

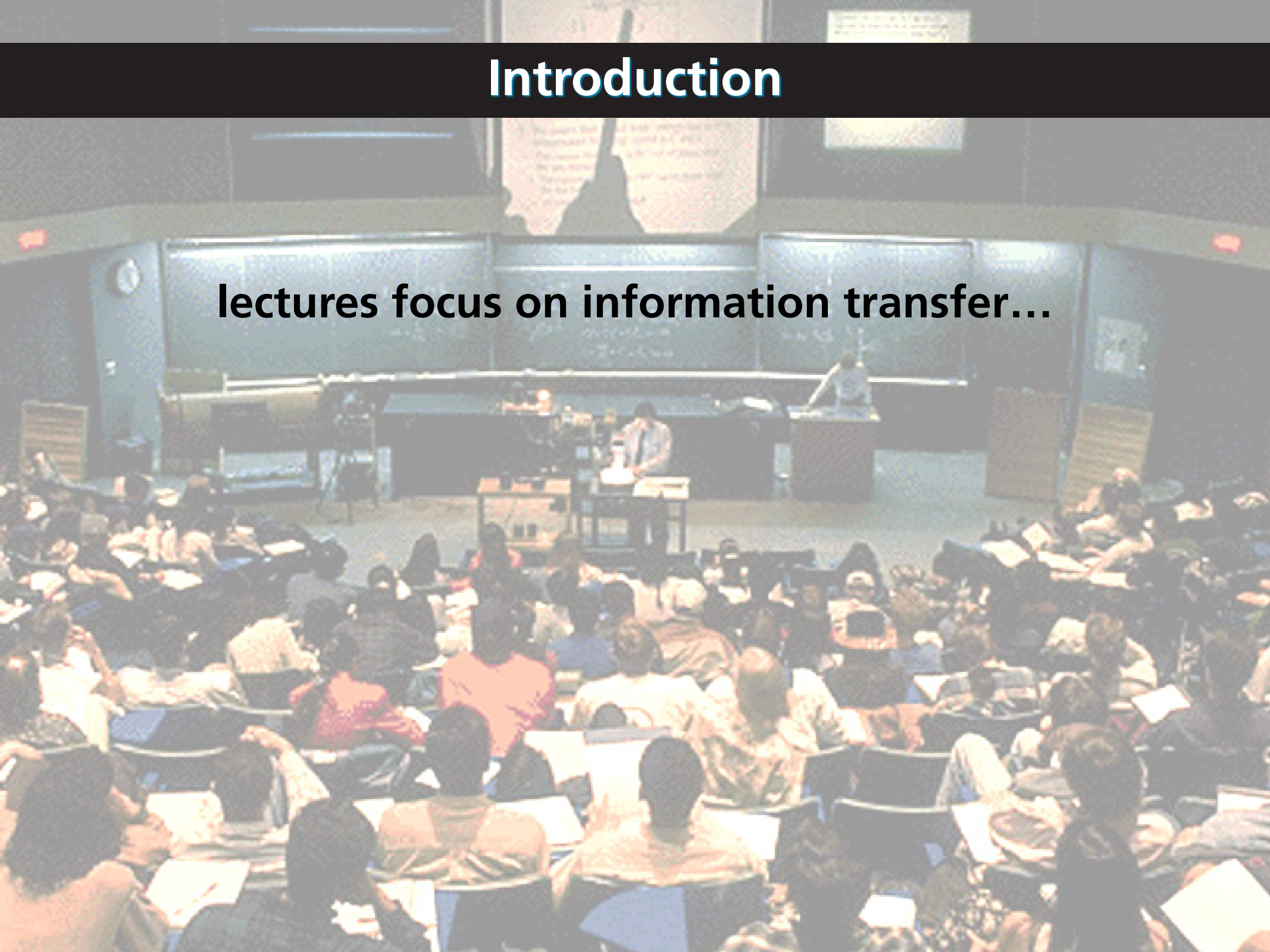
Peer Instruction



University of Rhode Island
Kingston, RI / 13 April 2012

Introduction

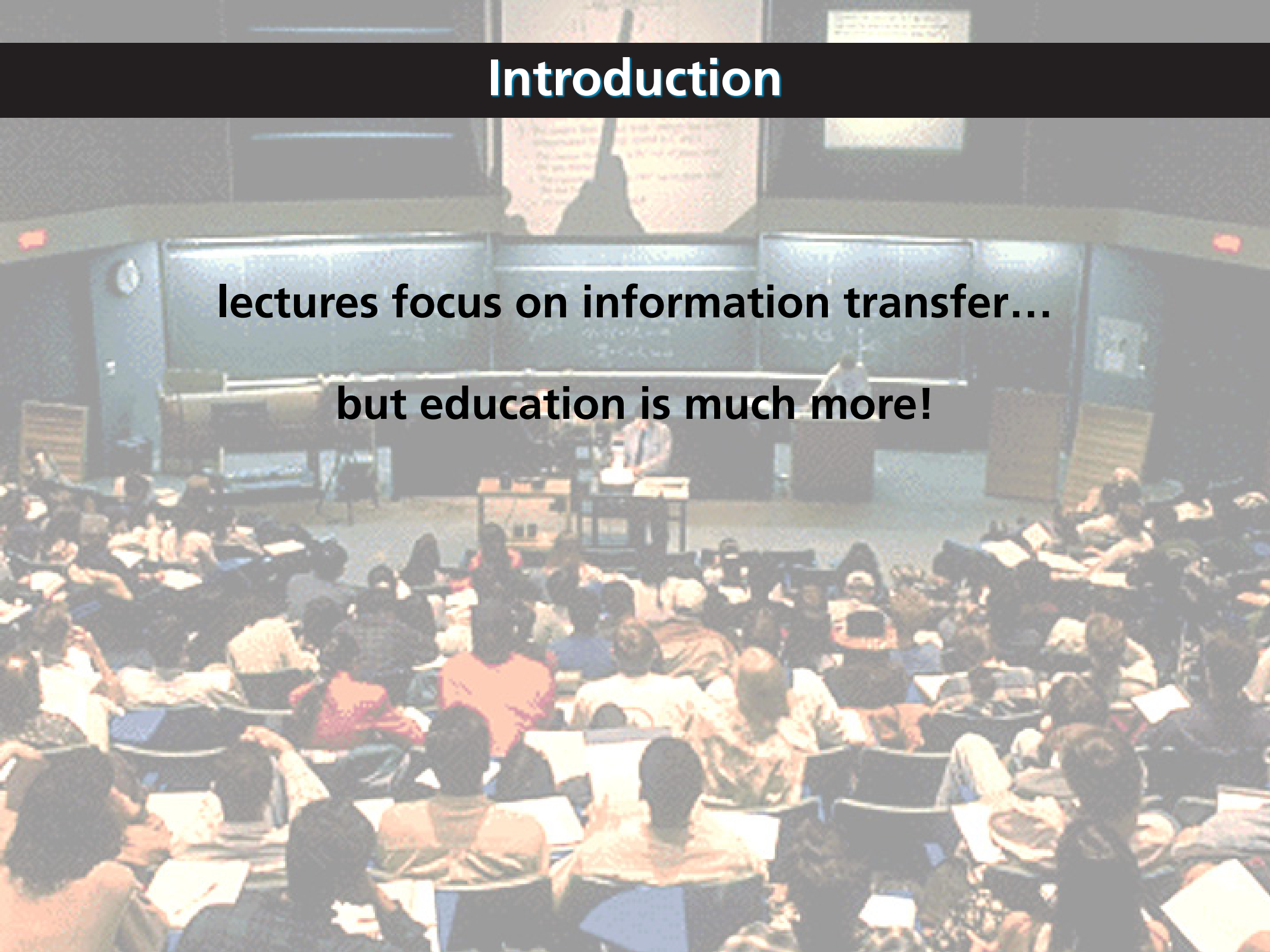
lectures focus on information transfer...



Introduction

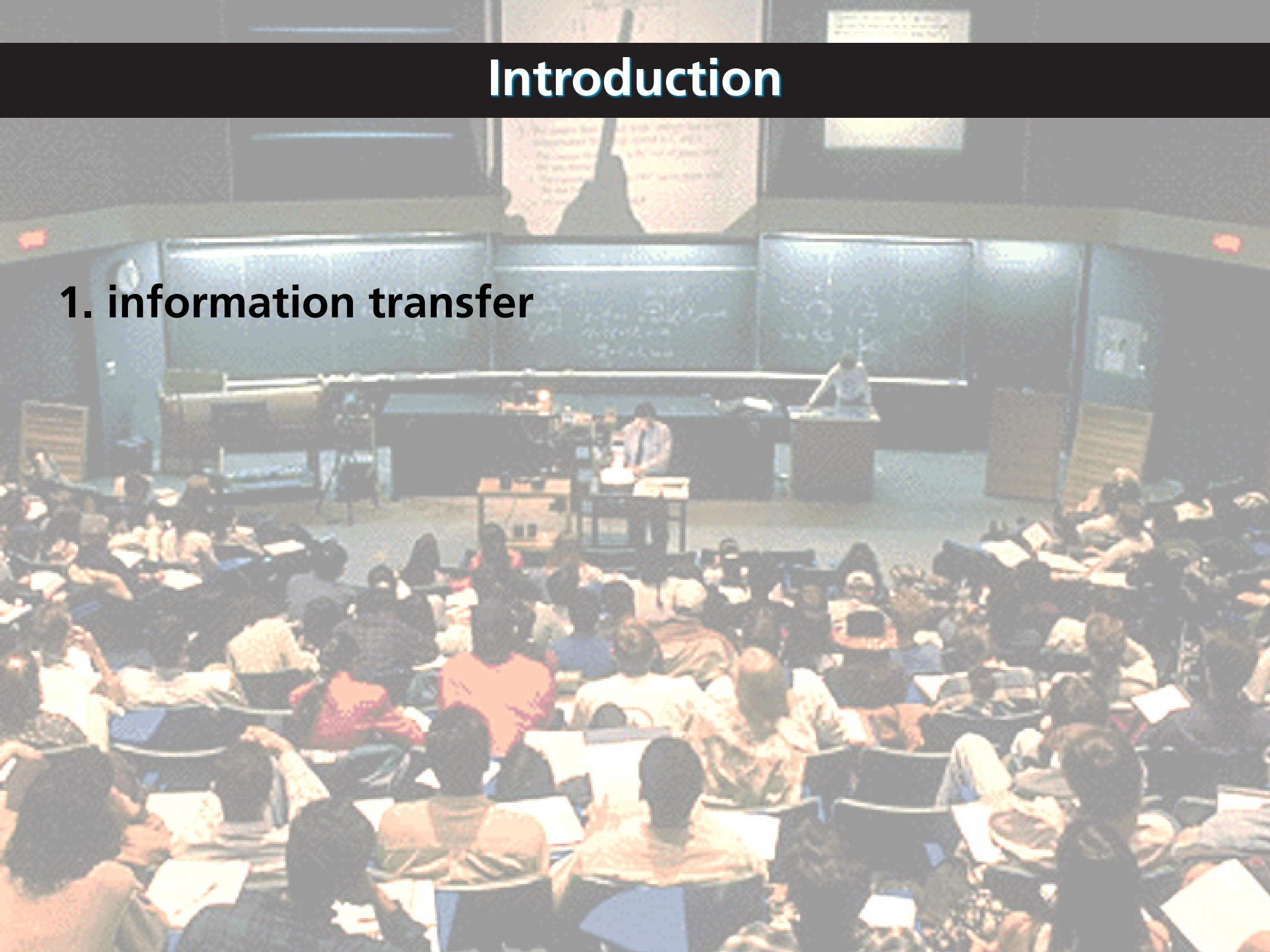
lectures focus on information transfer...

but education is much more!



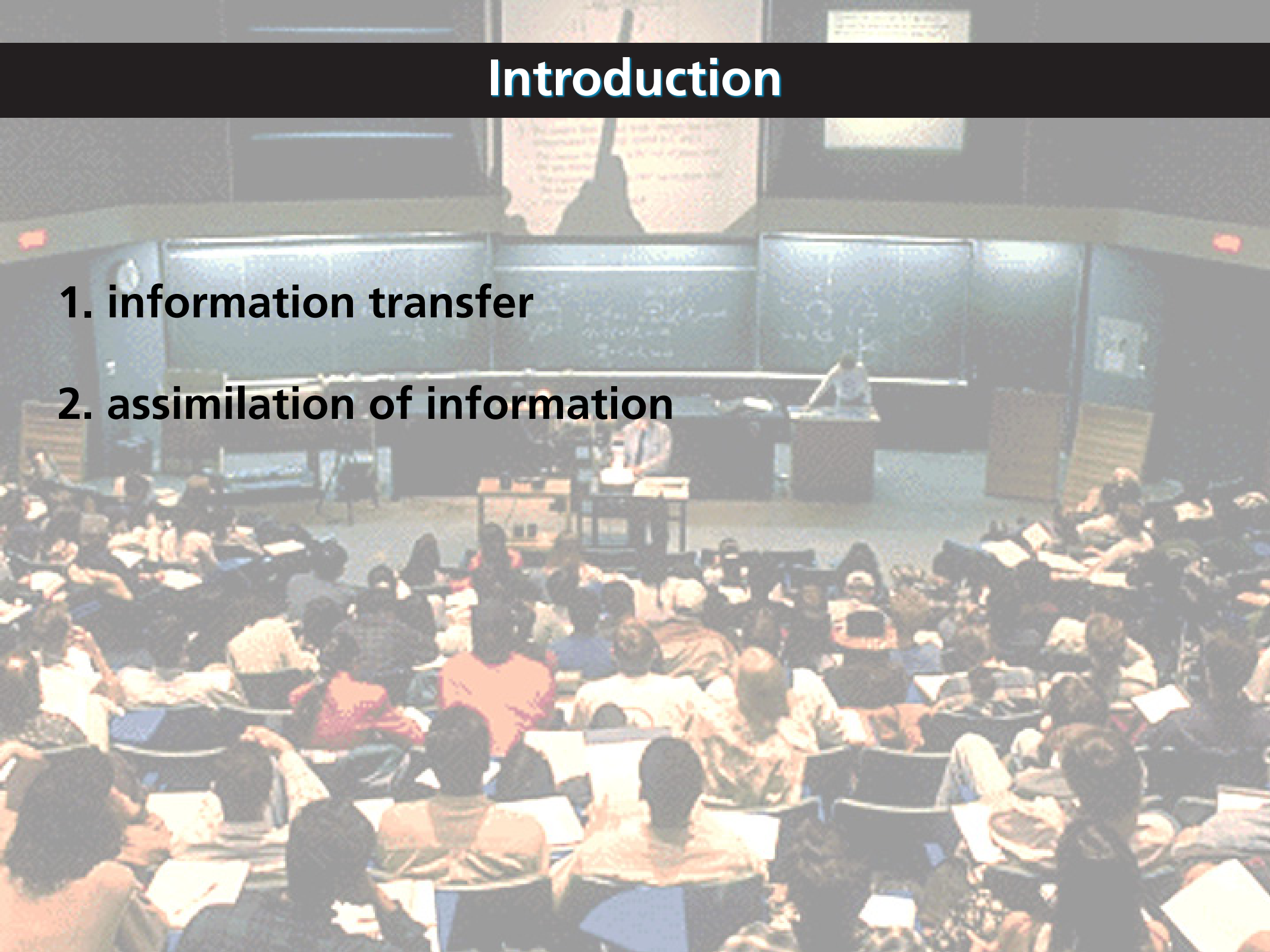
Introduction

1. information transfer



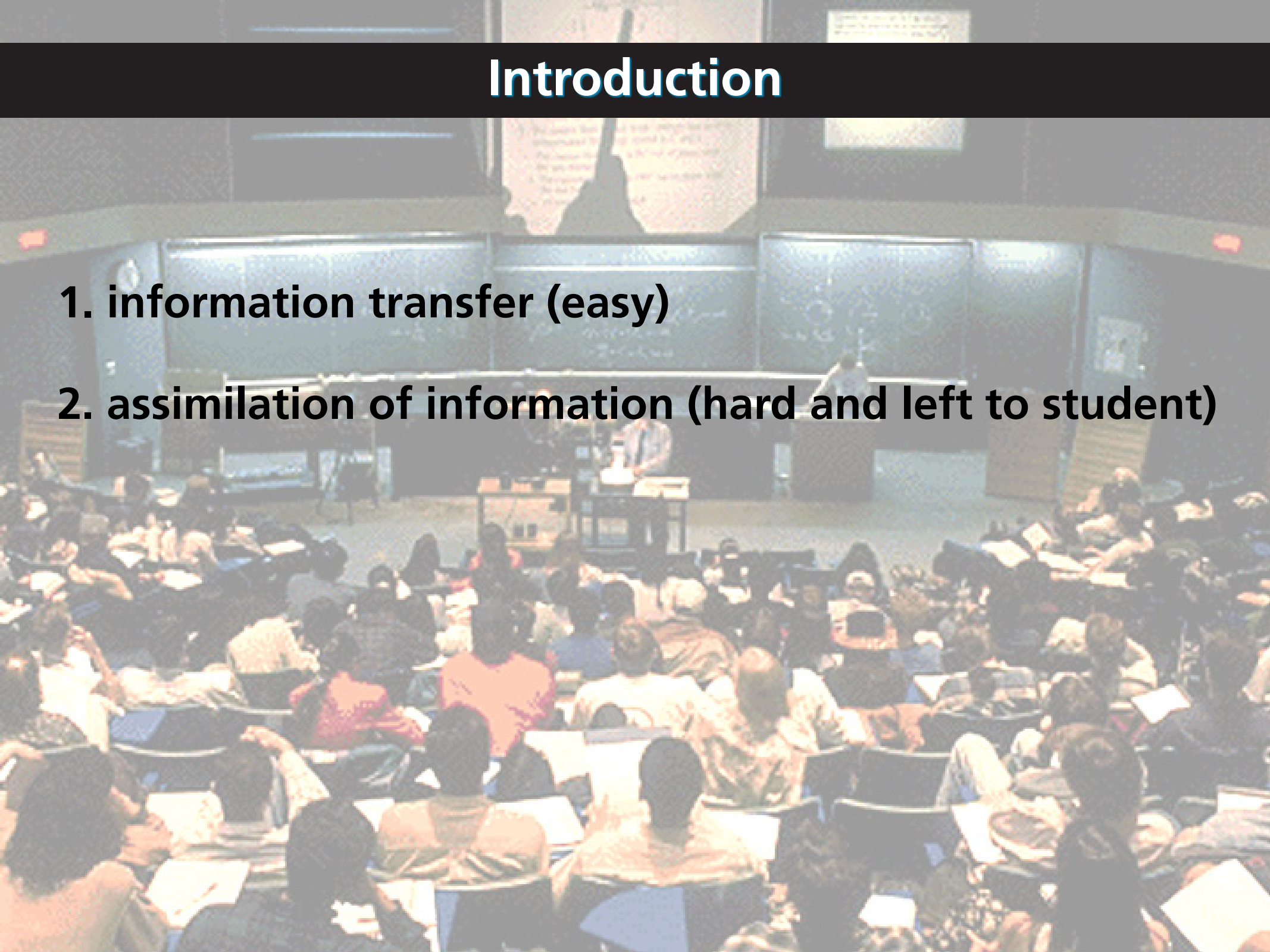
Introduction

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)!

Survey

Interactive teaching requires significantly more instructor preparation time than traditional lecture.

- 1. Strongly Agree**
- 2. Agree**
- 3. Neither agree nor disagree**
- 4. Disagree**
- 5. Strongly Disagree**



Survey

Interactive teaching requires clickers.

- 1. Strongly Agree**
- 2. Agree**
- 3. Neither agree nor disagree**
- 4. Disagree**
- 5. Strongly Disagree**



Survey

If I give my students a pre-class (reading) assignment, most of them will complete it before coming to class.

1. Strongly Agree
2. Agree
3. Neither agree nor disagree
4. Disagree
5. Strongly Disagree



Survey

It is difficult to see how to apply interactive teaching techniques in my courses.

1. Strongly Agree
2. Agree
3. Neither agree nor disagree
4. Disagree
5. Strongly Disagree



Survey

I am worried that interactive teaching will negatively affect my end-of-course evaluations.

1. Strongly Agree
2. Agree
3. Neither agree nor disagree
4. Disagree
5. Strongly Disagree



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!**

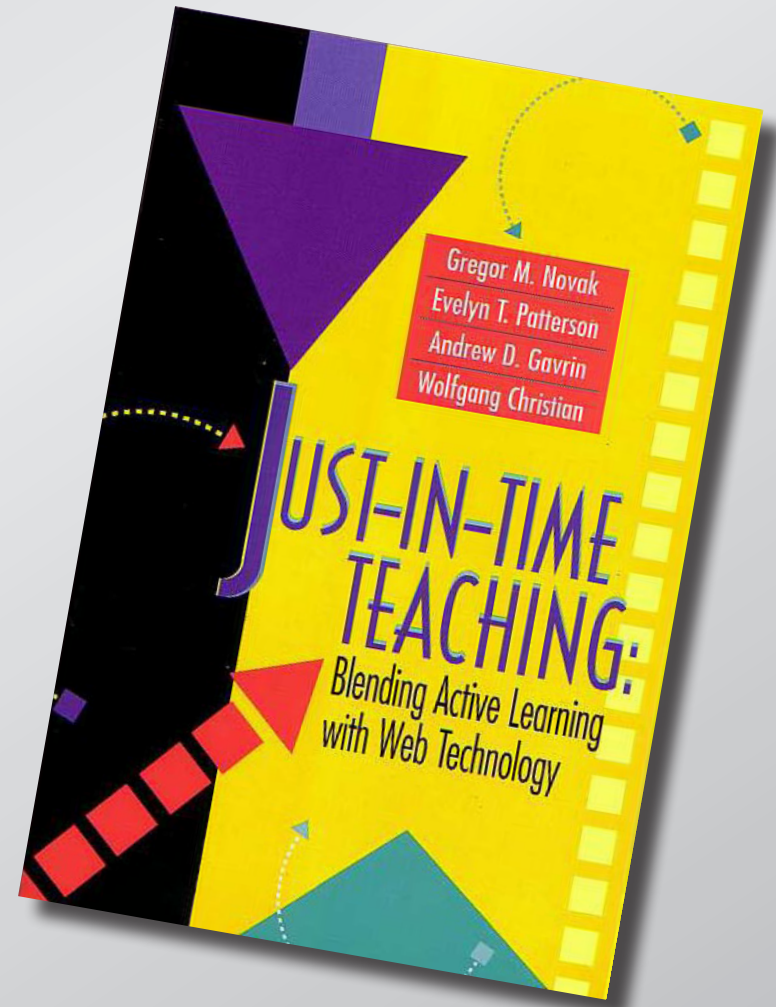
(select what you consider to be the main reason)



PI & JiTT Overview

Just-in-time-Teaching (JiTT)

www.jitt.org



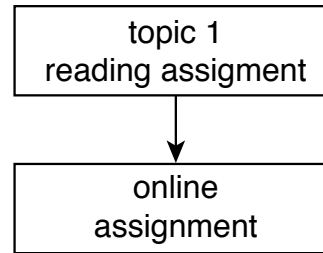
PI & JiTT Overview

JiTT workflow

topic 1
reading assignment

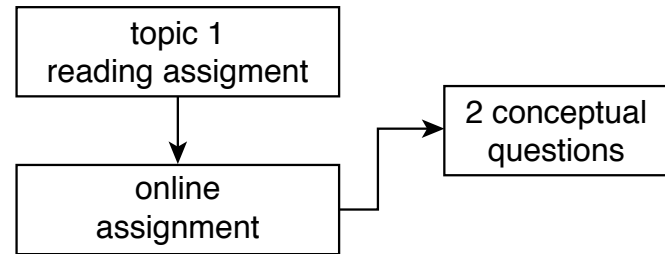
PI & JiTT Overview

JiTT workflow



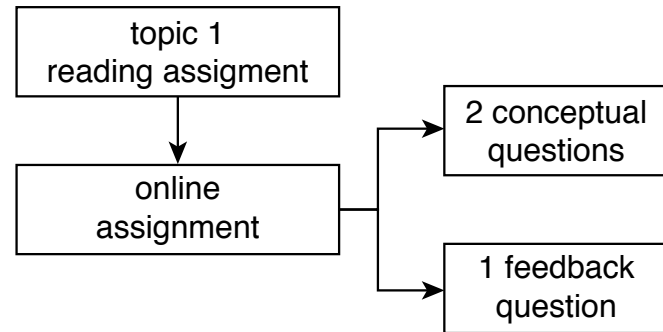
PI & JiTT Overview

JiTT workflow



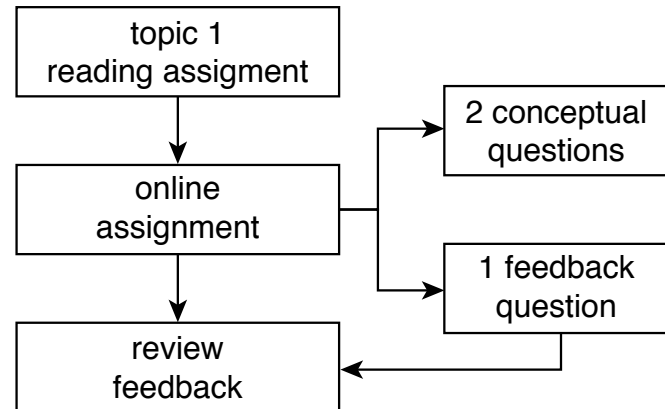
PI & JiTT Overview

JiTT workflow



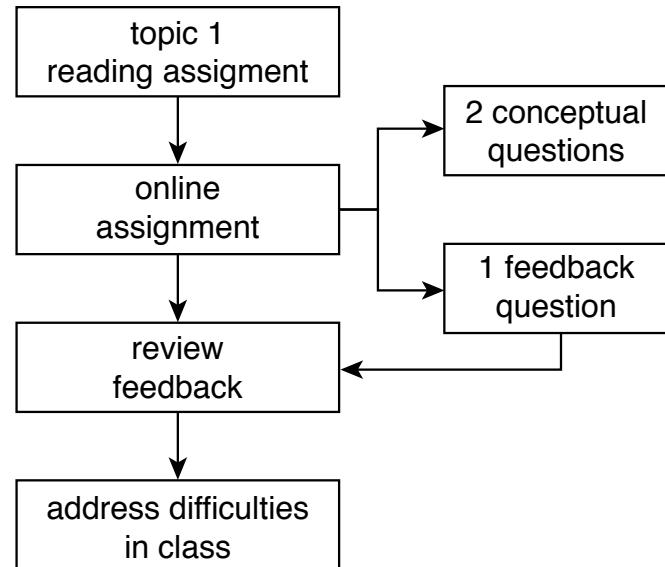
PI & JiTT Overview

JiTT workflow



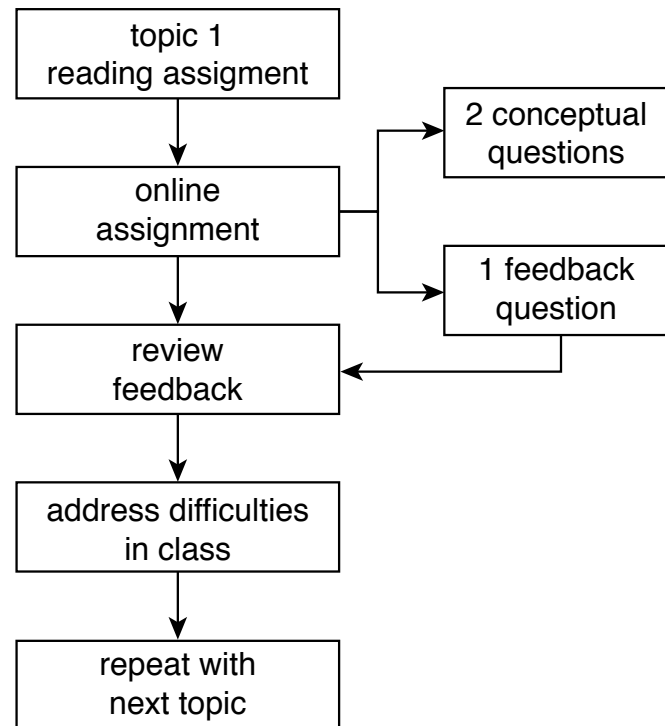
PI & JiTT Overview

JiTT workflow



PI & JiTT Overview

JiTT workflow



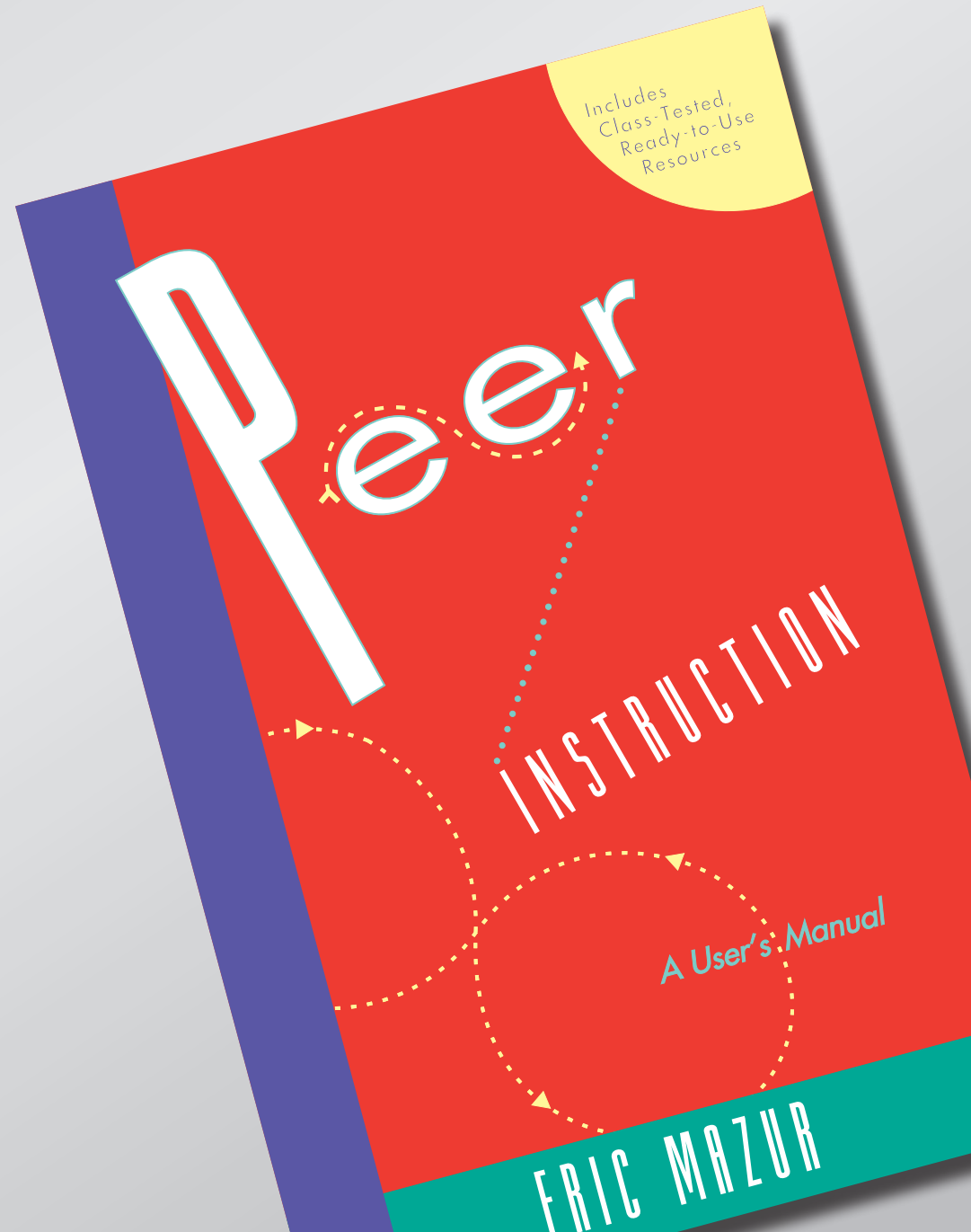
PI & JiTT Overview

JiTT:

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

PI & JiTT Overview

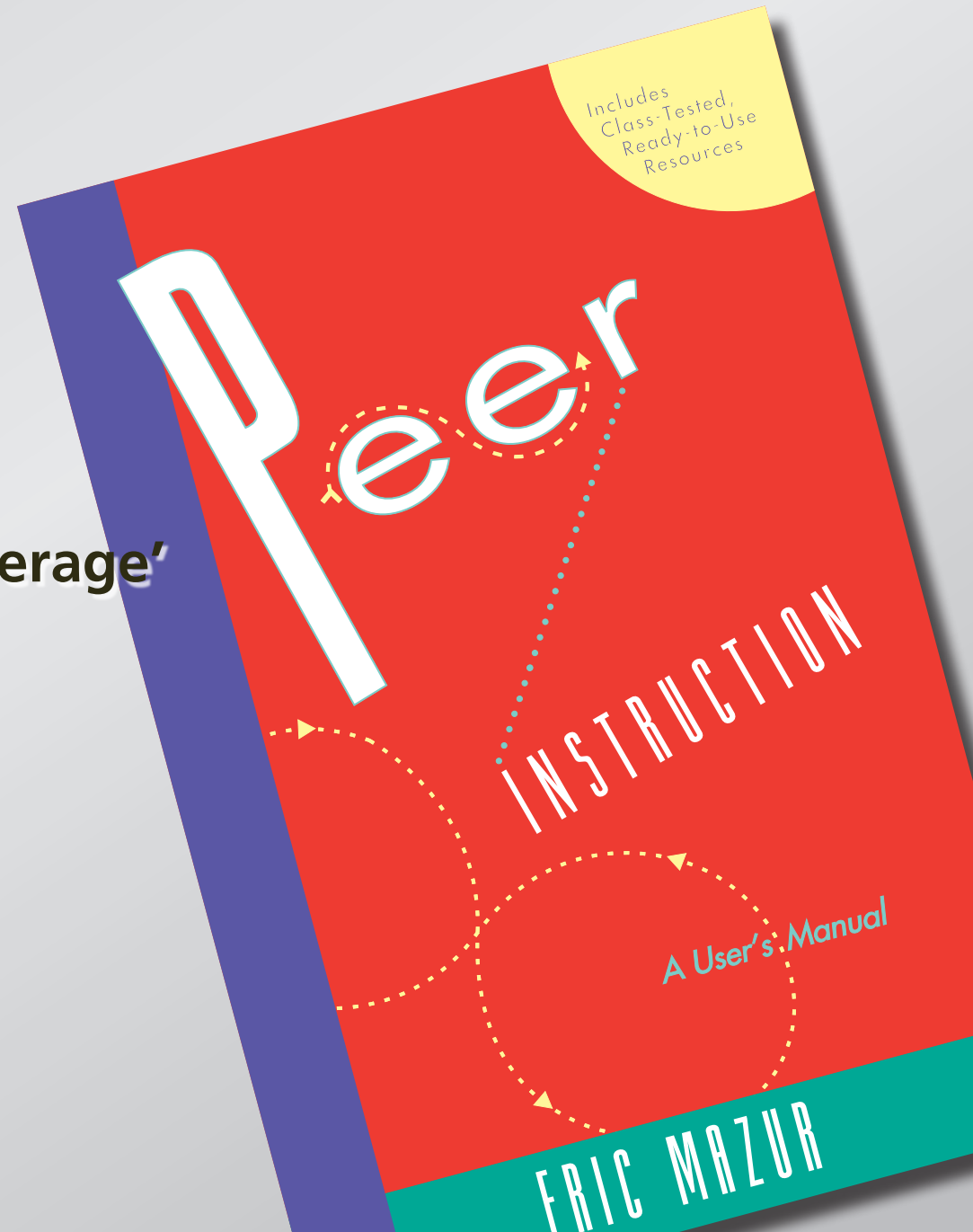
Peer Instruction (PI)



PI & JiTT Overview

Main features:

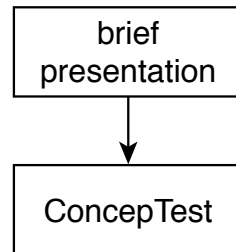
- pre-class assignment
- in-class: depth, not 'coverage'
- ConcepTests



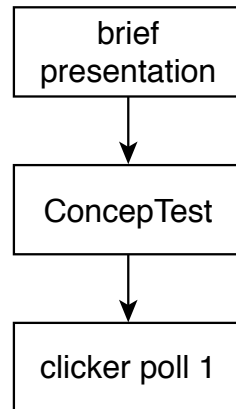
PI & JiTT Overview

brief
presentation

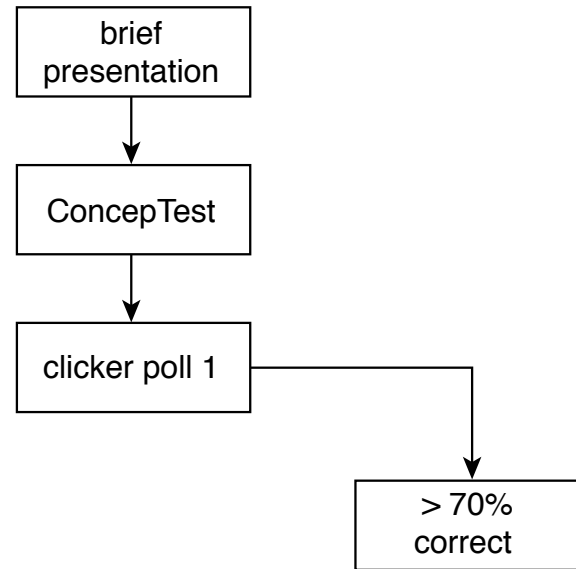
PI & JiTT Overview



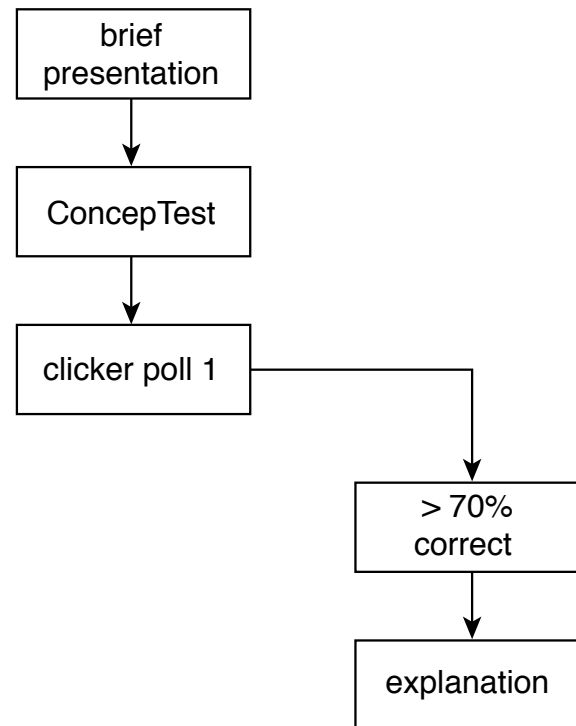
PI & JiTT Overview



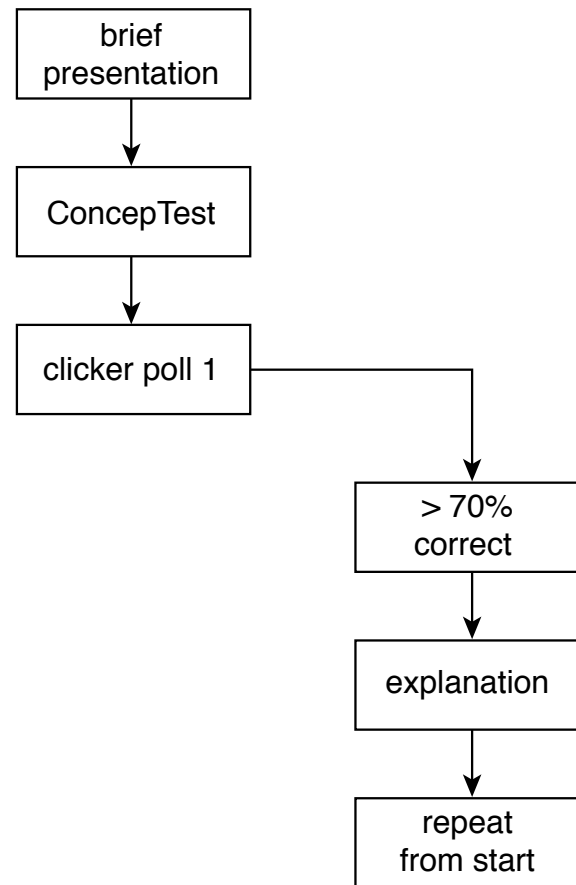
PI & JiTT Overview



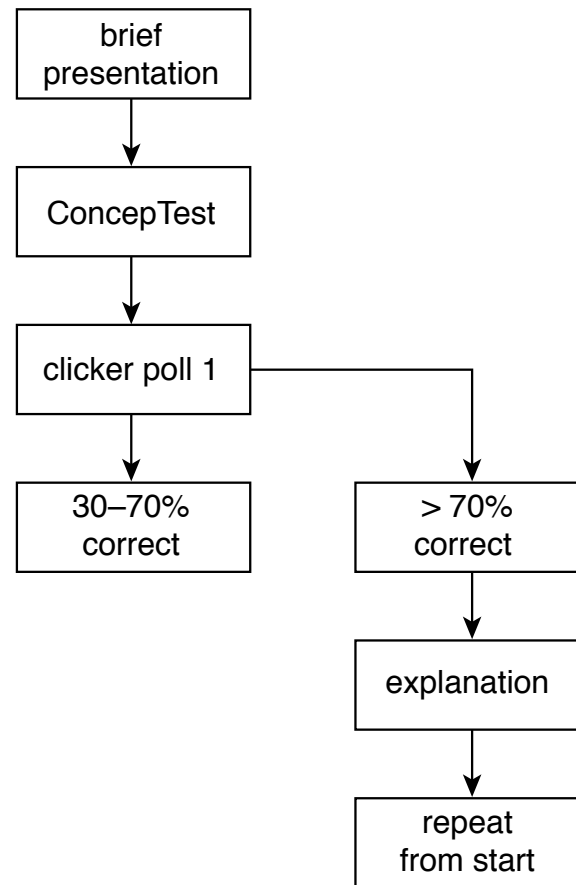
PI & JiTT Overview



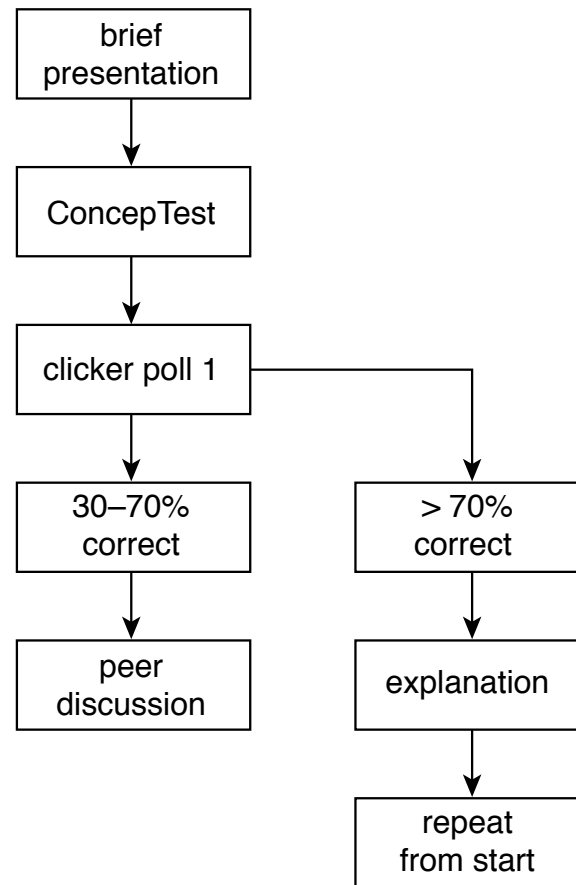
PI & JiTT Overview



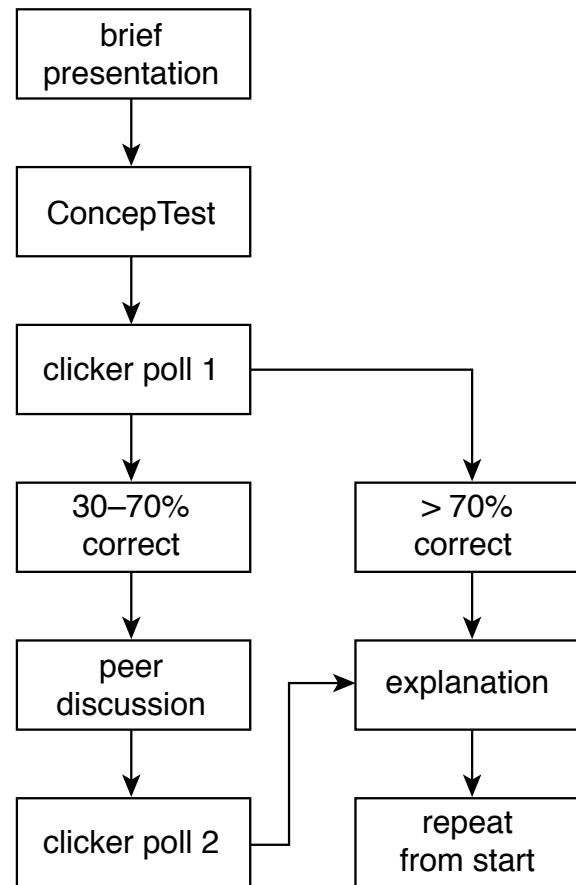
PI & JiTT Overview



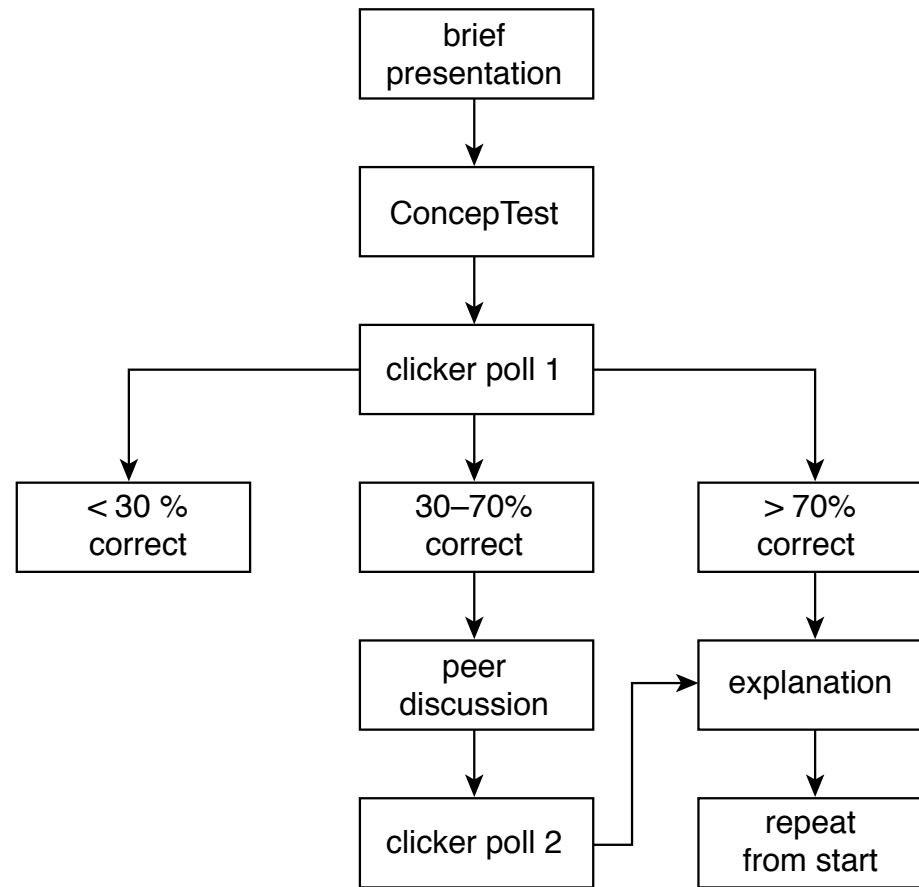
PI & JiTT Overview



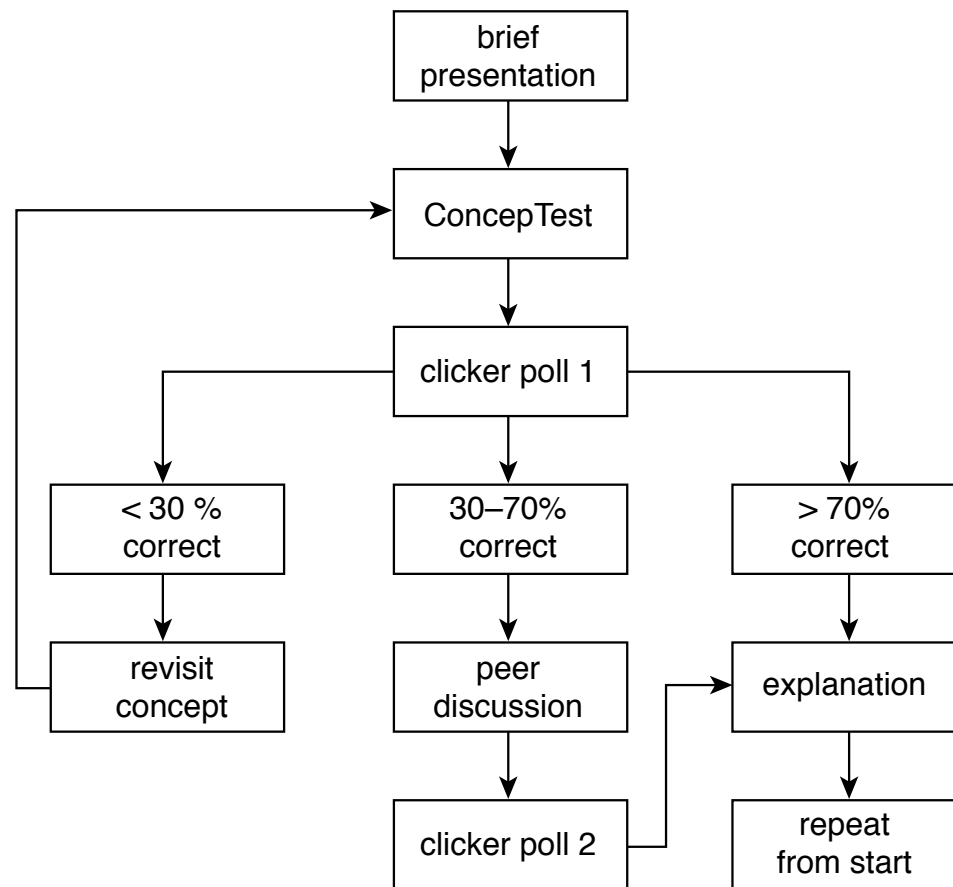
PI & JiTT Overview



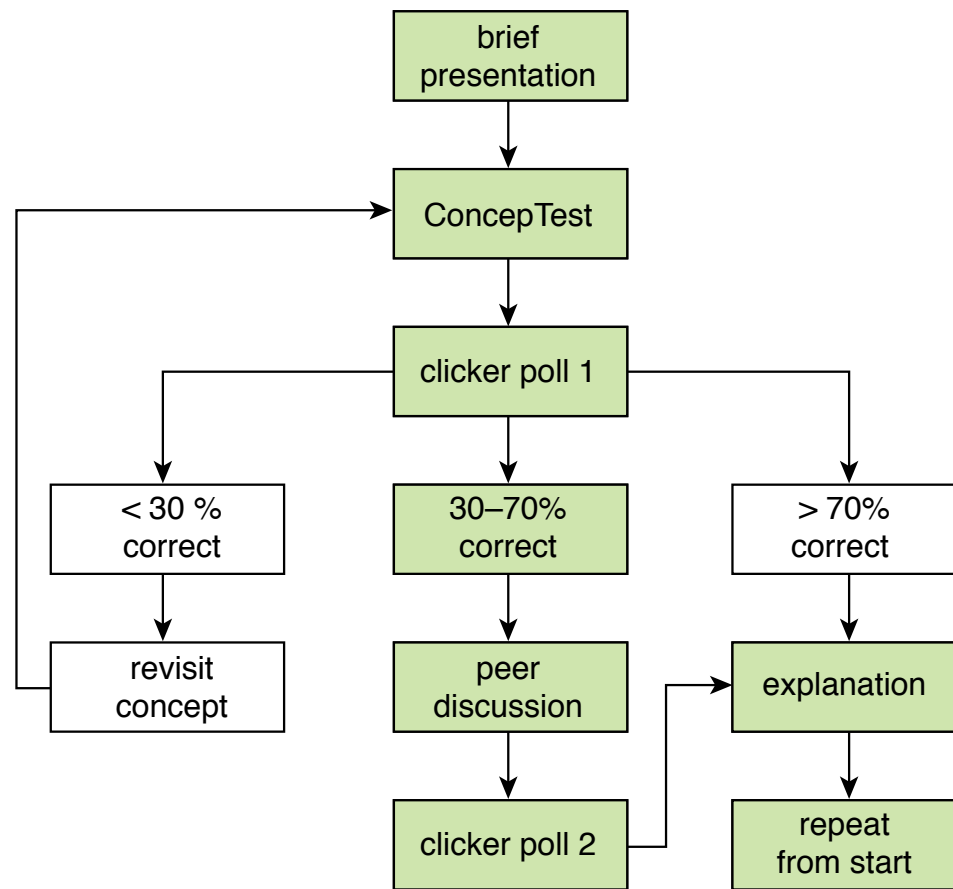
PI & JiTT Overview



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

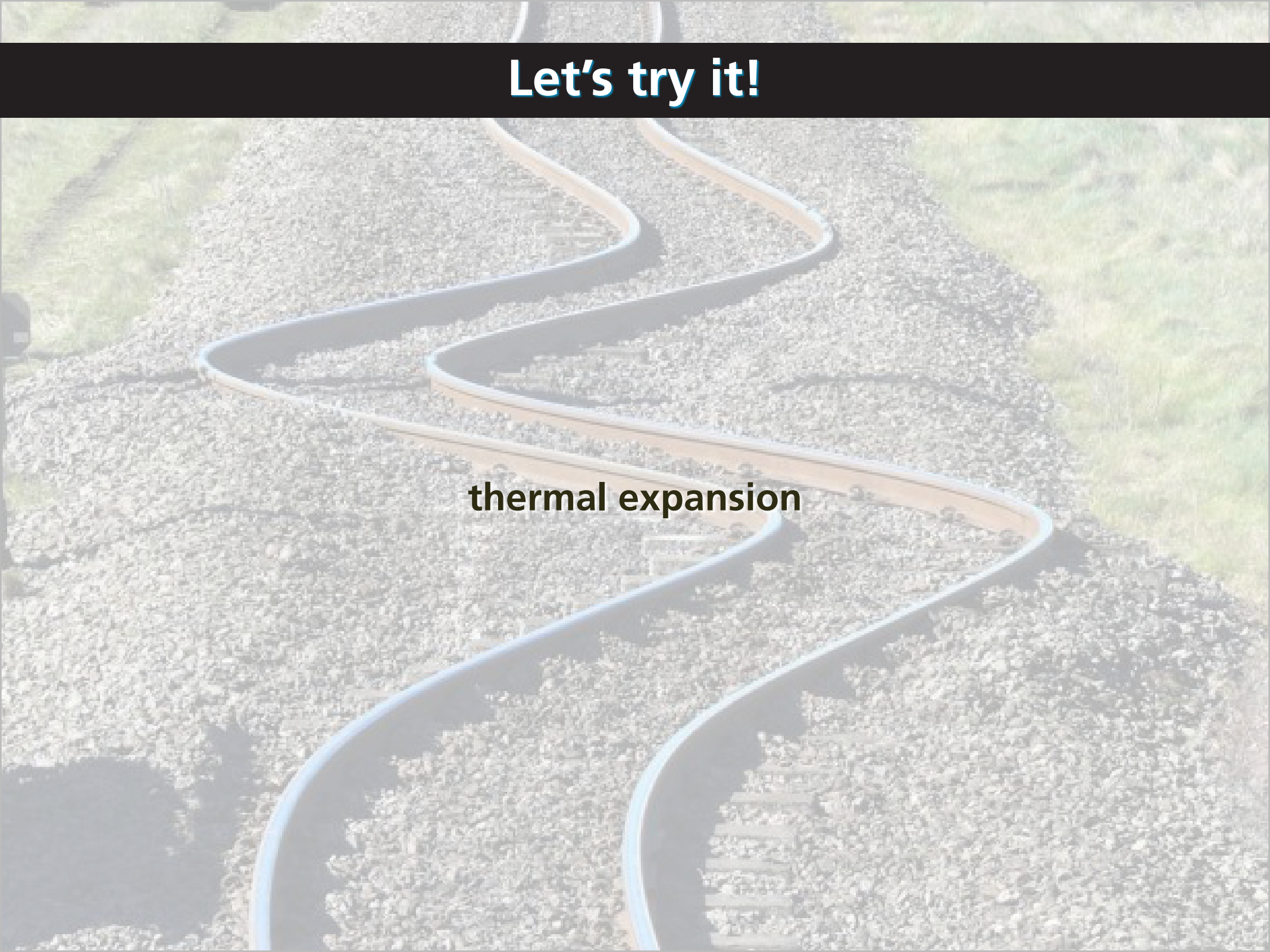
“How do I promote fruitful discussion?”

PI & JiTT Overview

Find someone with a *different* answer

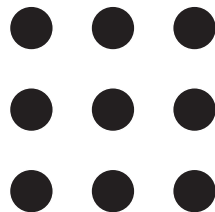
Let's try it!

thermal expansion



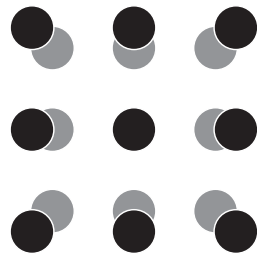
Let's try it!

When metals heat up, they expand because all atoms get farther away from each other.



Let's try it!


When metals heat up, they expand because all atoms get farther away from each other.



Let's try it!

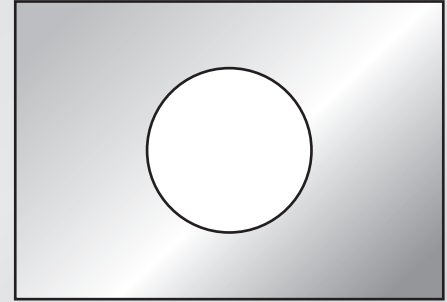
When metals heat up, they expand because all atoms get farther away from each other.

all of them



Let's try it!

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

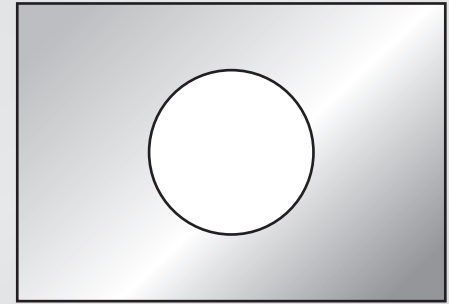


Let's try it!

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

When the plate is uniformly heated, the diameter of the hole

1. increases.
2. stays the same.
3. decreases.



Let's try it!

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

When the plate is uniformly heated, the diameter of the hole

1. increases.
2. stays the same.
3. decreases.



you got all fired up!

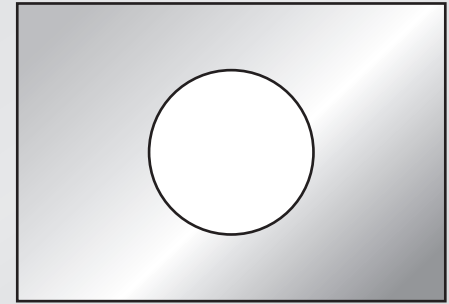


Let's try it!

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

When the plate is uniformly heated, the diameter of the hole

1. increases.
2. stays the same.
3. decreases.



Let's try it!

Before I tell you the answer...

Let's try it!

Before I tell you the answer, let's analyze what happened.

Let's try it!

Before I tell you the answer, let's analyze what happened.

You...

Let's try it!

Before I tell you the answer, let's analyze what happened.

You...

1. made a commitment

Let's try it!

Before I tell you the answer, let's analyze what happened.

You...

- 1. made a commitment**
- 2. externalized your answer**

Let's try it!

Before I tell you the answer, let's analyze what happened.

You...

- 1. made a commitment**
- 2. externalized your answer**
- 3. moved from the answer/fact to reasoning**

Let's try it!

Before I tell you the answer, let's analyze what happened.

You...

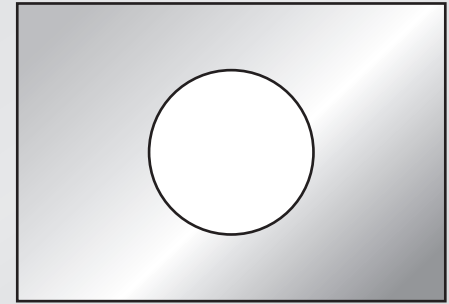
- 1. made a commitment**
- 2. externalized your answer**
- 3. moved from the answer/fact to reasoning**
- 4. became emotionally invested in the learning process**

Let's try it!

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

When the plate is uniformly heated, the diameter of the hole

1. increases.
2. stays the same.
3. decreases.

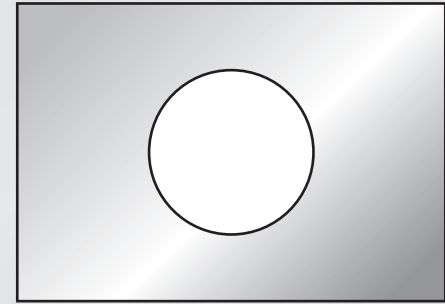


Let's try it!

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

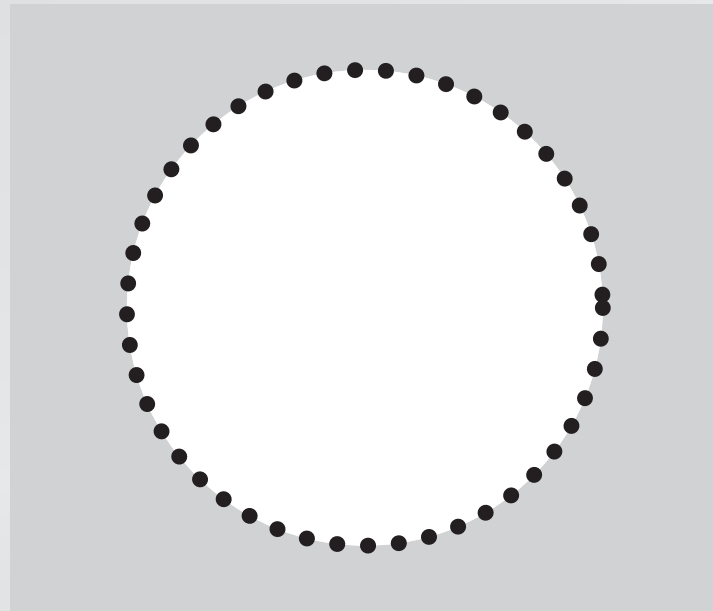
When the plate is uniformly heated, the diameter of the hole

1. increases. ✓
2. stays the same.
3. decreases.



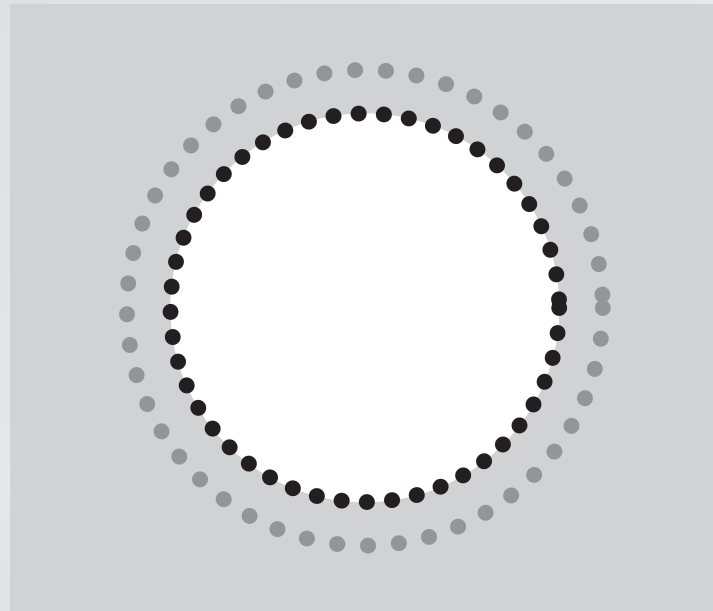
Let's try it!

consider the atoms at the rim of the hole



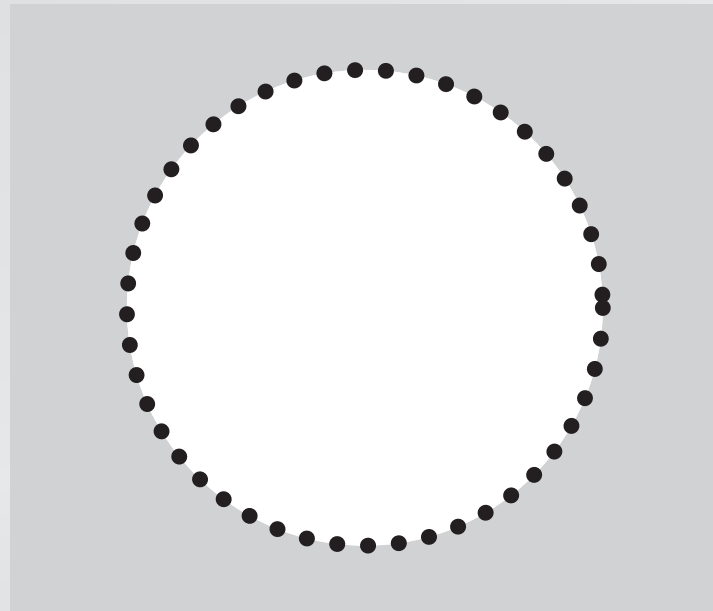
Let's try it!

consider the atoms at the rim of the hole



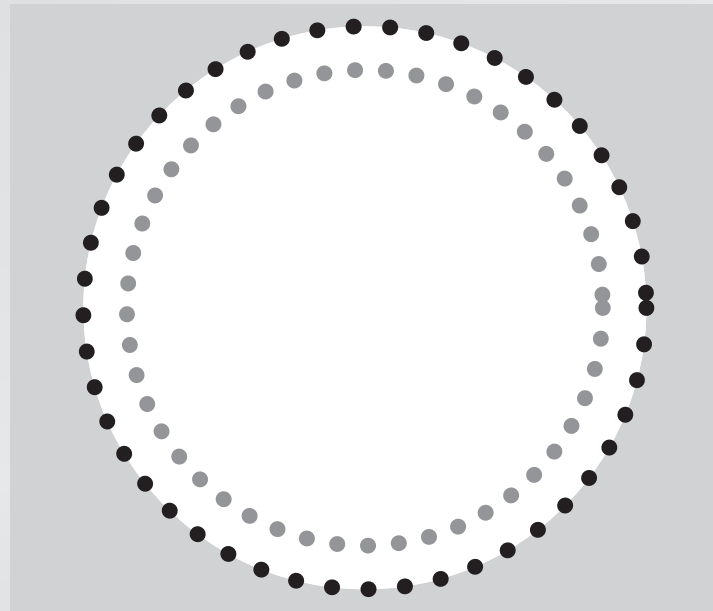
Let's try it!

consider the atoms at the rim of the hole



Let's try it!

consider the atoms at the rim of the hole



Let's try it!

consider the atoms at the rim of the hole

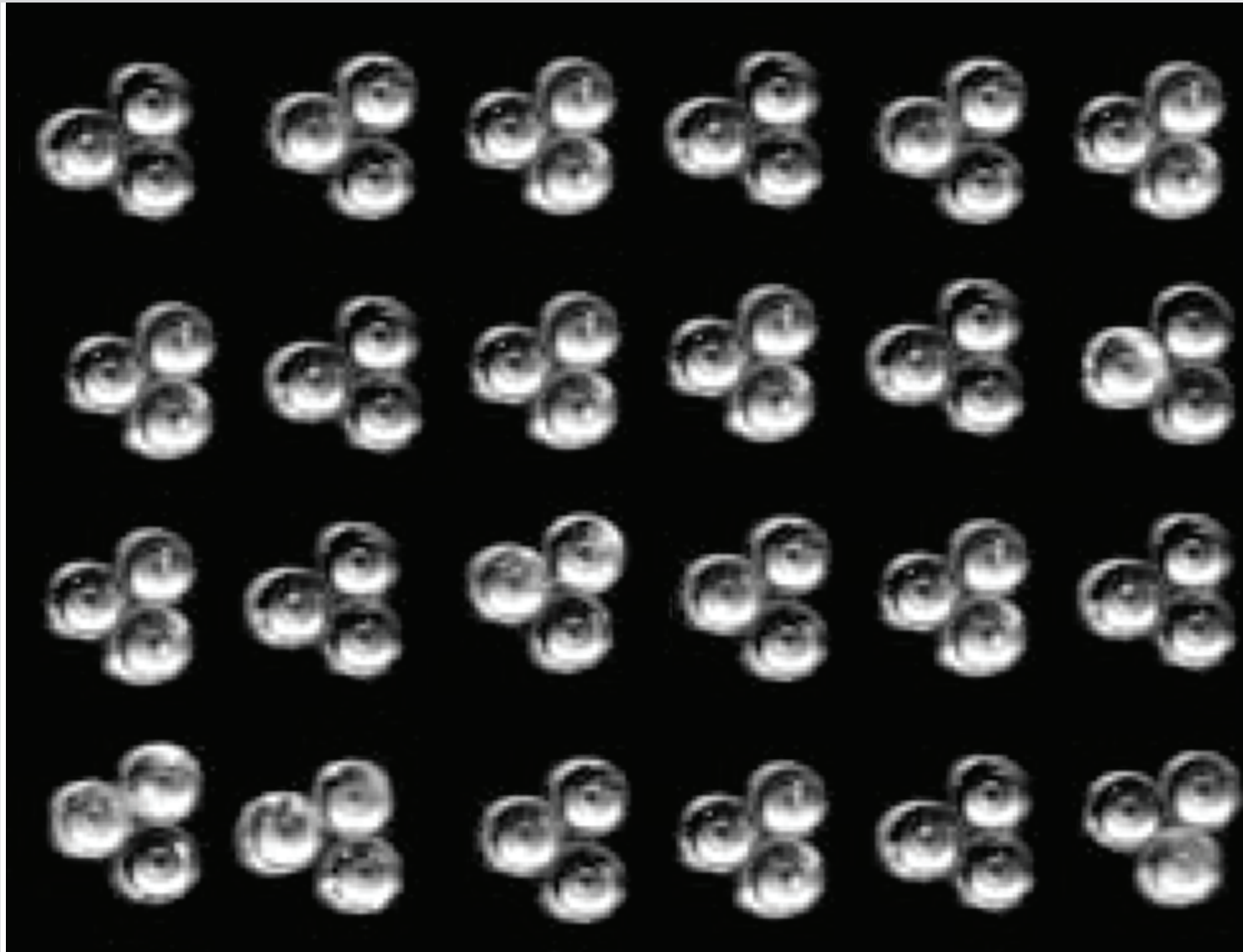
you won't forget this



PI & JiTT Overview

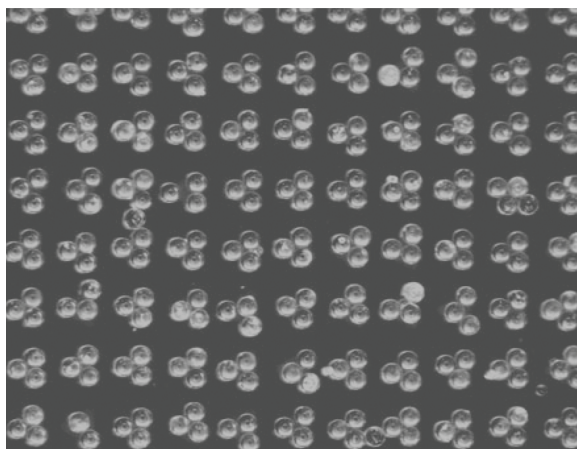
*“Can this method be used in my class,
where questions don’t necessarily have right answers?”*

Let's try it!

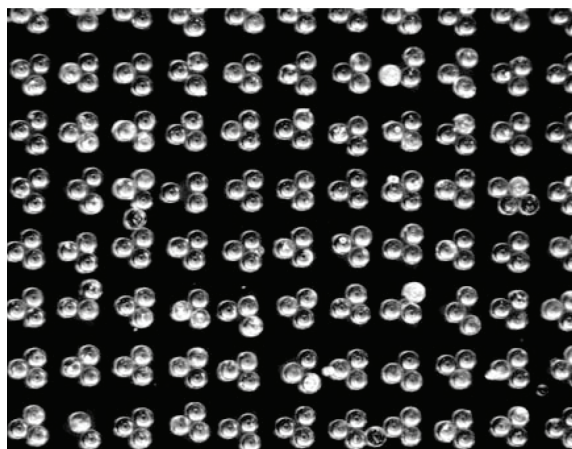


Let's try it!

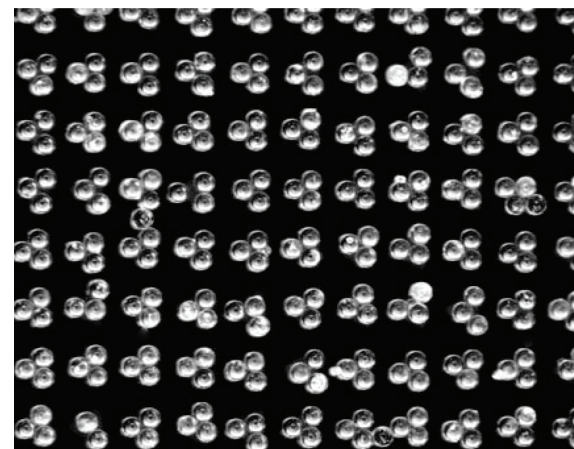
original



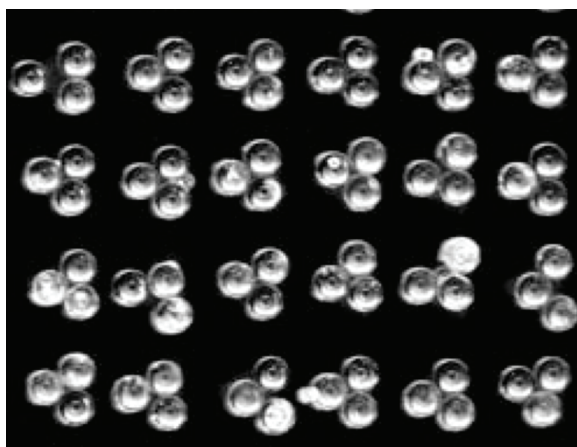
1. adjust contrast



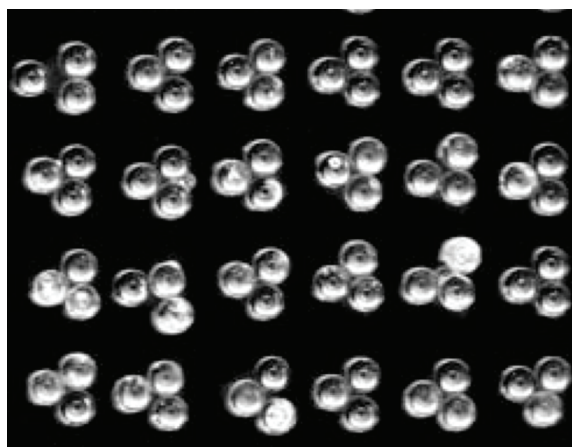
2. remove blemishes



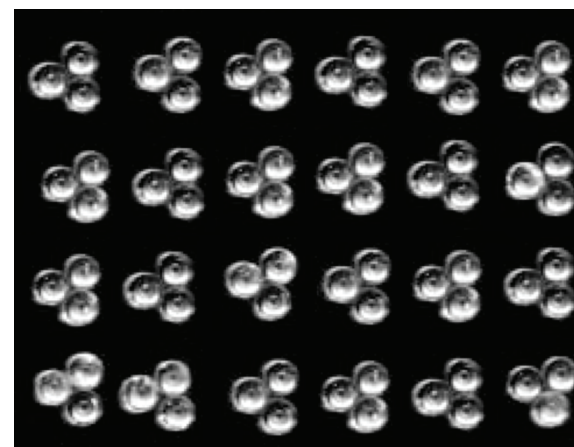
3. crop



4. remove outliers

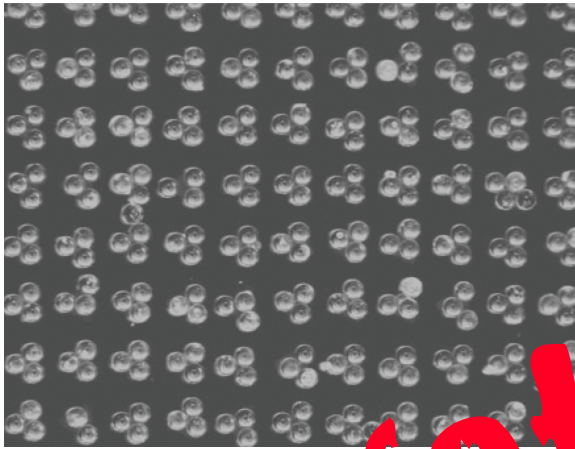


5. reconstruct



Let's try it!

original



1. adjust contrast



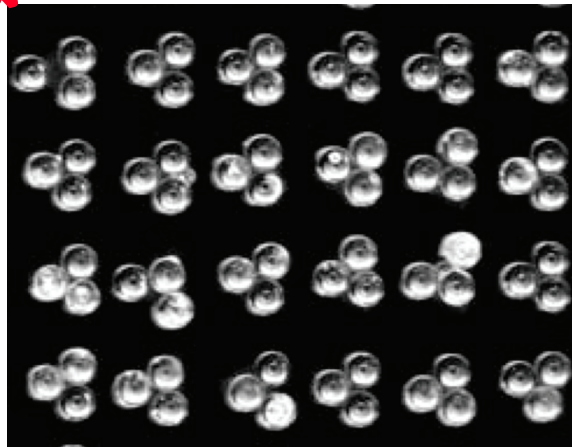
2. remove blemishes



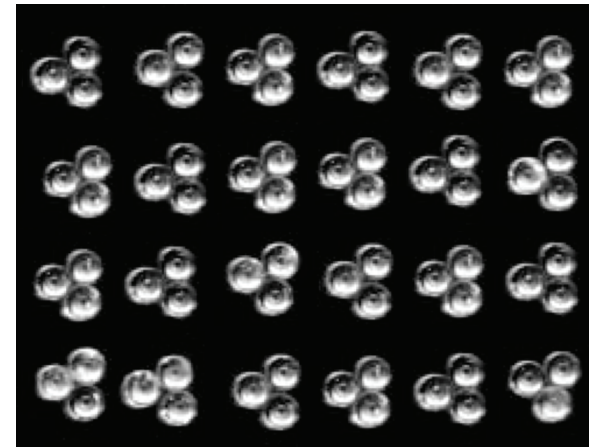
3. crop



4. remove outliers



5. reconstruct



you got all engaged!

PI & JiTT Overview

Don't need a correct answer!

Outline

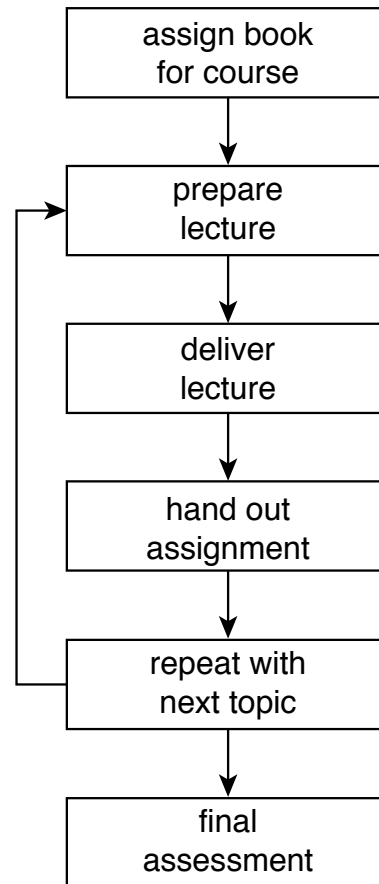
- **PI & JiTT Overview**
- **Implementing PI & JiTT**
- **ConceptTests**

Implementing PI & JiTT

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

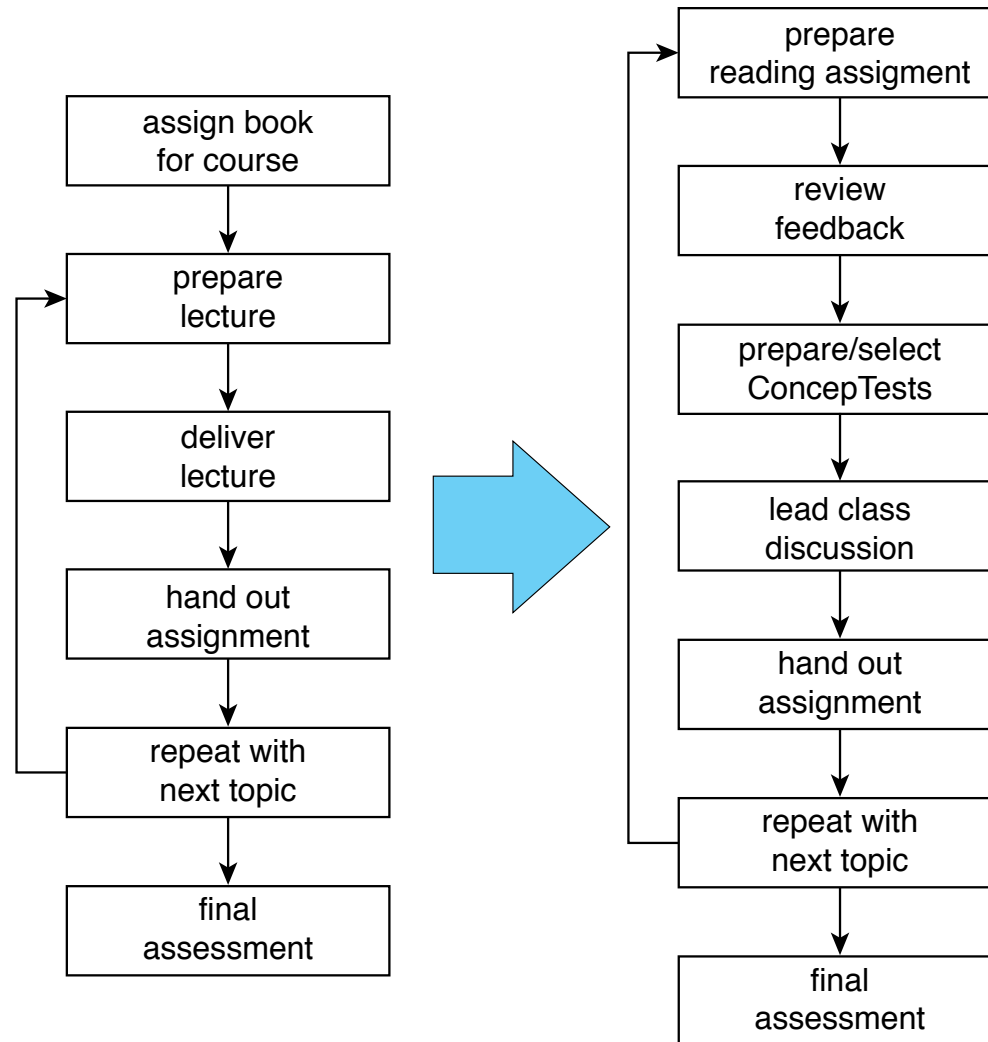
Implementing PI & JiTT

preparing for a lecture-based class



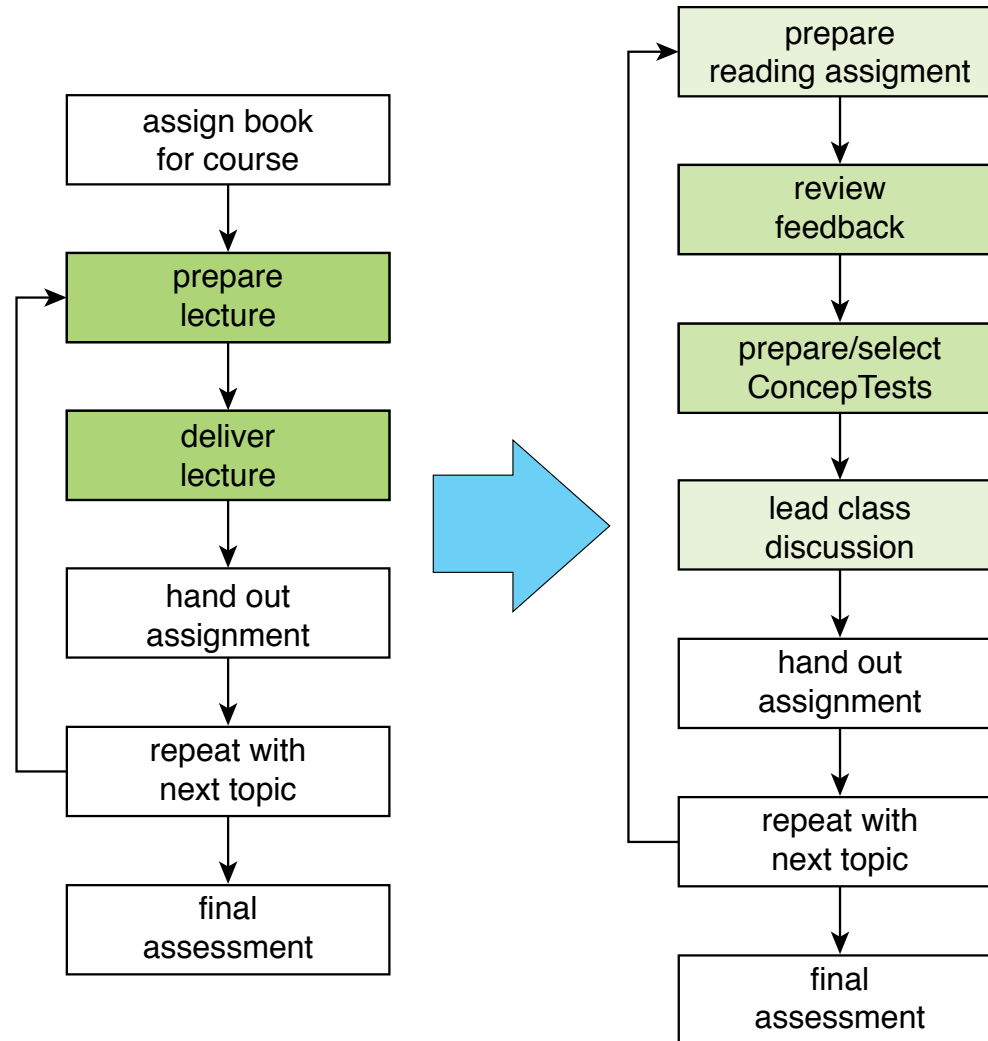
Implementing PI & JiTT

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

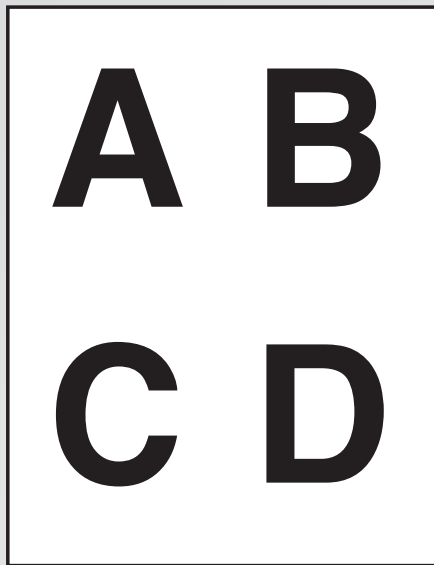
what good is coverage if little is retained?

Implementing PI & JiTT

“Do I need clickers?”

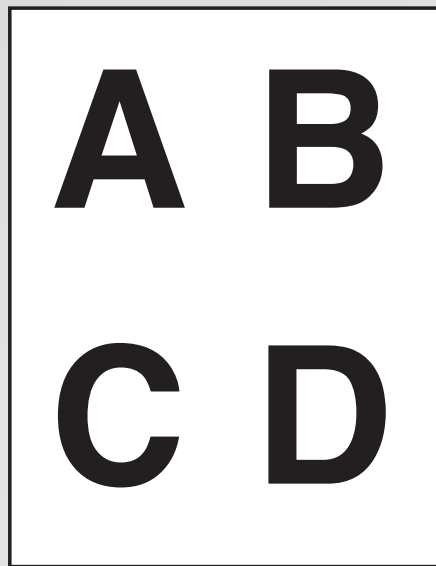
Implementing PI & JiTT

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!

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1. the width of a few atoms
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3. about 0.15 m ✓
4. exactly 1 m
5. more than 1 m



Let's try it!

circumference at the equator:

$$2\pi R_E$$

Let's try it!

circumference at the equator:

$$2\pi R_E$$

new circumference:

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

Let's try it!

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)

Outline

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

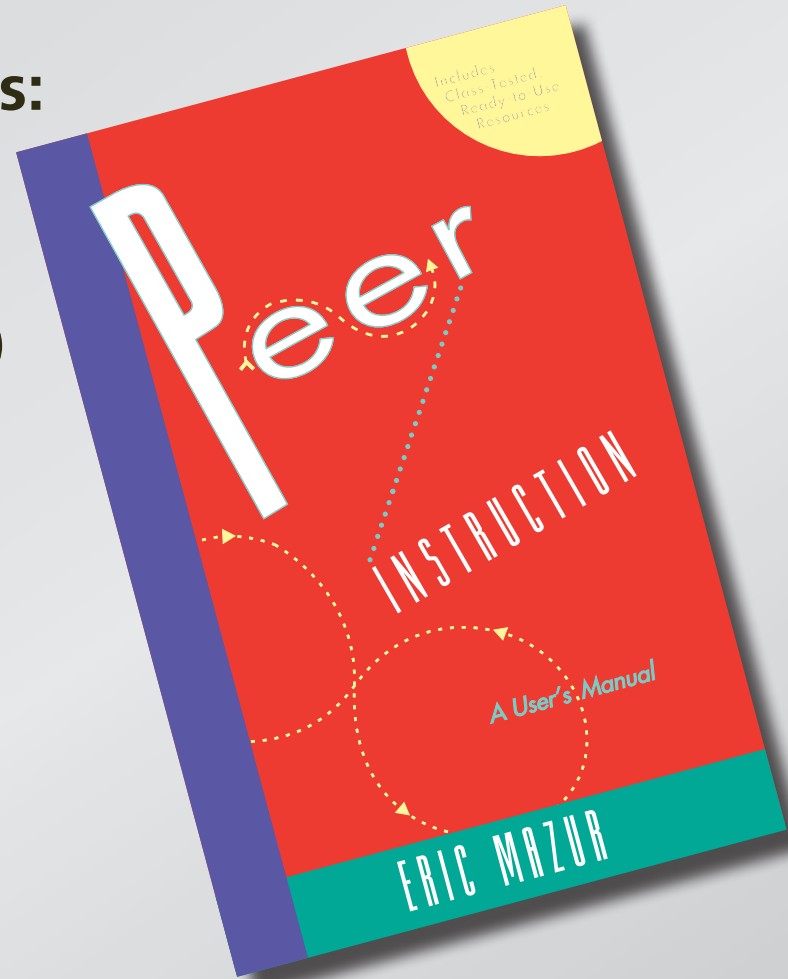
ConceptTests

“Where can I get examples of good questions?”

ConceptTests

Books with ConceptTests:

- Physics (Prentice Hall)



ConceptTests

Books with ConceptTests:

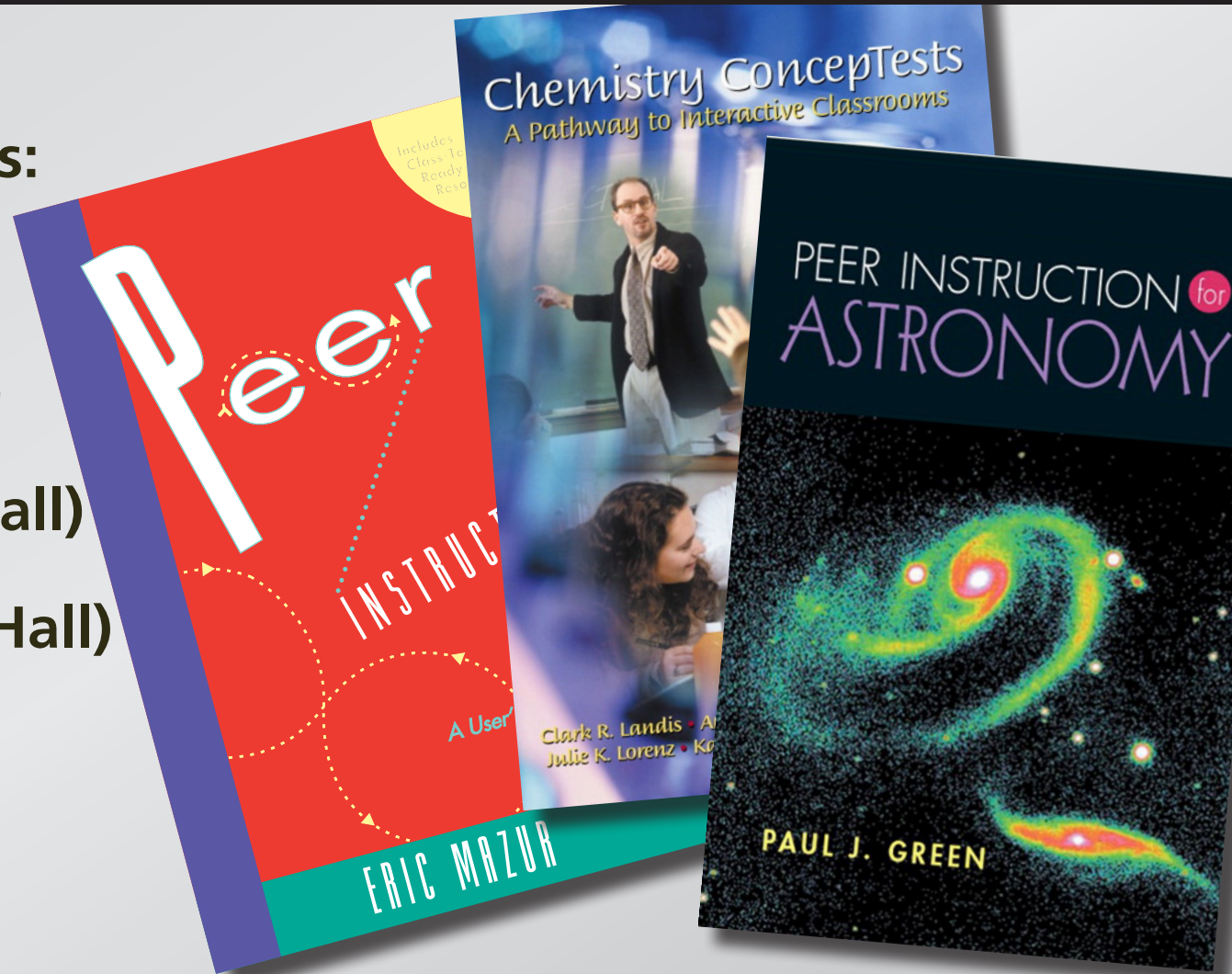
- Physics (Prentice Hall)
- Chemistry (Prentice Hall)



ConceptTests

Books with ConceptTests:

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



ConcepTests

Books with ConcepTests:

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



ConceptTests

... or try searching Google:

<subject> "Peer Instruction"

<subject> ConcepTest

<subject> "Concept Test"

<subject> clickers

ConceptTests

Types of questions

- survey
- model testing
- discussion
- select from list

Let's try it!

Which of the following airlines tries to save fuel by suggesting that its passengers use the bathroom before boarding?

1. Delta Airlines
2. Lufthansa
3. All Nippon Airways
4. British Midland Airways
5. Air France
6. JAL
7. Aboriginal Air Services
8. Aeroflot
9. Are you kidding me? None of the above.



Let's try it!

Which of the following airlines tries to save fuel by suggesting that its passengers use the bathroom before boarding?

1. Delta Airlines
2. Lufthansa
3. **All Nippon Airways ✓**
4. British Midland Airways
5. Air France
6. JAL
7. Aboriginal Air Services
8. Aeroflot
9. Are you kidding me? None of the above.



ConceptTests

hole in plate/circumference

model

microscopy image

discussion

airline

fact

ConceptTests

hole in plate/circumference

model

microscopy image

discussion

airline

fact

fact-recall not engaging

ConcepTests

Good conceptual questions (ConcepTests):

- **are based on common student difficulties**
- **focus on single concept**
- **require more than “plug and chug” or recall**
- **are clear and concise**
- **are of manageable difficulty**

Survey

Interactive teaching requires significantly more instructor preparation time than traditional lecture.

- 1. Strongly Agree**
- 2. Agree**
- 3. Neither agree nor disagree**
- 4. Disagree**
- 5. Strongly Disagree**



Survey

Interactive teaching requires clickers.

1. Strongly Agree
2. Agree
3. Neither agree nor disagree
4. Disagree
5. Strongly Disagree



Survey

If I give my students a pre-class (reading) assignment, most of them will complete it before coming to class.

1. Strongly Agree
2. Agree
3. Neither agree nor disagree
4. Disagree
5. Strongly Disagree



Survey

It is difficult to see how to apply interactive teaching techniques in my courses.

- 1. Strongly Agree**
- 2. Agree**
- 3. Neither agree nor disagree**
- 4. Disagree**
- 5. Strongly Disagree**



Survey

I am worried that interactive teaching will negatively affect my end-of-course evaluations.

- 1. Strongly Agree**
- 2. Agree**
- 3. Neither agree nor disagree**
- 4. Disagree**
- 5. Strongly Disagree**





Join now!

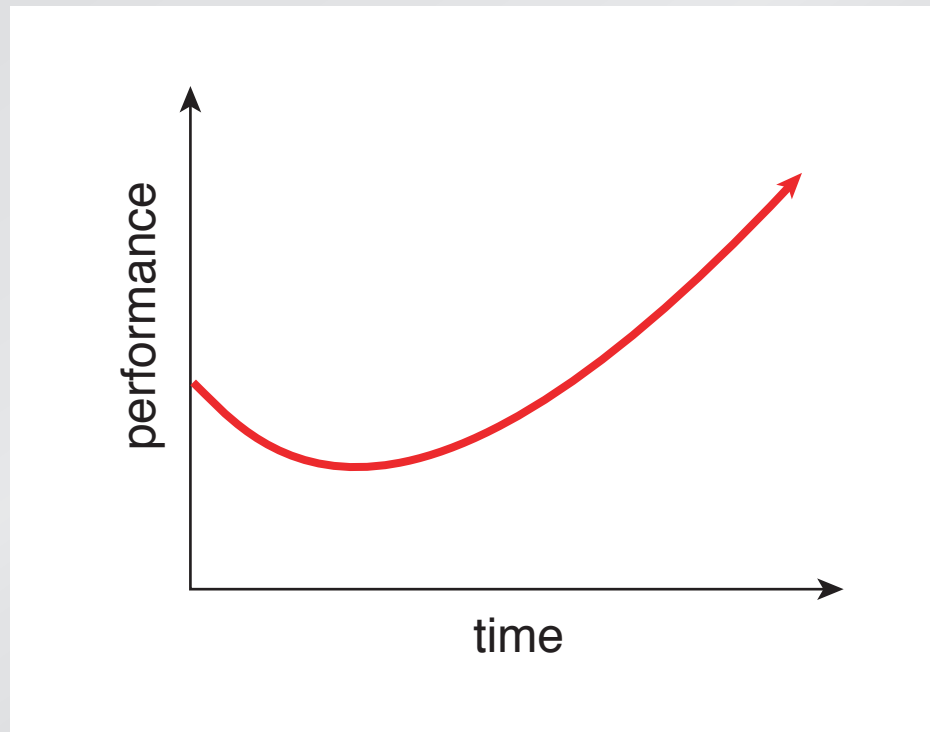
PeerInstruction.net

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

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



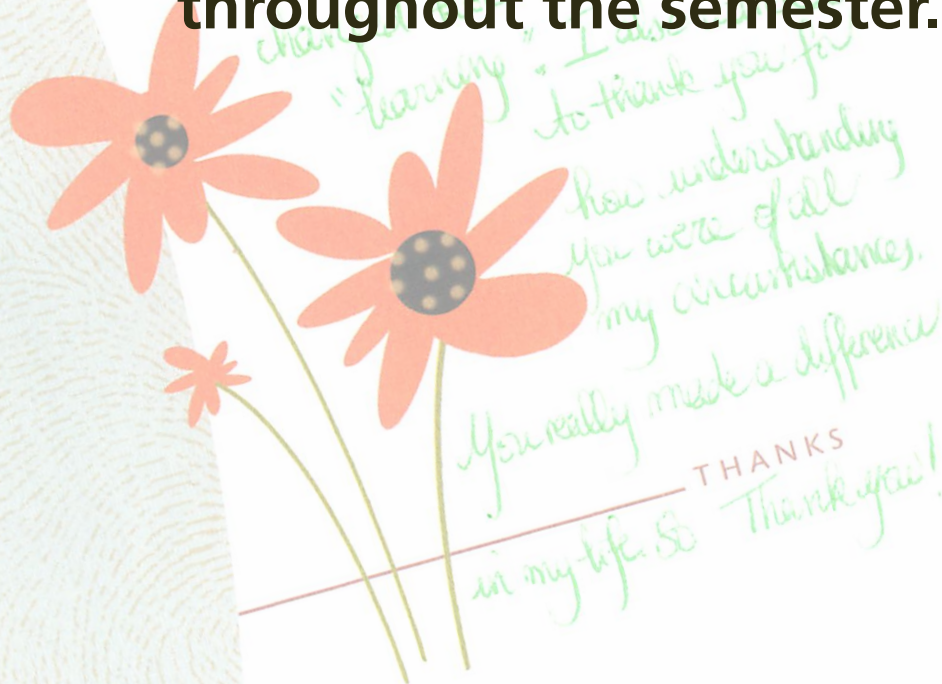
You made a difference.

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 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.



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look at "learning". I look at
"learning" - I look at
how you were great
in my circumstances.
You really made a difference
in my life. So THANKS
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."

You made a difference.

*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!