

Peer Instruction and ConcepTest design workshop



Pontificia Universidad Católica de Chile
Santiago, Chile, 14 January 2016

Peer Instruction and ConcepTest design workshop



@eric_mazur



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ERIC MAZUR



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

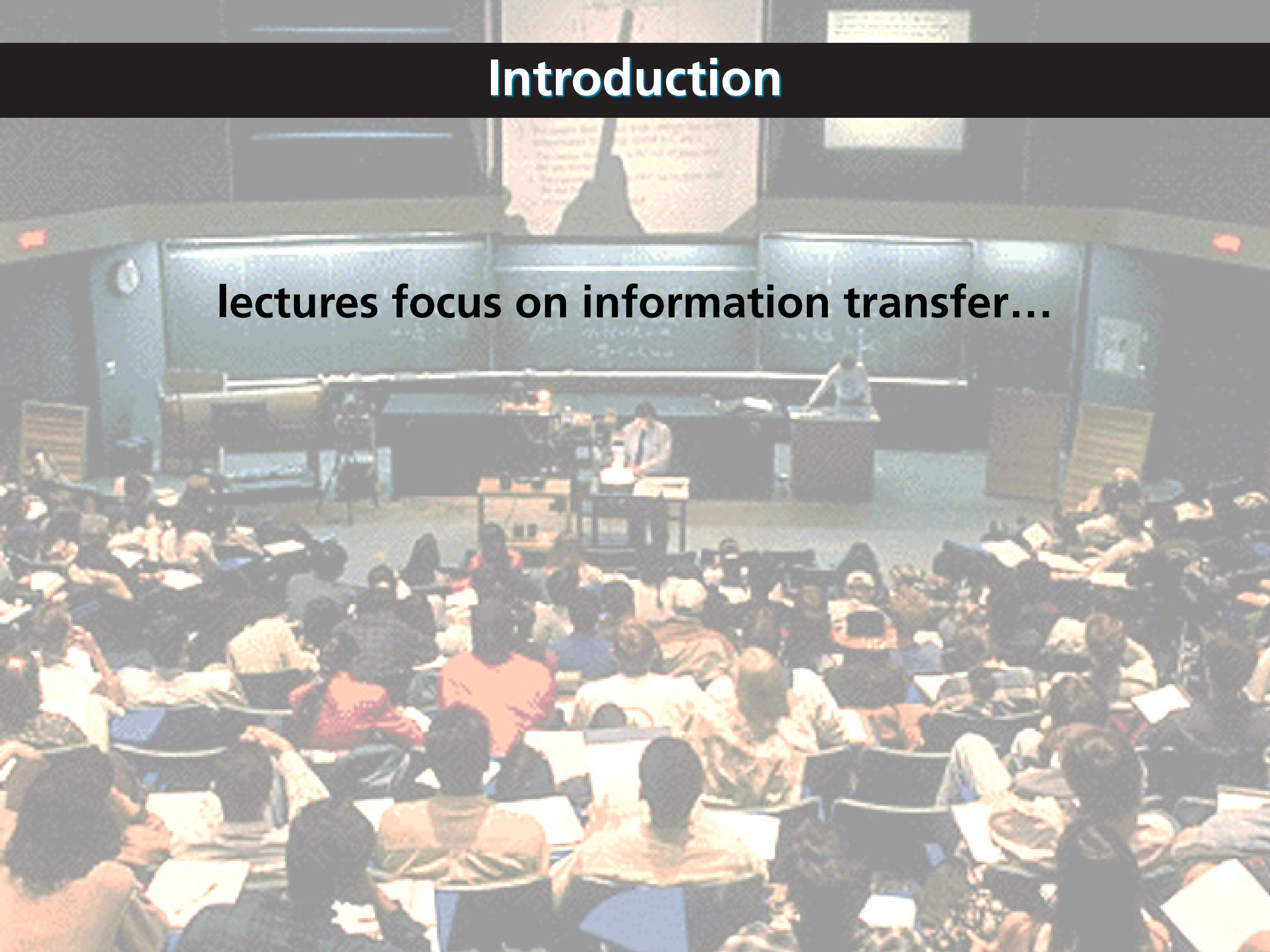
Quick survey...

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.

Introduction

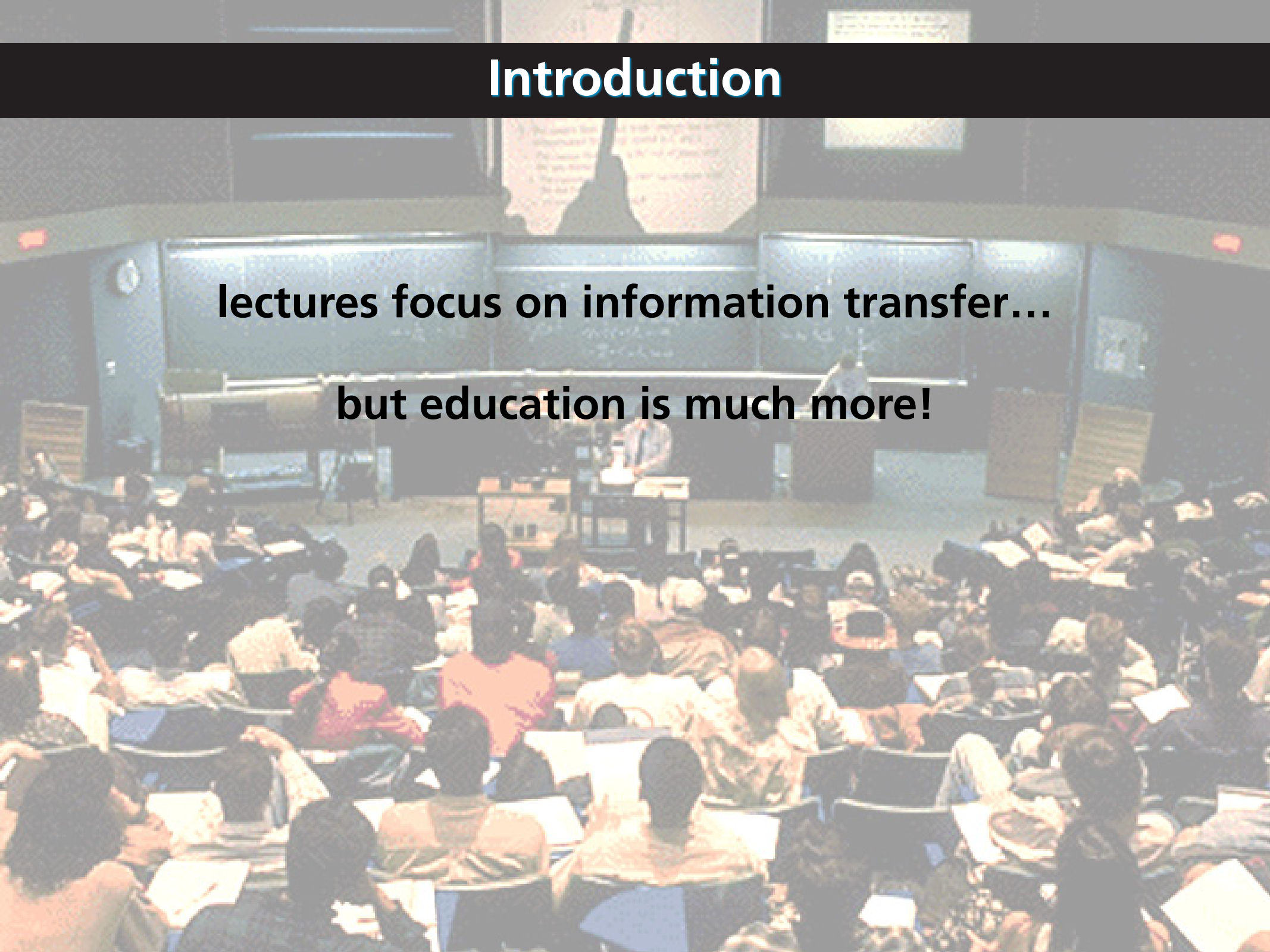
lectures focus on information transfer...



Introduction

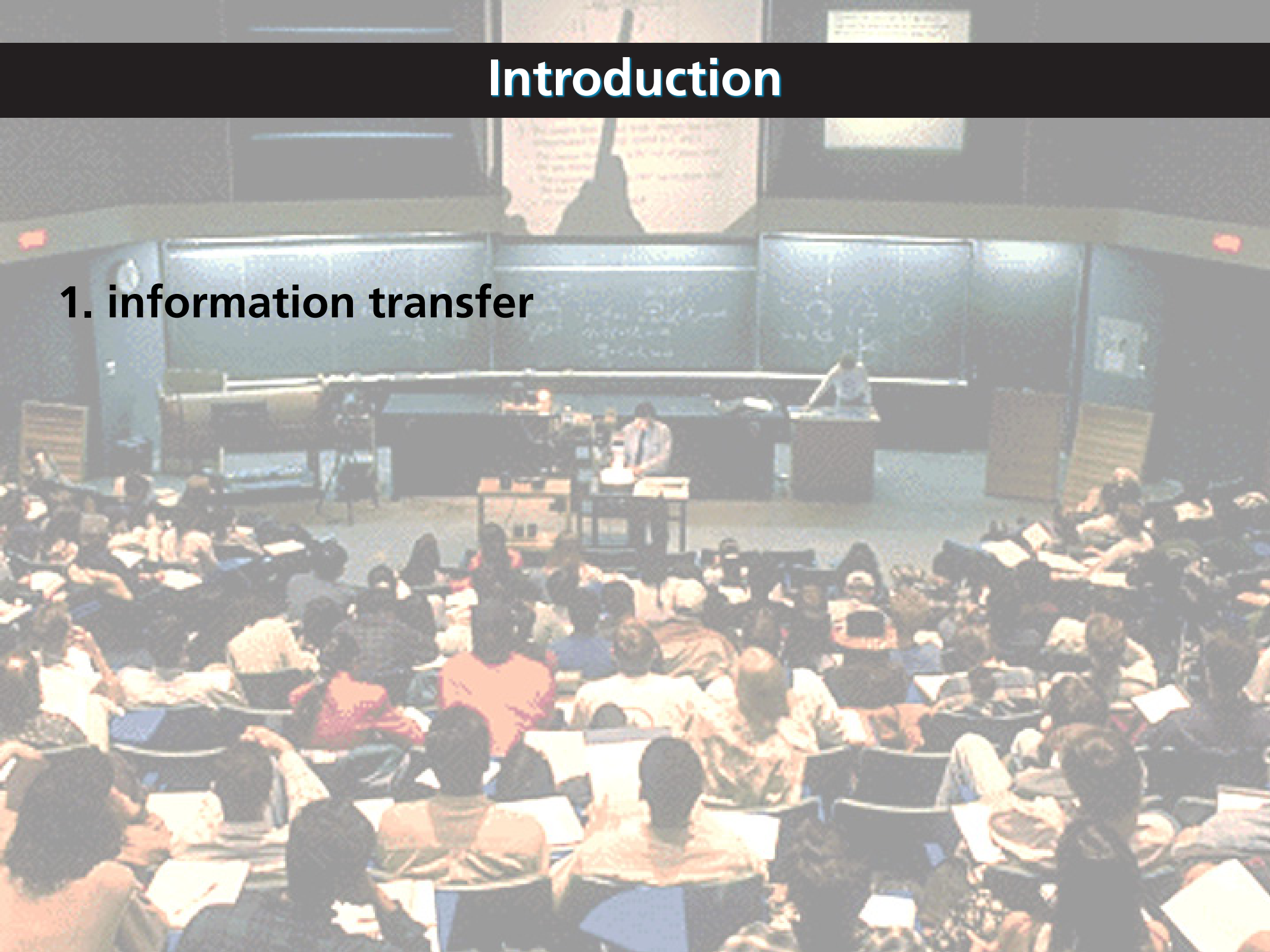
lectures focus on information transfer...

but education is much more!



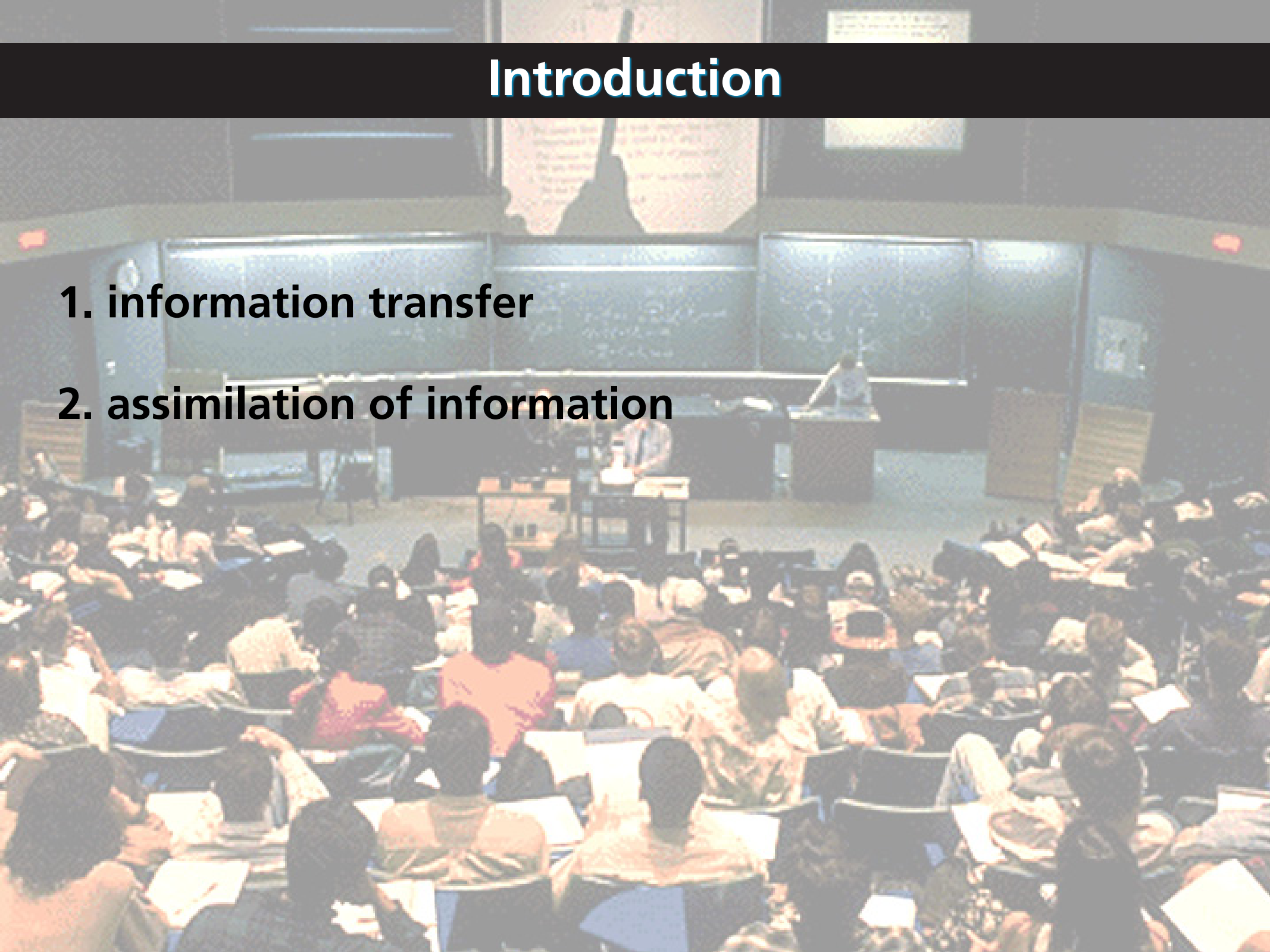
Introduction

1. information transfer



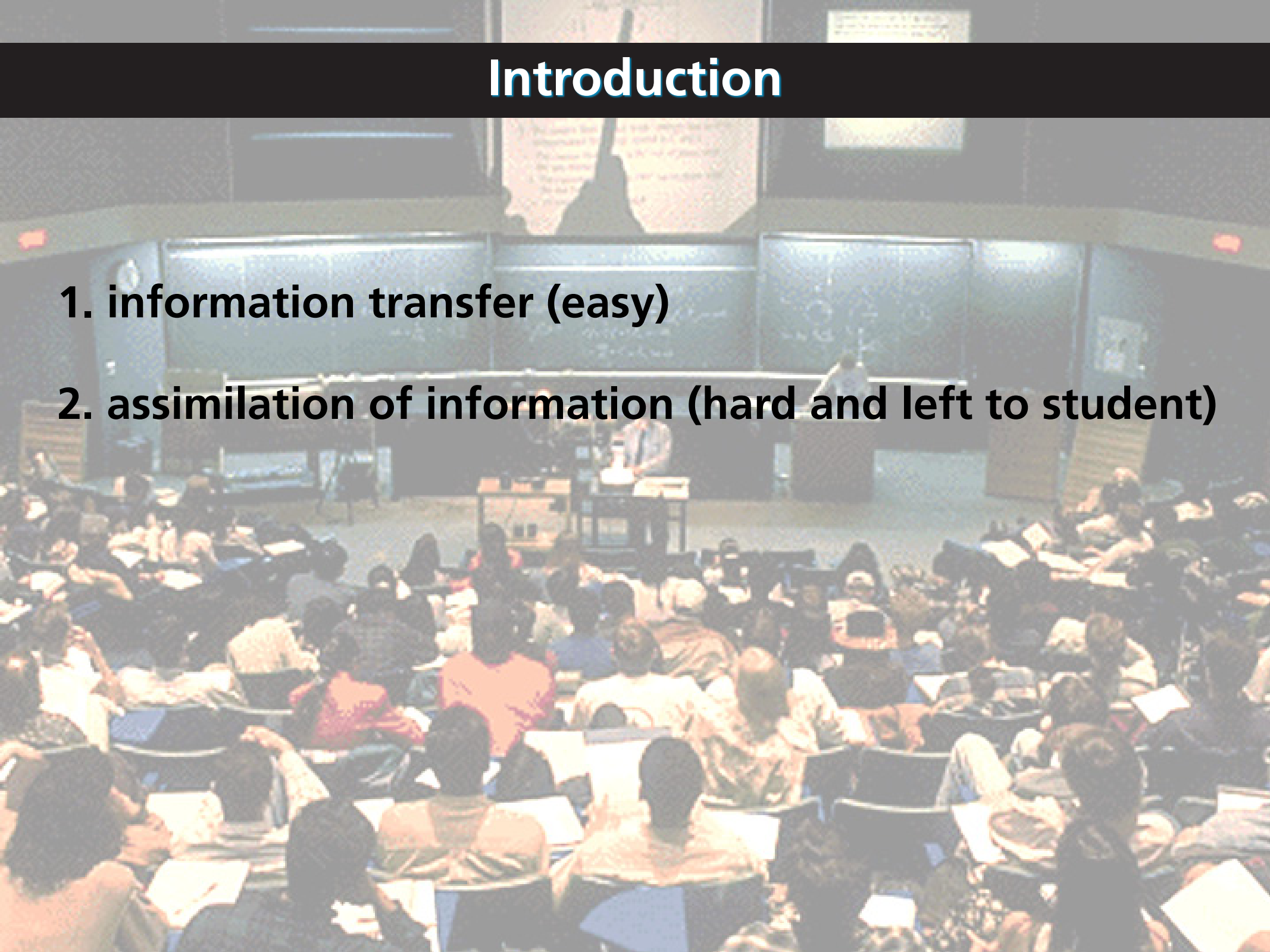
Introduction

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!**

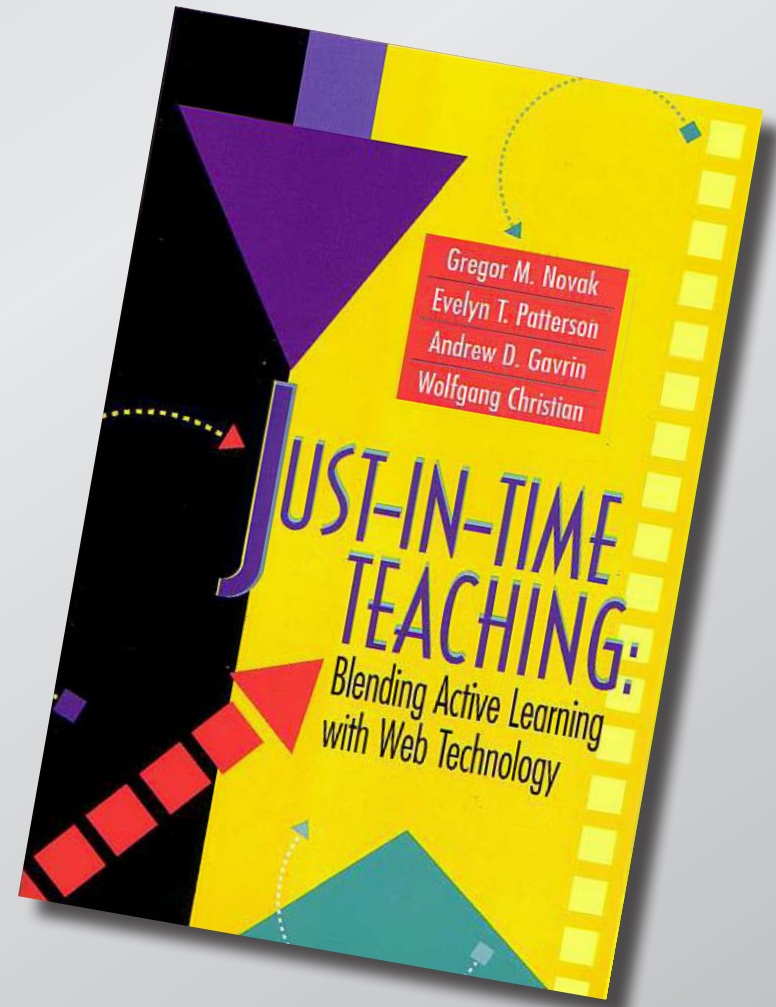
(select what you consider to be the main reason)



PI & JiTT Overview

Just-in-time-Teaching (JiTT)

www.jitt.org



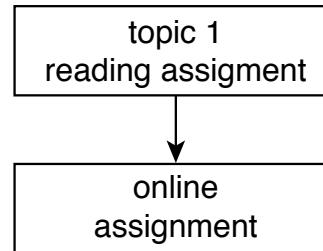
PI & JiTT Overview

JiTT workflow

topic 1
reading assignment

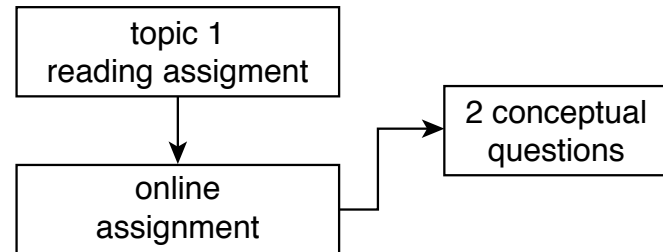
PI & JiTT Overview

JiTT workflow



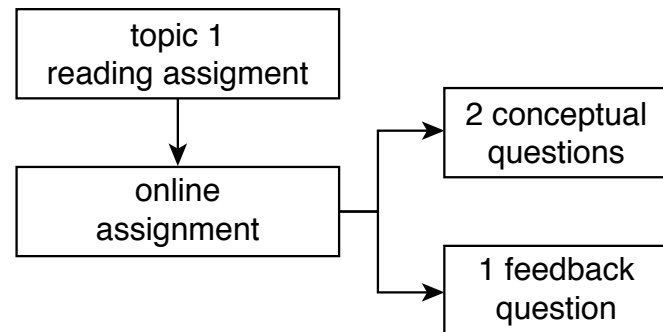
PI & JiTT Overview

JiTT workflow



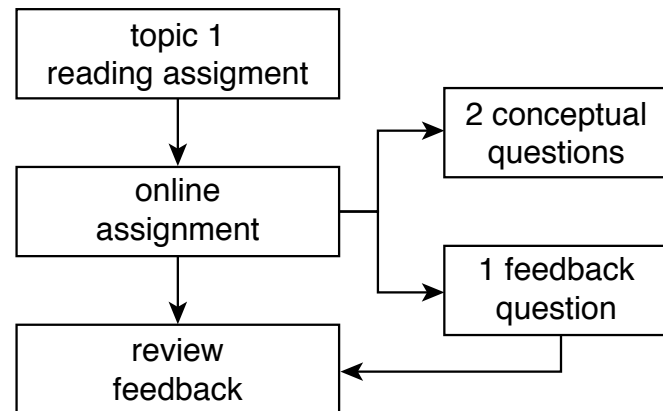
PI & JiTT Overview

JiTT workflow



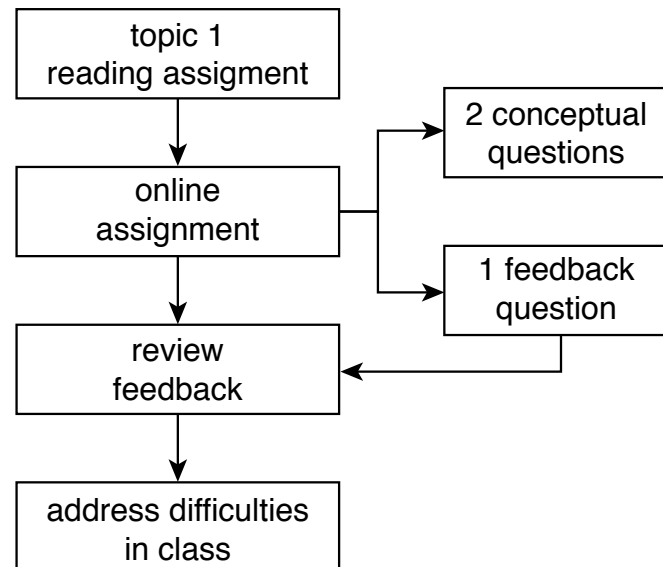
PI & JiTT Overview

JiTT workflow



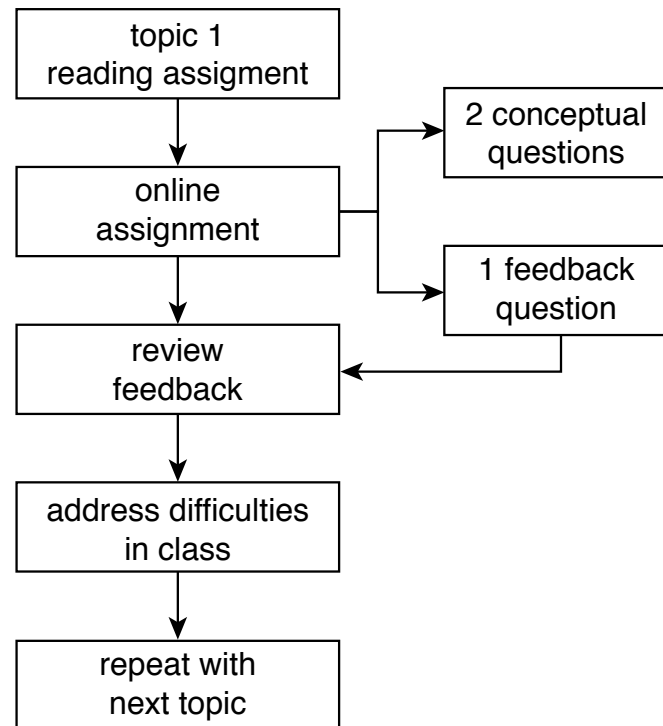
PI & JiTT Overview

JiTT workflow



PI & JiTT Overview

JiTT workflow



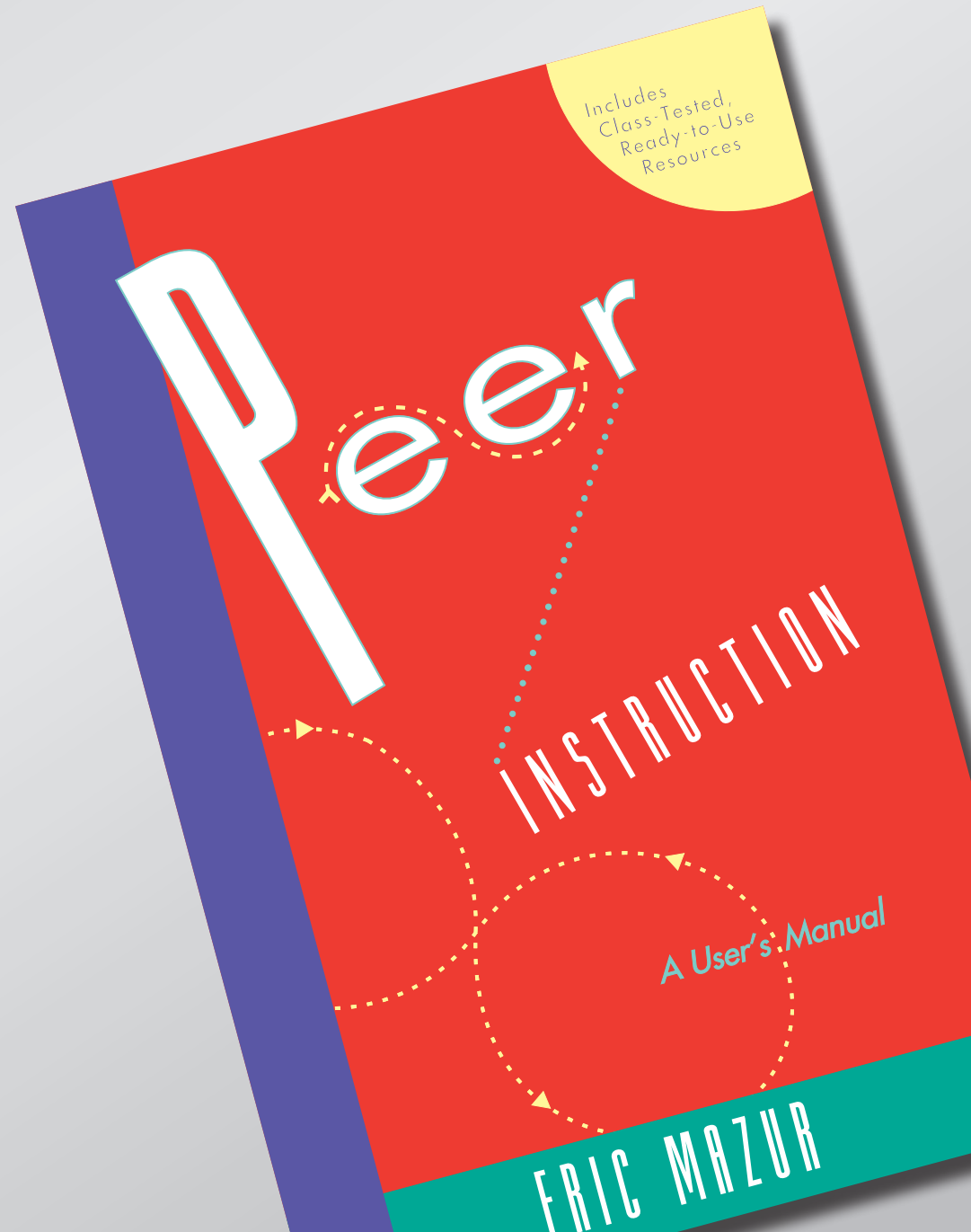
PI & JiTT Overview

JiTT:

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

PI & JiTT Overview

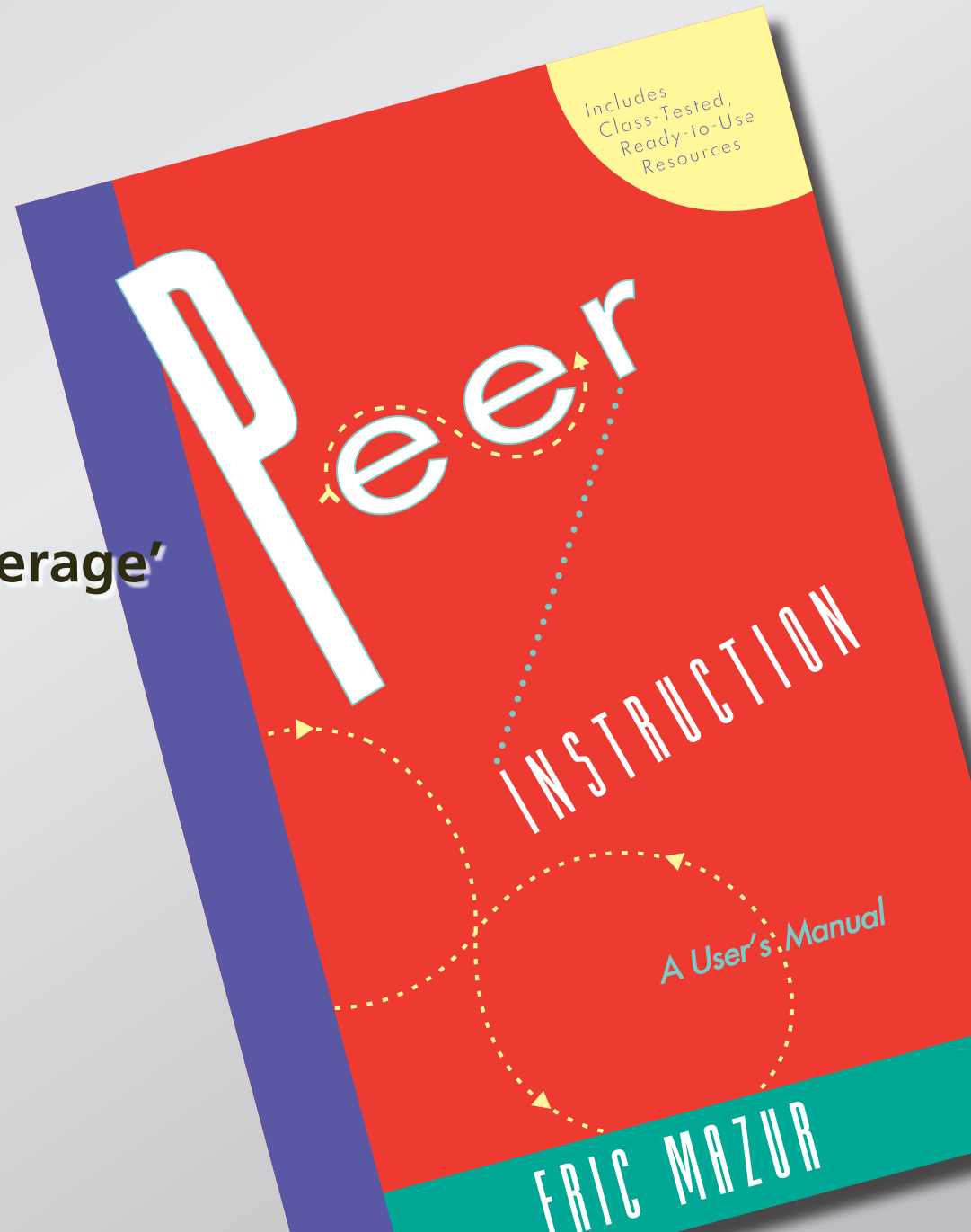
Peer Instruction (PI)



PI & JiTT Overview

Main features:

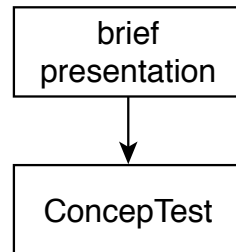
- pre-class assignment
- in-class: depth, not 'coverage'
- ConcepTests



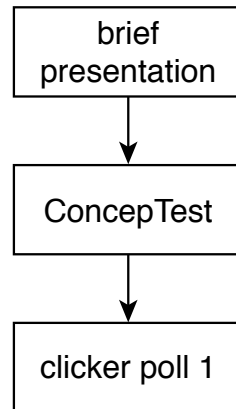
PI & JiTT Overview

brief
presentation

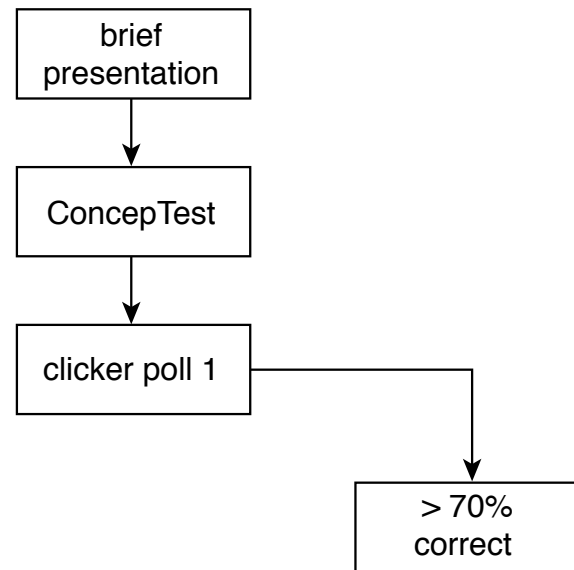
PI & JiTT Overview



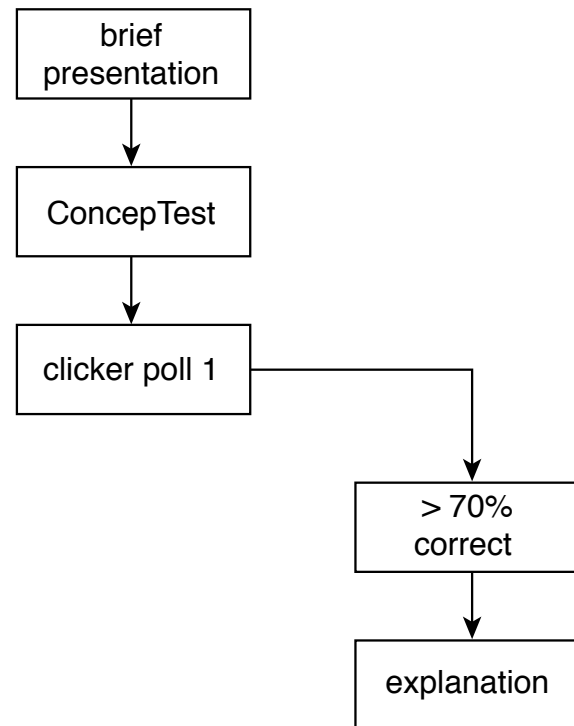
PI & JiTT Overview



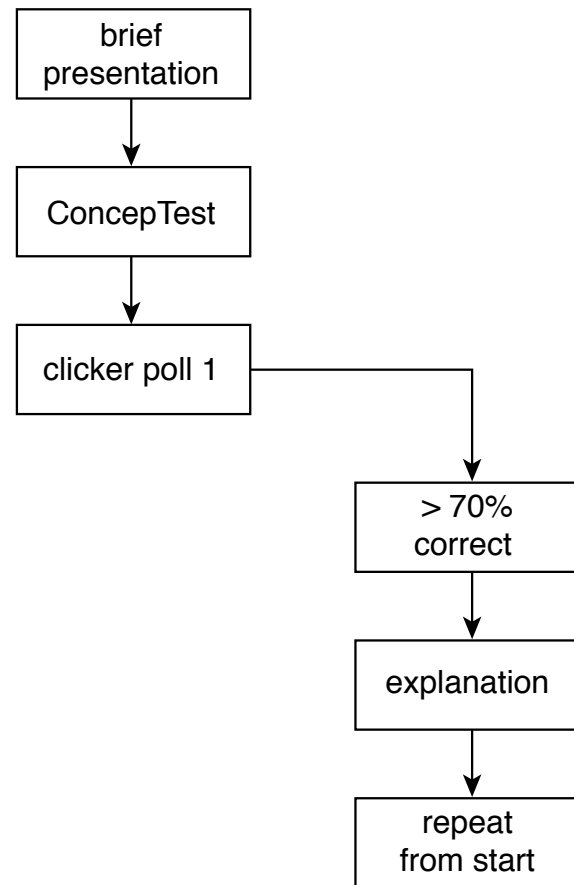
PI & JiTT Overview



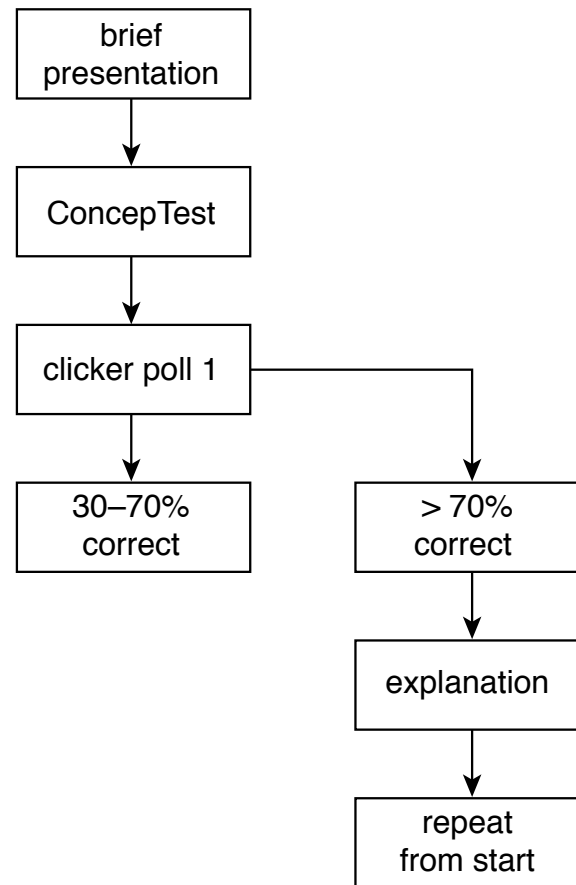
PI & JiTT Overview



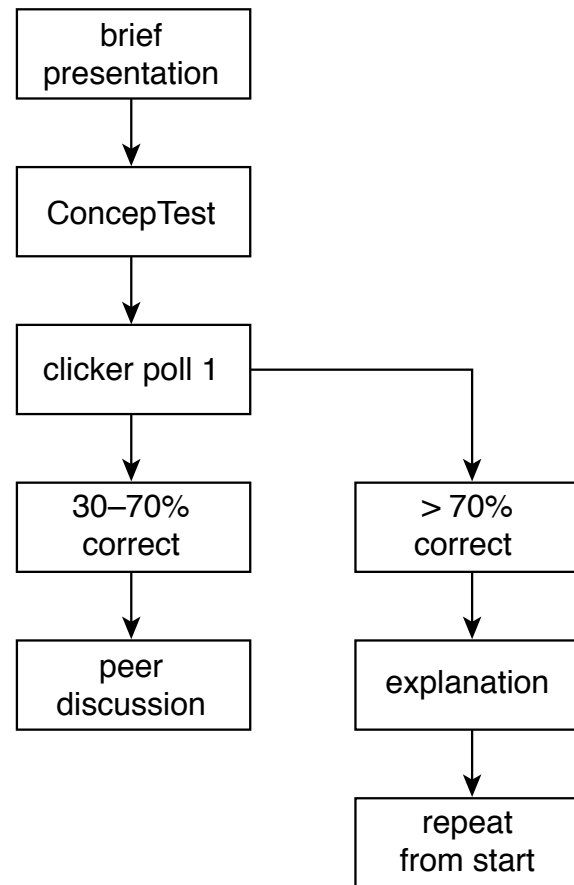
PI & JiTT Overview



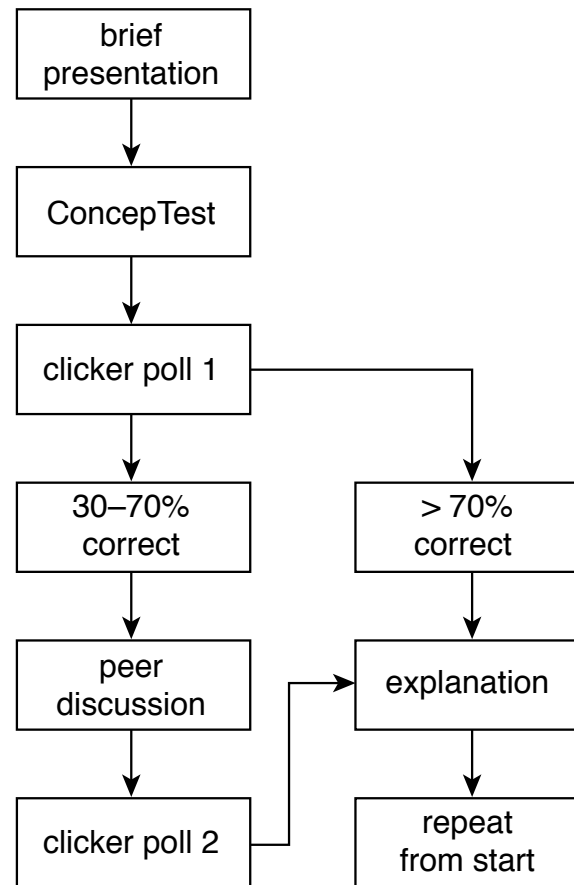
PI & JiTT Overview



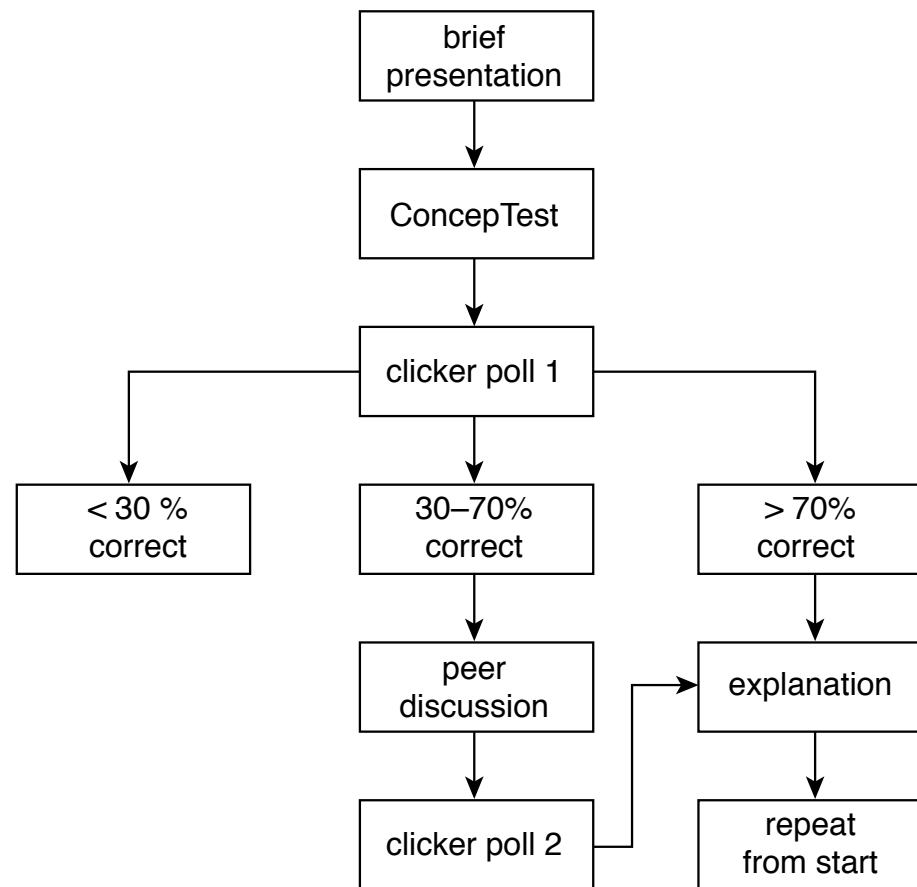
PI & JiTT Overview



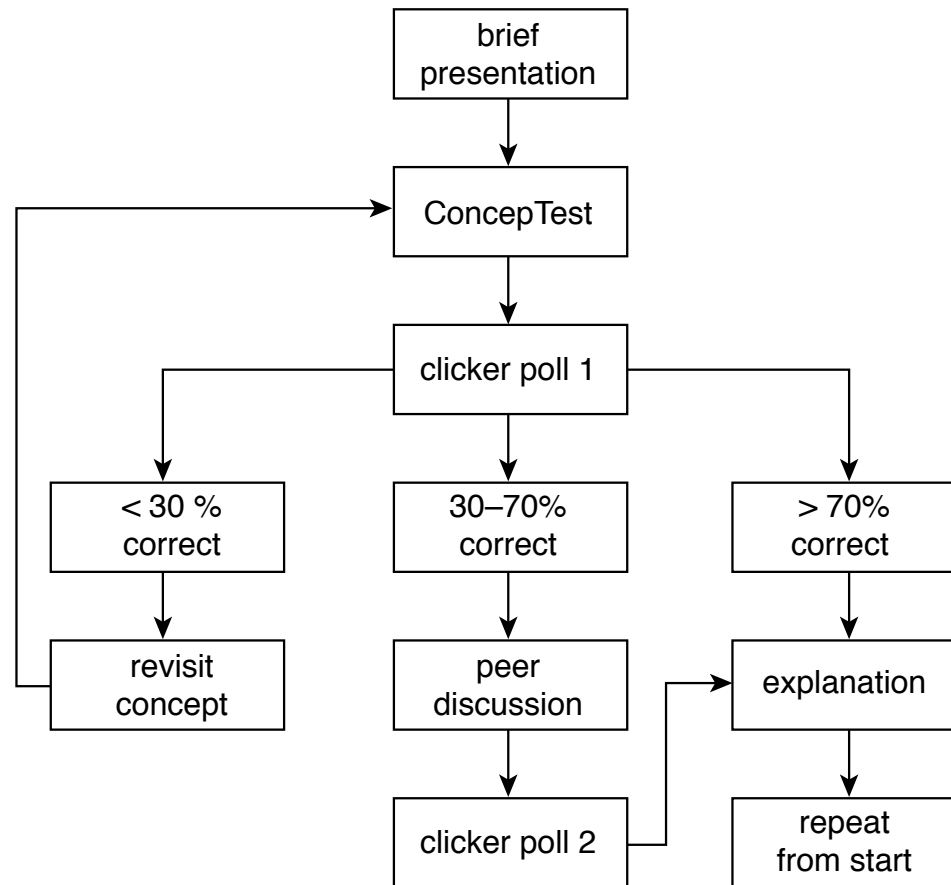
PI & JiTT Overview



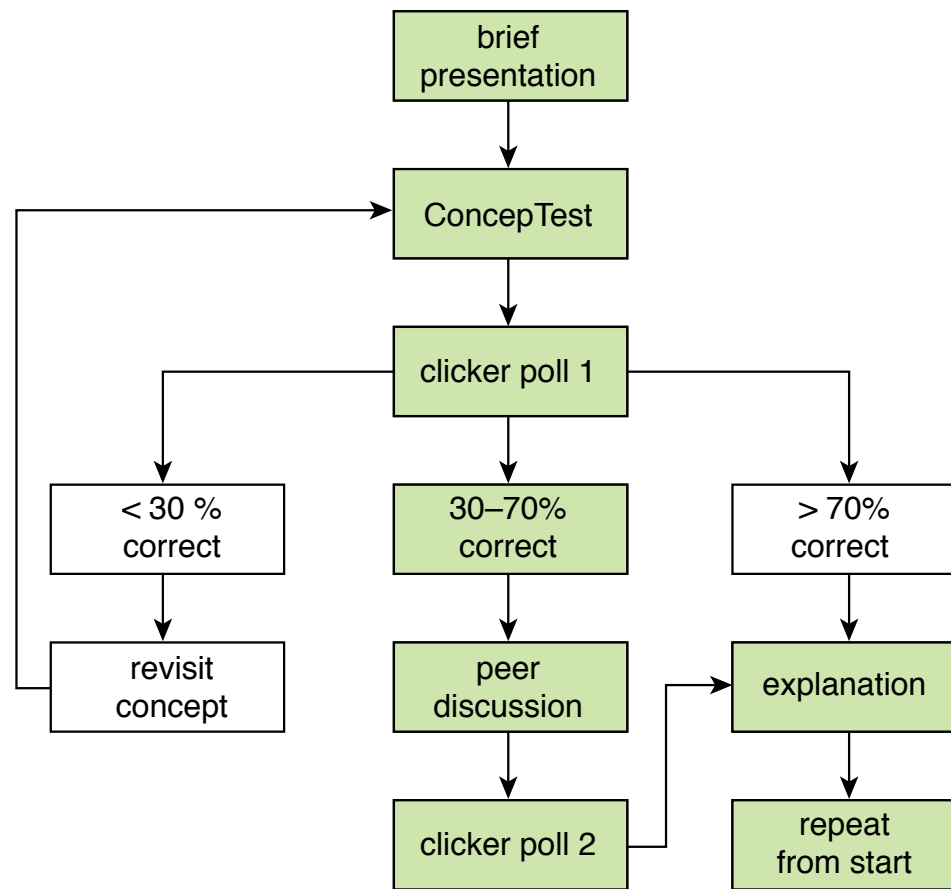
PI & JiTT Overview



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

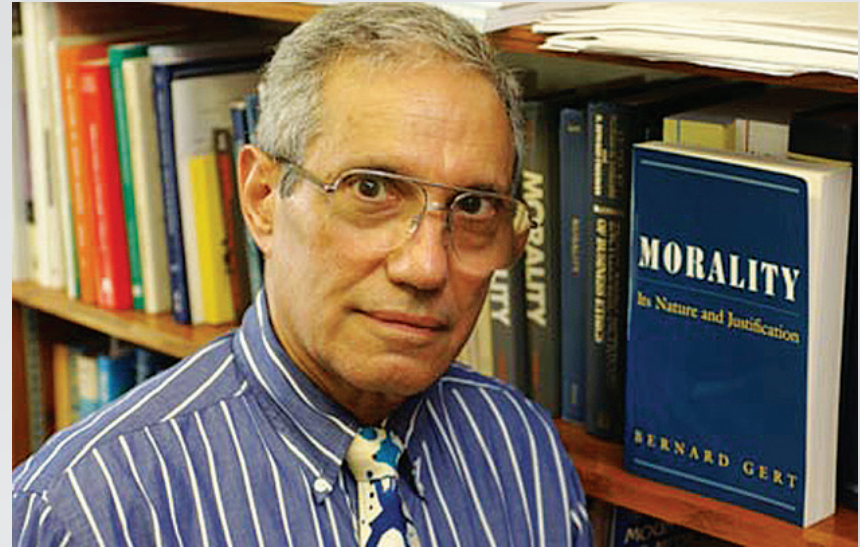
PI & JiTT Overview

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

Let's try it!

Bernard Gert (1934 – 2011)

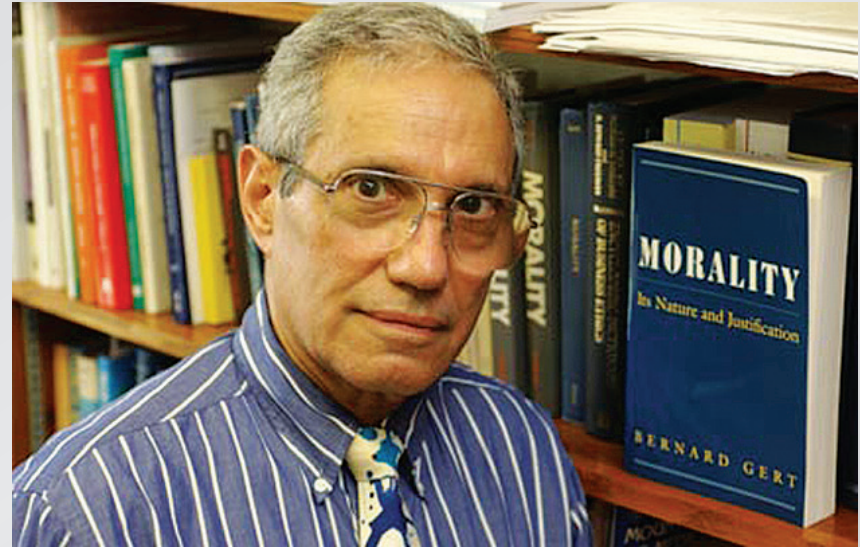
**Moral philosopher
Professor at Dartmouth**



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?

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**



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



PI & JiTT Overview

Don't need a correct answer!

Outline

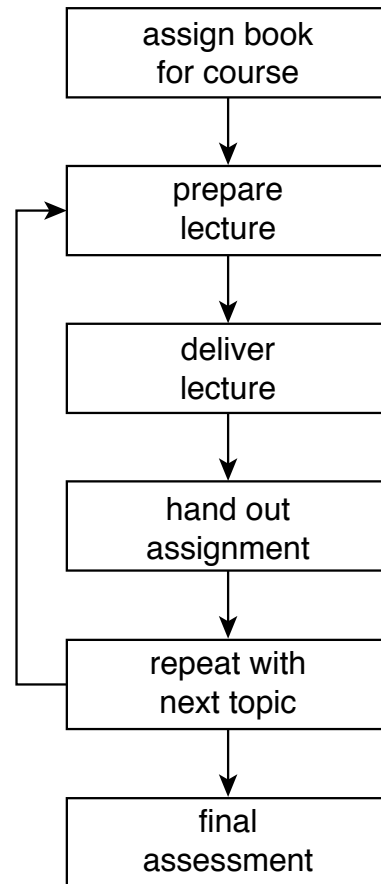
- **PI & JiTT Overview**
- **Implementing PI & JiTT**
- **ConceptTests**

Implementing PI & JiTT

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

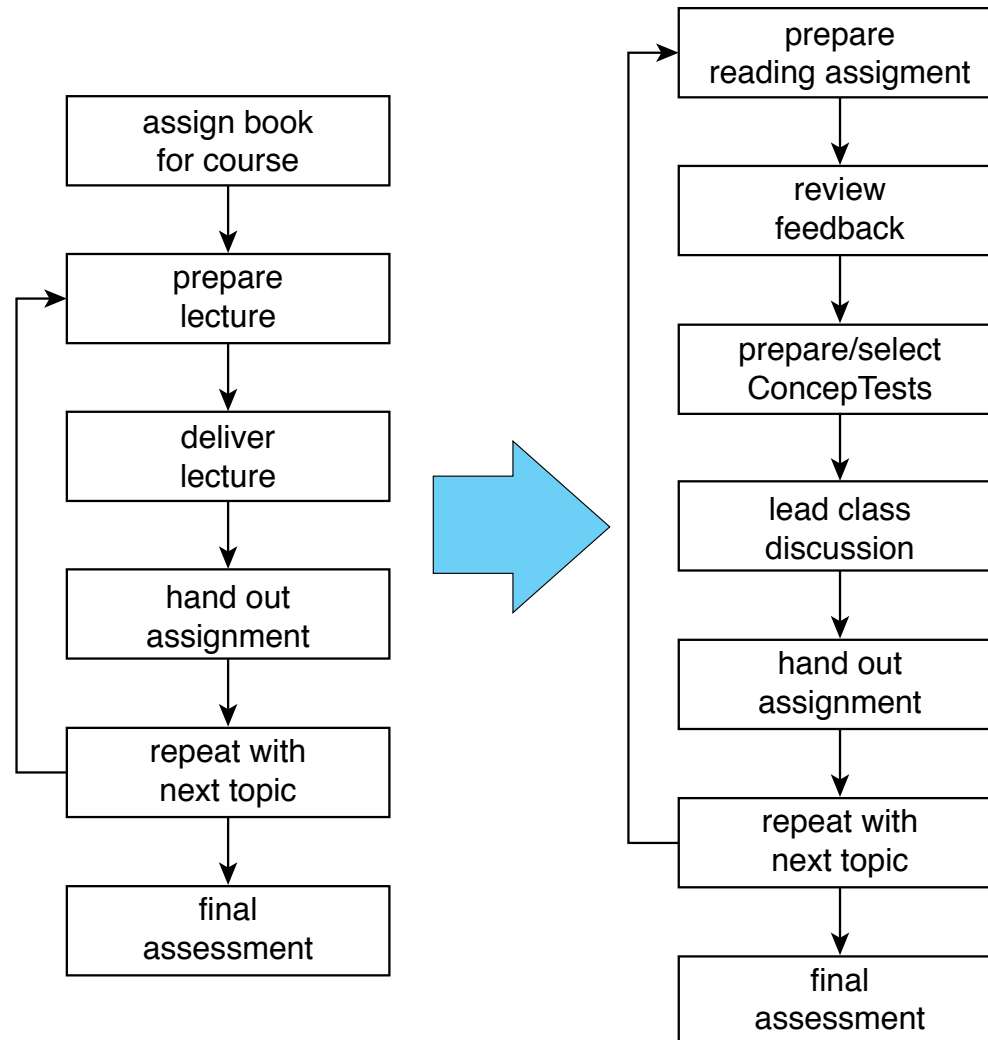
Implementing PI & JiTT

preparing for a lecture-based class



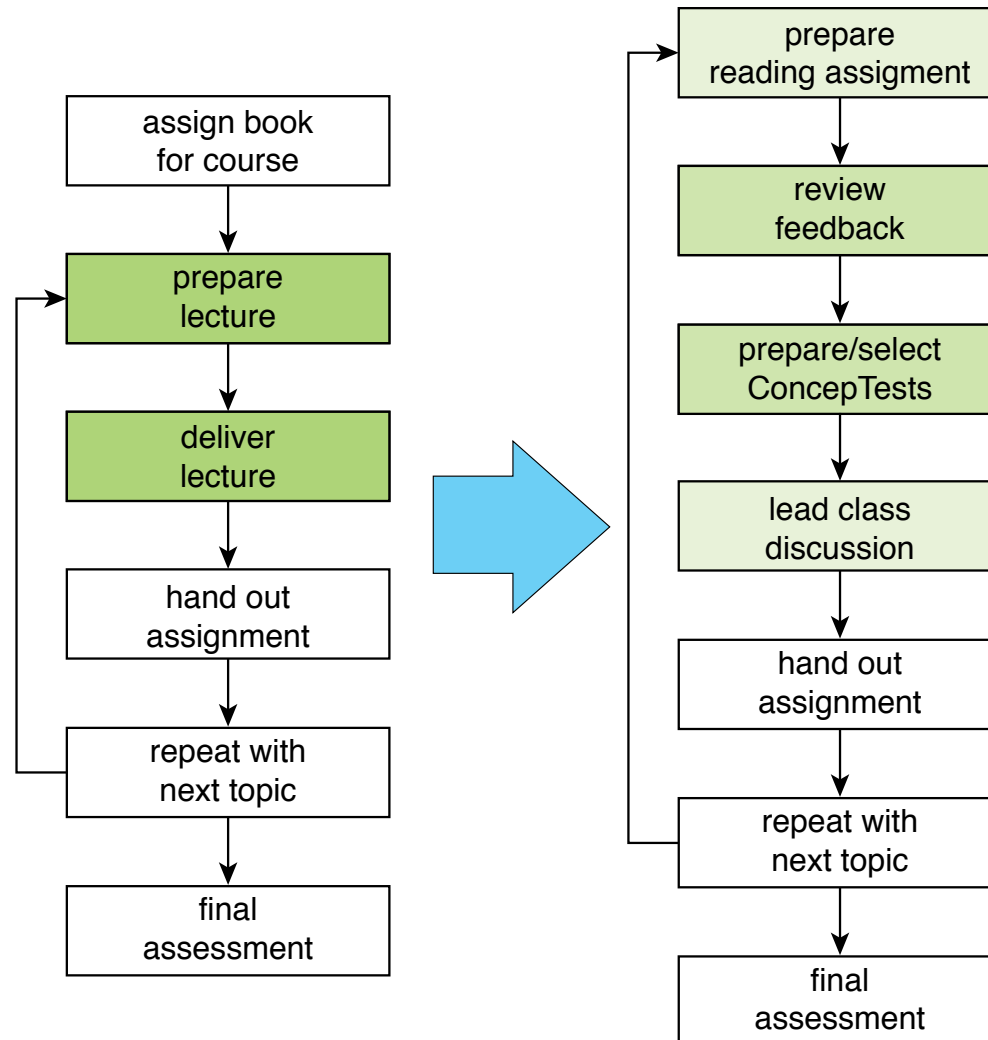
Implementing PI & JiTT

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

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

Implementing PI & JiTT

	traditional	PI
in-class coverage	complete	partial
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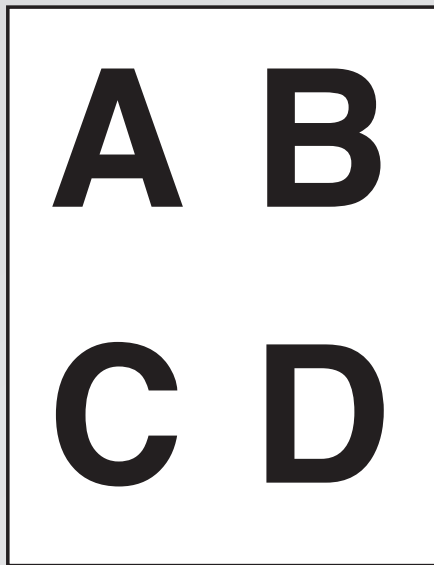
what good is coverage if little is retained?

Implementing PI & JiTT

“Do I need clickers?”

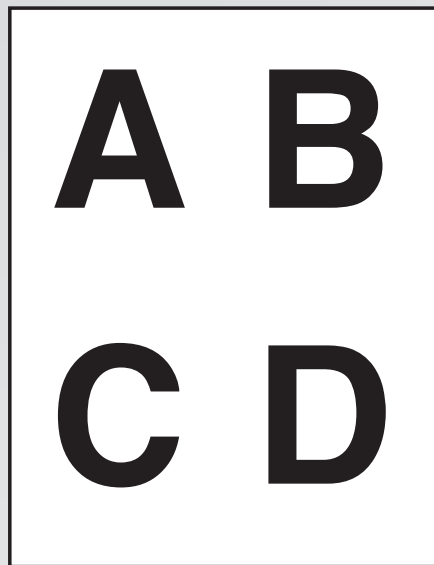
Implementing PI & JiTT

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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Clickers necessary?

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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?

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!

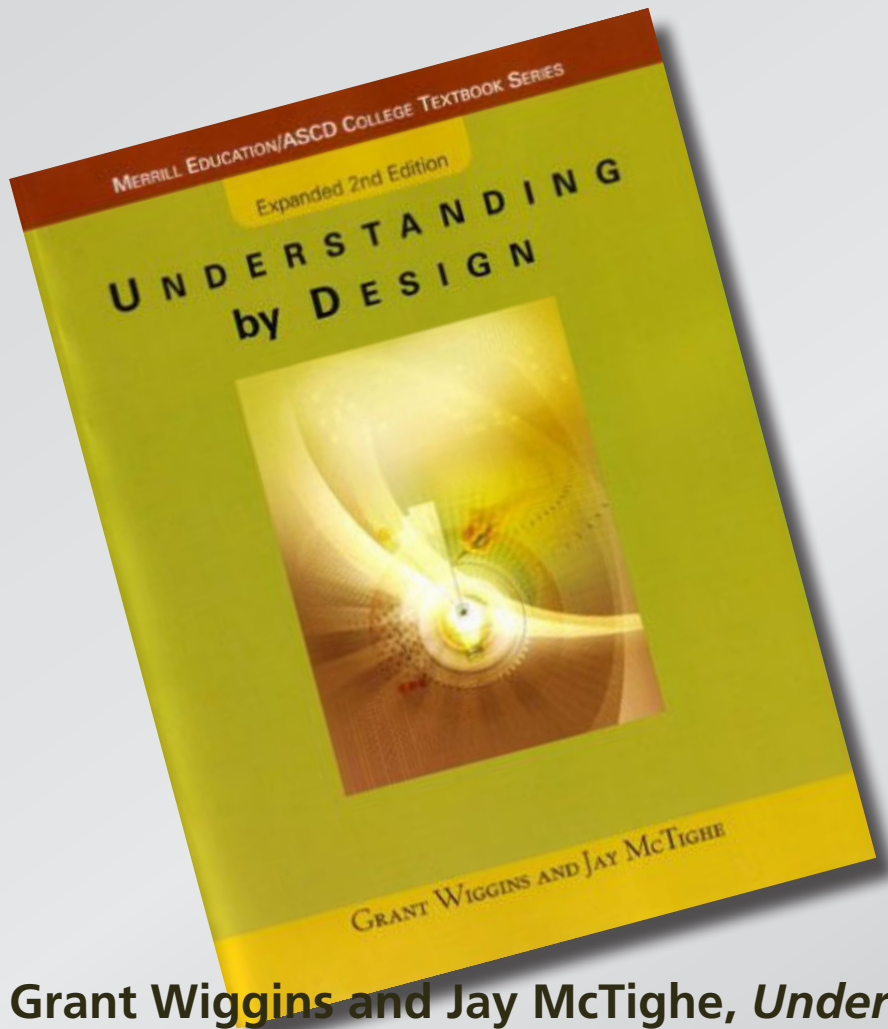
(but clickers do offer advantages)

Implementing PI & JiTT

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

Implementing PI & JiTT

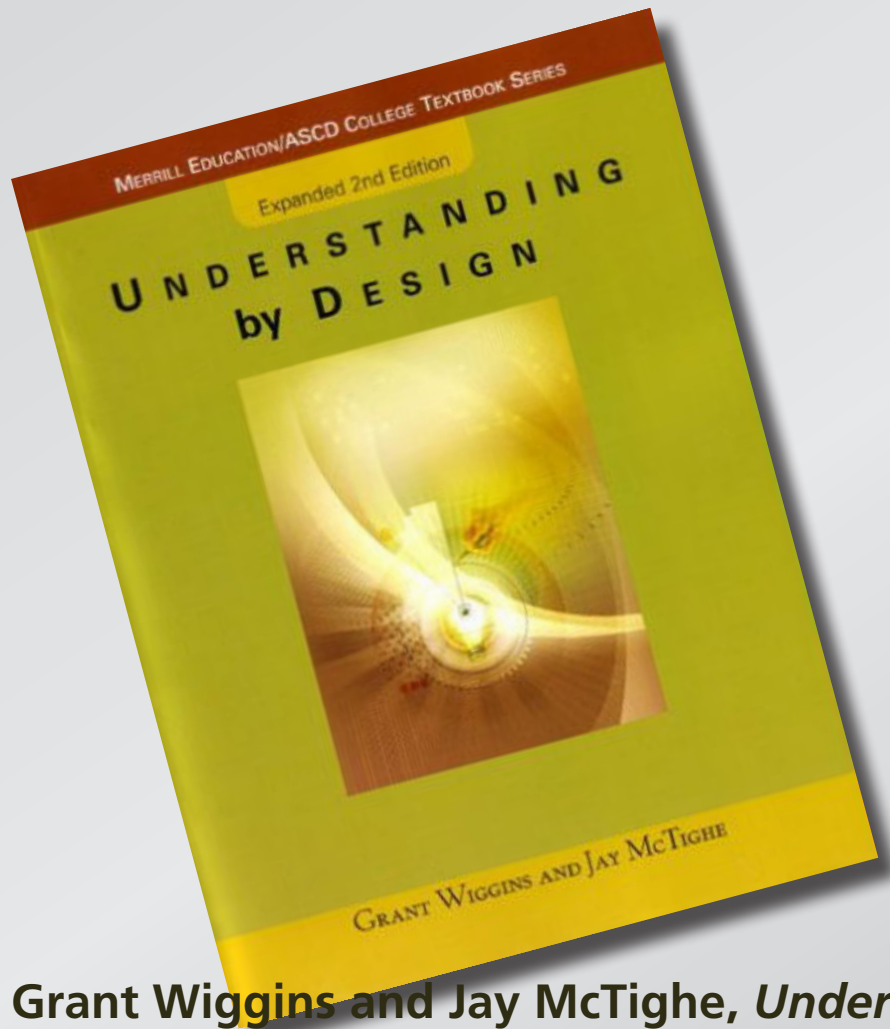
Begin by setting learning goals



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

Implementing PI & JiTT

Begin by setting learning goals

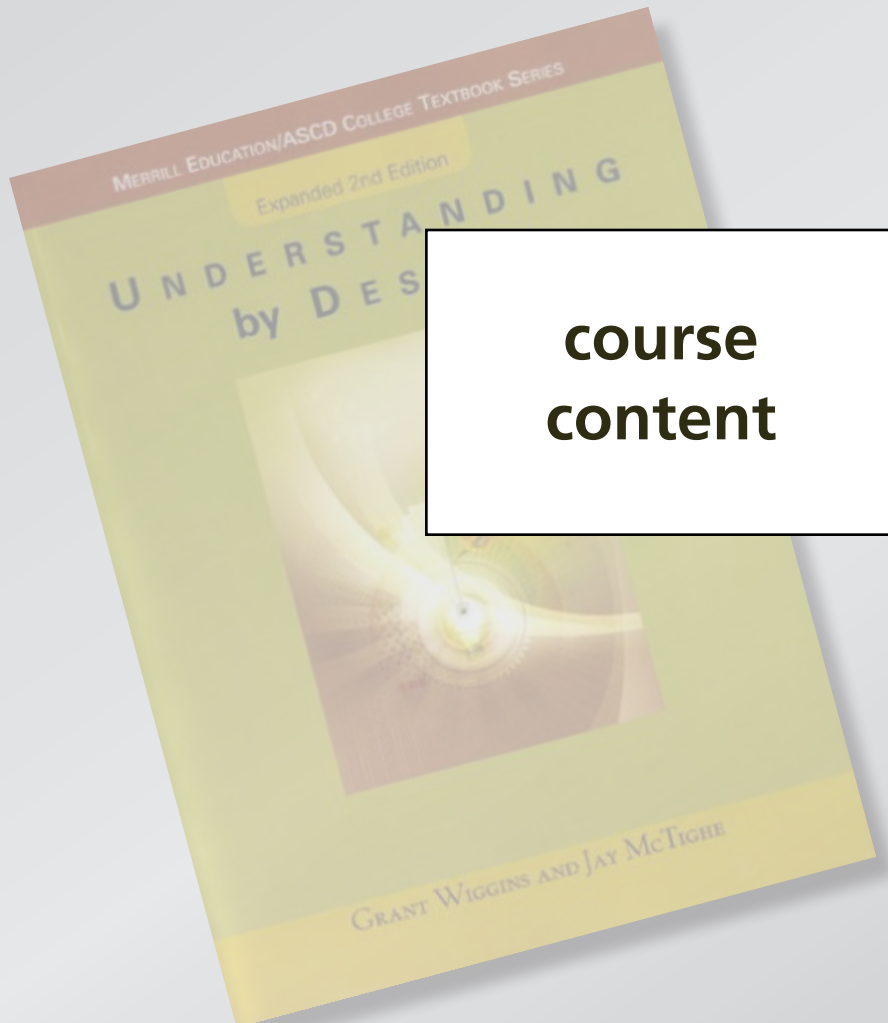


- approach, not content
- focus on understanding
- backward design

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

Implementing PI & JiTT

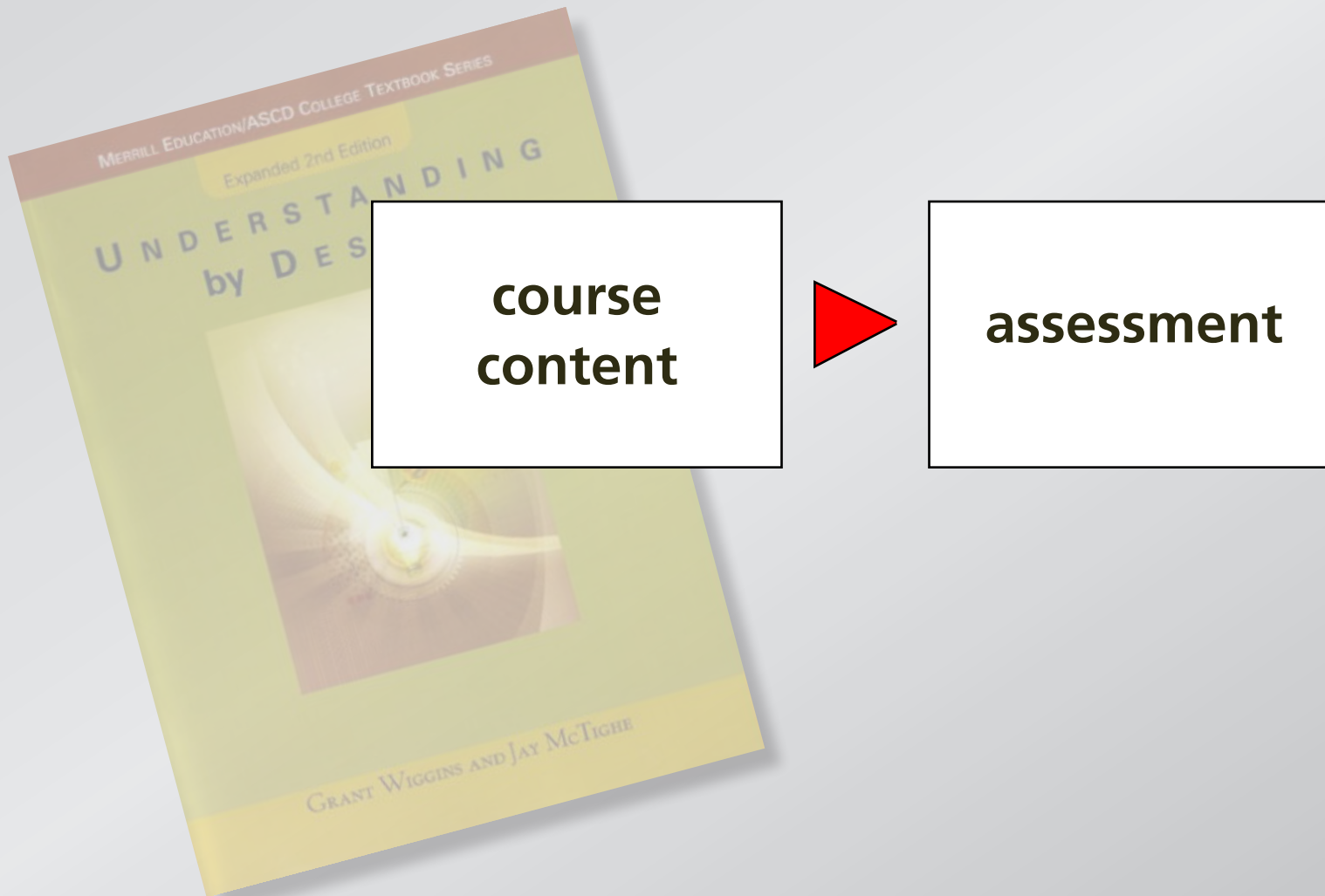
Traditional approach to course planning



**course
content**

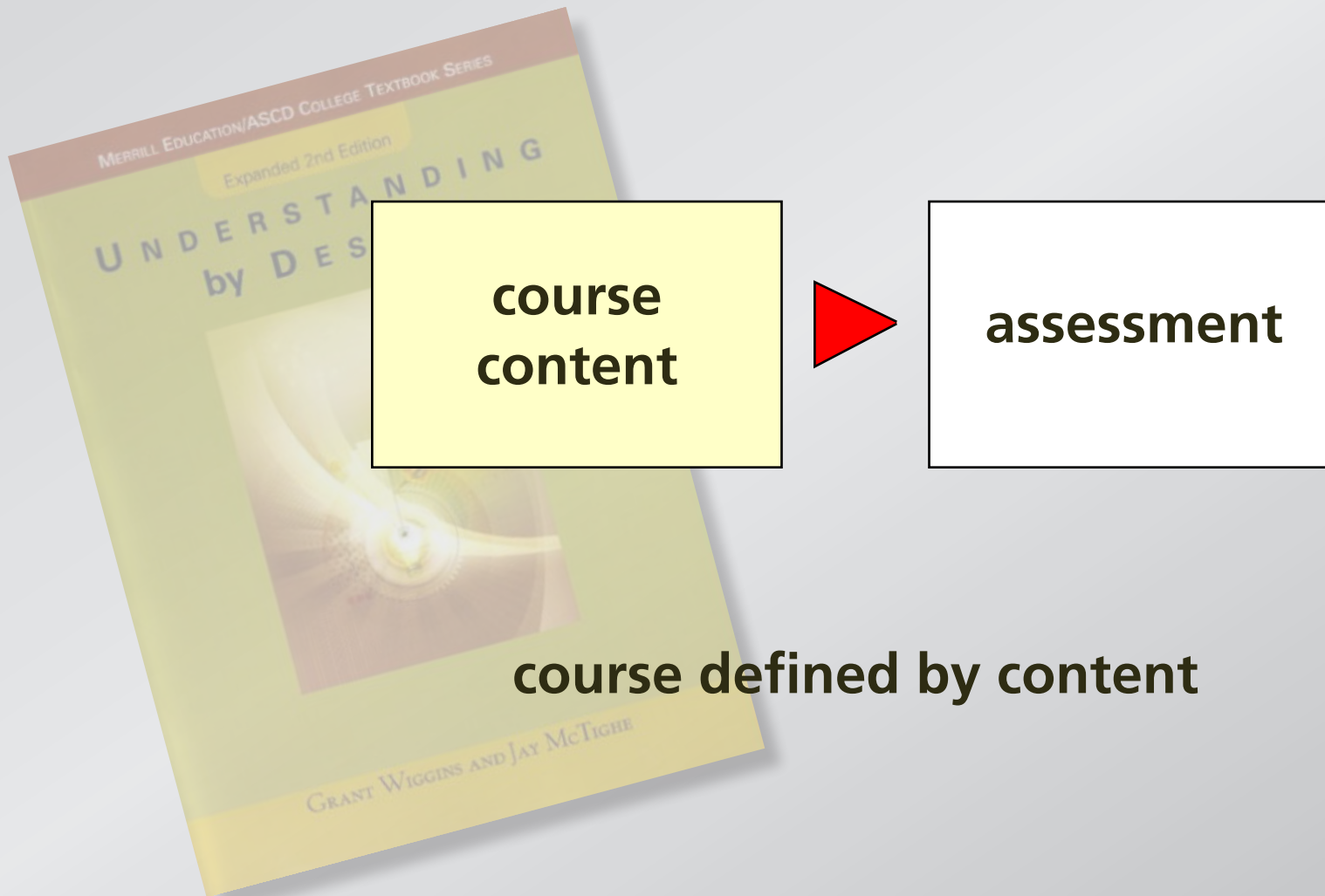
Implementing PI & JiTT

Traditional approach to course planning



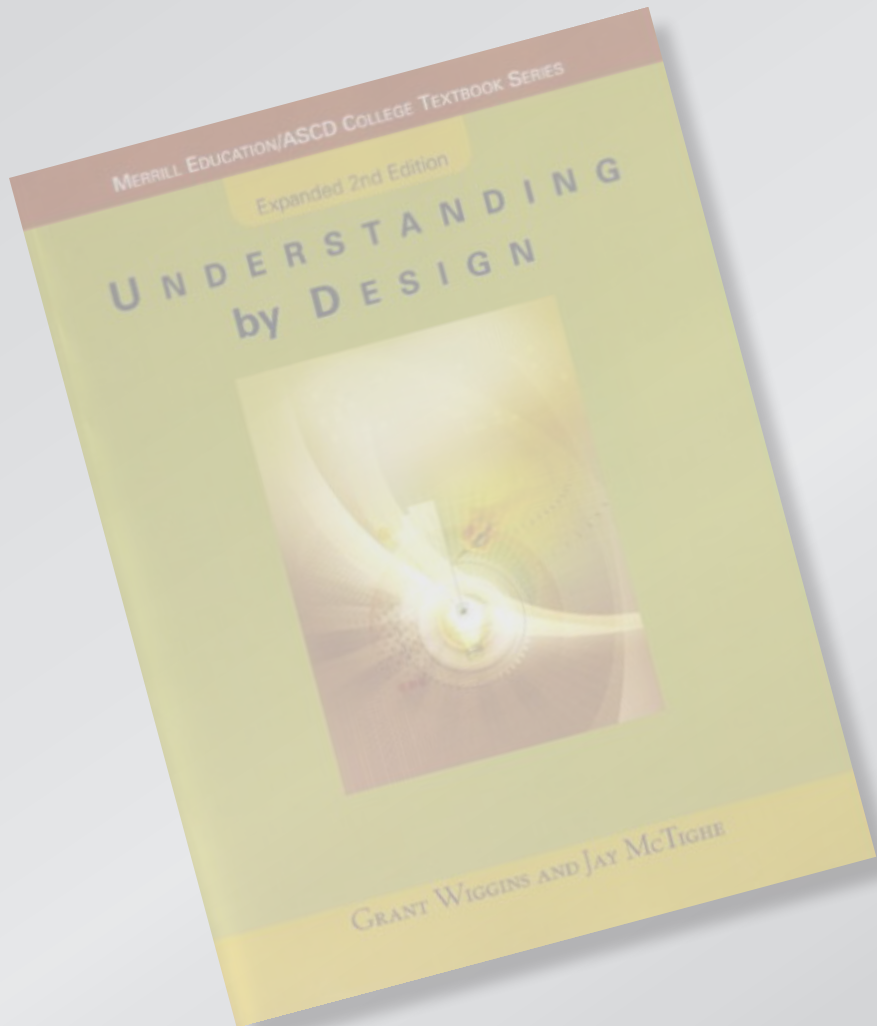
Implementing PI & JiTT

Traditional approach to course planning



Implementing PI & JiTT

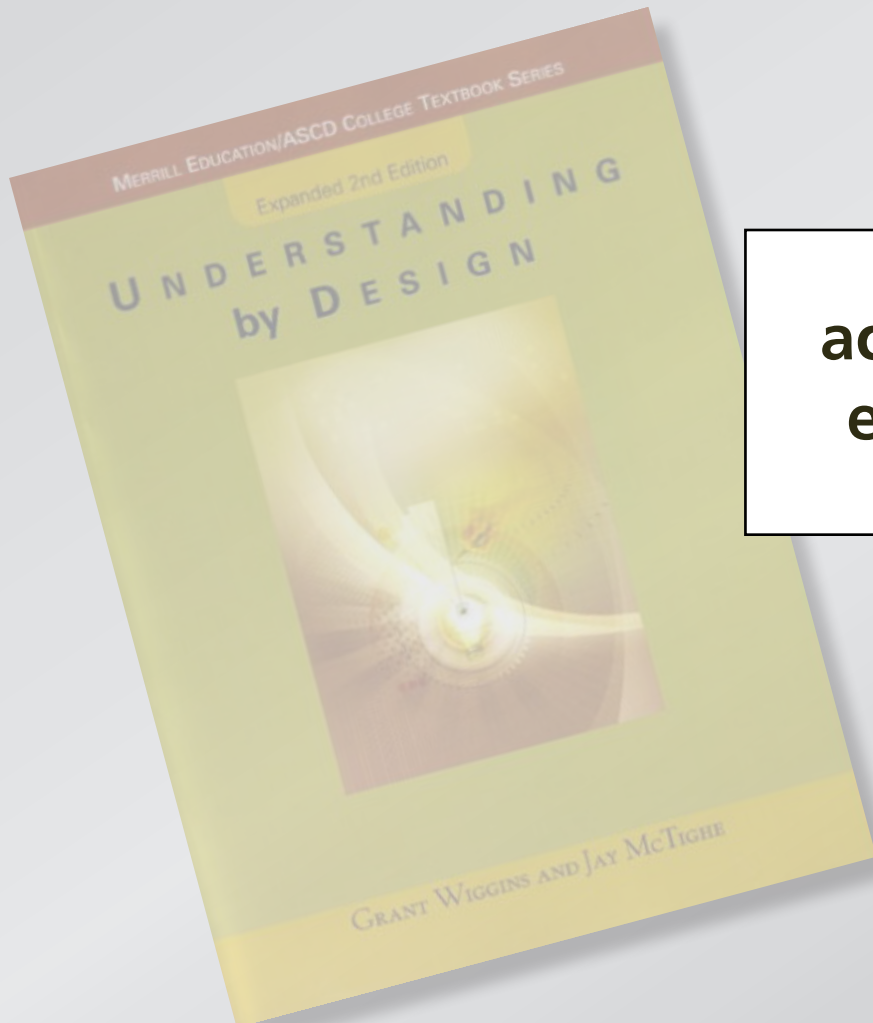
Backward design



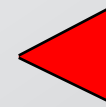
**desired
outcomes**

Implementing PI & JiTT

Backward design



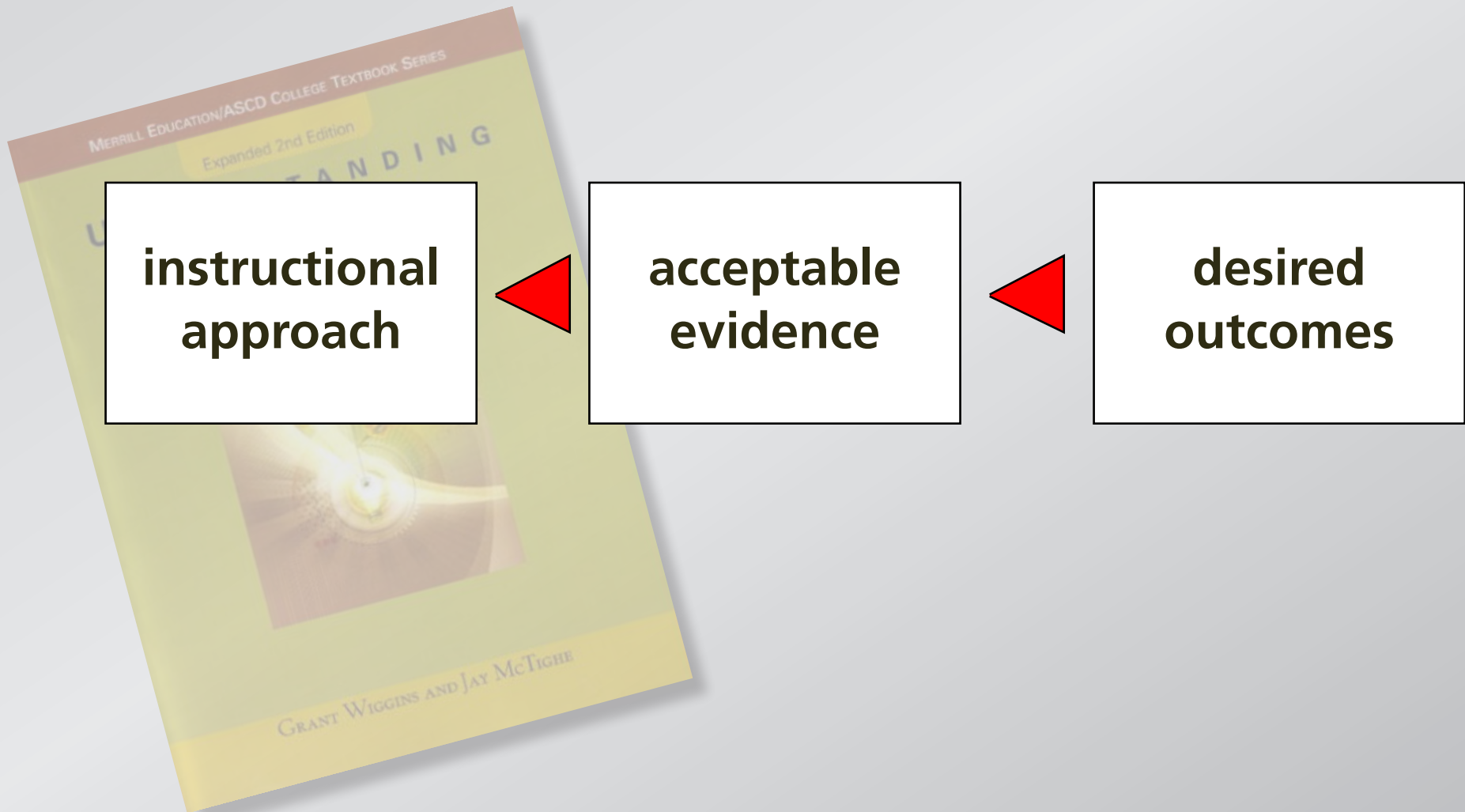
**acceptable
evidence**



**desired
outcomes**

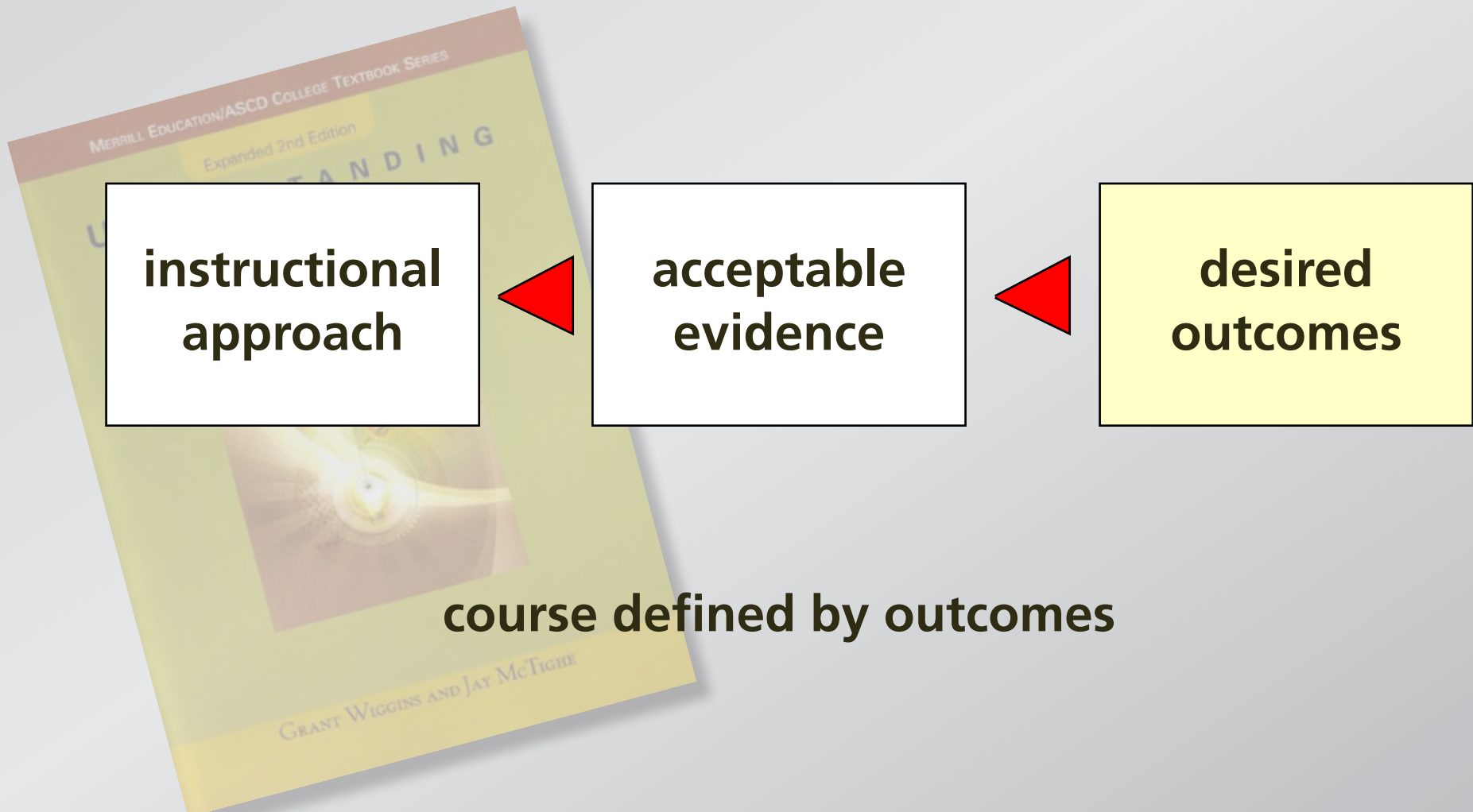
Implementing PI & JiTT

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:

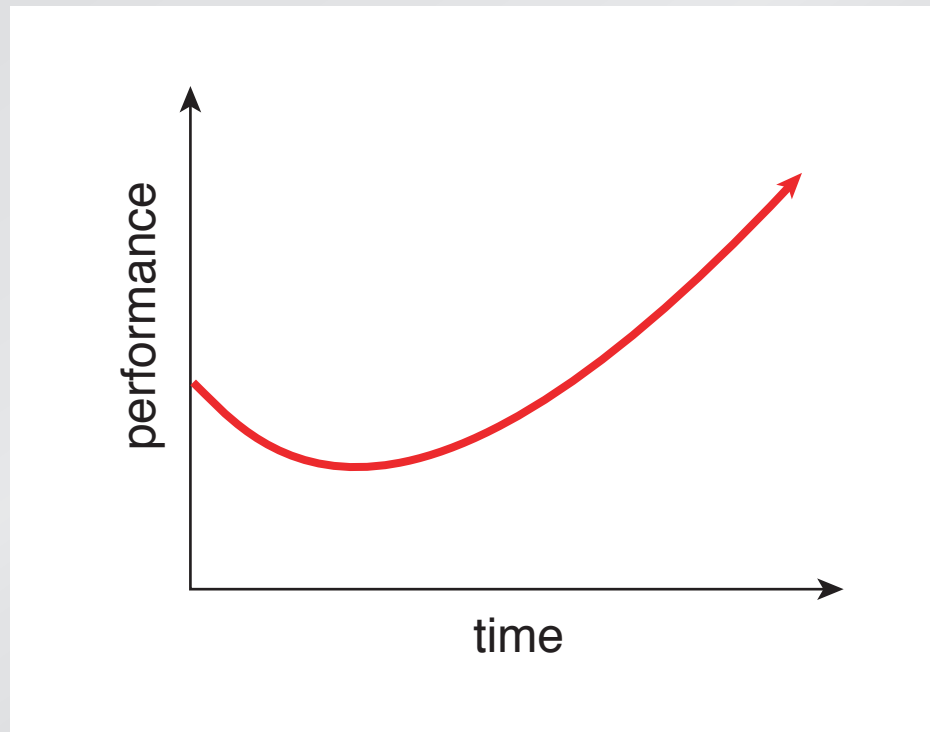
- **Open book/computer exam**
- **Collaborative exam**
- **Multidimensional testing**

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!

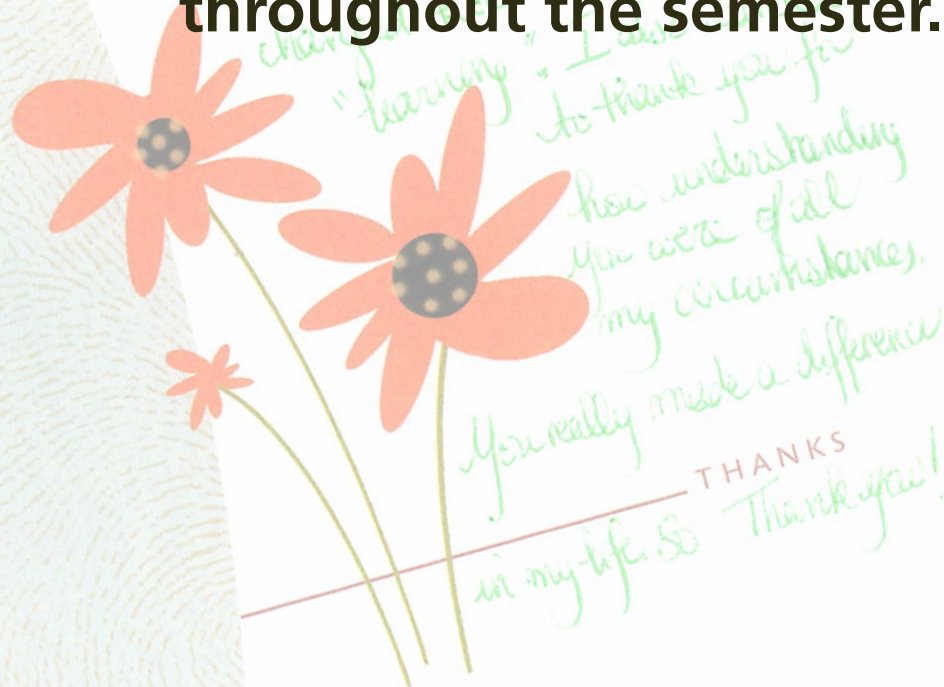
Love, Best.

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

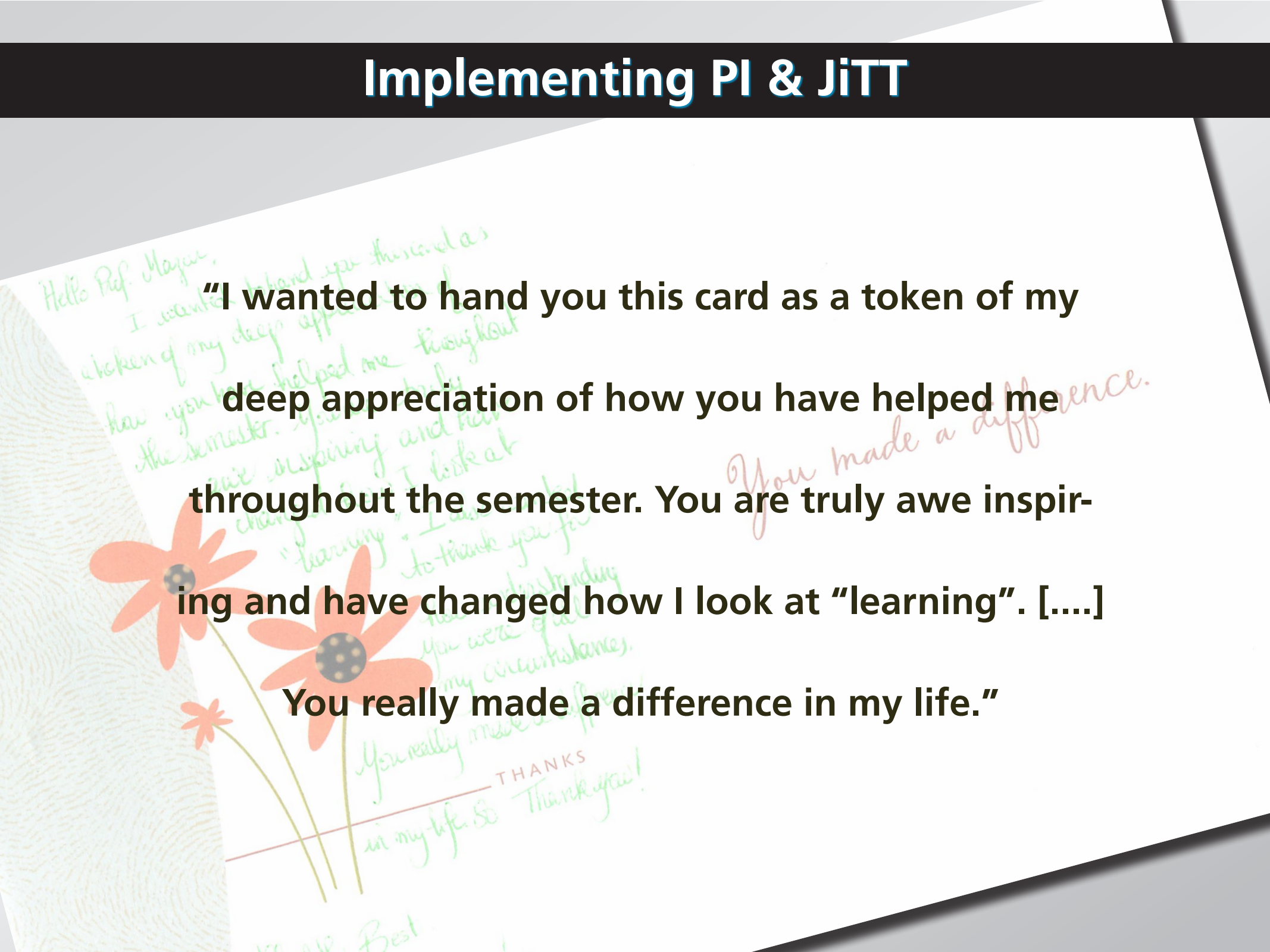
"I wanted to hand you this card as a token of my deep appreciation of how you have helped me throughout the semester. You are truly awe inspiring and have changed how I look at "learning".

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 process that is truly inspiring and awe inspiring. You were a great teacher and made a difference in my life. So Thank you!
THANKS
in my life. So Thank you!
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**

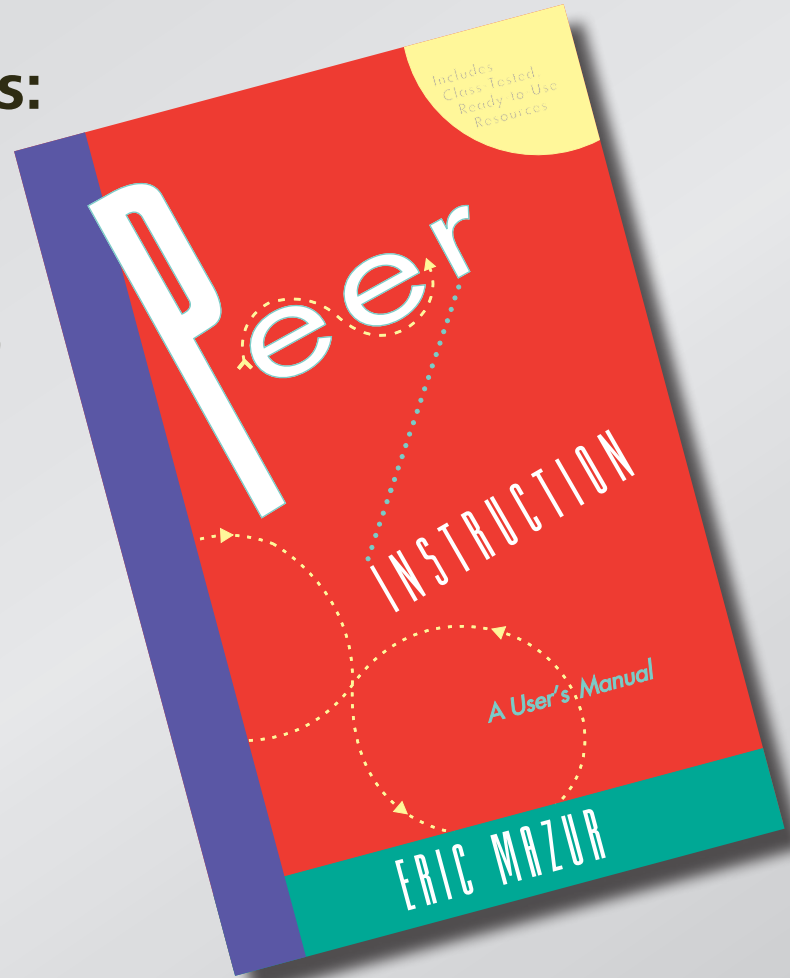
ConcepTests

“Where can I get examples of good questions?”

ConceptTests

Books with ConceptTests:

- Physics (Prentice Hall)



ConcepTests

Books with ConcepTests:

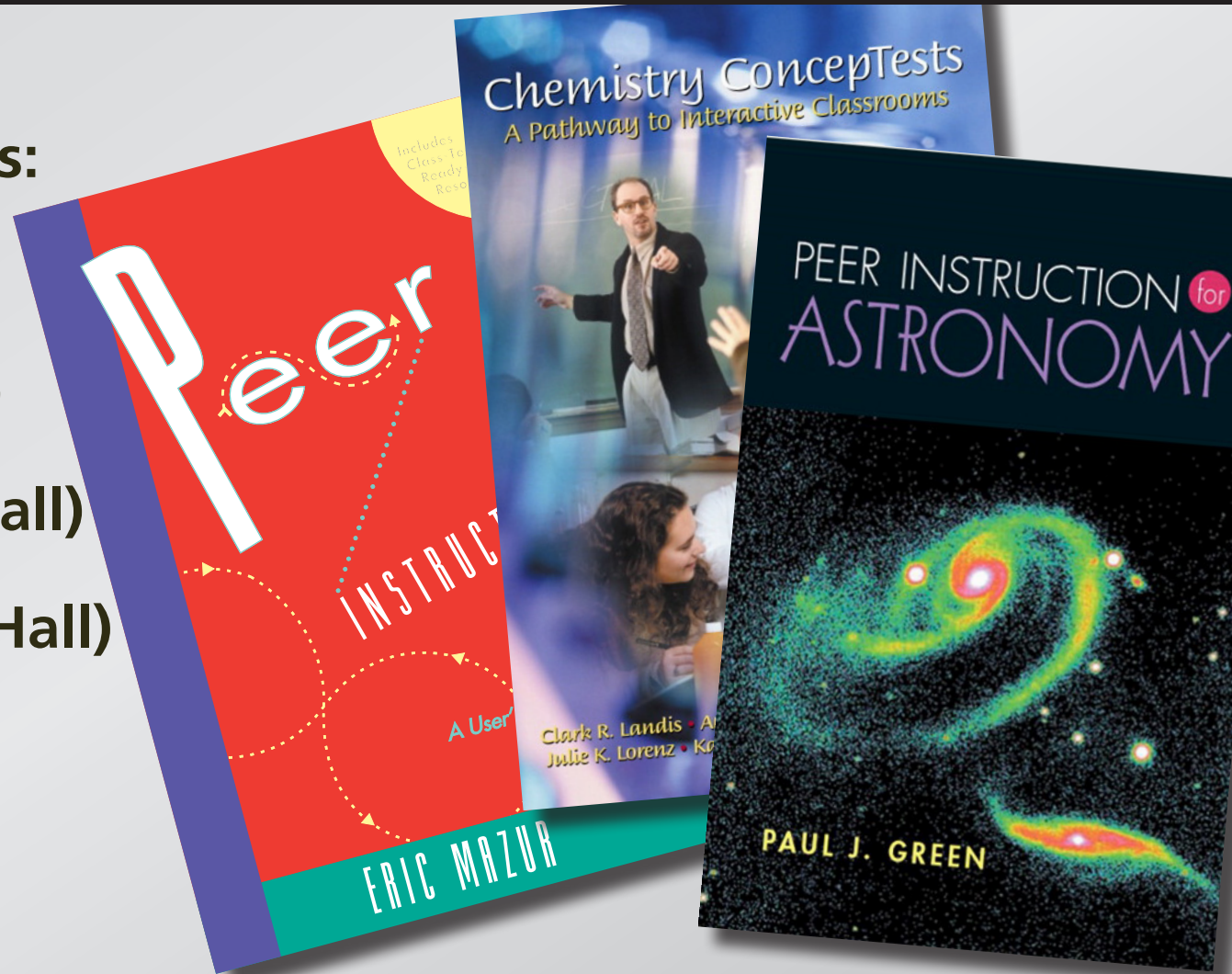
- Physics (Prentice Hall)
- Chemistry (Prentice Hall)



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Books with ConcepTests:

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



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Books with ConcepTests:

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



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... or try searching Google:

<subject> "Peer Instruction"

<subject> ConcepTest

<subject> "Concept Test"

<subject> clickers

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Types of questions

- survey
- model testing
- discussion
- select from list



Join now!

PeerInstruction.net

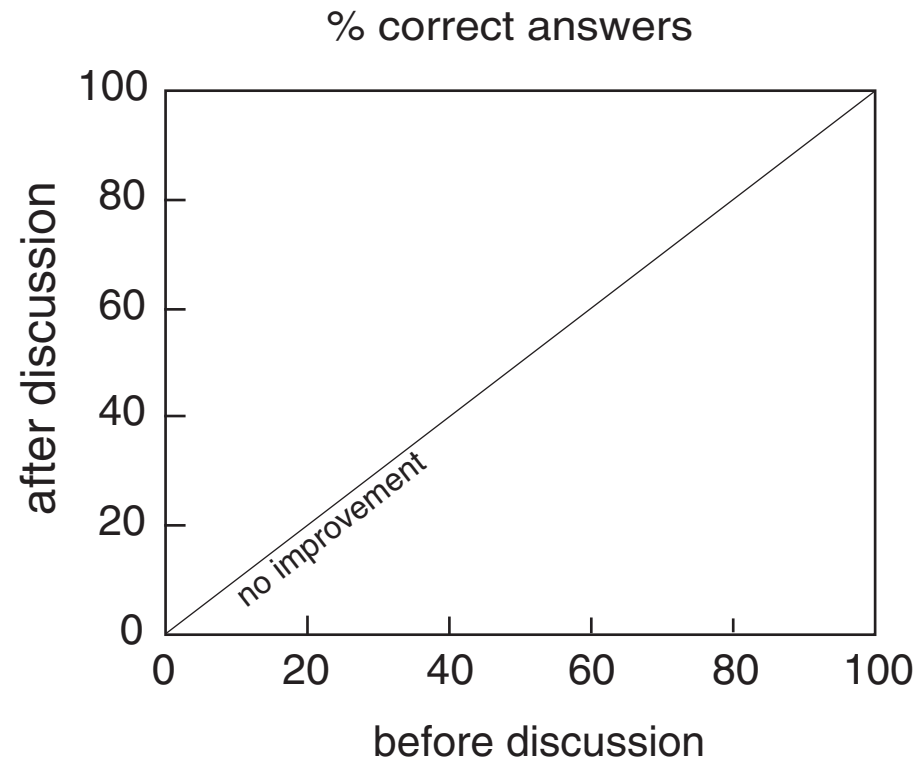
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Good conceptual questions (ConcepTests):

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

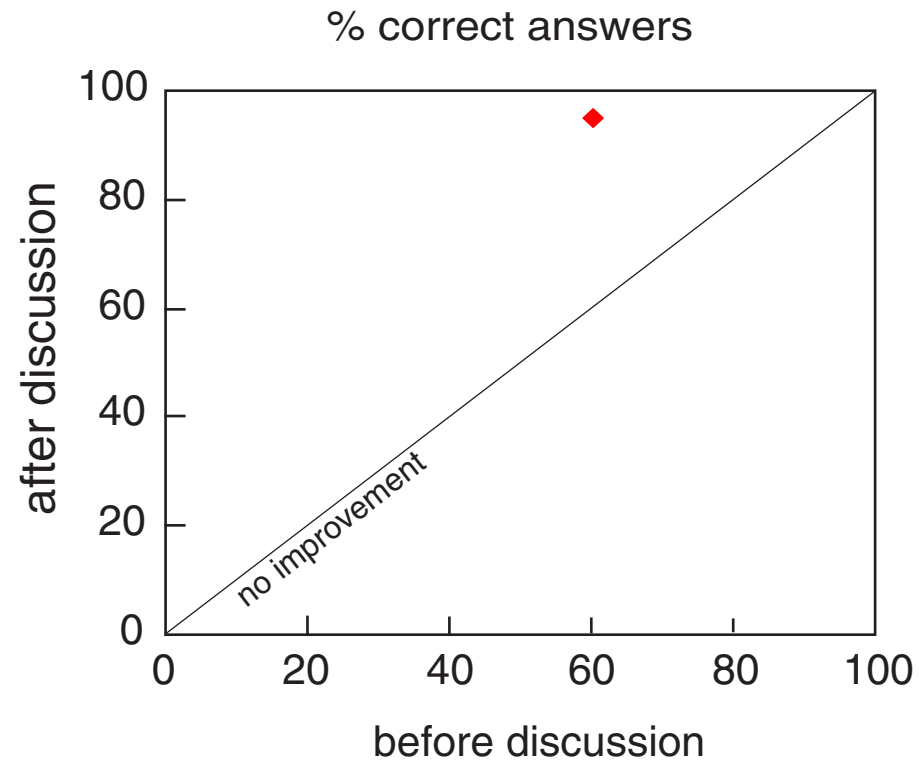
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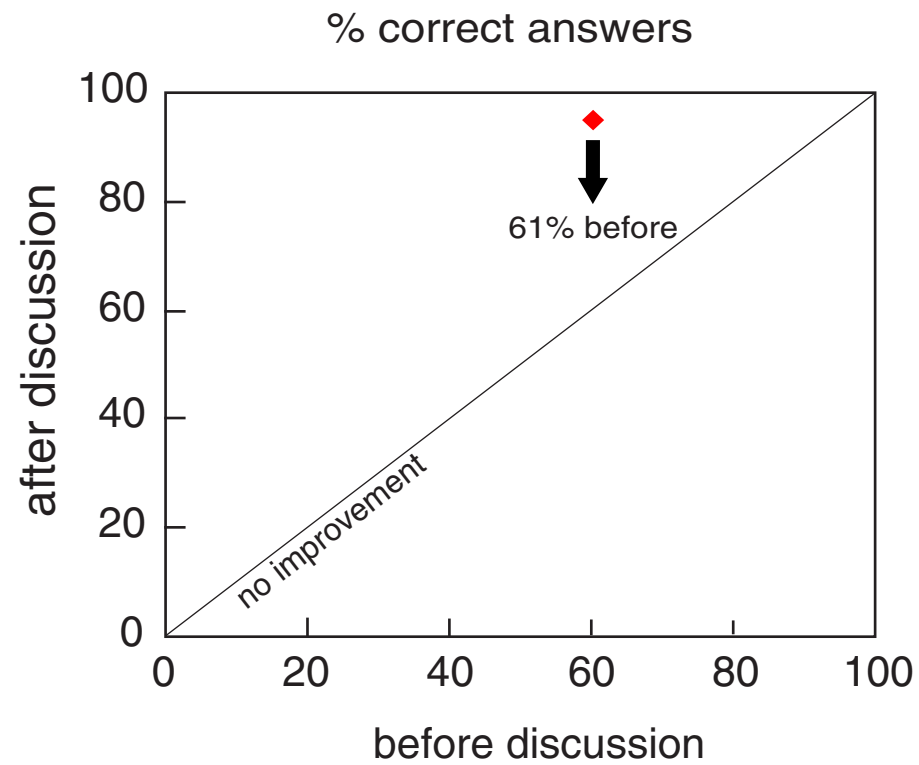
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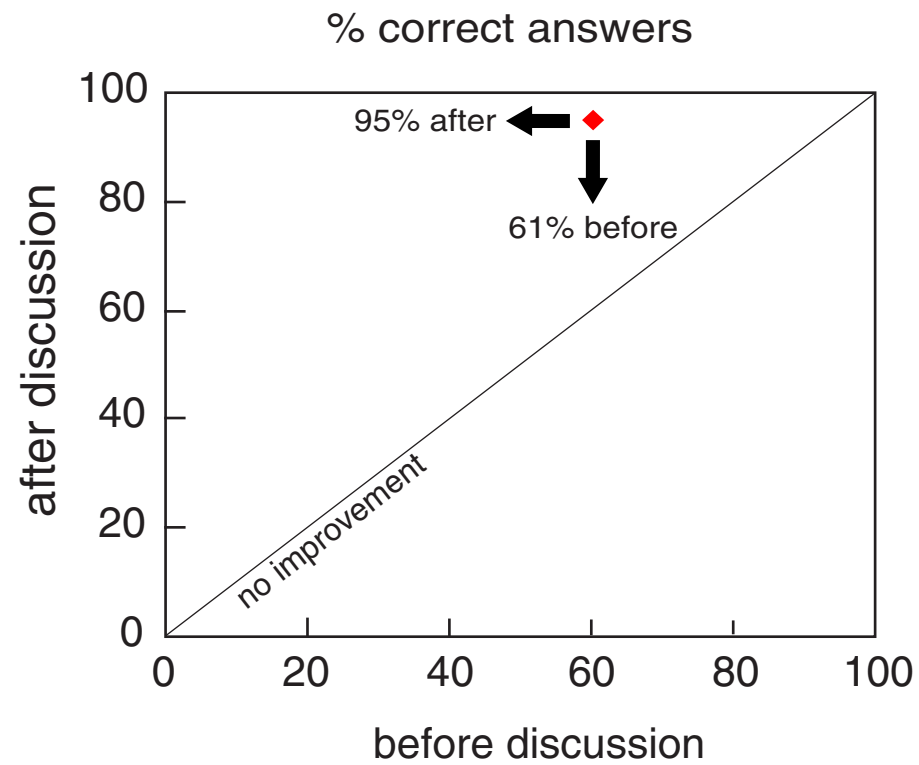
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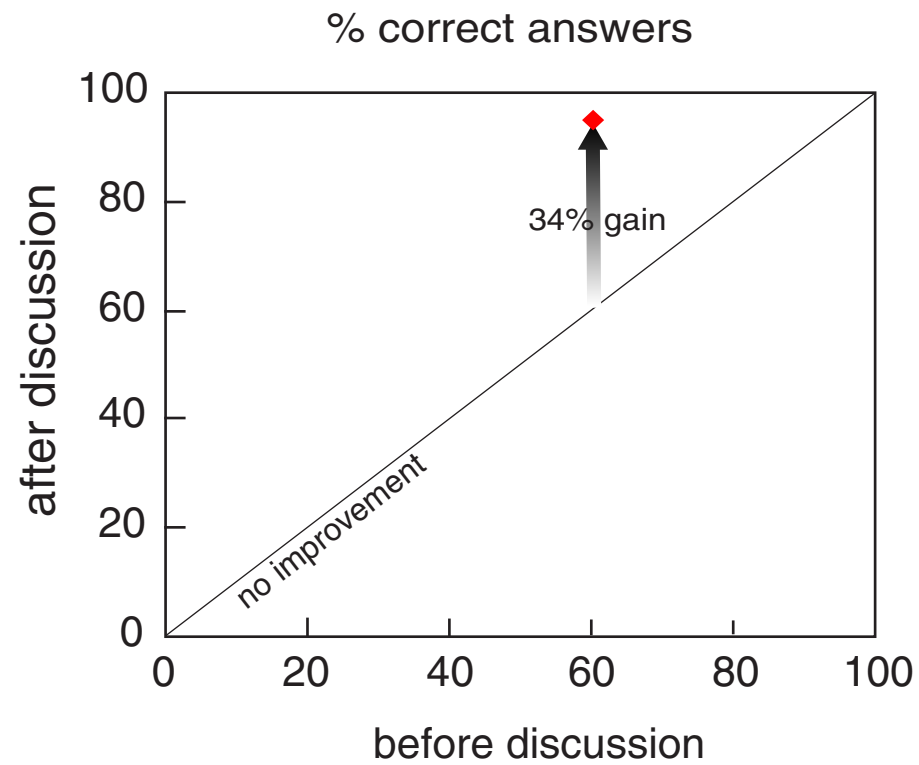
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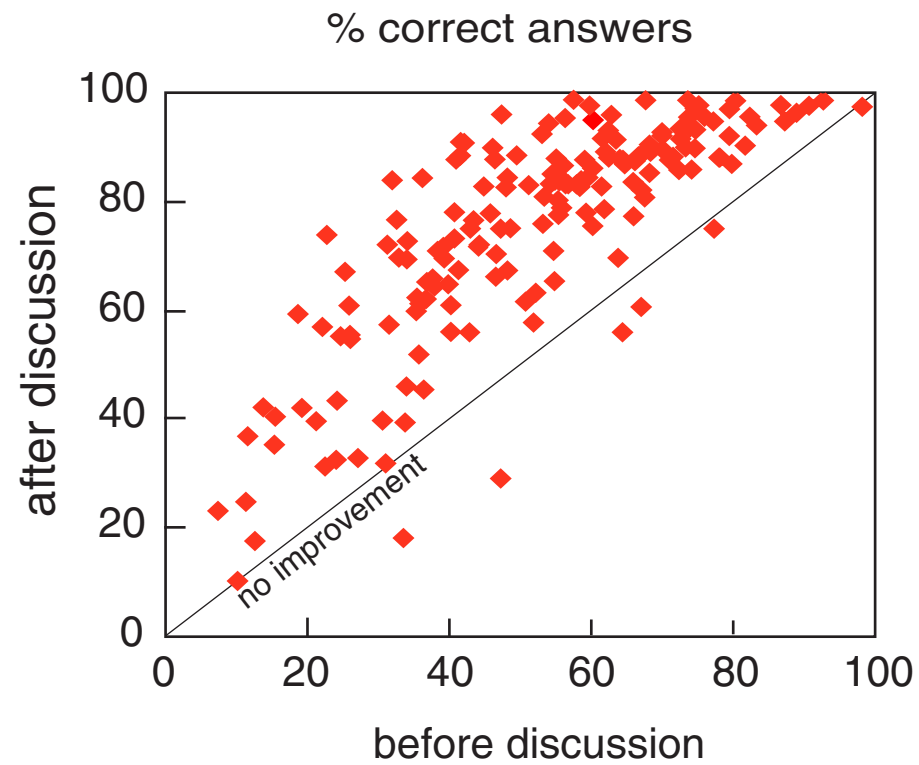
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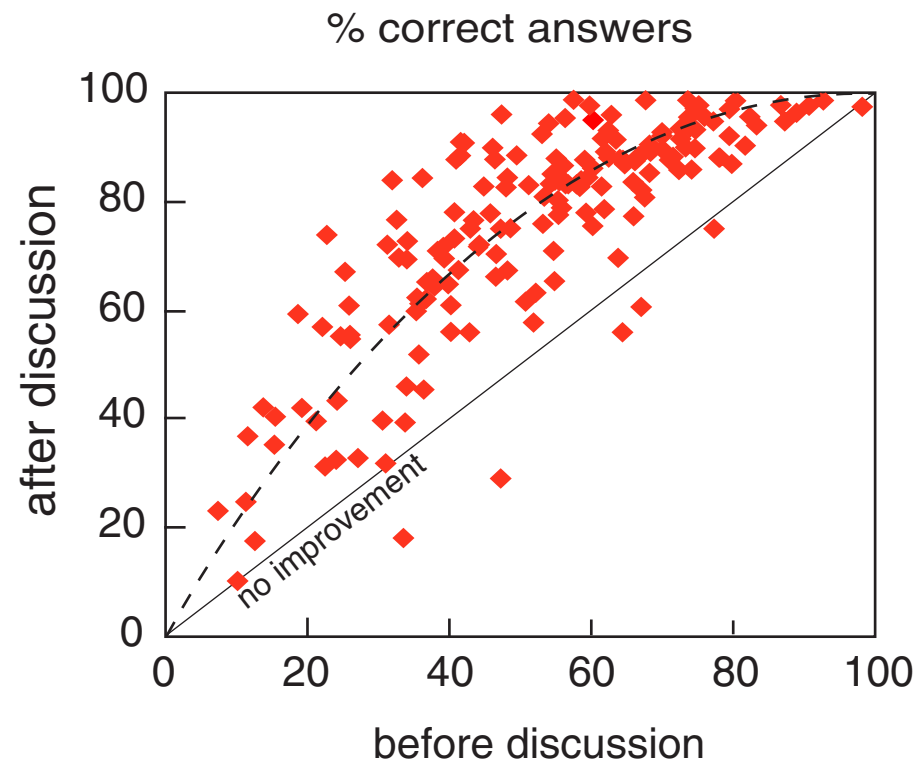
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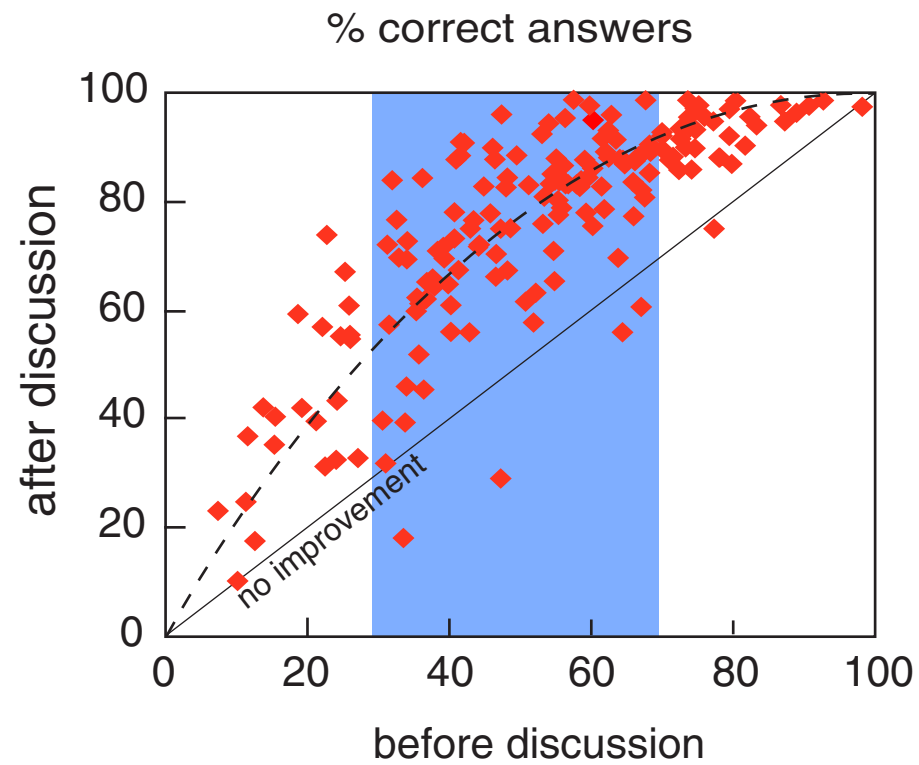
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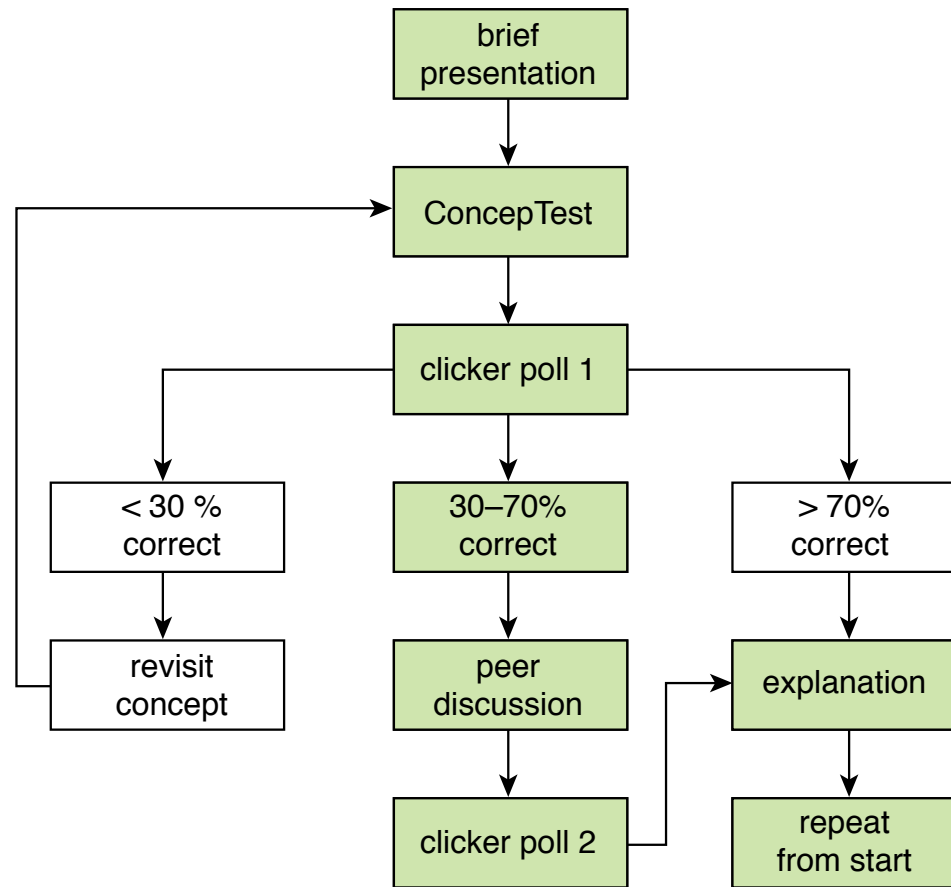


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