Peer Instruction

Curso de Innovación en la Enseñanza y el Aprendizaje
Universidad de los Andes
Santiago, Chile, 23 August 2012

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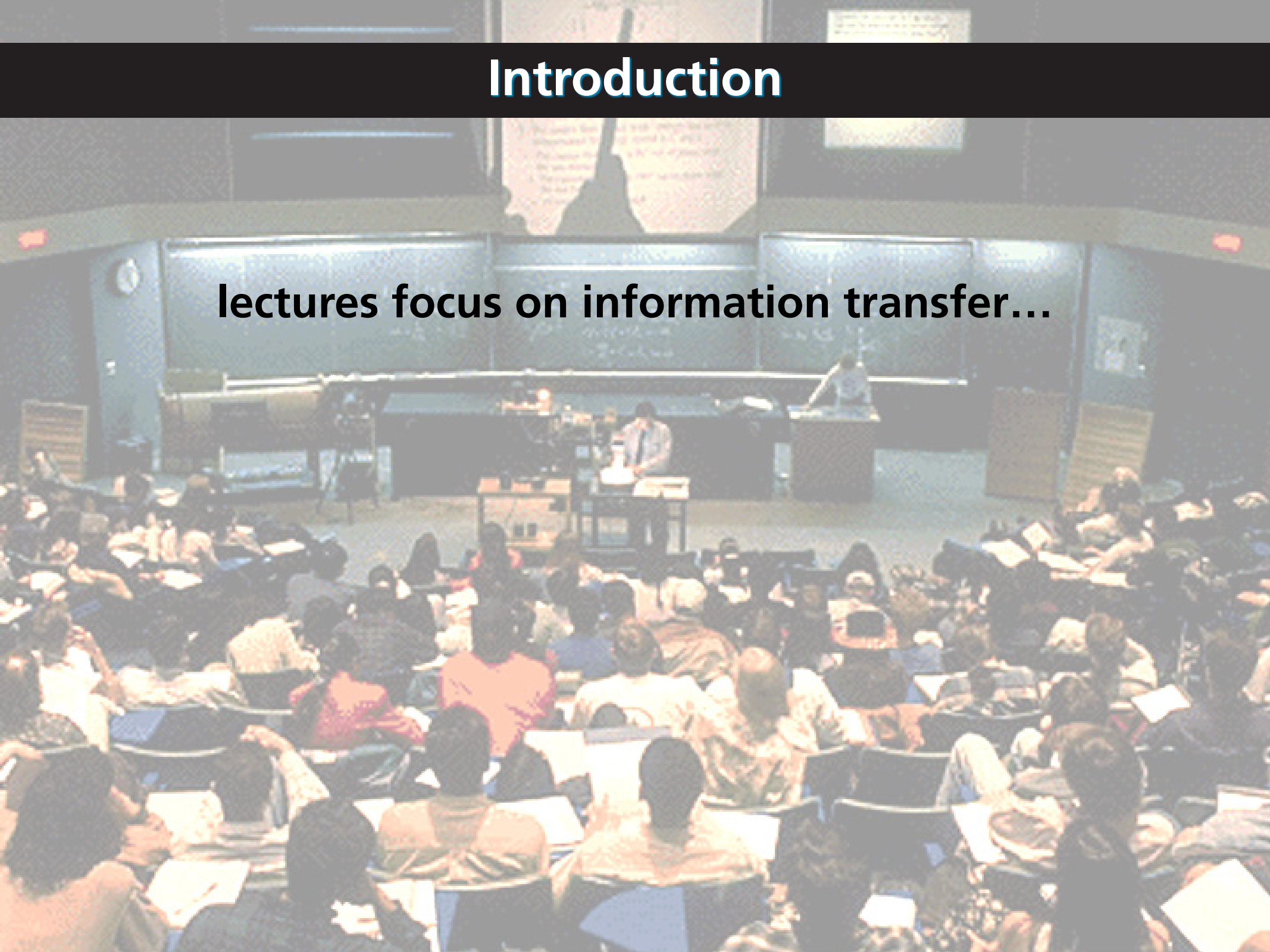
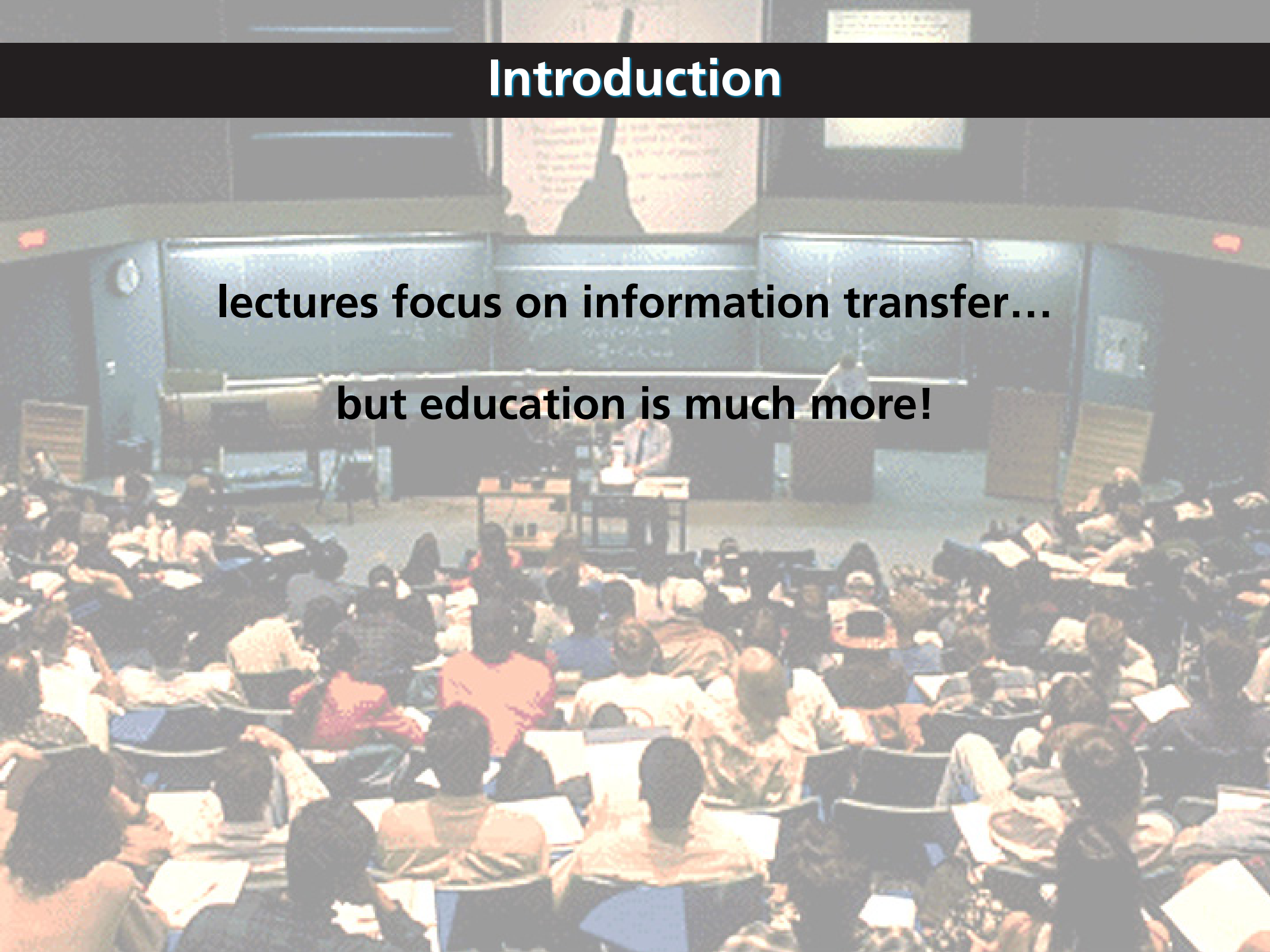
Introduction



lectures focus on information transfer…

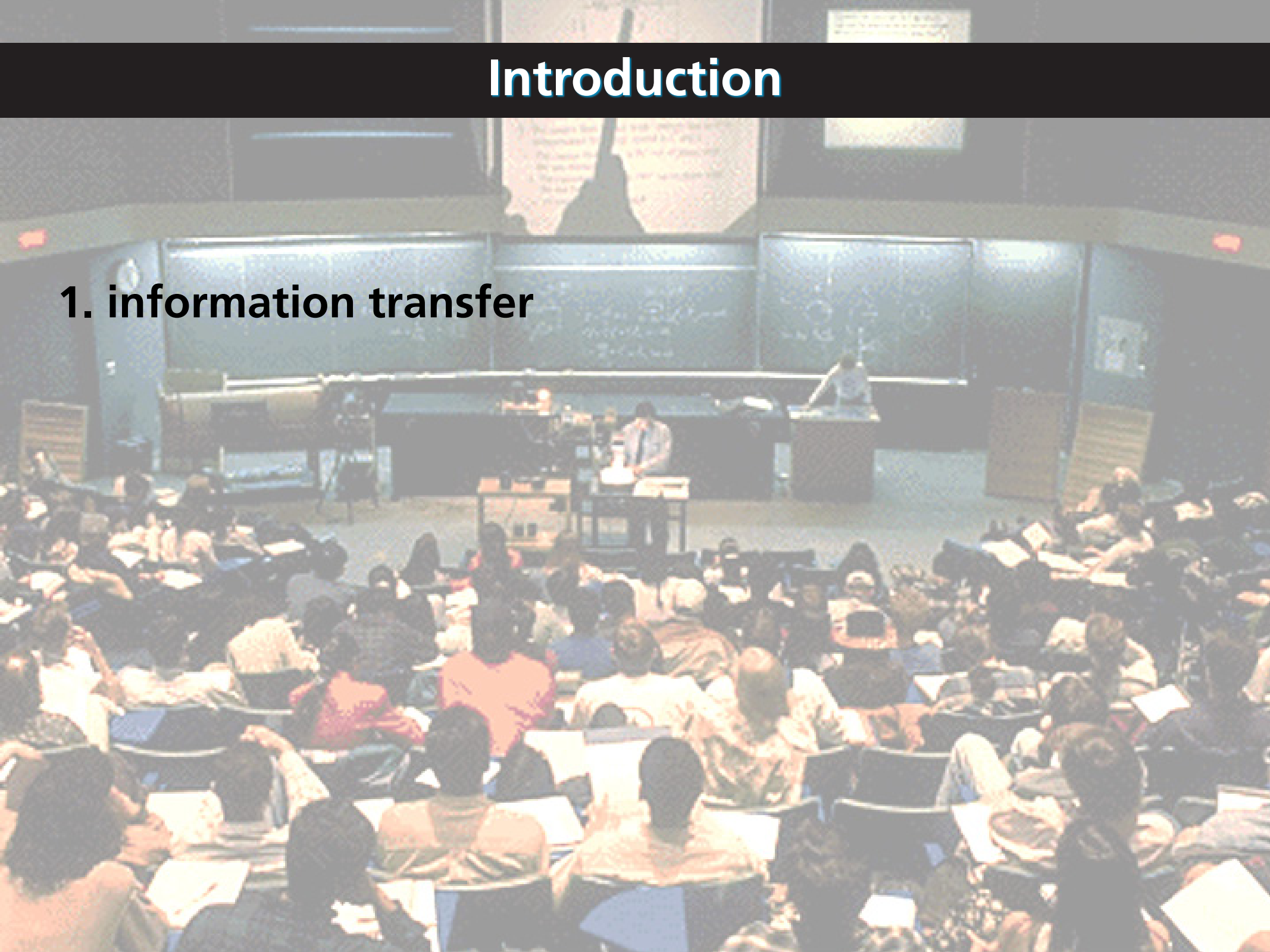
Introduction



lectures focus on information transfer…

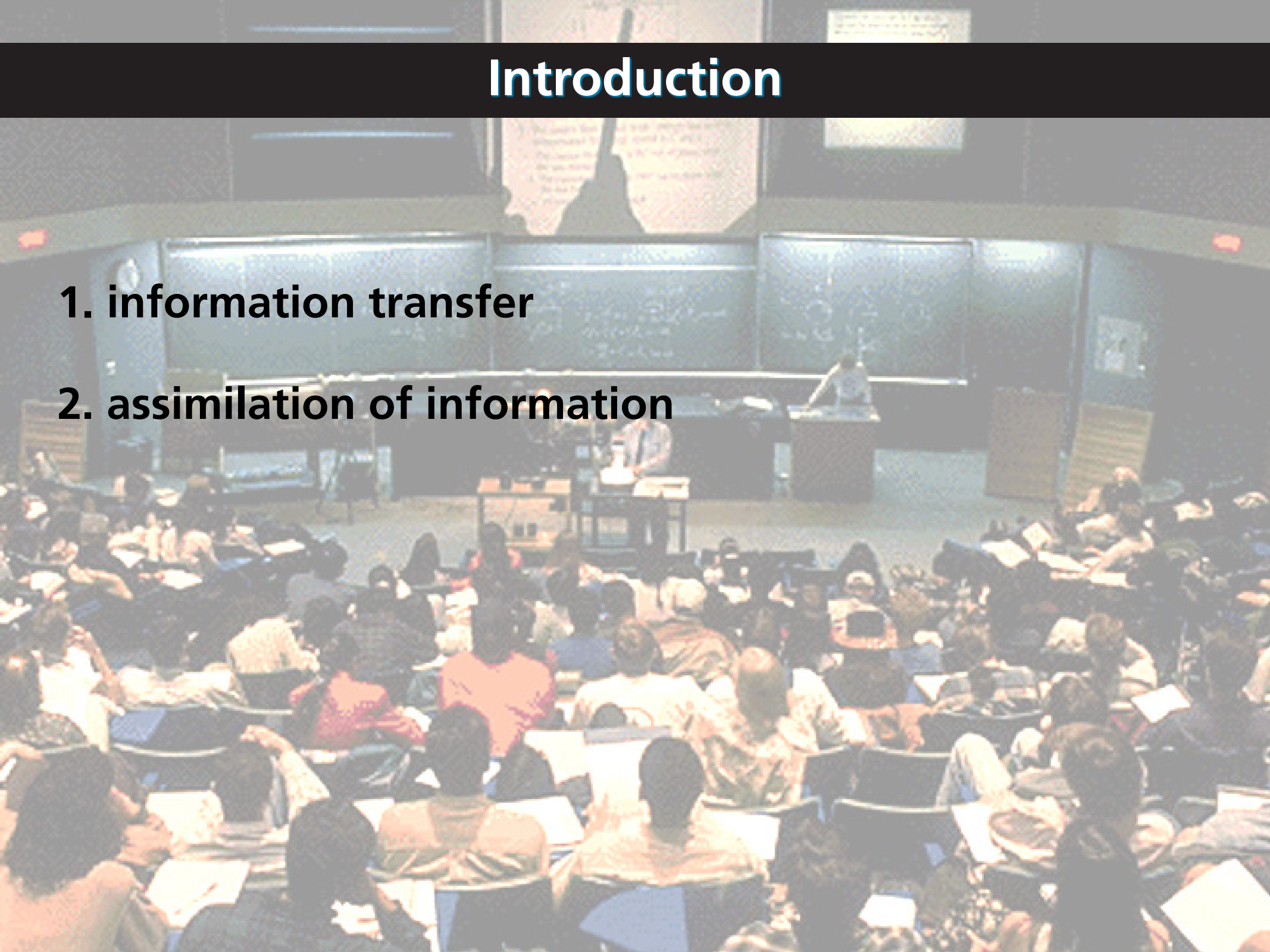
but education is much more!

Introduction



1. information transfer

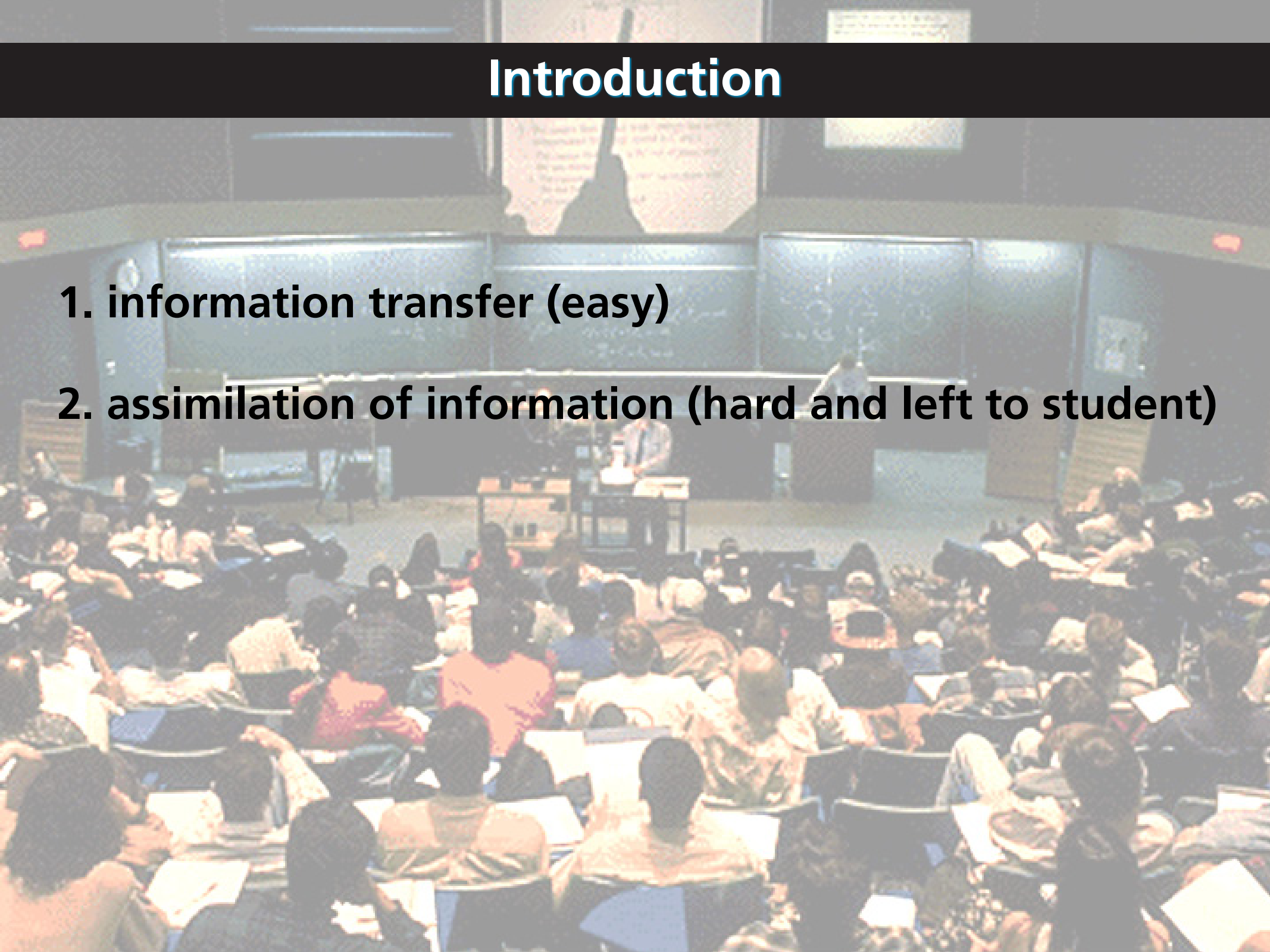
Introduction



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

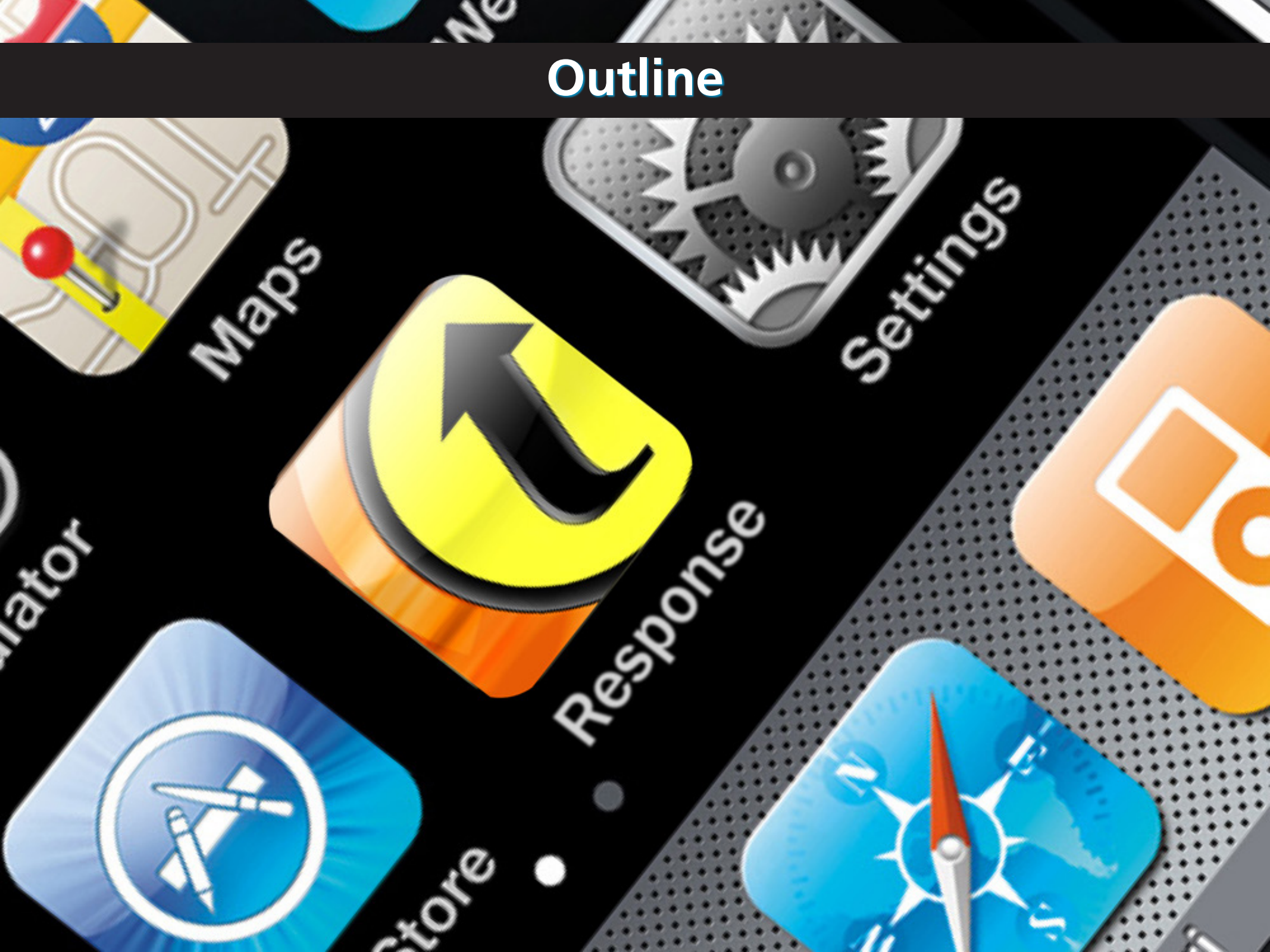
How to move information transfer out of classroom?

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
- ConcepTests

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...

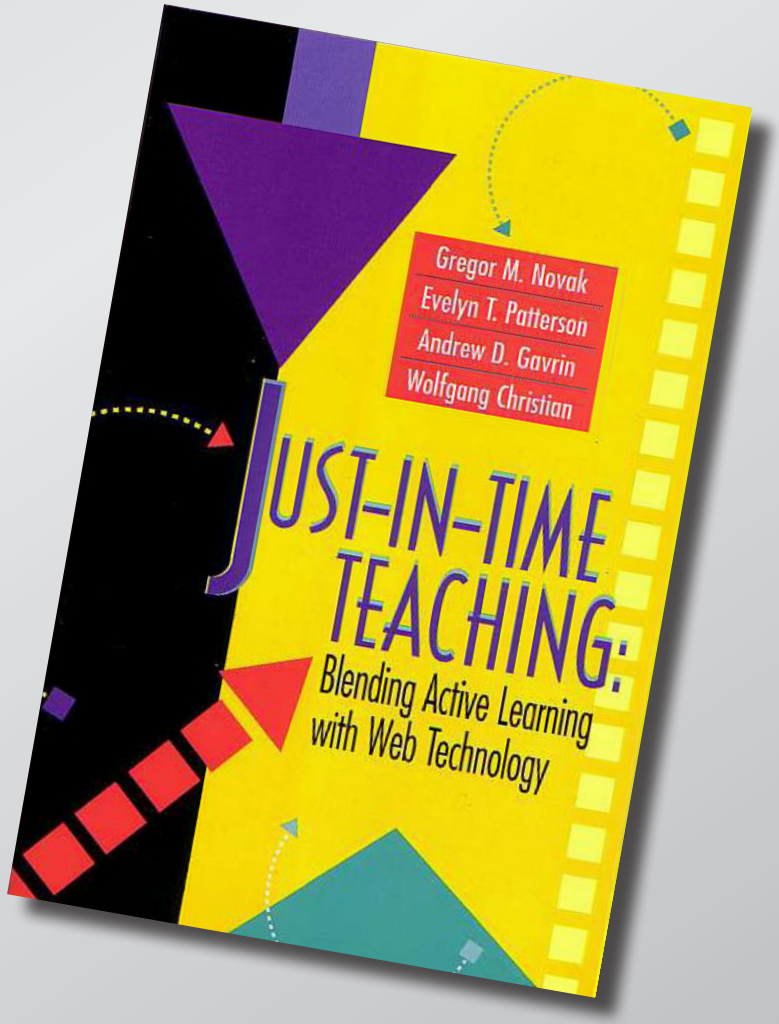
1. they don't have time.
2. they are not motivated to learn.
3. their instructors take away the incentive.
4. they do not have the requisite skills.
5. of some other reason.
6. They do come prepared in my class!

(select what you consider to be the main reason)

PI & JiTT Overview

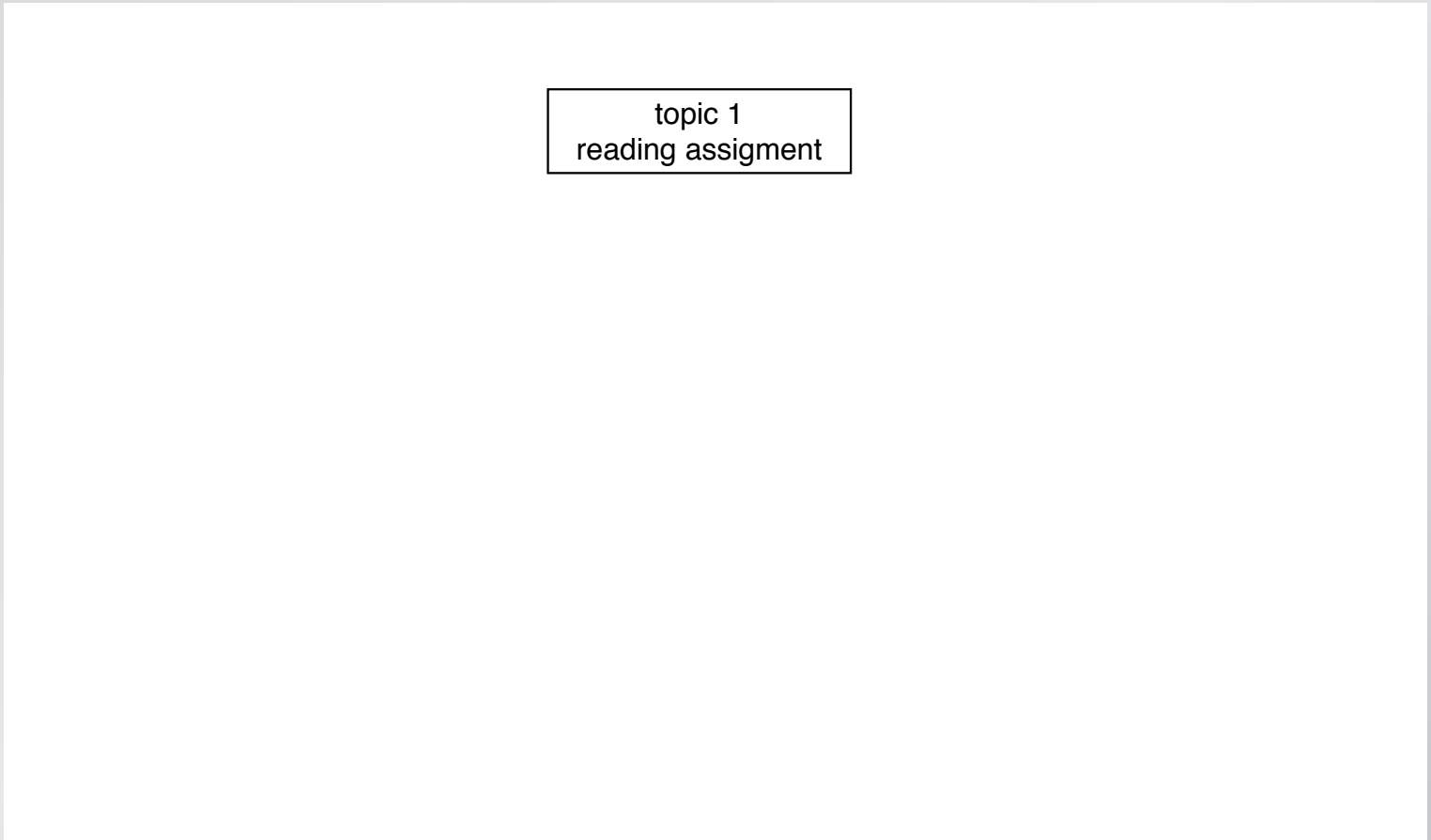
Just-in-time-Teaching (JiTT)

www.jitt.org



PI & JiTT Overview

JiTT workflow



PI & JiTT Overview

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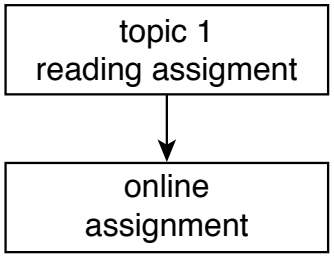
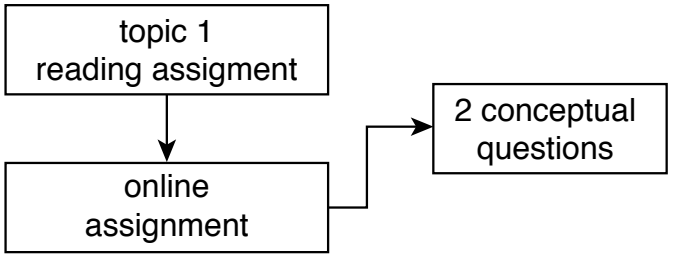


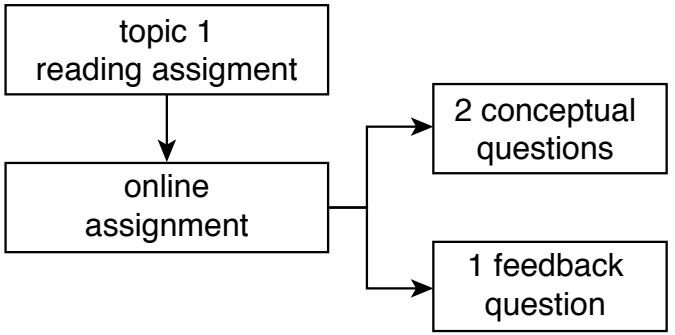
PI & JiTT Overview

JiTT workflow



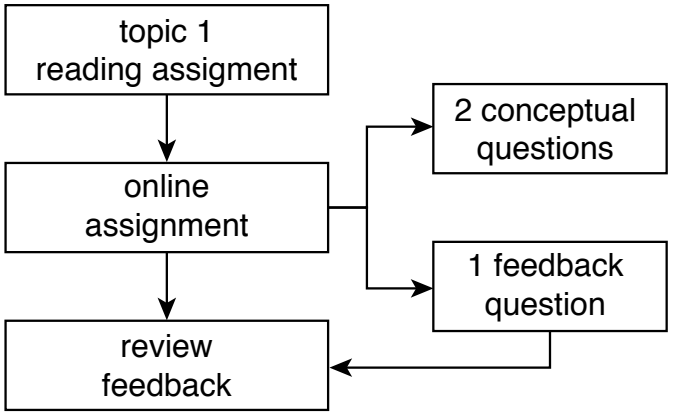
PI & JiTT Overview

JiTT workflow



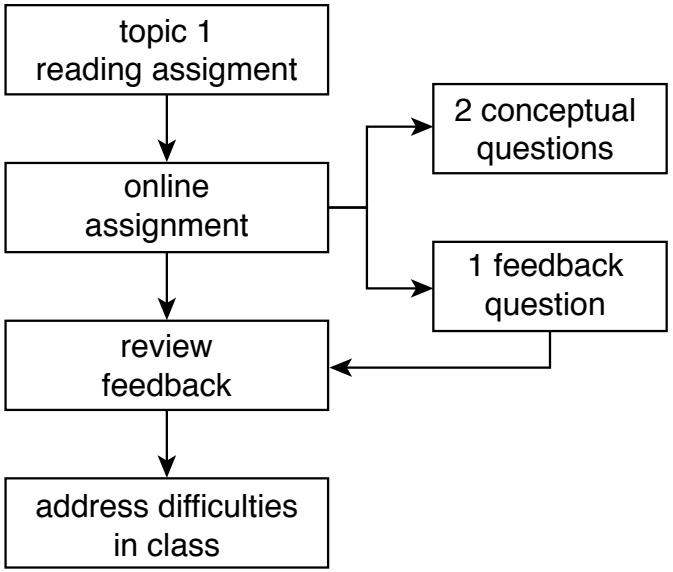
PI & JiTT Overview

JiTT workflow



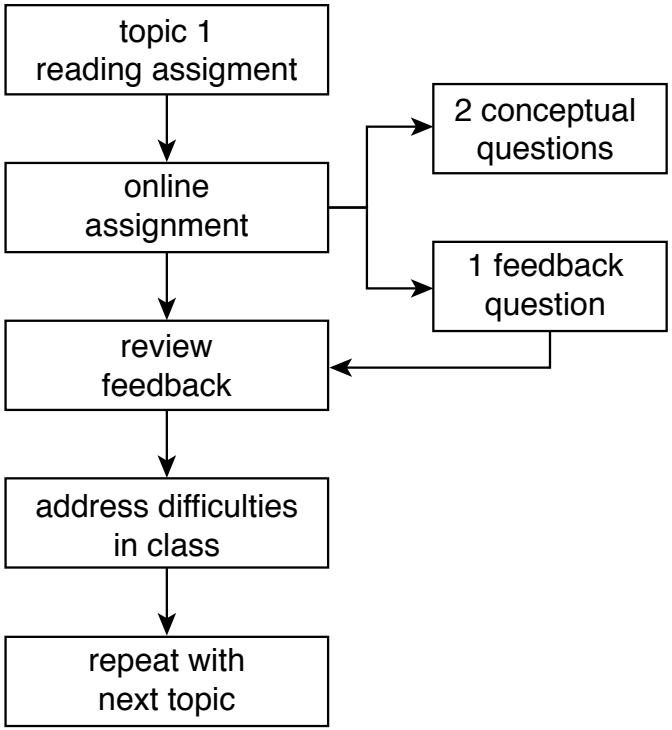
PI & JiTT Overview

JiTT workflow



PI & JiTT Overview

JiTT workflow



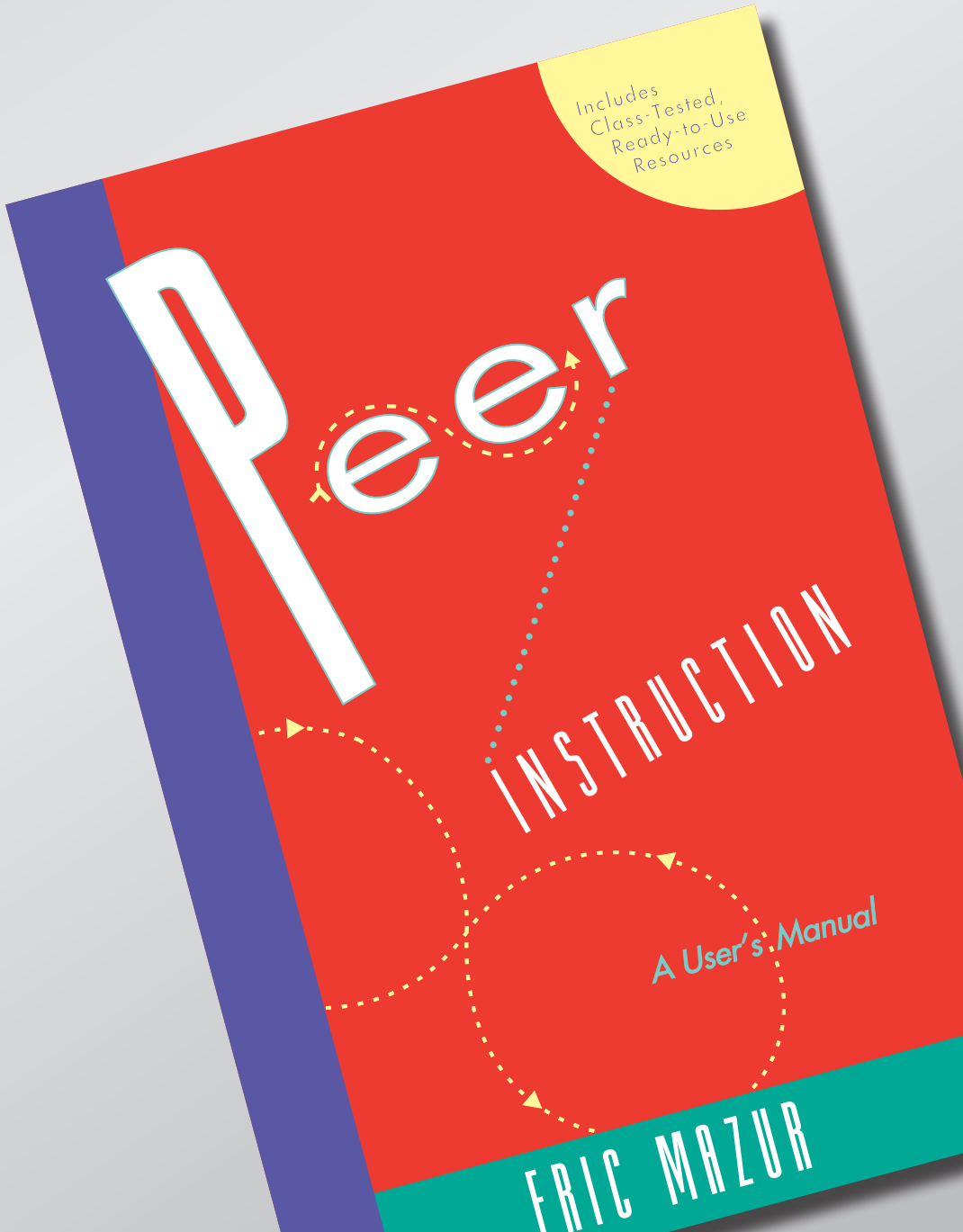
PI & JiTT Overview

JiTT:

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

PI & JiTT Overview

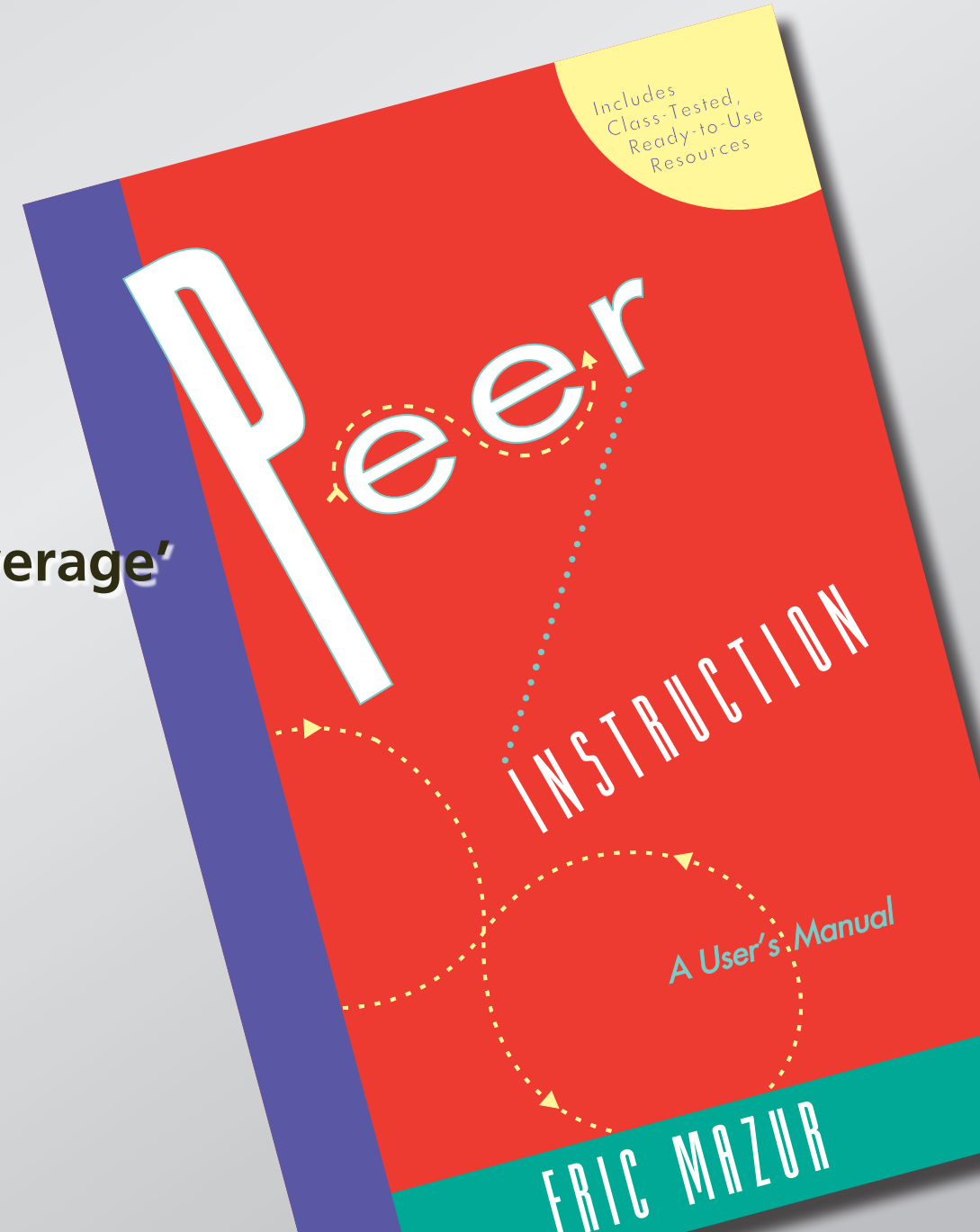
Peer Instruction (PI)



PI & JiTT Overview

Main features:

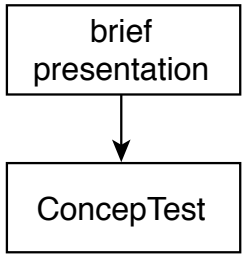
- **pre-class assignment**
- **in-class: depth, not 'coverage'**
- **ConcepTests**



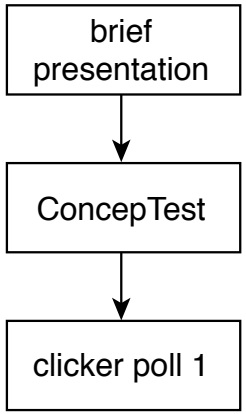
PI & JiTT Overview

brief
presentation

PI & JiTT Overview



PI & JiTT Overview



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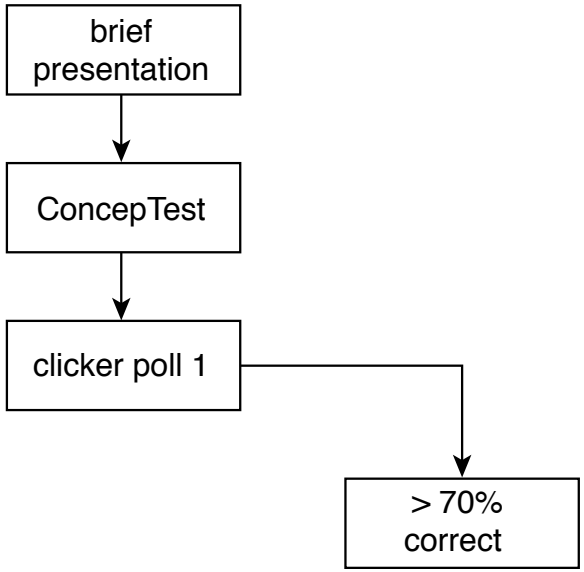

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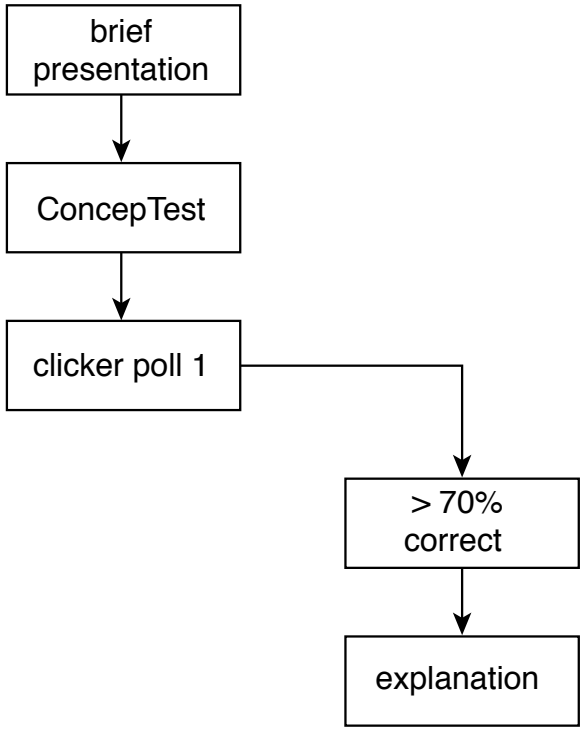

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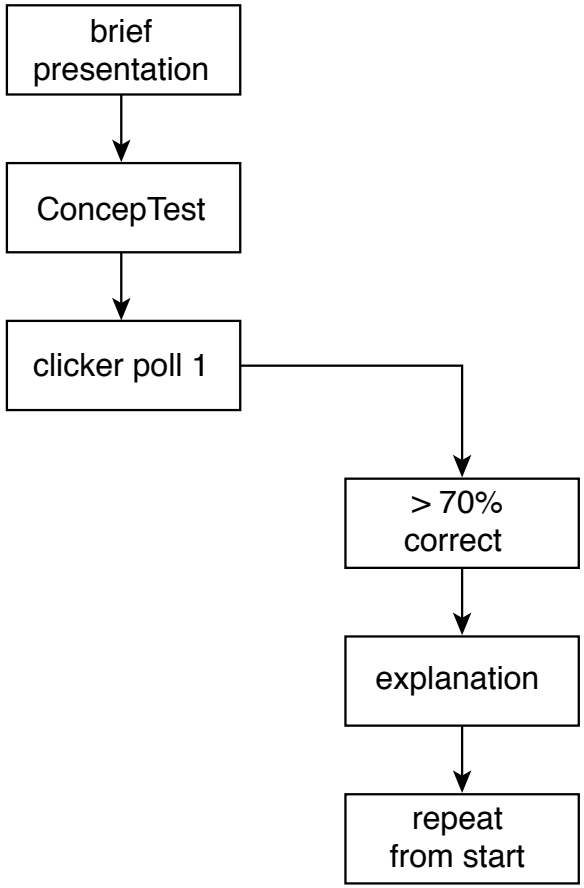

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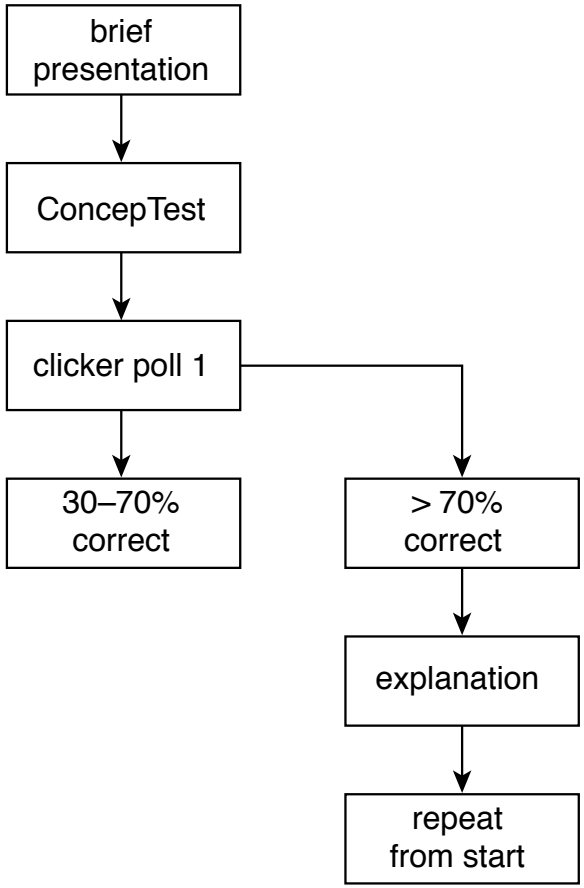

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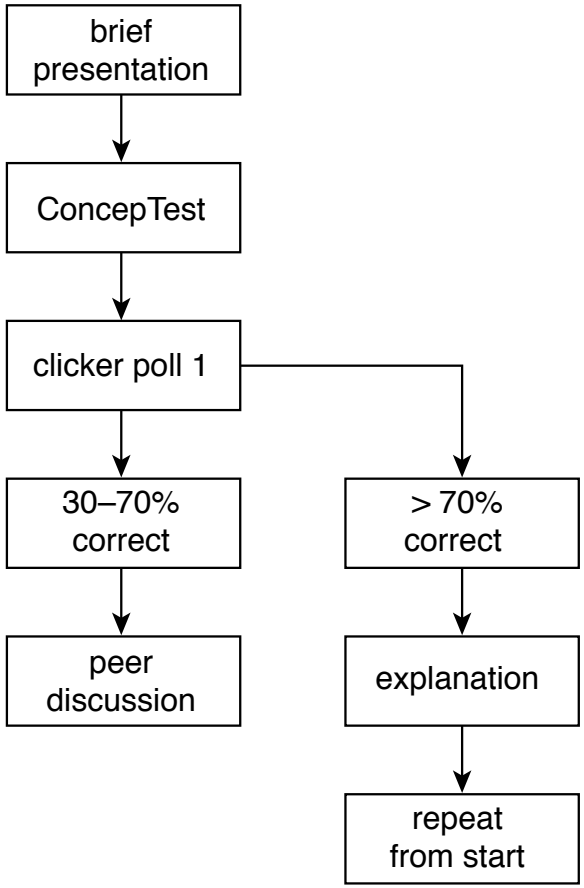

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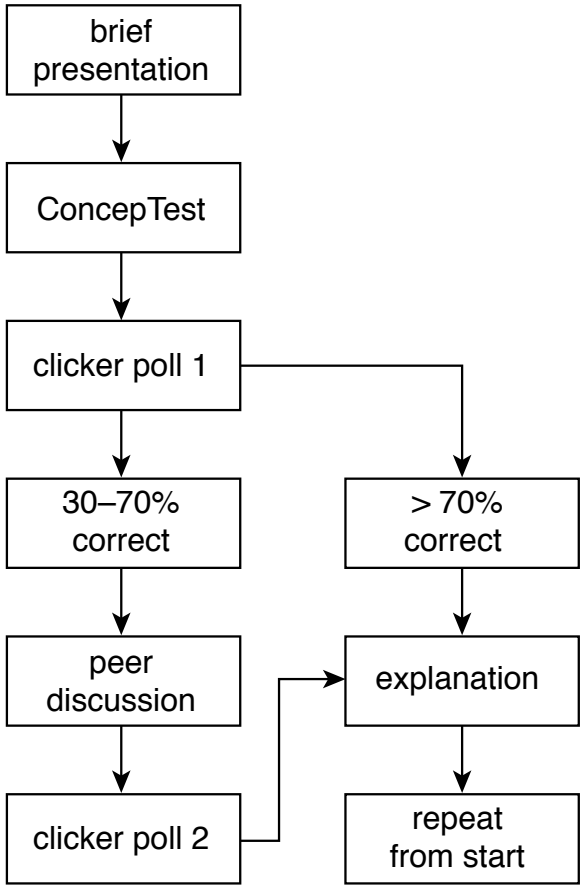

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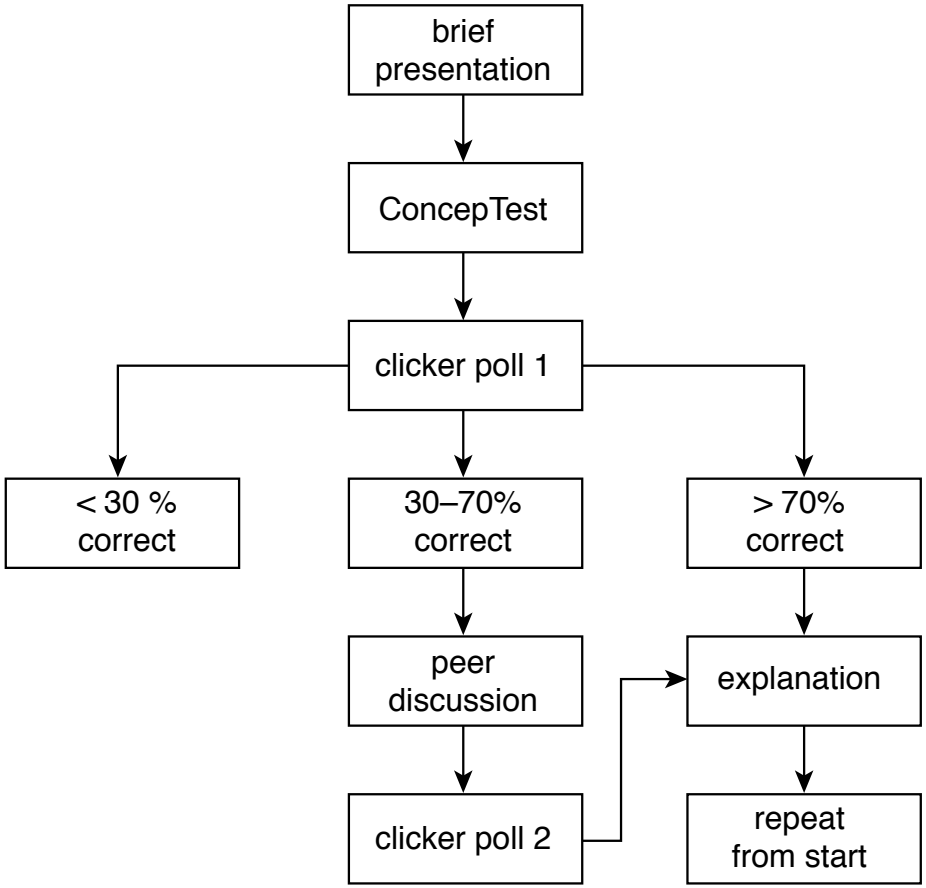

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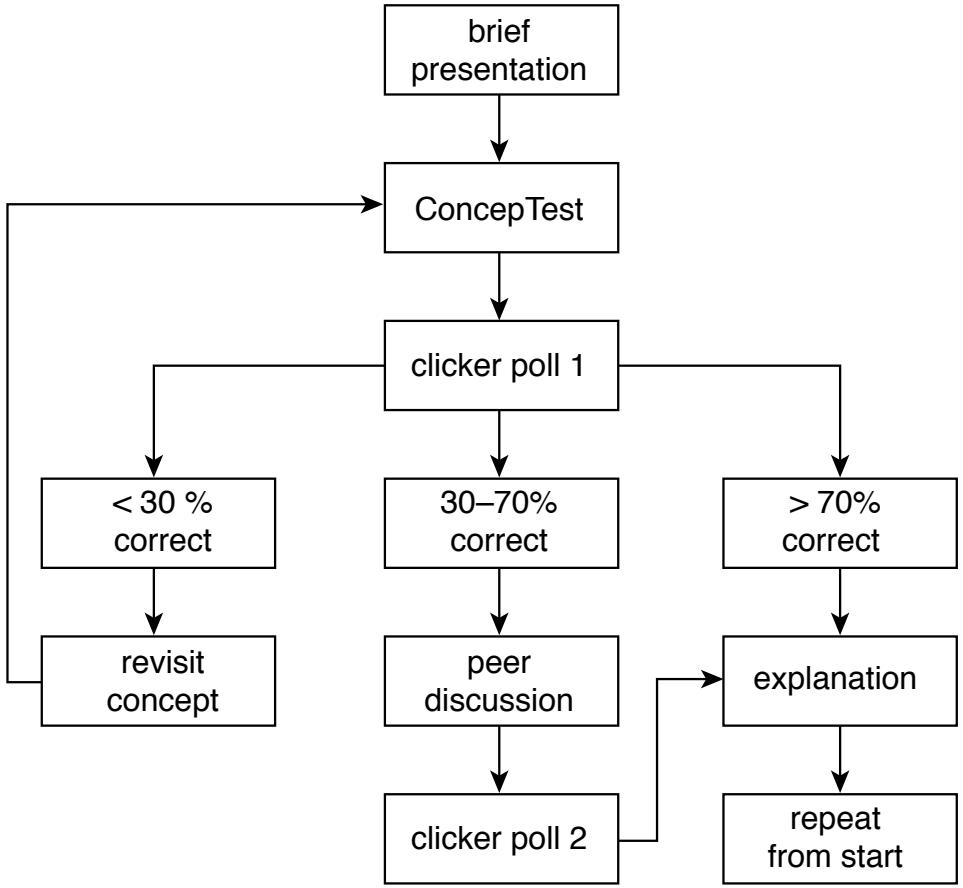

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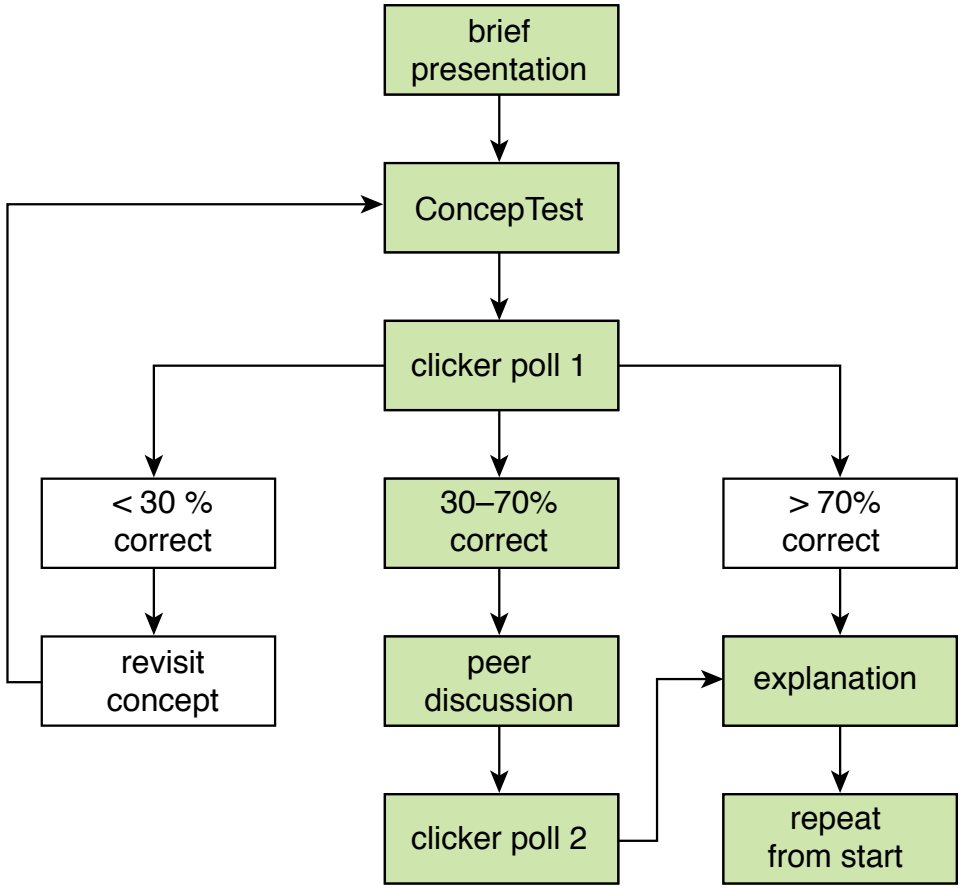


PI & JiTT Overview

PI:

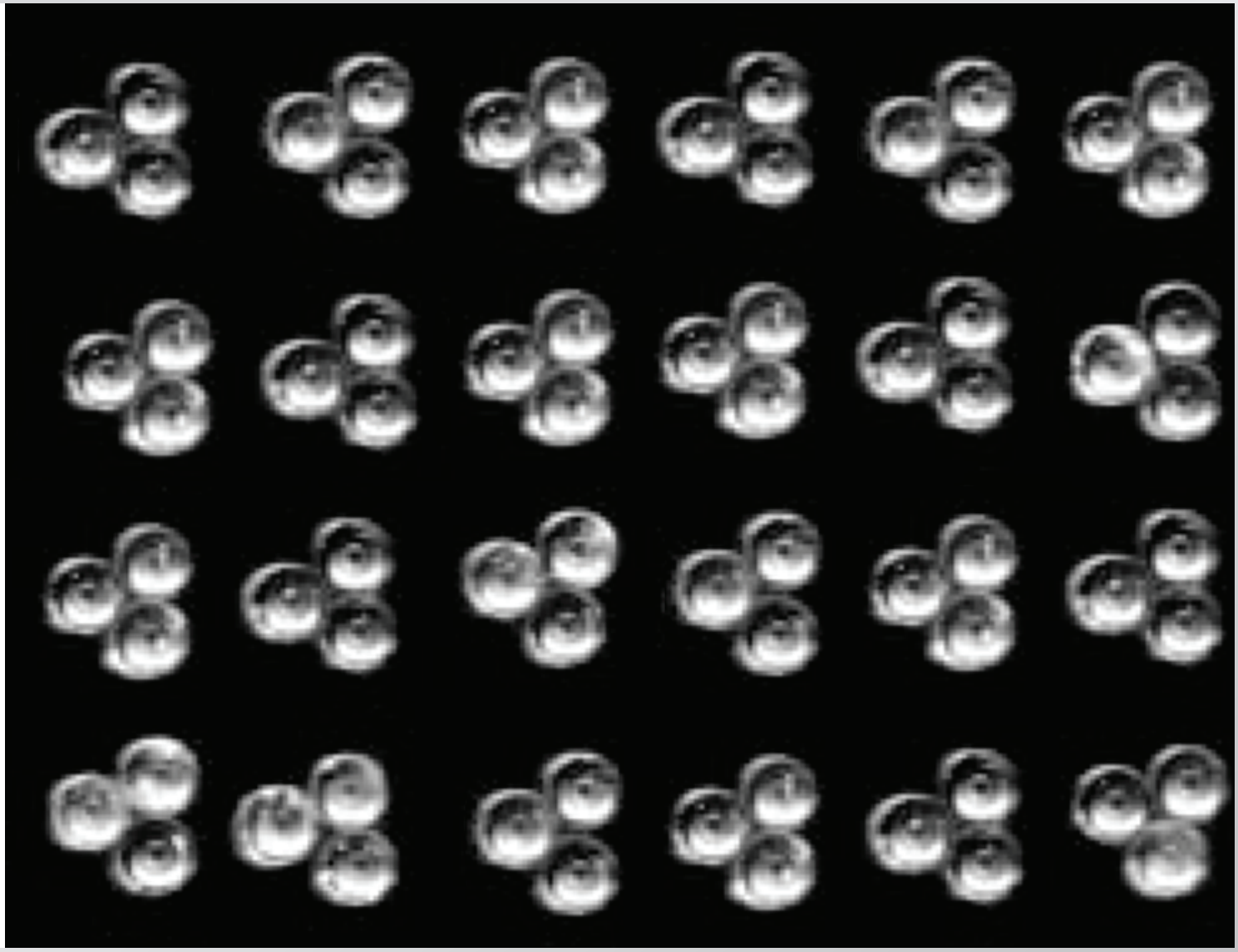
- **helps students overcome difficulties**
- **encourages deep learning**
- **provides depth, not “coverage”**
- **helps you become aware of misconceptions**

PI & JiTT Overview

“Can this method be used in my class,

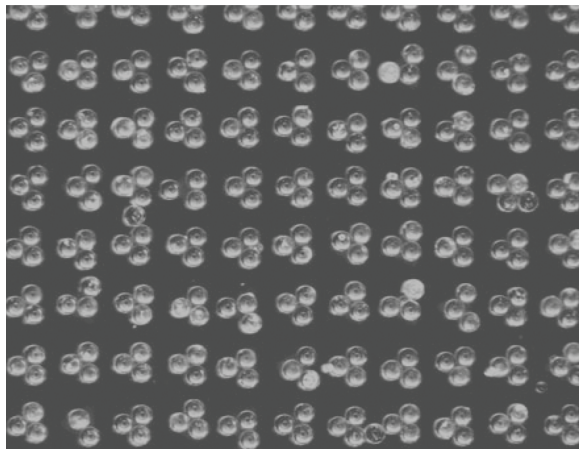
where questions don’t necessarily have right answers?”

Let's try it!

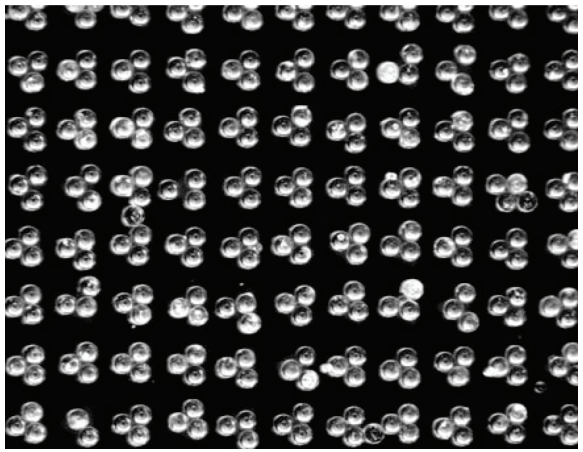


Let's try it!

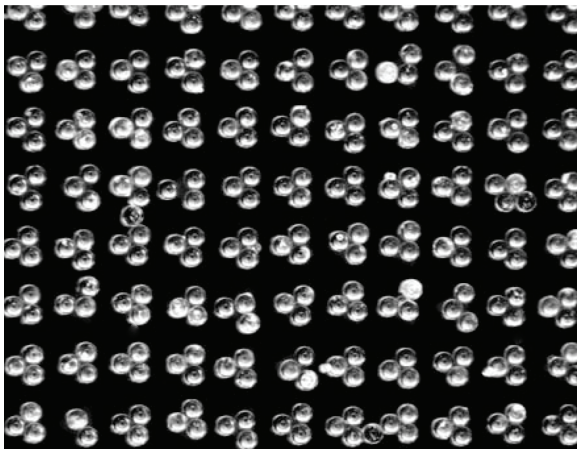
original



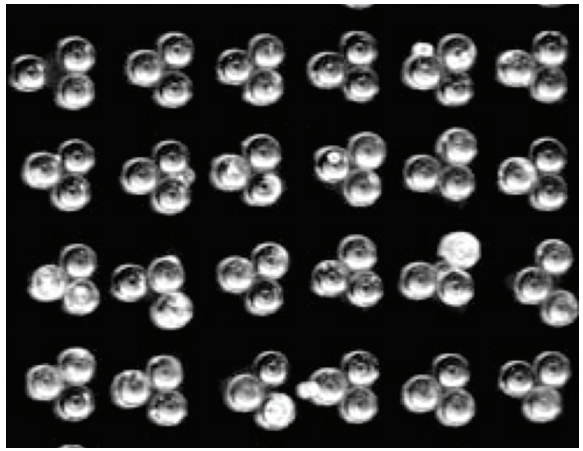
1. adjust contrast



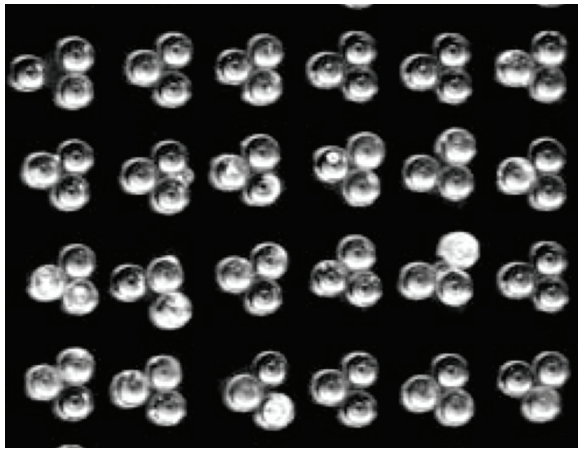
2. remove blemishes



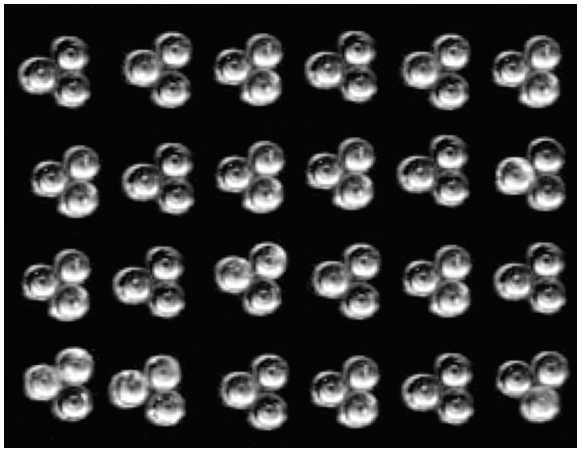
3. crop



4. remove outliers

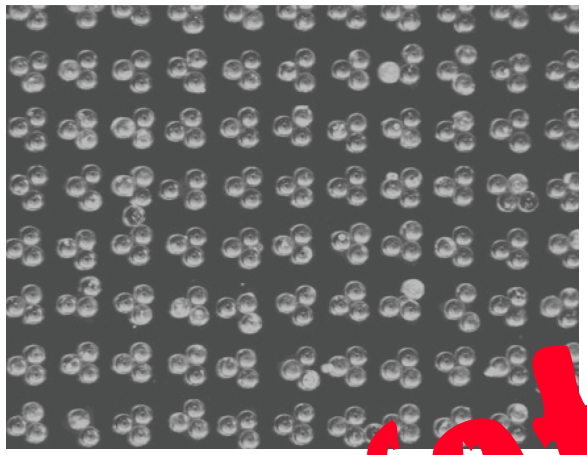


5. reconstruct



Let's try it!

original

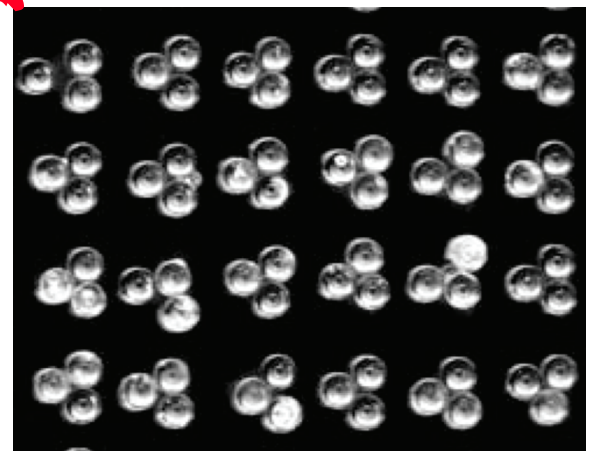


1. adjust contrast

2. remove blemishes

3. crop

4. remove outliers



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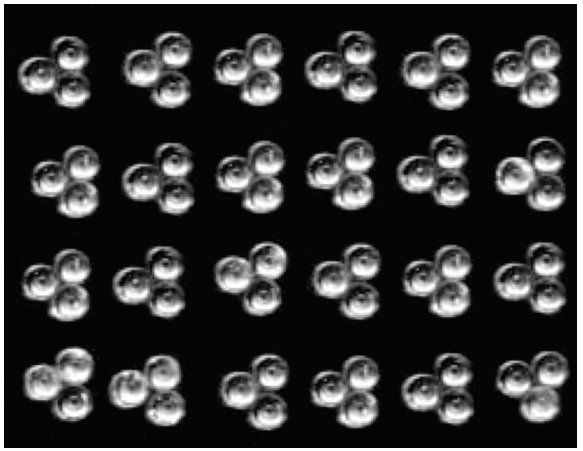

you got all engaged!

Let's try it!

You are triaging patients in a pediatric urgent care clinic and the following patients are waiting.

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1. 3-yr old F with a FUO and *T* = 40 °C who is riding a tricycle in the waiting room

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2. 6-wk old term M, cc: fussy breast, *T* = 38.6 °C

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2. 6-wk old term M, cc: fussy breast, *T* = 38.6 °C

3. 14-yr old M with hx of epilepsy who had a seizure at home lasting 5 minutes about half hour ago

Let's try it!

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Whom would you triage first?

Let's try it!

You are triaging patients in a pediatric urgent care clinic and the following patients are waiting.

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2. 6-wk old term M ex: fussy breast, *T* = 38.6 °C

3. 14-yr old M with hx of epilepsy who had a seizure at home lasting 5 minutes about half hour ago

Whom would you triage first?

you got all engaged!

PI & JiTT Overview

Don’t need a correct answer!

PI & JiTT Overview

“Why does it work?”

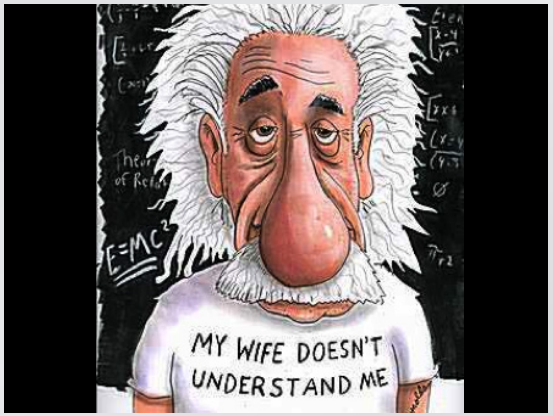
PI & JiTT Overview

discussion or more time to think?

PI & JiTT Overview

compare three activities

question

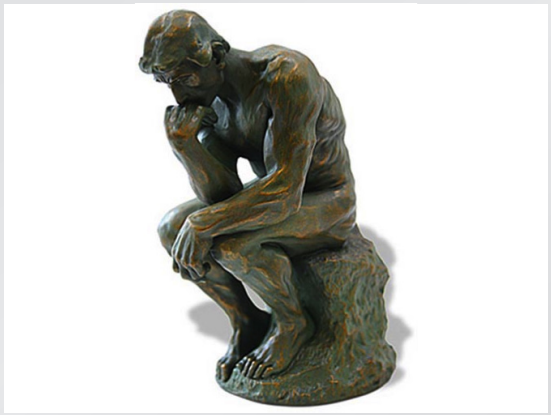


distract

question

PI & JiTT Overview

compare three activities



question

reflect

question

PI & JiTT Overview

compare three activities

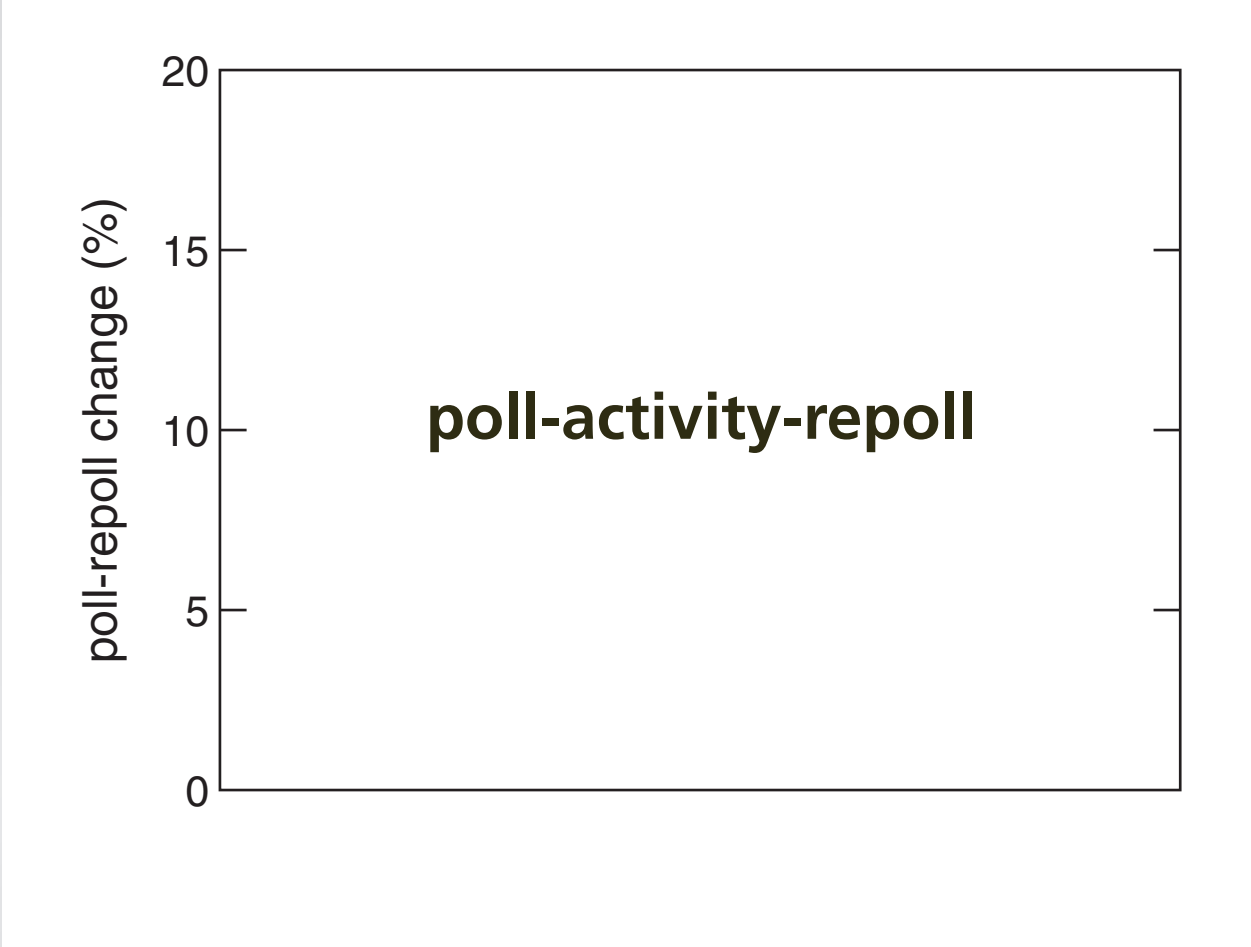
question

discuss

question

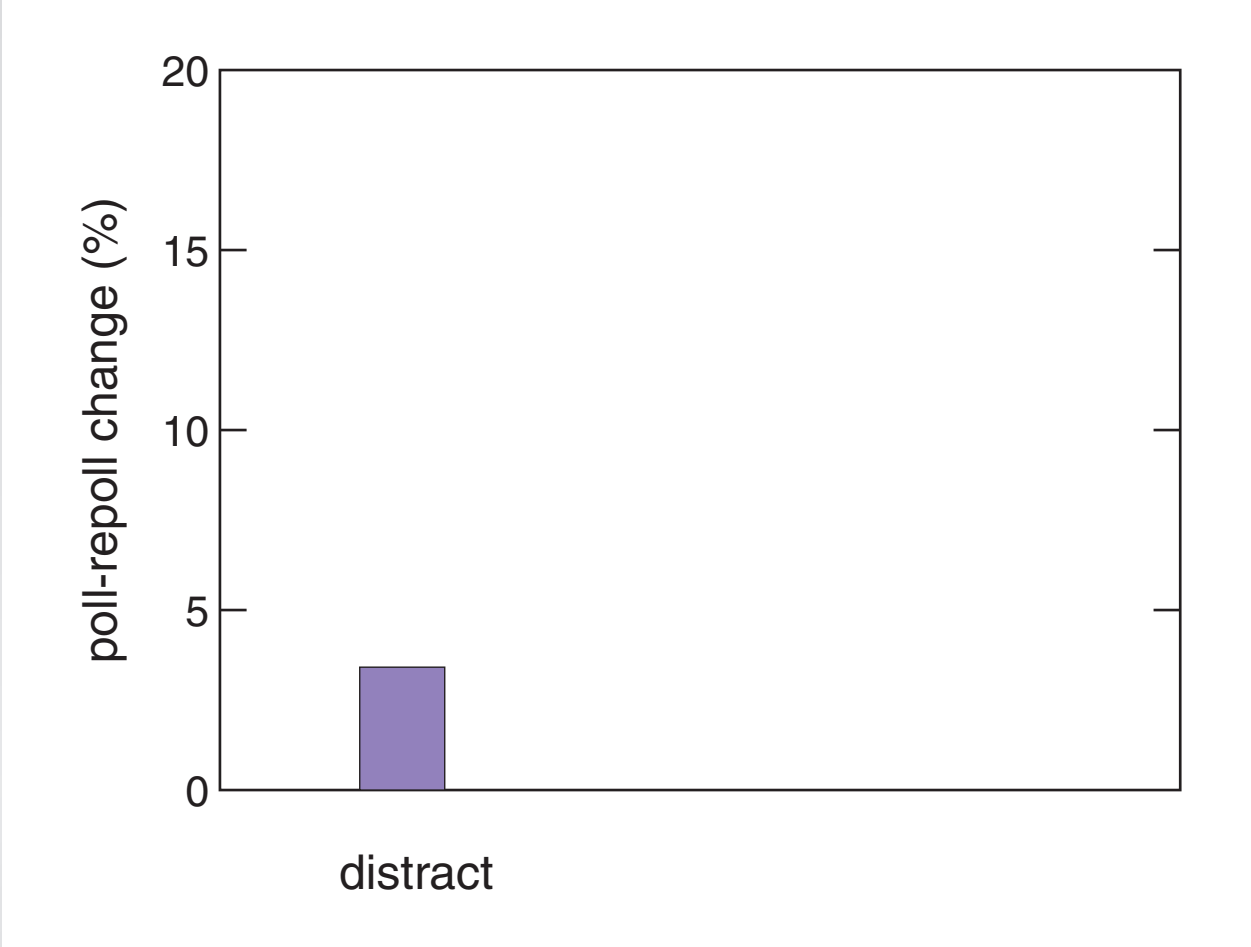
PI & JiTT Overview

the importance of discussion



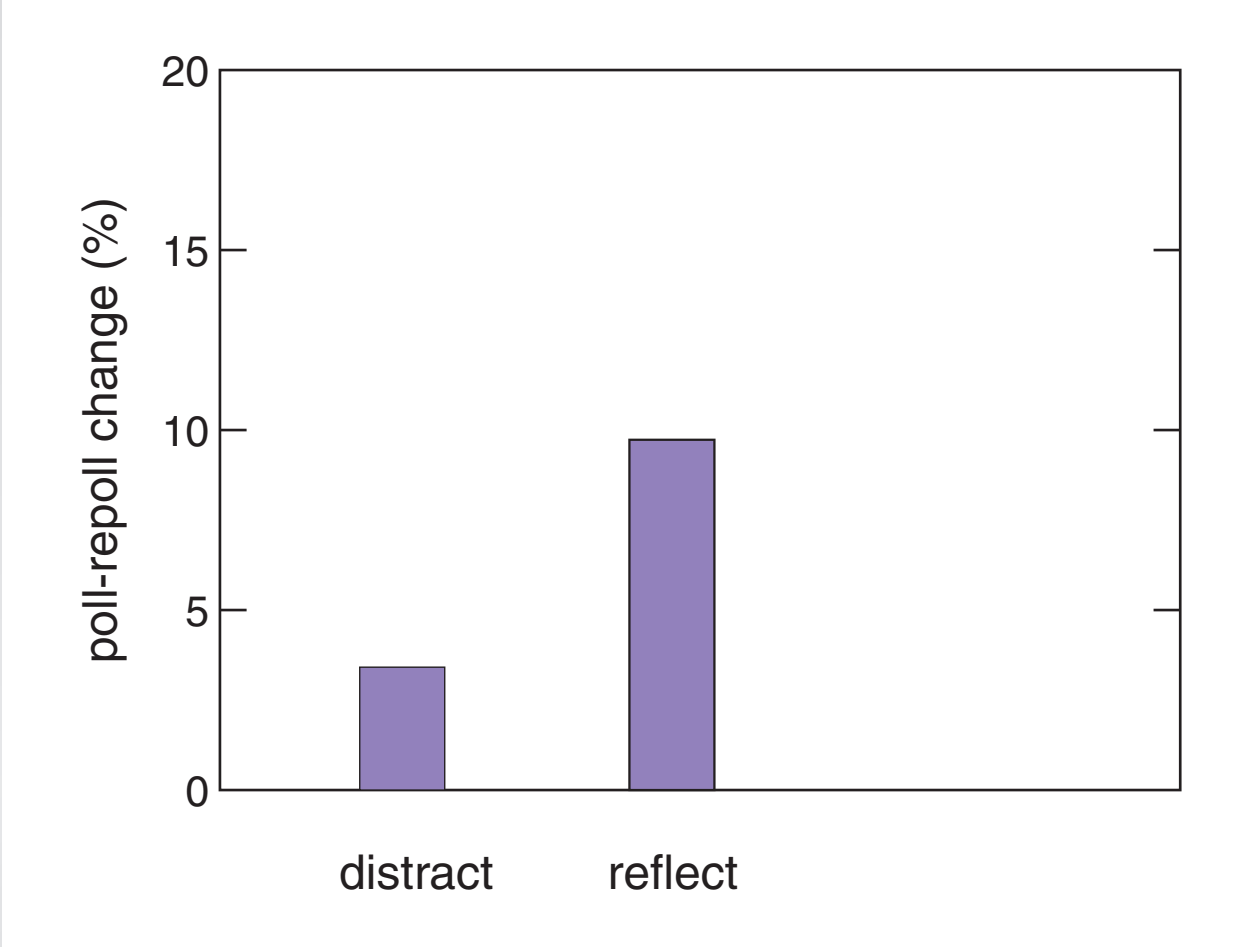
PI & JiTT Overview

the importance of discussion



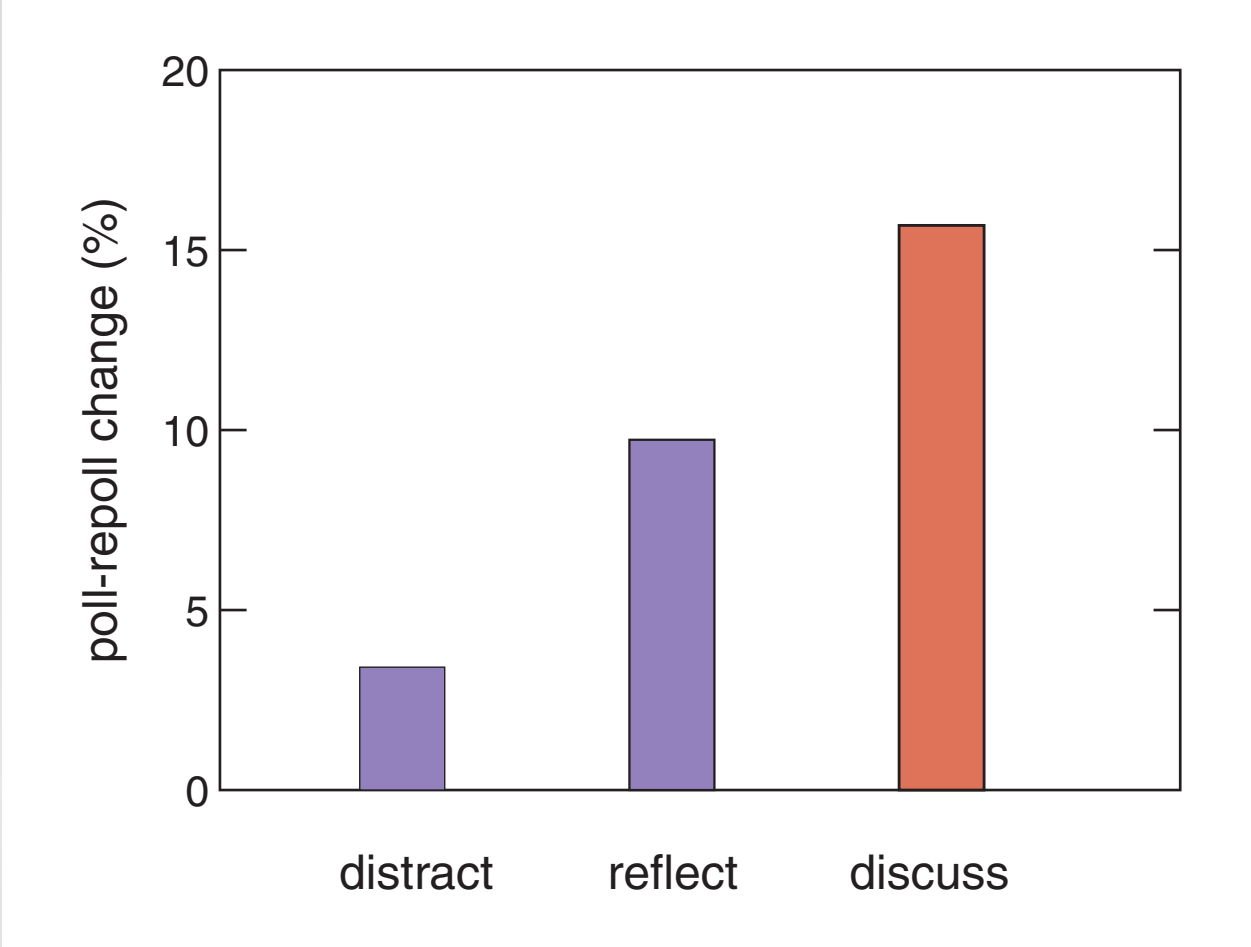
PI & JiTT Overview

the importance of discussion



PI & JiTT Overview

the importance of discussion



Outline

- PI & JiTT Overview
- **Implementing PI & JiTT**
- ConcepTests

Implementing PI & JiTT

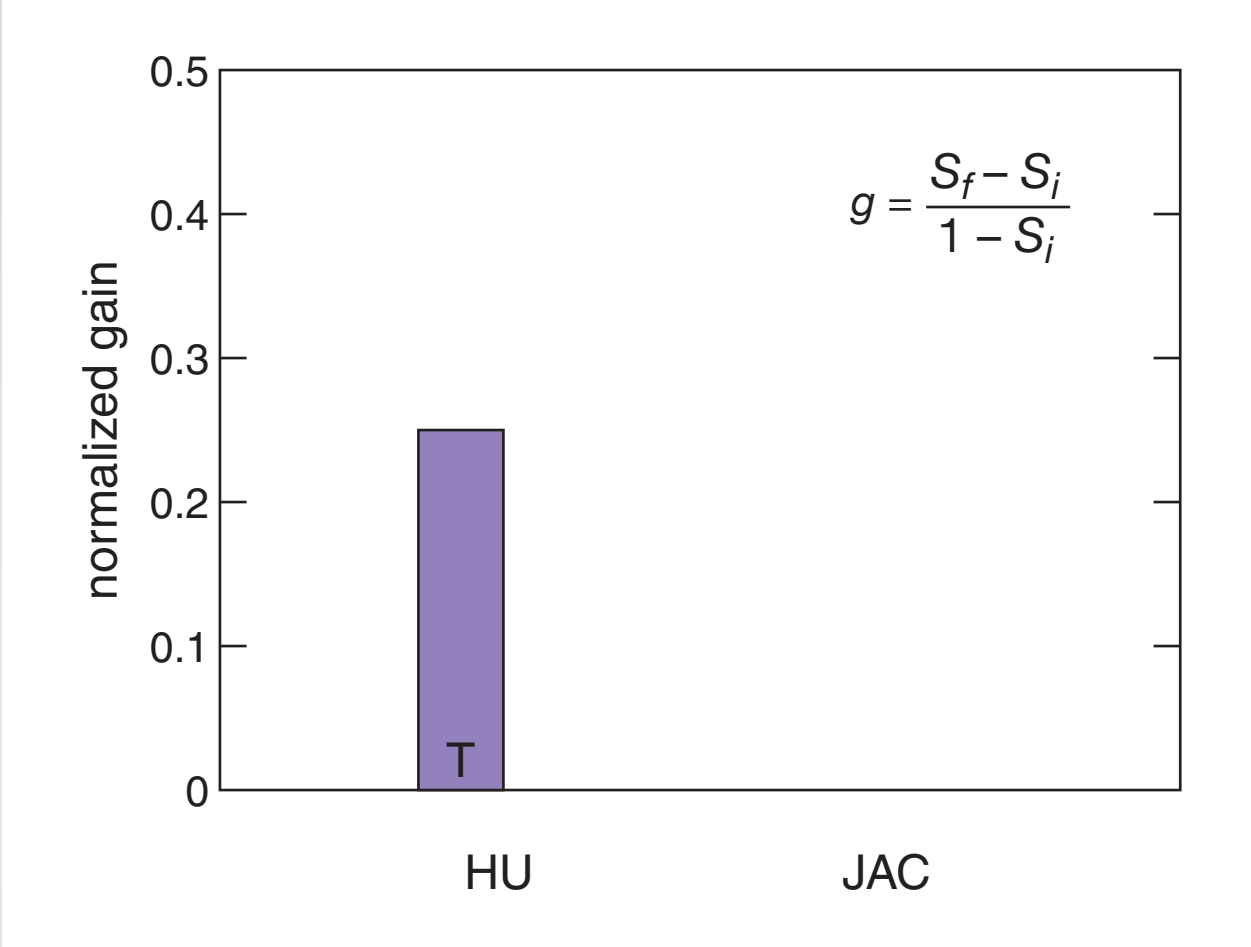
“Will it work at my institution?”

It works here…

…but will it work here?

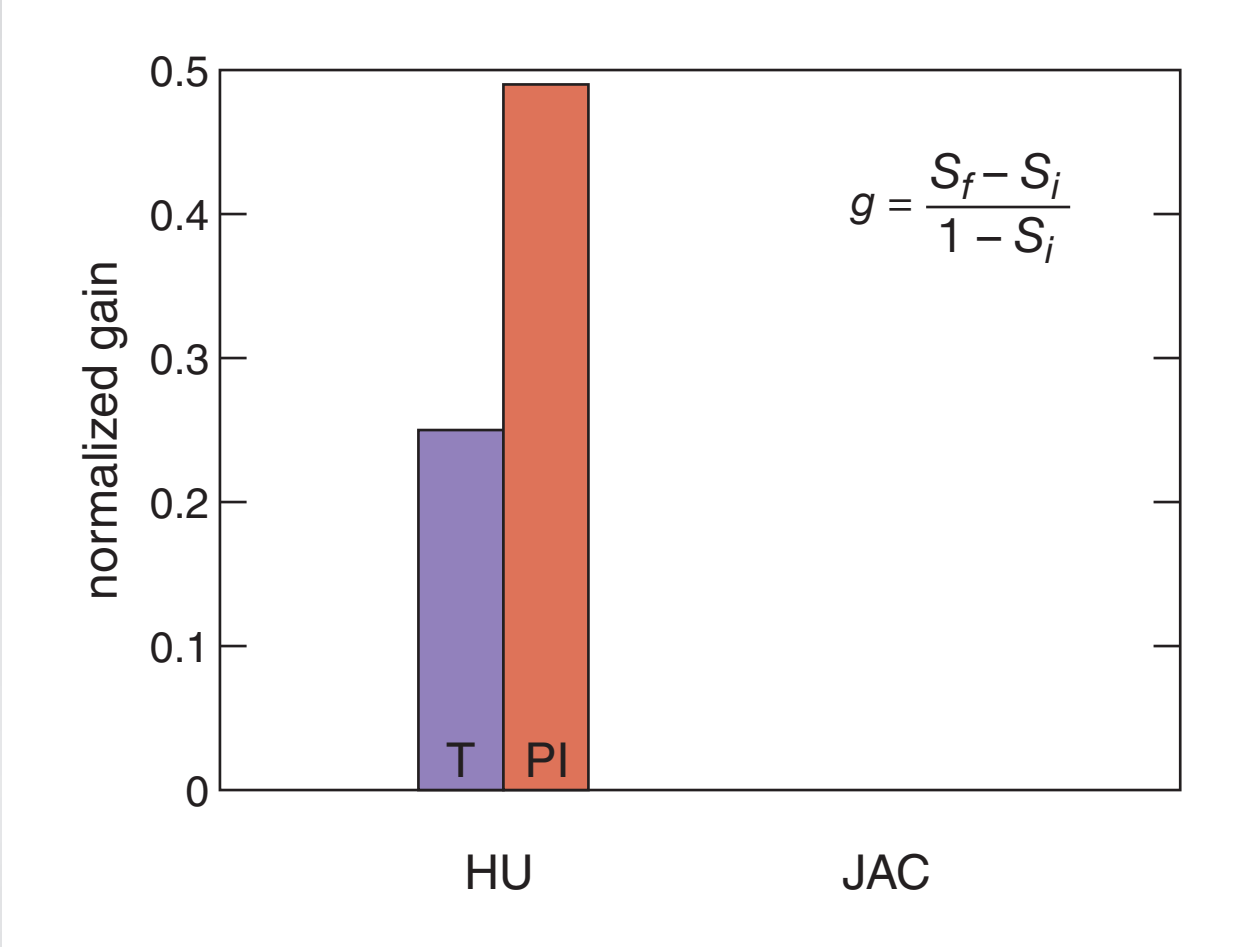
Implementing PI & JiTT

FCI normalized gain



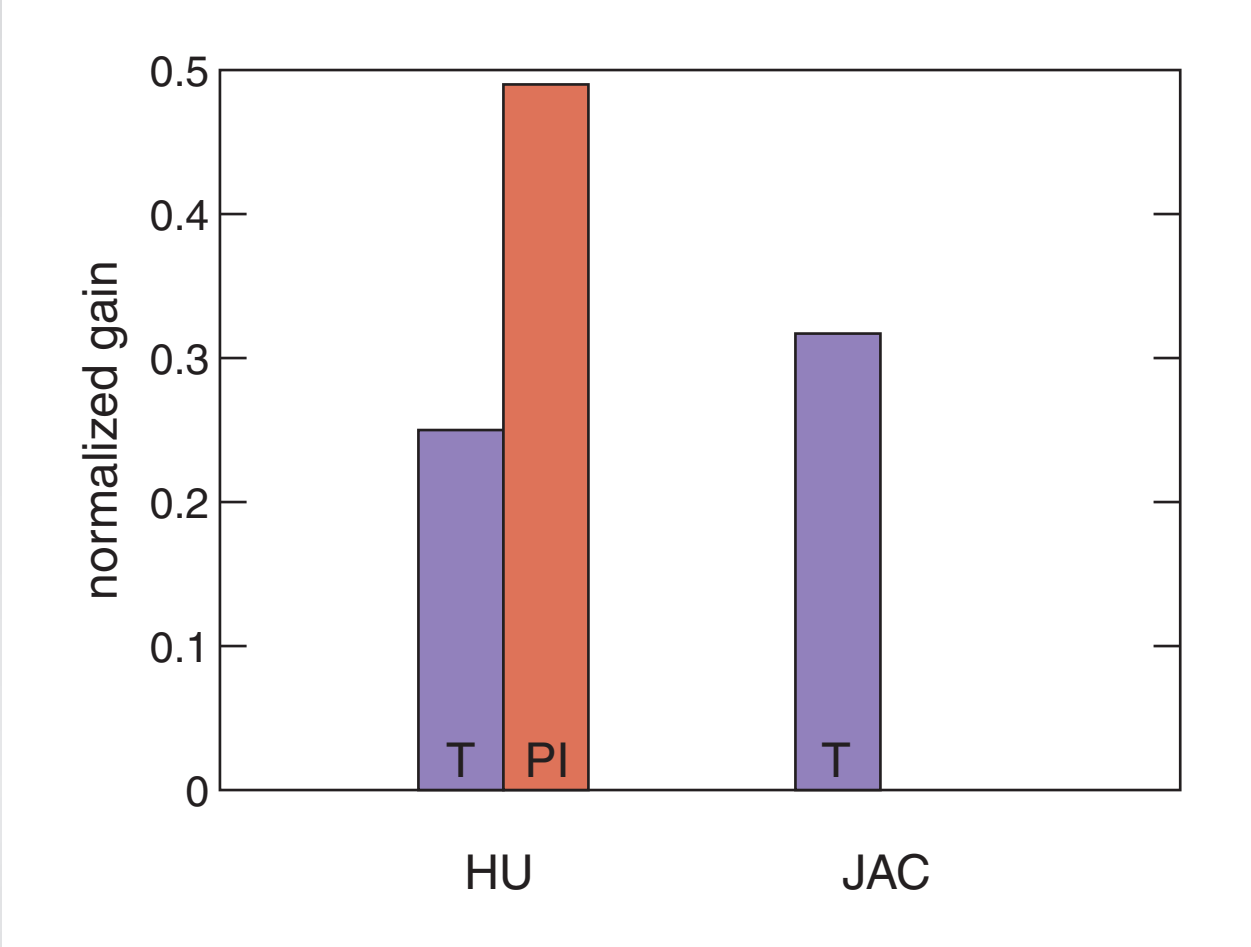
Implementing PI & JiTT

FCI normalized gain



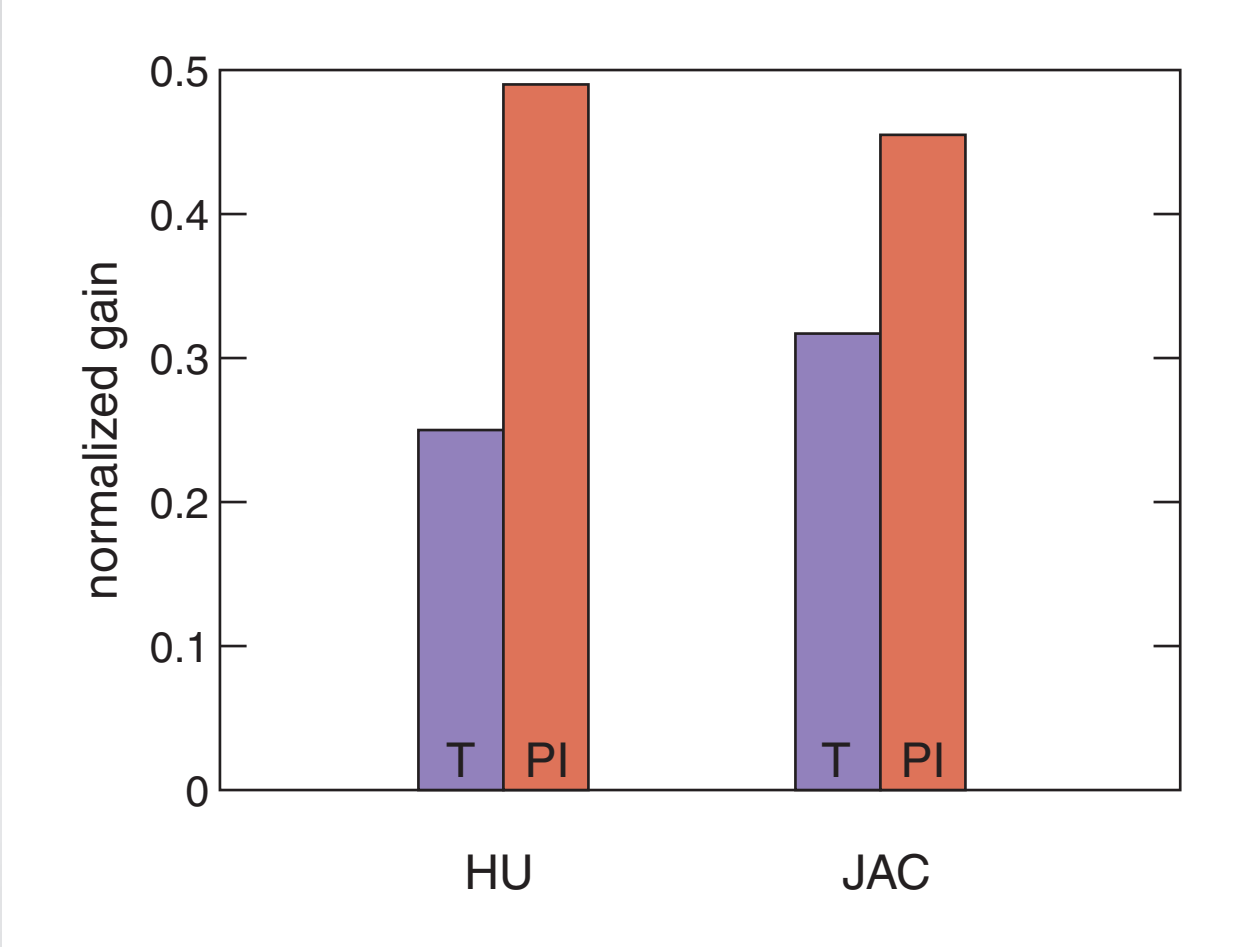
Implementing PI & JiTT

FCI normalized gain



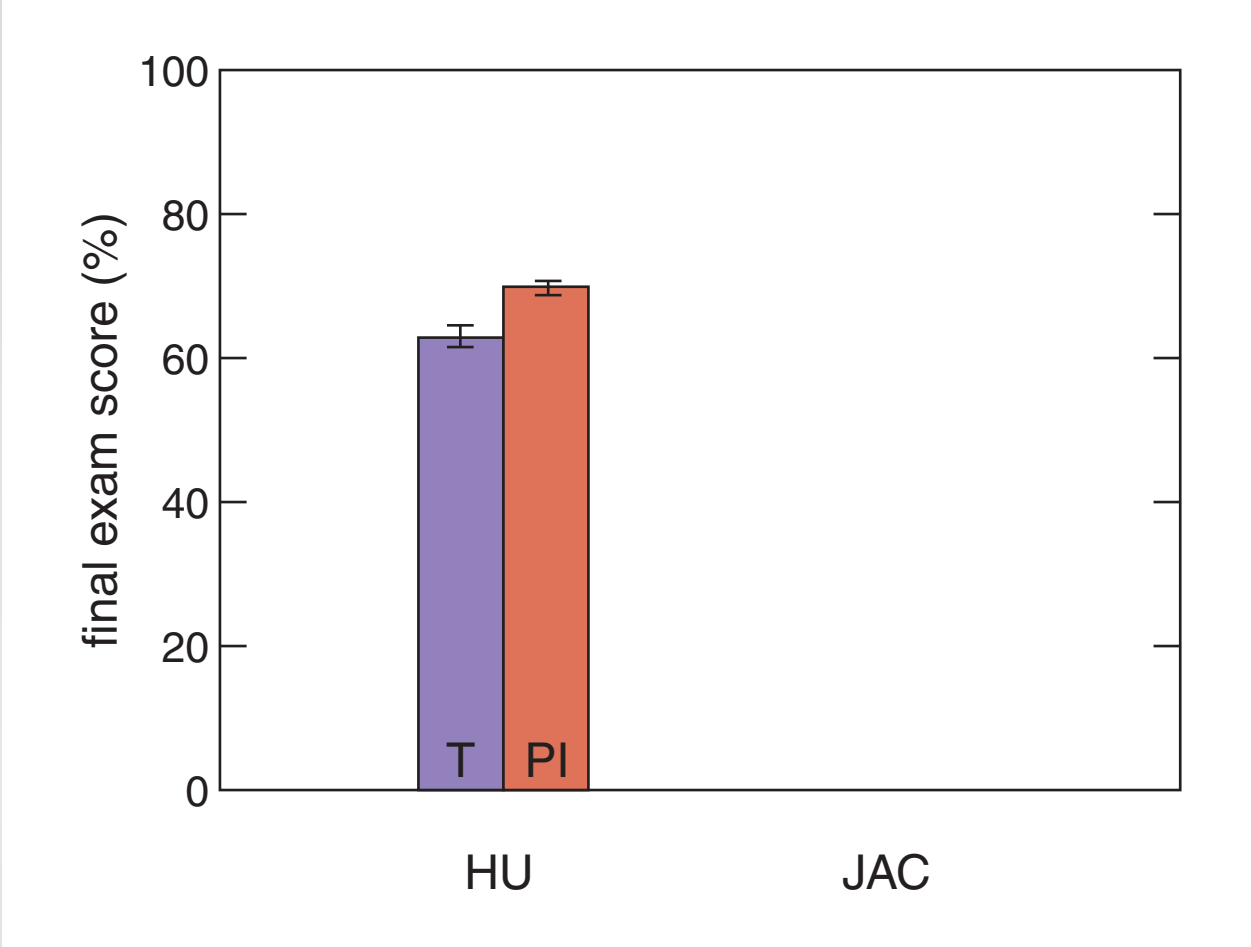
Implementing PI & JiTT

FCI normalized gain



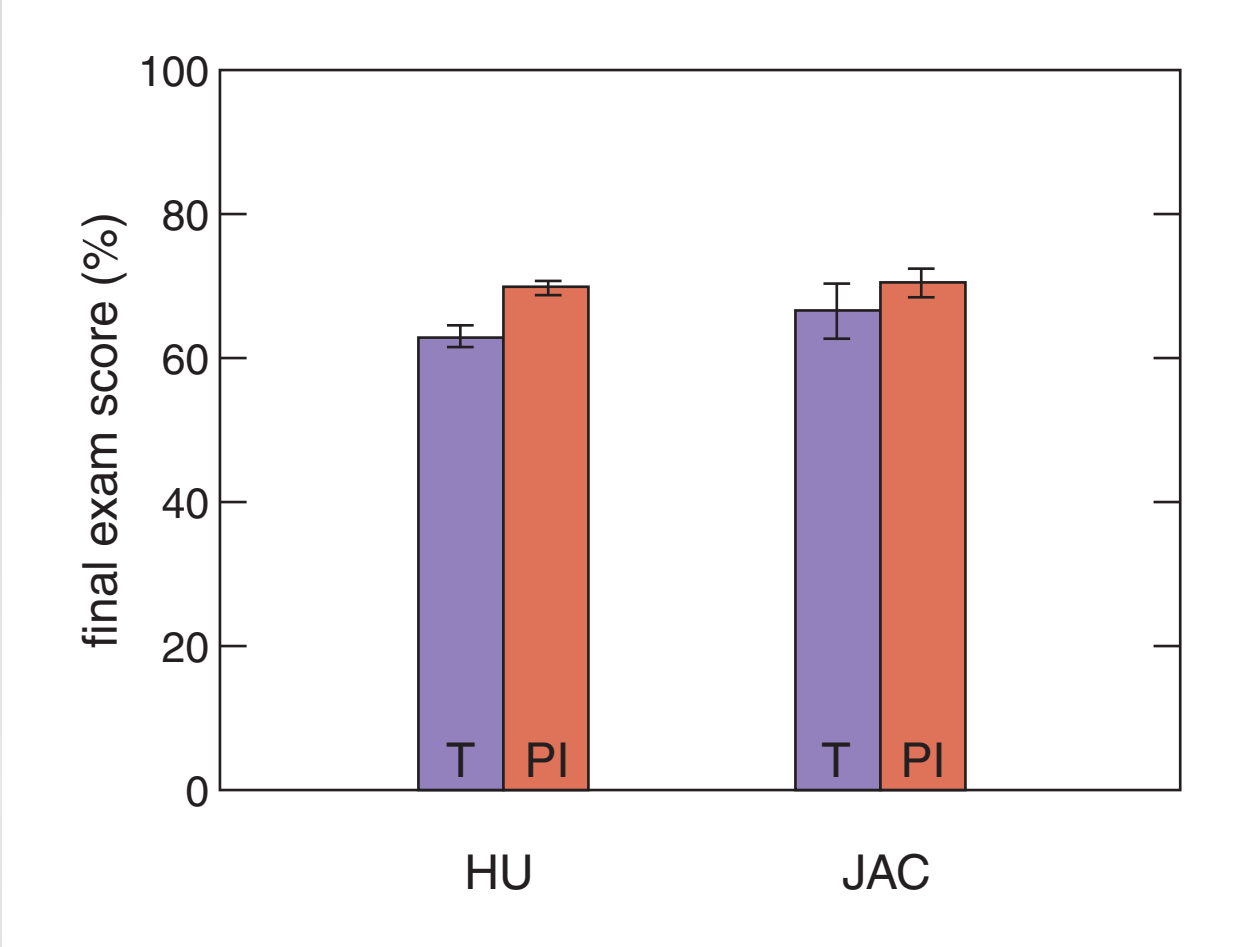
Implementing PI & JiTT

exam performance



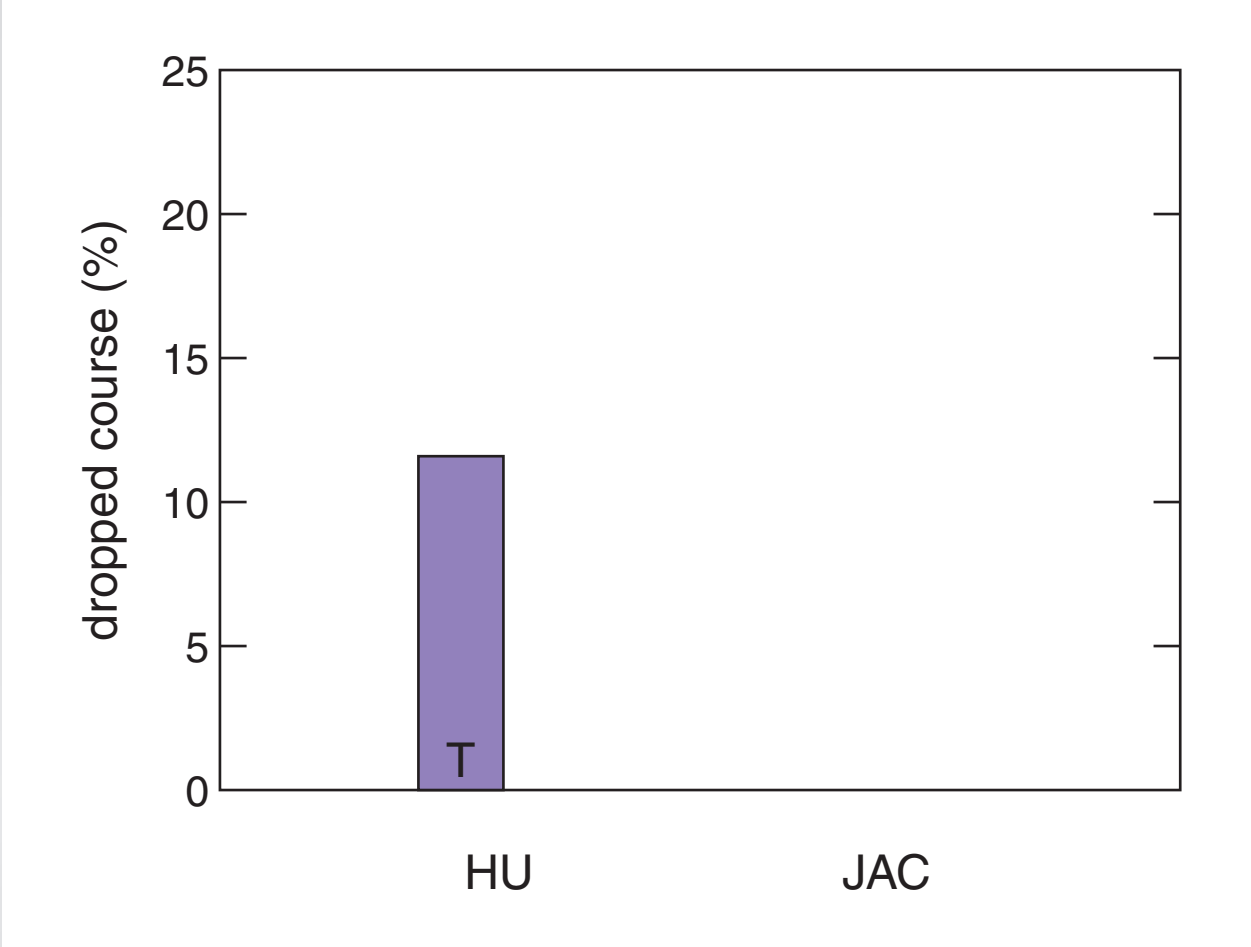
Implementing PI & JiTT

exam performance



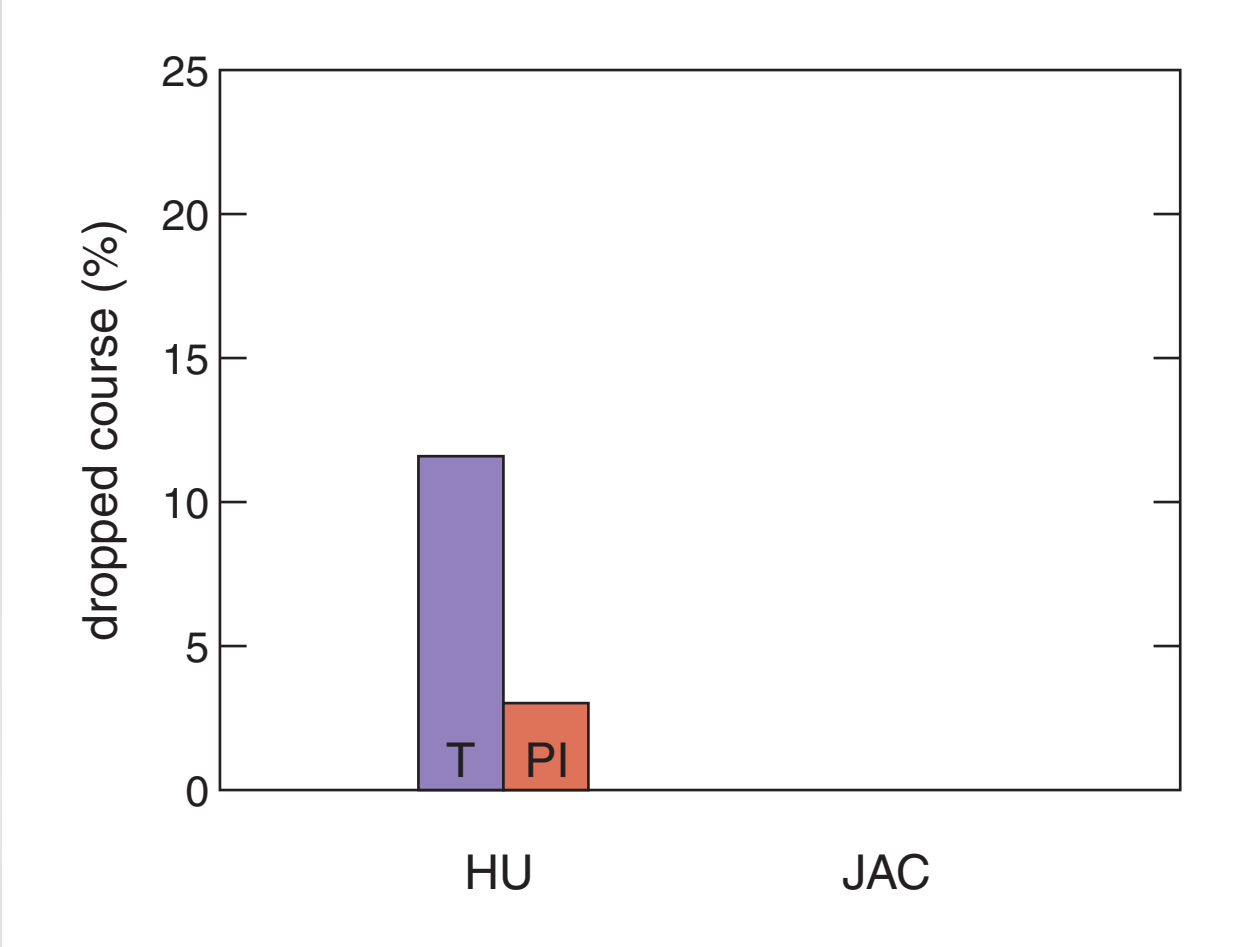
Implementing PI & JiTT

student retention



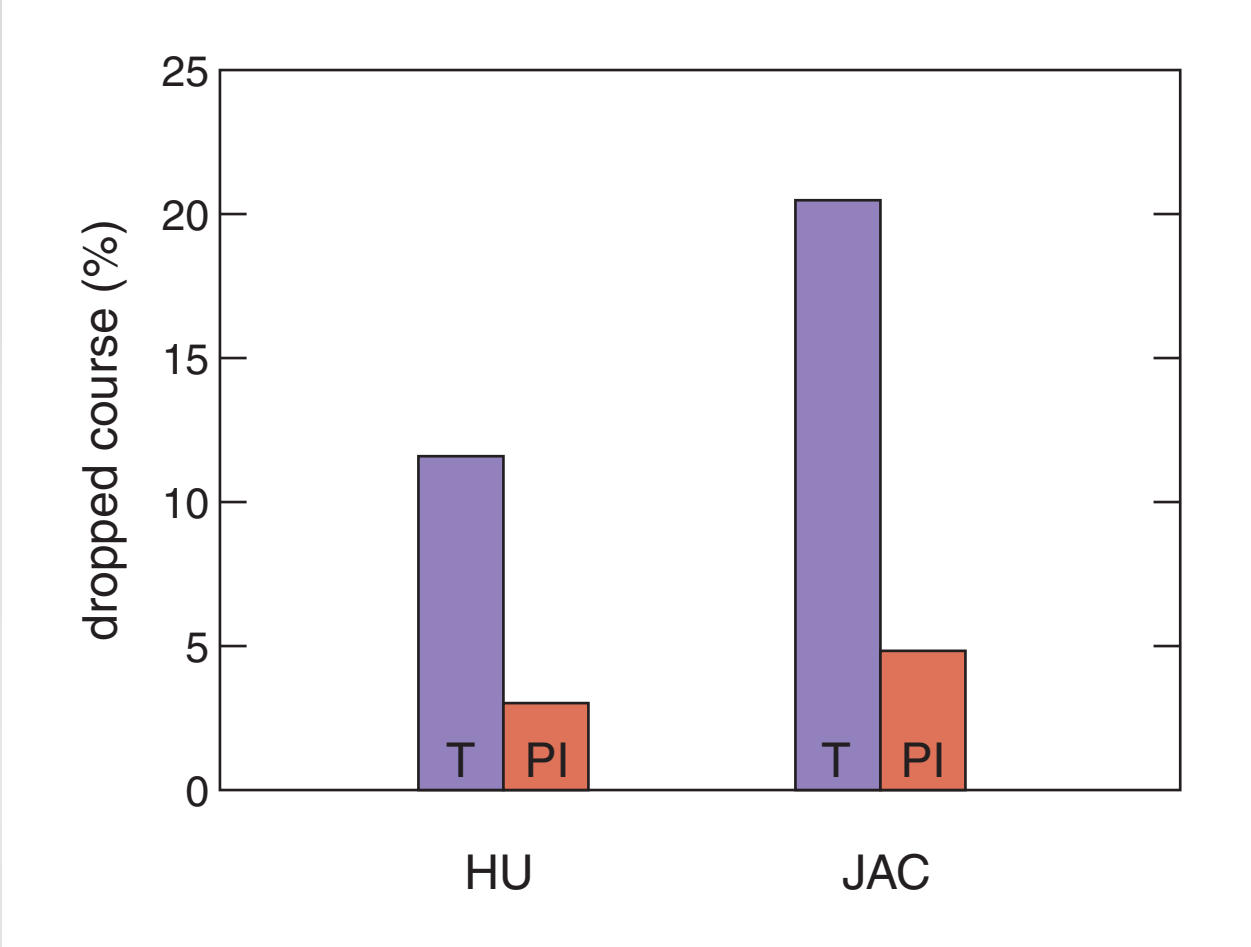
Implementing PI & JiTT

student retention



Implementing PI & JiTT

student retention



Implementing PI & JiTT

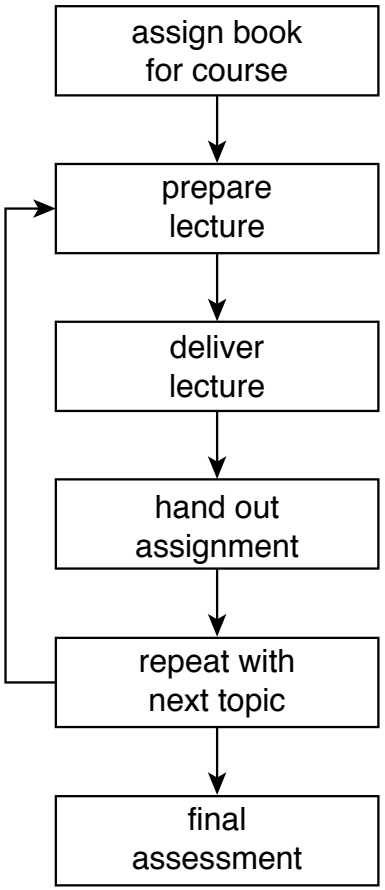
similar learning gains in different environments

Implementing PI & JiTT

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

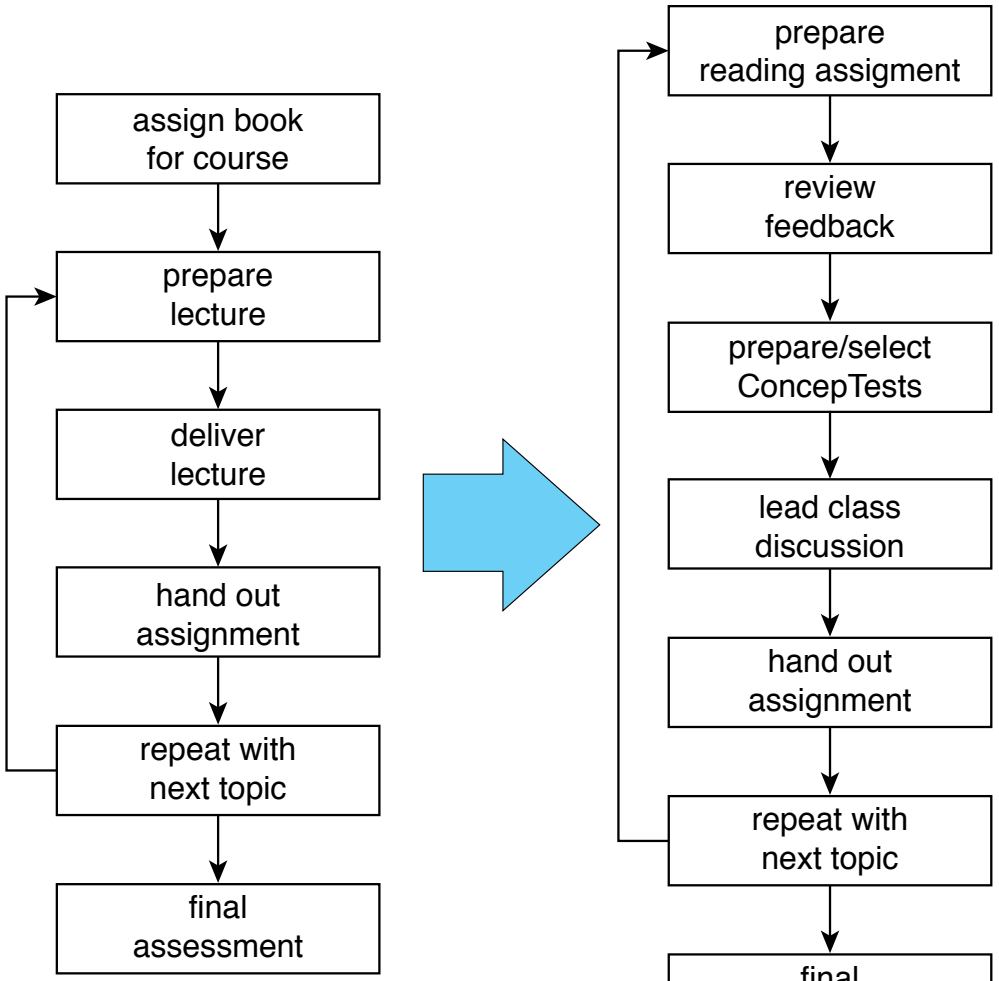
Implementing PI & JiTT

preparing for a lecture-based class



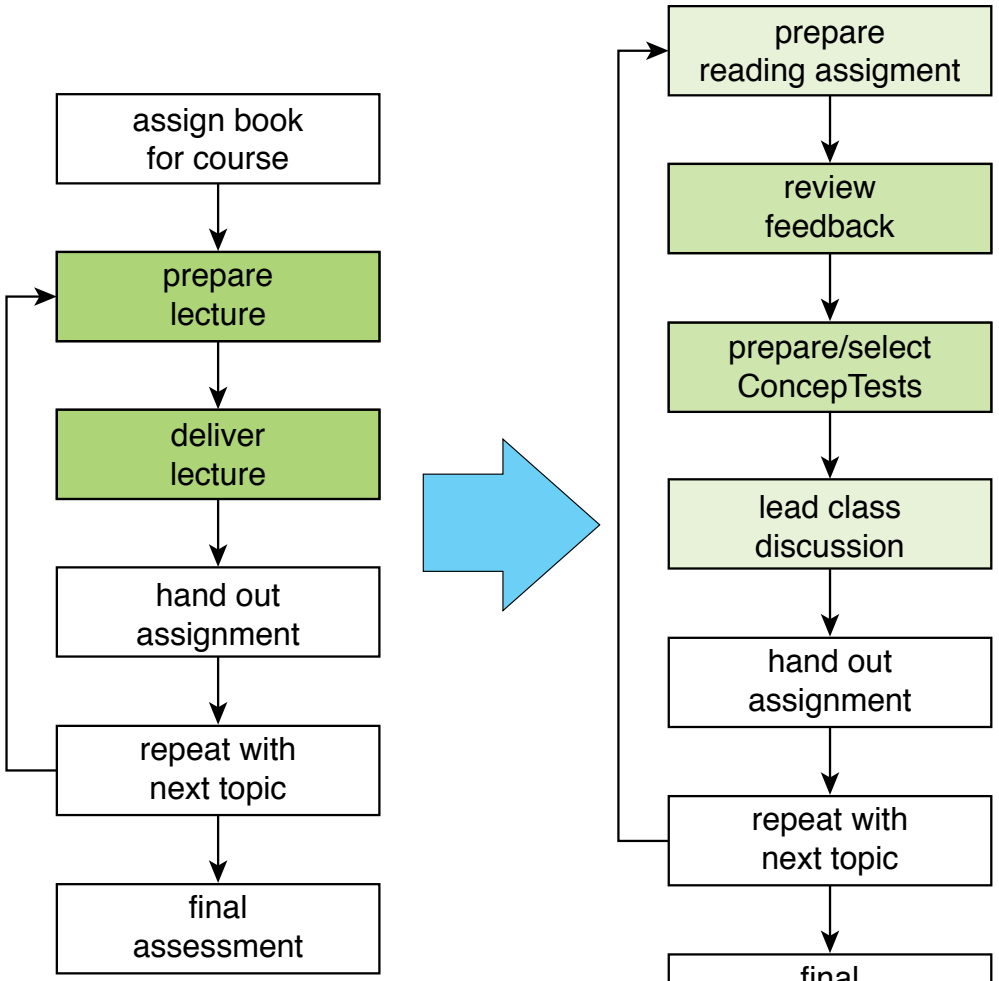
Implementing PI & JiTT

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

	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
out-of-class coverage	?	complete
material learned	little	substantial

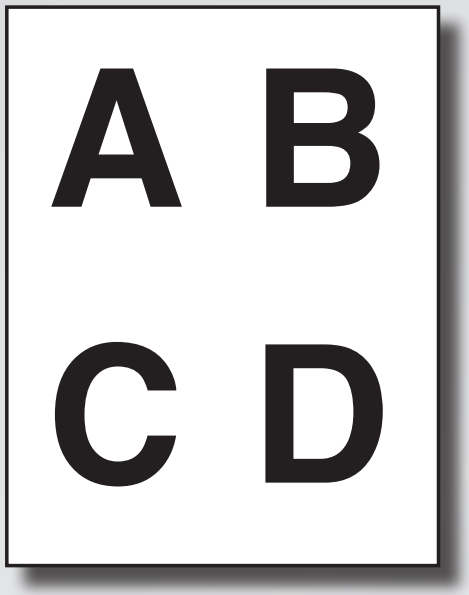
what good is coverage if little is retained?

Implementing PI & JiTT

“Do I need clickers?”

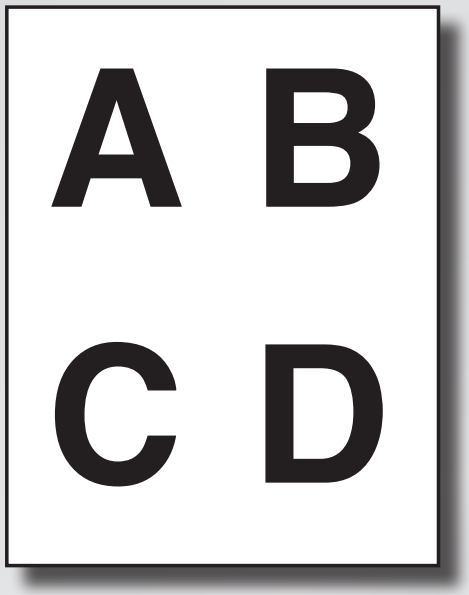
Implementing PI & JiTT

Flashcards: simple and effective



Implementing PI & JiTT

Flashcards: simple and effective



Meltzer and Mannivanan, South Eastern Louisiana University

Let's try it!

circumference

Let's try it!

circumference

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

Let's try it!

Imagine a rope that fits snugly along the equator.

Let's try it!

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?

Let's try it!

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

Let's try it!

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?

you got all fired up!

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you got all fired up!

without clickers

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2. the width of a few hairs
3. about 0.15 m ✔
4. exactly 1 m
5. more than 1 m

Let's try it!

circumference at the equator:

$$2\pi R_{\mathrm{E}}$$

Let's try it!

circumference at the equator:

$$2\pi R_{\mathrm{E}}$$

new circumference:

$$2\pi R_{\mathrm{E}} + 1\ \mathrm{m}$$

Let's try it!

circumference at the equator:

$$2\pi R_{\mathrm{E}}$$

new circumference:

$$2\pi R_{\mathrm{E}} + 1\ \mathrm{m}$$

radius of circle with new circumference:

$$2\pi R = 2\pi R_{\mathrm{E}} + 1\ \mathrm{m}, \quad \textbf{and so} \quad R = R_{\mathrm{E}} + \frac{1\ \mathrm{m}}{2\pi}.$$

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)

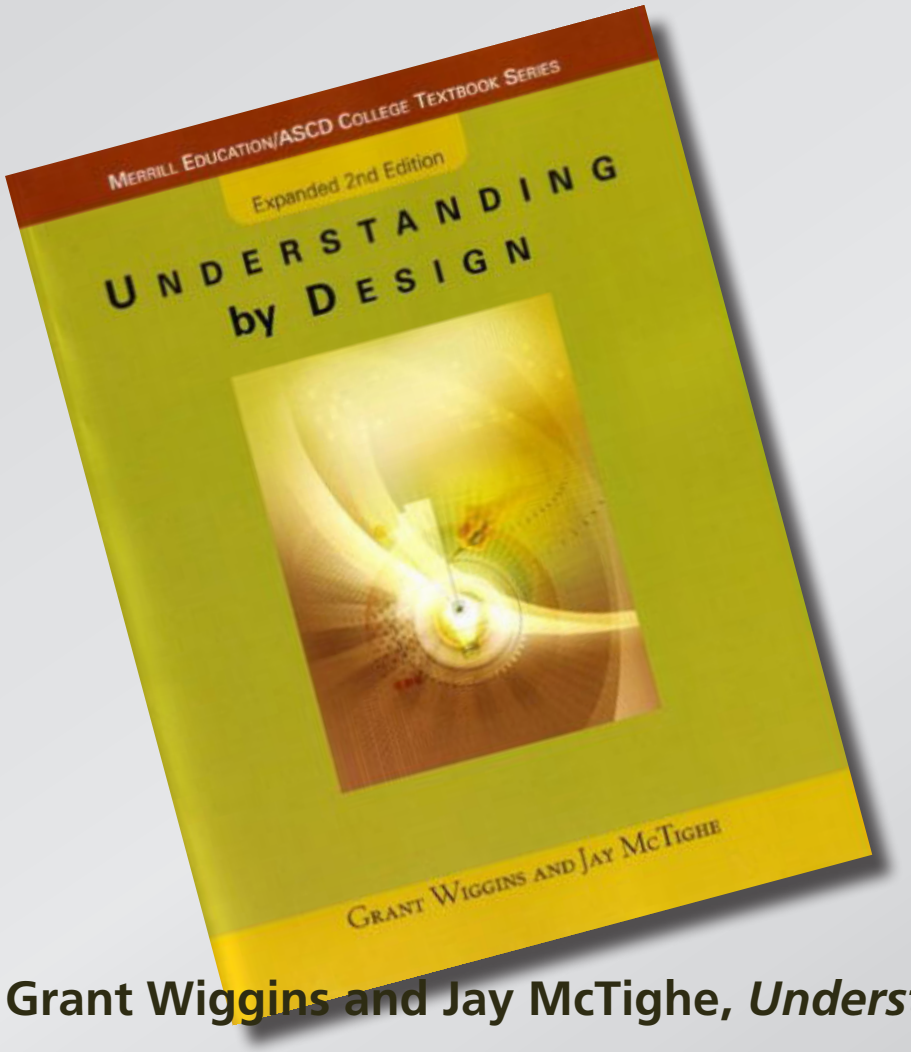
Implementing PI & JiTT

"How should I assess my students

when using this approach?"

Implementing PI & JiTT

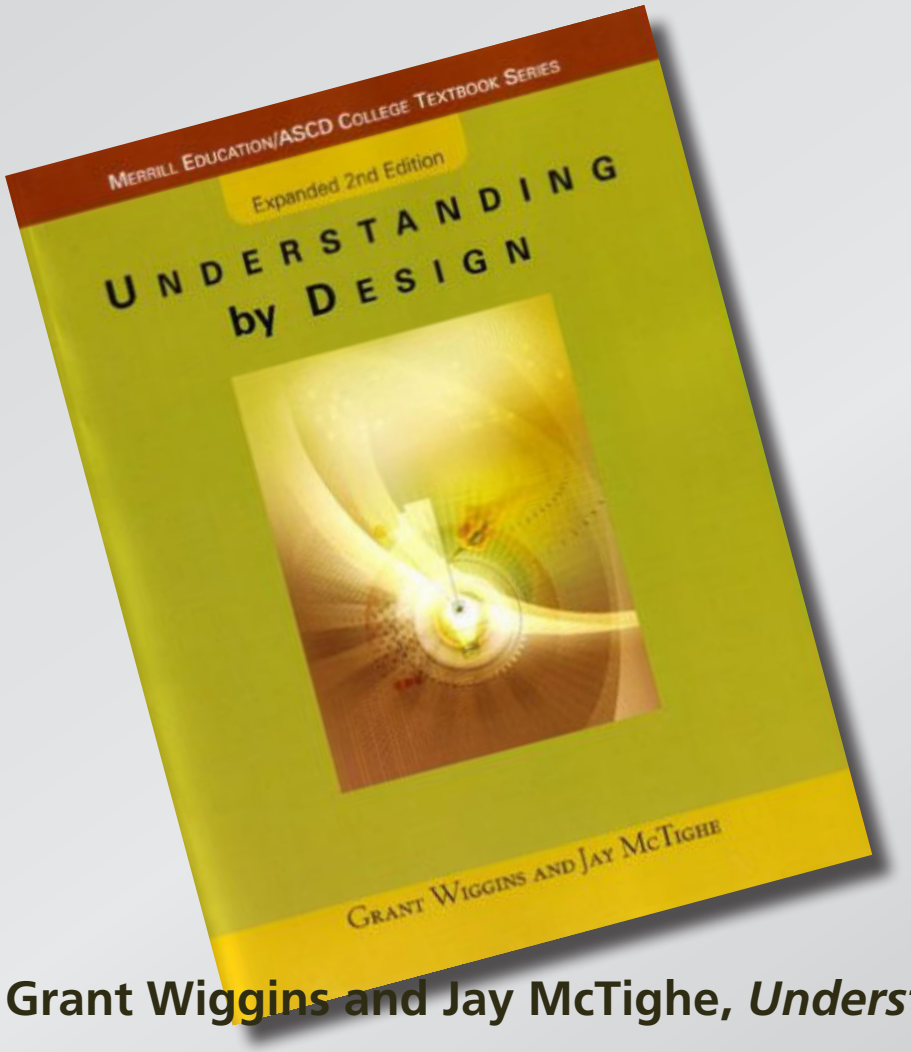
Begin by setting learning goals



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

Implementing PI & JiTT

Begin by setting learning goals

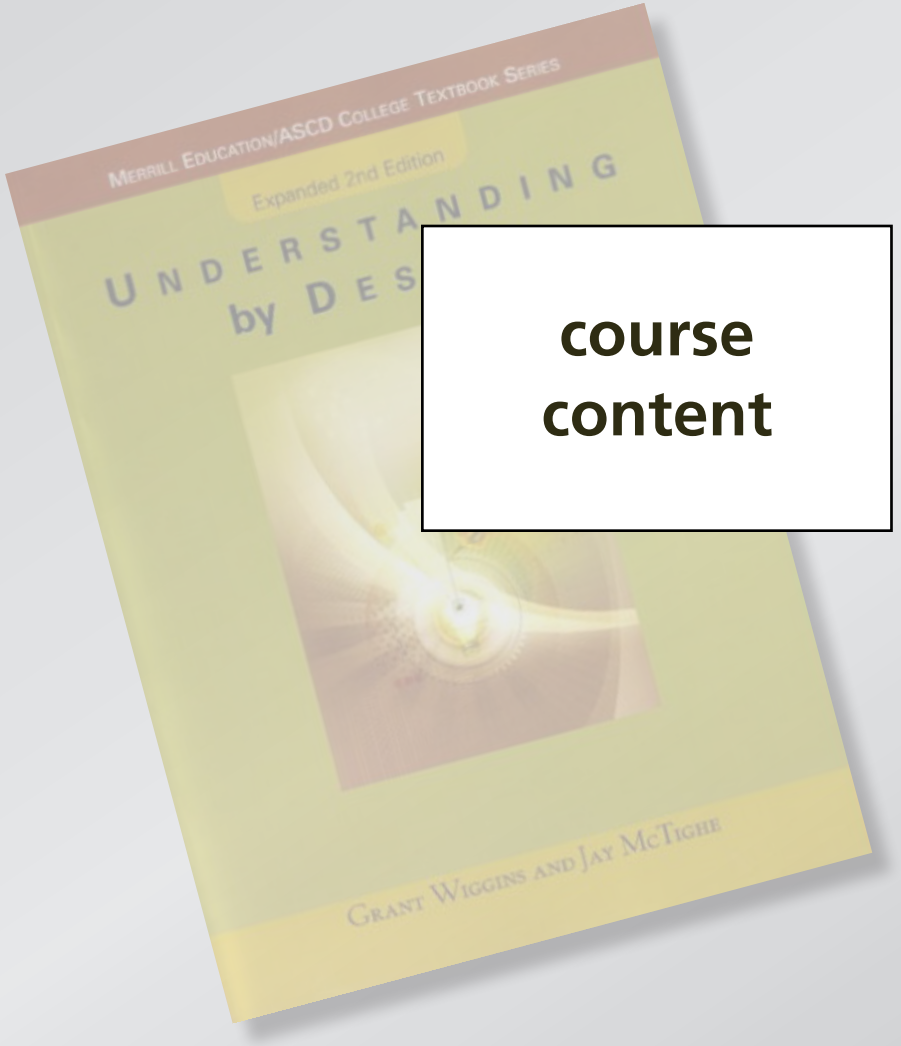


- approach, not content
- focus on understanding
- backward design

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

Implementing PI & JiTT

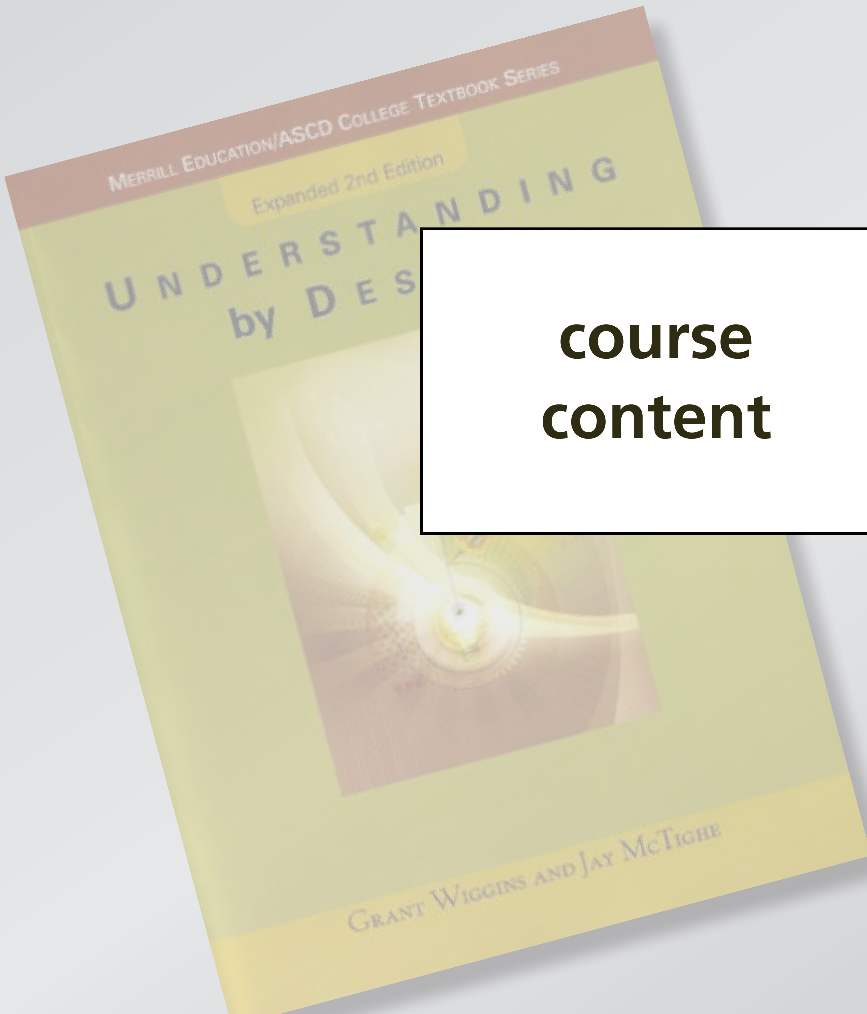
Traditional approach to course planning



course content

Implementing PI & JiTT

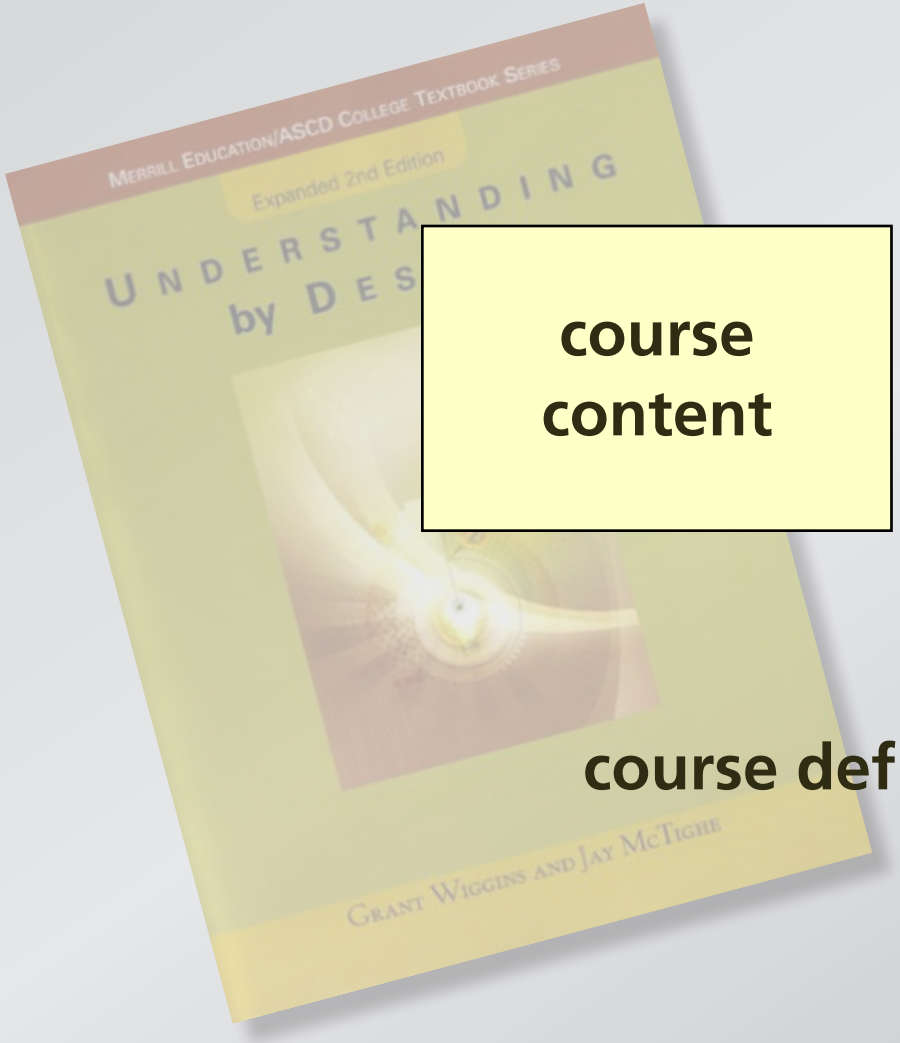
Traditional approach to course planning



course content ▶ assessment

Implementing PI & JiTT

Traditional approach to course planning

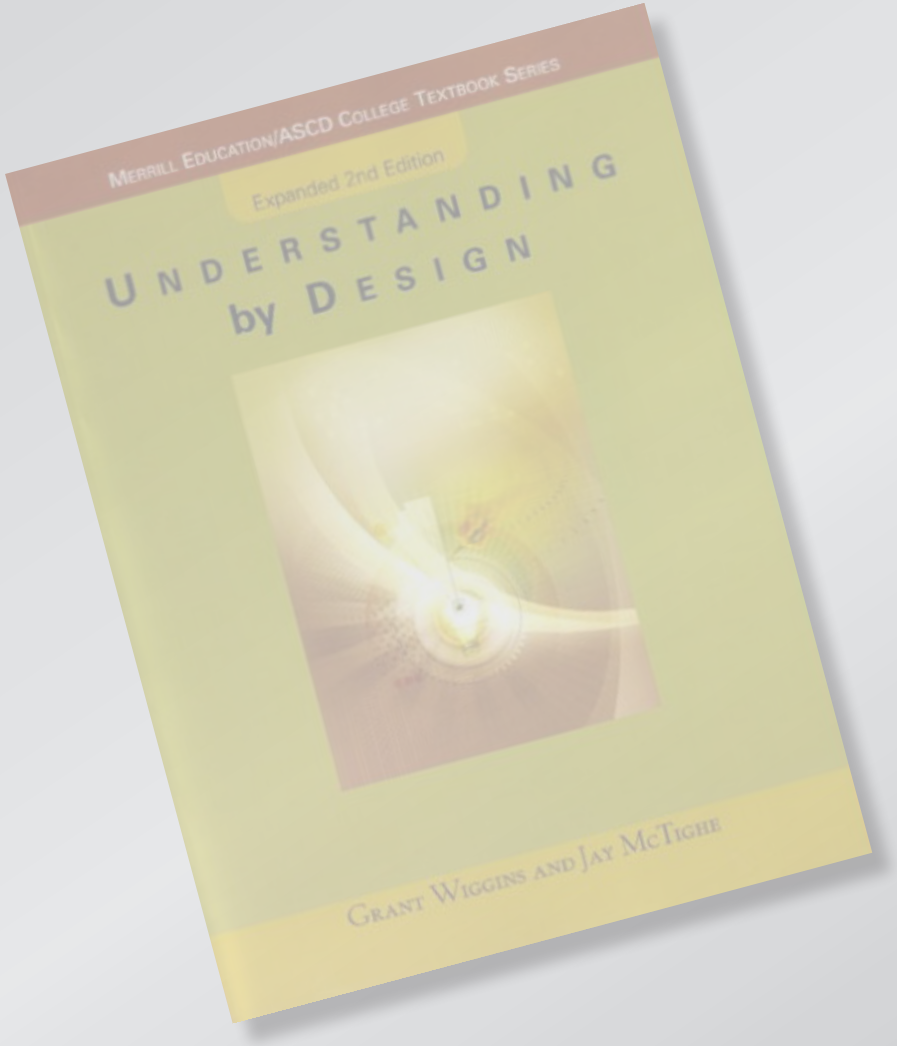


course content → assessment

course defined by content

Implementing PI & JiTT

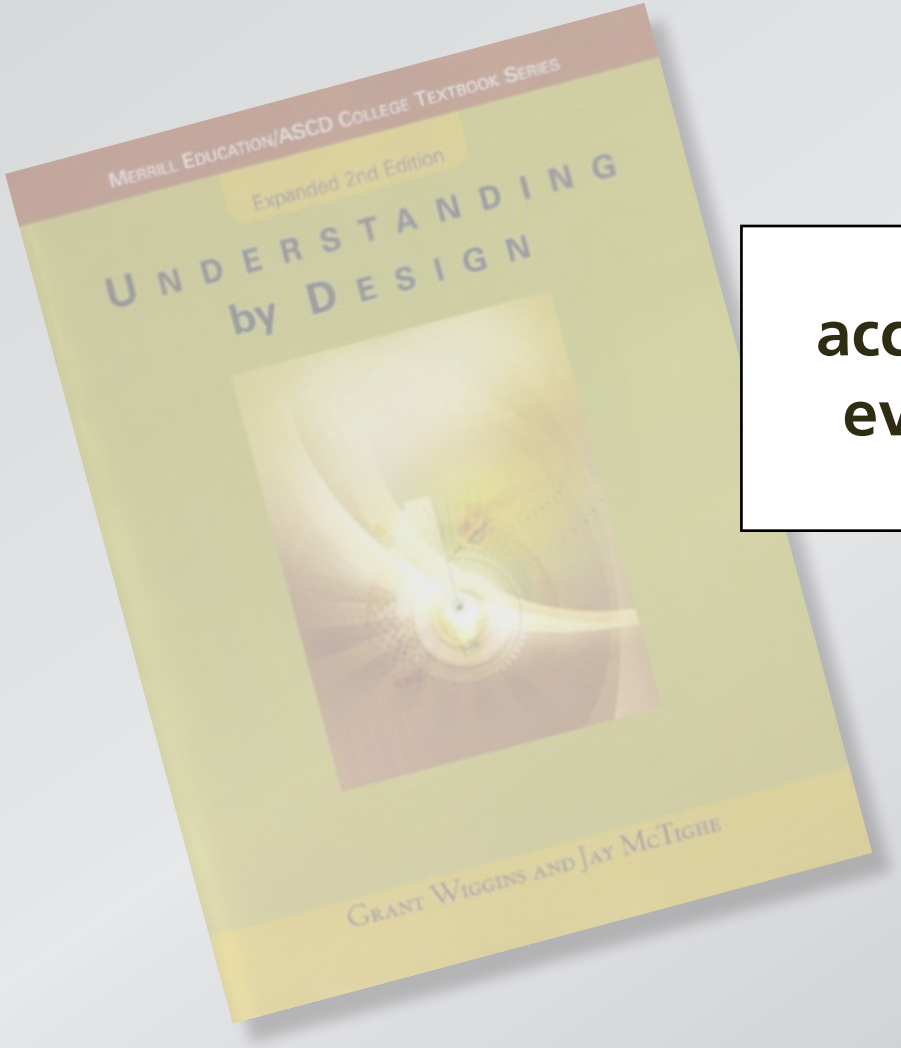
Backward design



desired outcomes

Implementing PI & JiTT

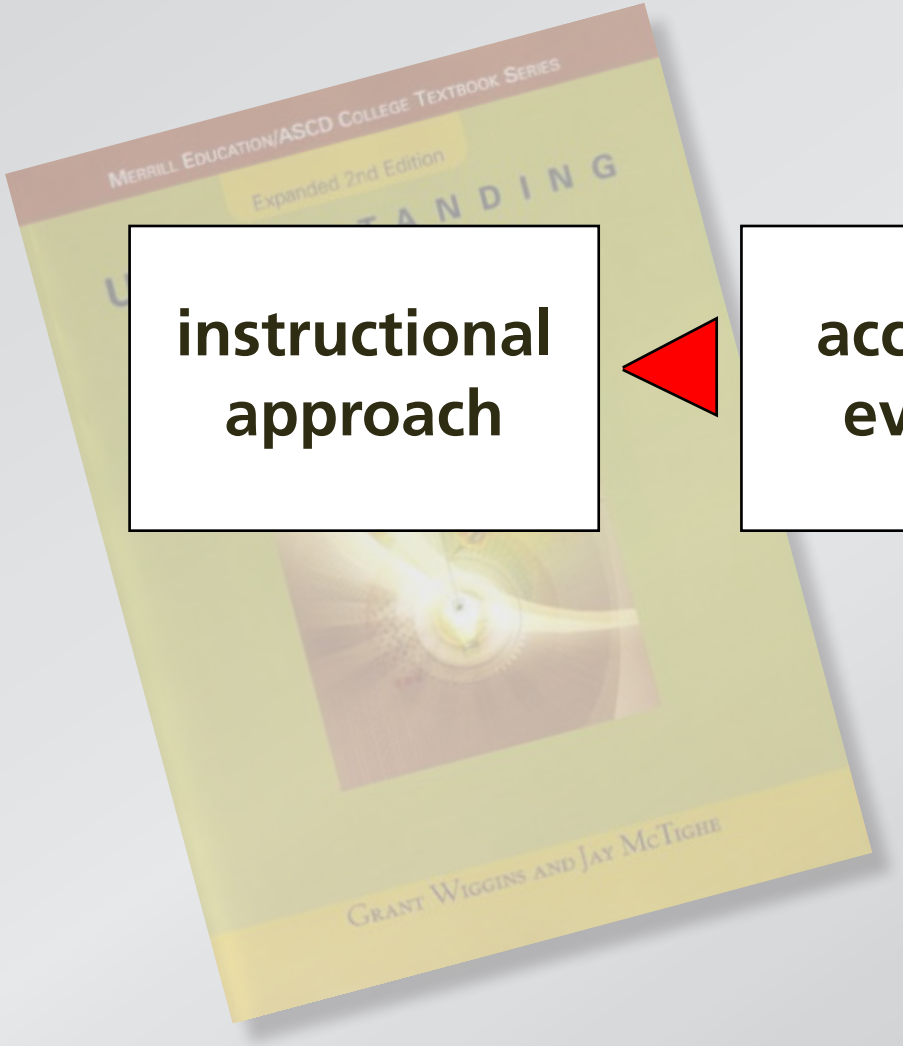
Backward design



acceptable evidence ◀ **desired outcomes**

Implementing PI & JiTT

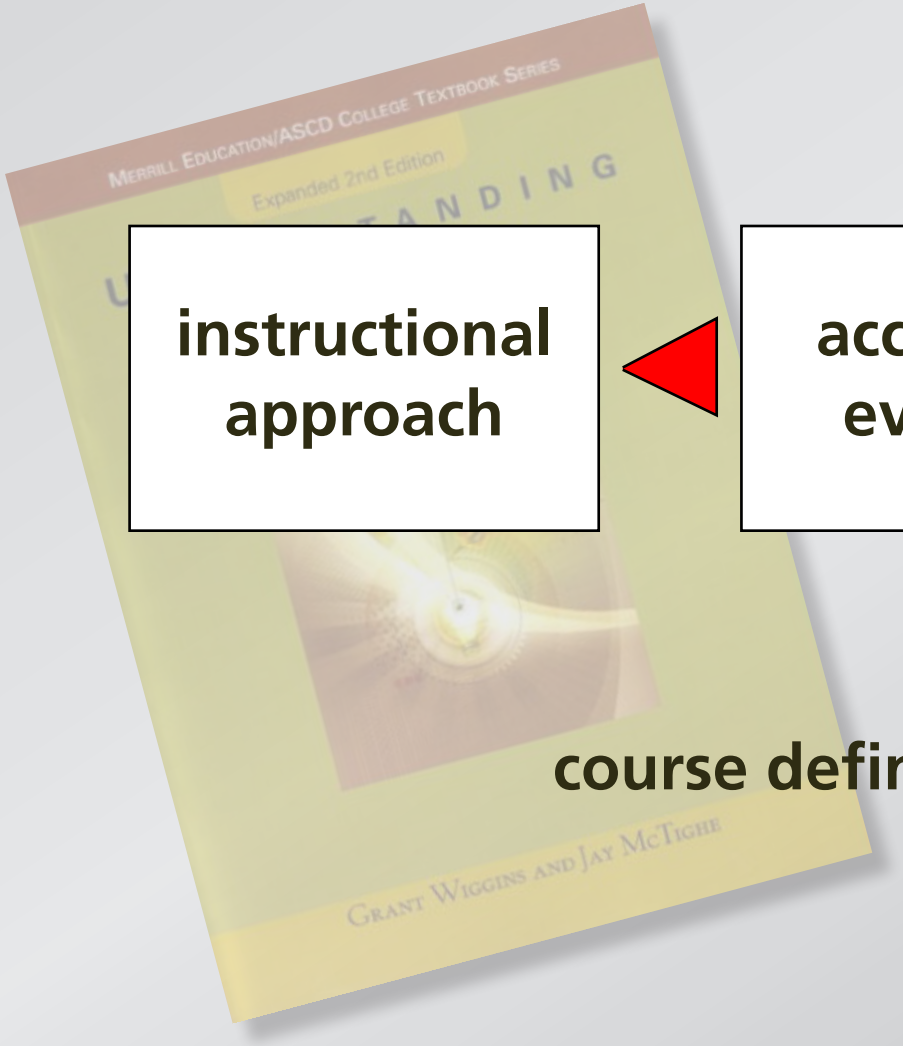
Backward design



instructional approach ◀ **acceptable evidence** ◀ **desired outcomes**

Implementing PI & JiTT

Backward design



instructional approach ◀ **acceptable evidence** ◀ **desired outcomes**

course defined by outcomes

Implementing PI & JiTT

Evaluate assessment by comparing

student performance on various kinds of problems

Implementing PI & JiTT

“What constitutes a good problem?”

Implementing PI & JiTT

On a Saturday afternoon, you pull into a parking lot with unmetered 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.

Implementing PI & JiTT

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

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

Implementing PI & JiTT

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

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

Requires:

Assumptions
Developing a model
Applying that model

Implementing PI & JiTT

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

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

Implementing PI & JiTT

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Implementing PI & JiTT

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

Implementing PI & JiTT

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

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

Requires:

Applying a (new) model

Implementing PI & JiTT

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

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

Implementing PI & JiTT

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

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

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

Implementing PI & JiTT

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

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

Requires:

Using a calculator

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

Implementing PI & JiTT

Need to test meaningful skills!

Implementing PI & JiTT

Some additional ideas:

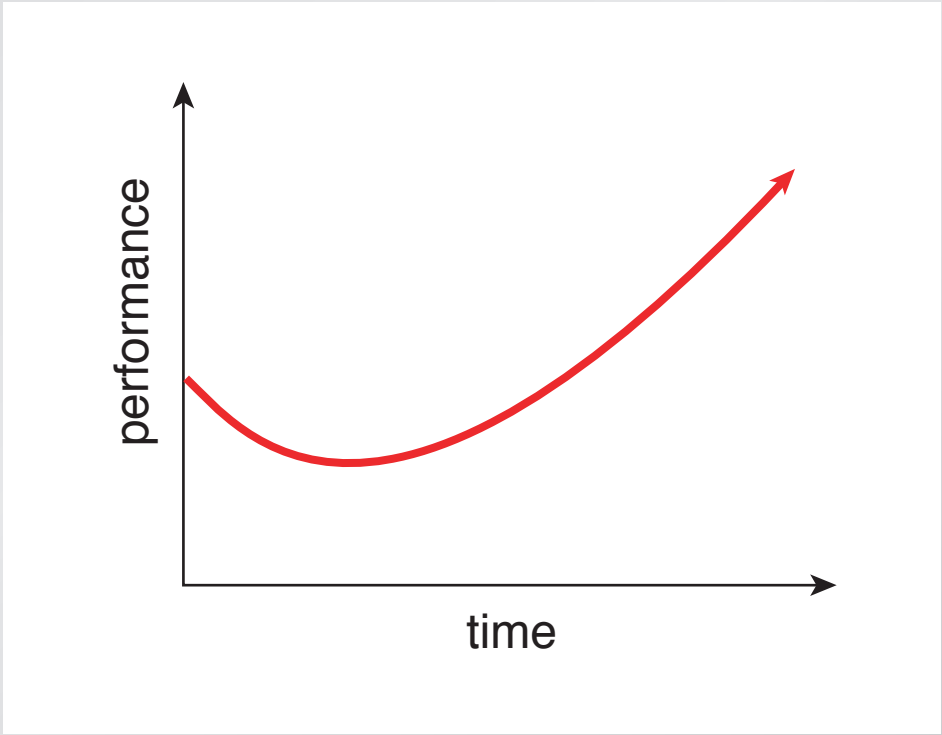
- Open book/computer exam
- Collaborative exam
- Multidimensional testing

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 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.

Implementing PI & JiTT

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

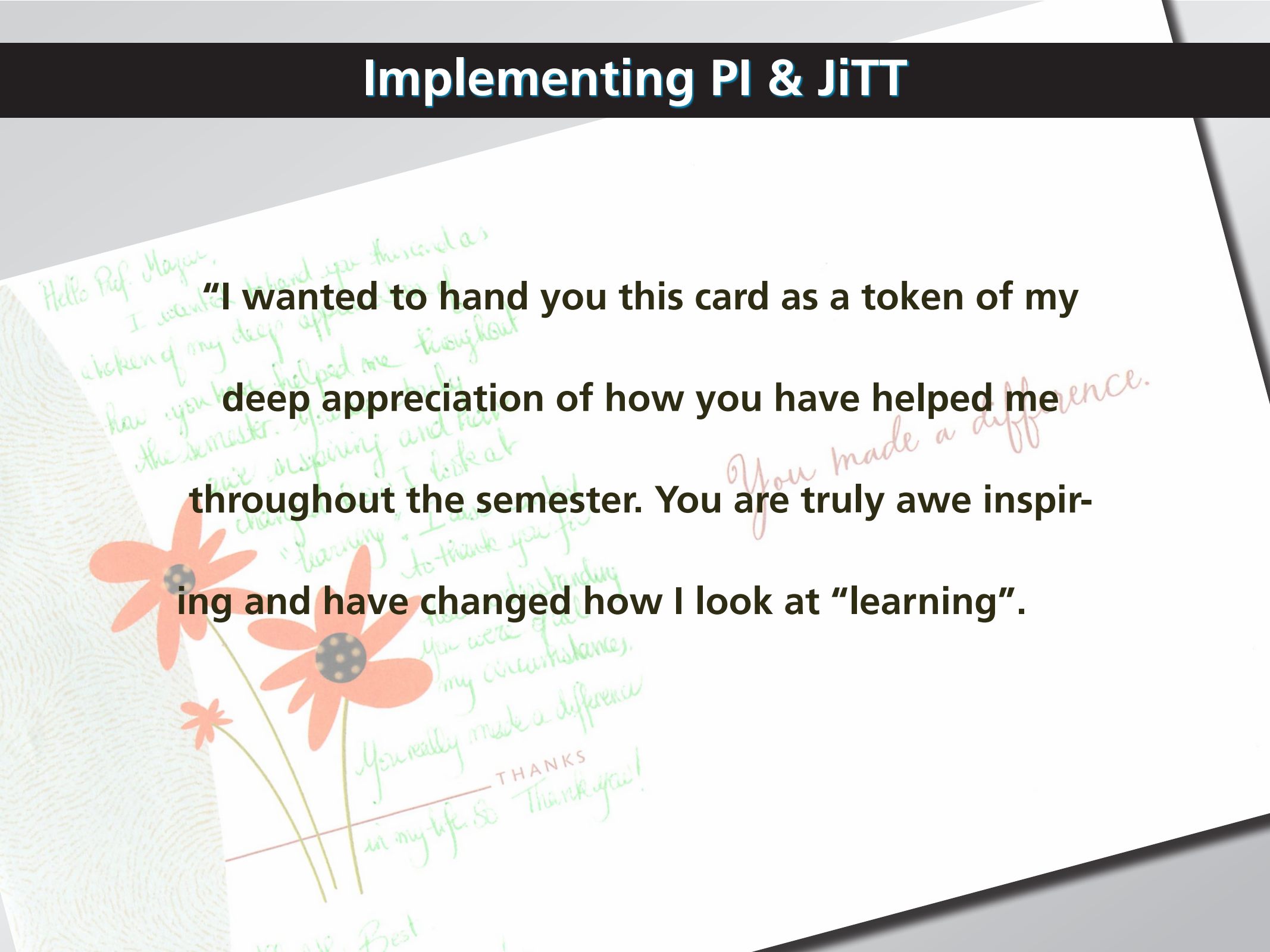
> Subject: Thanks!
>
> Professor Mazur,
>
> First of all I want to thank you for a great semester. You are an excellent professor, and it is clear that you truly care about each and every student.
>
> The exam went well today. I'm not sure to what extent you will curve the final grades (if at all), but 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

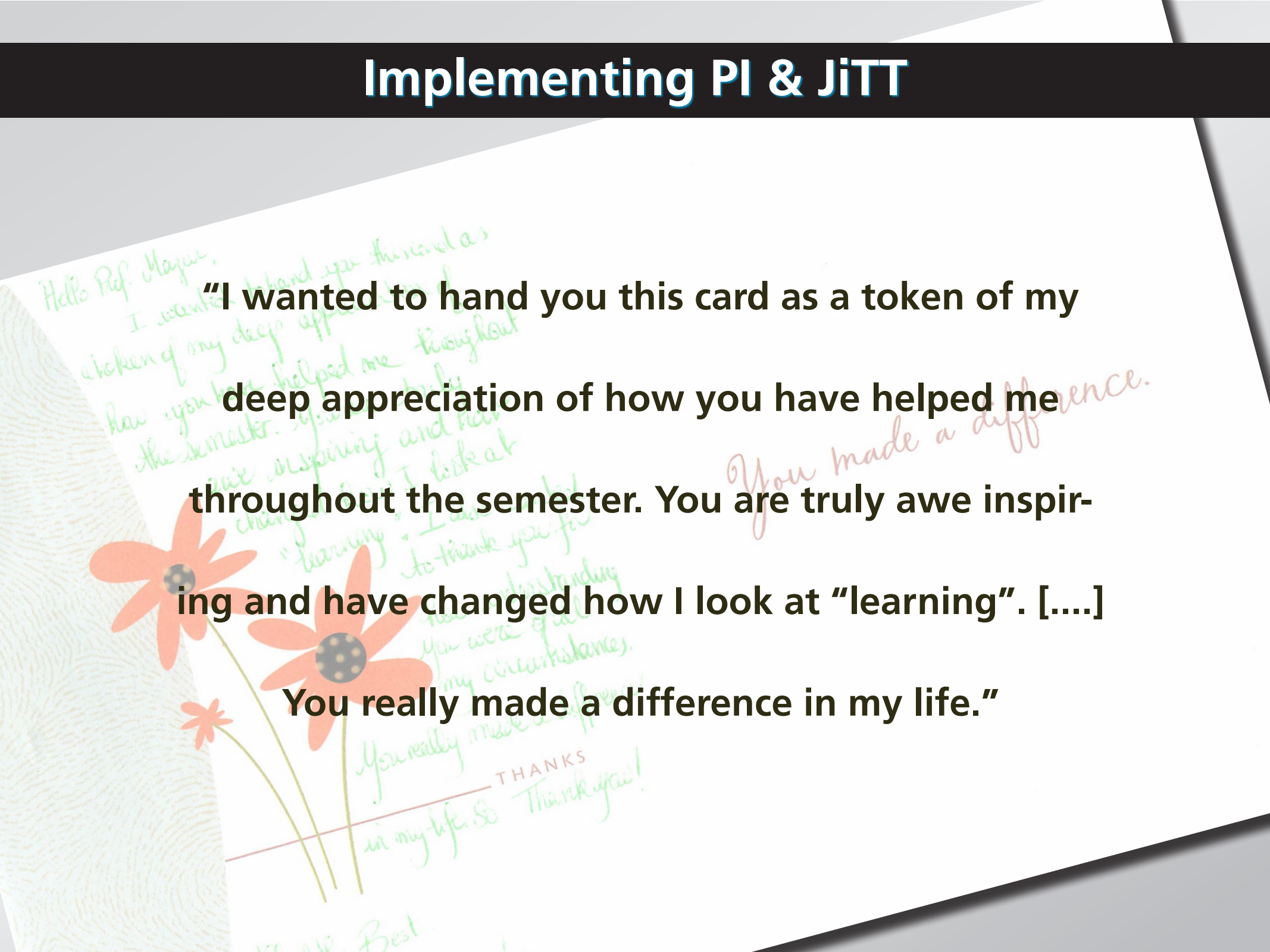
Implementing PI & JiTT

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

Implementing PI & JiTT



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."

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
- ConcepTests

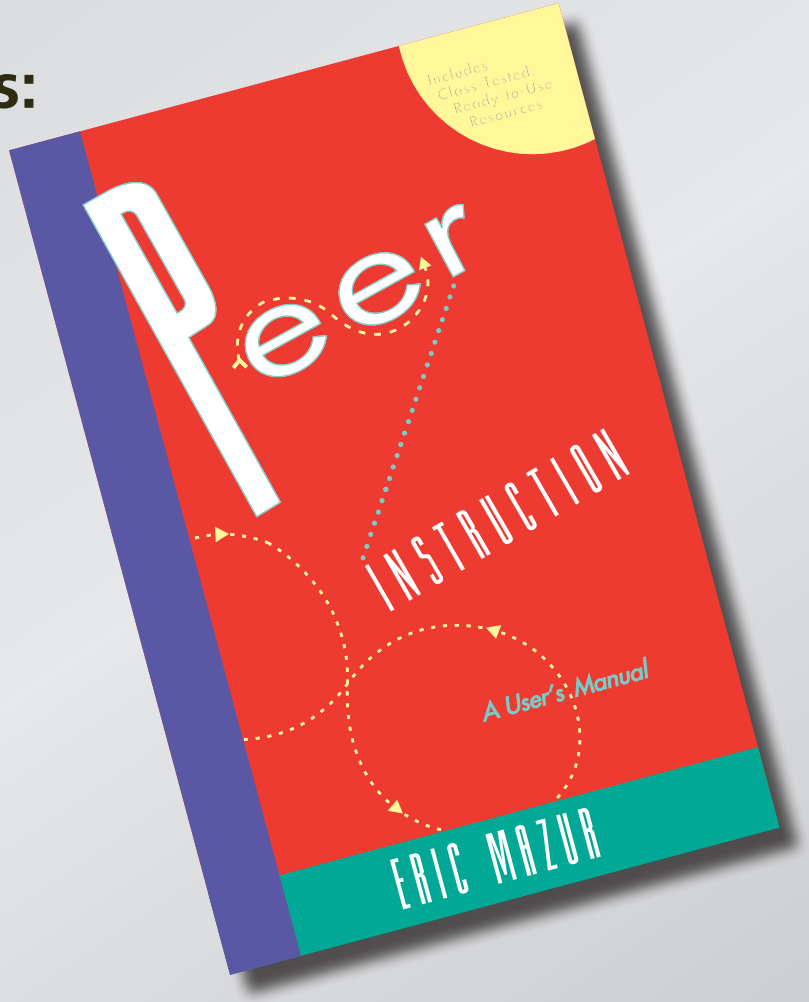
ConcepTests

“Where can I get examples of good questions?”

ConcepTests

Books with ConcepTests:

- **Physics (Prentice Hall)**



ConcepTests

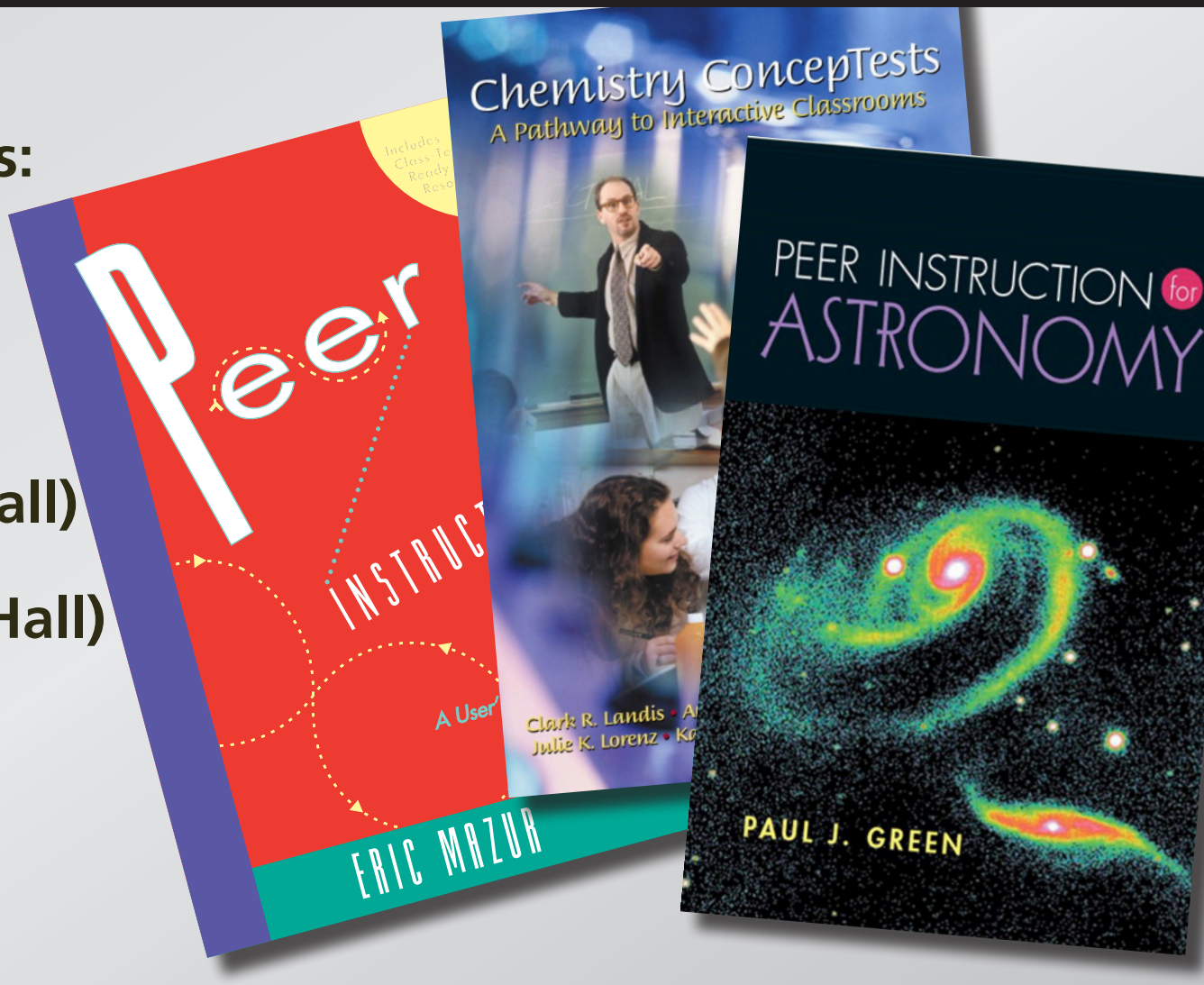
Books with ConcepTests:

- 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)

ConcepTests

… or try searching Google:

<subject> “Peer Instruction”

<subject> ConcepTest

<subject> “Concept Test”

<subject> clickers


Join now!
PeerInstruction.net

ConcepTests

Types of questions

- survey
- model testing
- discussion
- select from list

ConcepTests

hole in plate/circumference	model
microscopy image	discussion
airline	fact

ConcepTests

hole in plate/circumference

model

microscopy image

discussion

airline

fact

fact-recall not engaging

ConcepTests

Good conceptual questions (ConcepTests):

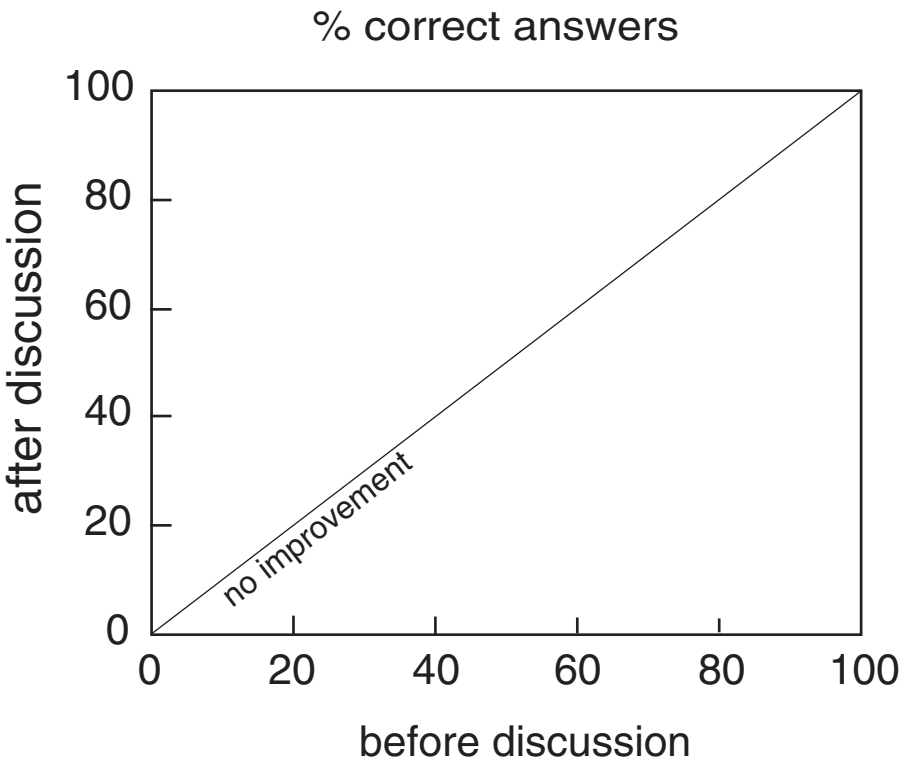
- focus on interpretation/model (not recall)
- stimulate discussion
- are not “leading questions”
- are of manageable difficulty

ConcepTests

“How can I promote active/fruitful discussions?”

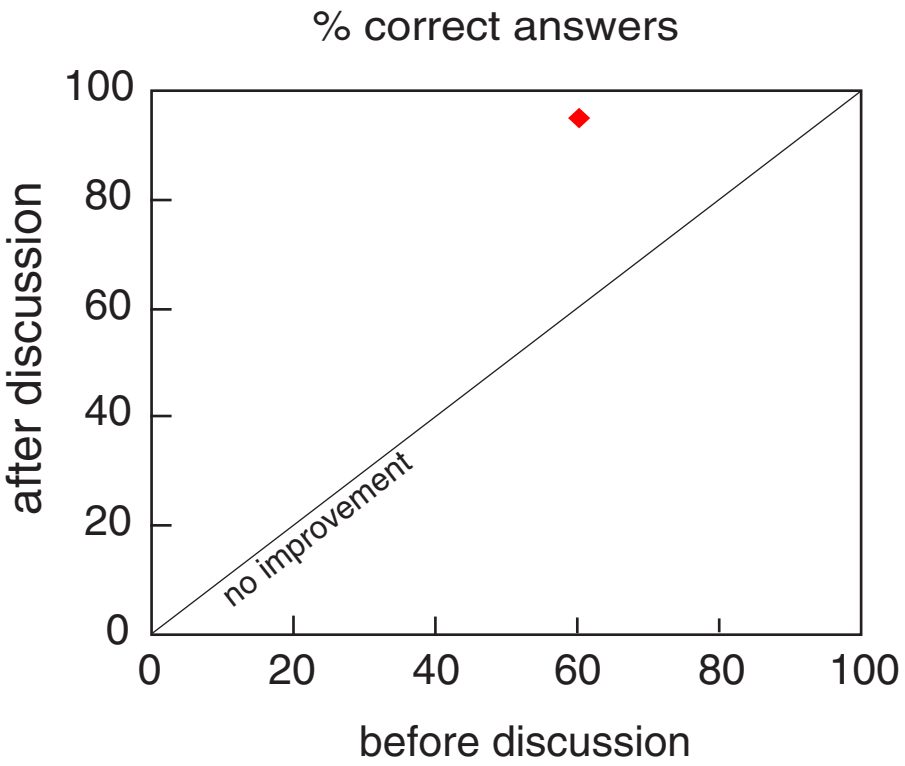
ConcepTests

ConcepTest data



ConcepTests

ConcepTest data



ConcepTests

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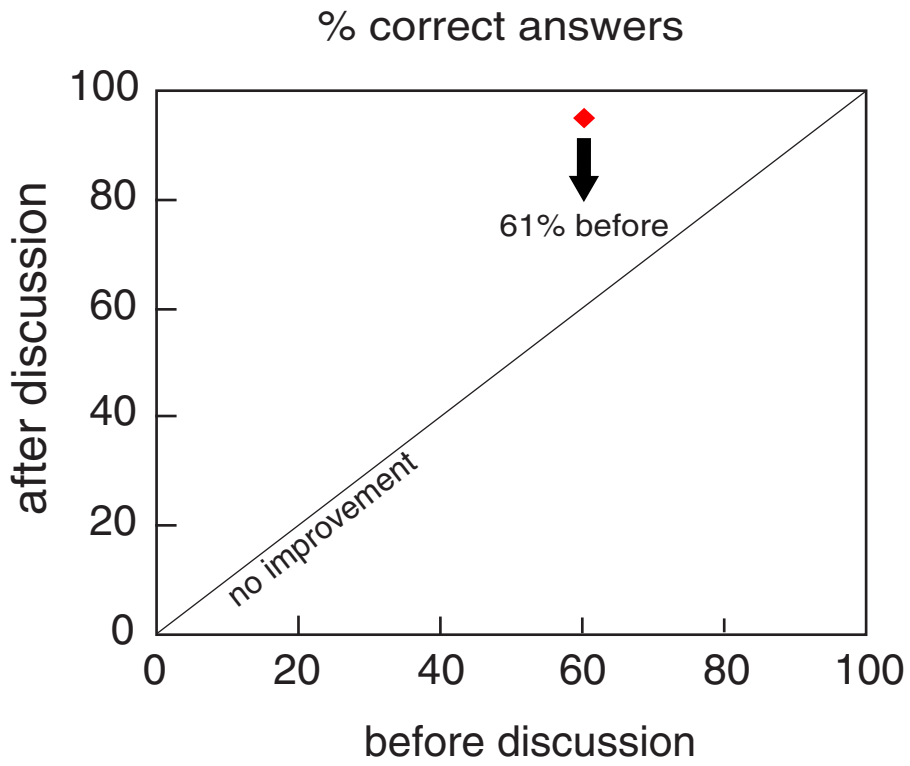
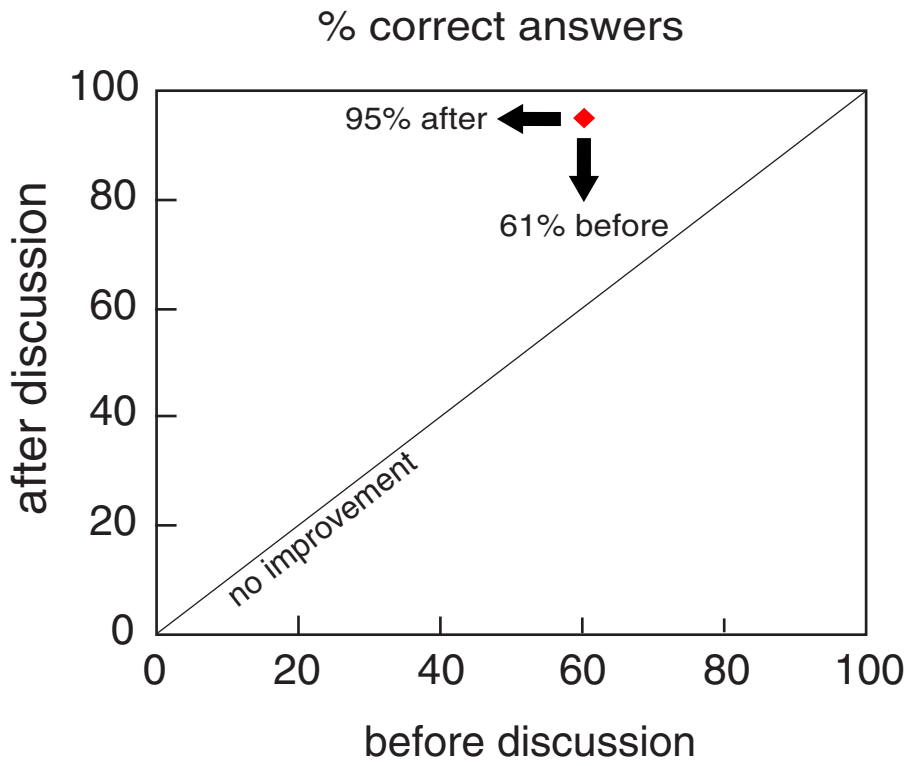


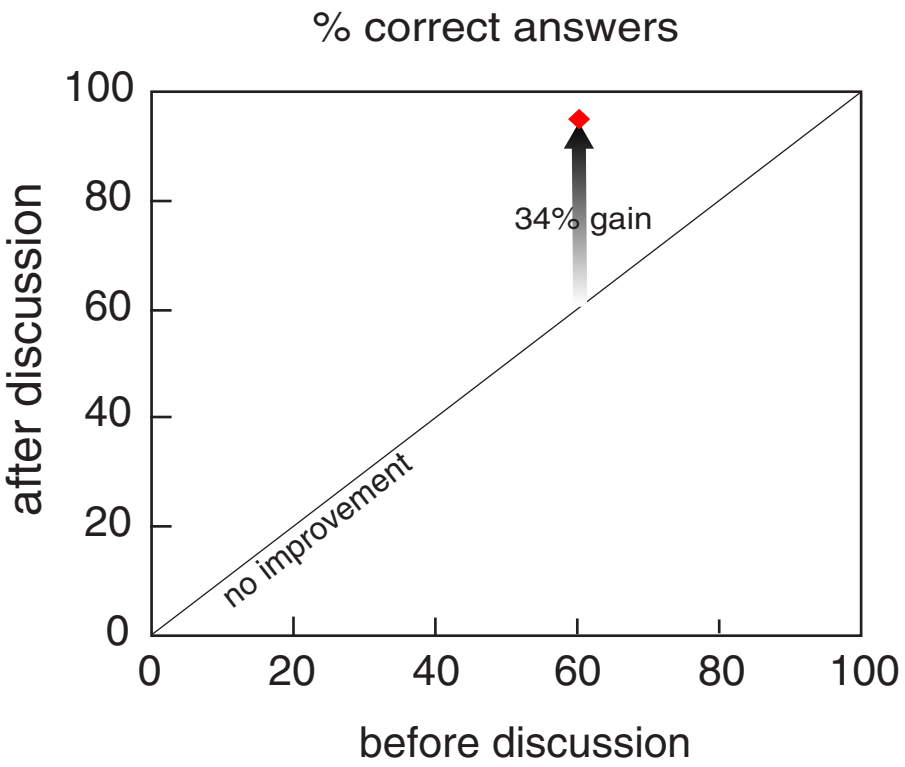
ConcepTests

ConcepTest data



ConcepTests

ConcepTest data



ConcepTests

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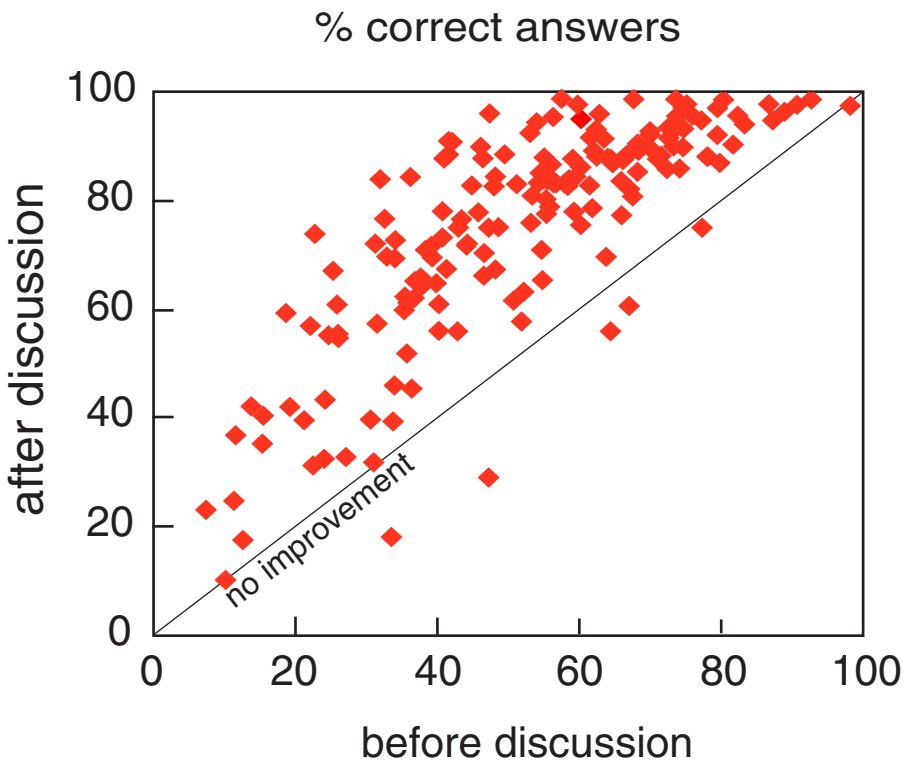

ConcepTests

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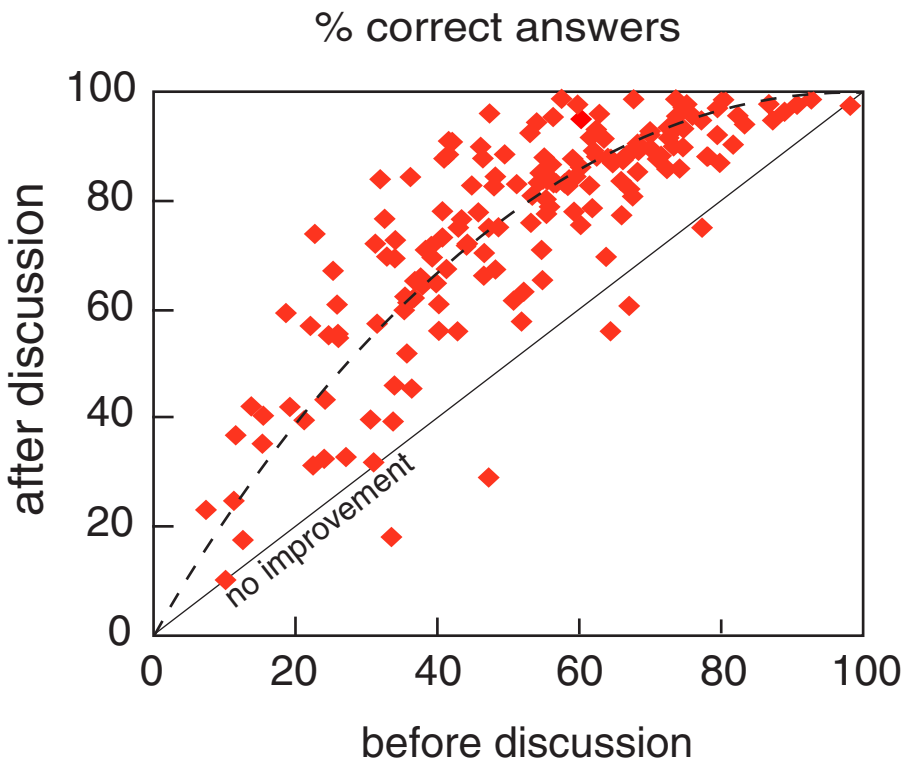

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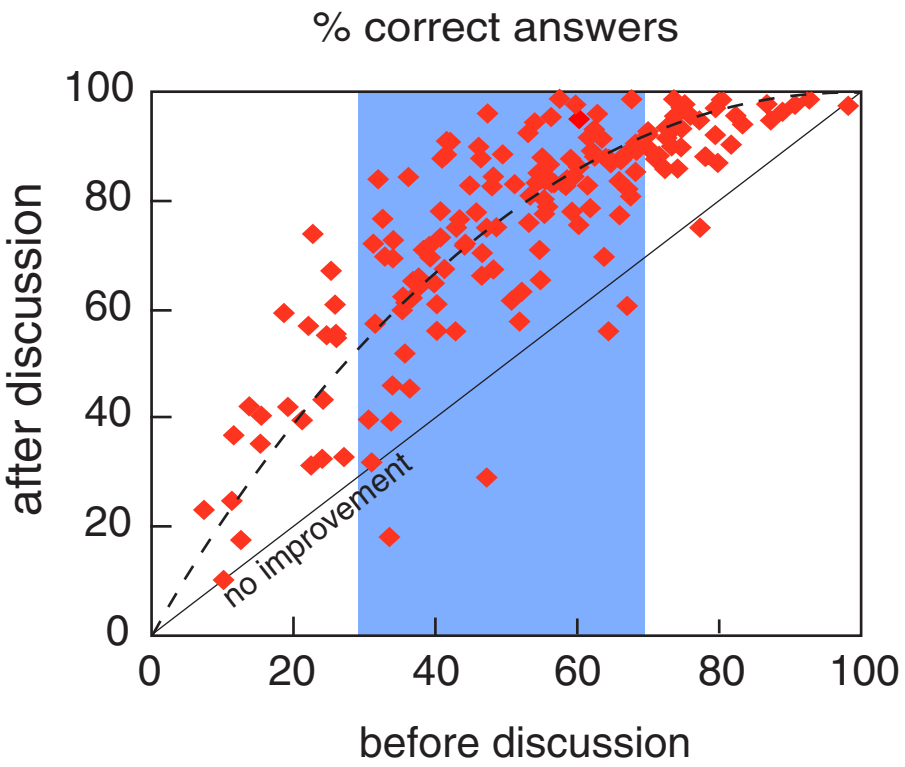
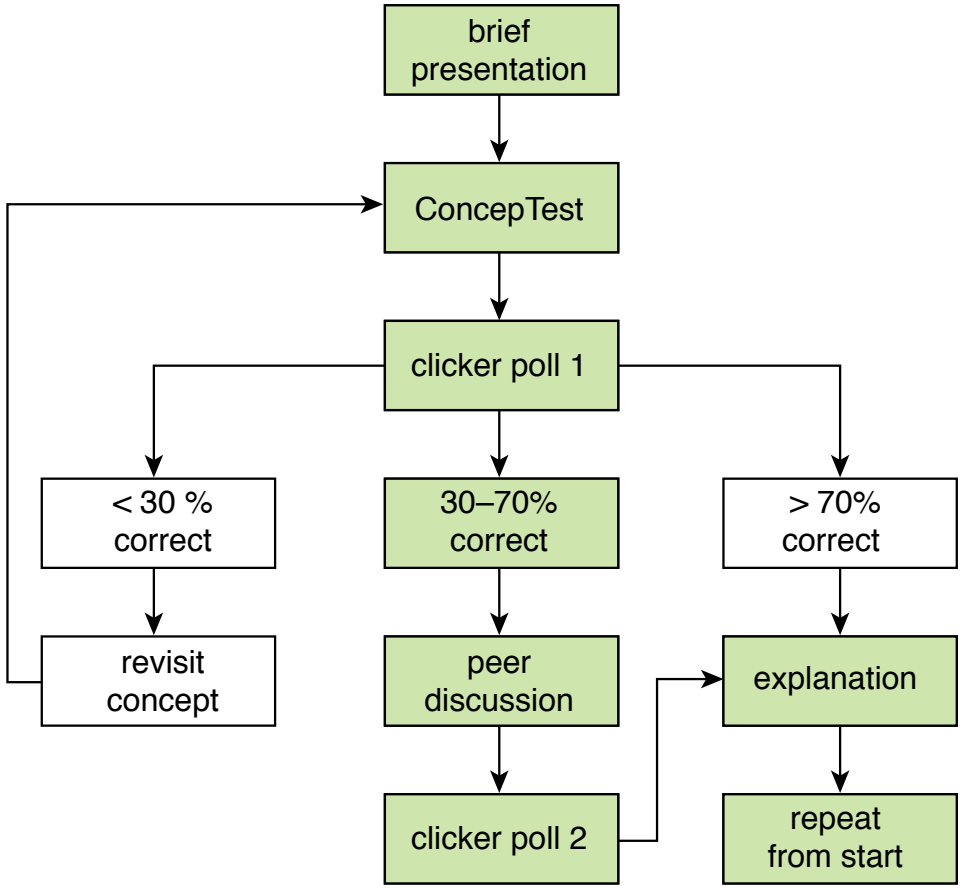


ConcepTests




First International Asia-Pacific Conference
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14-16 December 2012
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