

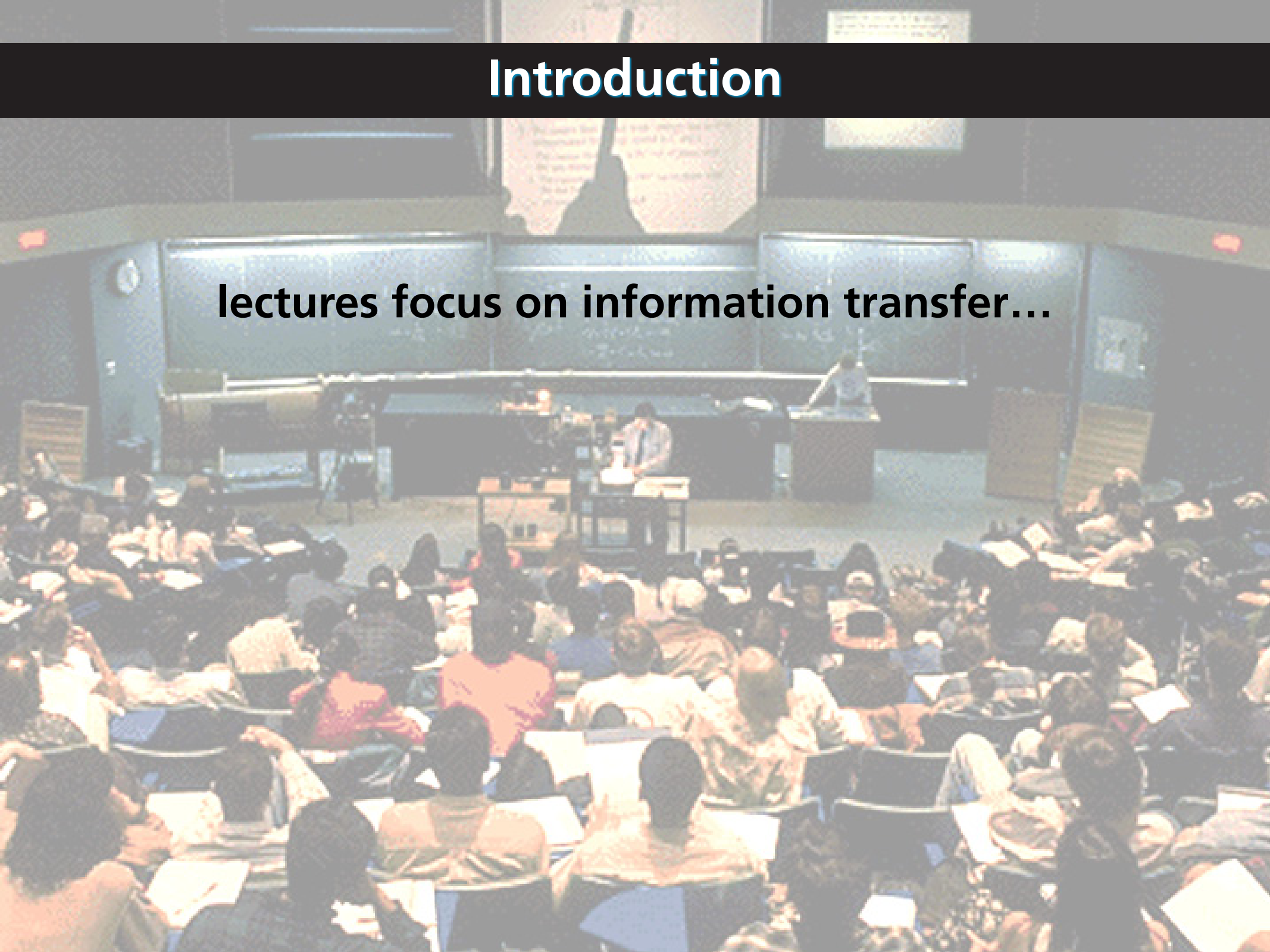
# Peer Instruction



Peer Instruction Workshop  
Universiteit Groningen  
Groningen, Netherlands, 9 May 2012

# Introduction

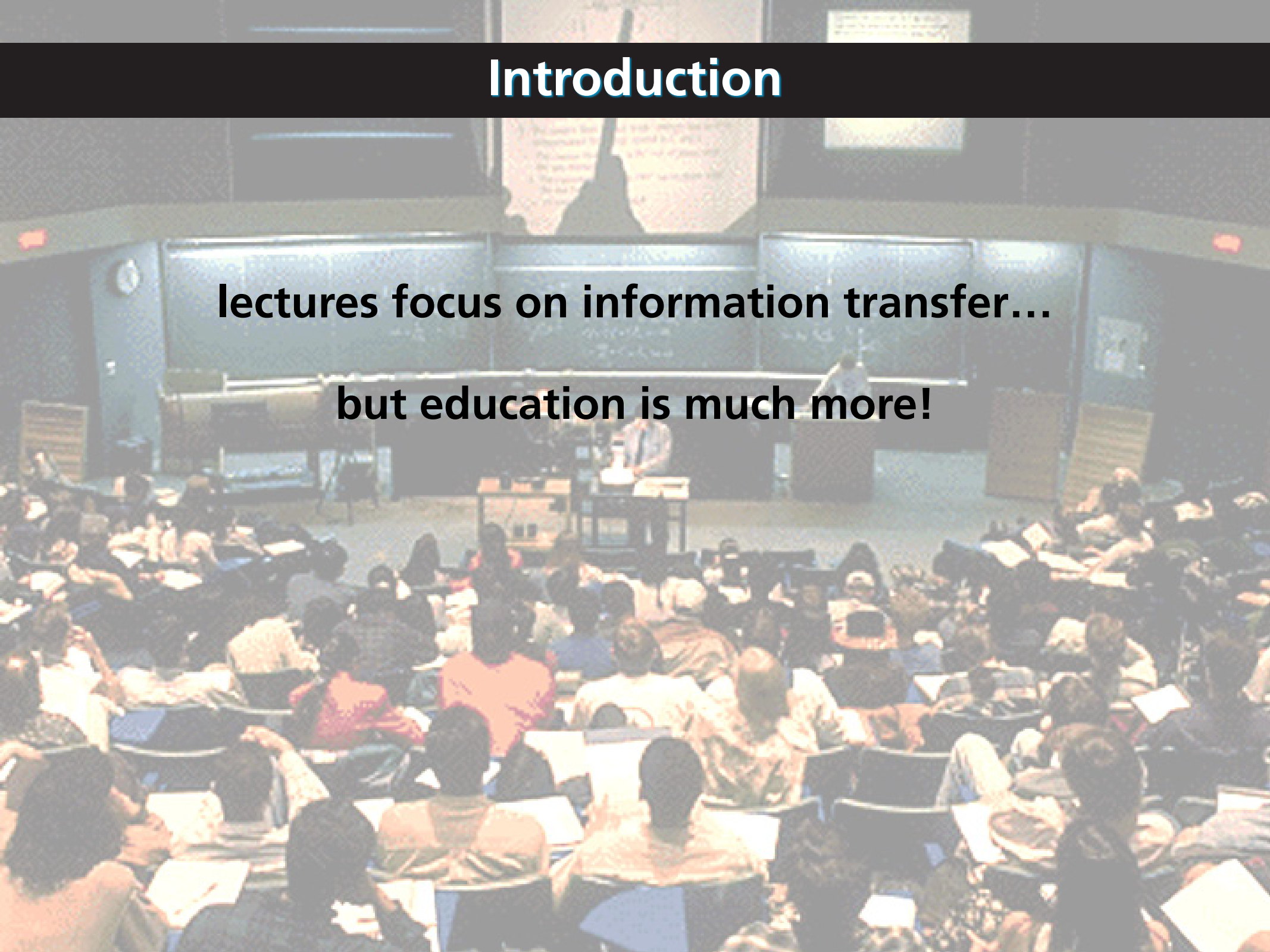
lectures focus on information transfer...



# Introduction

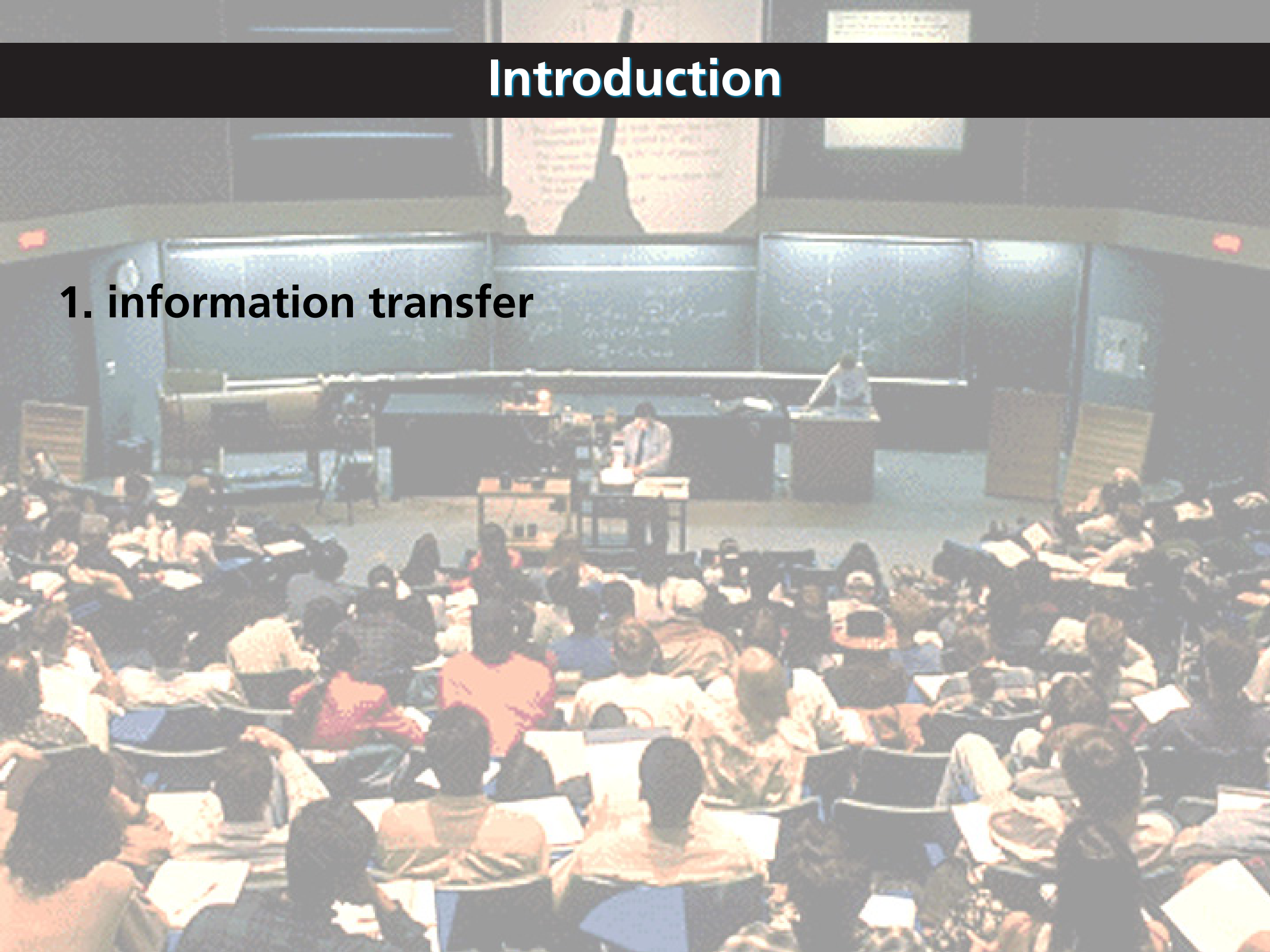
lectures focus on information transfer...

but education is much more!



# Introduction

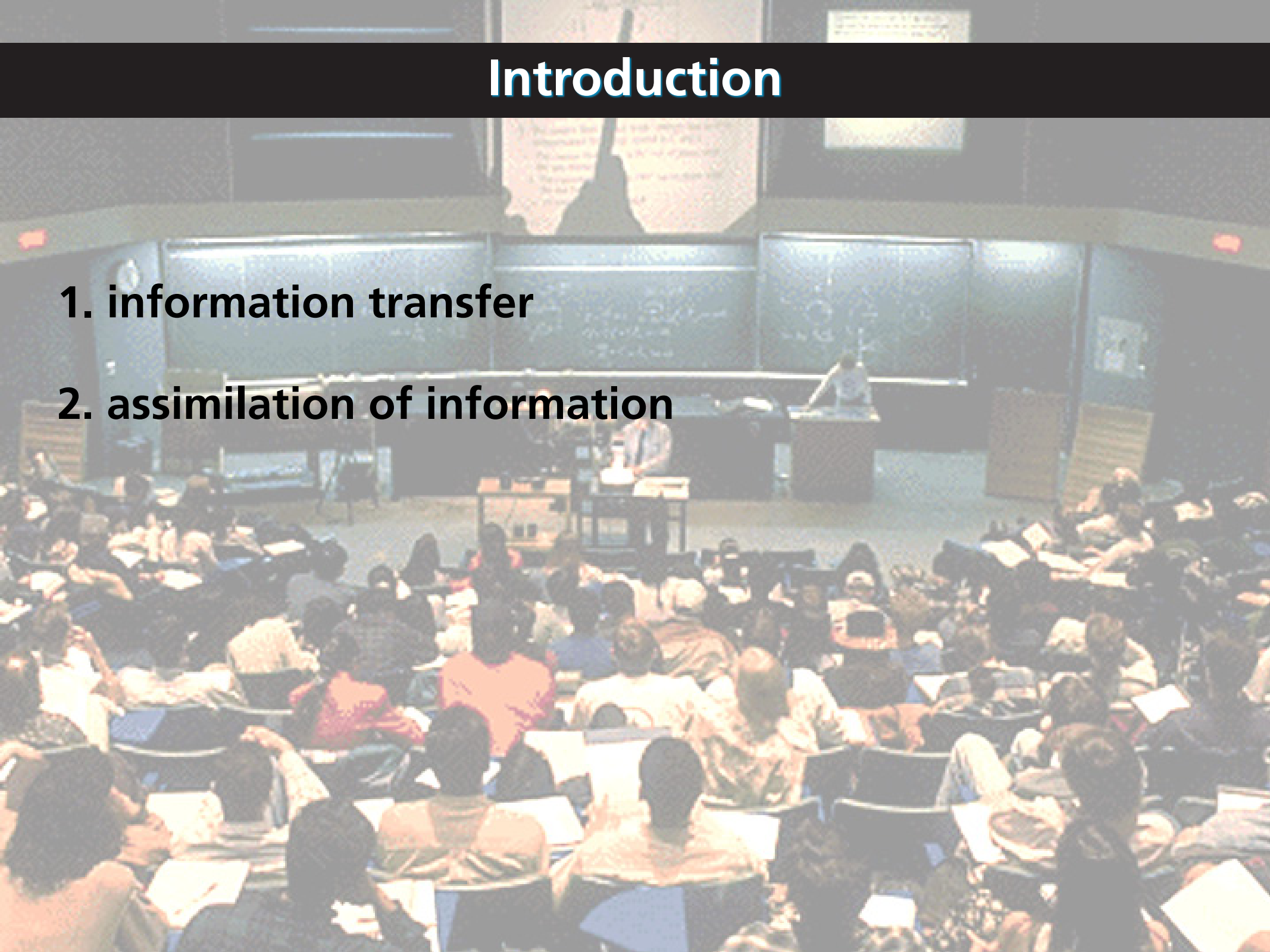
## 1. information transfer





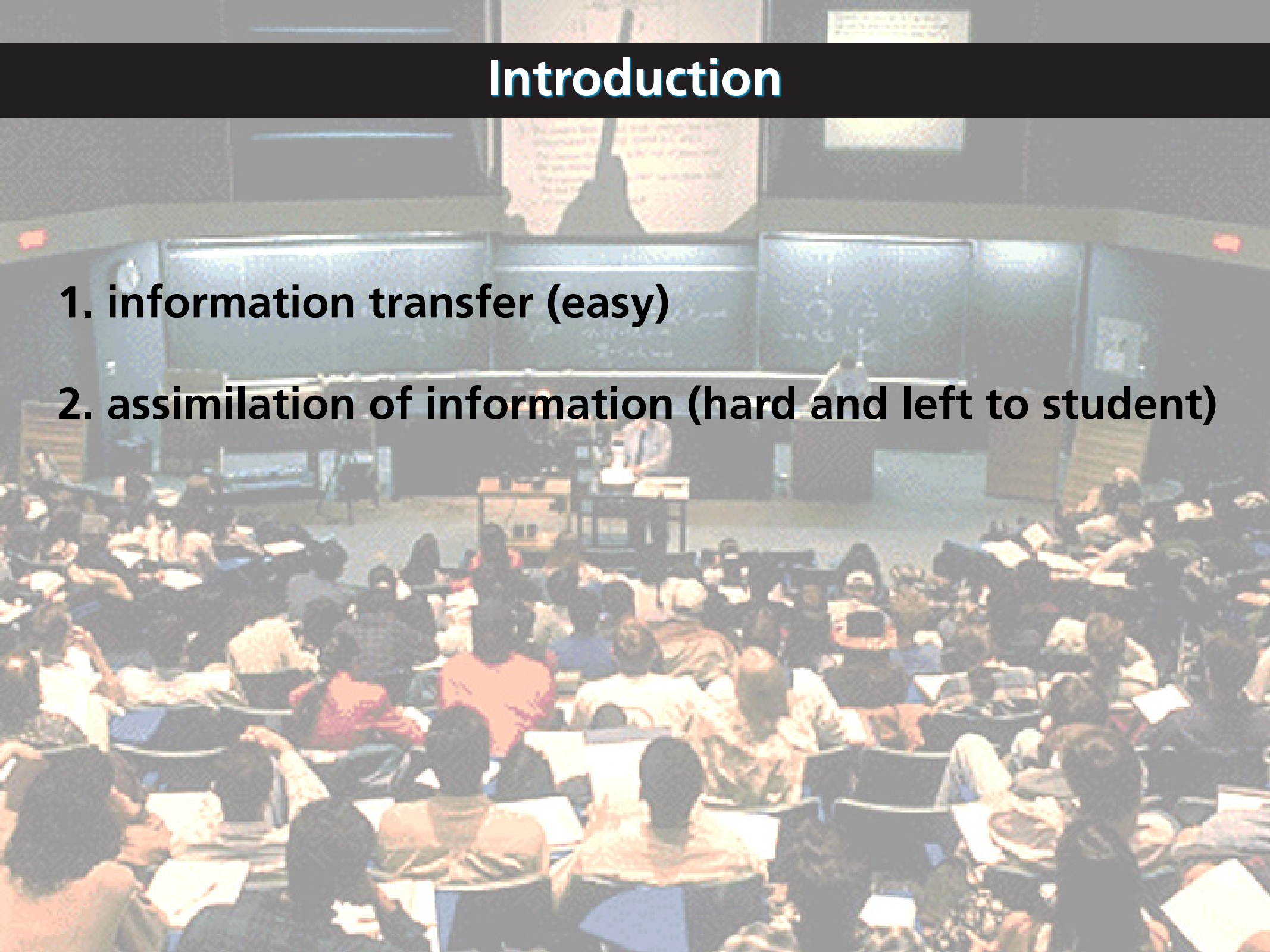
# Introduction

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)!**

# Outline



# Outline

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

# PI & JiTT Overview

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



# PI & JiTT Overview

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

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

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

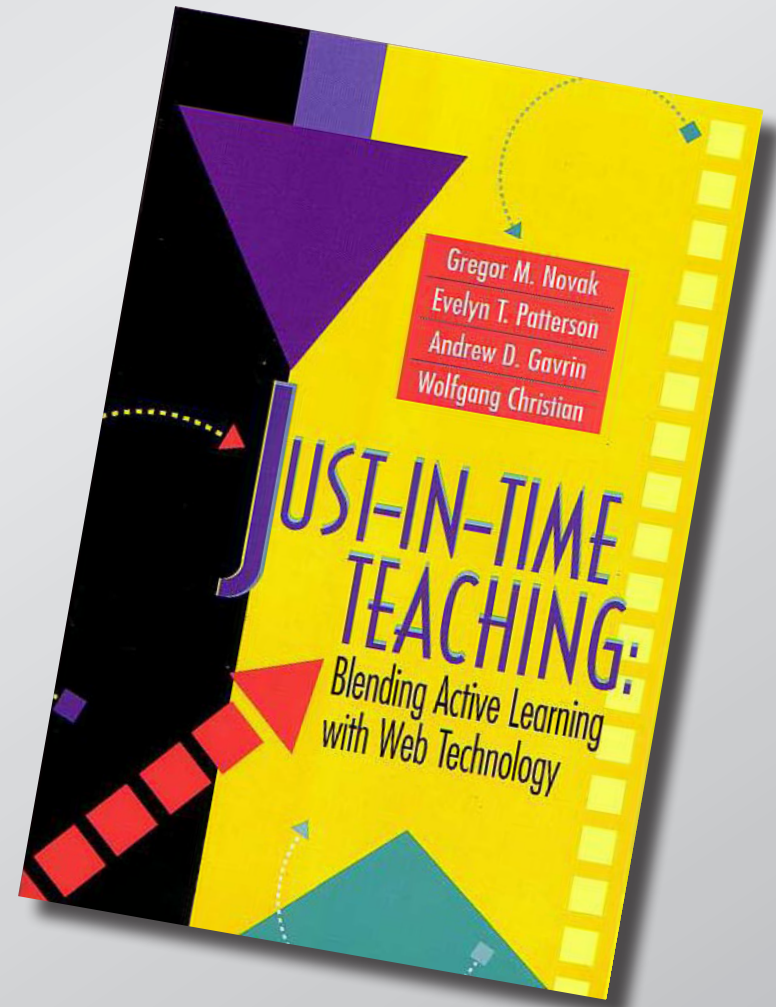




# PI & JiTT Overview

Just-in-time-Teaching (JiTT)

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



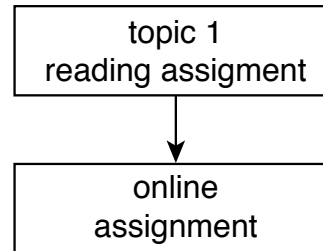
# PI & JiTT Overview

## JiTT workflow

topic 1  
reading assignment

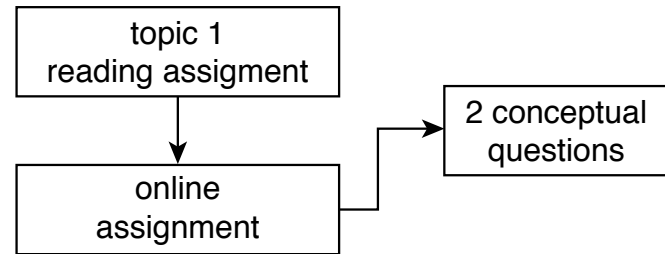
# PI & JiTT Overview

## JiTT workflow



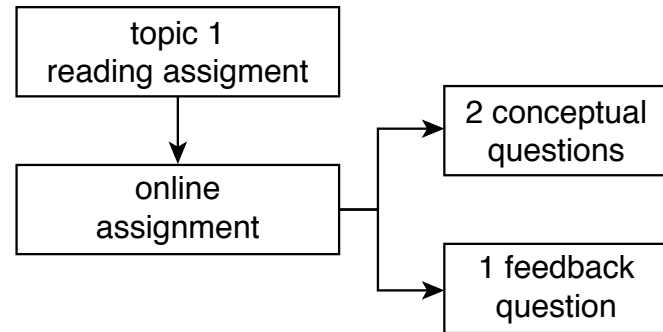
# PI & JiTT Overview

## JiTT workflow



# PI & JiTT Overview

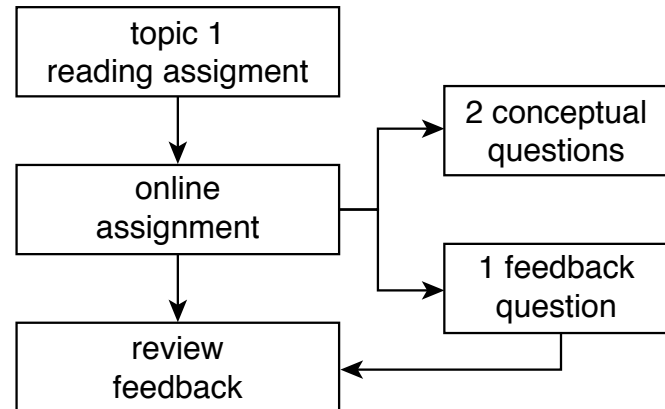
## JiTT workflow





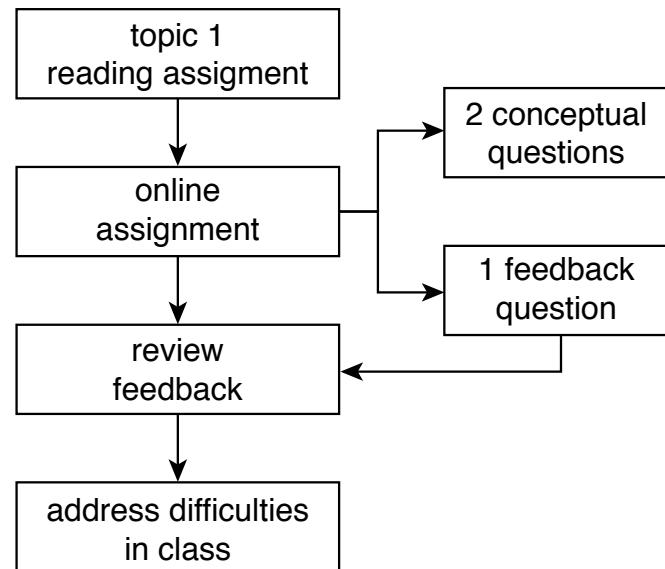
# PI & JiTT Overview

## JiTT workflow



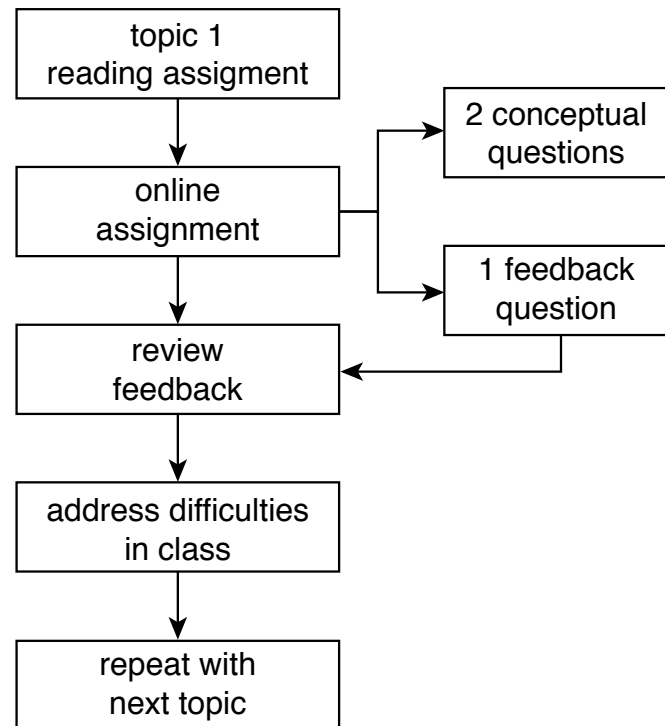
# PI & JiTT Overview

## JiTT workflow



# PI & JiTT Overview

## JiTT workflow



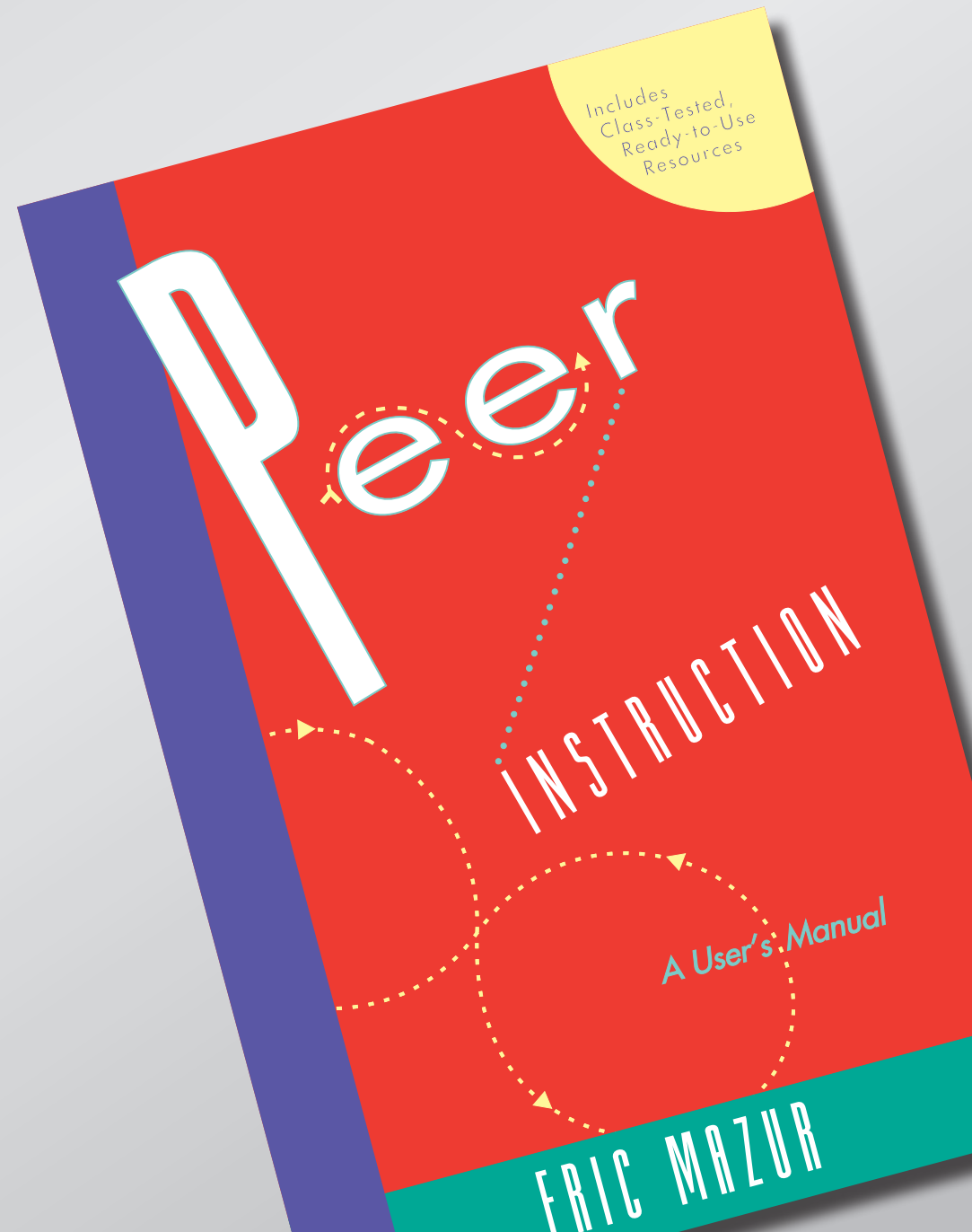
# PI & JiTT Overview

## JiTT:

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

# PI & JiTT Overview

## Peer Instruction (PI)

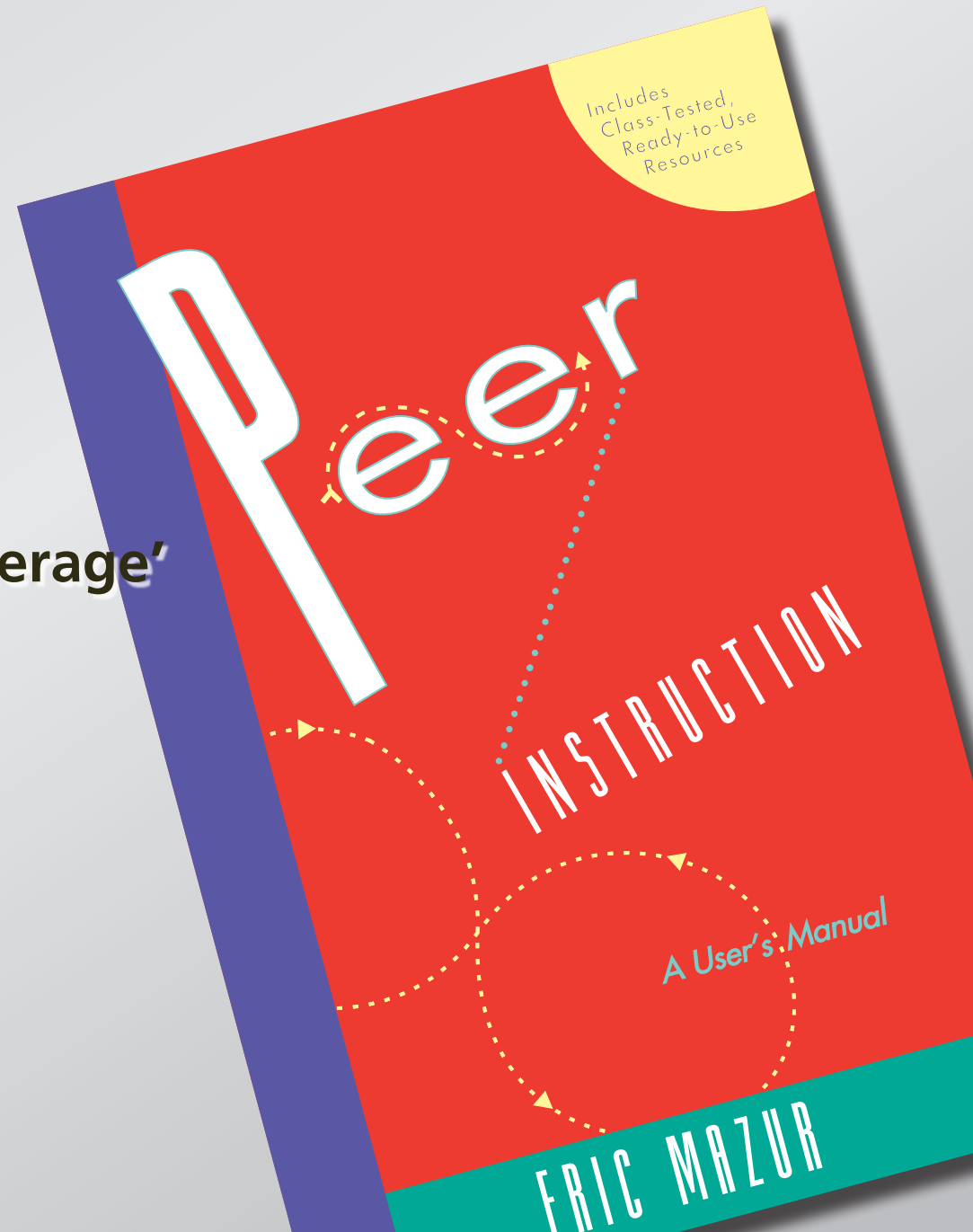




# PI & JiTT Overview

## Main features:

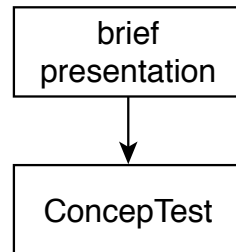
- pre-class assignment
- in-class: depth, not 'coverage'
- ConcepTests



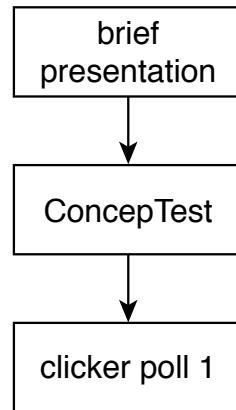
# PI & JiTT Overview

brief  
presentation

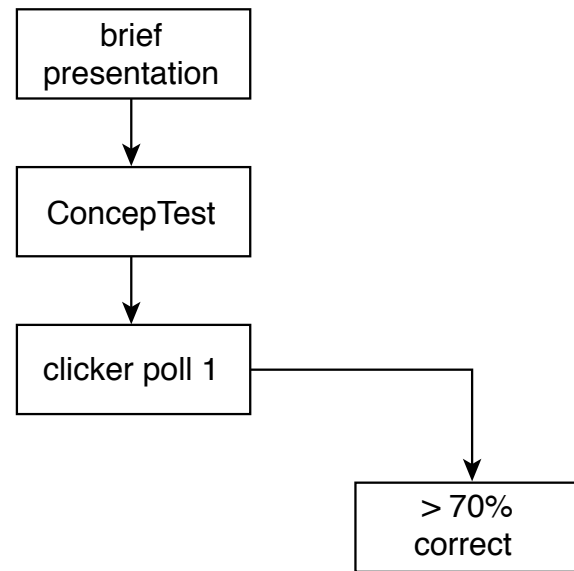
# PI & JiTT Overview



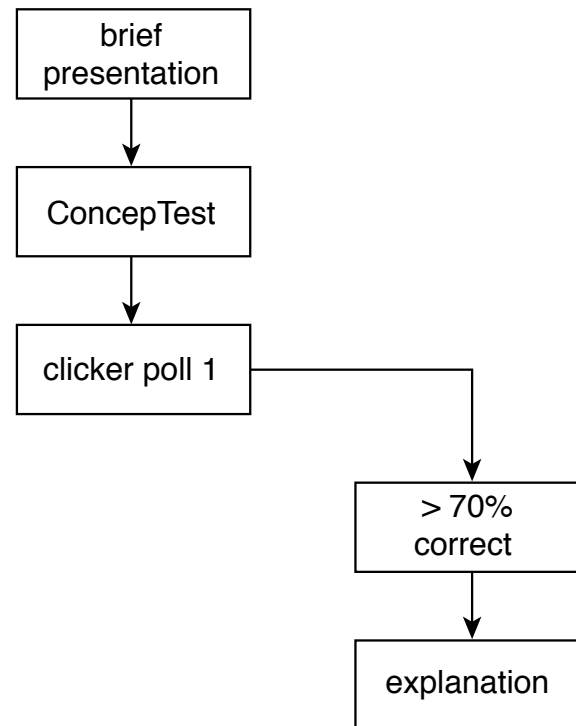
# PI & JiTT Overview



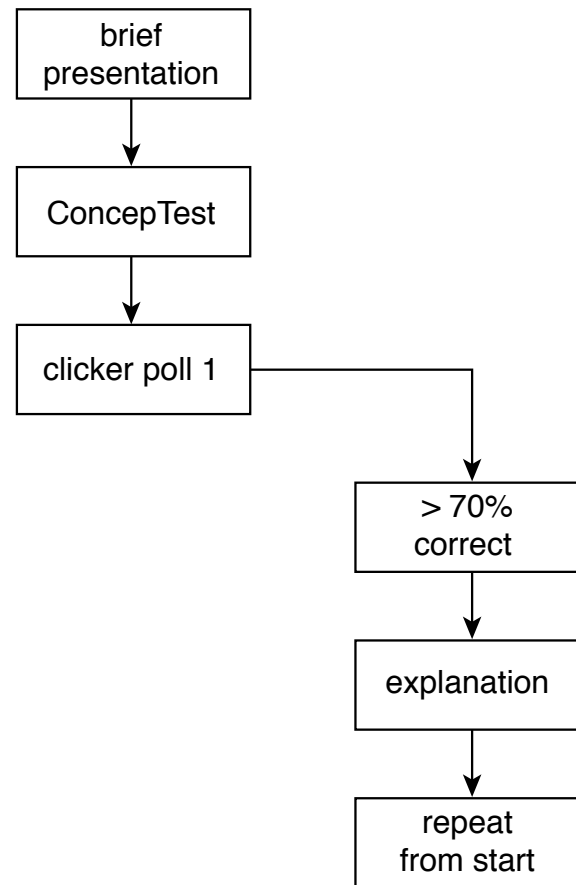
# PI & JiTT Overview



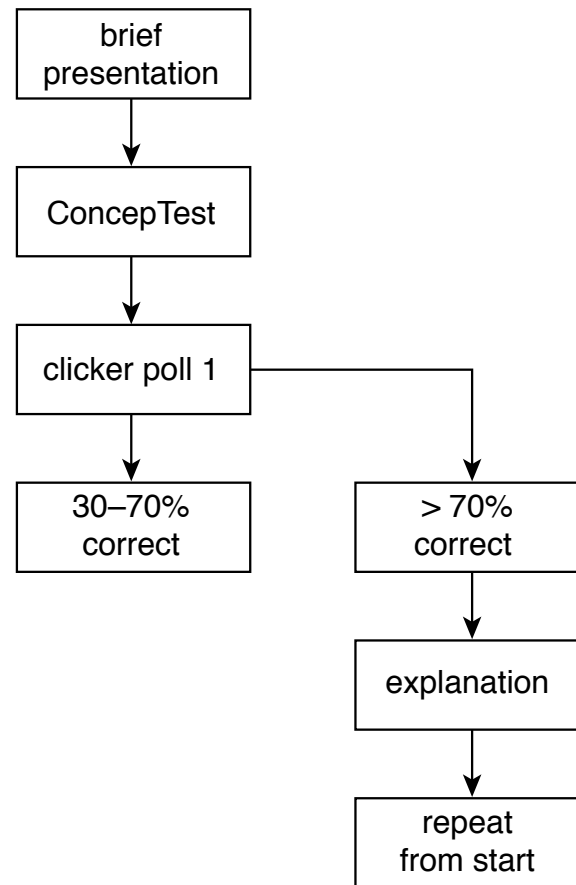
# PI & JiTT Overview



# PI & JiTT Overview

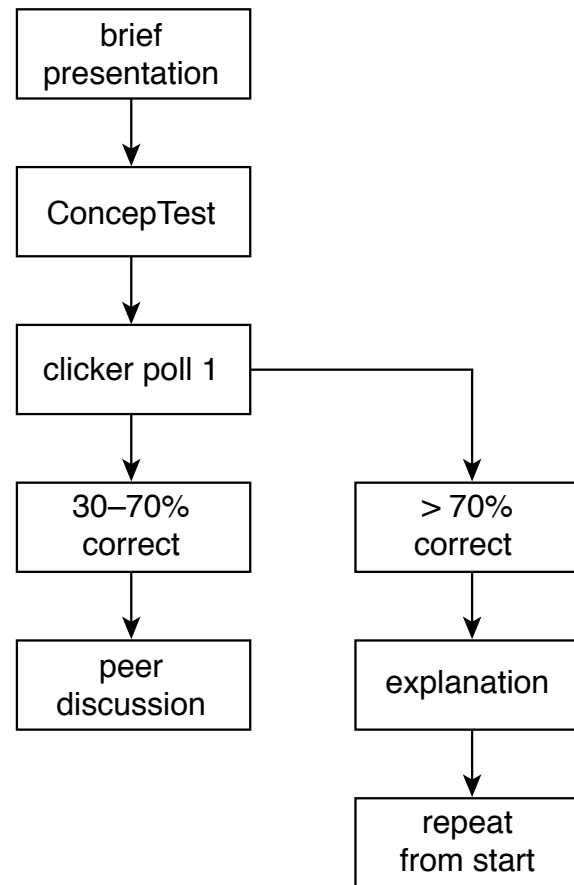


# PI & JiTT Overview

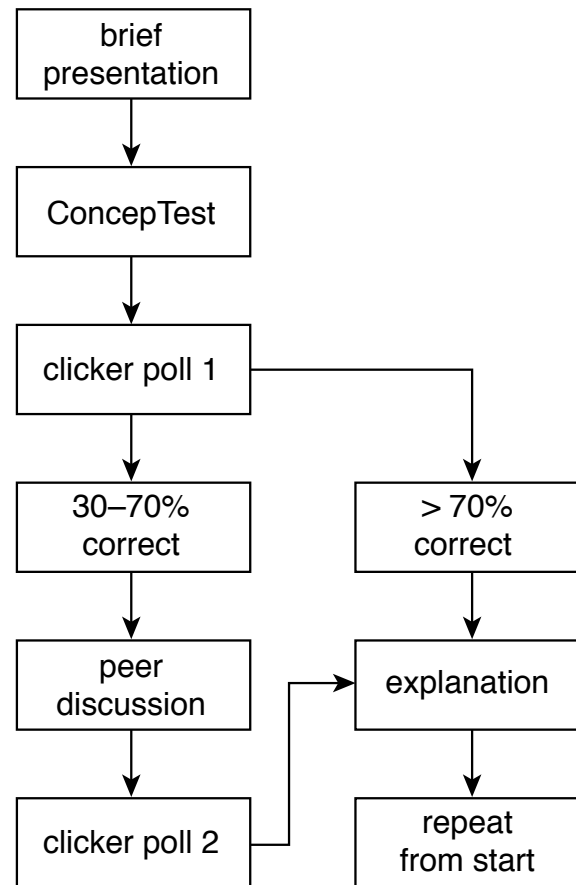




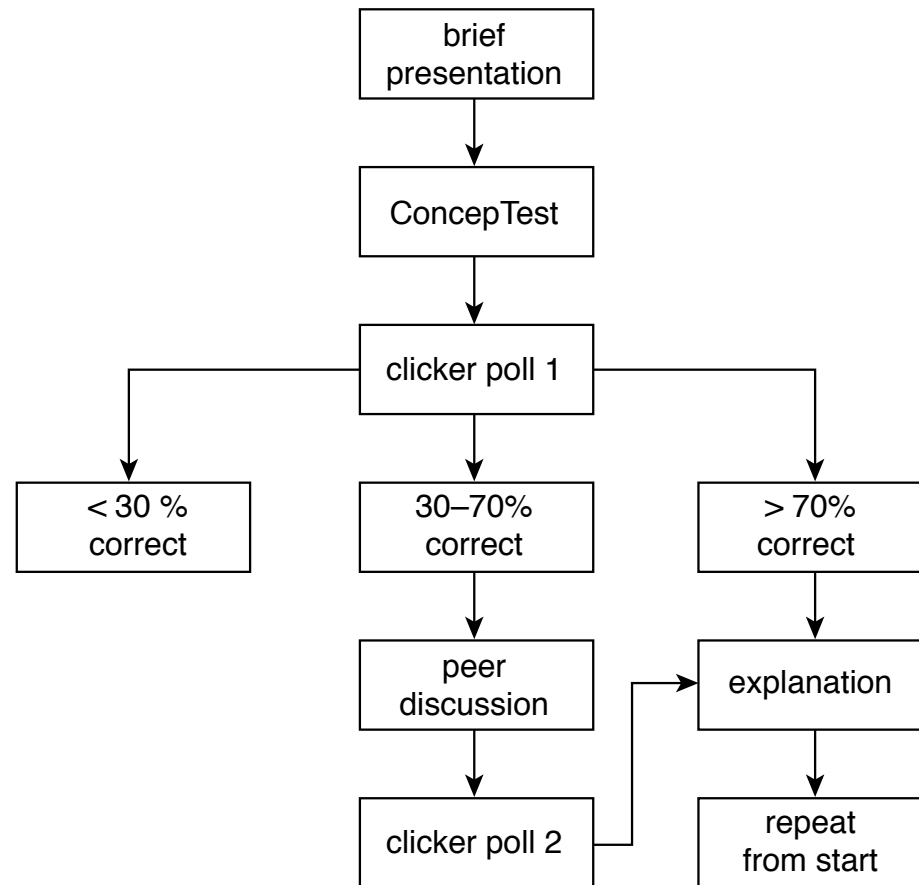
# PI & JiTT Overview



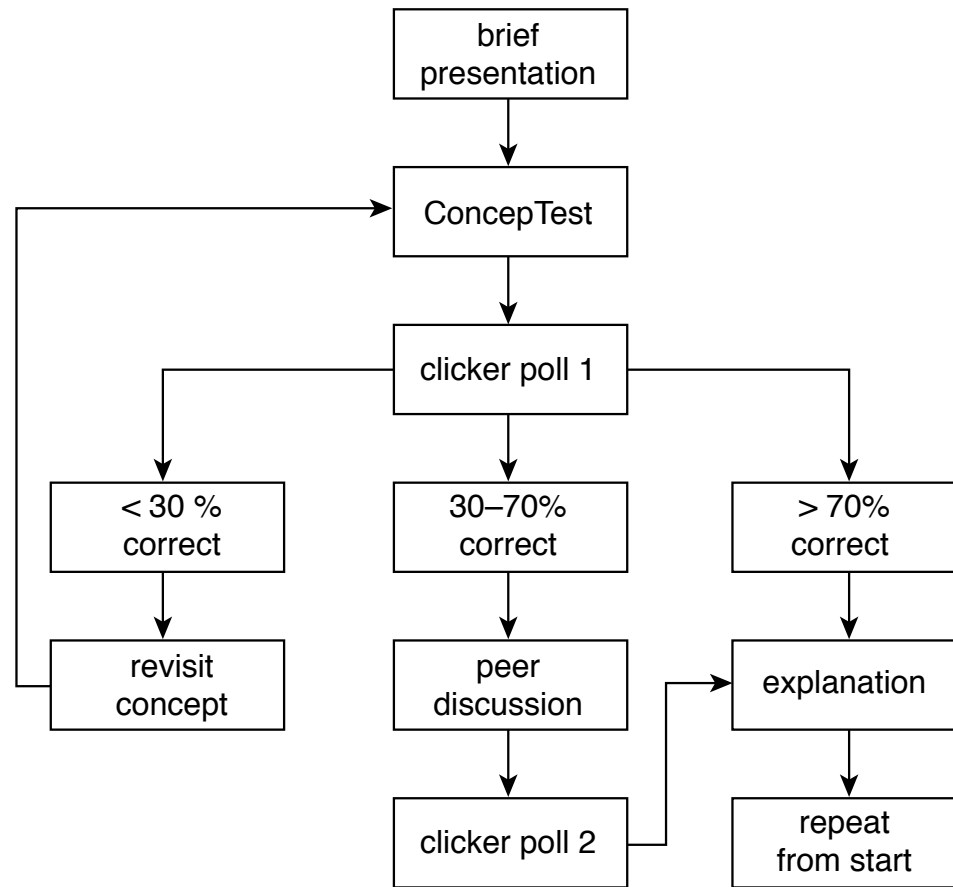
# PI & JiTT Overview



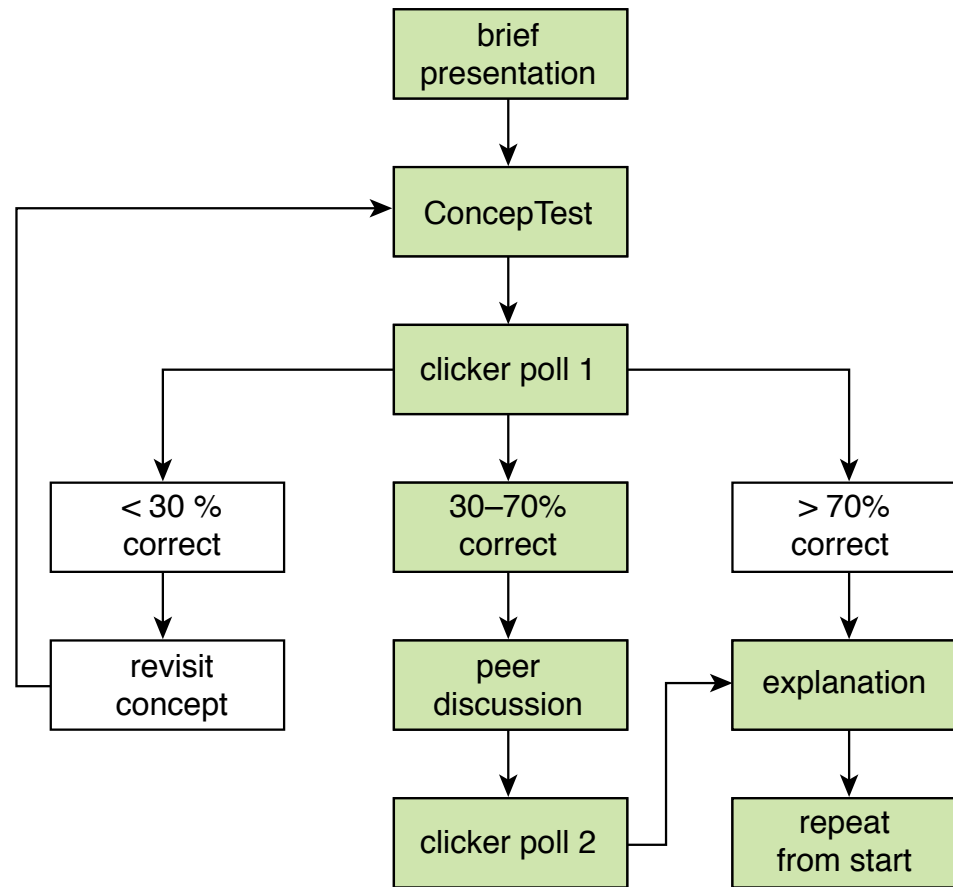
# PI & JiTT Overview



# 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?”*

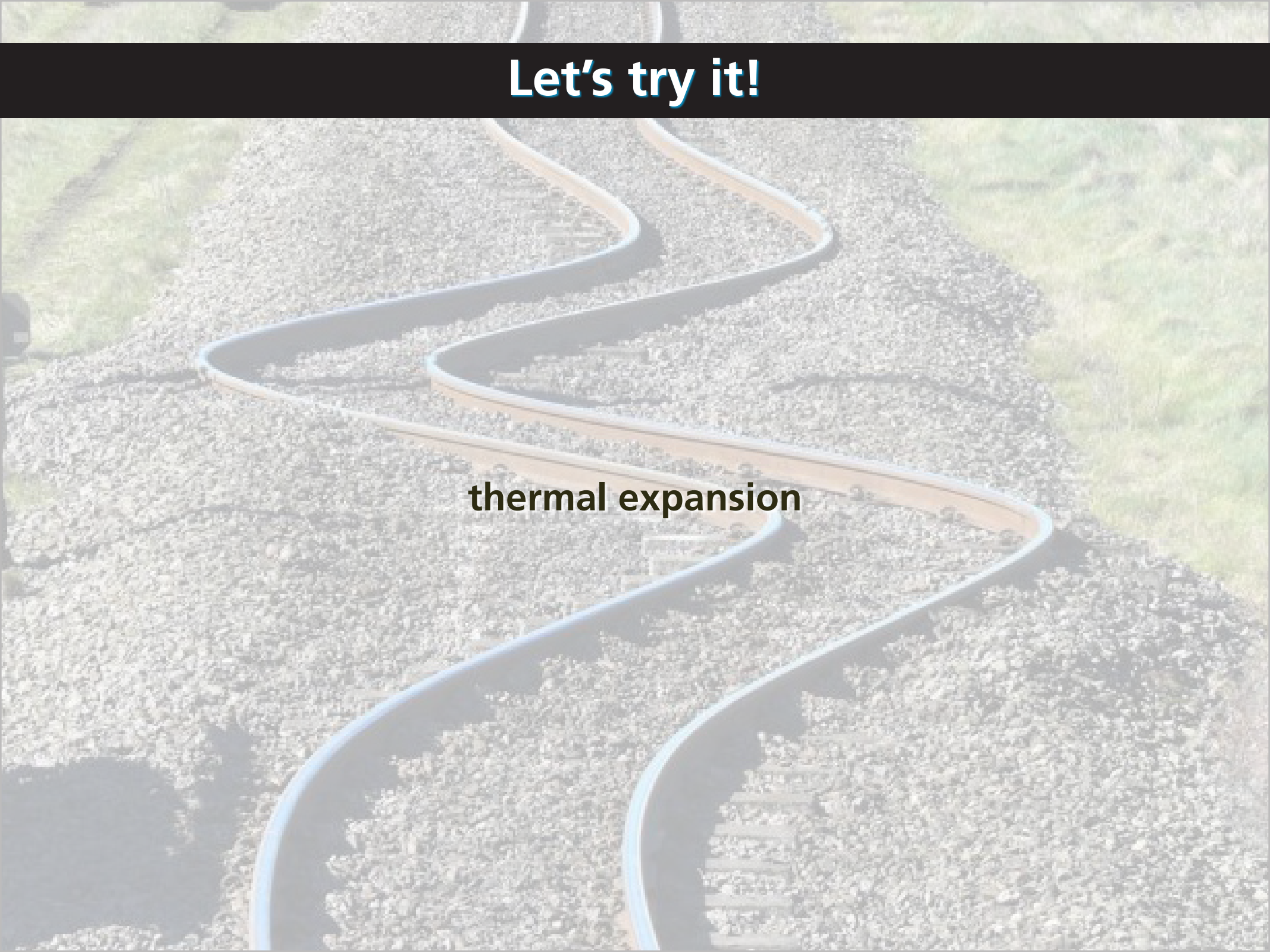


# PI & JiTT Overview

Find someone with a *different* answer

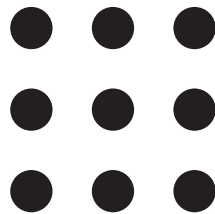
**Let's try it!**

**thermal expansion**



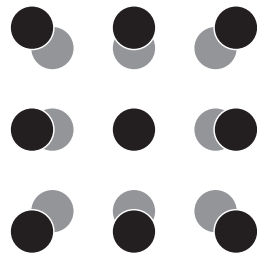
# Let's try it!

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!

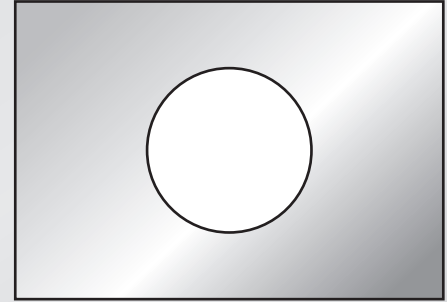
When metals heat up, they expand because all atoms get farther away from each other.

all of them



# Let's try it!

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

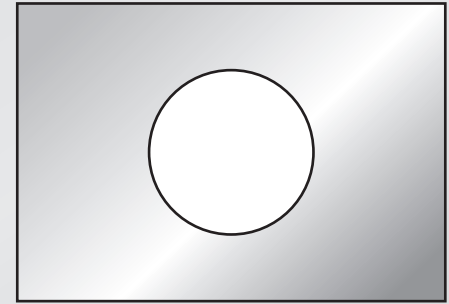


# Let's try it!

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!**

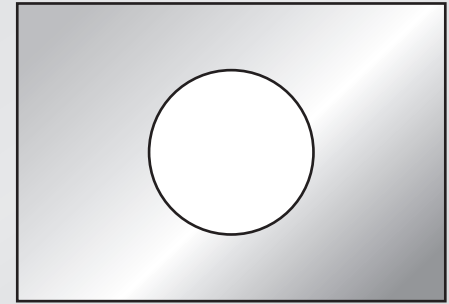


# Let's try it!

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...**

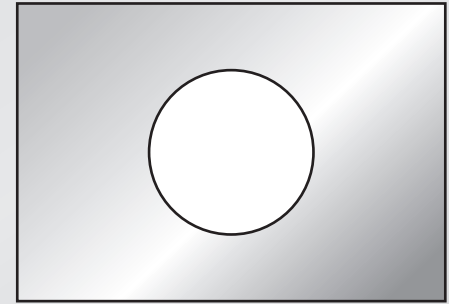
- 1. made a commitment**
- 2. externalized your answer**
- 3. moved from the answer/fact to reasoning**
- 4. became emotionally invested in the learning process**

# 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.

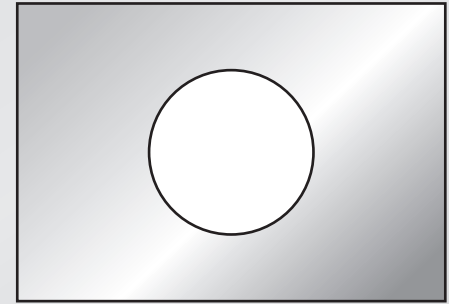


# Let's try it!

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

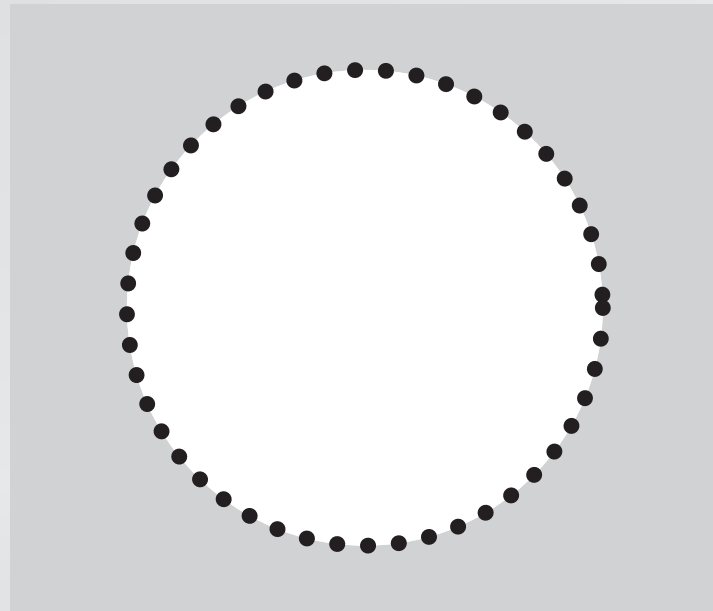
When the plate is uniformly heated, the diameter of the hole

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



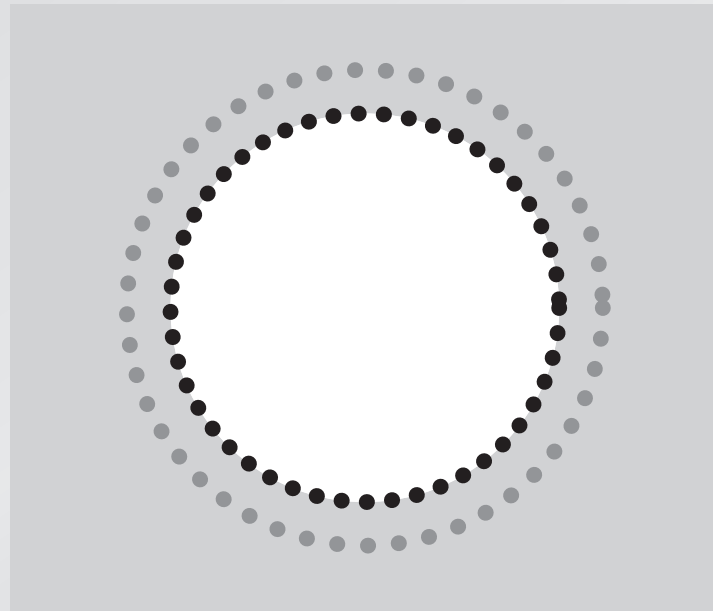
# Let's try it!

consider the atoms at the rim of the hole



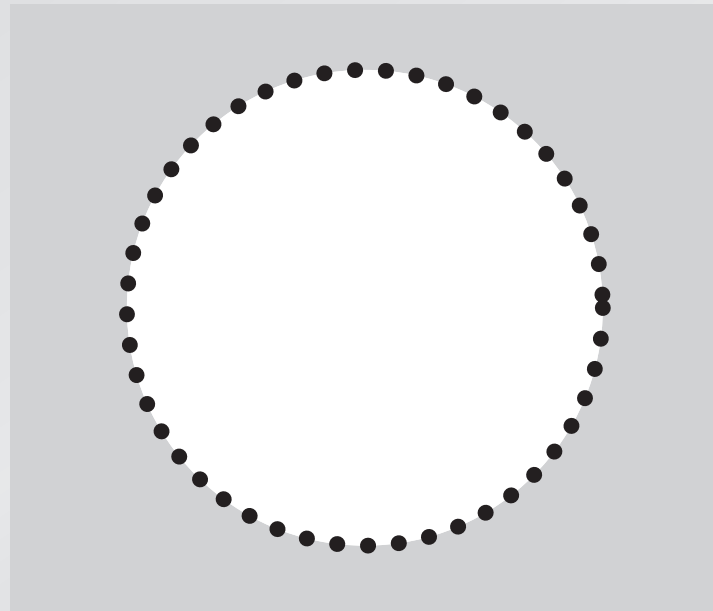
# Let's try it!

consider the atoms at the rim of the hole



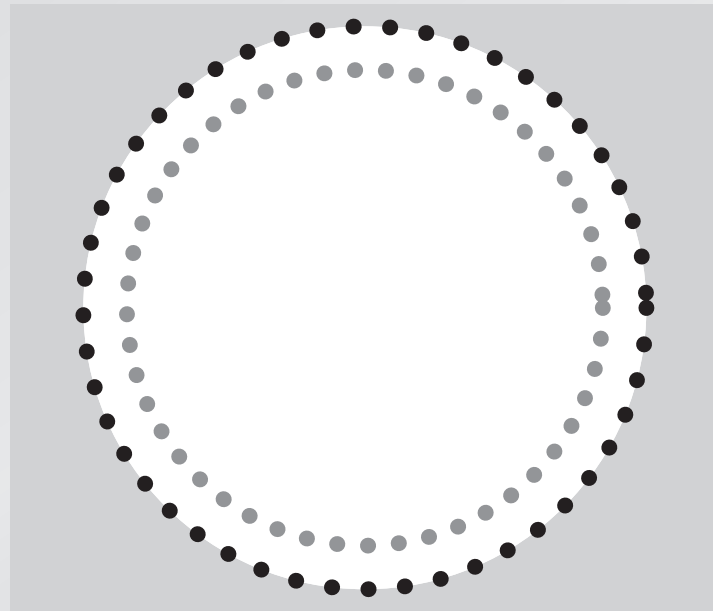
# Let's try it!

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**



# Outline

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

# Implementing PI & JiTT

*“Will it work at my institution?”*

It works here...



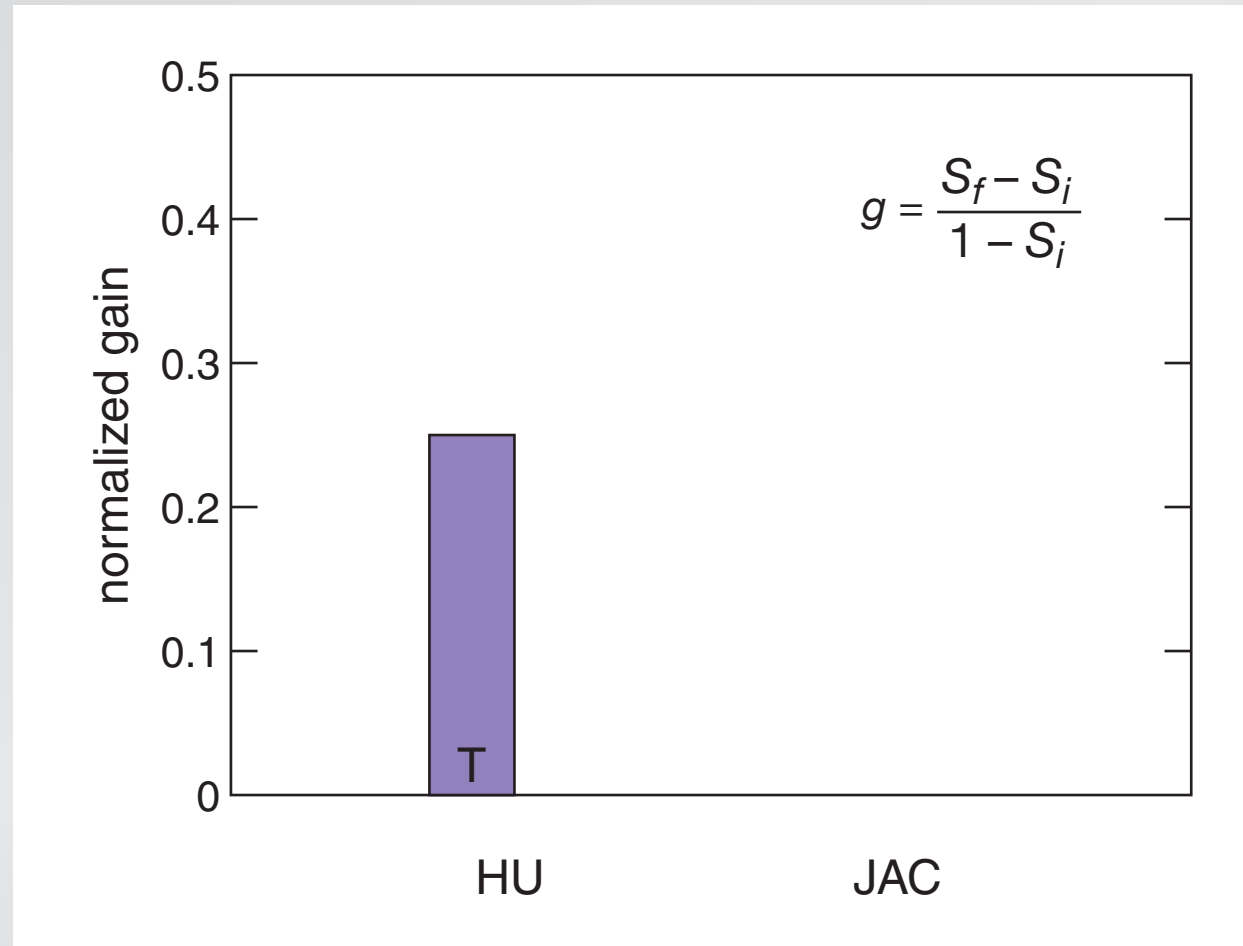


...but will it work here?



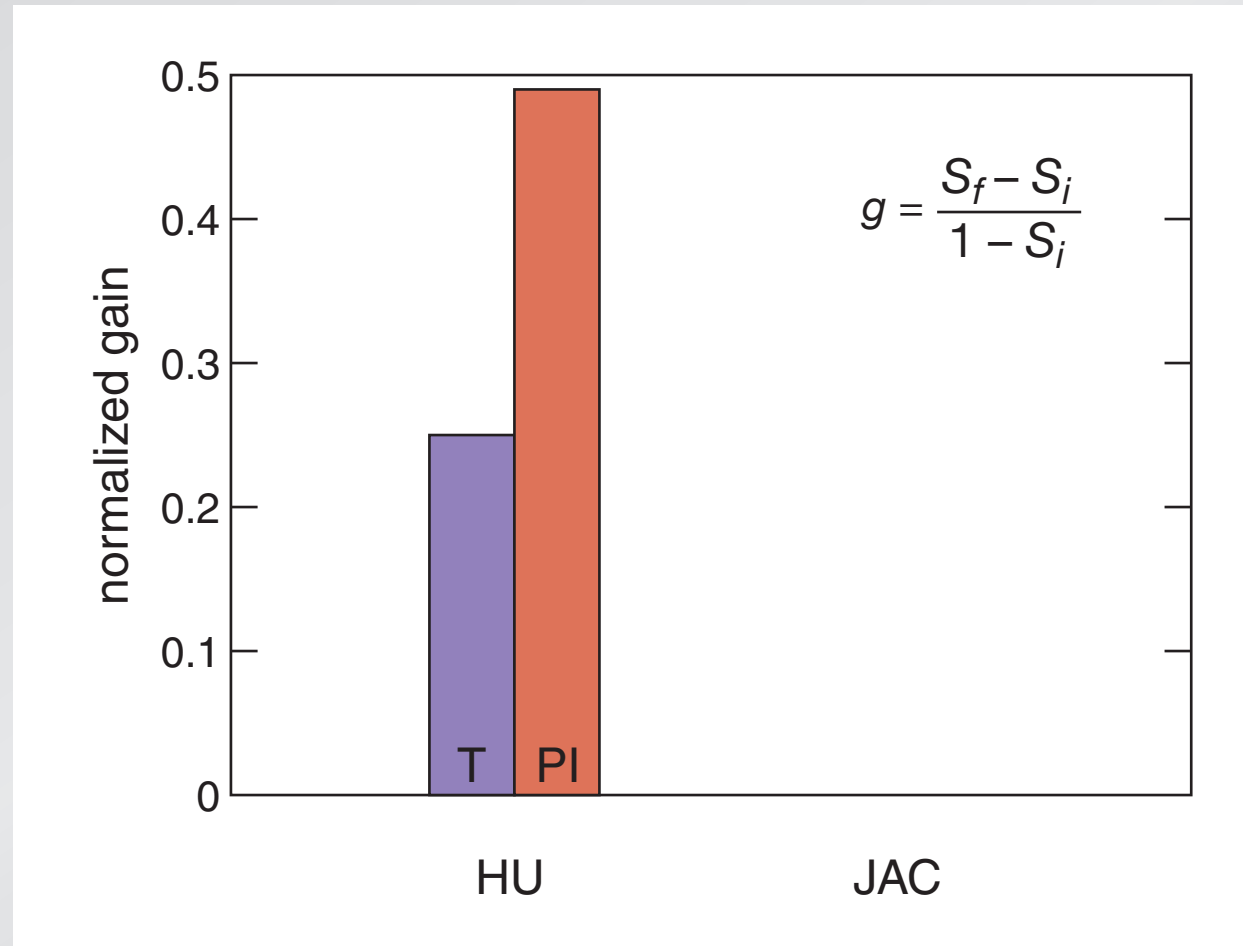
# Implementing PI & JiTT

## FCI normalized gain



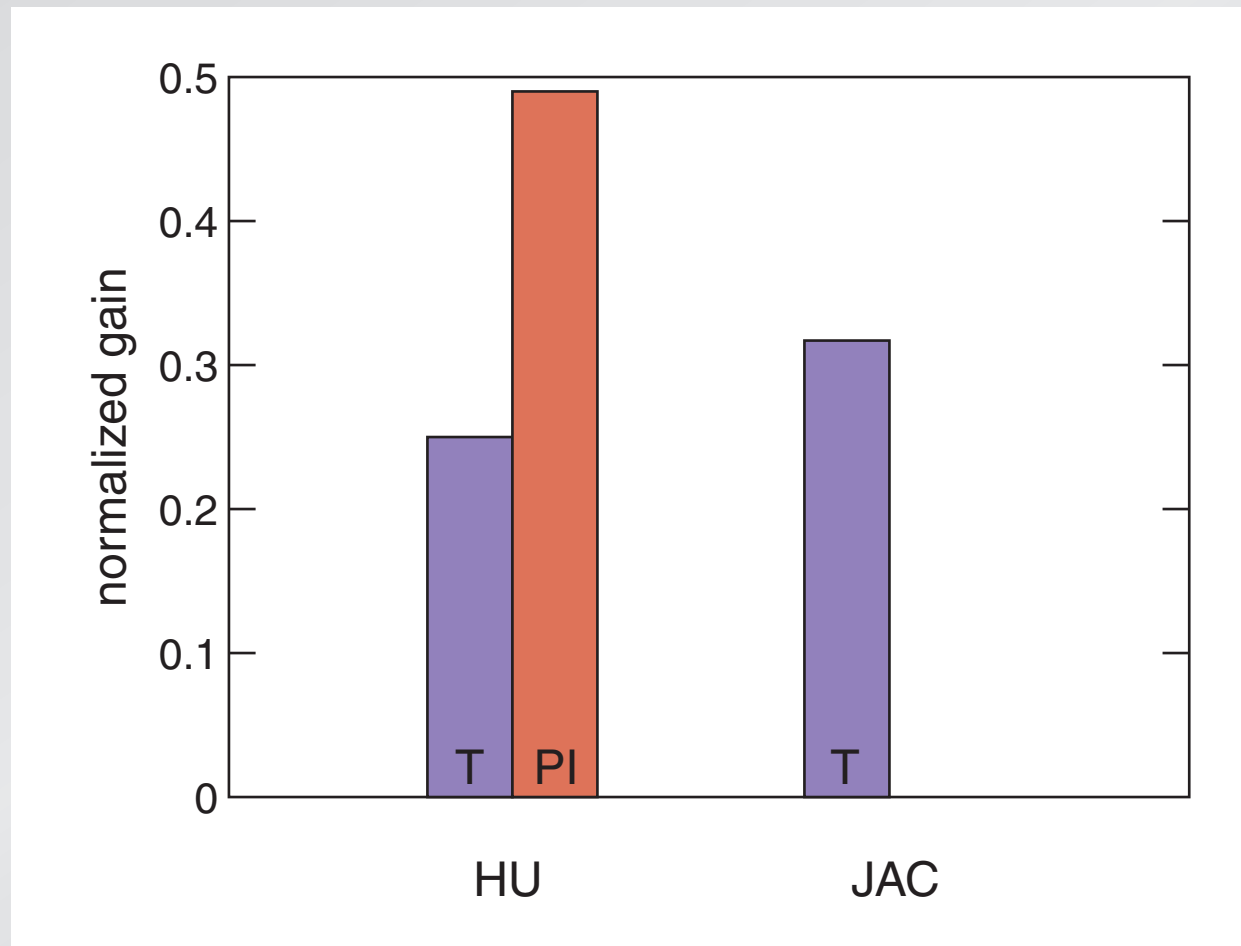
# Implementing PI & JiTT

## FCI normalized gain



# Implementing PI & JiTT

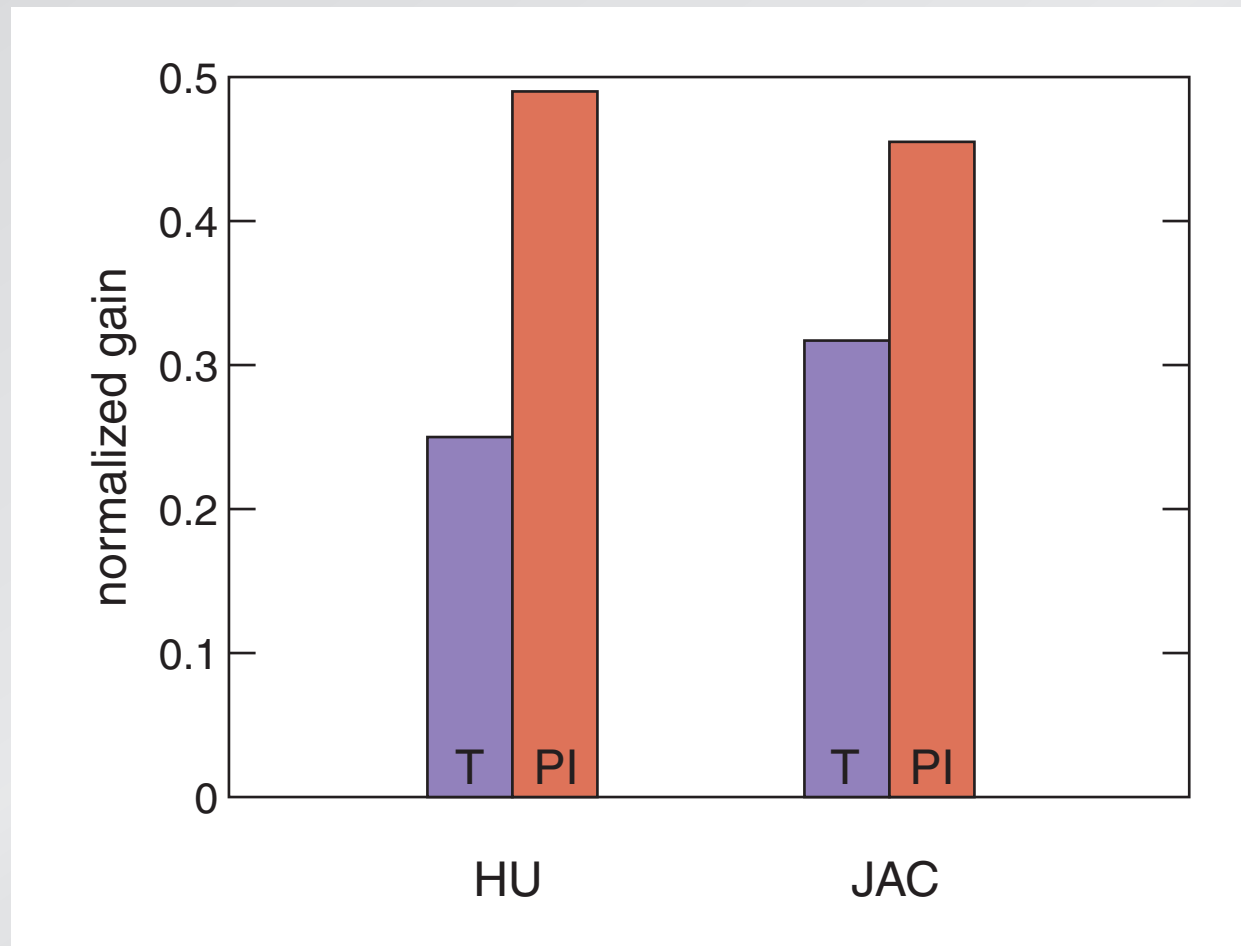
## FCI normalized gain





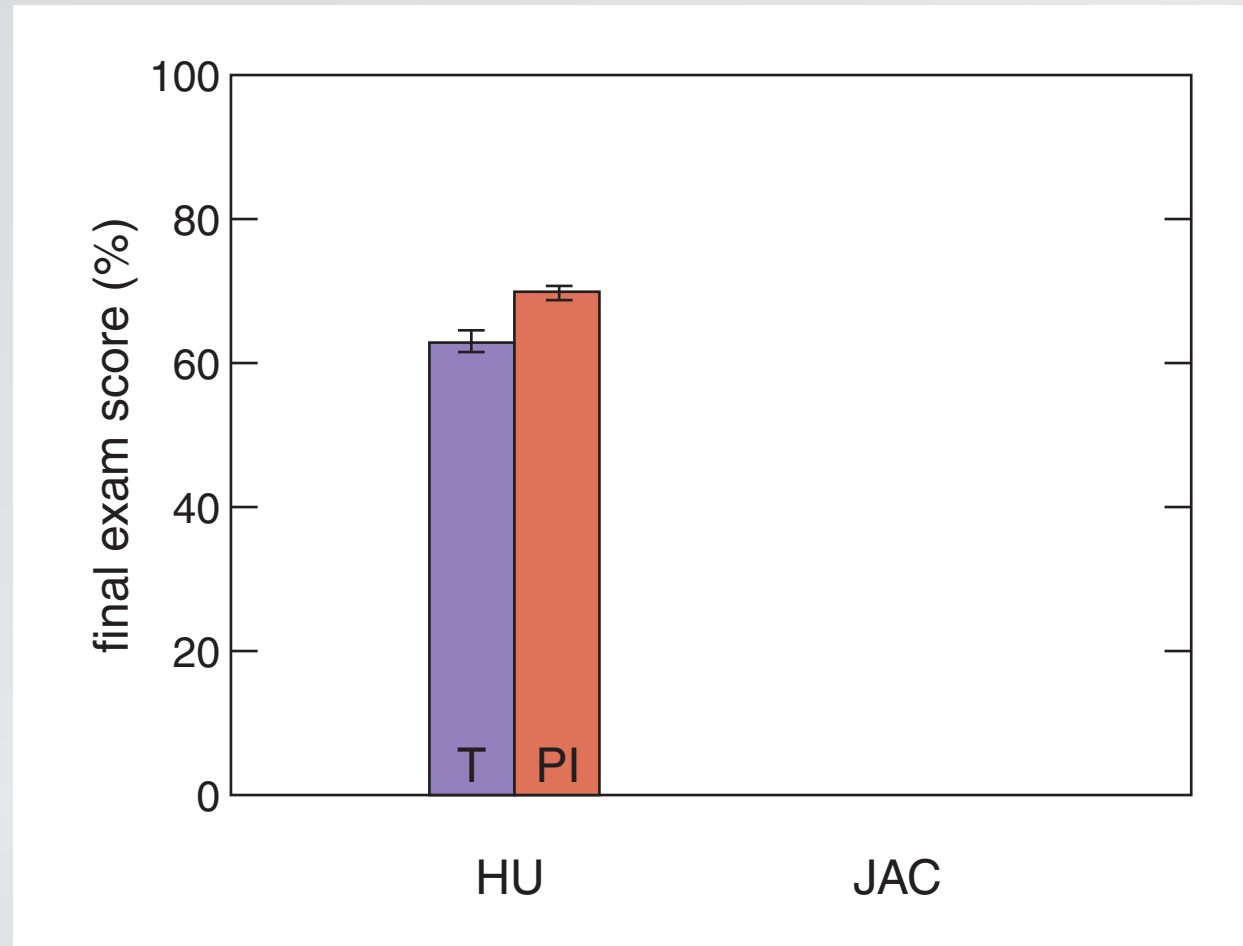
# Implementing PI & JiTT

## FCI normalized gain



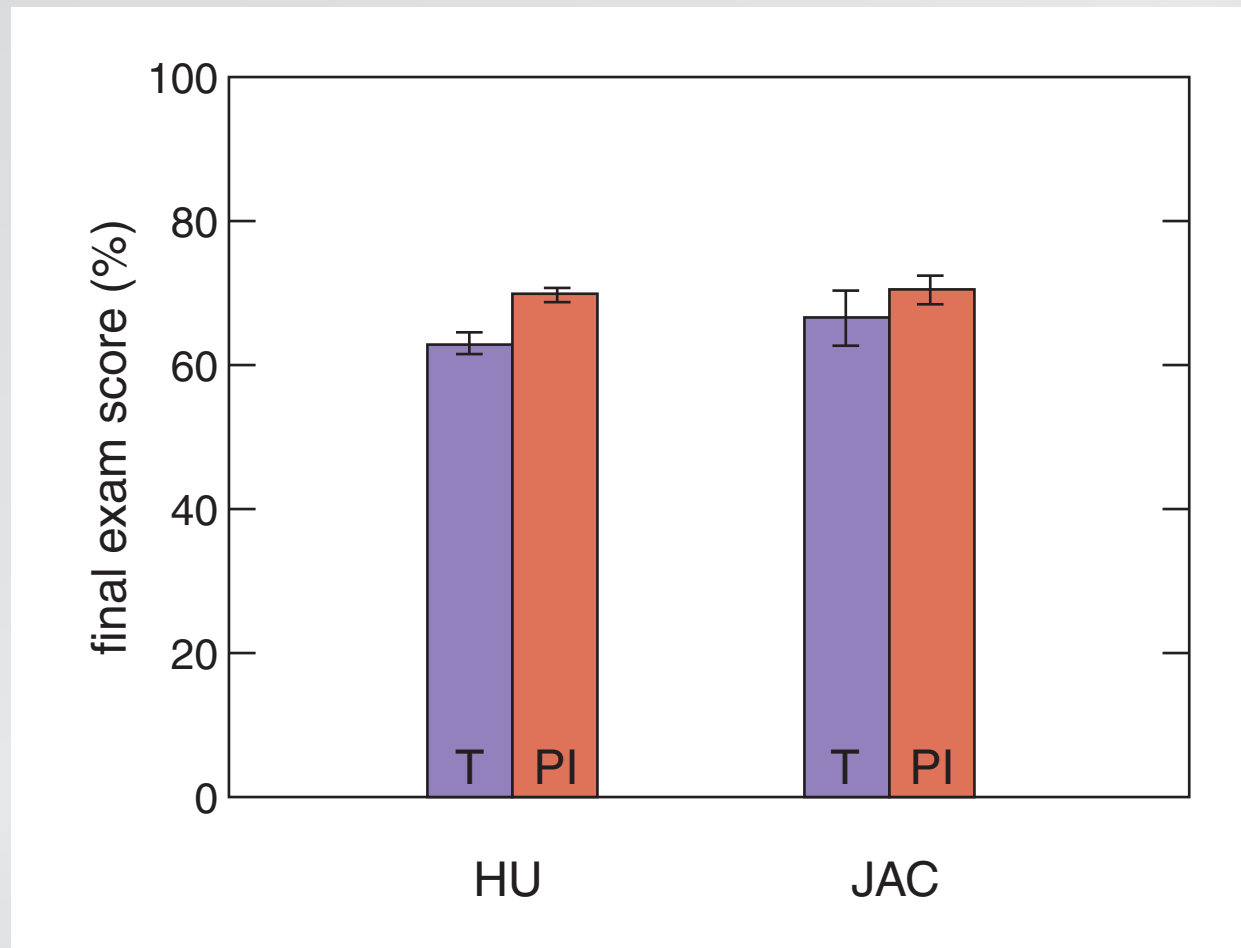
# Implementing PI & JiTT

exam performance



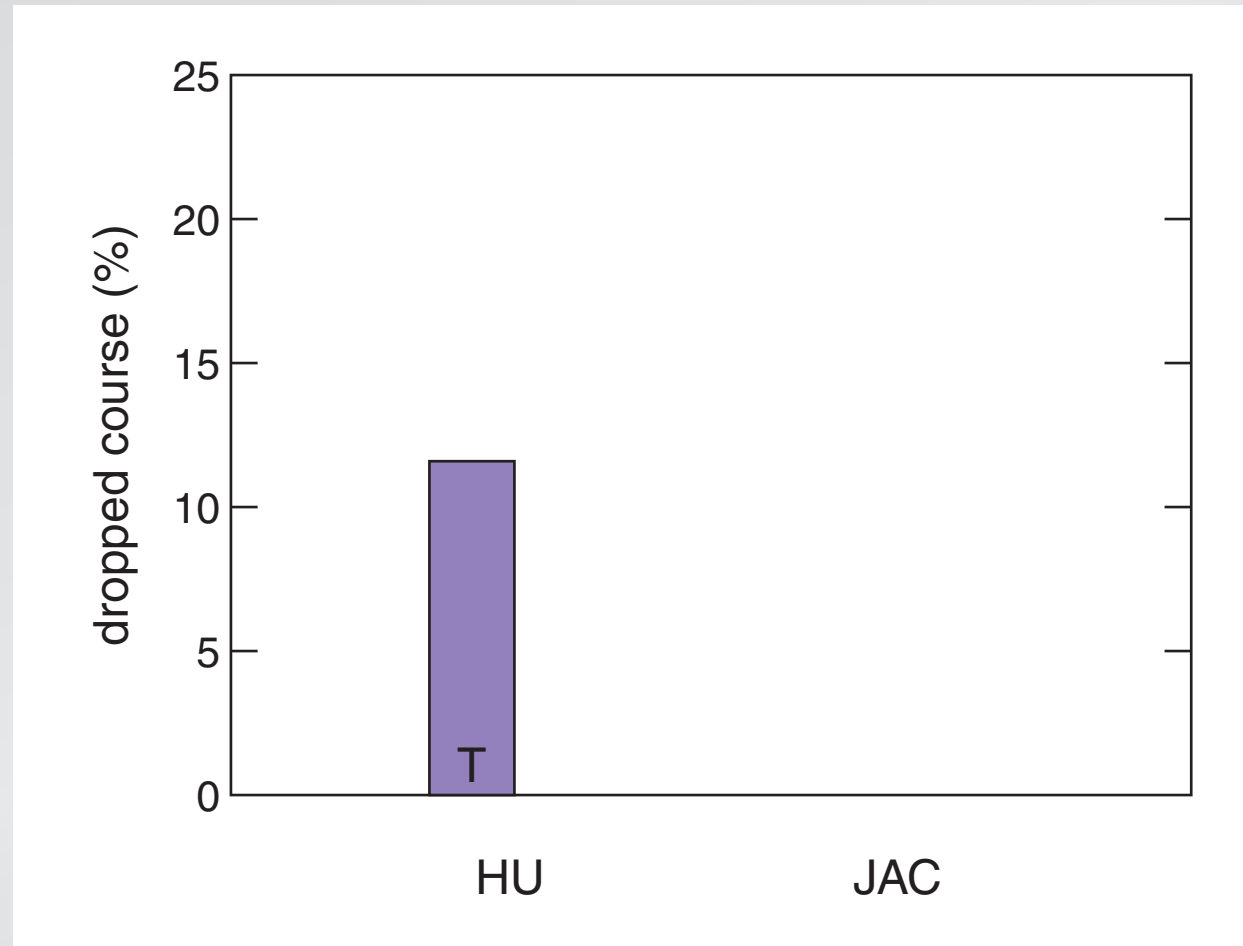
# Implementing PI & JiTT

exam performance



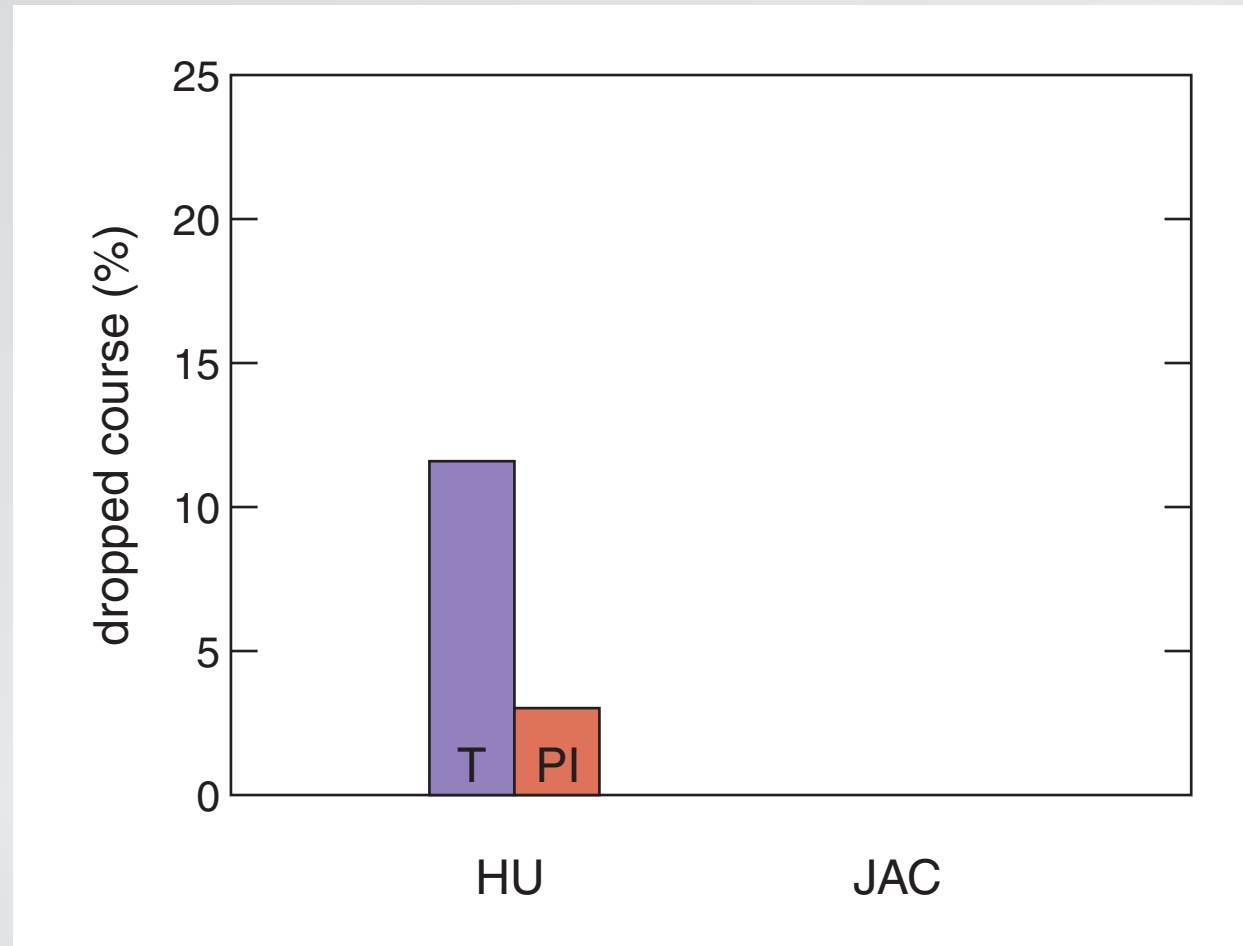
# Implementing PI & JiTT

student retention



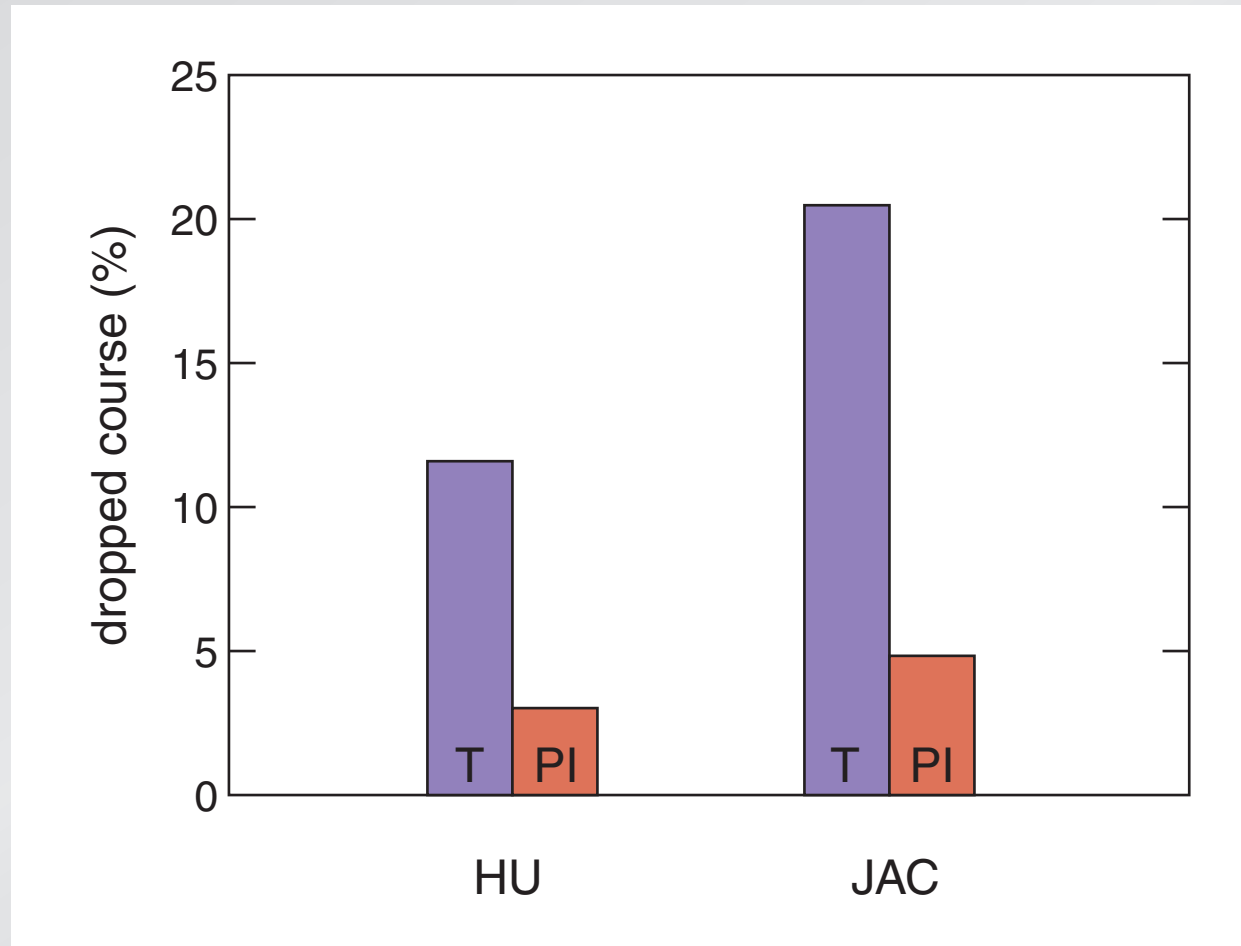
# Implementing PI & JiTT

## student retention



# Implementing PI & JiTT

student retention



# Implementing PI & JiTT

**similar learning gains in different environments**

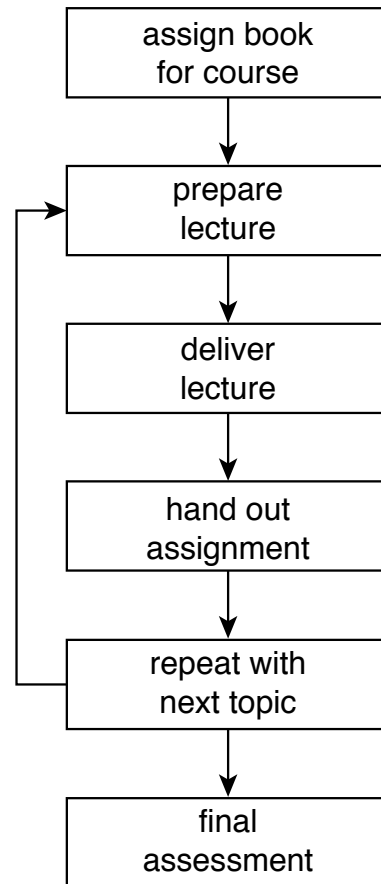
# Implementing PI & JiTT

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



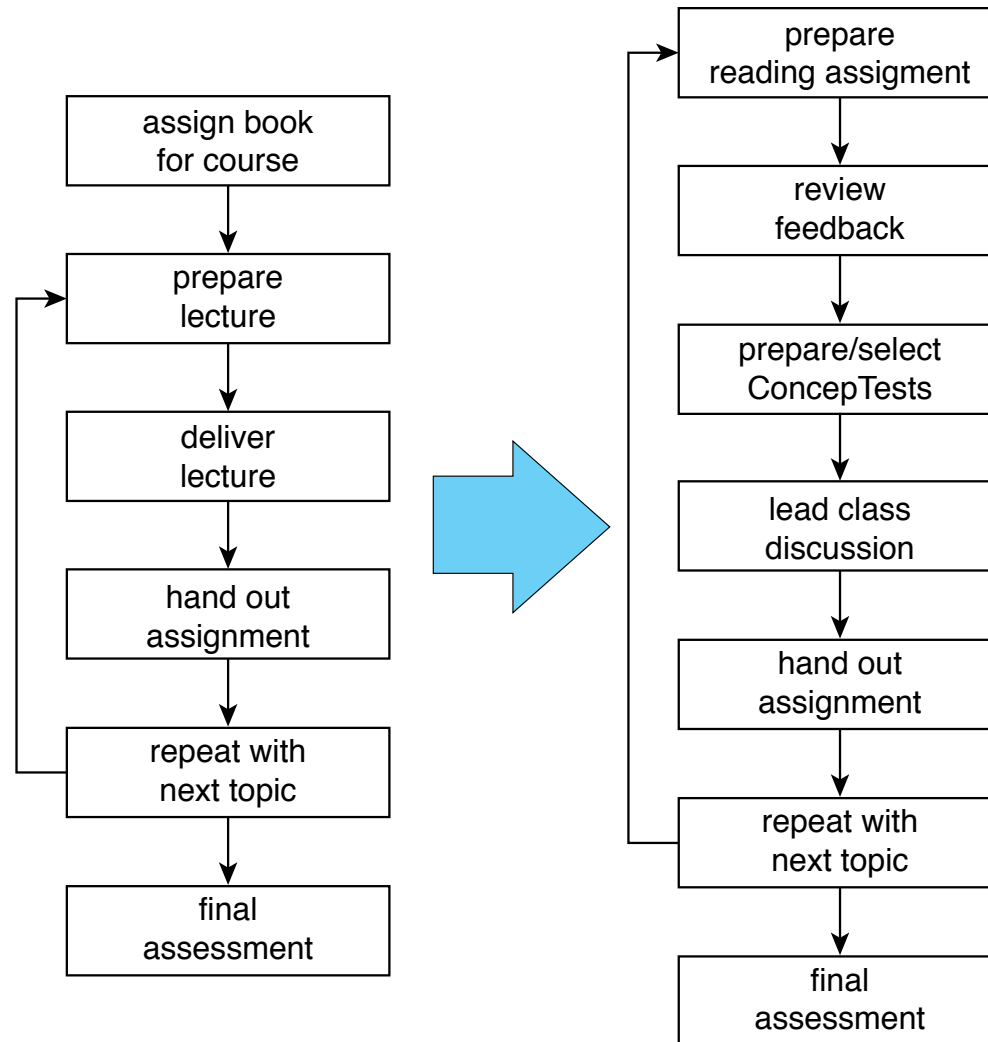
# Implementing PI & JiTT

## preparing for a lecture-based class



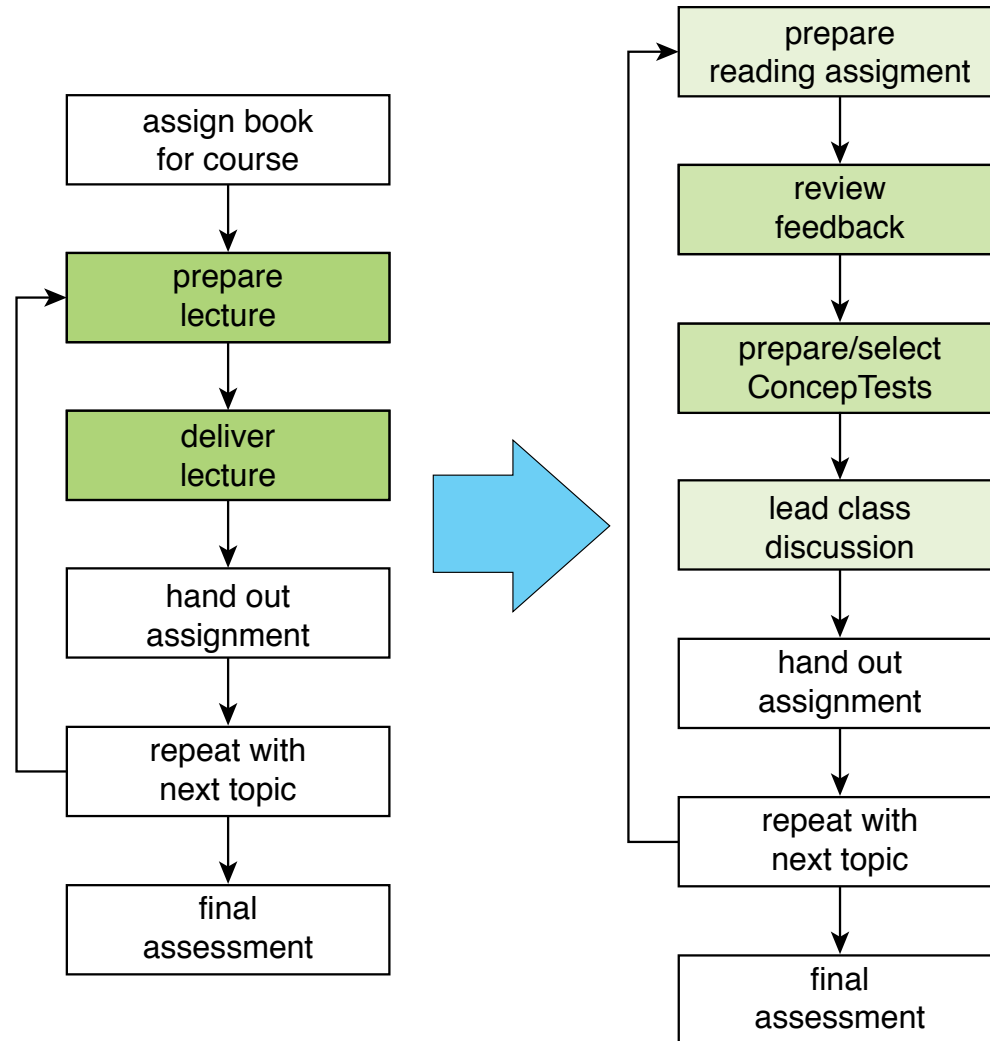
# Implementing PI & JiTT

transitioning: where does the effort go?



# Implementing PI & JiTT

transitioning: where does the effort go?



# Implementing PI & JiTT

**New activities:**

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

# Implementing PI & JiTT

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

# Implementing PI & JiTT

---

	<b>traditional</b>	<b>PI</b>
<b>in-class coverage</b>	<b>complete</b>	<b>partial</b>

---

# Implementing PI & JiTT

---

	<b>traditional</b>	<b>PI</b>
<b>in-class coverage</b>	<b>complete</b>	<b>partial</b>
<b>out-of-class coverage</b>	<b>?</b>	<b>complete</b>

---

# Implementing PI & JiTT

---

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

---



# Implementing PI & JiTT

---

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

---

**what good is coverage if little is retained?**

# Outline

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

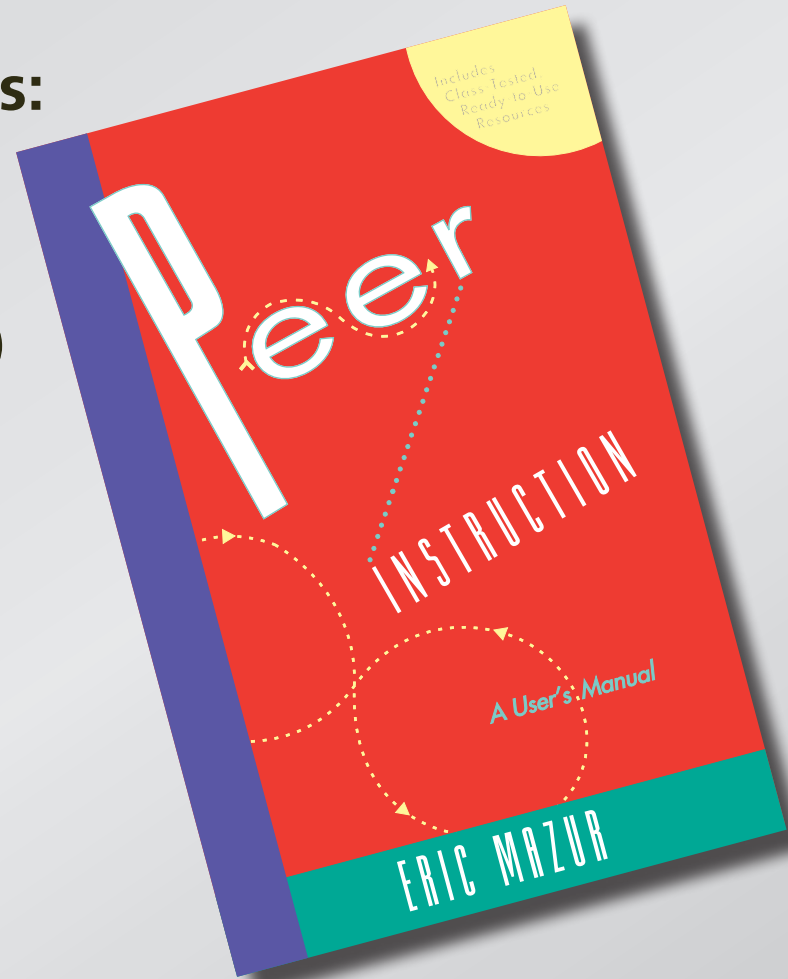
# ConceptTests

*“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



# ConcepTests

**Good conceptual questions (ConcepTests):**

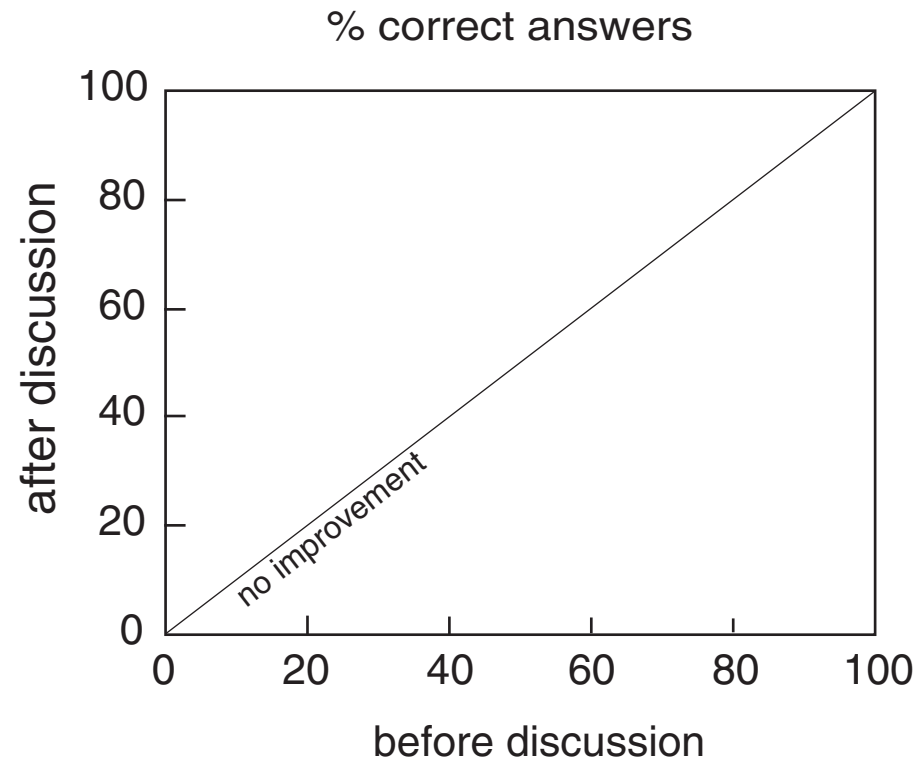
- **are based on common student difficulties**
- **focus on single concept**
- **require more than “plug and chug” or recall**
- **are clear and concise**
- **are of manageable difficulty**

# ConceptTests

*“How can I promote active/fruitful discussions?”*

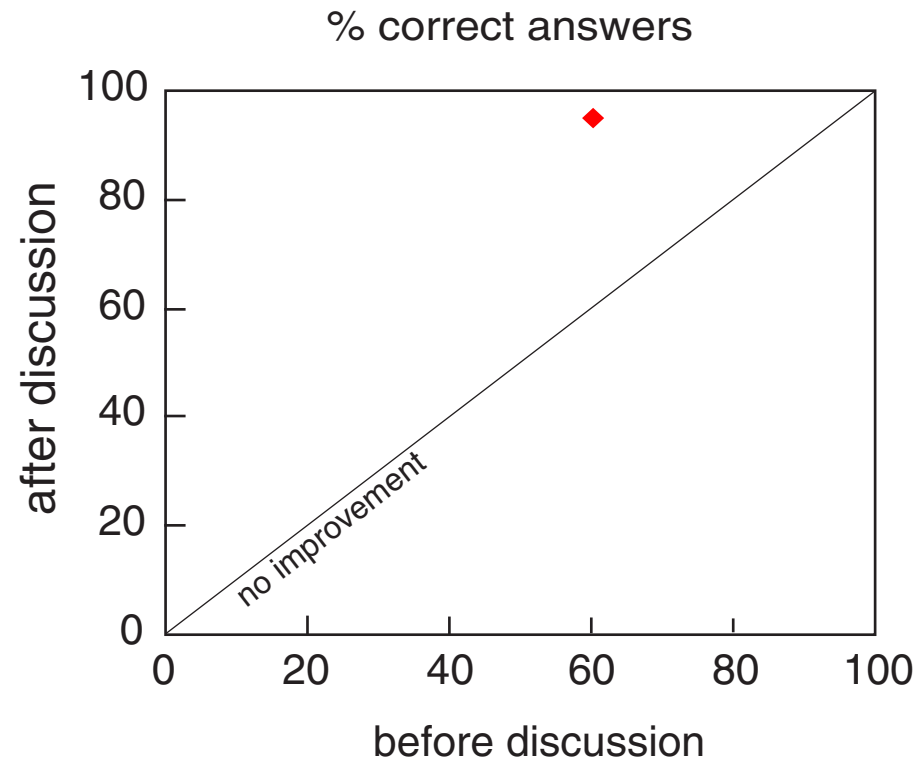
# ConceptTests

## ConceptTest data



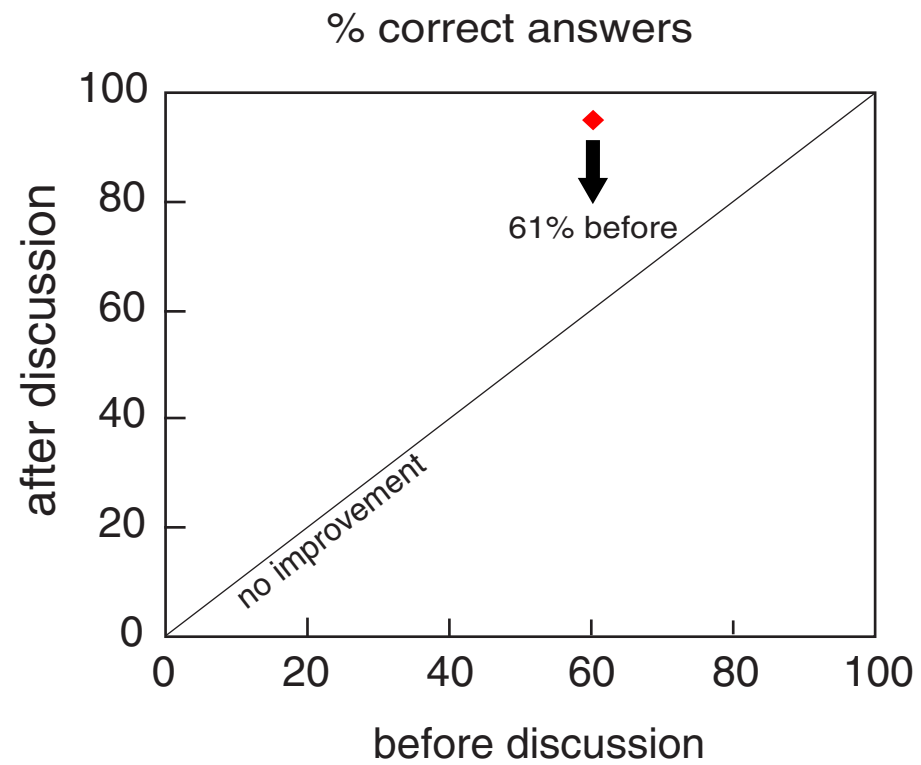
# ConceptTests

## ConceptTest data



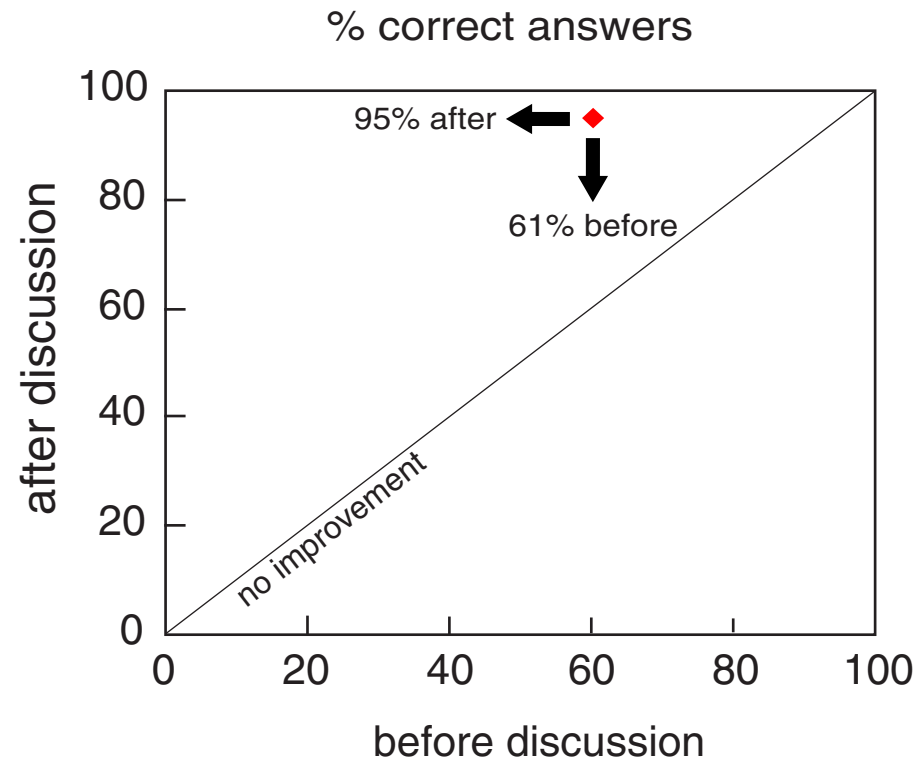
# ConceptTests

## ConceptTest data



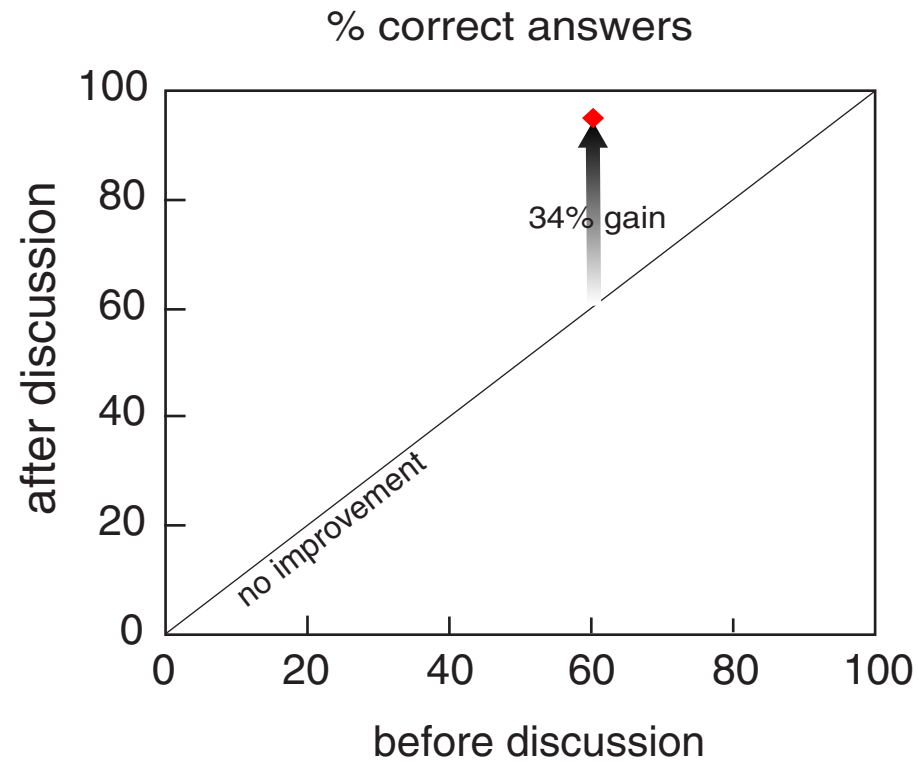
# ConceptTests

## ConceptTest data



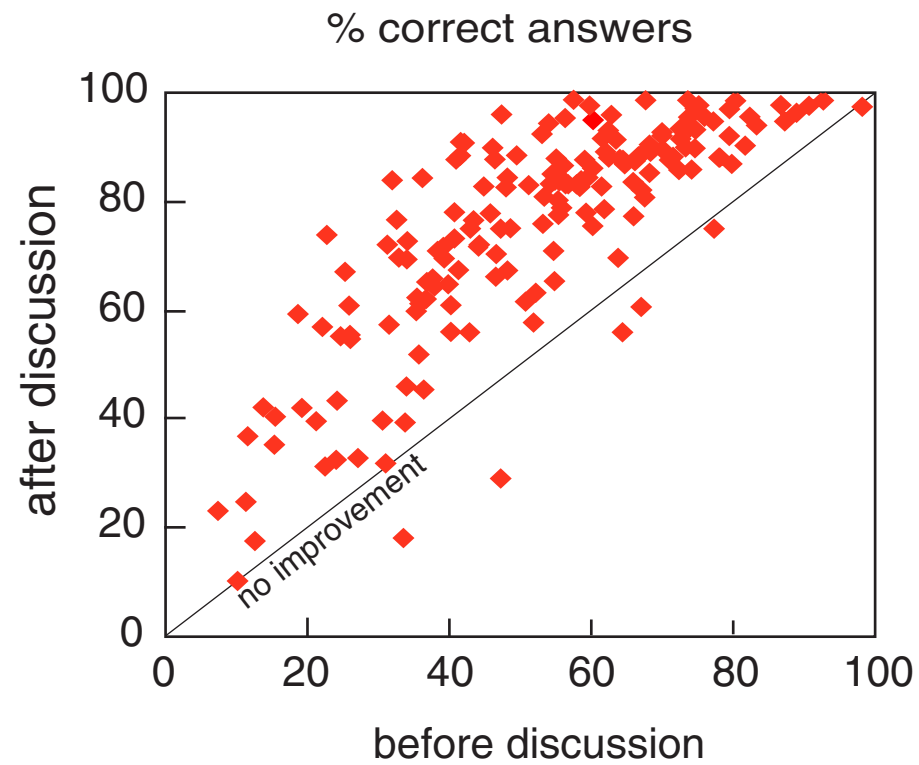
# ConceptTests

## ConceptTest data



# ConceptTests

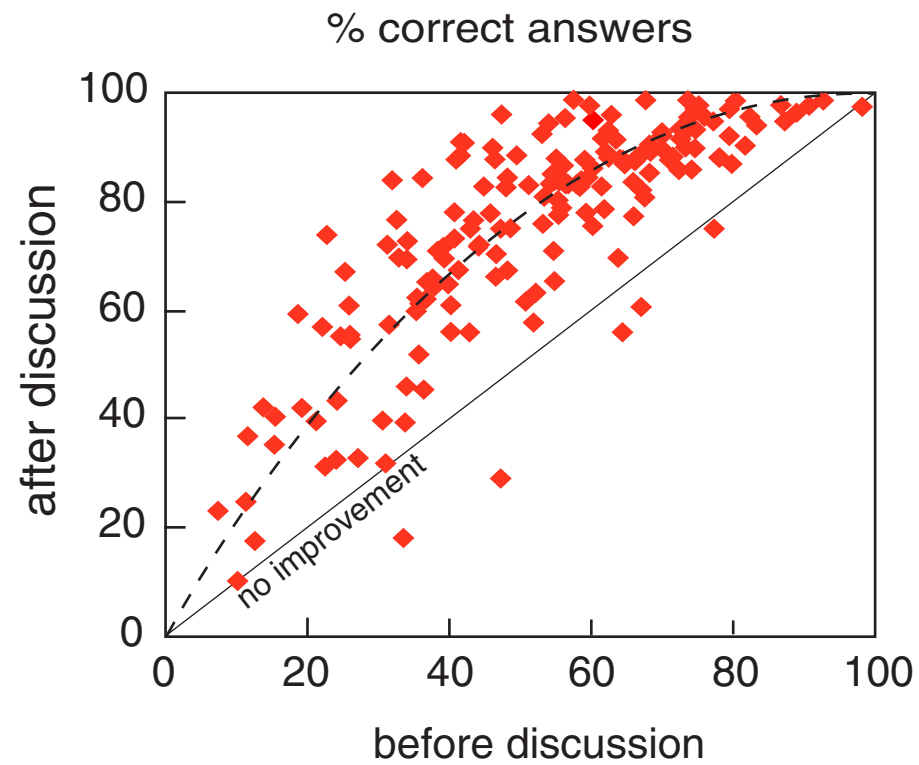
## ConceptTest data





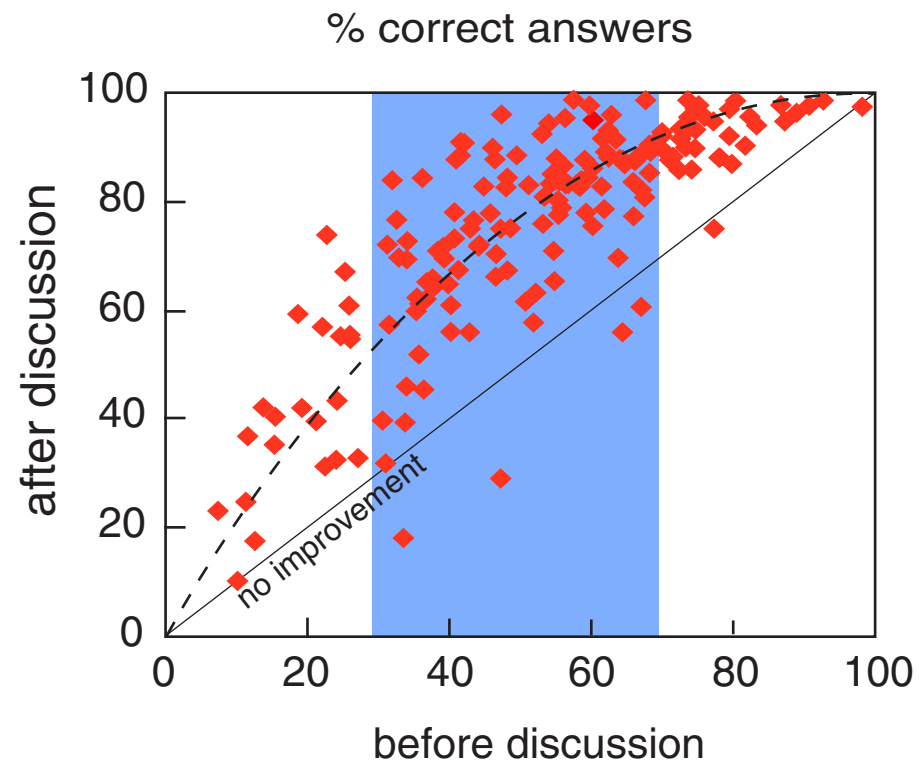
# ConceptTests

## ConceptTest data

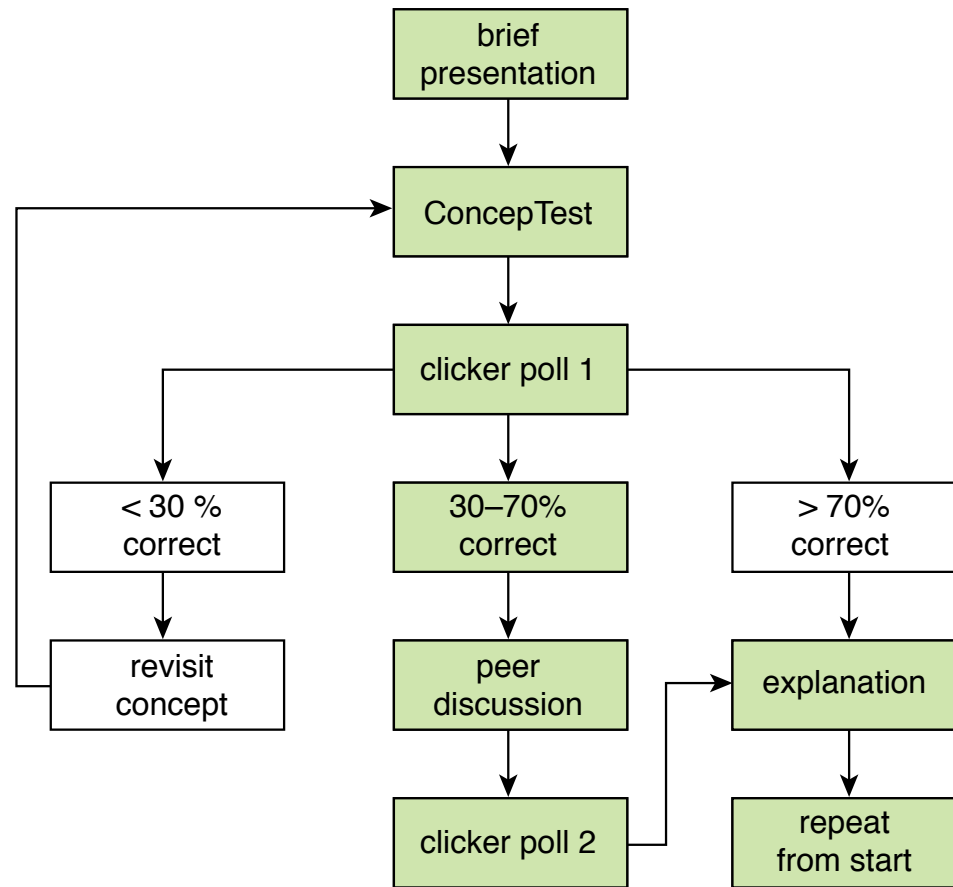


# ConcepTests

## ConcepTest data



# ConcepTests



# Assignment

**In preparation for tomorrow:**

- 1. Search for ConcepTests in your field**
- 2. Which concepts in your field could you apply PI to?**
- 3. Create instructor account at <http://lcatalytics.com>**



**Join now!**

**PeerInstruction.net**

# Implementing PI & JiTT

*“What constitutes a good problem?”*

# Implementing PI & JiTT

On a Saturday afternoon, you pull into a parking lot with unmeasured 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 unmeasured 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 unmeasured 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

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

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Developing a model  
Applying that model

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

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**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

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

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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:**

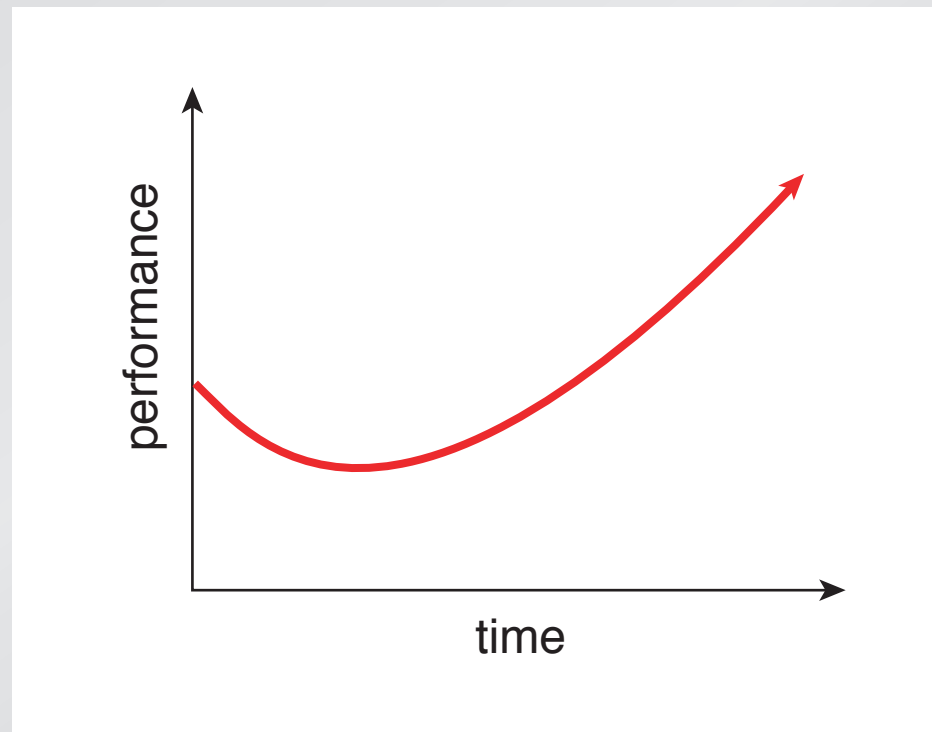
- **Open book/computer exam**
- **Collaborative exam**
- **Multidimensional testing**

# 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

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.

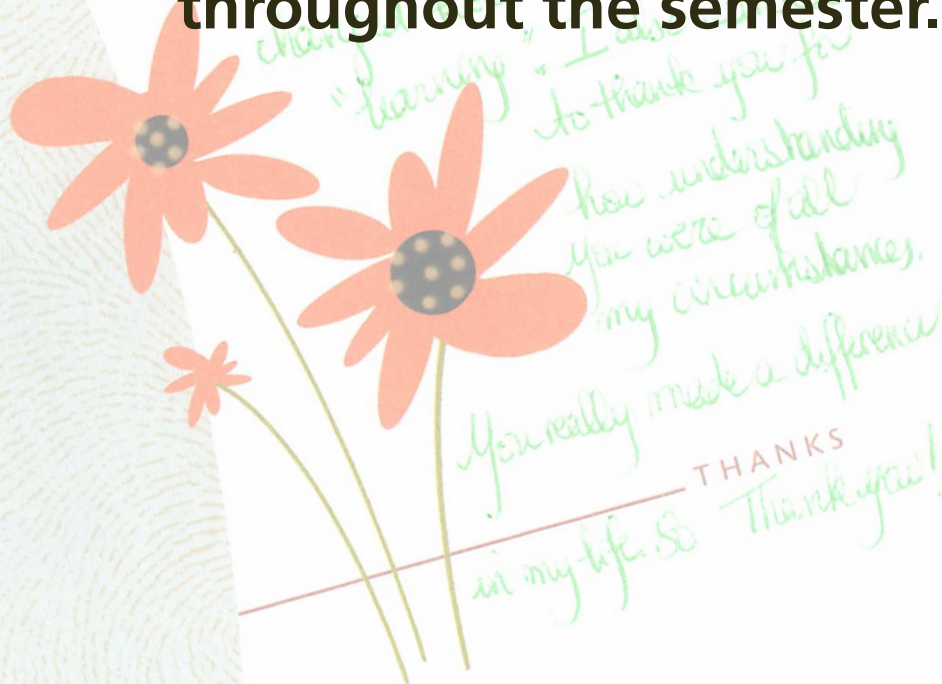
Best



# 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.*



*THANKS  
in my life. So Thank you!*

*Best*



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**"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.*



*You really made a difference  
in my life. So THANKS  
Thank you!*

*Best*

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**"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  
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*Best*

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

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