

# Technology at the service of pedagogy



Exploring Educational Technologies for Mexico  
Harvard University — LASPAU  
Cambridge, MA, 31 January 2014



# Technology at the service of pedagogy



@eric\_mazur

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**Think of something you are really good at**

**EDUCACION**

Now think how you became good at it



GACiON





**1** lecture



1 lecture

2 PI



1 lecture

2 PI

3 PI 2.0






**EXCITING  
stuff!**

**1** lecture

**2** PI

**3** PI 2.0



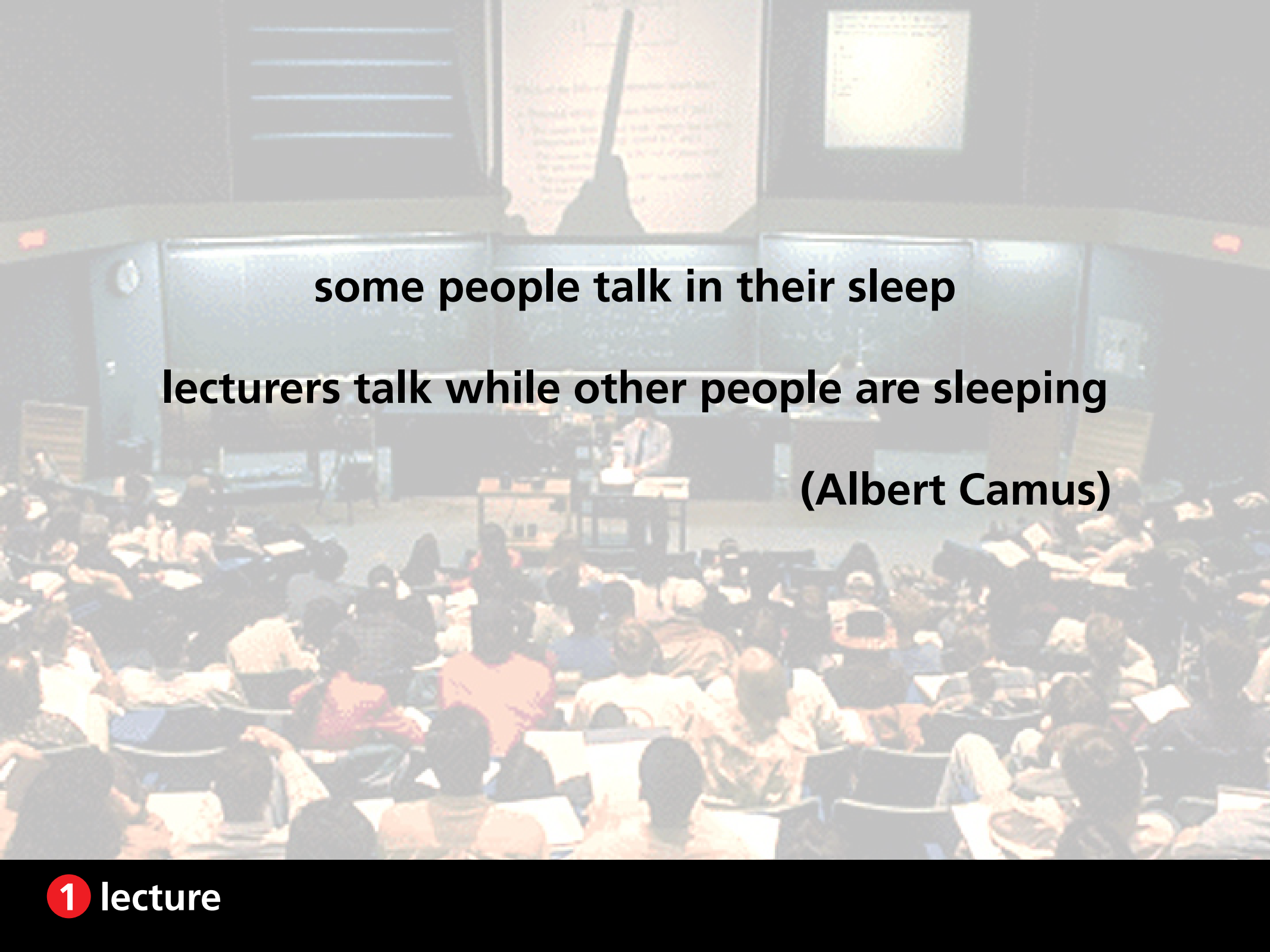
**What happens  
in a lecture?**



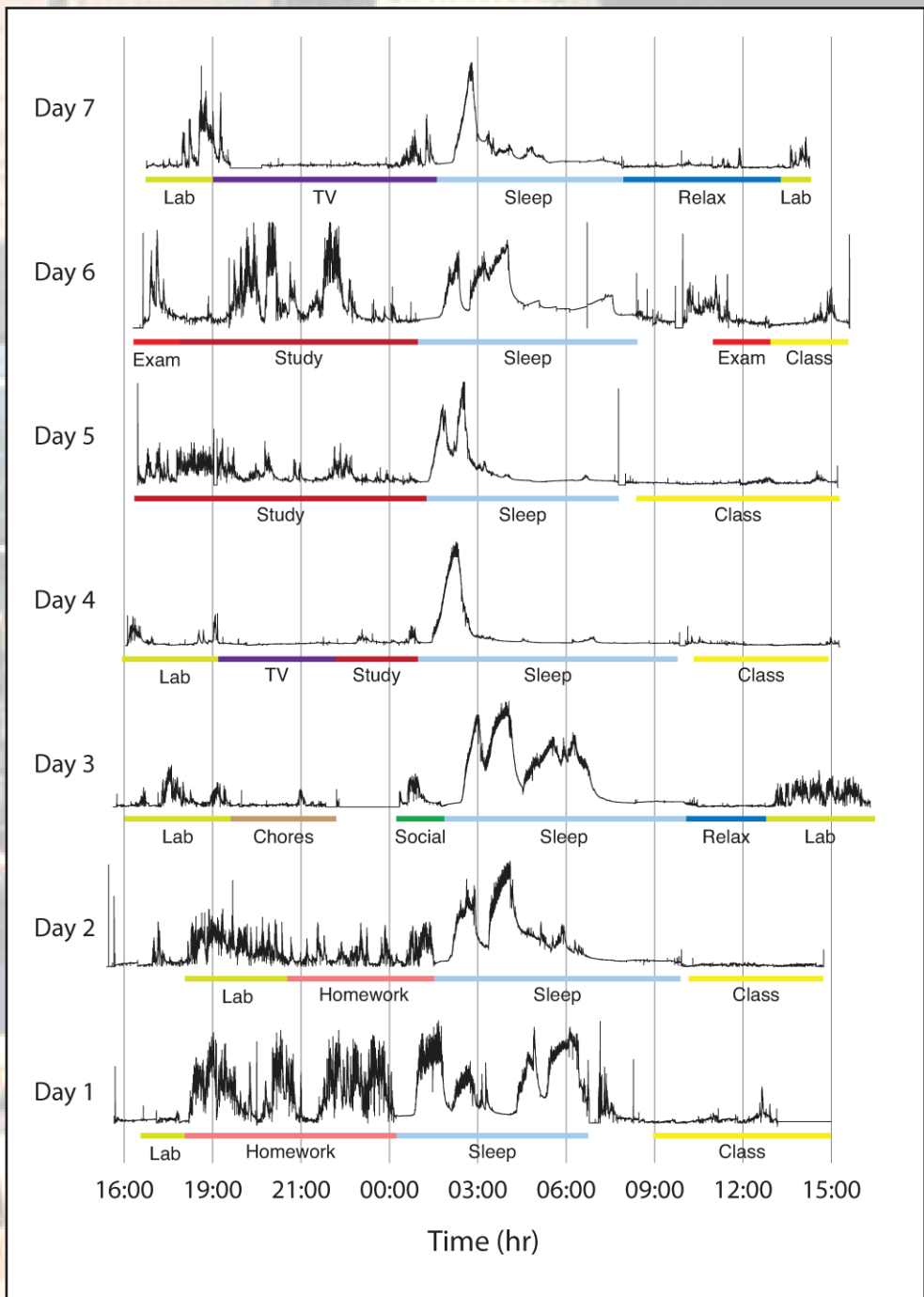
**1** lecture

A large lecture hall with a professor at a podium and students in the audience. The professor is standing at a podium on a stage, facing the audience. The audience is seated in rows of chairs, filling the hall. The stage has a large screen behind the professor displaying text. The text on the screen is partially legible and appears to be a list of items or a document. The overall scene is a typical university lecture hall.

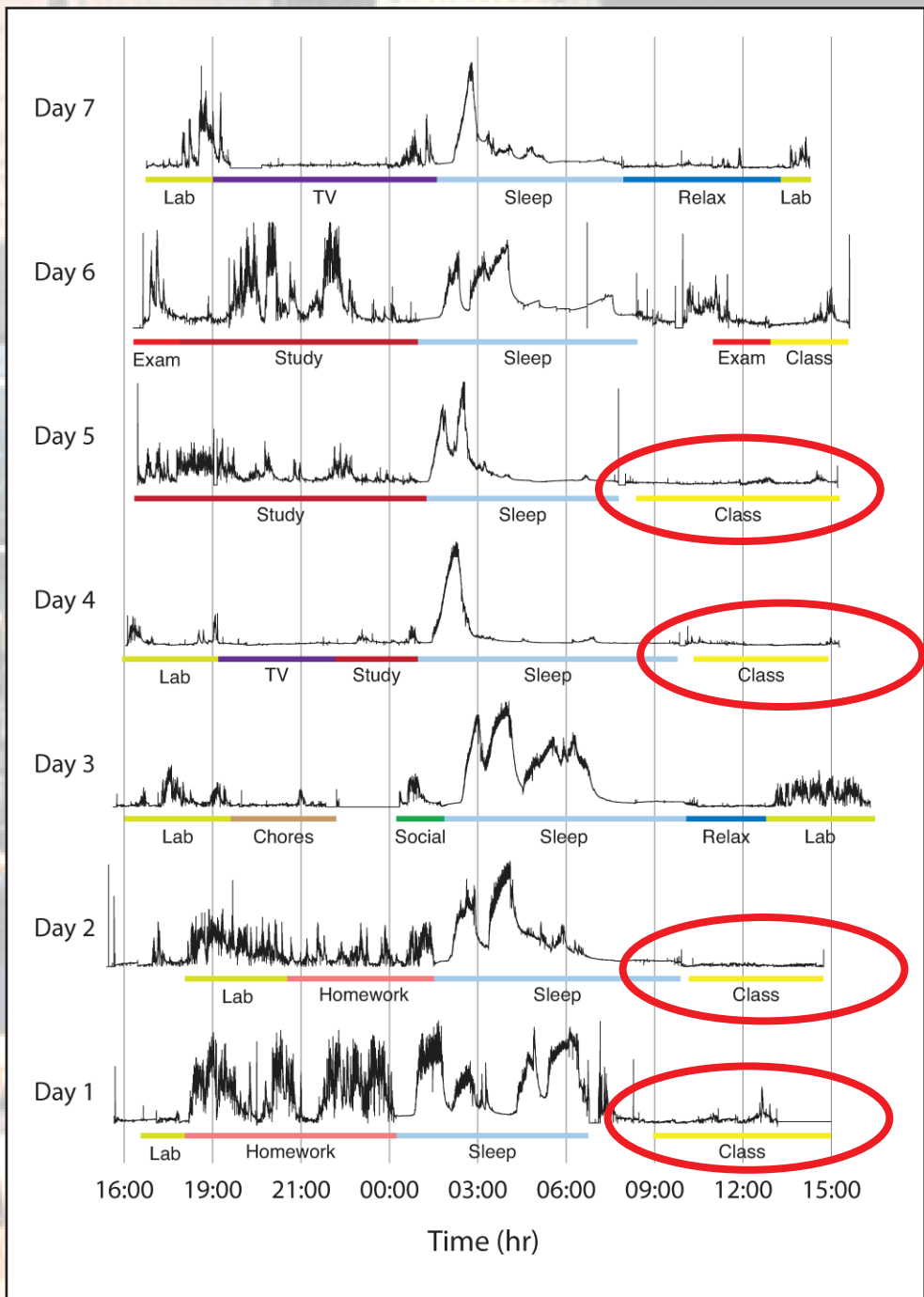
**some people talk in their sleep**

A large lecture hall with a lecturer at a podium and a large audience of students. The room is filled with people, many of whom appear to be sleeping or resting. The lecturer is standing at a podium in the center of the stage, facing the audience. The audience is seated in rows of chairs, filling the foreground and middle ground. The background features a large screen displaying text and a chalkboard. The overall atmosphere is one of a lecture in progress, but with a significant portion of the audience appearing disengaged or asleep.

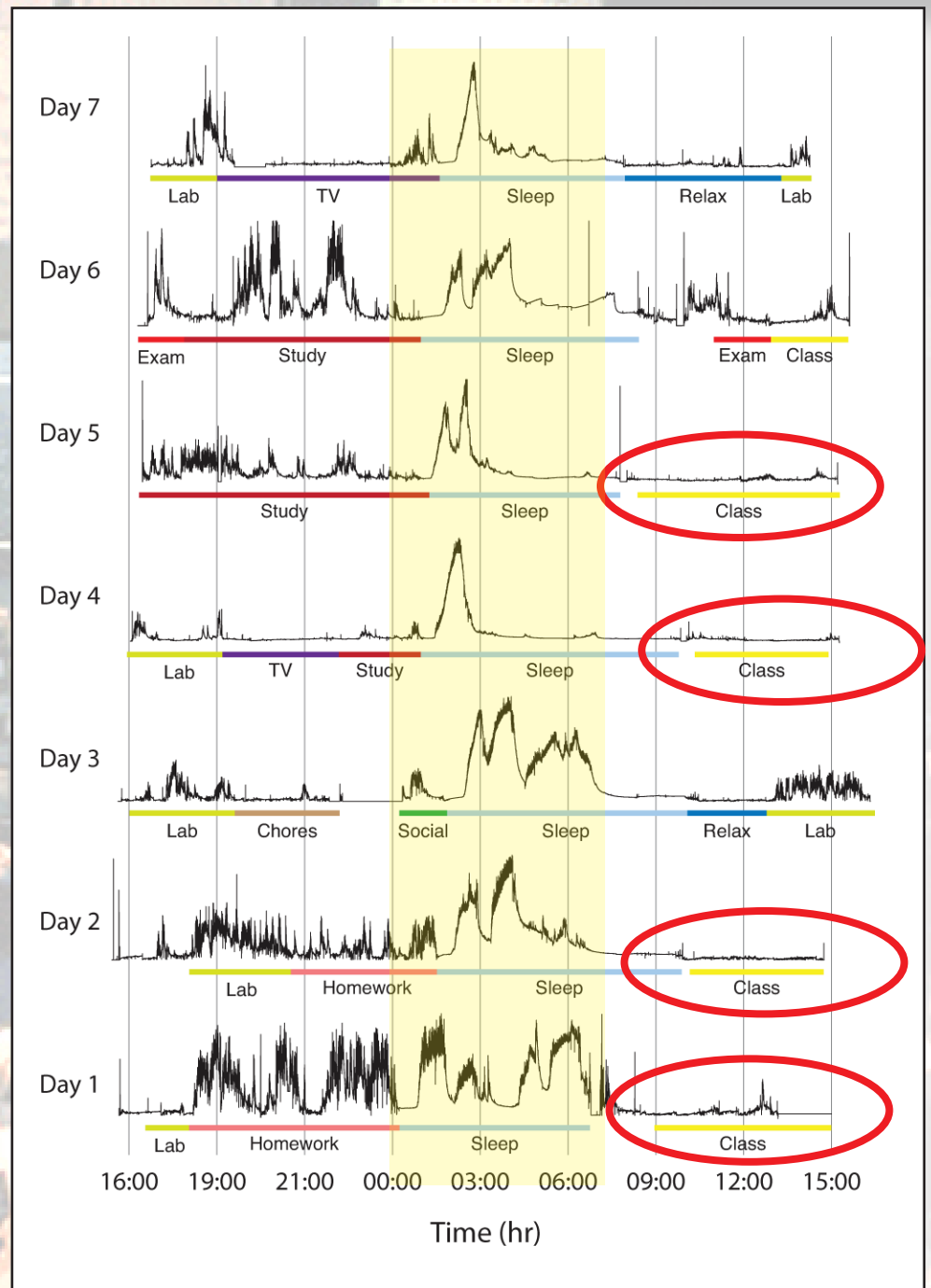
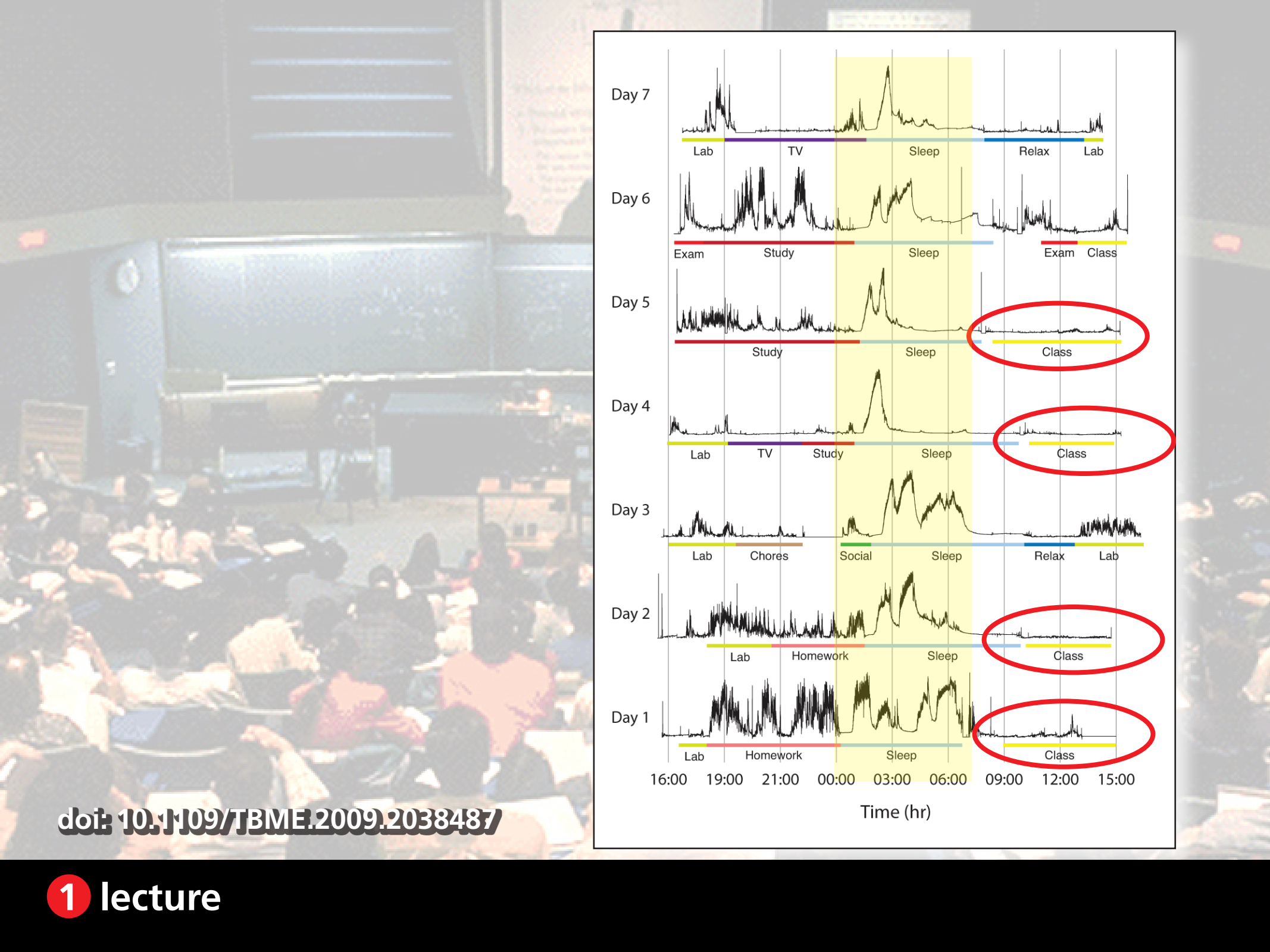
**some people talk in their sleep**  
**lecturers talk while other people are sleeping**  
**(Albert Camus)**



doi: 10.1109/TBME.2009.2038487

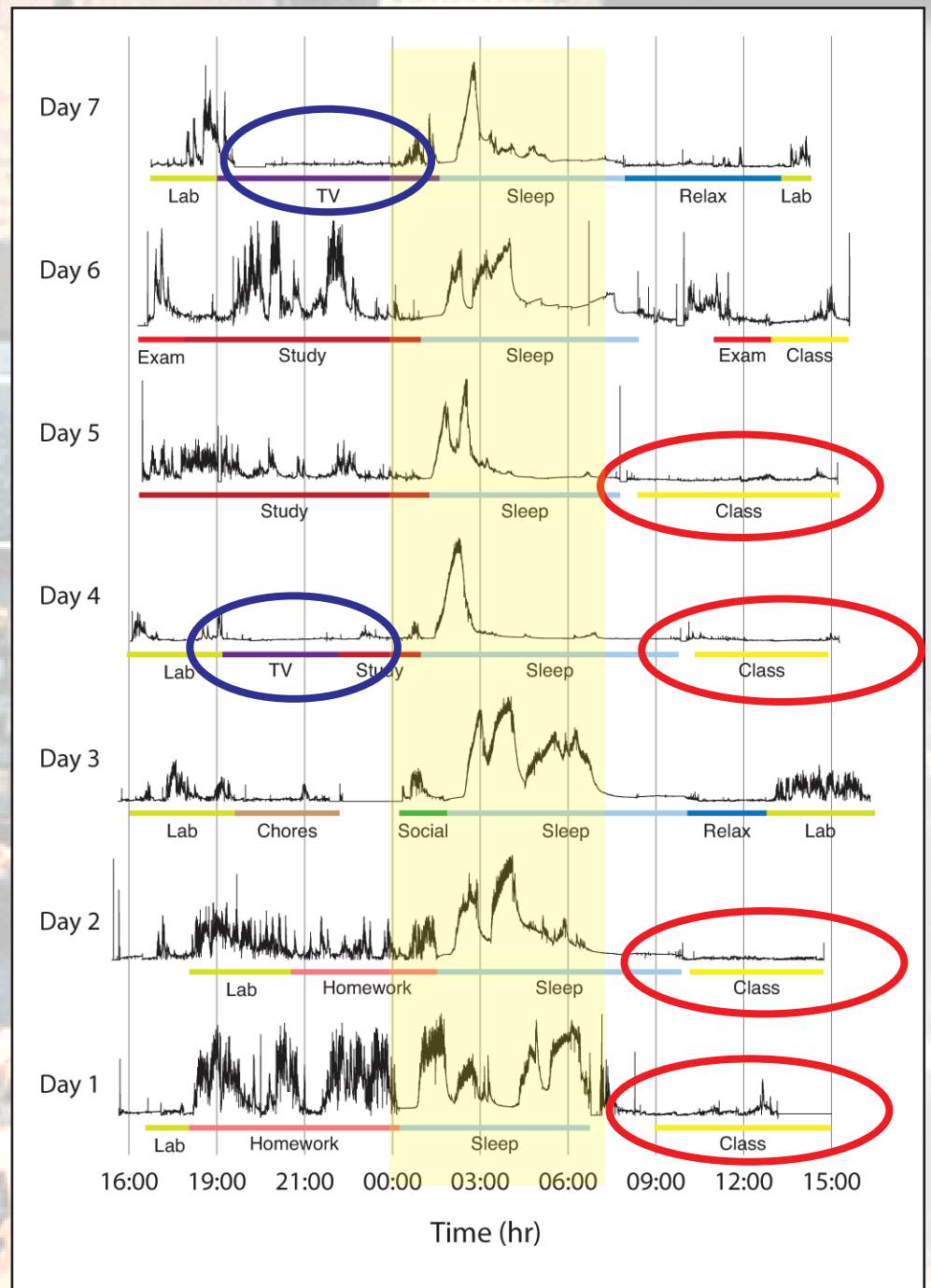
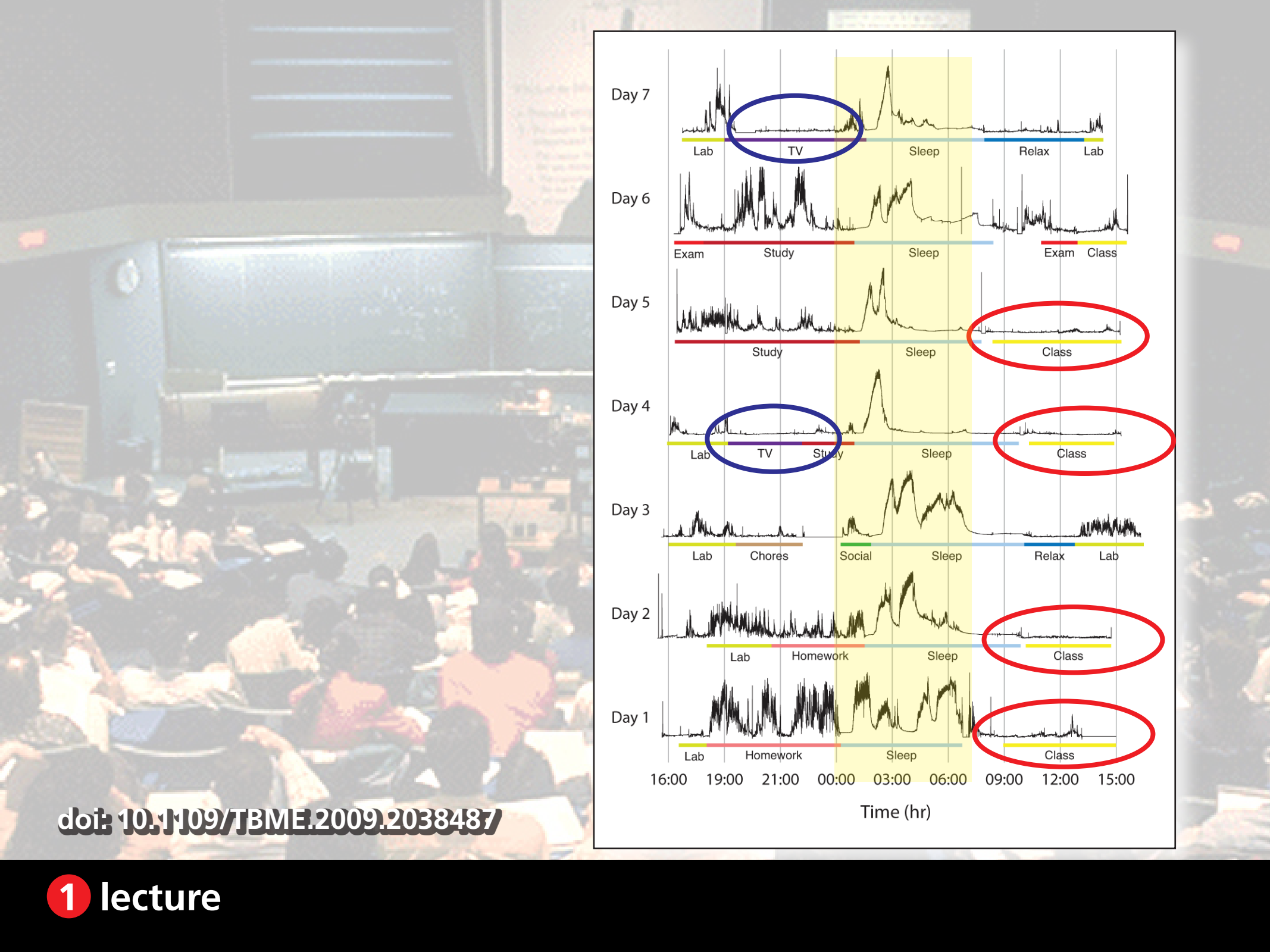


doi: 10.1109/TBME.2009.2038487



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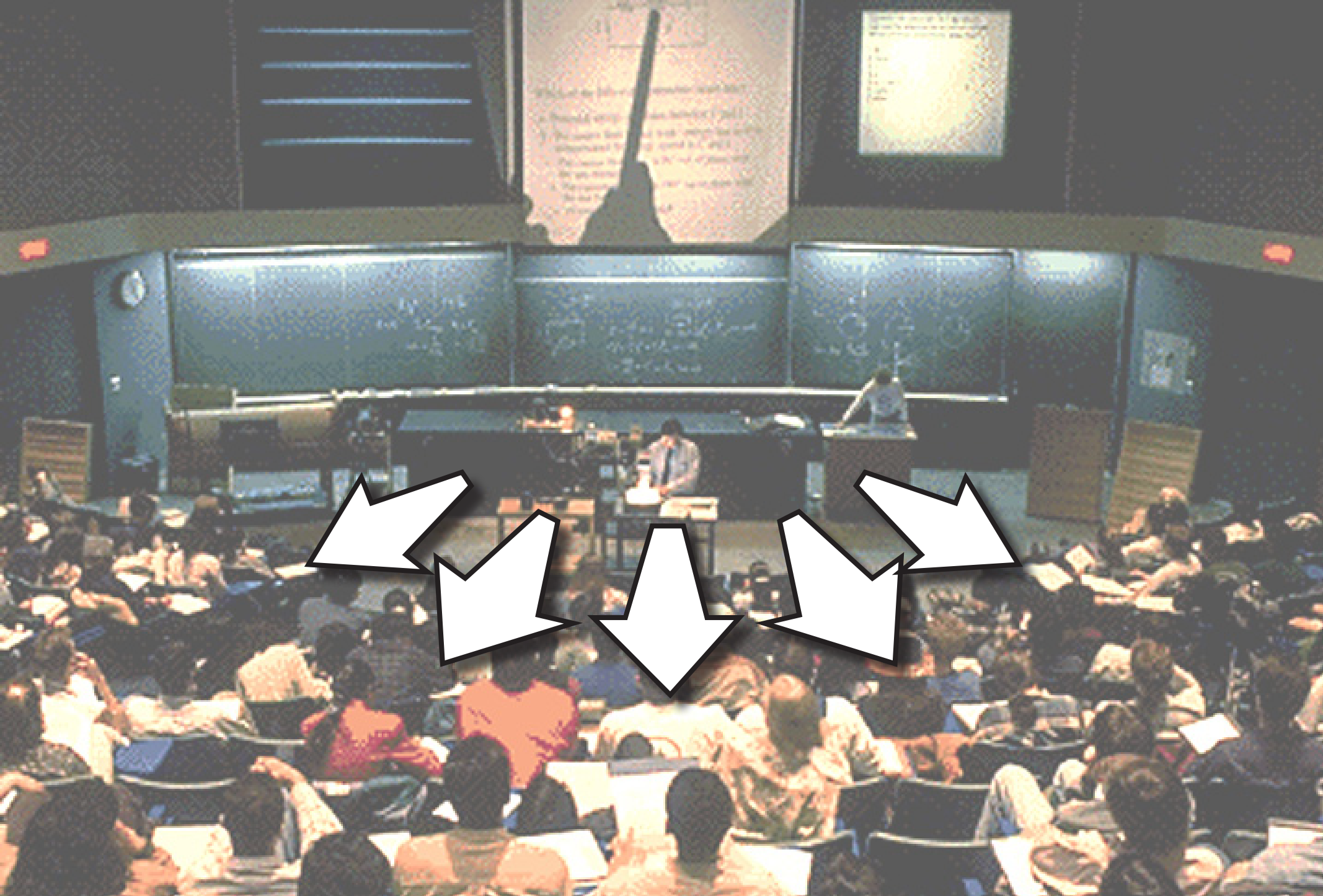




doi: 10.1109/TBME.2009.2038487



**1** lecture



The result?

EDUCACION

**Lack of learning**

EDUCACION

**Lack of learning**

**Lack of retention**



1 lecture

2 PI



# 1. transfer of information





**1. transfer of information**


**2. assimilation of that information**

- 
1. transfer of information (in class)
  2. assimilation of that information



1. transfer of information (in class)

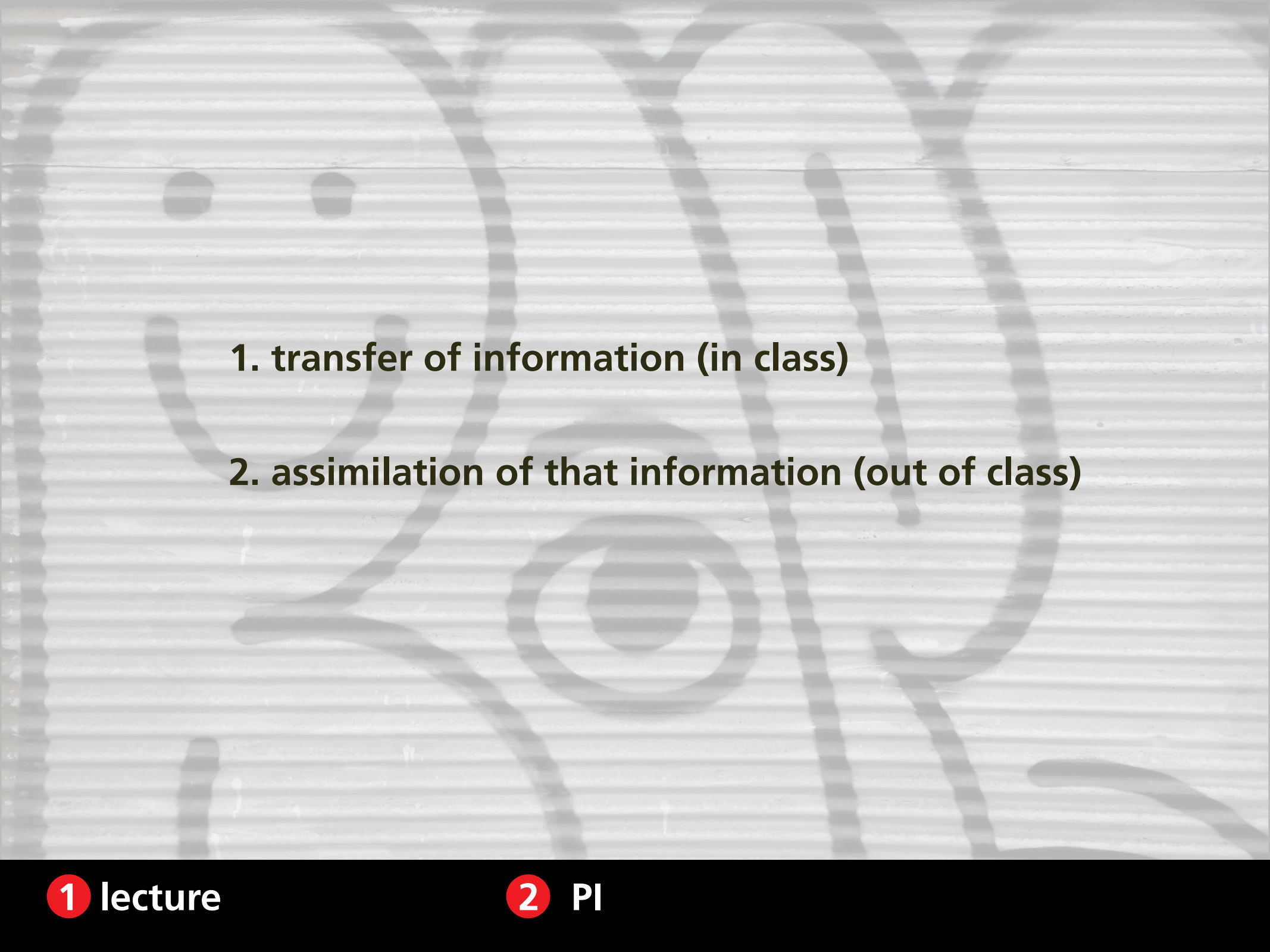
2. assimilation of that information (out of class)

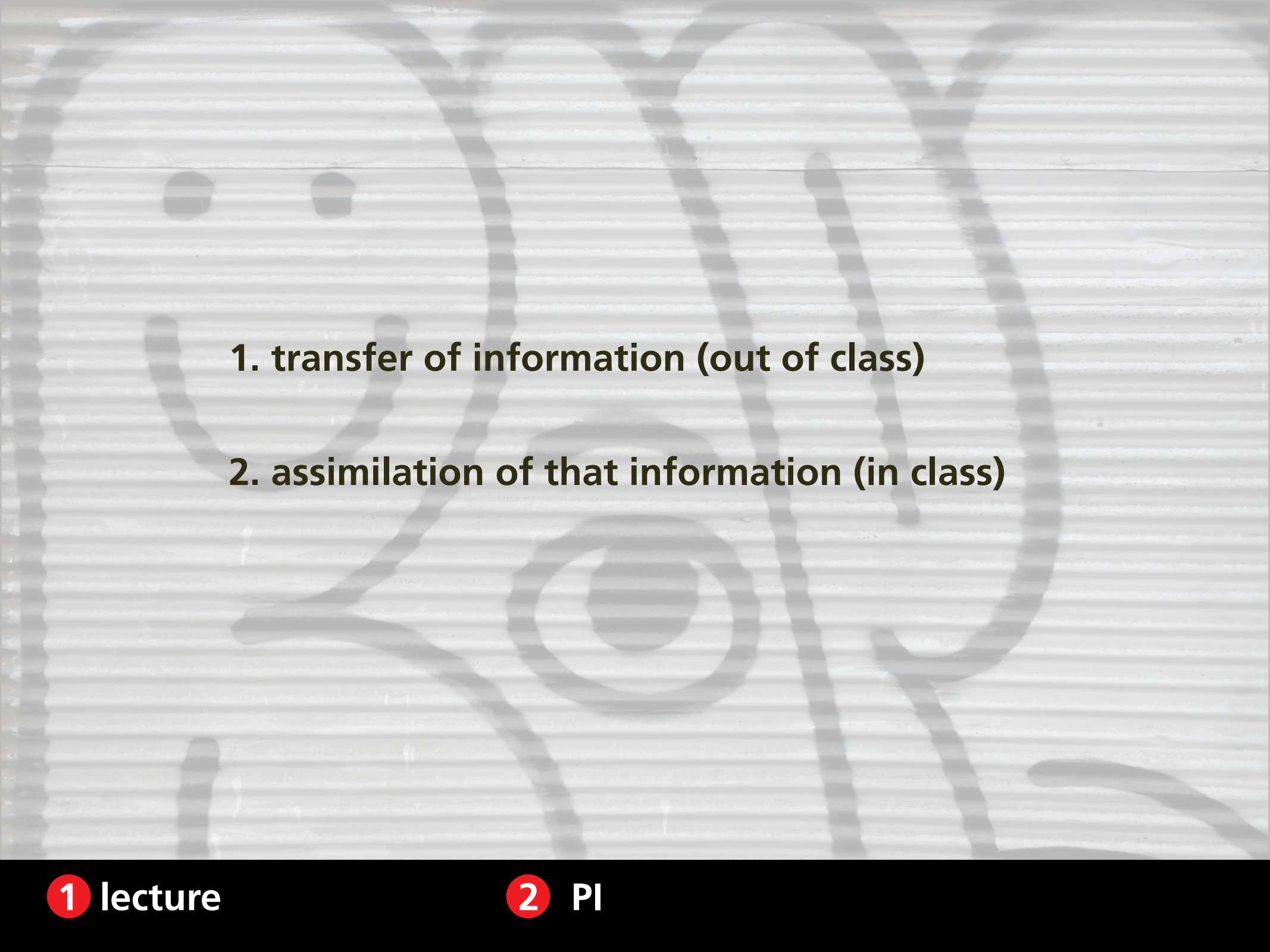


**Should focus  
on THIS!**

1. transfer of information (in class)

**2. assimilation of that information (out of class)**

- 
- 1. transfer of information (in class)**
  - 2. assimilation of that information (out of class)**

- 
1. transfer of information (out of class)
  2. assimilation of that information (in class)

A photograph of a man in a dark suit and red tie leaning over a group of students in a lecture hall. He is pointing at a document held by one of the students. The students are seated in green chairs with purple carpeting. The background shows other students and a wooden wall.

1. transfer of information (out of class)

2. assimilation of that information (in class)

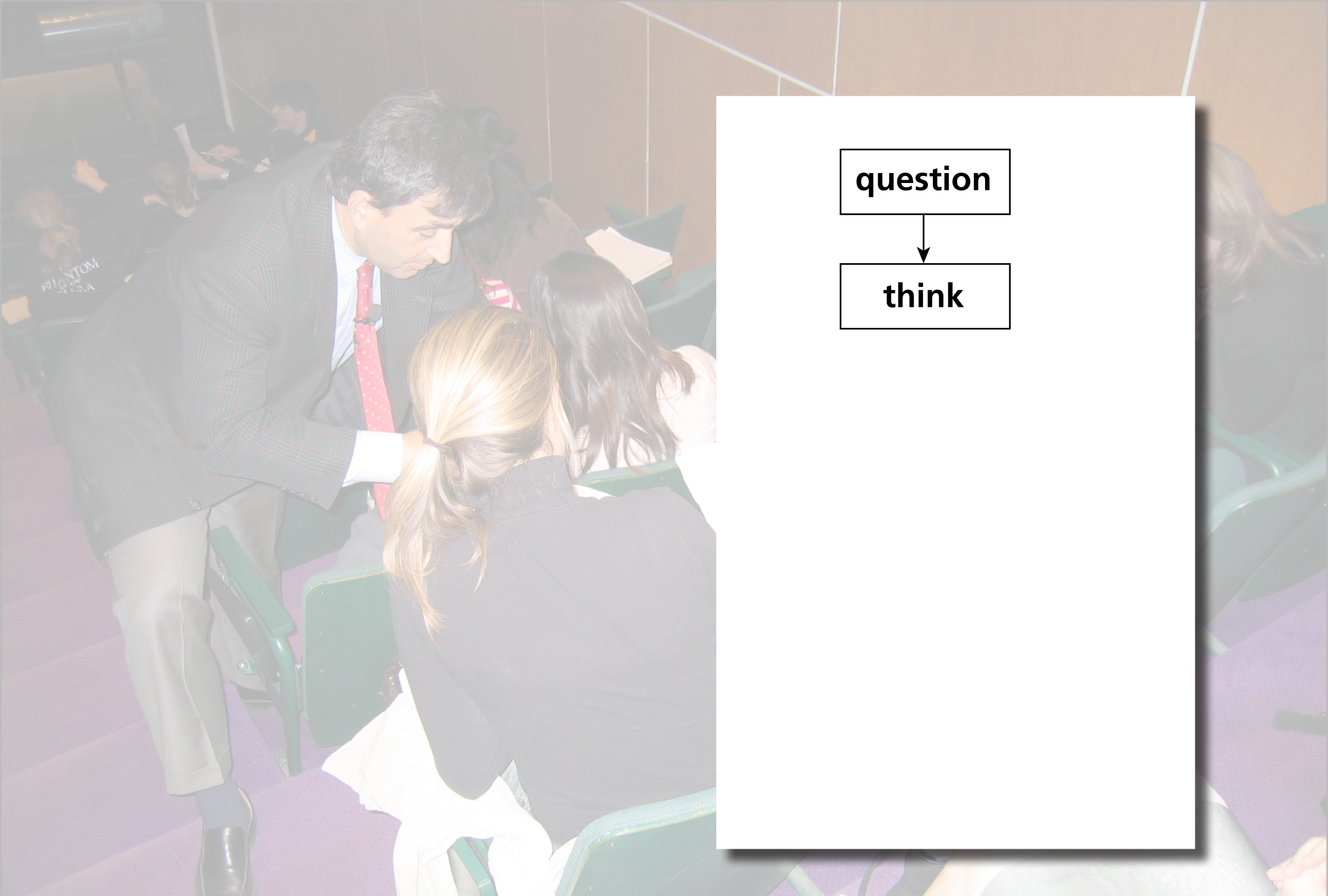
A man in a dark plaid suit and red tie is leaning over a woman with long blonde hair in a lecture hall. He appears to be adjusting her chair or providing assistance. Other people are visible in the background, some sitting at desks. The room has wood-paneled walls and green chairs.

question

1 lecture

2 PI

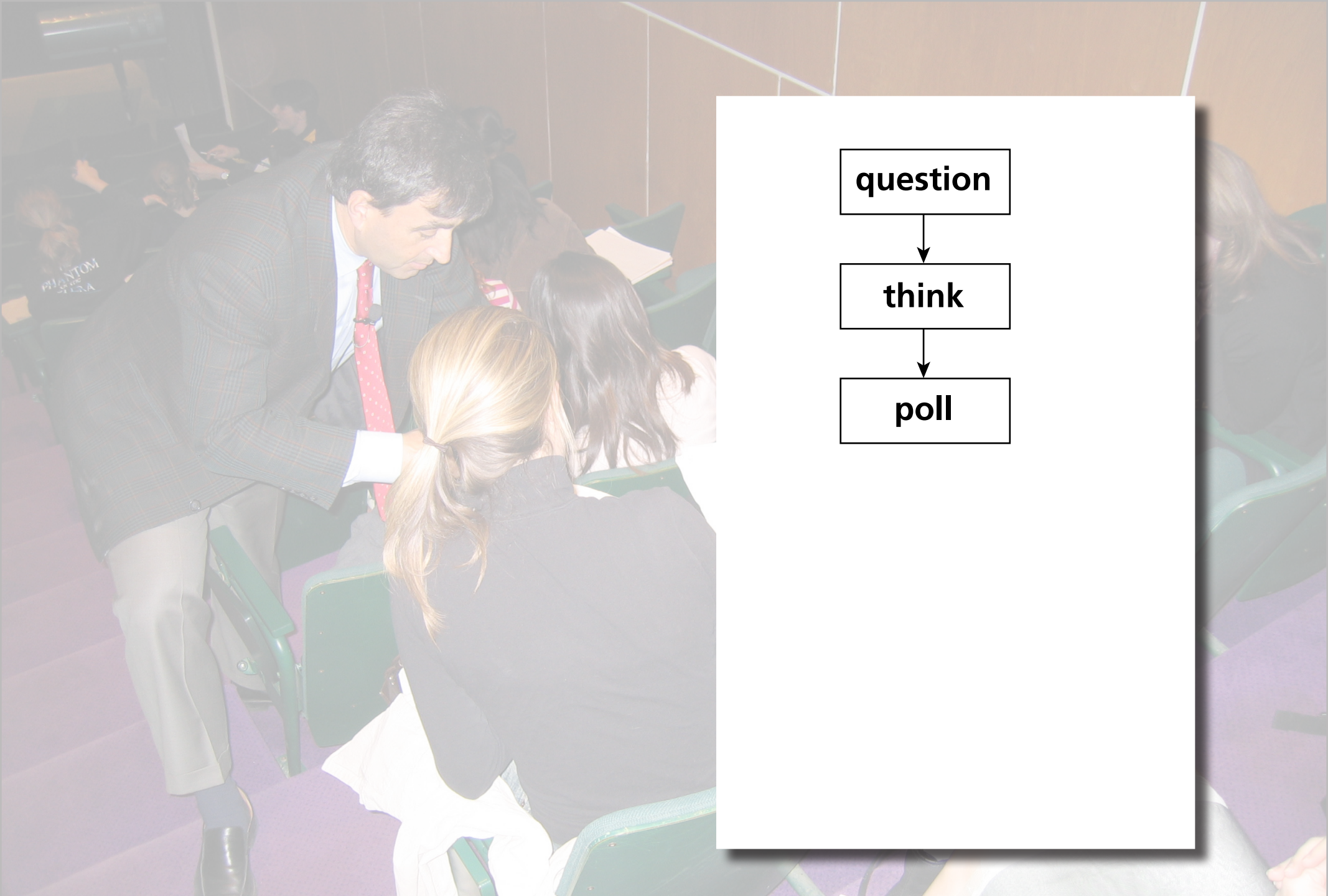




question



think



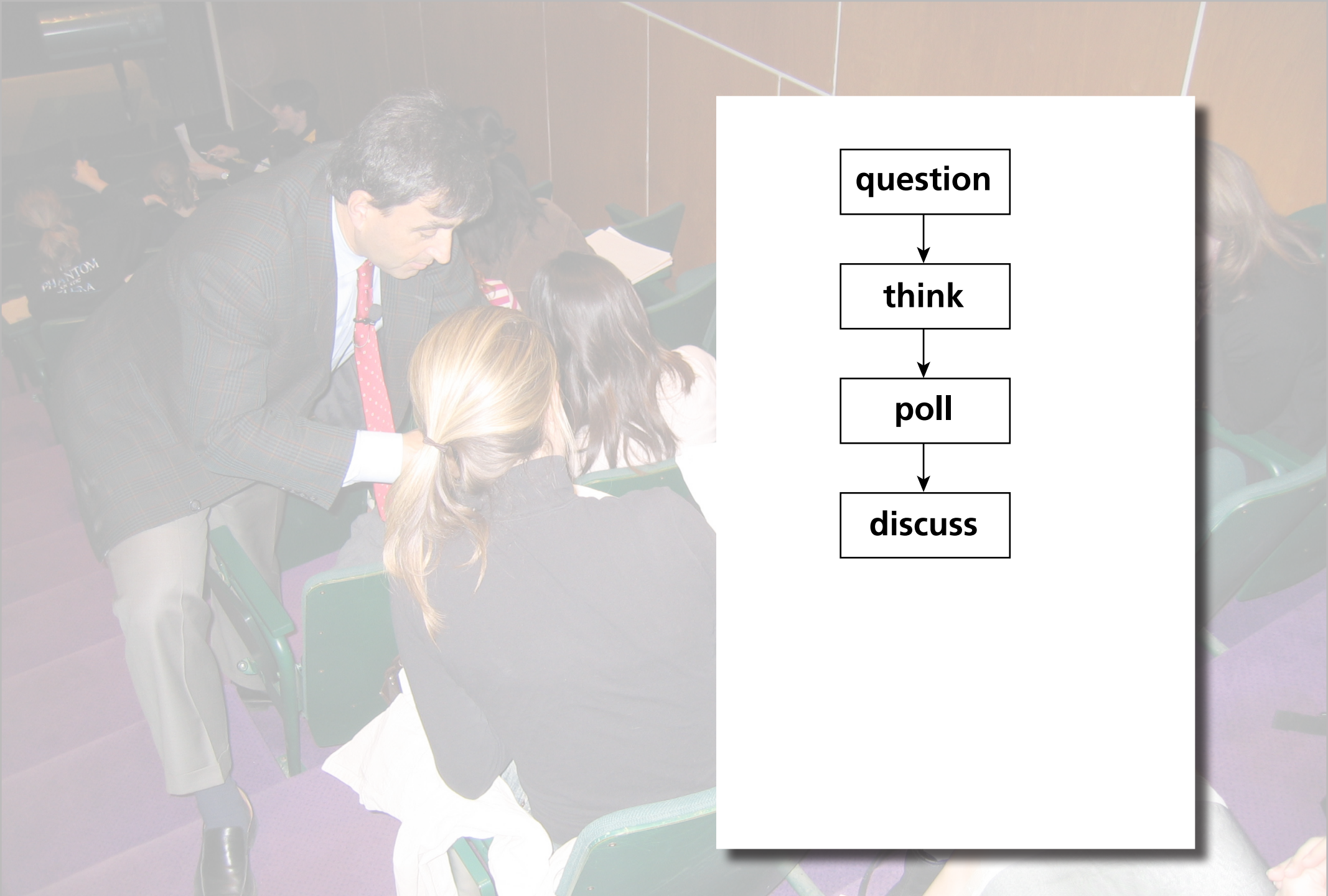
question



think



poll



**question**



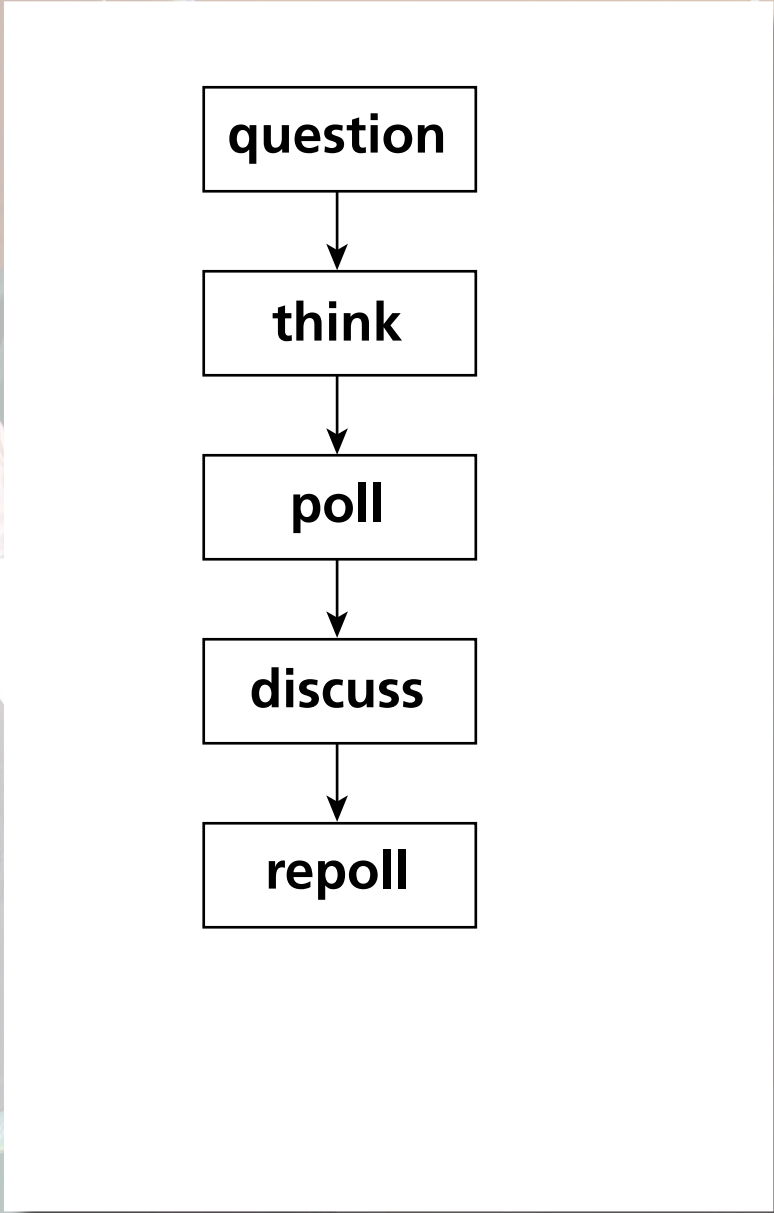
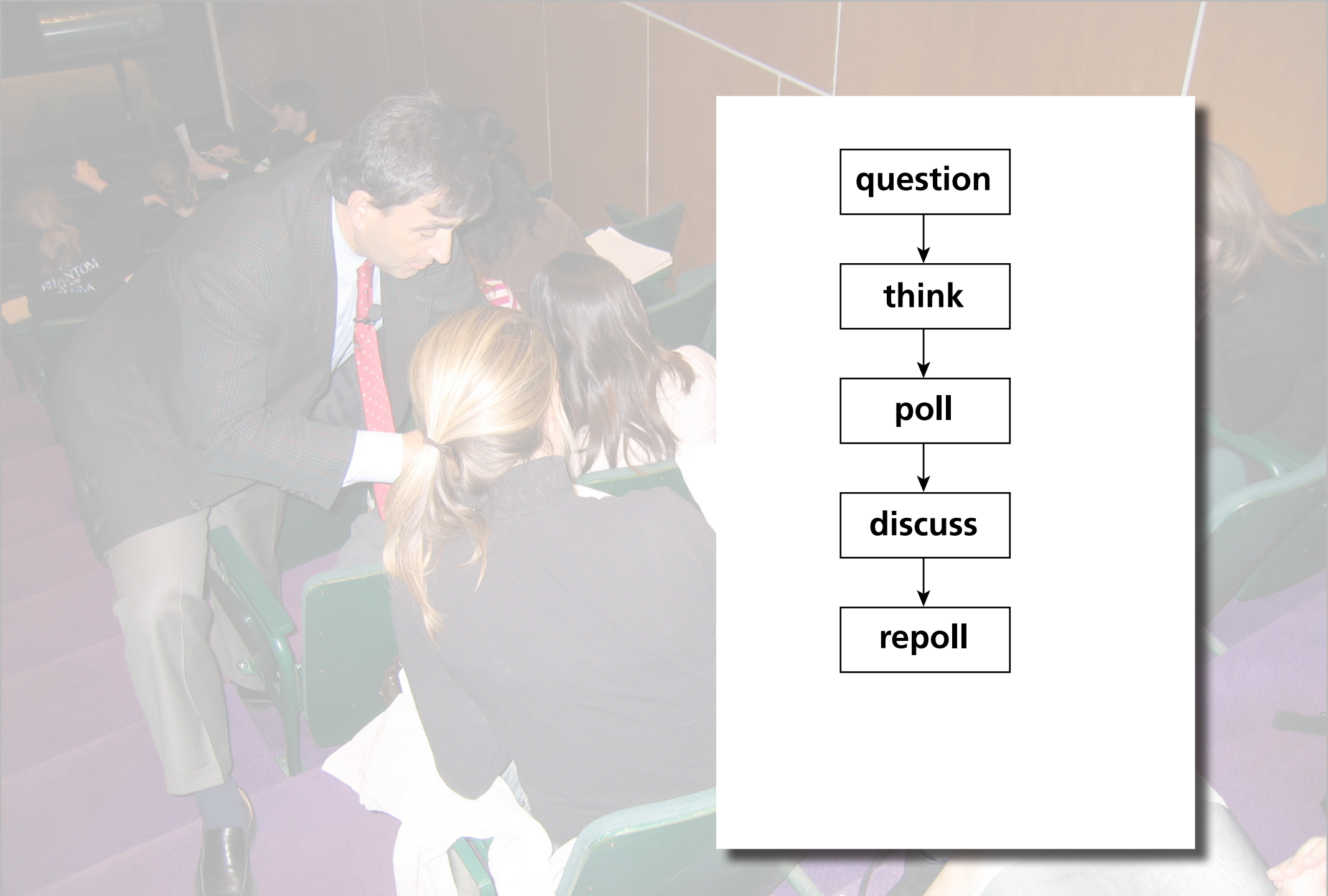
**think**

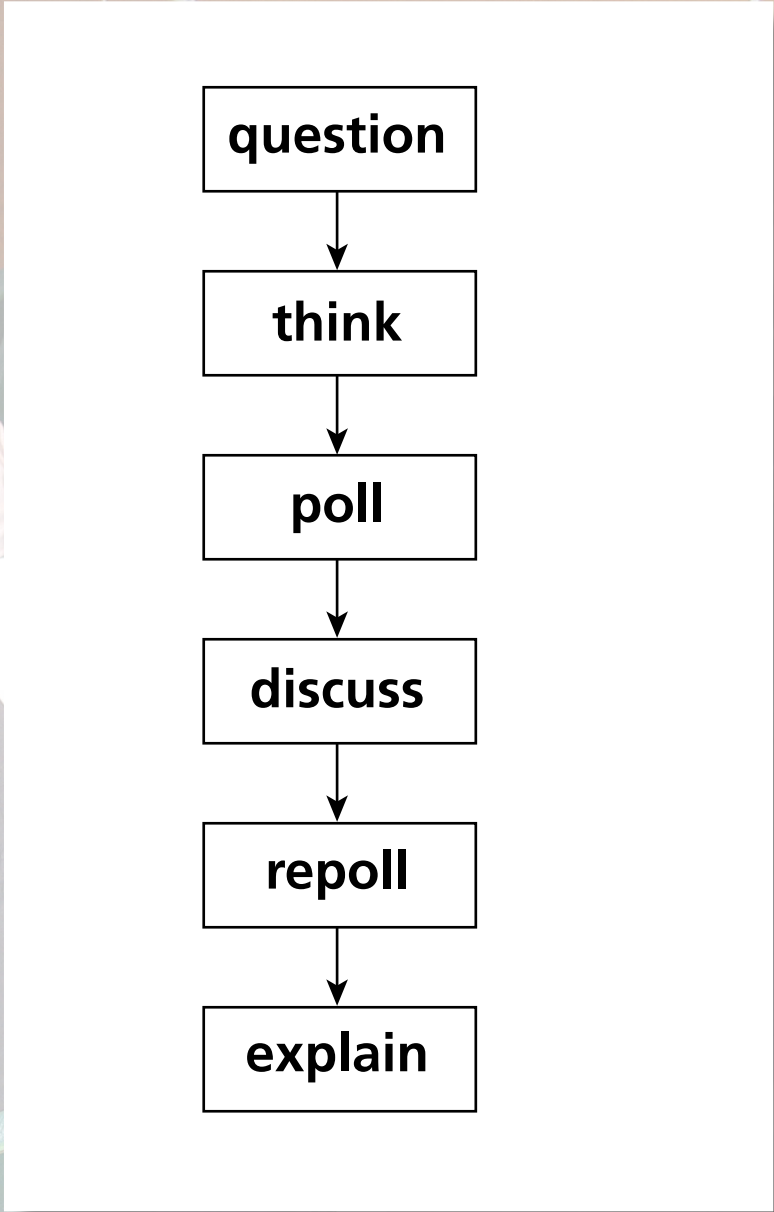
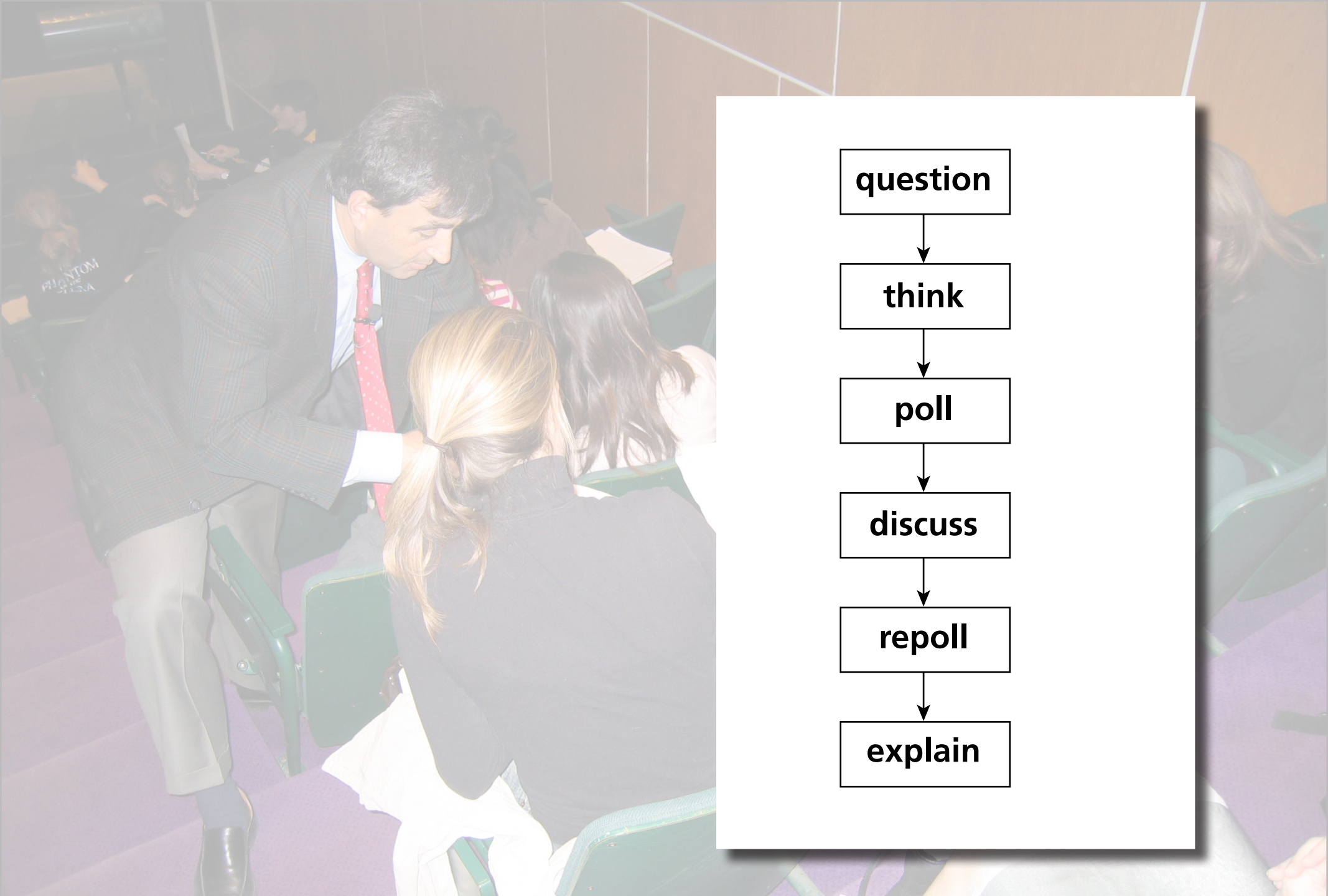


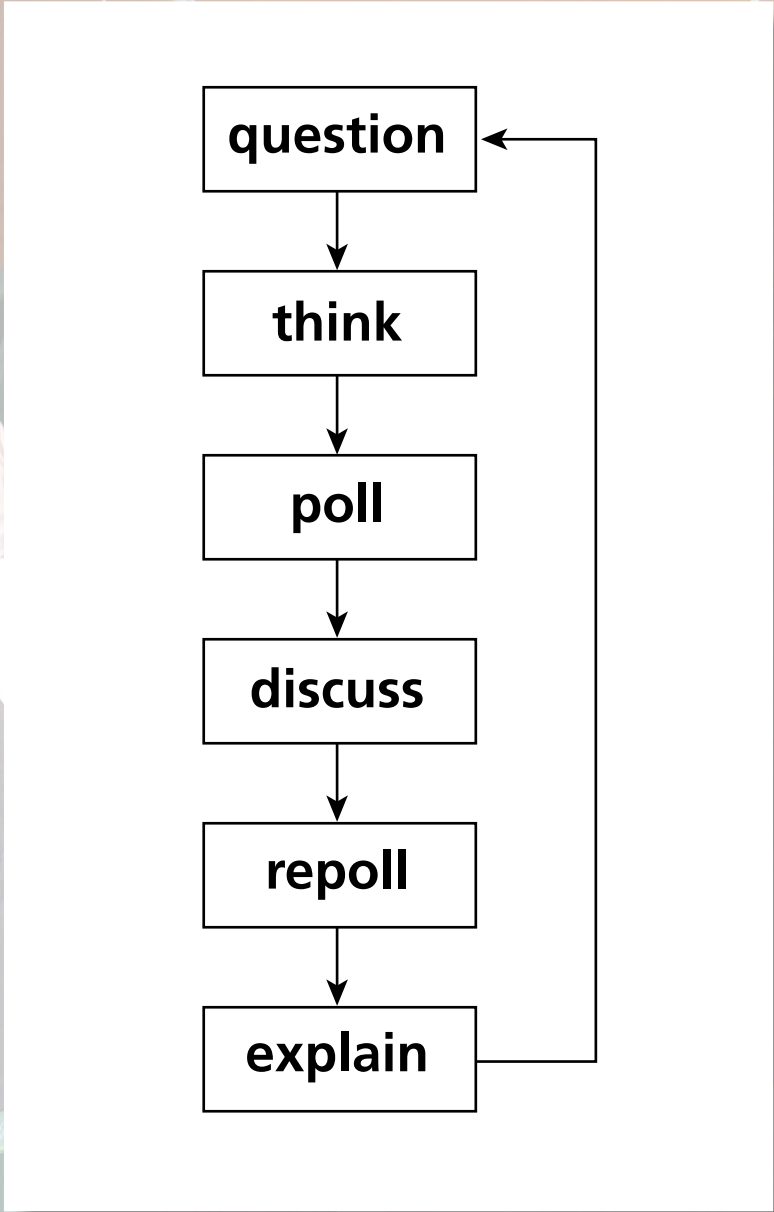
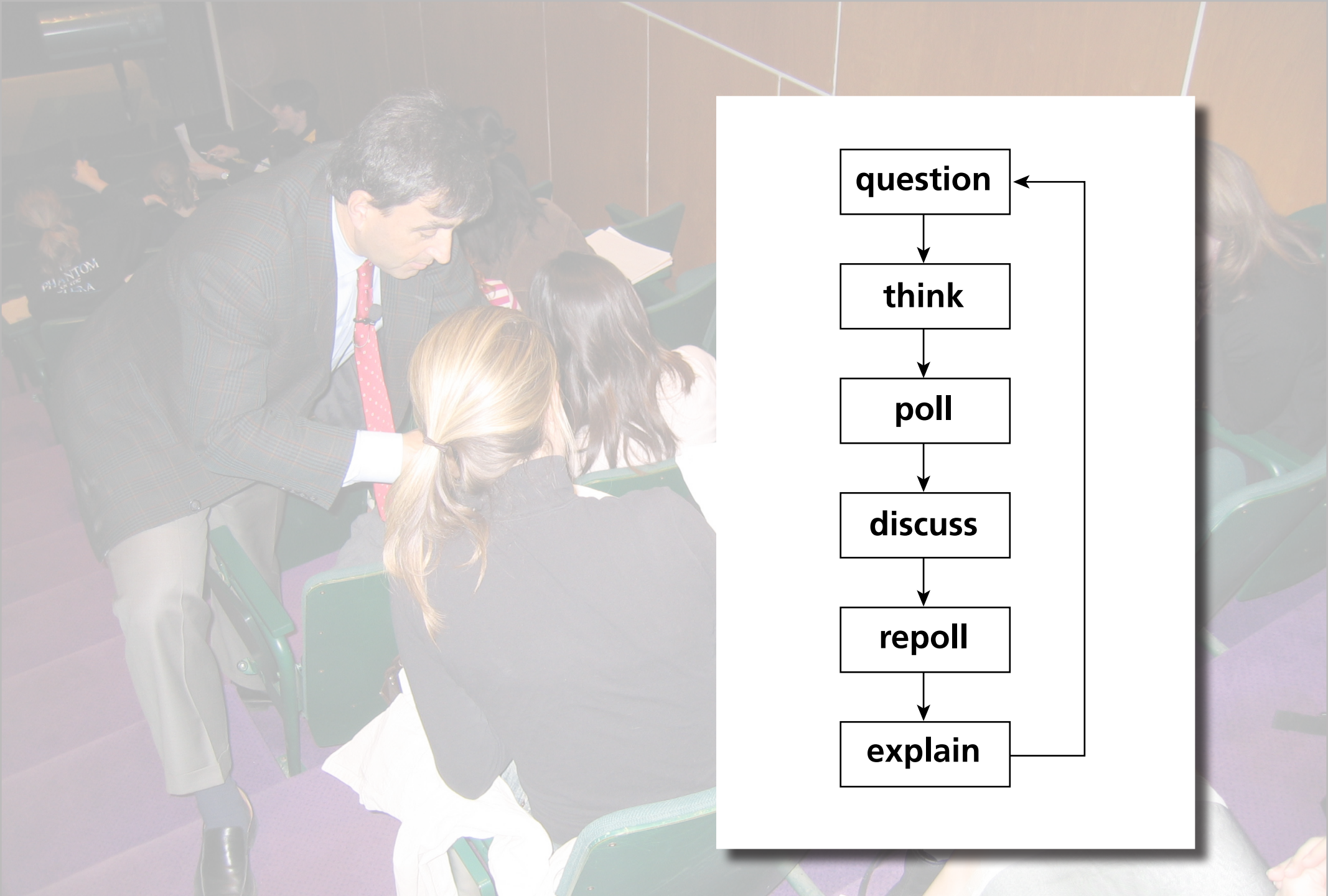
**poll**

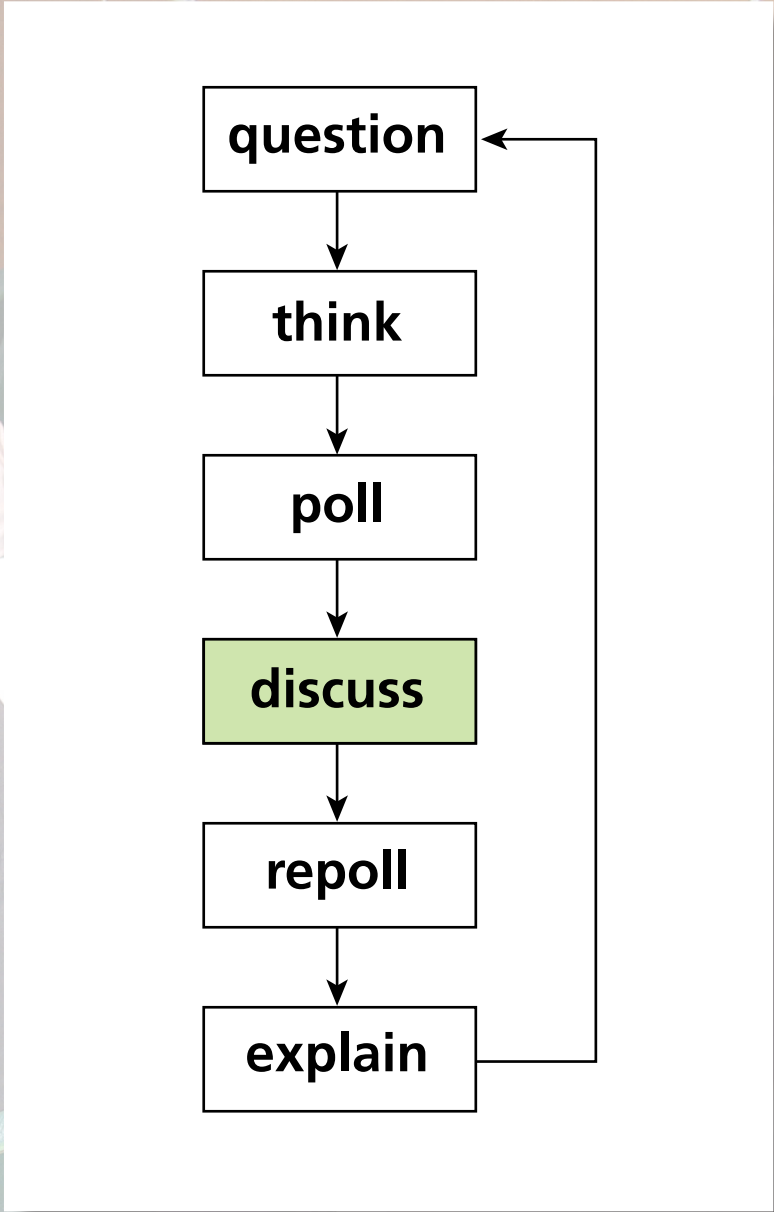
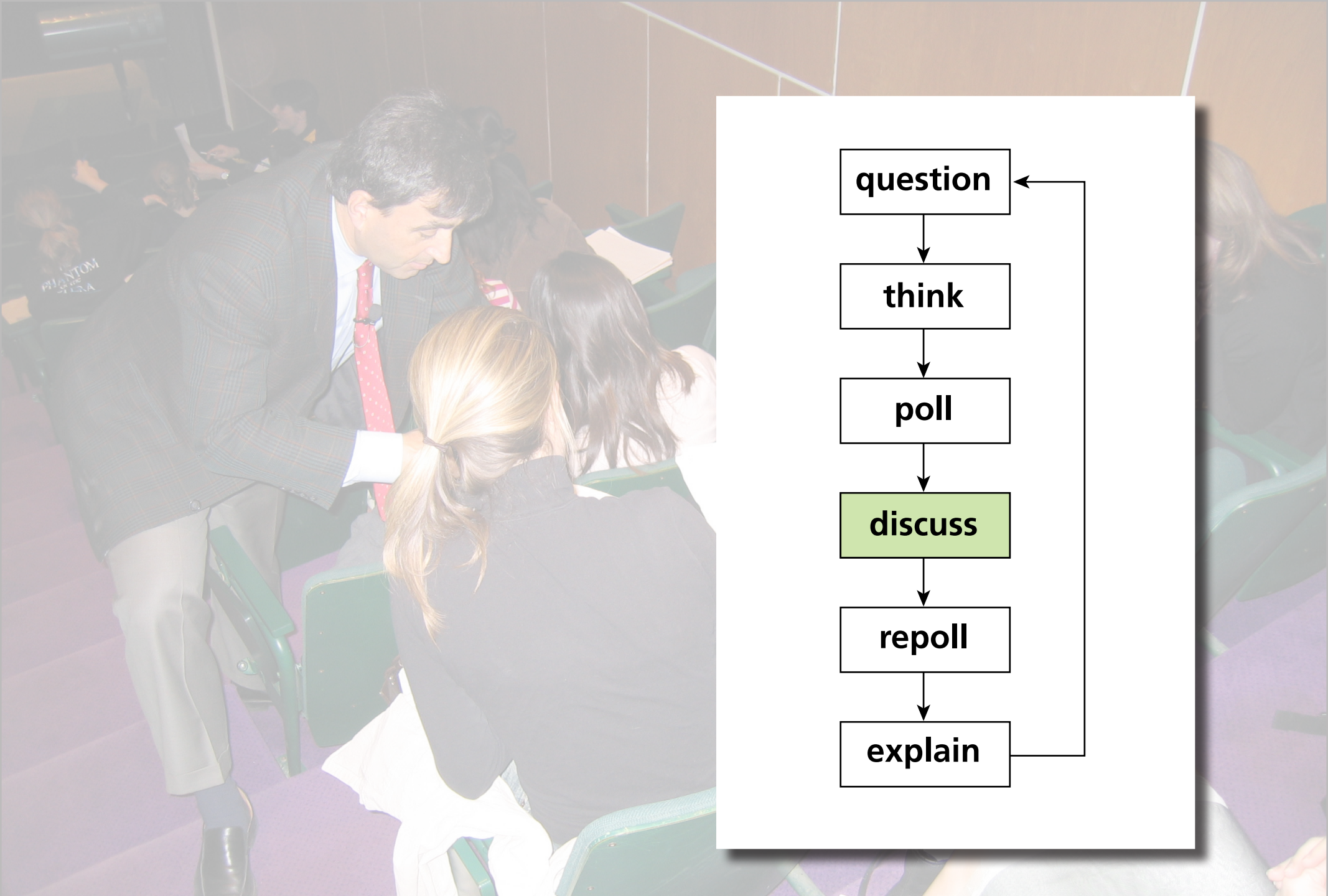


**discuss**











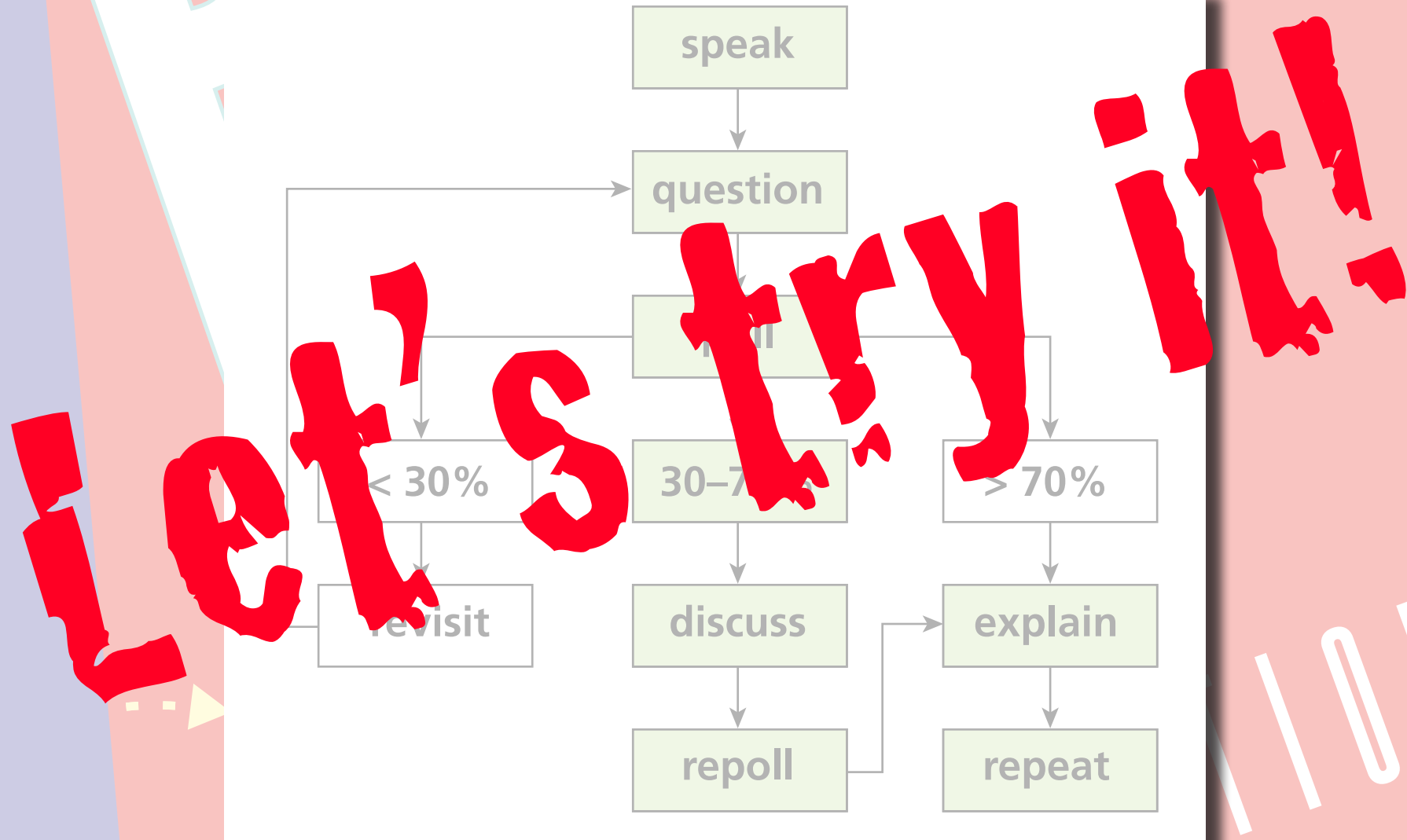


# Peer INSTRUCTION

The title 'Peer INSTRUCTION' is displayed in a large, white, sans-serif font. The word 'Peer' is on the top line, and 'INSTRUCTION' is on the bottom line. The 'I' in 'INSTRUCTION' is significantly larger than the other letters. The text is set against a light red background. A dashed yellow line with arrowheads forms a path that starts at the bottom left, curves up to the 'e' in 'Peer', then loops around the 'ee' and points to the 'r'. A dotted blue line starts from the 'r' and curves downwards and to the left, ending near the 'I' in 'INSTRUCTION'. A vertical blue bar is on the far left edge of the image.

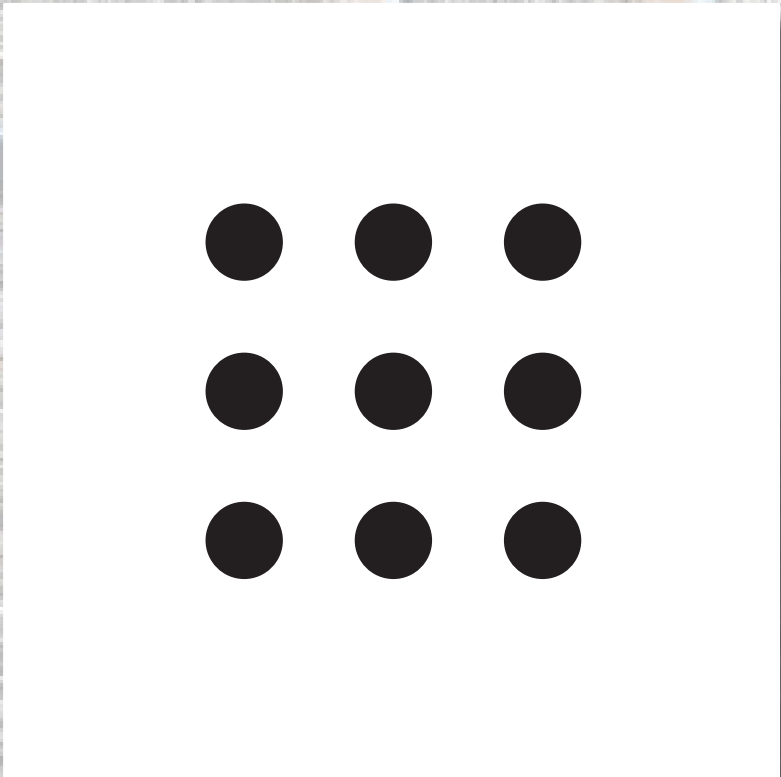
1 lecture

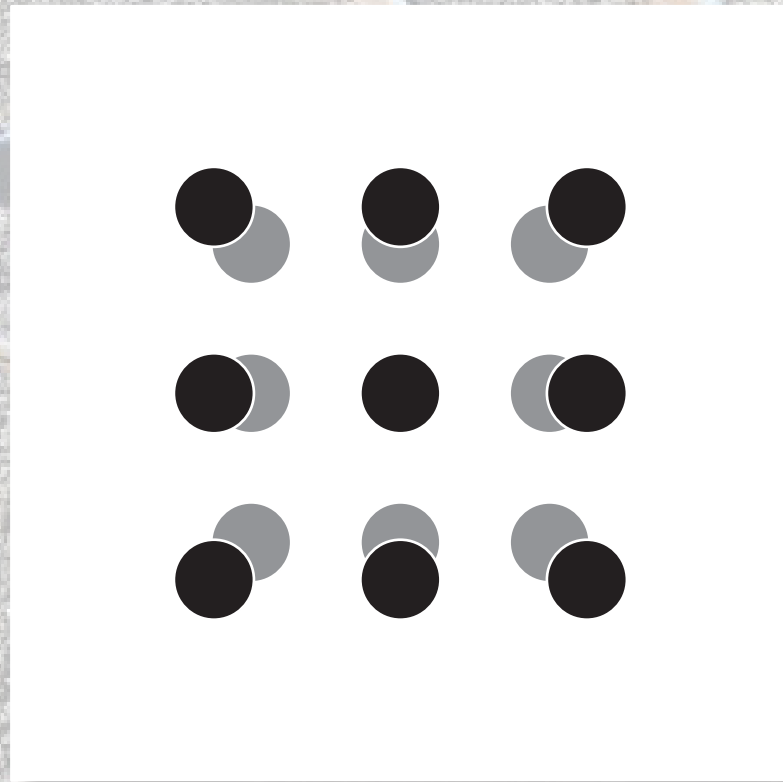
2 PI





**thermal expansion**

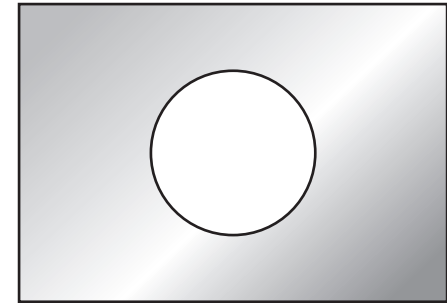




all of them

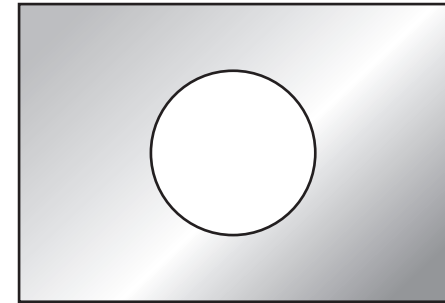
A white square is centered on the page, containing a 3x3 grid of black dots. Overlaid on this square and extending to the left and right is the text "all of them" in a large, red, stylized, handwritten font. The background of the entire slide is a photograph of a gravel path with several circular pits dug into it, set against a grassy area.

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



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

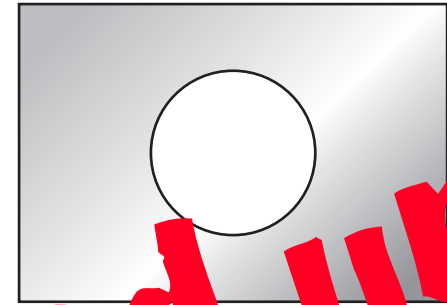
**When the plate is uniformly heated, the diameter of the hole**



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



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



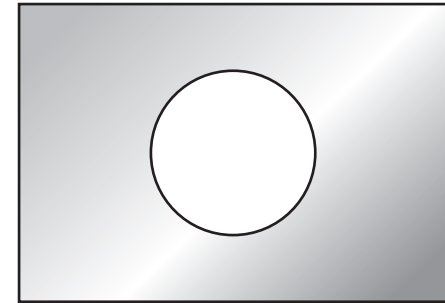
When the plate is uniformly heated, the diameter of the hole

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

**you got all fired up!**

**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.**

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

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

**You...**

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

**You...**

**1. made a commitment**

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

**You...**

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

**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**

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

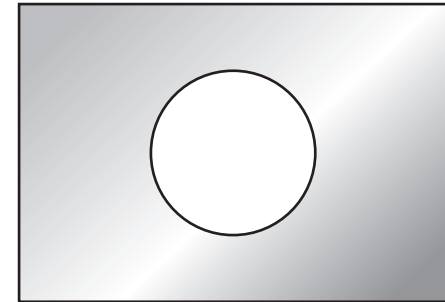
**You...**

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



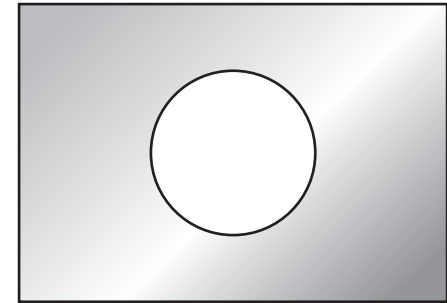
**Consider a rectangular metal plate with a circular hole in it.**

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



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

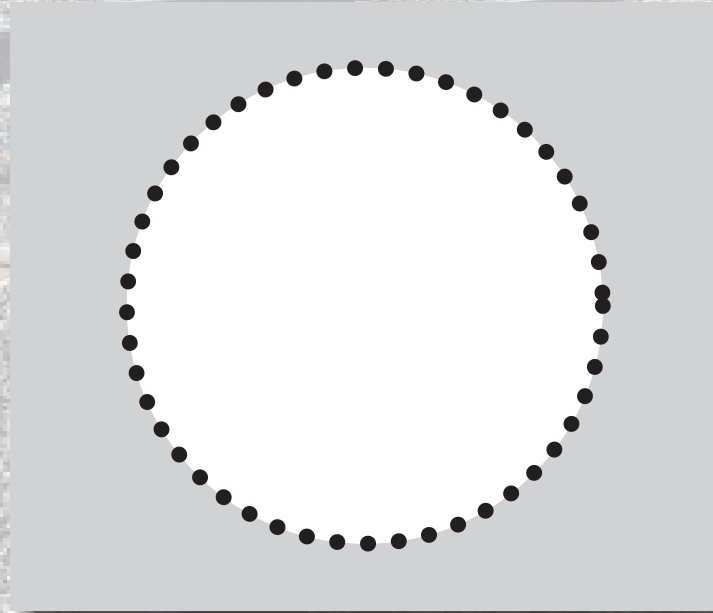
**Consider a rectangular metal plate with a circular hole in it.**



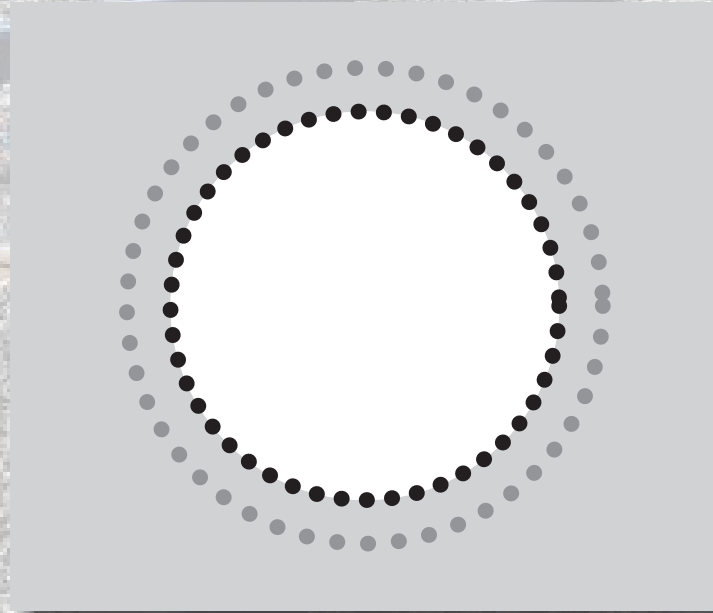
**When the plate is uniformly heated, the diameter of the hole**

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

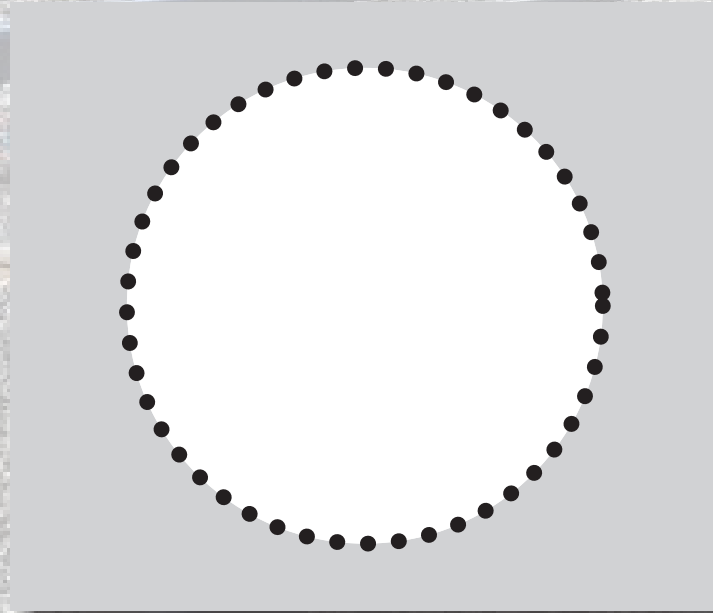
consider atoms at rim of hole



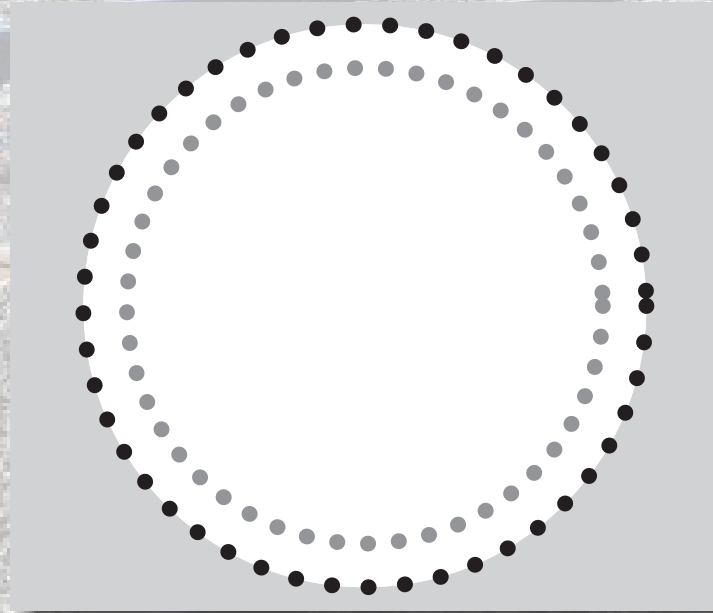
consider atoms at rim of hole



consider atoms at rim of hole



consider atoms at rim of hole



consider atoms at rim of hole

**you won't forget this**

A diagram of a circular hole with a dotted border, overlaid on a background of a winding path in a field. The text "you won't forget this" is written in a large, red, stylized font across the diagram.

# Peer

back to pi

INSTRUCTION



Peer  
**Higher learning & gains**

INSTRUCTION

1 lecture

2 PI

# Peer

**Higher learning gains**

**Better retention**

INSTRUCTION



**1** lecture

**2** PI

**3** PI 2.0

**feedback**

**1** lecture

**2** PI

**3** PI 2.0



1991



1 lecture

2 PI

3 PI 2.0



1993

A black handheld device, possibly a remote control or a small keypad, is shown at an angle. It features a numeric keypad with buttons labeled 1 through 9, 0, and a red button. A green logo with the letters 'FRS' is visible on the bottom right. The year '1998' is overlaid in large white text in the center.

# 1998



1 lecture

2 PI

3 PI 2.0





# technology

1 lecture

2 PI

3 PI 2.0



How do I...

- design good questions?
- optimize the discussions?
- manage time?

# learning | catalytics

1 lecture

2 PI

3 PI 2.0

Use intelligent algorithms and data analytics to...

- improve questioning
- manage discussions
- facilitate time management/flow

- lowest
- a. A 30-year fixed rate mortgage at 12%
  - b. A 15-year fixed rate mortgage at 12%
  - c. A 30-year fixed rate mortgage at 12%
  - d. A 15-year fixed rate mortgage at 12%
2. The biggest factor that leads American companies to manufacture their products overseas in India is:
- a. Higher quality of craftsmanship
  - b. Lower labor costs
  - c. Decreased transportation costs
  - d. Effective legal systems
3. Which of the following correctly summarizes the accounting equation for a sole proprietorship?
- a.  $Assets = Liabilities + Owners' equity$
  - b.  $Liabilities = Assets + Owners' equity$
  - c.  $Owner's equity = Assets + Liabilities$
  - d.  $Revenue = Assets - Liabilities$
4. In order to present a business plan to a group of potential investors, a businessperson would most likely use which of the following?
- a. Powerpoint
  - b. Quickbooks
  - c. Peoplesoft
  - d. Excel
5. In order to start an online business, and individual would need all but which of the following:
- a. business model
  - b. capital
  - c. market research
  - d. depreciation?

## extensible plug-in architecture for question types

- a. A 30-year fixed rate mortgage at 12%
- b. A 15-year fixed rate mortgage at 12%
- c. A 30-year fixed rate mortgage at 12%
- d. A 15-year fixed rate mortgage at 12%

2. The biggest factor that leads American companies to manufacture their products over India is:

- a. Higher quality of craftsmanship
- b. Lower labor costs
- c. Decreased transportation costs
- d. Effective legal systems

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4. In order to present a business plan to a group of potential investors, a businessperson should most likely use which of the following?

- a. Powerpoint
- b. Quickbooks
- c. Peoplesoft
- d. Excel

5. In order to start an online business, an individual would need all but which of the following:

business model

## Sample question types:

- direction
- mathematical expression
- long answer, short answer, word cloud
- numerical, data collection
- ranking, priority
- region (select point on image)
- sketch, composite sketch
- highlight passage

## Sample question types:

- direction

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- region (select point on image)

- sketch, composite sketch

- highlight passage





1 [lccatalytics.com](https://lccatalytics.com)

2 create student account

3 ID 1234567

# learning | catalytics

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4. direction of prevailing winds. The image provides several clues about the direction of prevailing winds in Oahu. Indicate this direction by drawing an arrow on your screen. [Deliver](#) [Show all results](#)



1 lecture

3 PI 2.0

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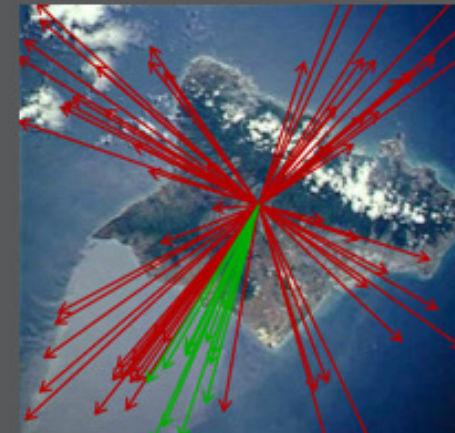
4. direction  
prevailing

...le. The image provides several clues about the direction of  
...on your screen.

[Deliver](#) [Show all results](#)

Round 1

77 responses, 16% correct



✓ 17 get it now  
✗ 3 still don't get it



1 lecture

3 PI 2.0

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optics i

current session: **766079** | 69 students

[Back to all lectures](#) [Stop session](#) [Review results](#) [Seat map](#) [Show floating session ID](#) [Edit](#) [Delete](#)



Jump to ▾

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15



4. direction Light enters horizontally into the combination of two perpendicular mirrors as shown below.

[Deliver](#) [Show all results](#)



Indicate the direction of the incident light after it reflects off of both mirrors.

[feedback & support](#)

1 lecture

2 PI

3 PI 2.0

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current session: **766079** | 69 students

[Map](#) [Show floating session ID](#) [Edit](#) [Delete](#)

6 7 8 9 10 11 12 13 14 15

perpendicular mirrors as shown below.

[Deliver](#) [Show all results](#)

[feedback & support](#)



1 lecture

3 PI 2.0

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current session: **766079** | 69 students

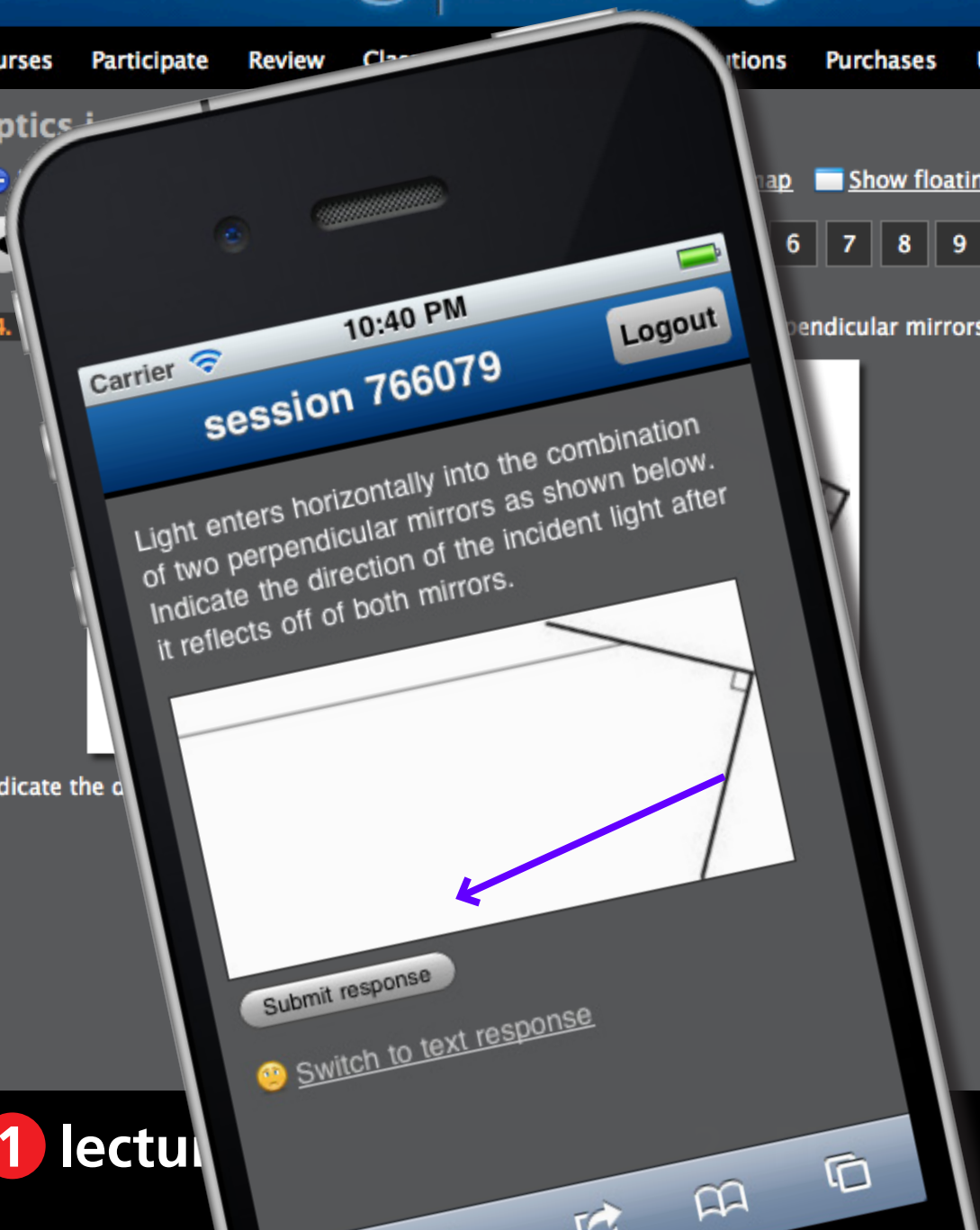
[Map](#)  [Show floating session ID](#) [Edit](#) [Delete](#)

6 7 8 9 10 11 12 13 14 15

perpendicular mirrors as shown below.

[Deliver](#) [Show all results](#)

[feedback & support](#)



1 lecture

3 PI 2.0

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current session: **766079** | 69 students

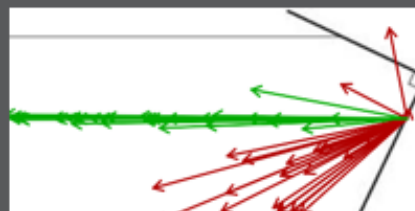
[Map](#) [Show floating session ID](#) [Edit](#) [Delete](#)

6 7 8 9 10 11 12 13 14 15

perpendicular mirrors as shown below.

[Deliver](#) [Show all results](#)

Round 1     
● 57 responses, 58% correct



 [feedback & support](#)



1 lecture

3 PI 2.0

# learning | catalytics

Courses Participate Review Classifications Purchases Users Tour Help

current session: **766079** | 69 students

Map  Show floating session ID  Edit  Delete

6 7 8 9 10 11 12 13 14 15

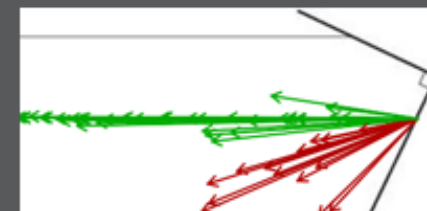
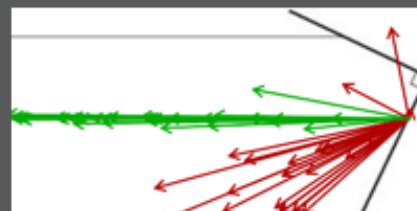


perpendicular mirrors as shown below.

Deliver  Show all results

Round 1     
● 57 responses, 58% correct

Round 2     
● 51 responses, 73% correct



✓ 8 get it now  
✗ 0 still don't get it

feedback & support



1 lecture

3 PI 2.0



## Sample question types:

- direction

- mathematical expression

- long answer, short answer, word cloud

- numerical, data collection

- ranking, priority

- region (select point on image)

- sketch, composite sketch

- highlight passage

**If  $2x - y = 4$ , then  $x =$**

## Sample question types:

- direction

- mathematical expression

- long answer, short answer, word cloud

- numerical, data collection

- ranking, priority

- region (select point on image)

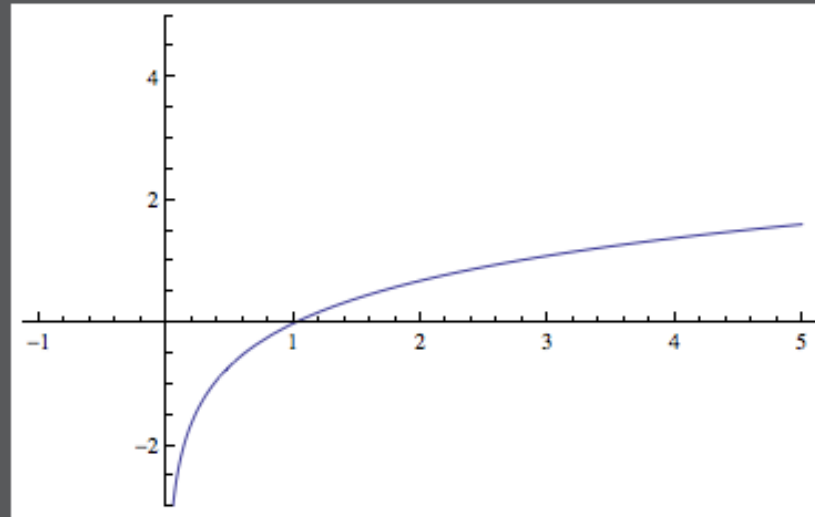
- sketch, composite sketch

- highlight passage

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This is a graph of  $f(x) = \ln x$ . Sketch a graph of the derivative  $f'(x)$ .



**1** lecture

**2** PI

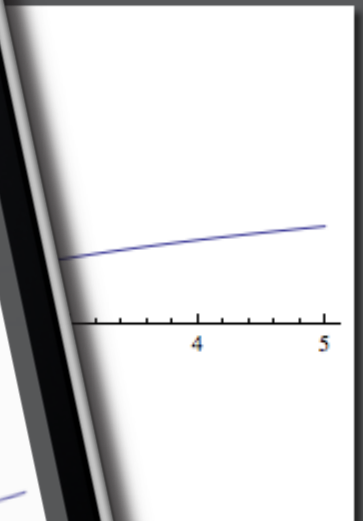
**3** PI 2.0

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This is a graph of  $f(x) =$



**1** lecture

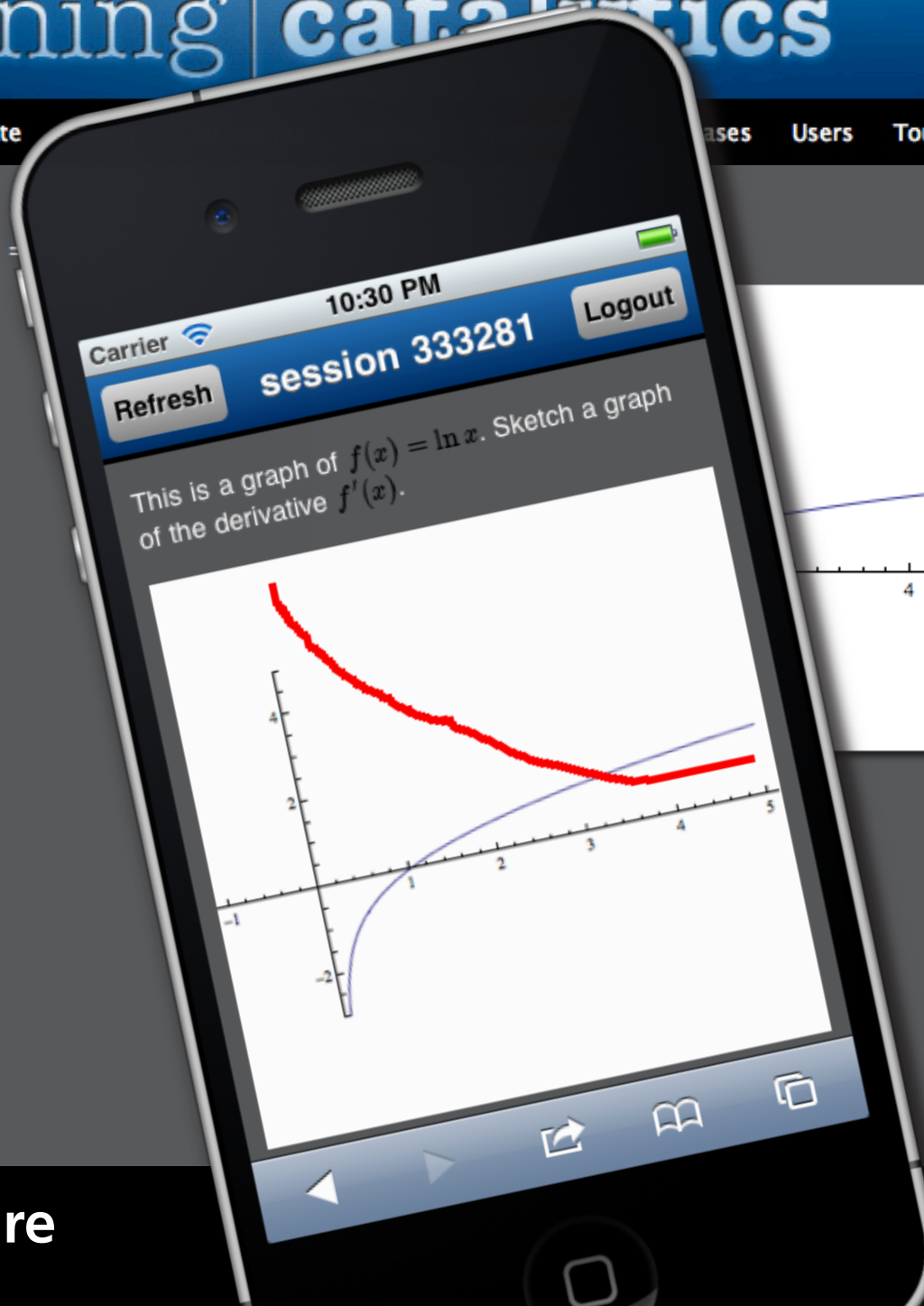
**3** PI 2.0

# learning | catalytics

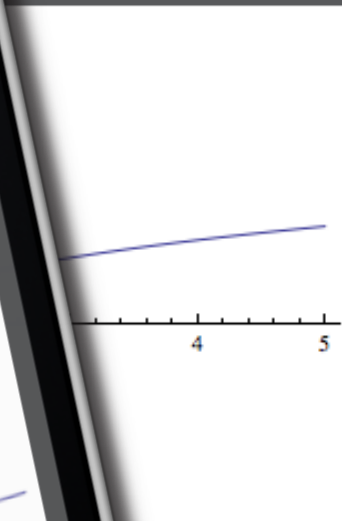
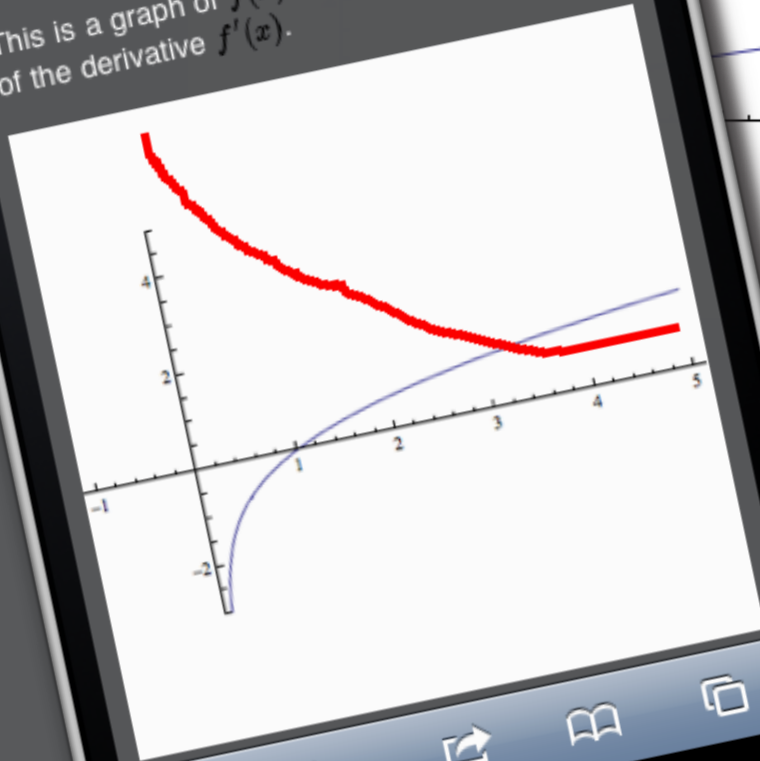
Courses Participate

ases Users Tour Help

This is a graph of  $f(x) =$

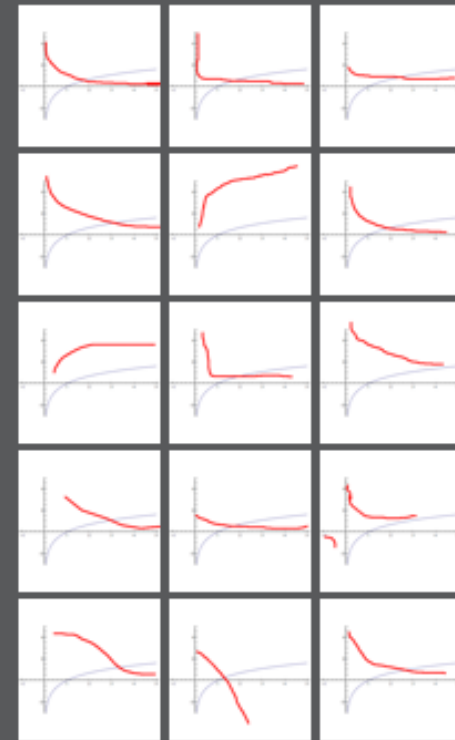


This is a graph of  $f(x) = \ln x$ . Sketch a graph of the derivative  $f'(x)$ .



Round 1

15 responses



✓ 6 get it now  
 ✗ 0 still don't get it

1 lecture

3 PI 2.0

## Sample question types:

- direction
- mathematical expression
- long answer, short answer, word cloud
- numerical data collection
- ranking priority
- region (select point on image)
- sketch, composite sketch
- highlight passage

# data analytics



1 lecture

2 PI

3 PI 2.0





# human interaction

1 lecture

2 PI

3 PI 2.0

Carrier 9:31 PM 100%

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A positively charged rod is held near a neutral conducting sphere as illustrated below. A positively charged particle is moved from point A to point B



Round 1  
74 responses, 61% correct

A. 61%
B. 4%
C. 35%
D. 0%
E. 0%

Round 2  
75 responses, 83% correct

A. 83%
B. 0%
C. 17%
D. 0%
E. 0%

A. positive  
B. zero  
C. negative  
D. depends on the path taken from A to B  
E. cannot be determined without knowing more about the polarization induced in the sphere

Search:

1 lecture

2 PI

3 PI 2.0

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A positively charged rod is held near a neutral conducting sphere as illustrated below. A positively charged particle is moved from point A to point B as illustrated below. The potential difference from A to B is

A. positive  
 B. zero  
 C. negative  
 D. depends on the path taken from A to B  
 E. cannot be determined without knowing more about the polarization induced in the sphere

**Round 1**  
 74 responses, 61% correct

A. 61%
B. 4%
C. 35%
D. 0%
E. 0%

**Round 2**  
 75 responses, 83% correct

A. 83%
B. 0%
C. 17%
D. 0%
E. 0%

Search: \_\_\_\_\_

1 lecture

2 PI

3 PI 2.0

Carrier 9:31 PM 100%

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Jump to 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Round 1 74 responses, 61% correct

Round 2 75 responses, 83% correct

A. 61% B. 4% C. 35% D. 0% E. 0%

A. 83% B. 0% C. 17% D. 0% E. 0%

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Search:

1 lecture

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3 PI 2.0

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# learning catalytics





A positively charged rod is held near a neutral conducting sphere as illustrated below. A positively charged particle is moved from point A to point B as illustrated below.



A. positive  
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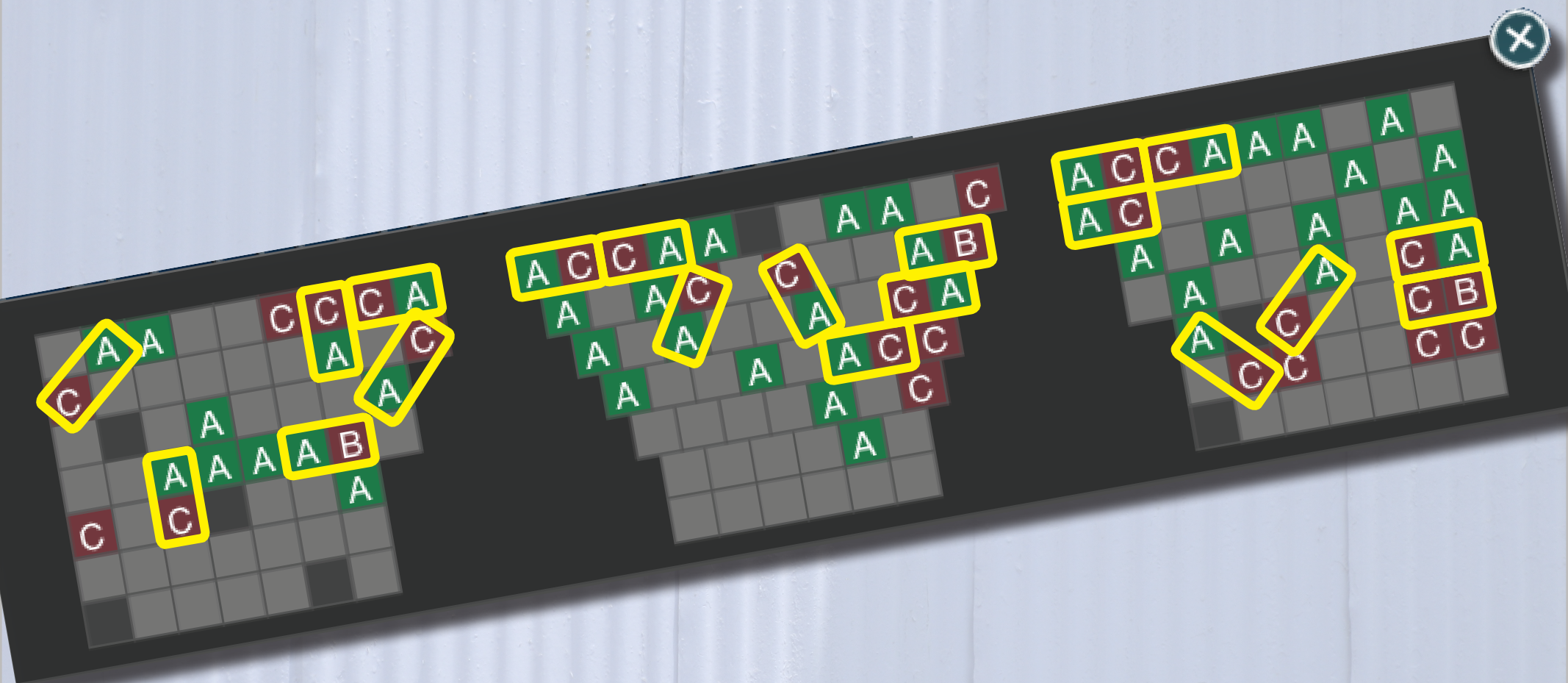
Search: \_\_\_\_\_

1 lecture

2 PI

3 PI 2.0

let system manage pairing

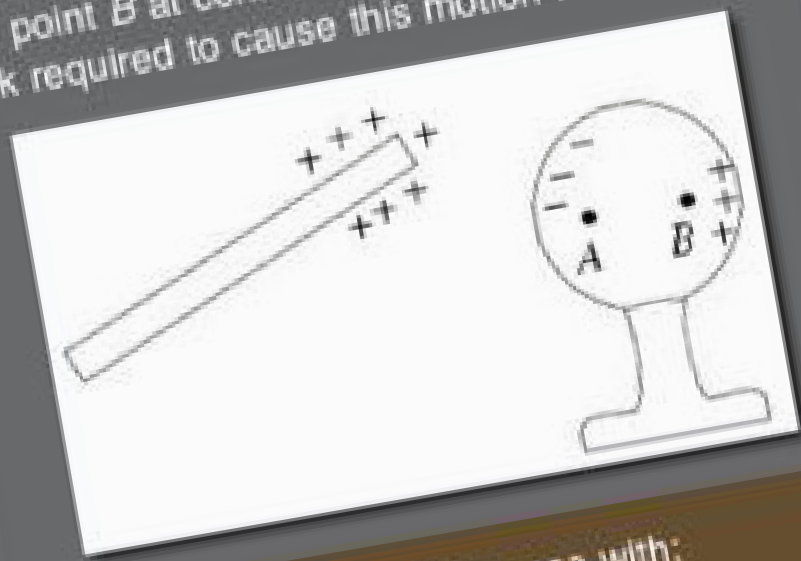


1 lecture

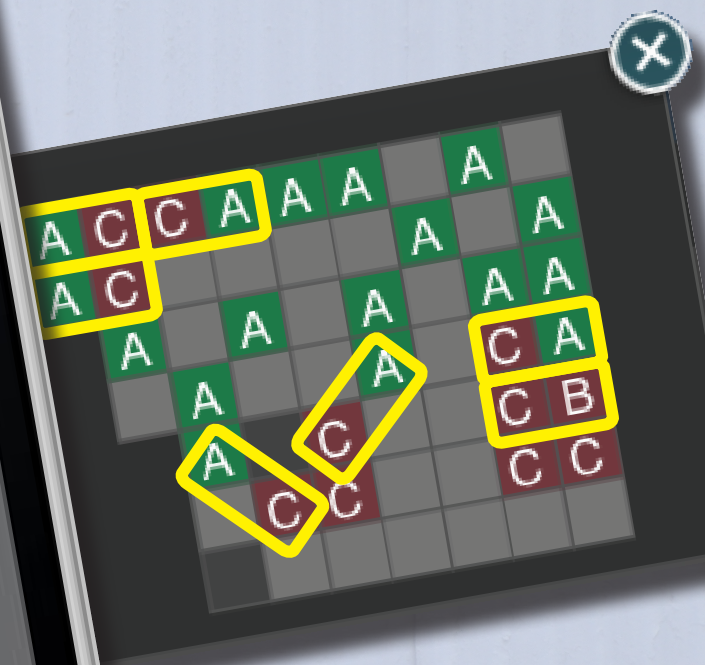
2 PI

3 PI 2.0

A positively charged rod is held near a neutral conducting sphere as illustrated below. A positively charged particle is moved from point A to point B at constant speed. The mechanical work required to cause this motion is



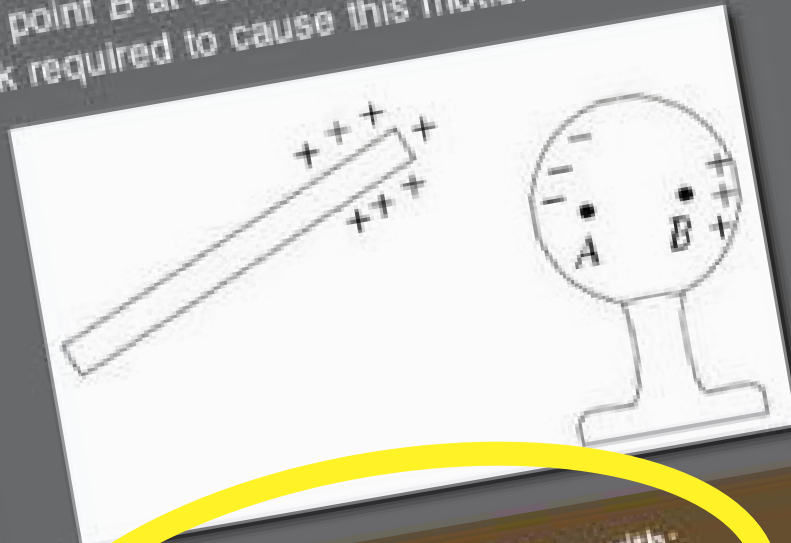
Please discuss your response with:  
• Brian Lukoff (to your left)  
✓ I am talking to this person/people





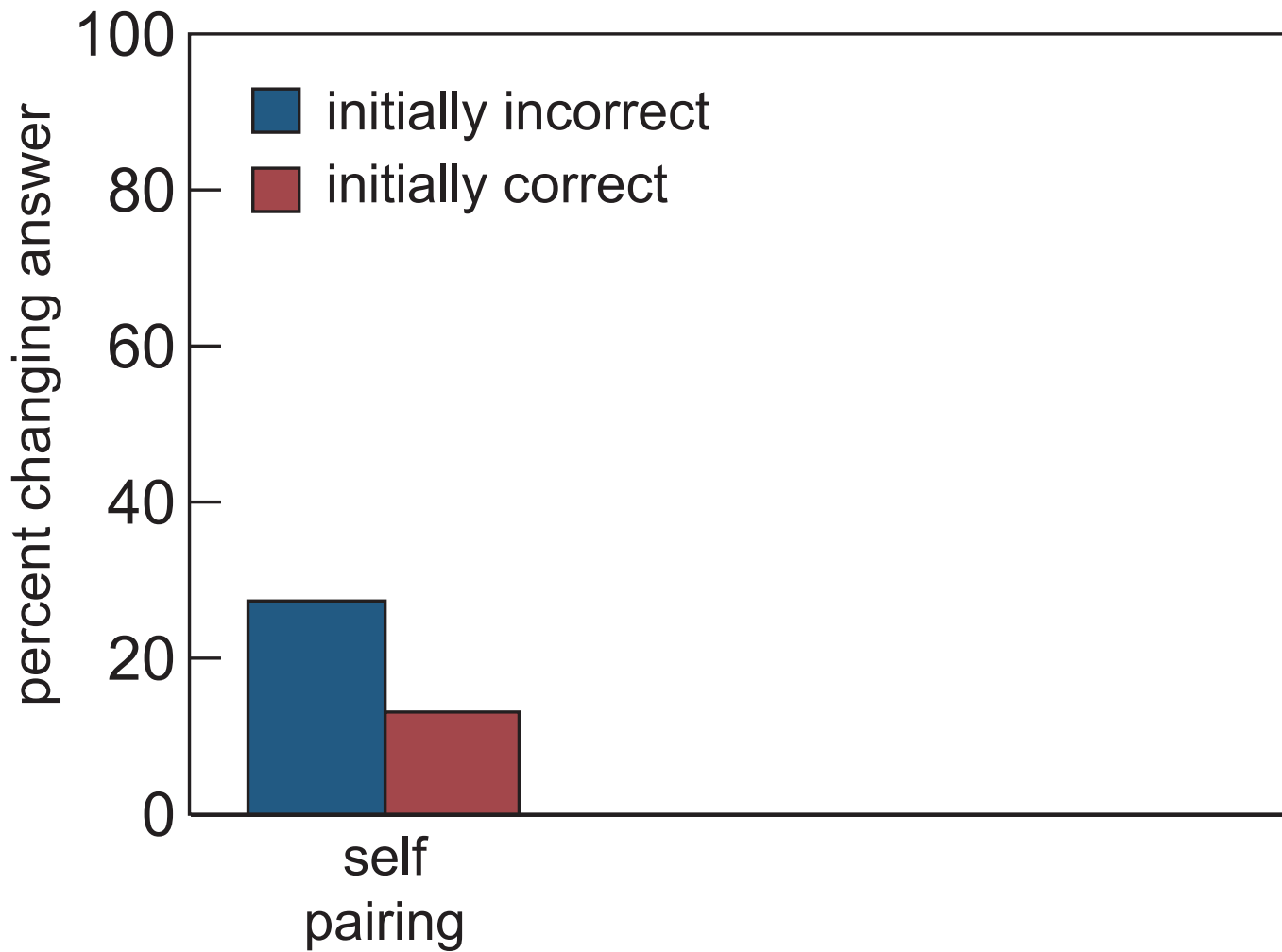
Leave

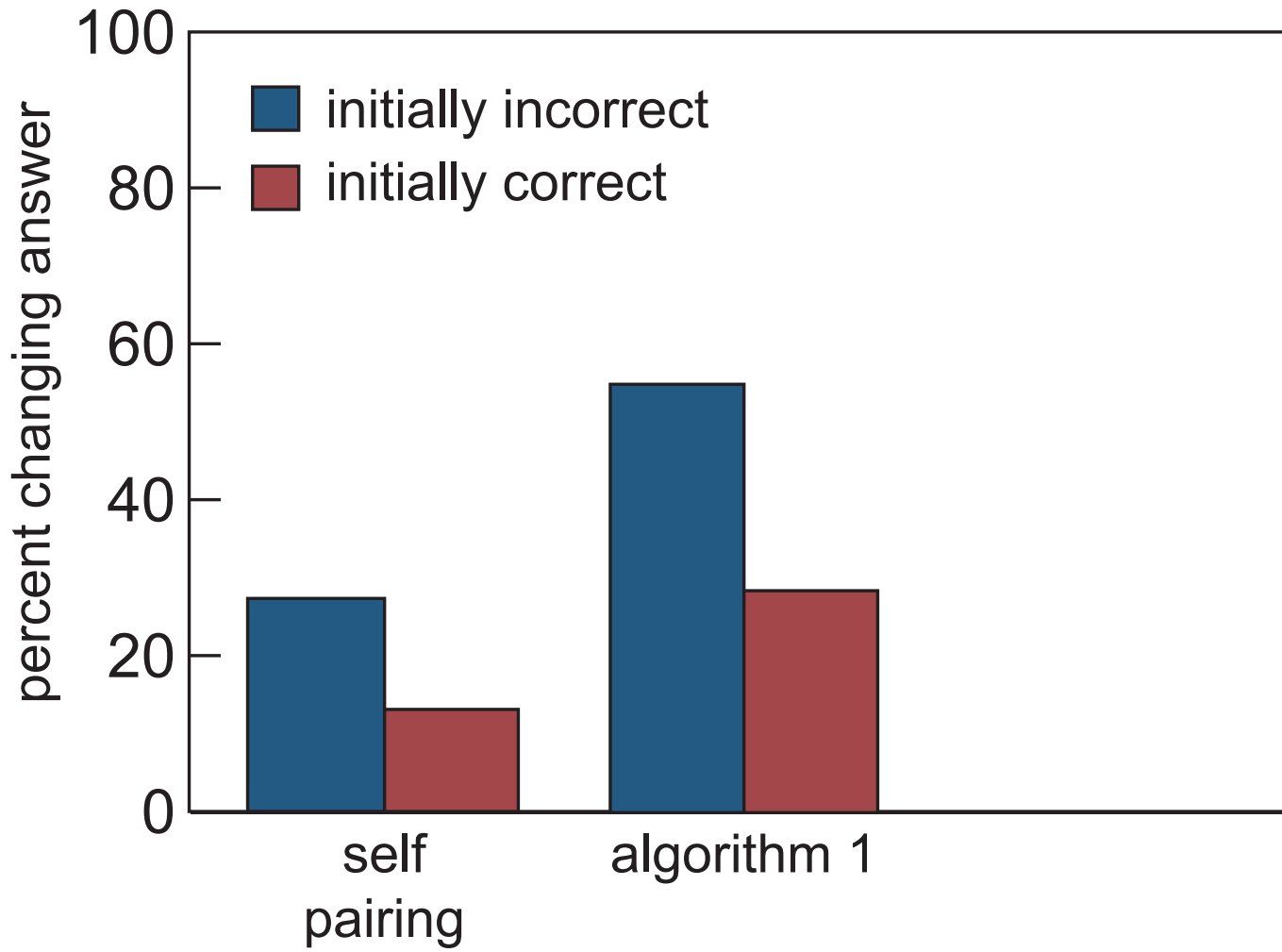
A positively charged rod is held near a neutral conducting sphere as illustrated below. A positively charged particle is moved from point A to point B at constant speed. The mechanical work required to cause this motion is

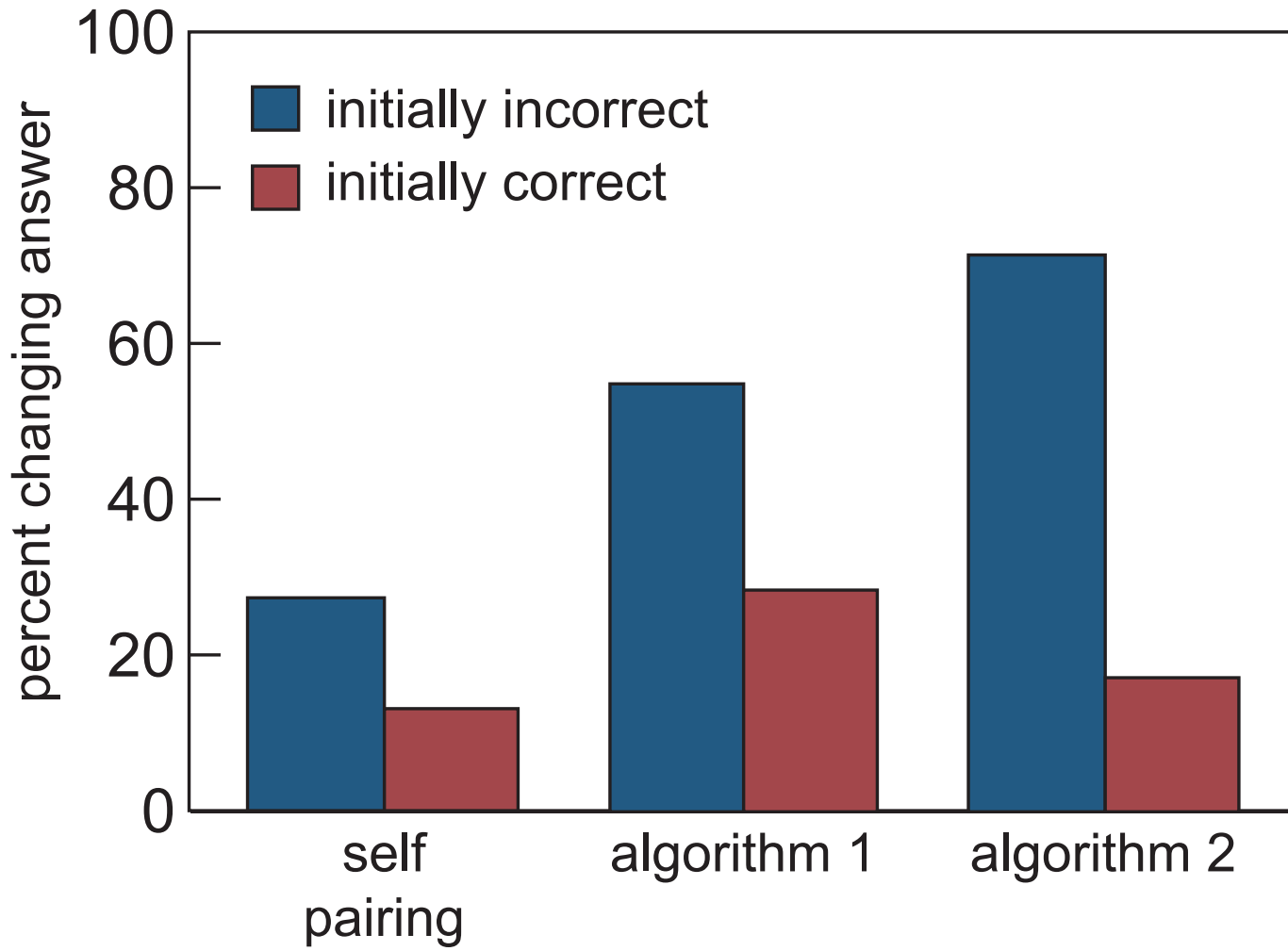


Please discuss your response with:

- Brian Lukoff (to your left)









**1** lecture

**2** PI

**3** PI 2.0



**Education is not just about:**

- **transferring information**
- **getting students to do what we do**



**Education is not just about:**

- **transferring information**
- **getting students to do what we do**

**discovery & exploration a must!**

The background of the slide features a painting of a window with horizontal blinds. A hand is visible on the right side, holding a pen and writing on the window pane. The scene is dimly lit, with light coming from the window. The text is overlaid on this background.

## Learning Catalytics:

- implement proven, researched pedagogy



## **Learning Catalytics:**

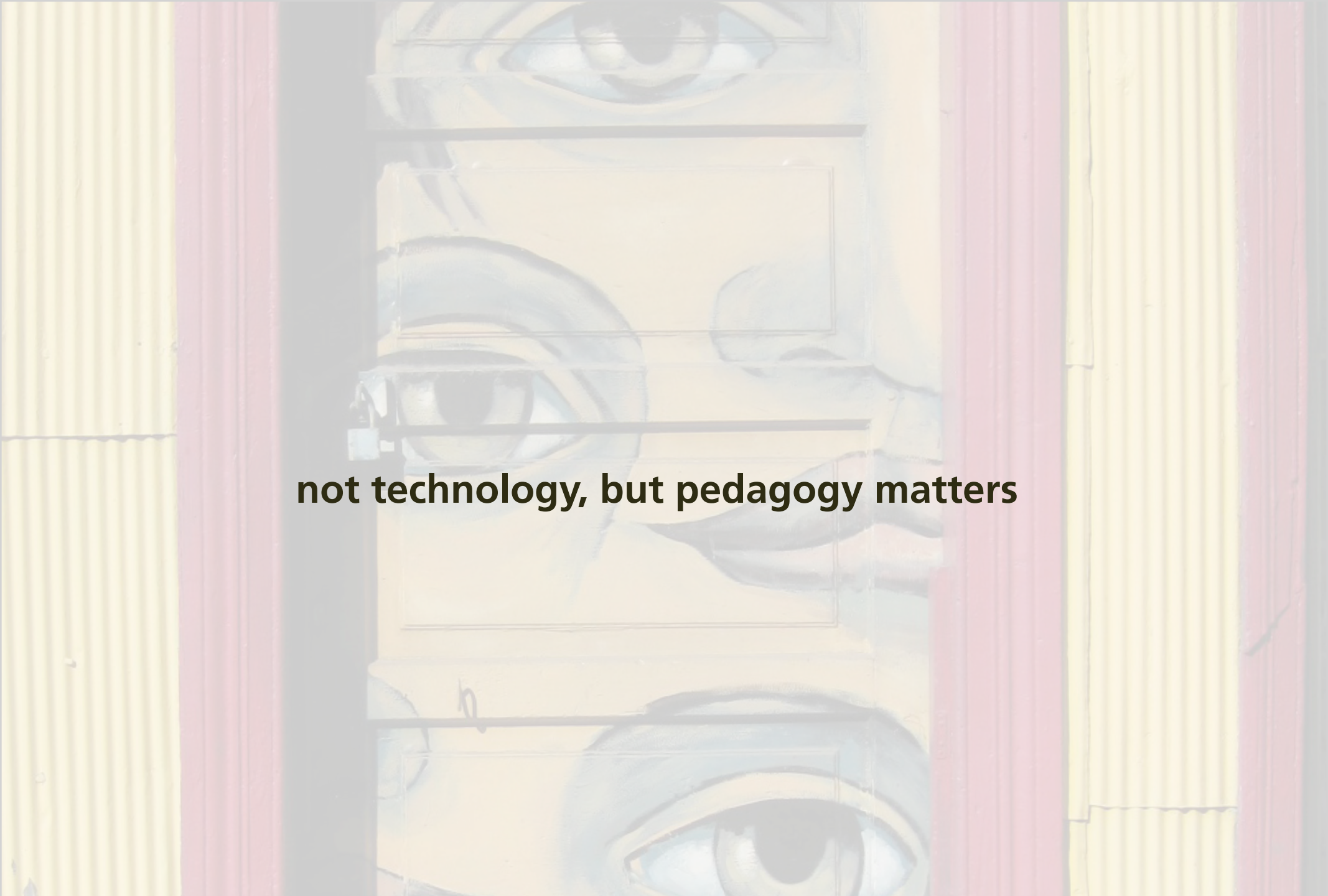
- **implement proven, researched pedagogy**
- **use consumer devices**

## **Learning Catalytics:**

- **implement proven, researched pedagogy**
- **use consumer devices**
- **avoid pitfalls of MC assessment**

## Learning Catalytics:

- implement proven, researched pedagogy
- use consumer devices
- avoid pitfalls of MC assessment
- create a smart classroom *anywhere*



**not technology, but pedagogy matters**

**1** education

**2** PI

**3** PI 2.0

**Funding:**

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