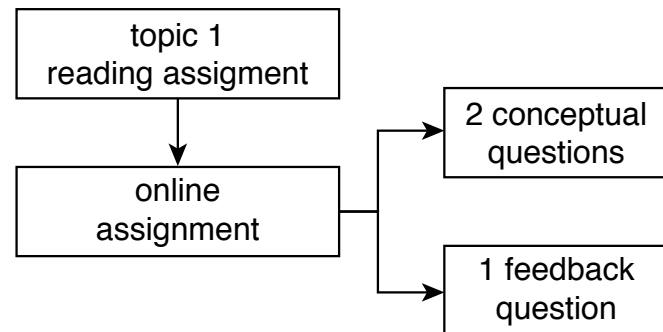
# PI & JiTT Overview

## JiTT workflow



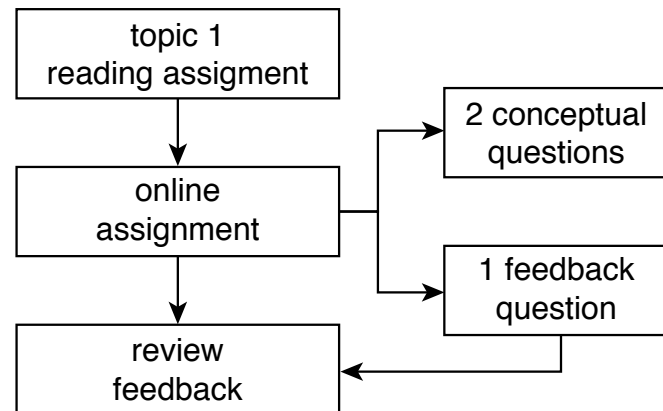
# PI & JiTT Overview

## JiTT workflow



# PI & JiTT Overview

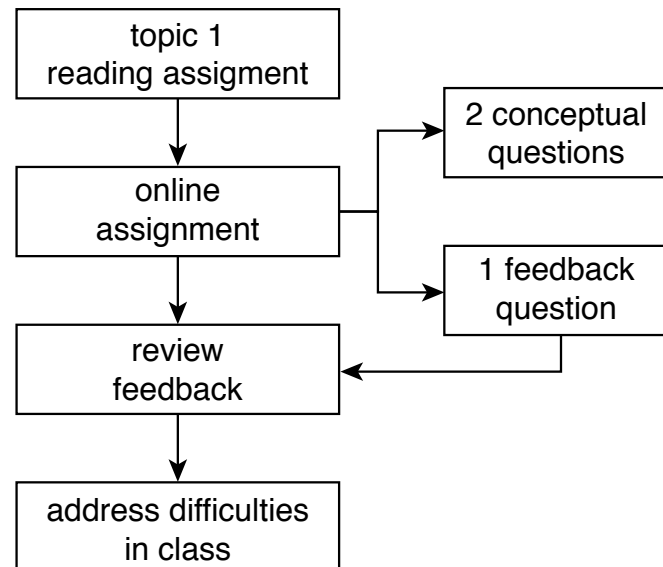
## JiTT workflow





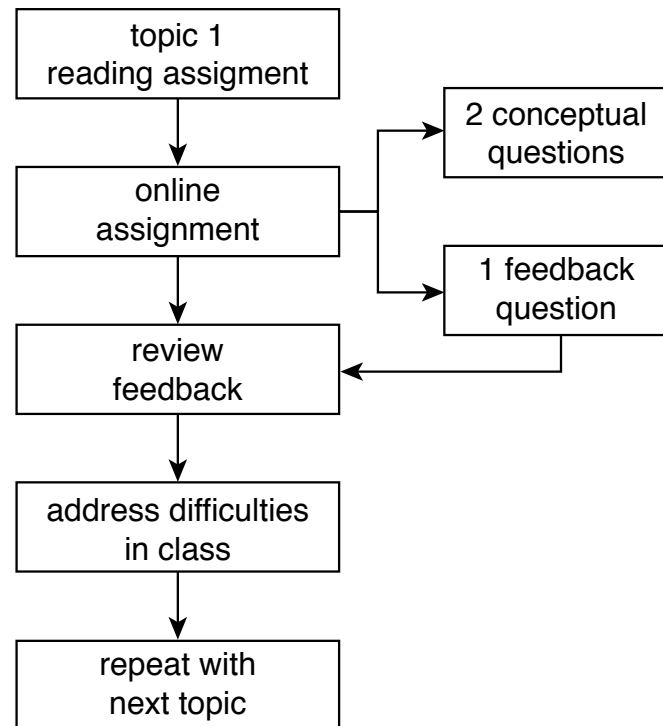
# PI & JiTT Overview

## JiTT workflow



# PI & JiTT Overview

## JiTT workflow



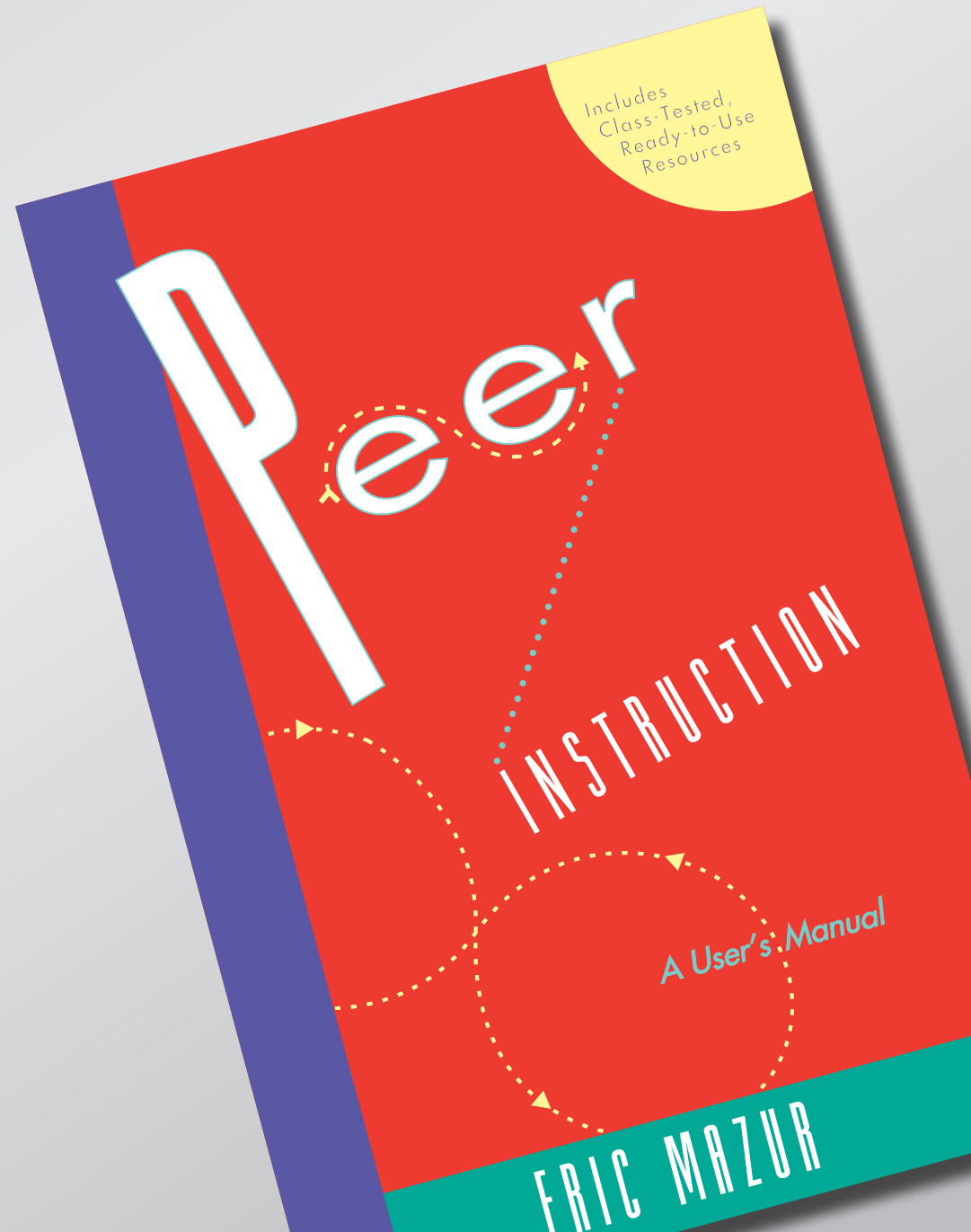
# PI & JiTT Overview

## JiTT:

- prepares you for class
- prepares students for class
- helps you address student difficulties

# PI & JiTT Overview

## Peer Instruction (PI)

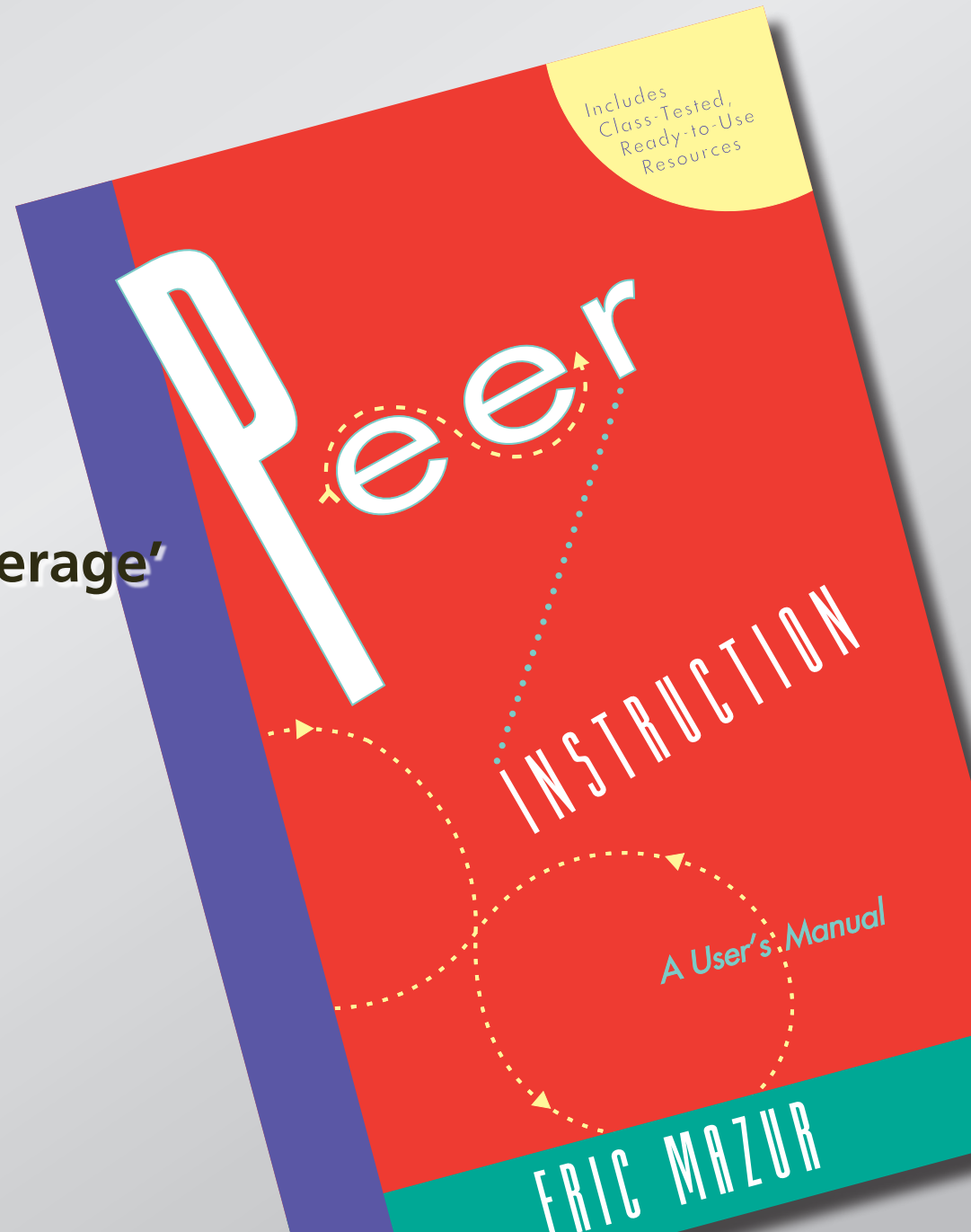




# PI & JiTT Overview

## Main features:

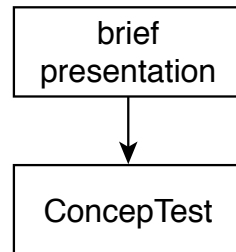
- pre-class assignment
- in-class: depth, not 'coverage'
- ConcepTests



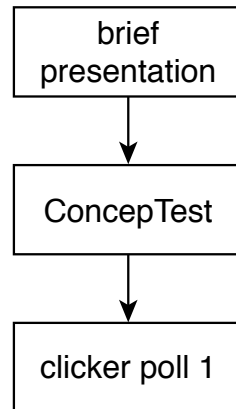
# PI & JiTT Overview

brief  
presentation

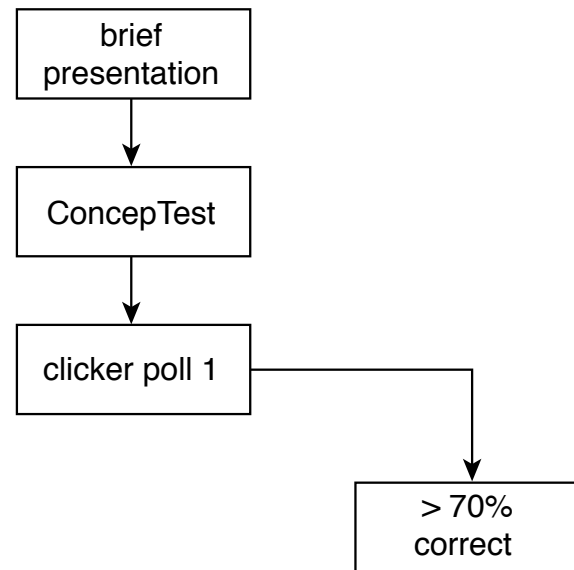
# PI & JiTT Overview



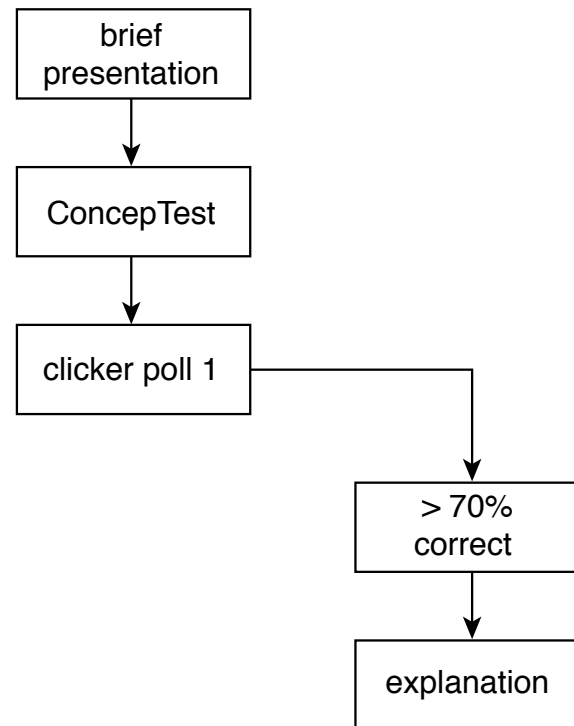
# PI & JiTT Overview



# PI & JiTT Overview

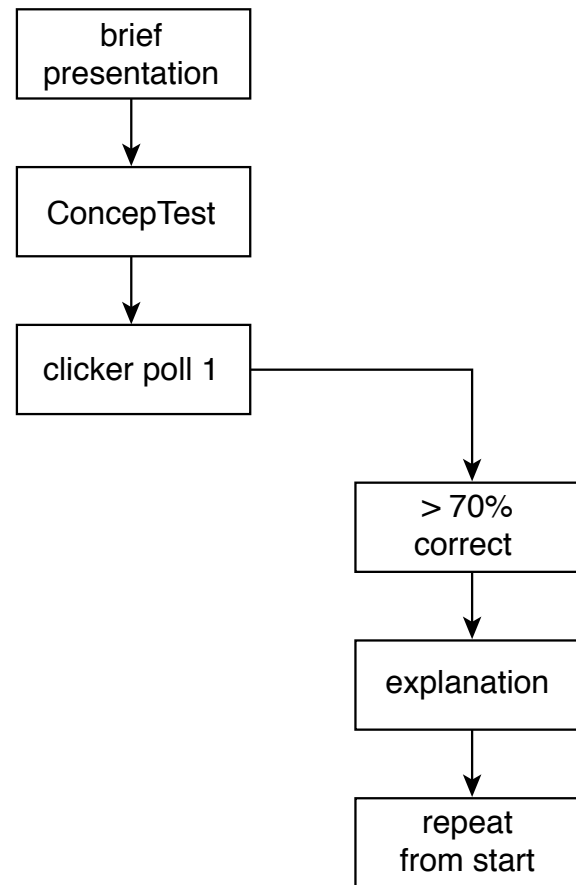


# PI & JiTT Overview

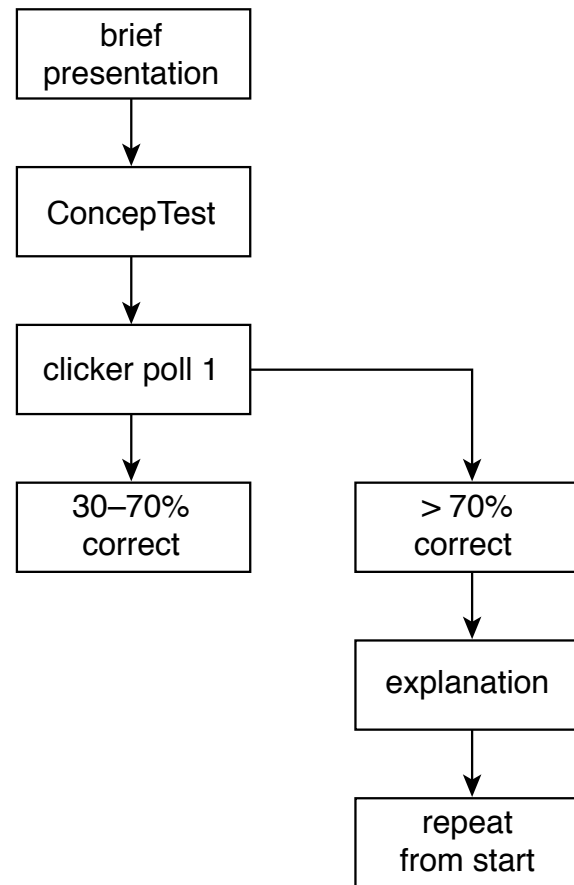




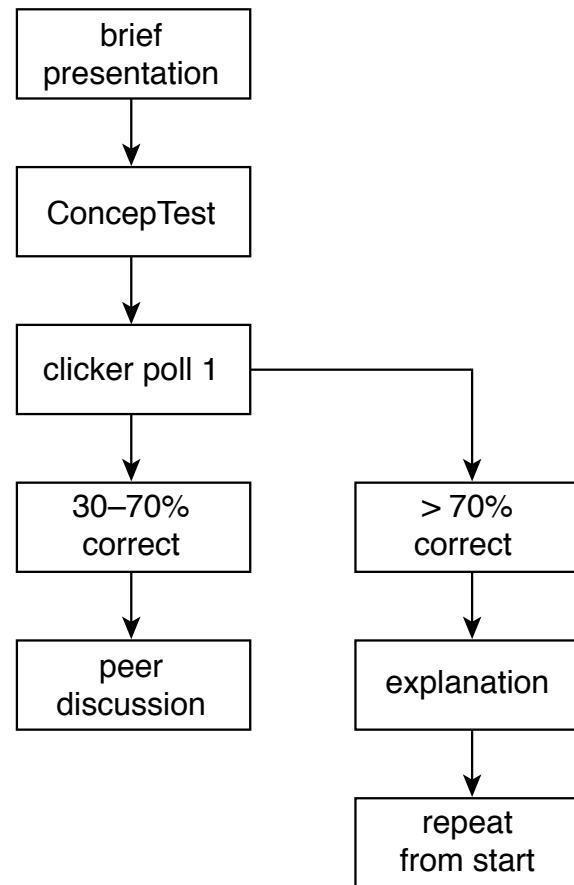
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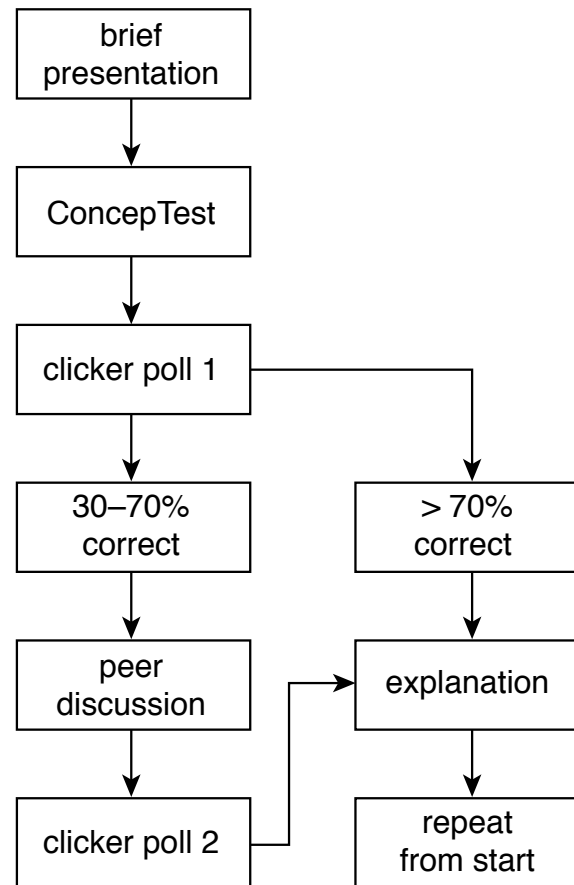
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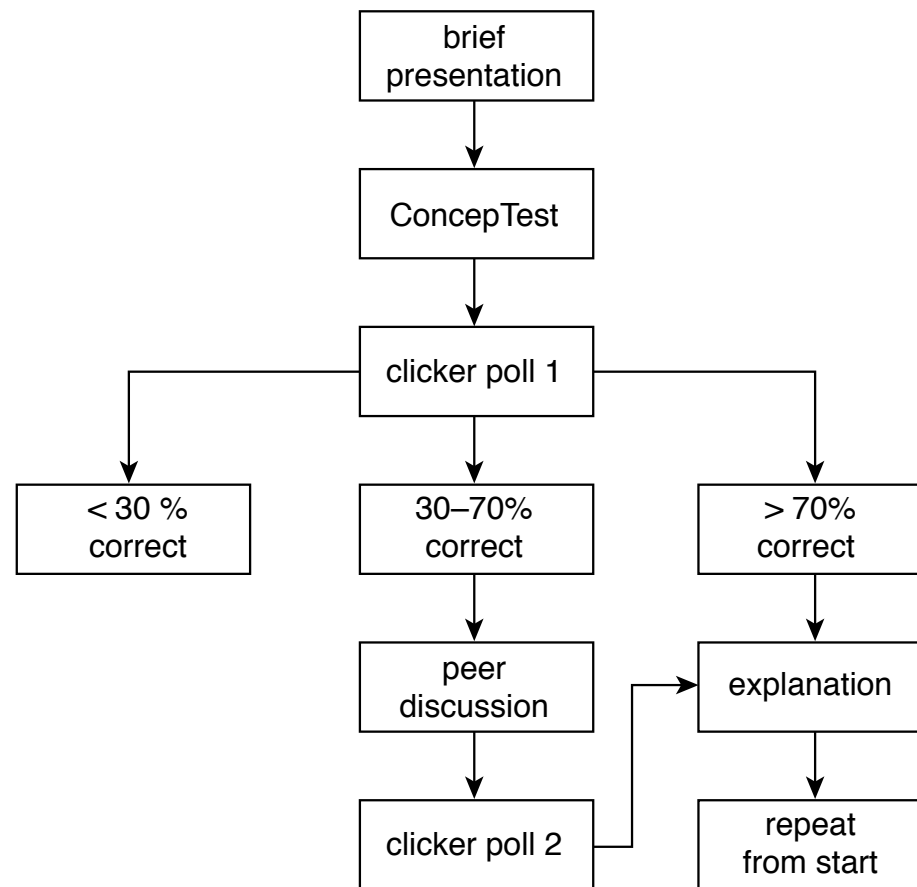
# PI & JiTT Overview



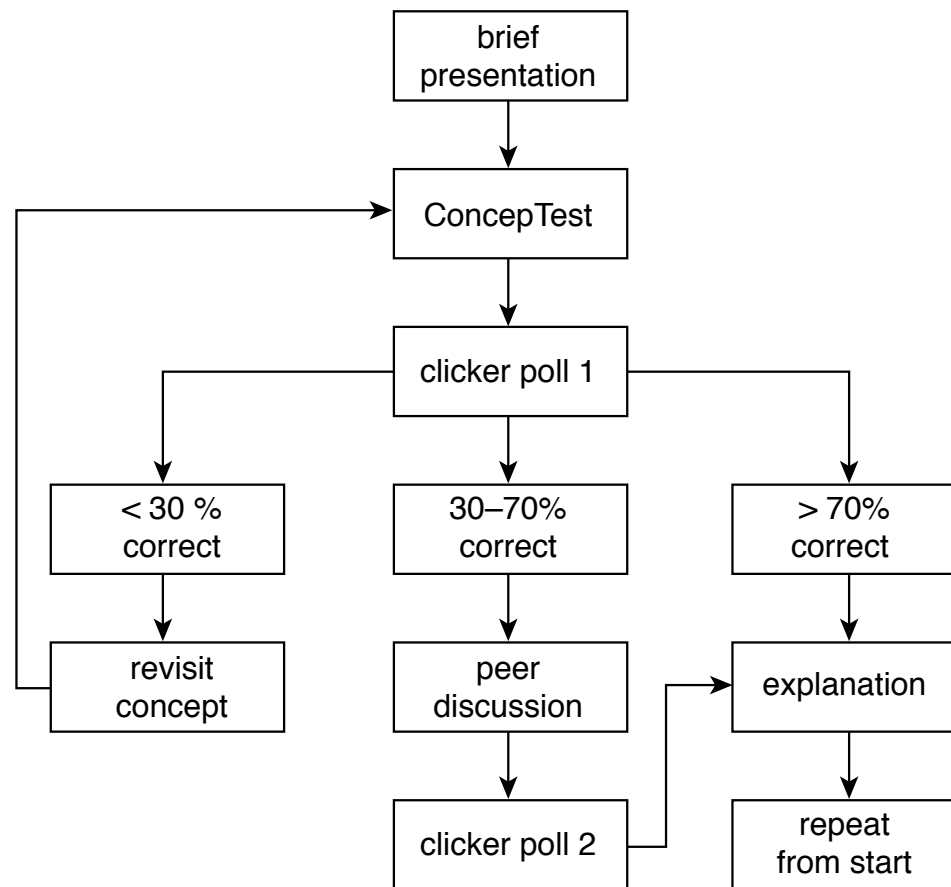
# PI & JiTT Overview



# PI & JiTT Overview

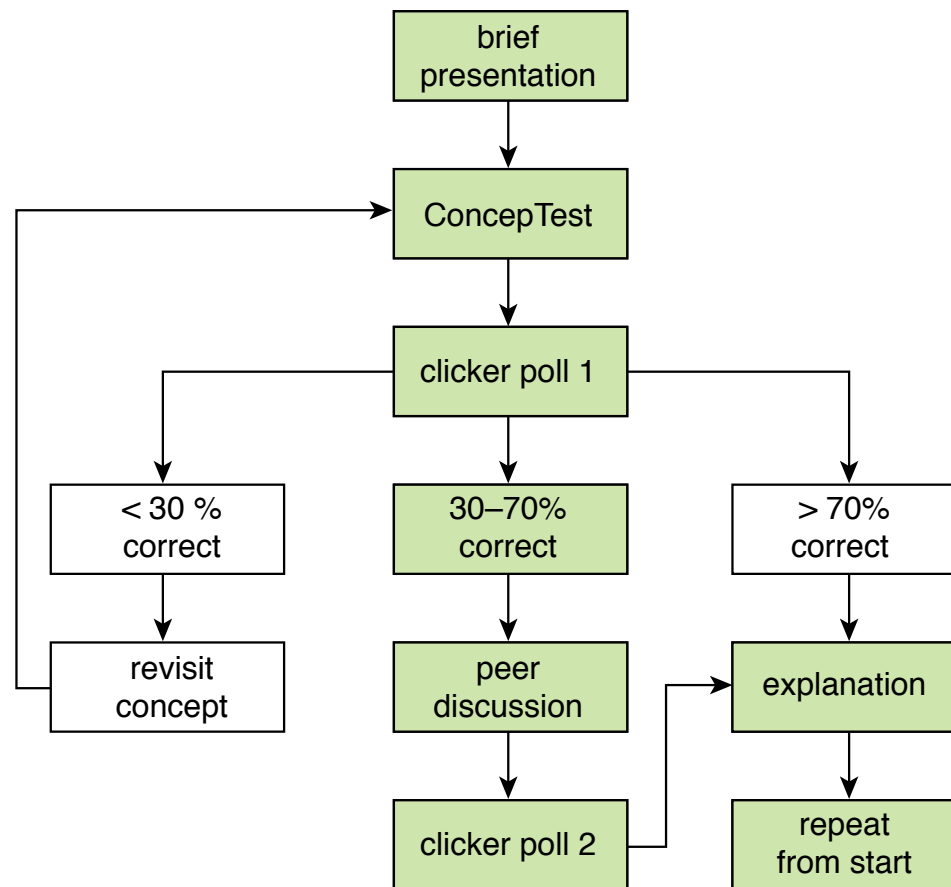


# PI & JiTT Overview





# PI & JiTT Overview



# PI & JiTT Overview

**PI:**

- **helps students overcome difficulties**
- **encourages deep learning**
- **provides depth, not “coverage”**
- **helps you become aware of misconceptions**

# PI & JiTT Overview

*“How do I promote fruitful discussion?”*

# PI & JiTT Overview

Find someone with a *different* answer

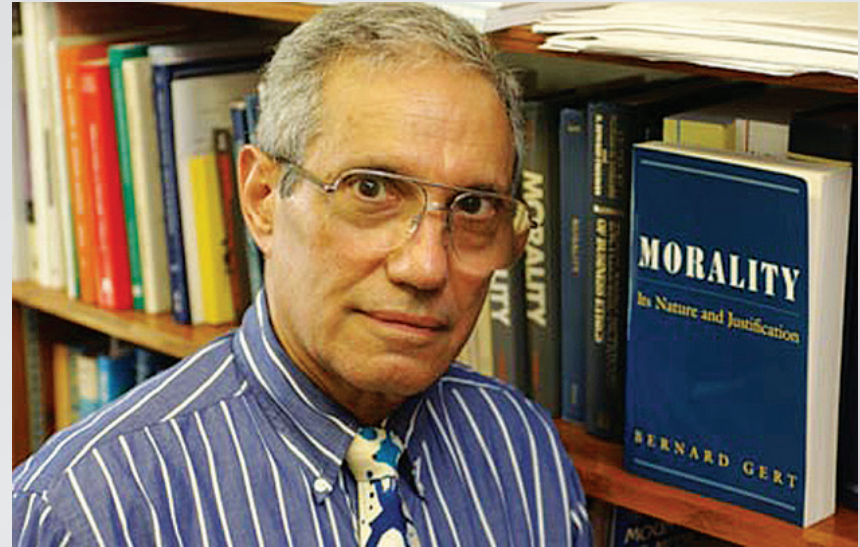
# PI & JiTT Overview

*“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**

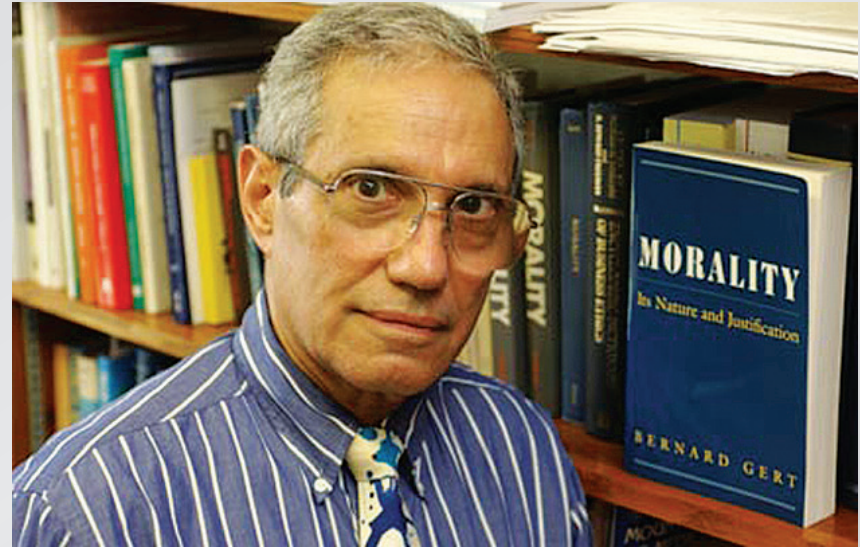




# Let's try it!

**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.

## Let's try it!

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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!

Bernard Gert's moral system created by 10 rules:

1. Do not kill
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Should Heinz have broken into the store to steal the drug for his wife?

1. Yes
2. No





# PI & JiTT Overview

**Don't need a correct answer!**

# Outline

- **PI & JiTT Overview**
- **Implementing PI & JiTT**
- **ConceptTests**

# Implementing PI & JiTT

*“Will it work at my institution?”*

It works here...



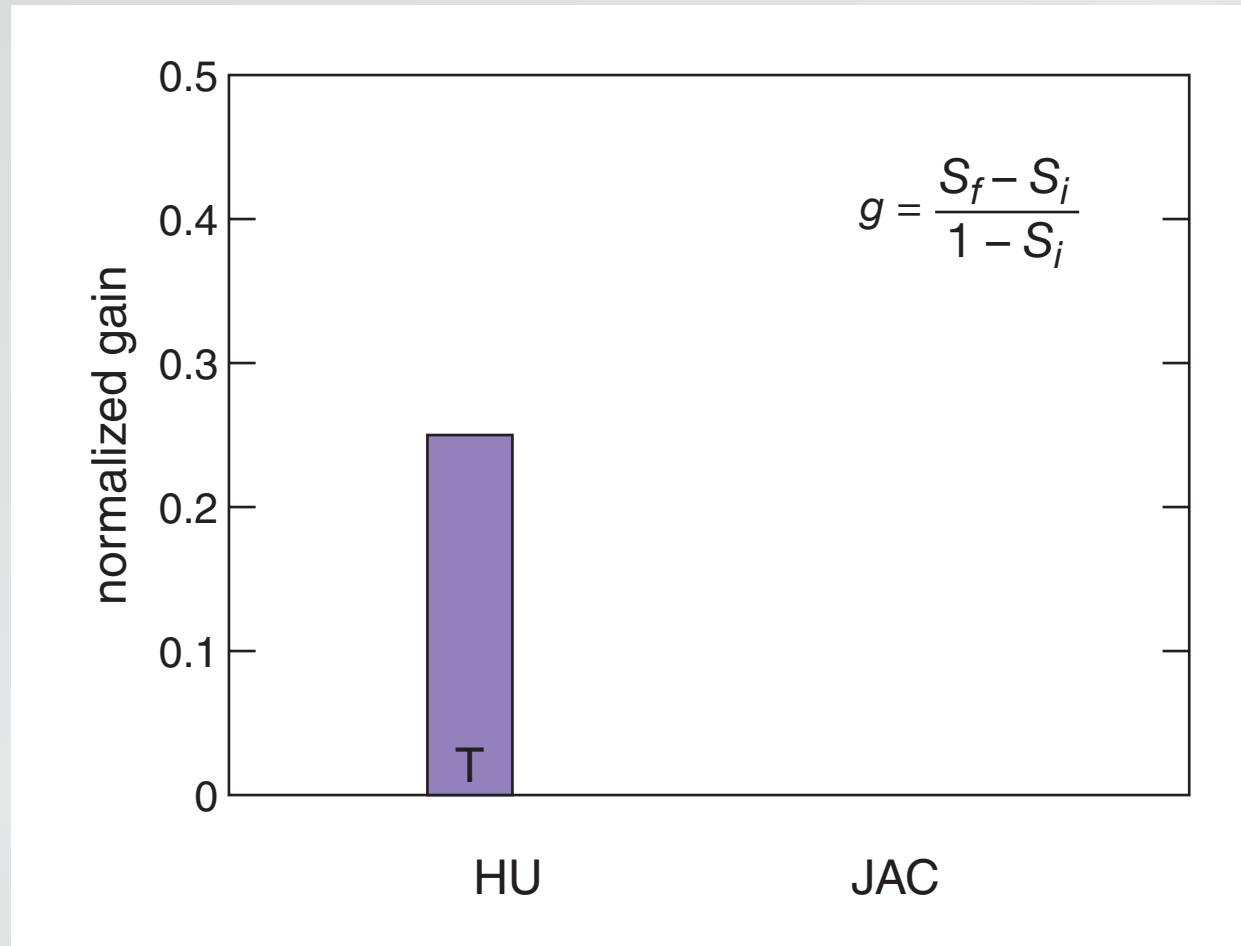


...but will it work here?



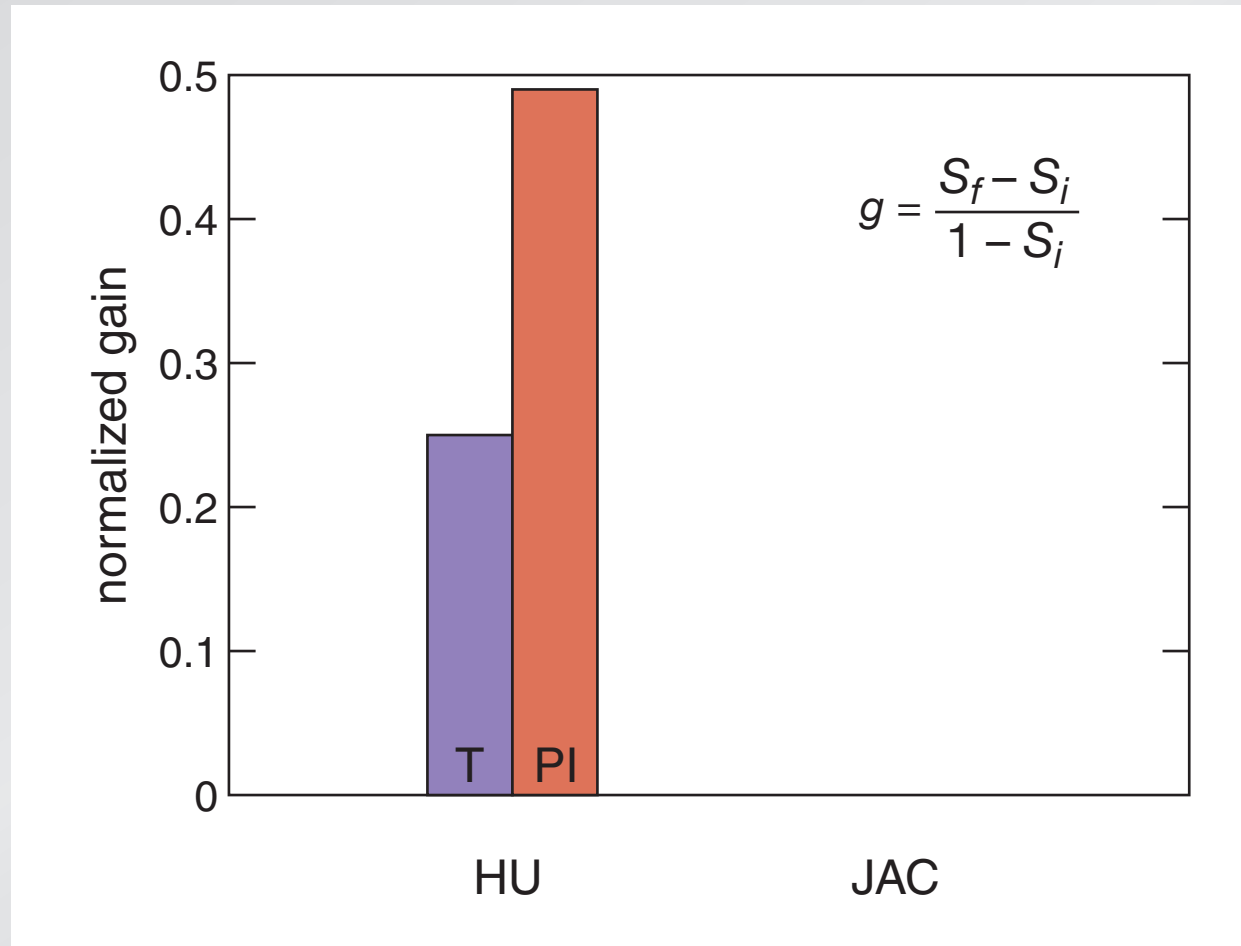
# Implementing PI & JiTT

## FCI normalized gain



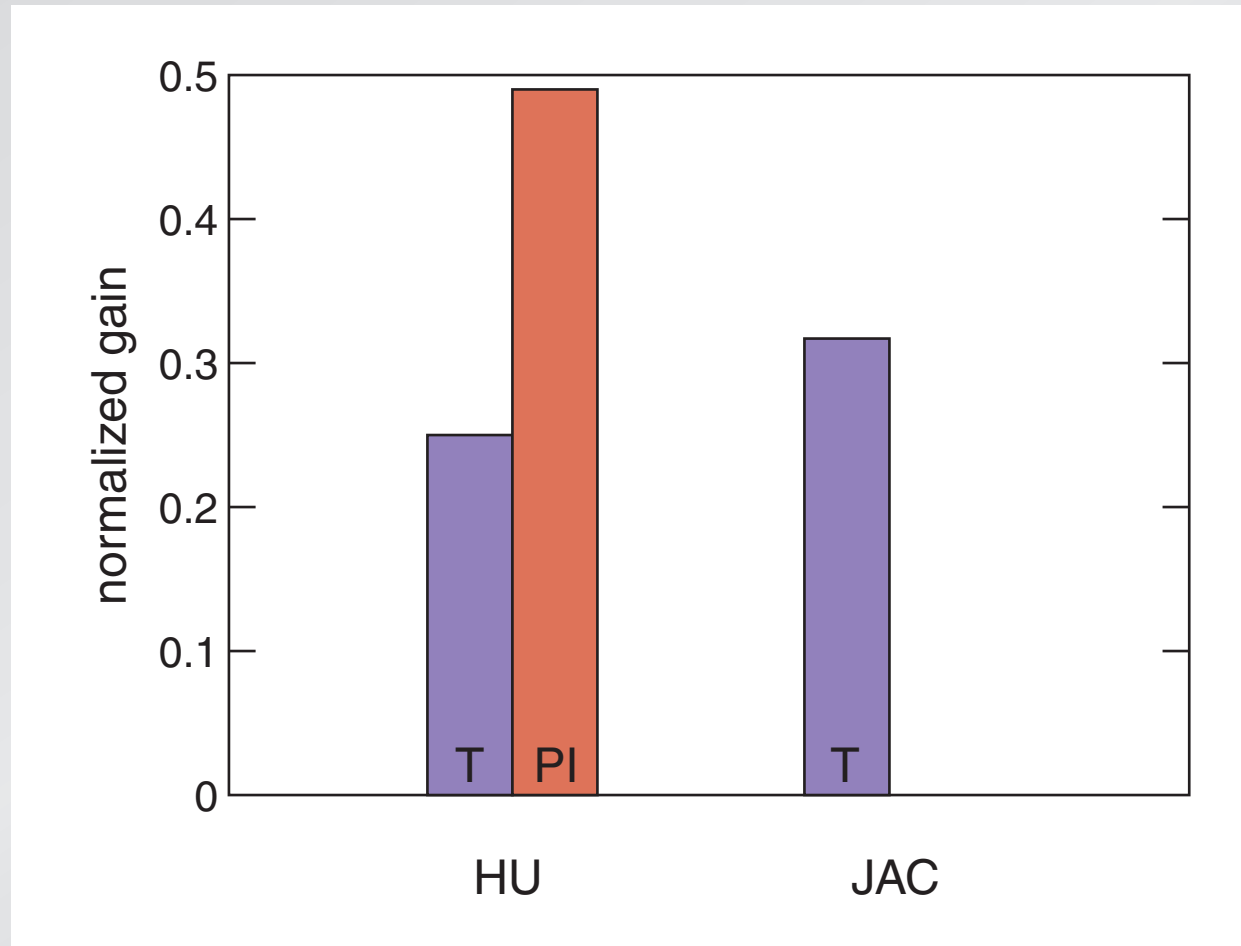
# Implementing PI & JiTT

## FCI normalized gain



# Implementing PI & JiTT

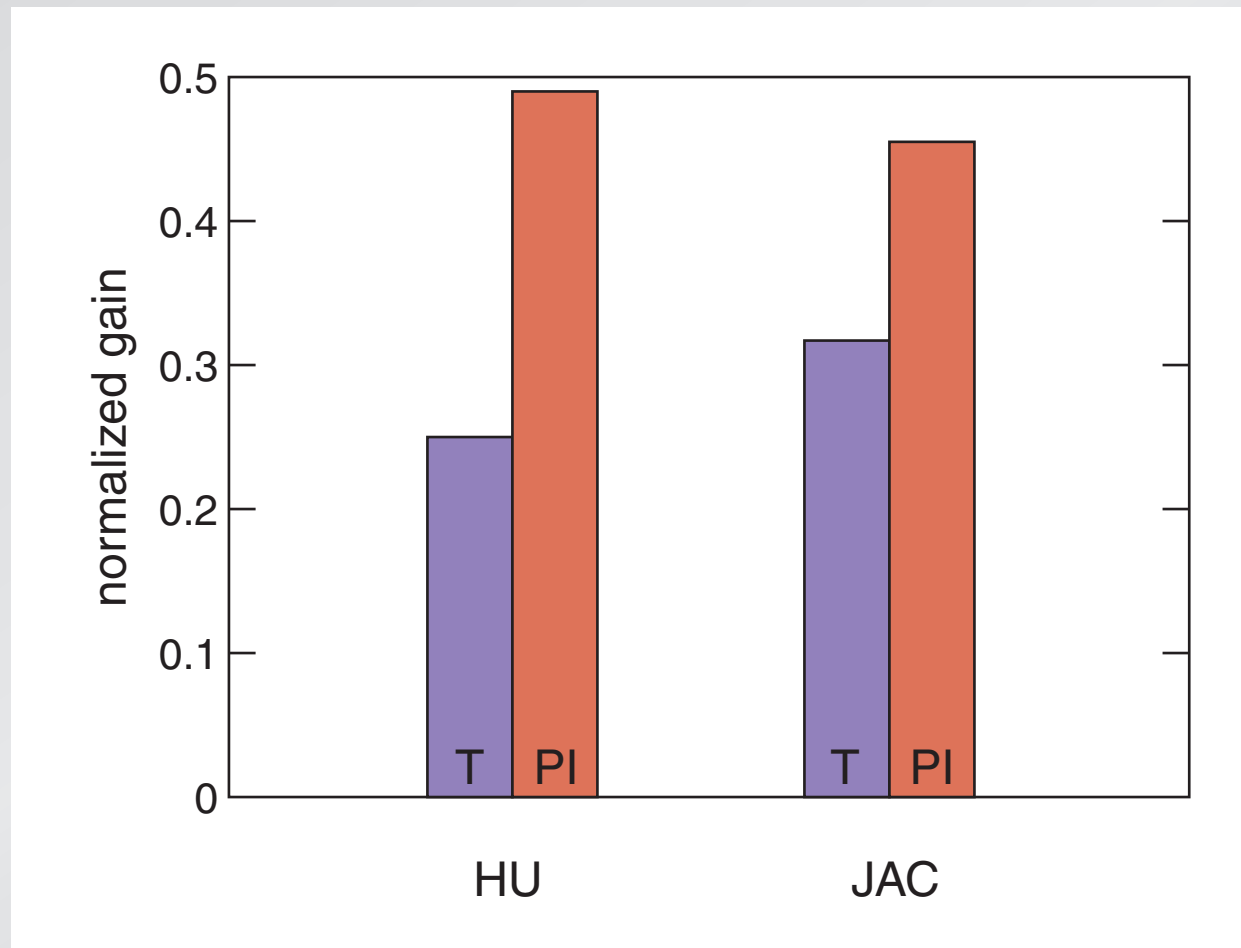
## FCI normalized gain





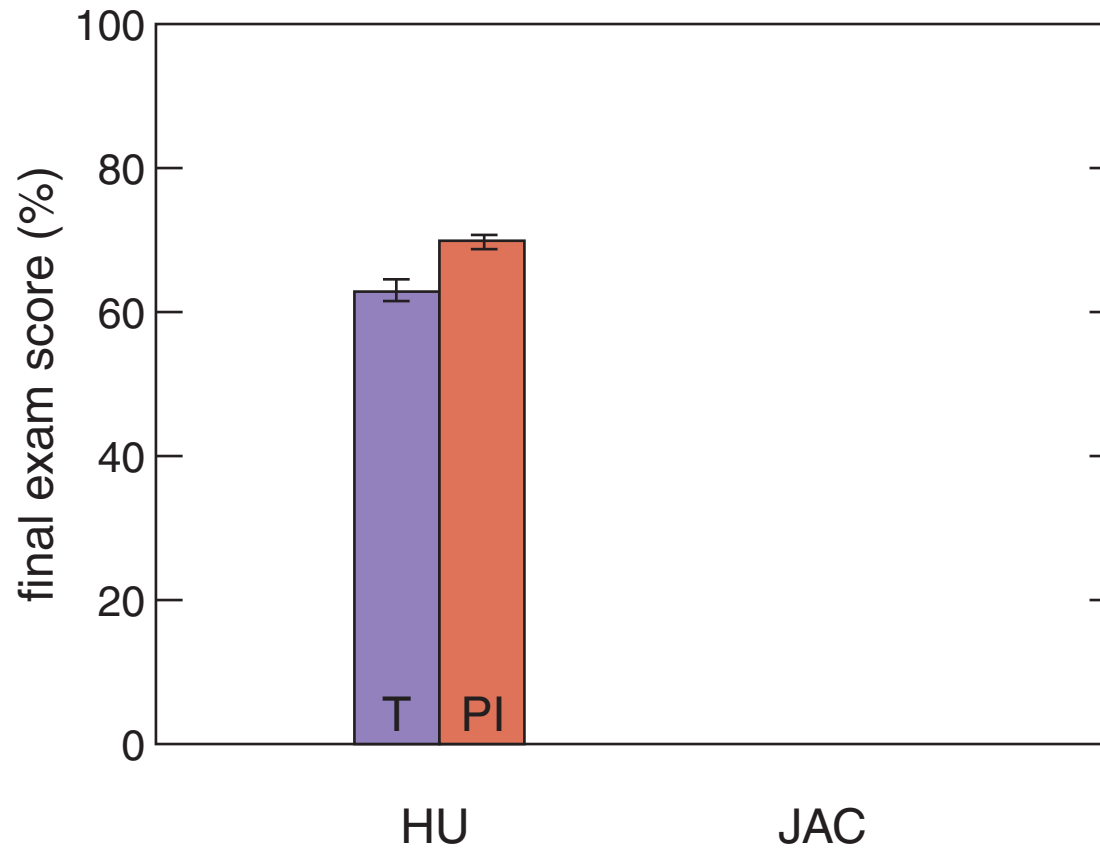
# Implementing PI & JiTT

## FCI normalized gain



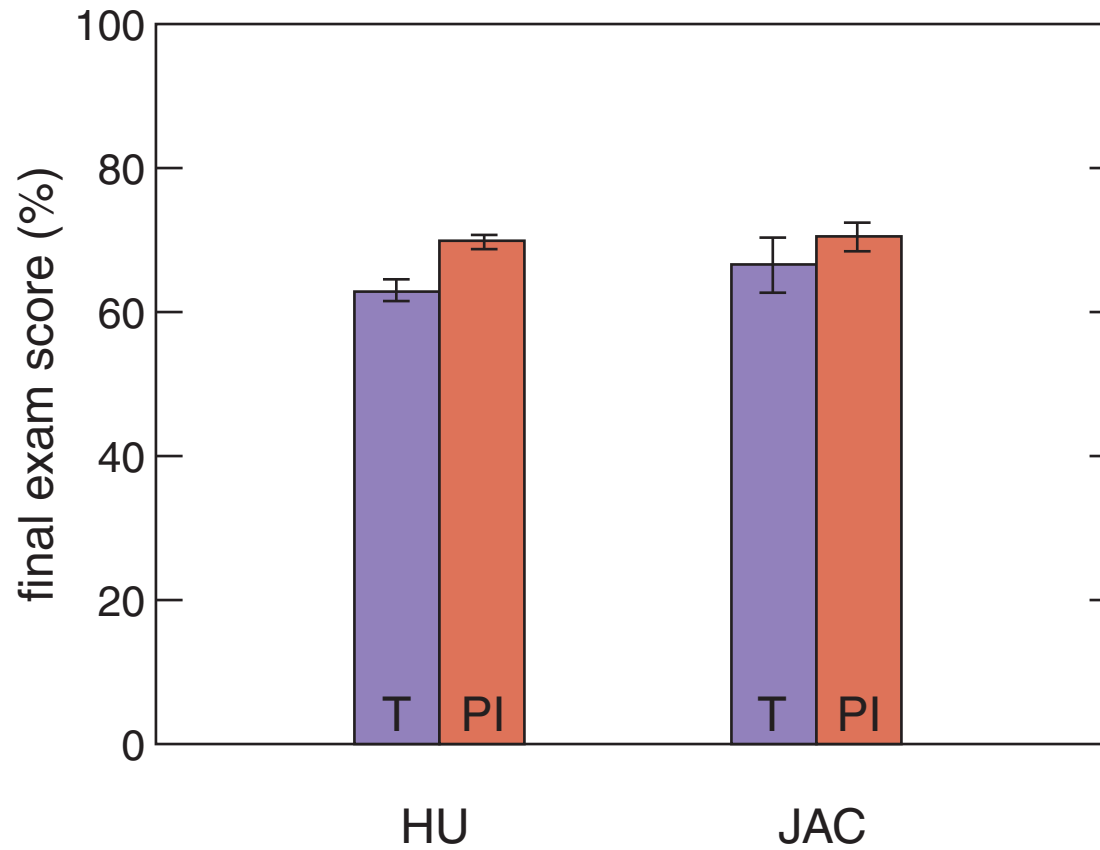
# Implementing PI & JiTT

exam performance



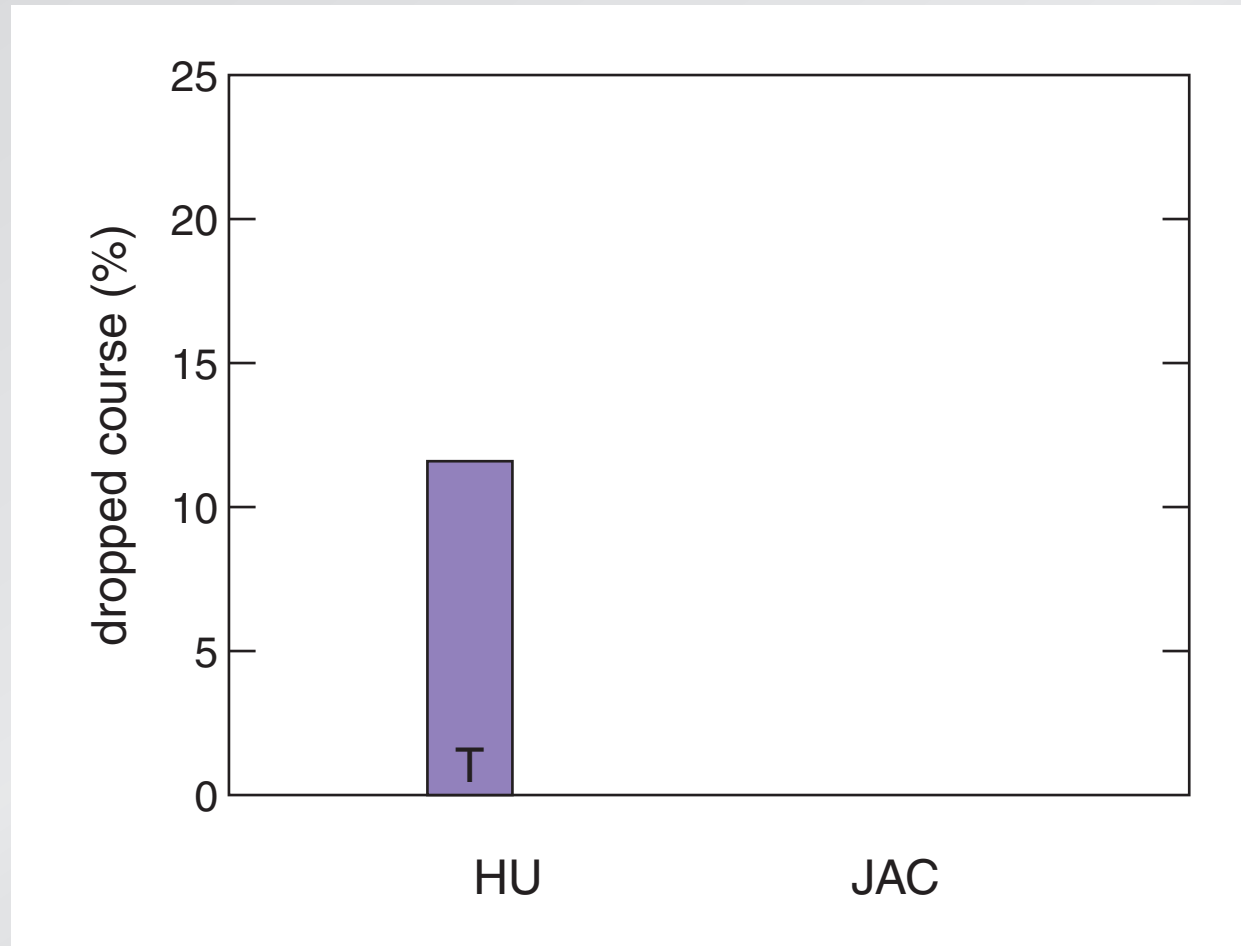
# Implementing PI & JiTT

## exam performance



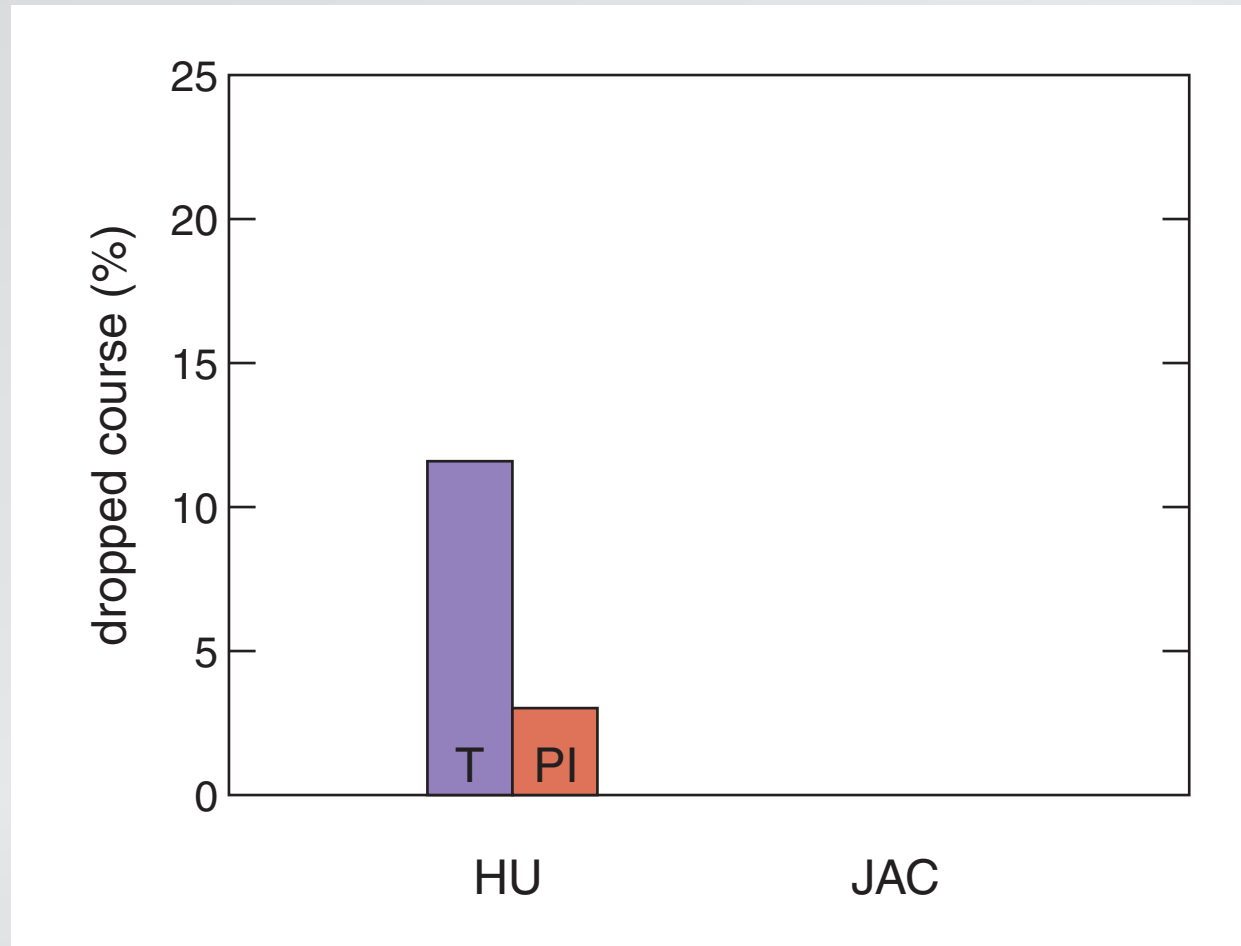
# Implementing PI & JiTT

student retention



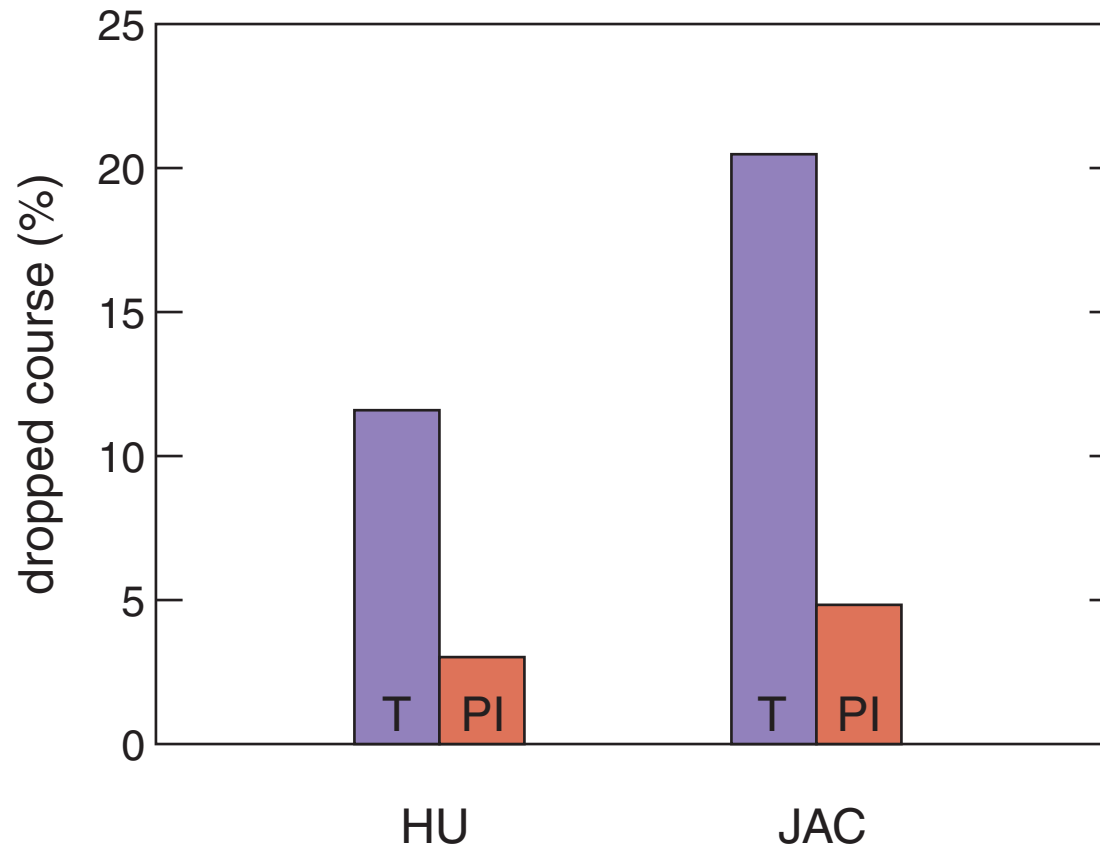
# Implementing PI & JiTT

student retention



# Implementing PI & JiTT

## student retention



# Implementing PI & JiTT

**similar learning gains in different environments**

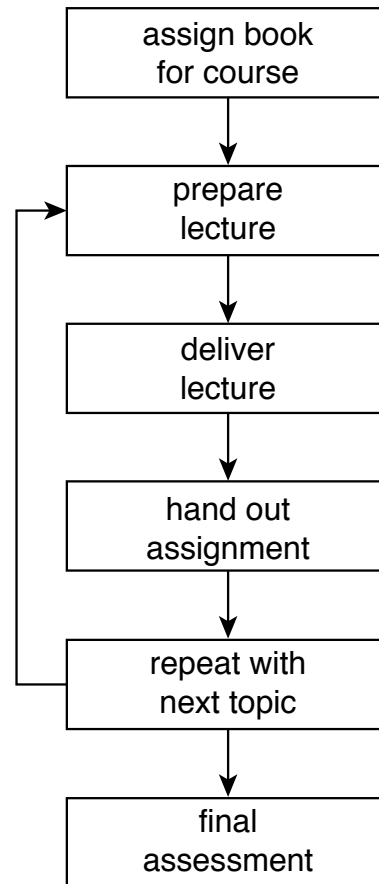
# Implementing PI & JiTT

*“How is preparing a PI class different from preparing a lecture-based class?”*



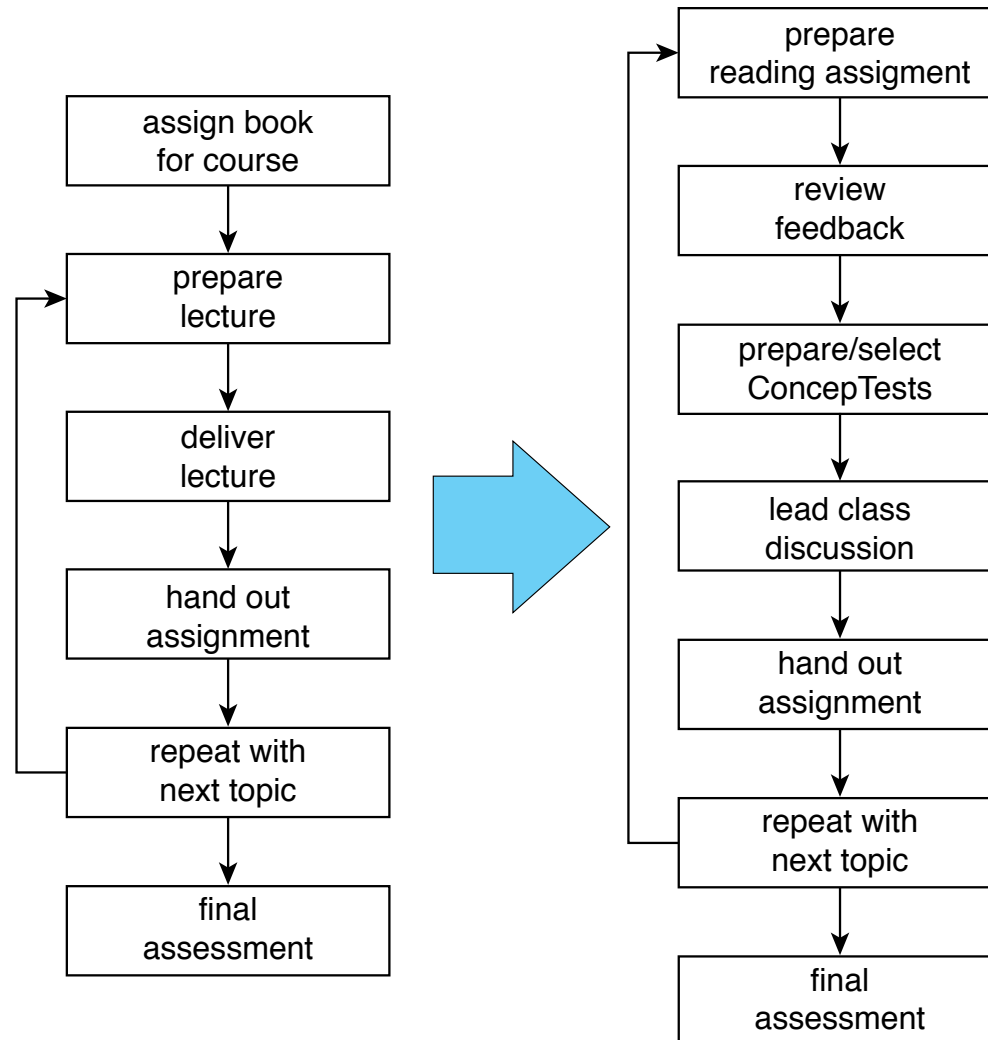
# Implementing PI & JiTT

## preparing for a lecture-based class



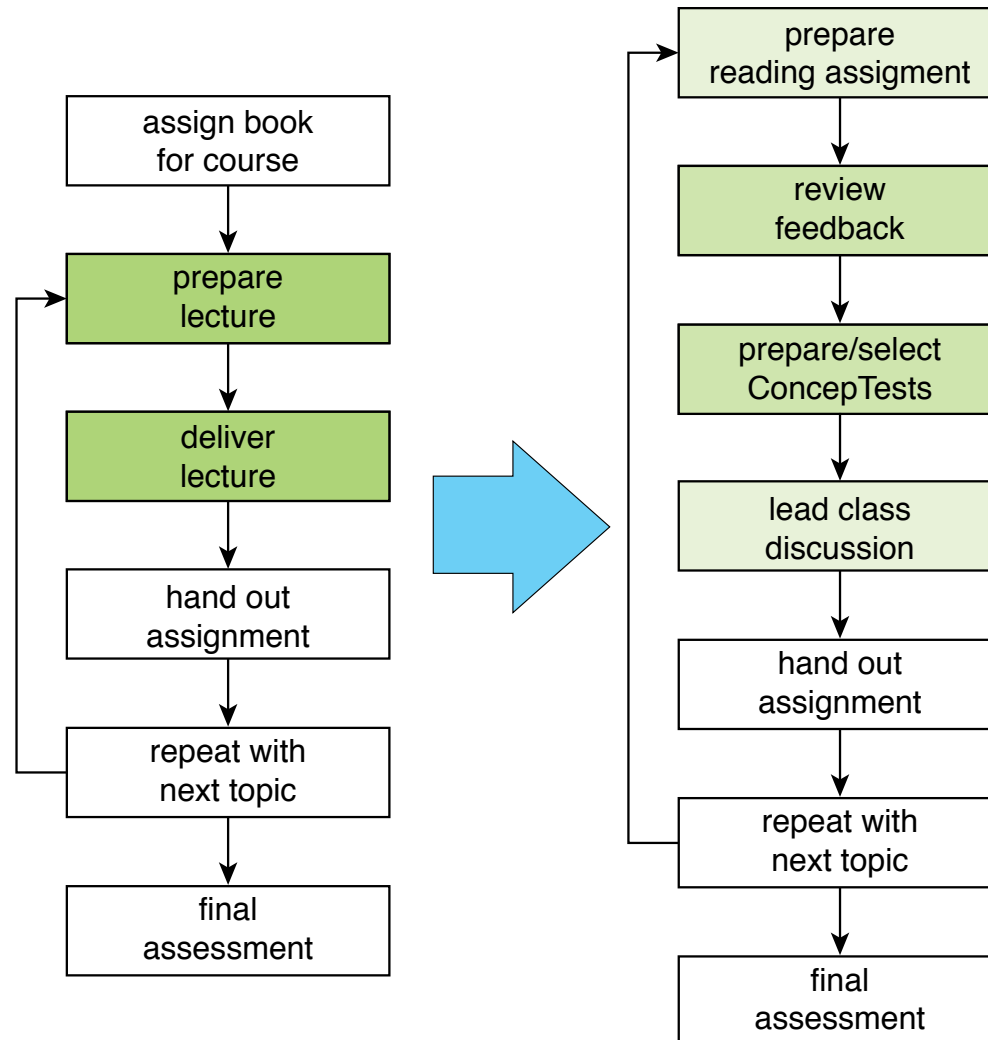
# Implementing PI & JiTT

transitioning: where does the effort go?



# Implementing PI & JiTT

transitioning: where does the effort go?



# Implementing PI & JiTT

**New activities:**

- 1. Reading assignment**
- 2. ConcepTests**

# Implementing PI & JiTT

*“How do I cover everything using this method?”*

# Implementing PI & JiTT

	traditional	PI
in-class coverage	complete	partial

# Implementing PI & JiTT

	traditional	PI
in-class coverage	complete	partial
out-of-class coverage	?	complete

# Implementing PI & JiTT

	<b>traditional</b>	<b>PI</b>
<b>in-class coverage</b>	<b>complete</b>	<b>partial</b>
<b>out-of-class coverage</b>	<b>?</b>	<b>complete</b>
<b>material learned</b>	<b>little</b>	<b>substantial</b>



# Implementing PI & JiTT

	traditional	PI
in-class coverage	complete	partial
out-of-class coverage	?	complete
material learned	little	substantial

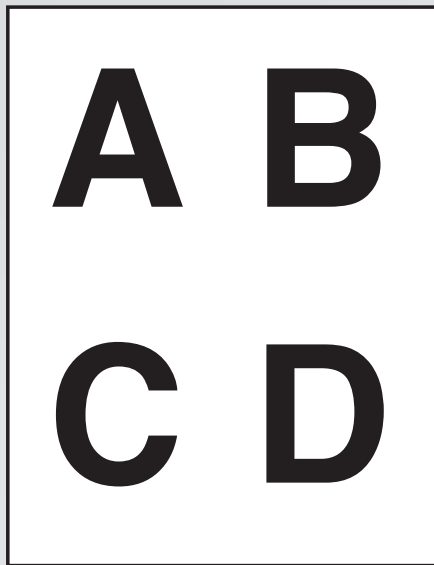
what good is coverage if little is retained?

# Implementing PI & JiTT

*“Do I need clickers?”*

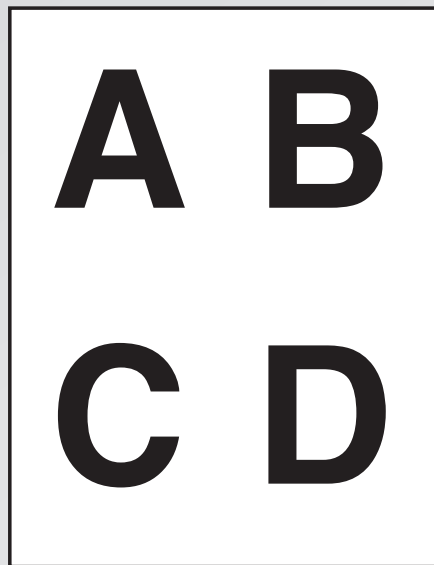
# Implementing PI & JiTT

Flashcards: simple and effective



# Implementing PI & JiTT

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?

Imagine a rope that fits snugly along the equator.

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1. the width of a few atoms
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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:

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

# Implementing PI & JiTT

**Research: same learning gains with and without clickers!**

Clickers or Flashcards: Is There Really a Difference?  
N. Lasry, *The Physics Teacher* 46 (2008) 242



# Implementing PI & JiTT

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

# Implementing PI & JiTT

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

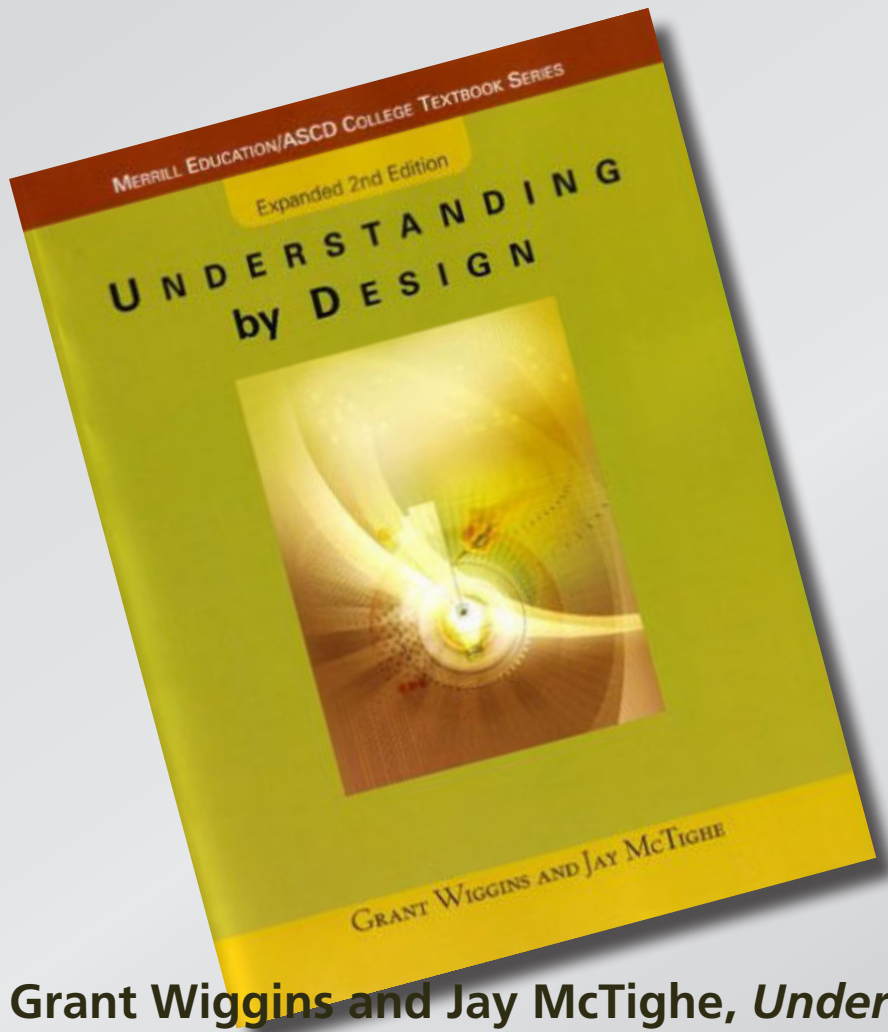
**(but clickers do offer advantages)**

# Implementing PI & JiTT

*“How should I assess my students  
when using this approach?”*

# Implementing PI & JiTT

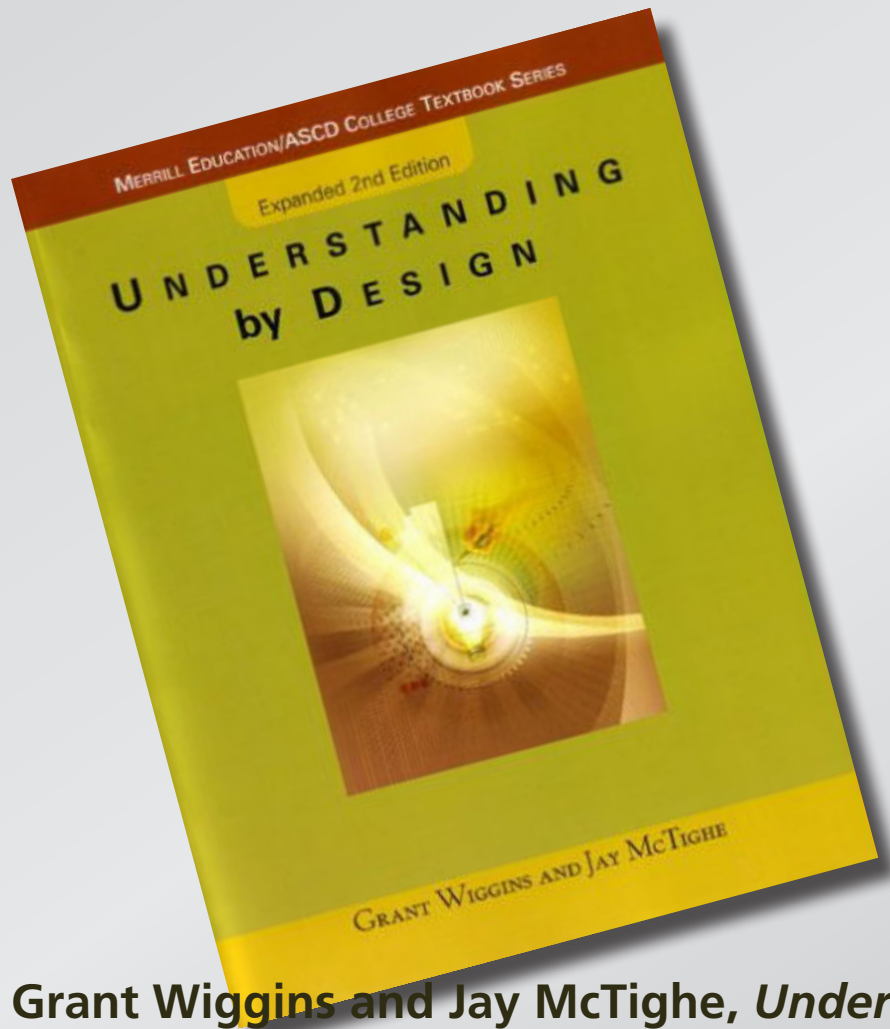
Begin by setting learning goals



Grant Wiggins and Jay McTighe, *Understanding by Design* (Prentice Hall, 2001)

# Implementing PI & JiTT

Begin by setting learning goals

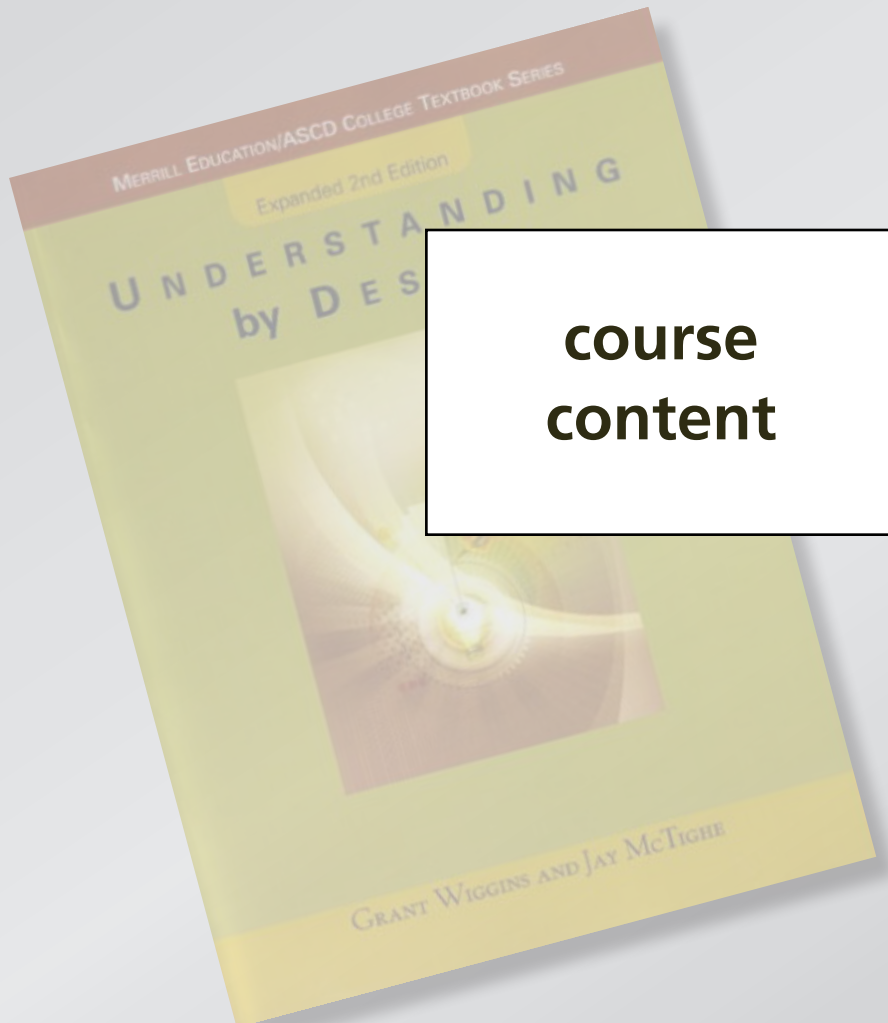


- approach, not content
- focus on understanding
- backward design

Grant Wiggins and Jay McTighe, *Understanding by Design* (Prentice Hall, 2001)

# Implementing PI & JiTT

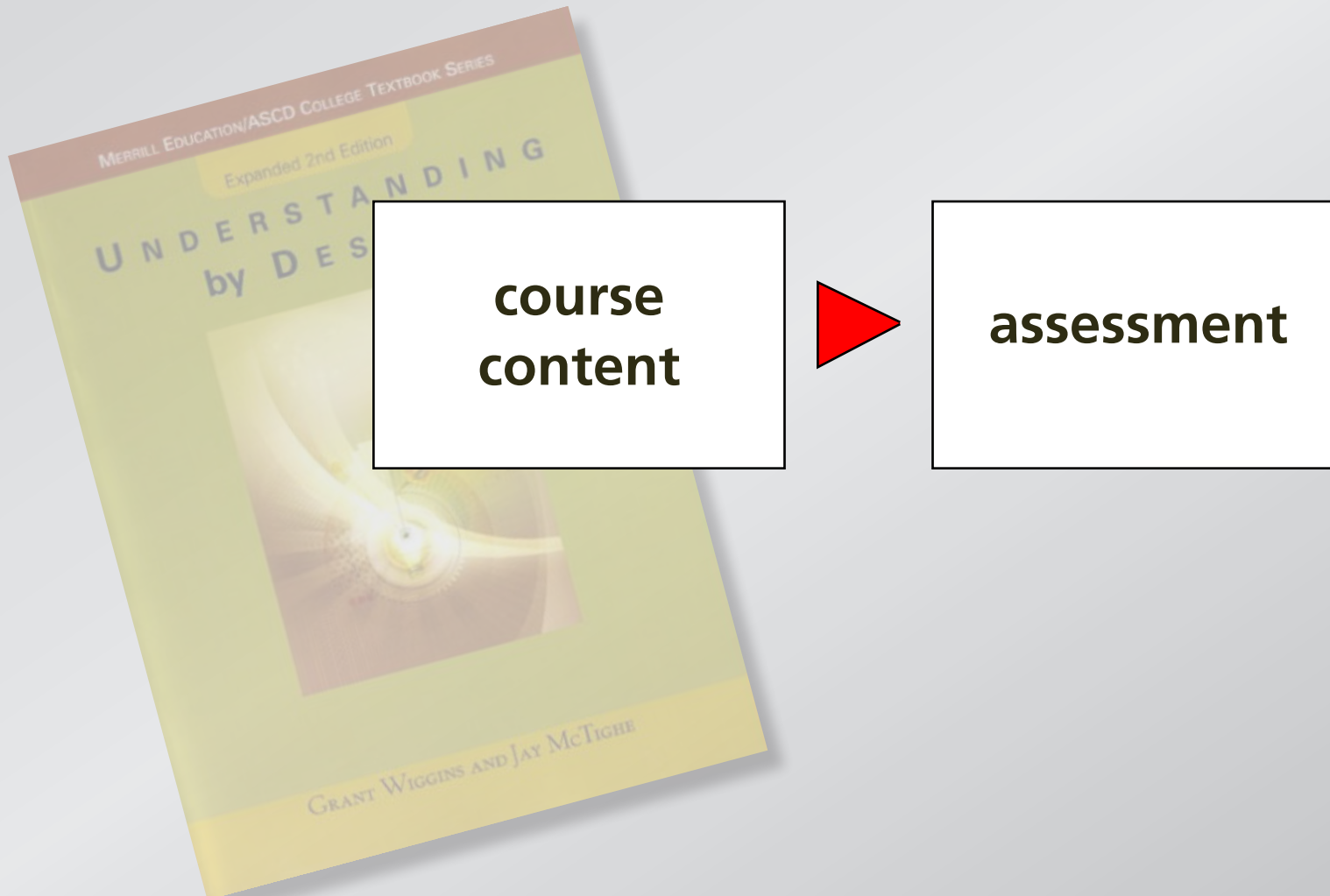
## Traditional approach to course planning



**course  
content**

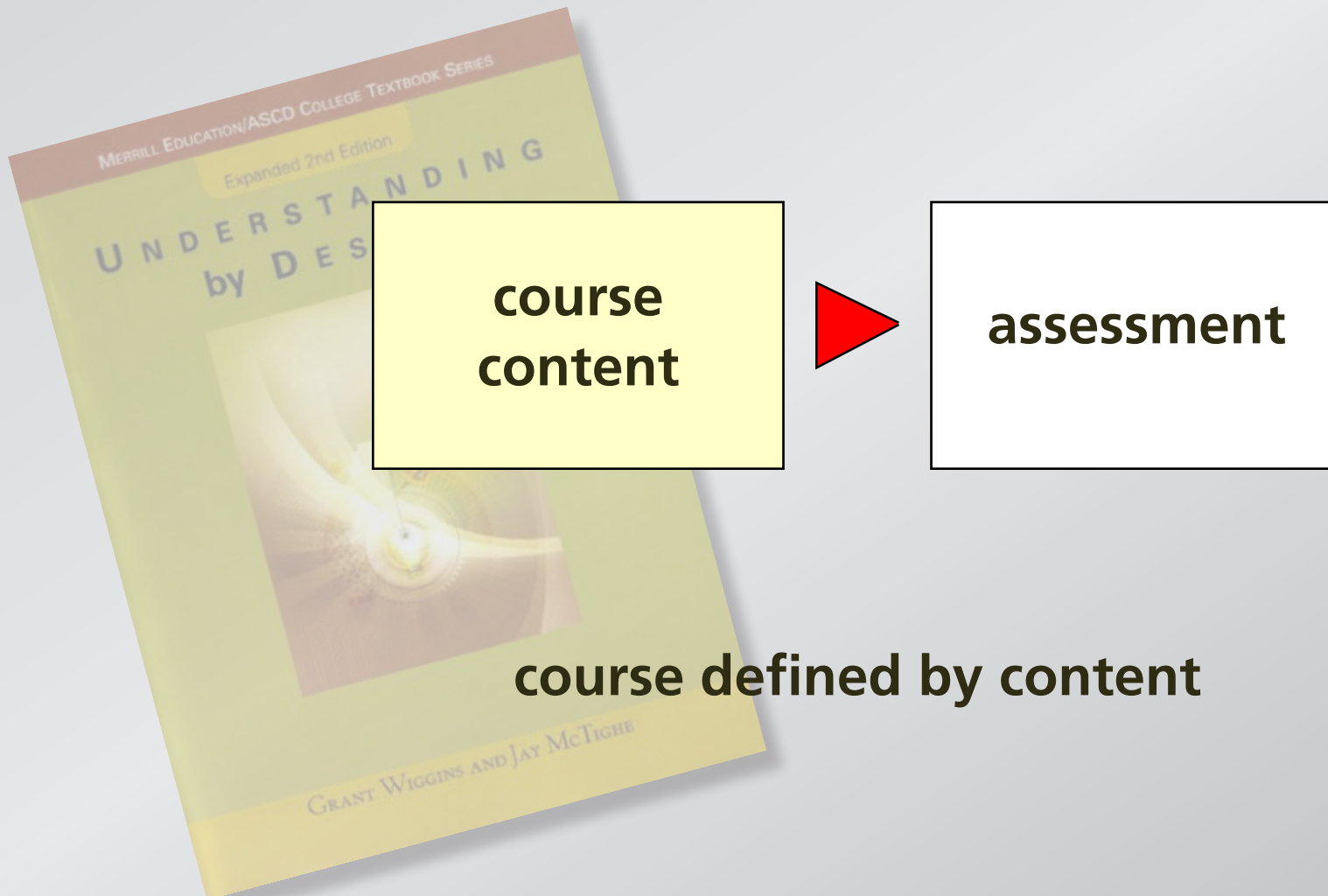
# Implementing PI & JiTT

## Traditional approach to course planning



# Implementing PI & JiTT

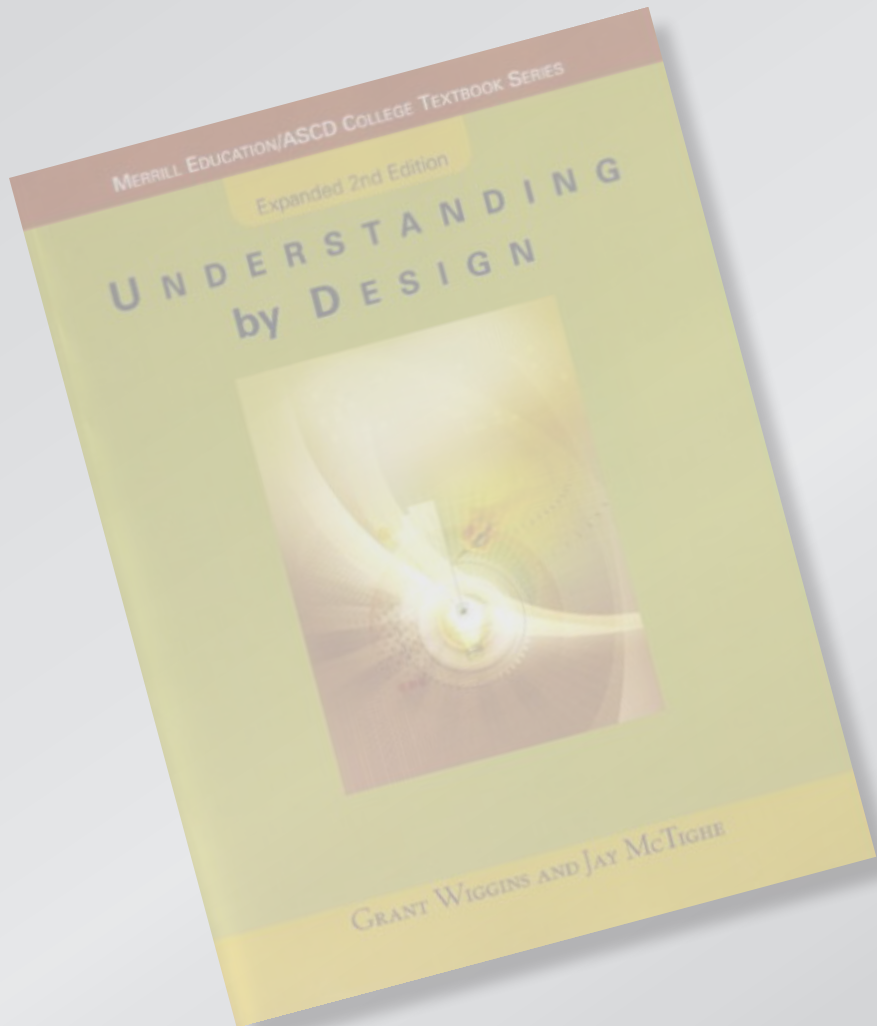
## Traditional approach to course planning





# Implementing PI & JiTT

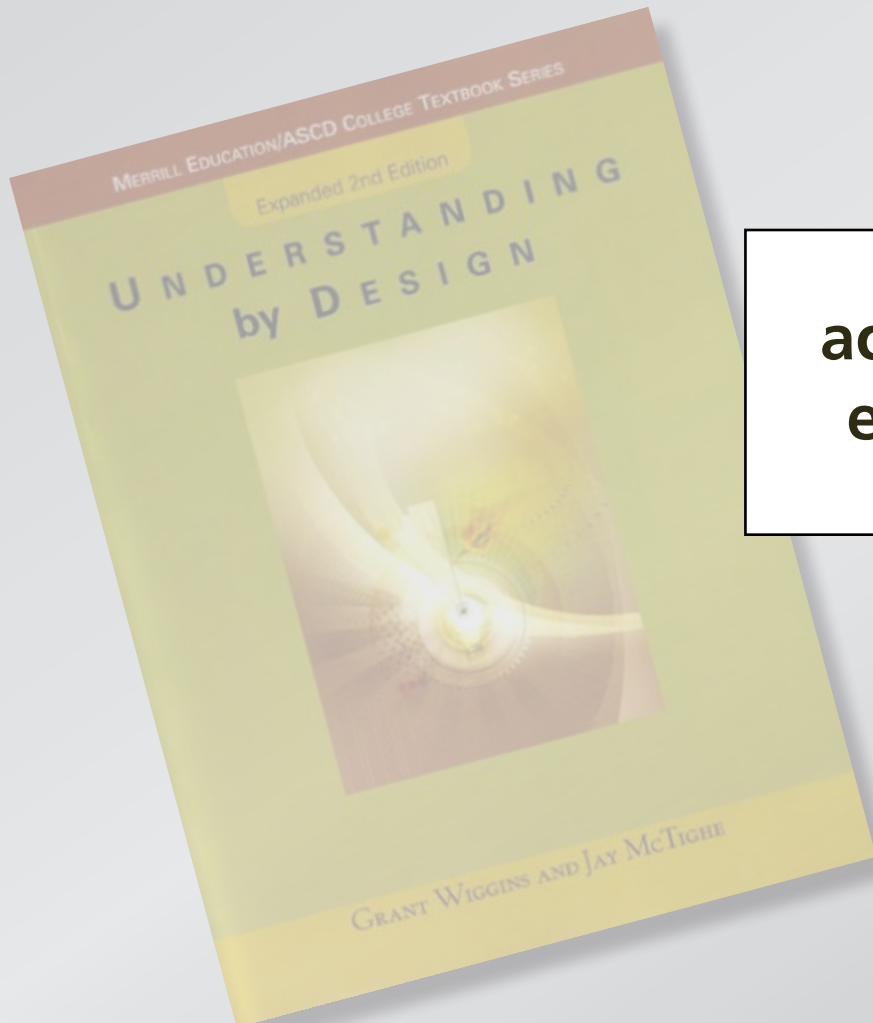
## Backward design



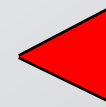
**desired  
outcomes**

# Implementing PI & JiTT

## Backward design



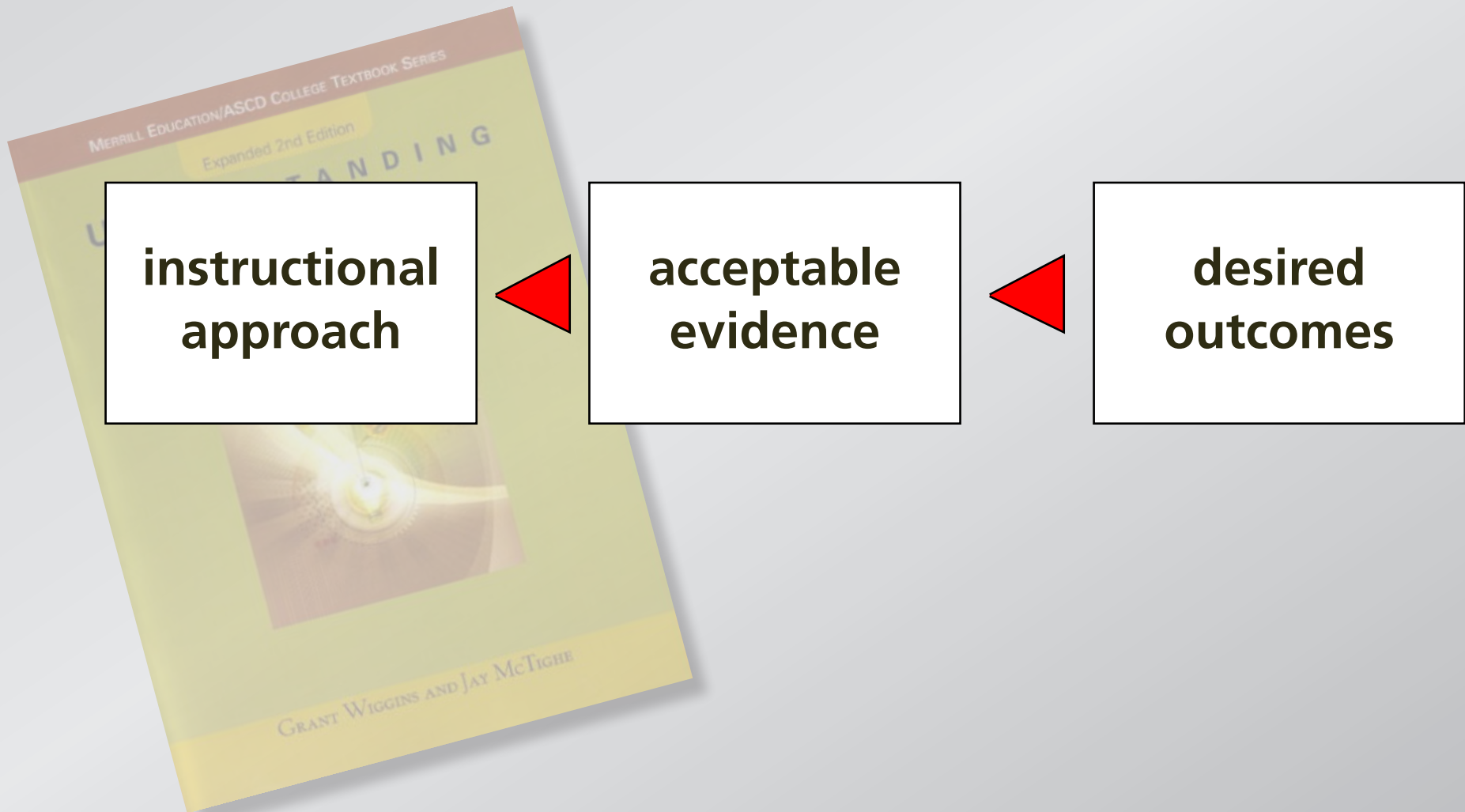
**acceptable  
evidence**



**desired  
outcomes**

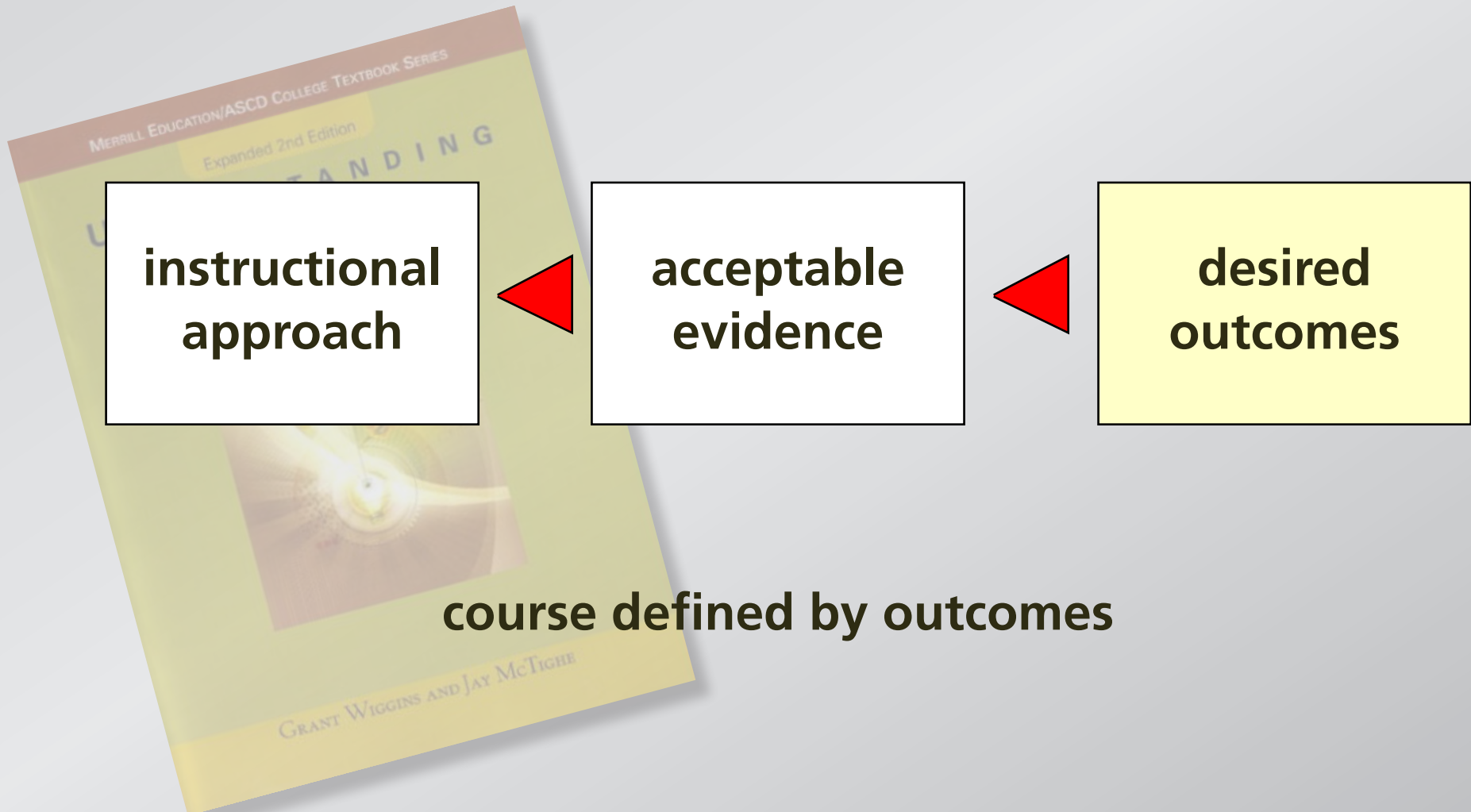
# Implementing PI & JiTT

## Backward design



# Implementing PI & JiTT

## Backward design



# Implementing PI & JiTT

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

# Implementing PI & JiTT

**Need to test meaningful skills!**

# Implementing PI & JiTT

**Some additional ideas:**

- **Open book/computer exam**
- **Collaborative exam**
- **Multidimensional testing**

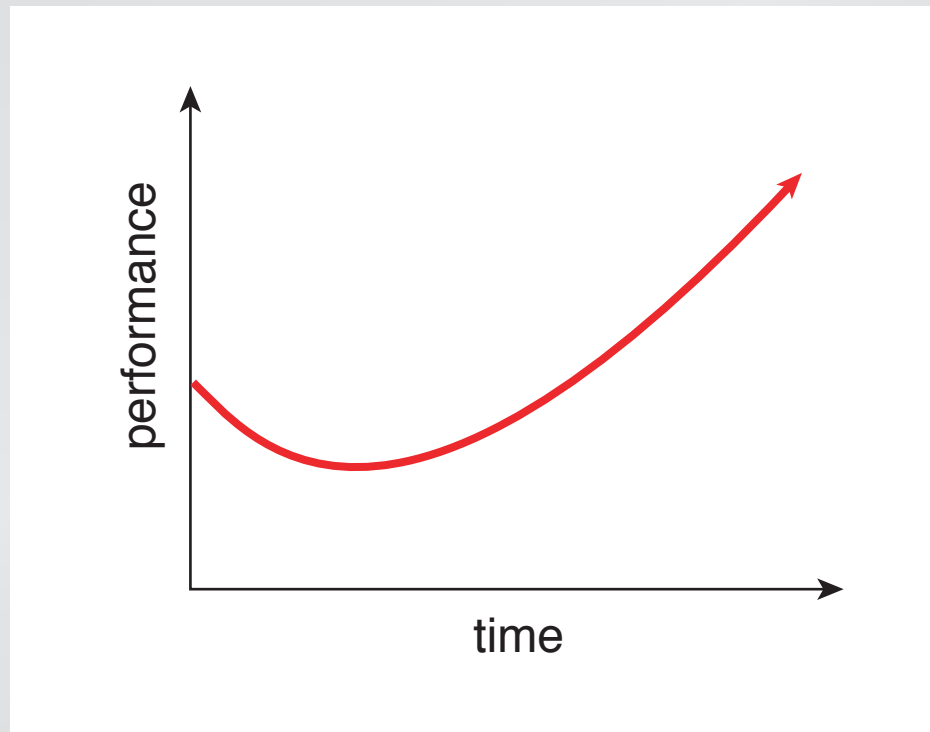
# Implementing PI & JiTT

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



# Implementing PI & JiTT

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



# Implementing PI & JiTT

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 too 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.

# Implementing PI & JiTT

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!

# Implementing PI & JiTT

Hello Prof. Mayer,

I wanted to hand you this card as  
evidence 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!

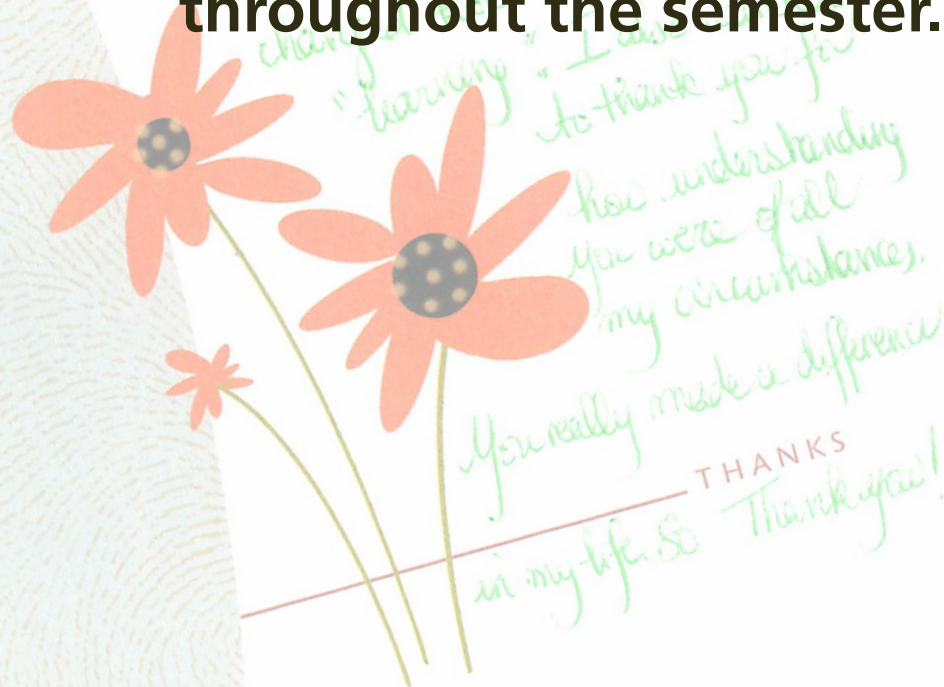
Love, Best.

You made a difference.

# Implementing PI & JiTT

**"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.*





# Implementing PI & JiTT

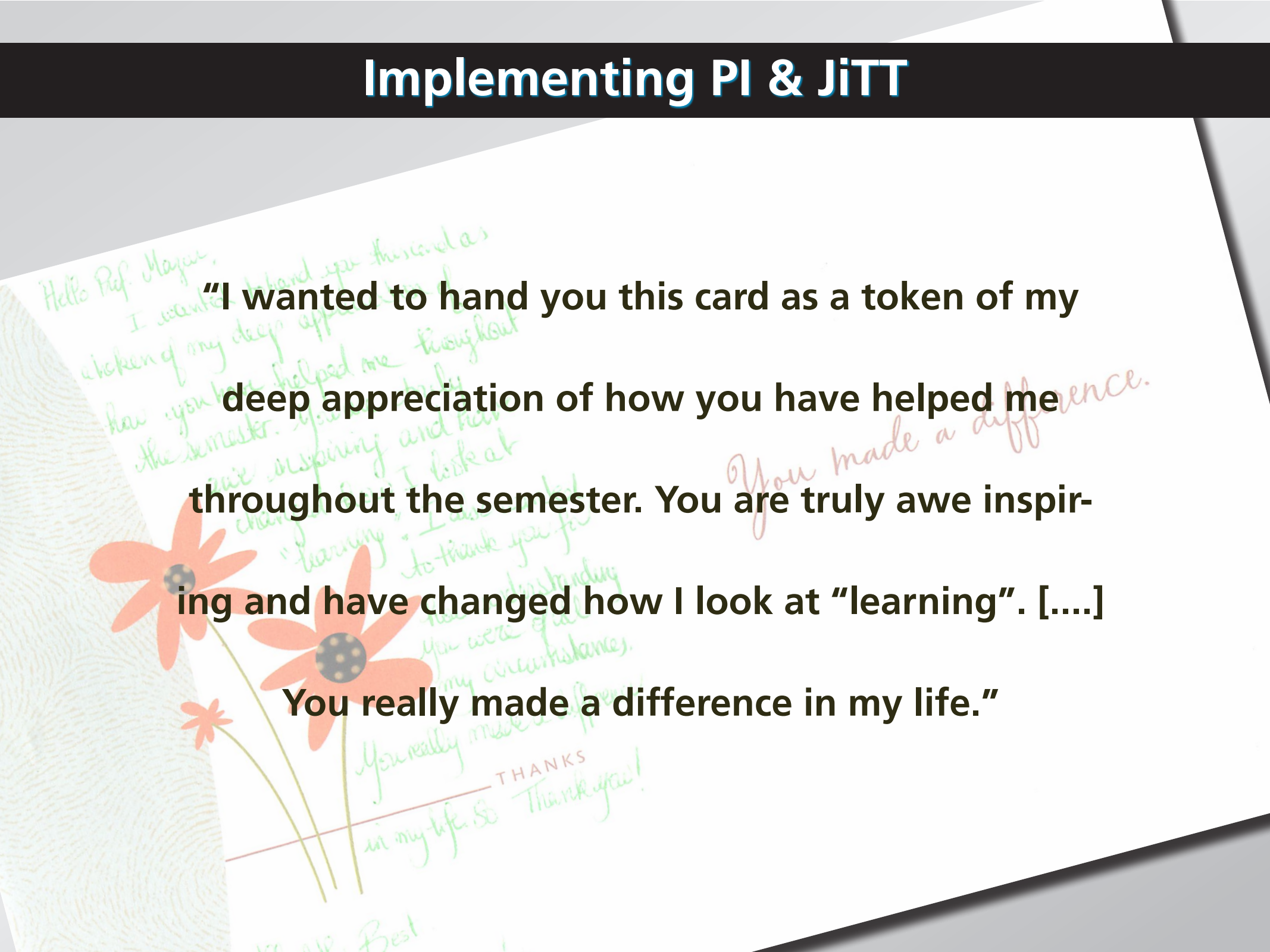
**"I wanted to hand you this card as a token of my deep appreciation of how you have helped me throughout the semester. You are truly awe inspiring and have changed how I look at "learning".**

*You made a difference.*

*THANKS  
in my life. So Thank you!*

*Best*

# Implementing PI & JiTT



**"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."**

*Handwritten text in background:*  
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 awe  
inspiring and have changed how I  
look at "learning". I look at  
"learning" as a journey and  
thank you for making it so.  
You were a great teacher and  
my circumstances.  
You really made a difference  
in my life. So Thank you!  
THANKS  
Best

# Implementing PI & JiTT

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



# Implementing PI & JiTT

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

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

# Outline

- **PI & JiTT Overview**
- **Implementing PI & JiTT**
- **ConceptTests**

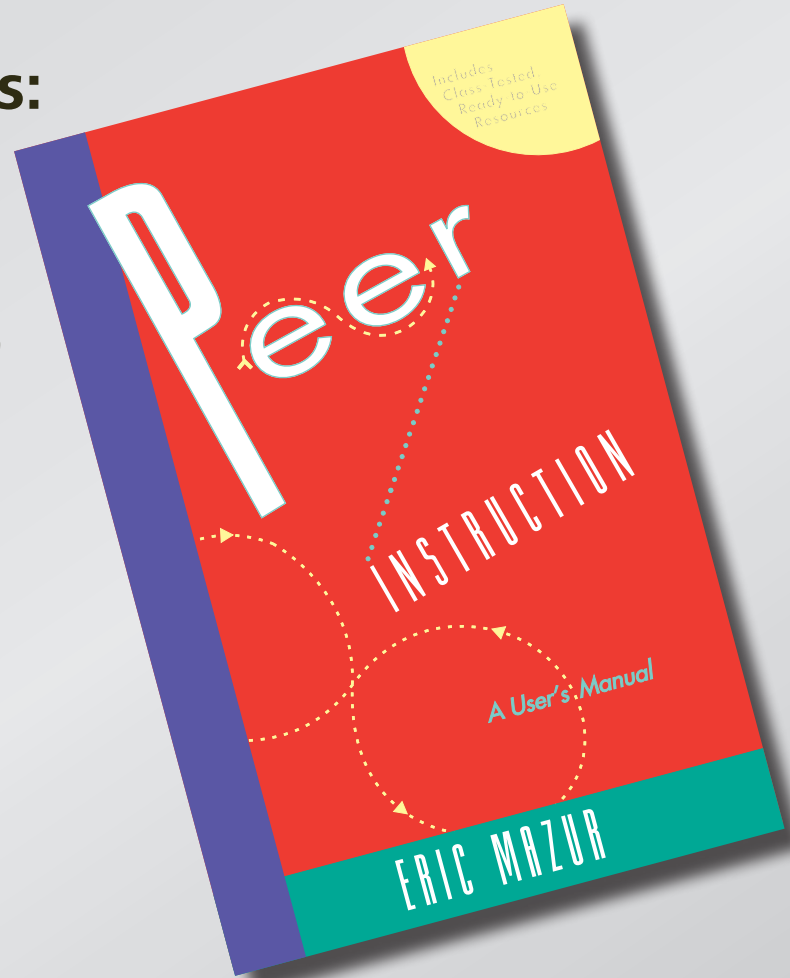
# ConcepTests

***“Where can I get examples of good questions?”***

# ConceptTests

## Books with ConceptTests:

- Physics (Prentice Hall)



# ConcepTests

## Books with ConcepTests:

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

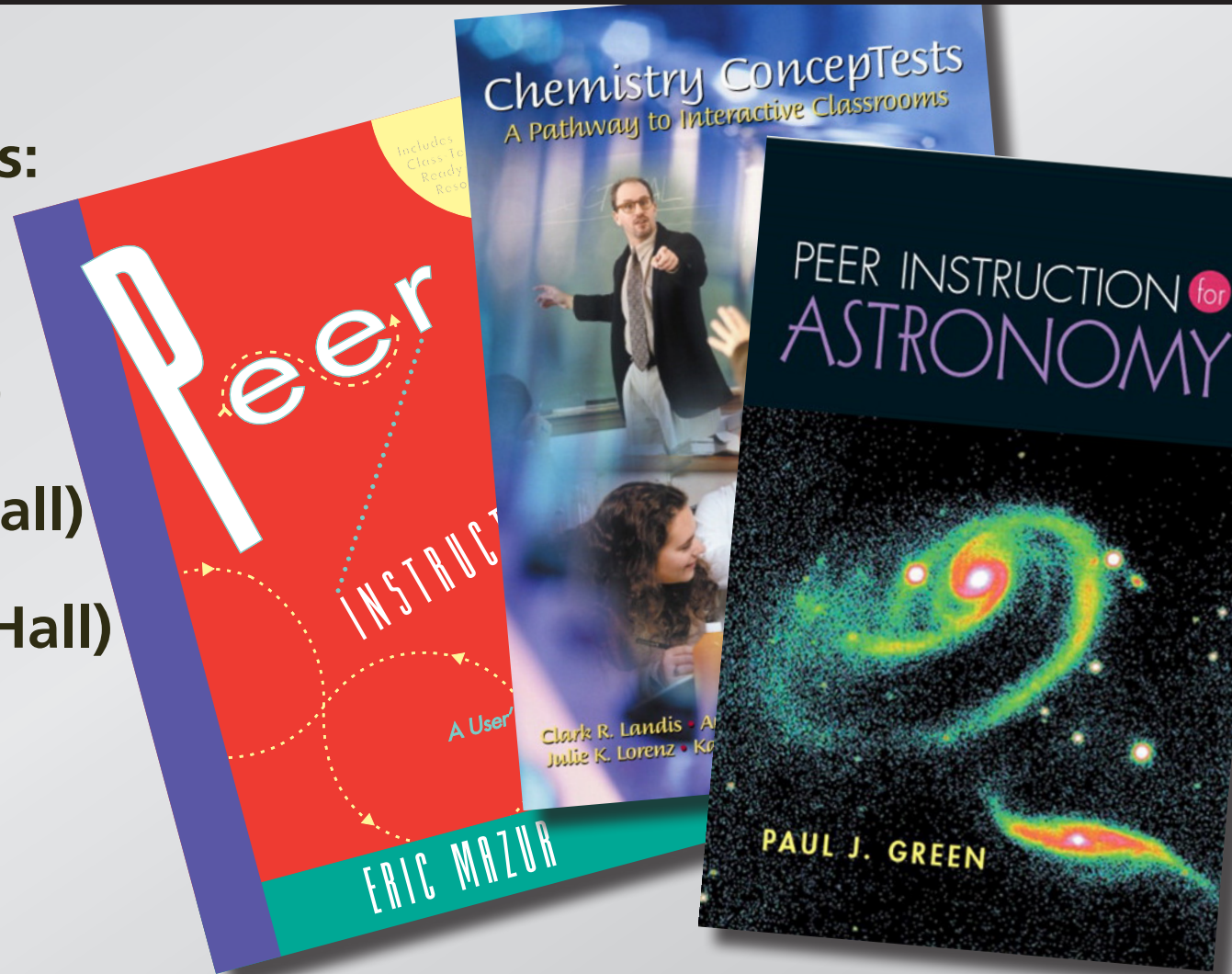




# ConcepTests

## Books with ConcepTests:

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



# ConcepTests

## Books with ConcepTests:

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



# ConceptTests

... or try searching Google:

**<subject> "Peer Instruction"**

**<subject> ConceptTest**

**<subject> "Concept Test"**

**<subject> clickers**



# ConcepTests

## Types of questions

- survey
- model testing
- discussion
- select from list

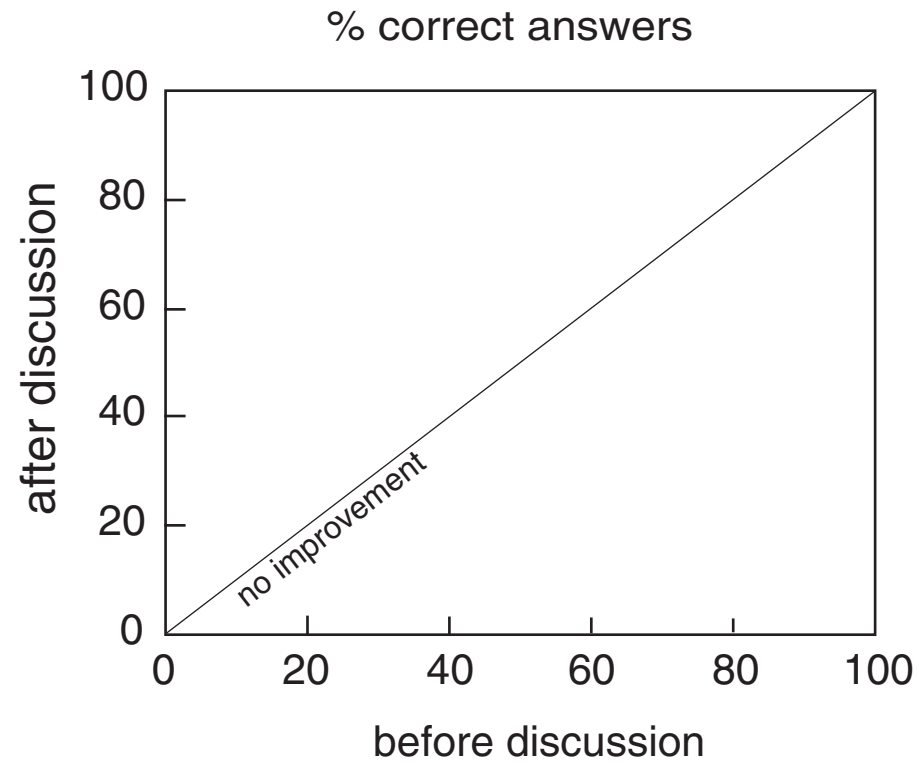
# ConcepTests

**Good conceptual questions (ConcepTests):**

- **focus on interpretation/model (not recall)**
- **stimulate discussion**
- **are not “leading questions”**
- **are of manageable difficulty**

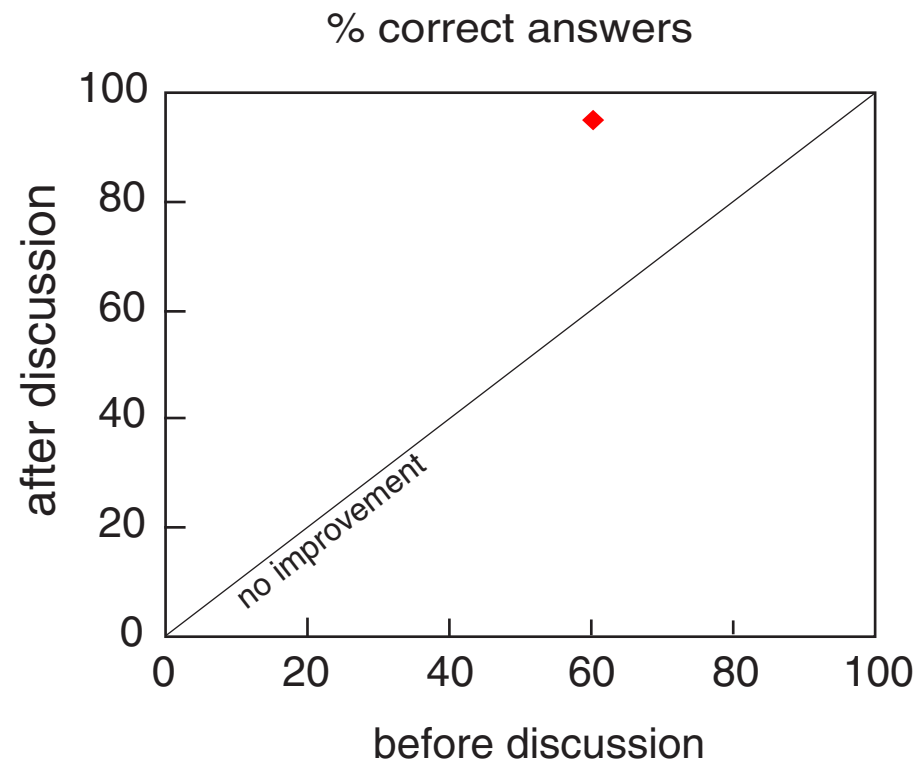
# ConceptTests

## ConceptTest data



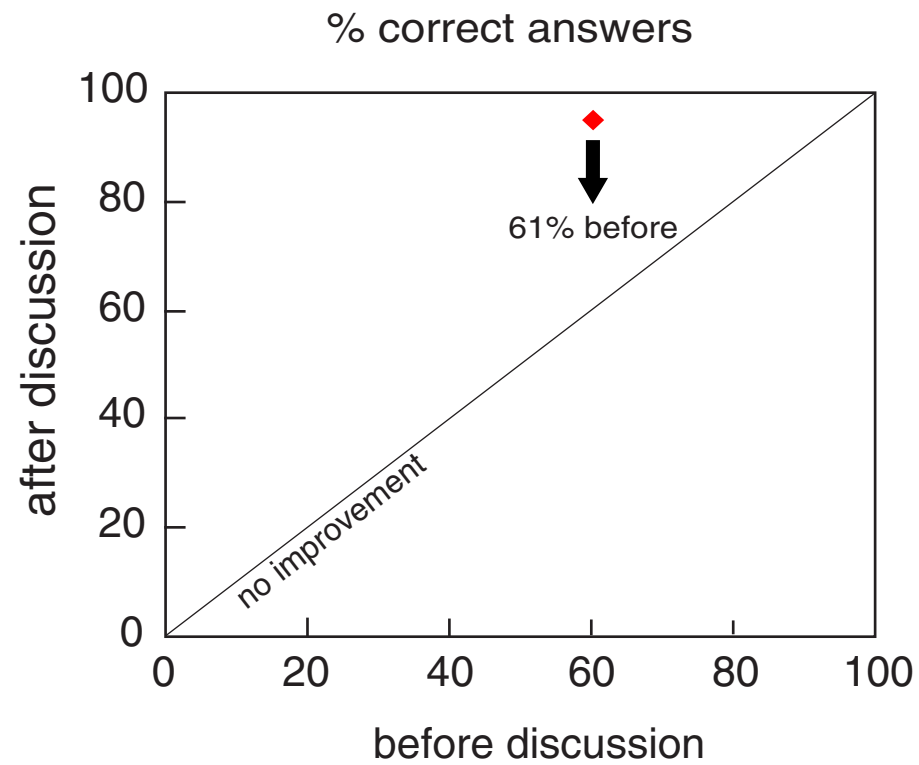
# ConceptTests

## ConceptTest data



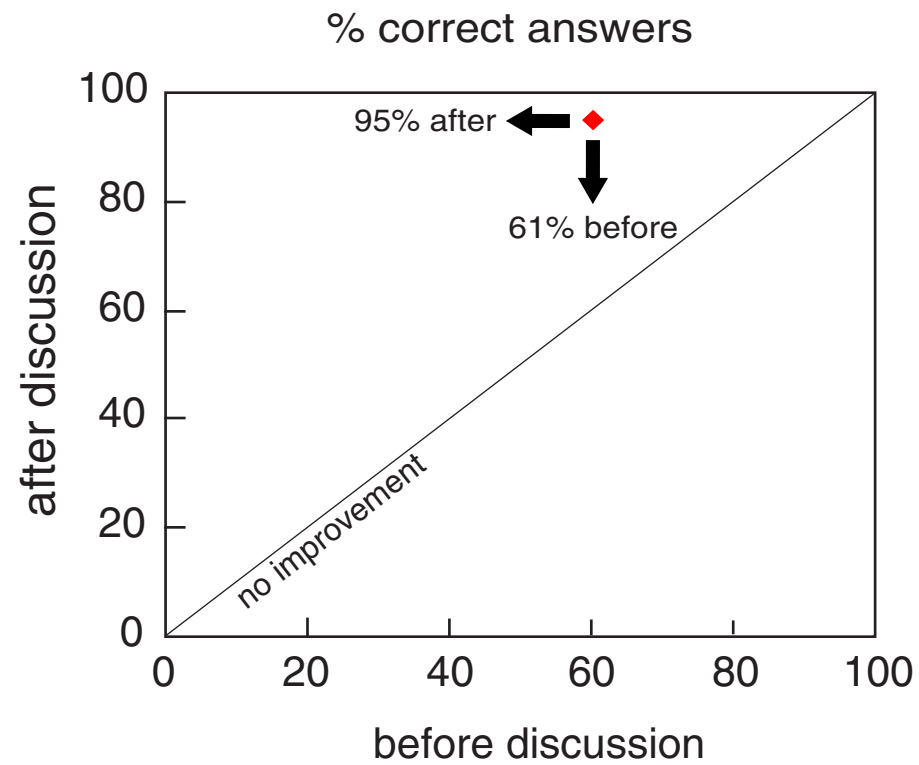
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## ConceptTest data



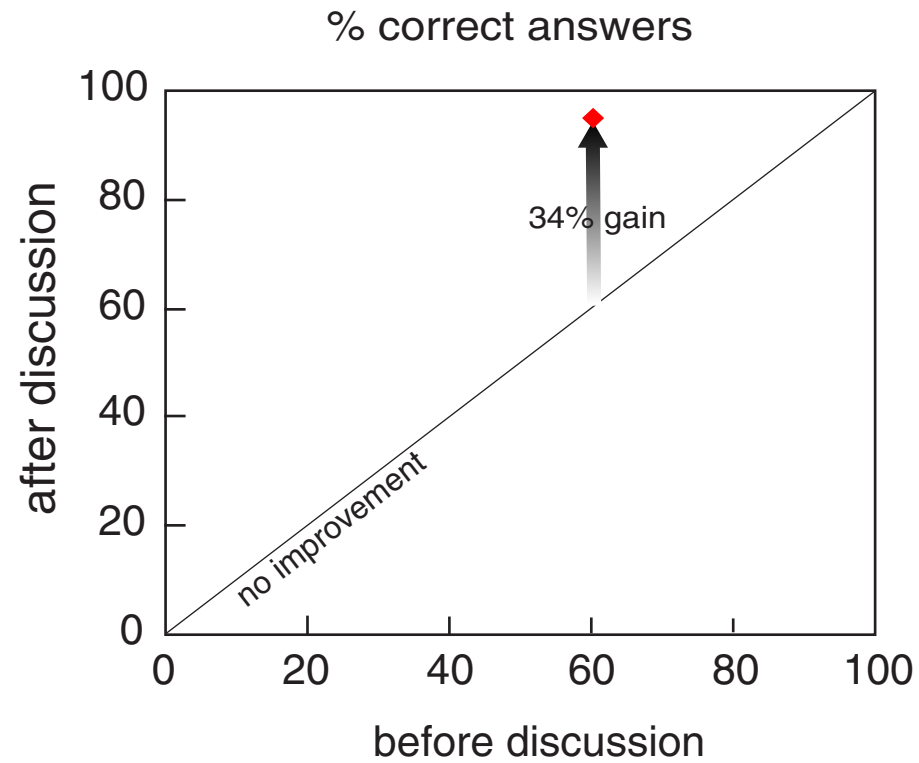
# ConceptTests

## ConceptTest data



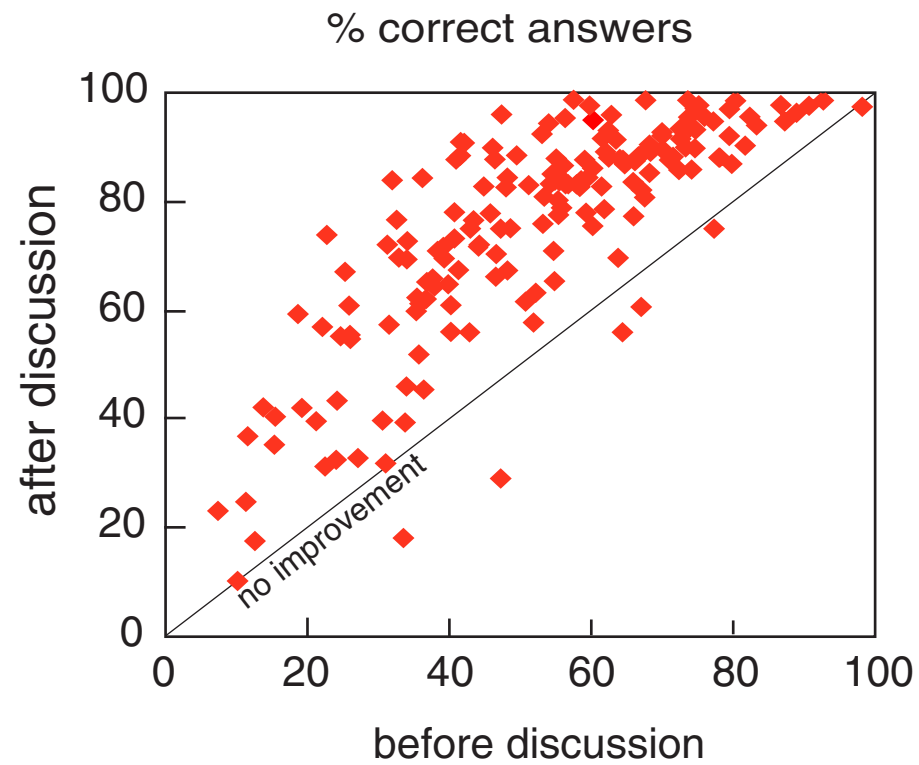
# ConceptTests

## ConceptTest data



# ConceptTests

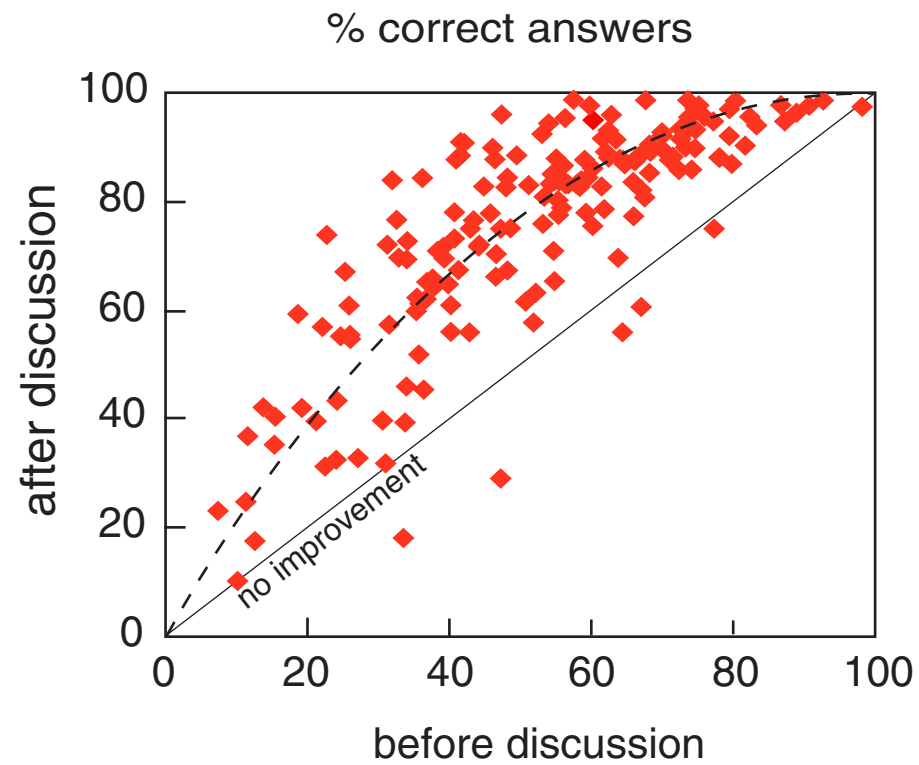
## ConceptTest data





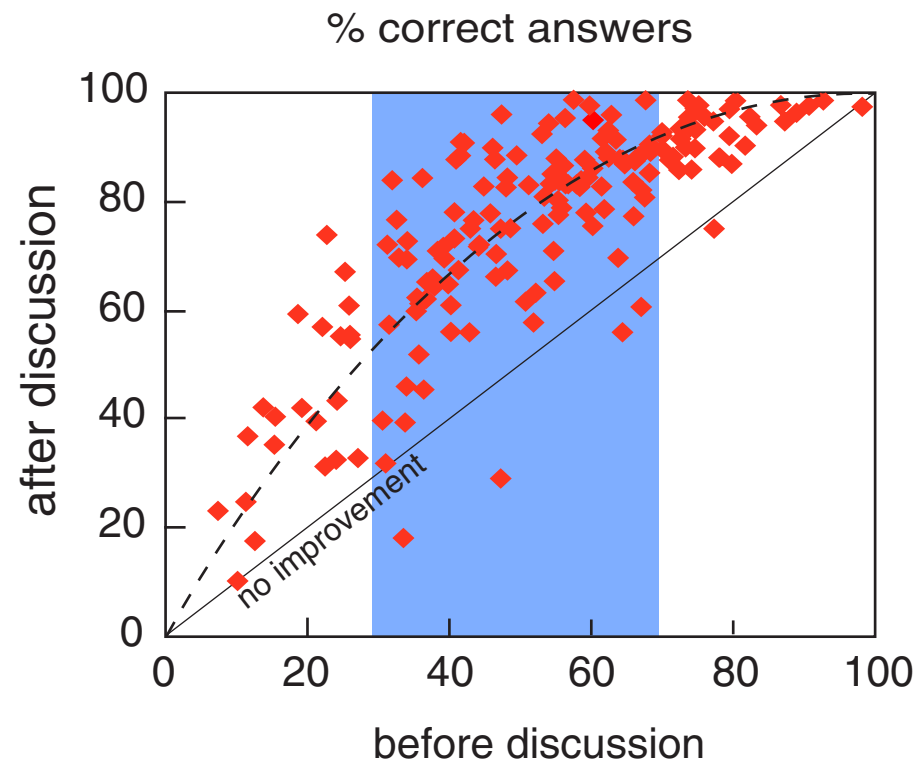
# ConceptTests

## ConceptTest data

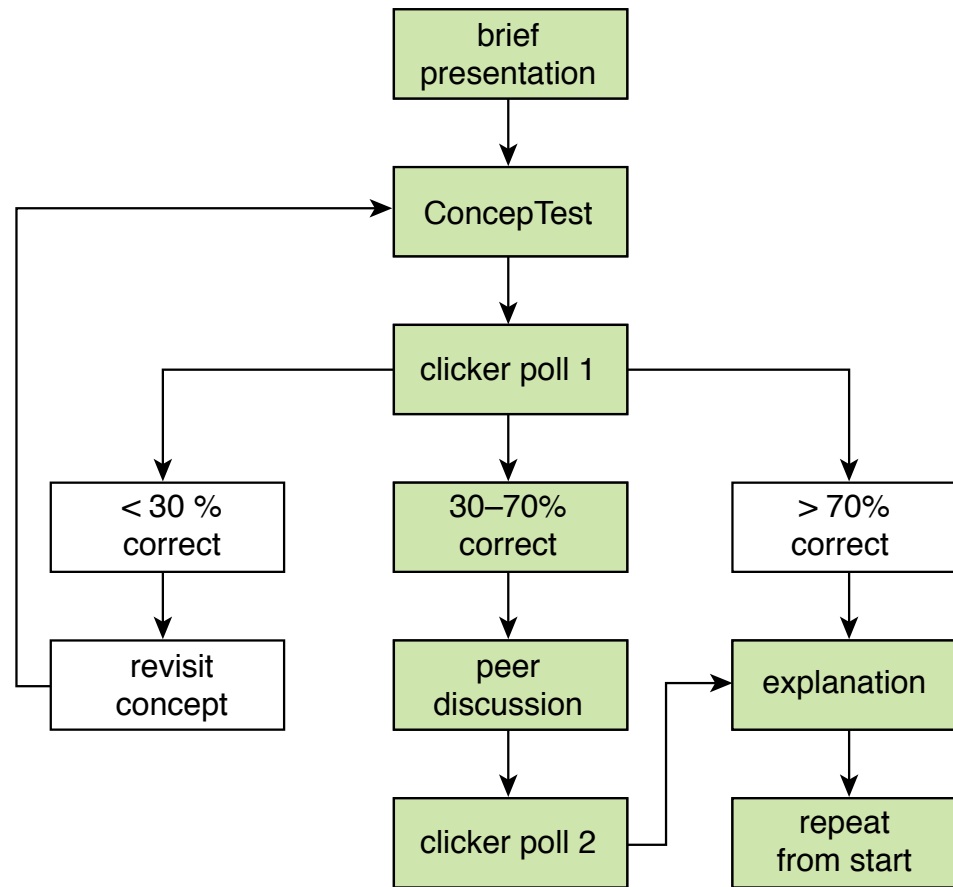


# ConceptTests

## ConceptTest data



# ConceptTests





**Join now!**

**PeerInstruction.net**