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**EDUCACION**

# Technology and Peer Instruction



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Singapore Polytechnic  
Singapore, 16 March 2015



# Technology and Peer Instruction



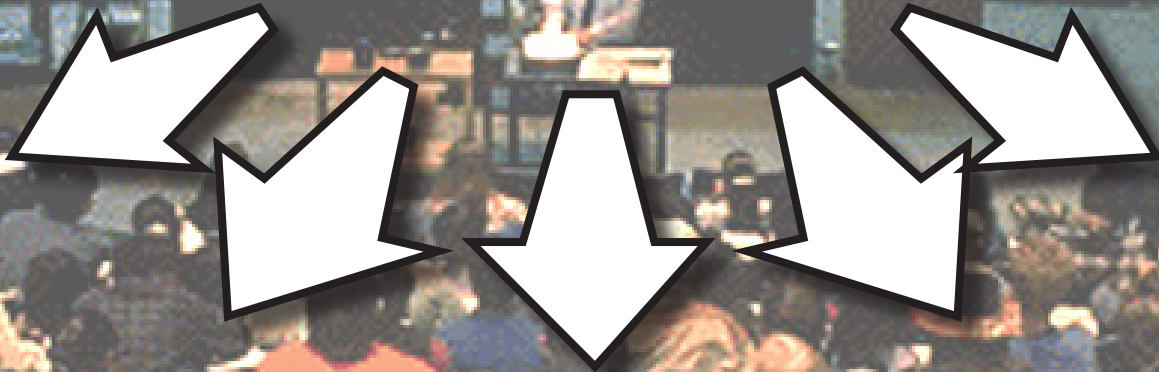
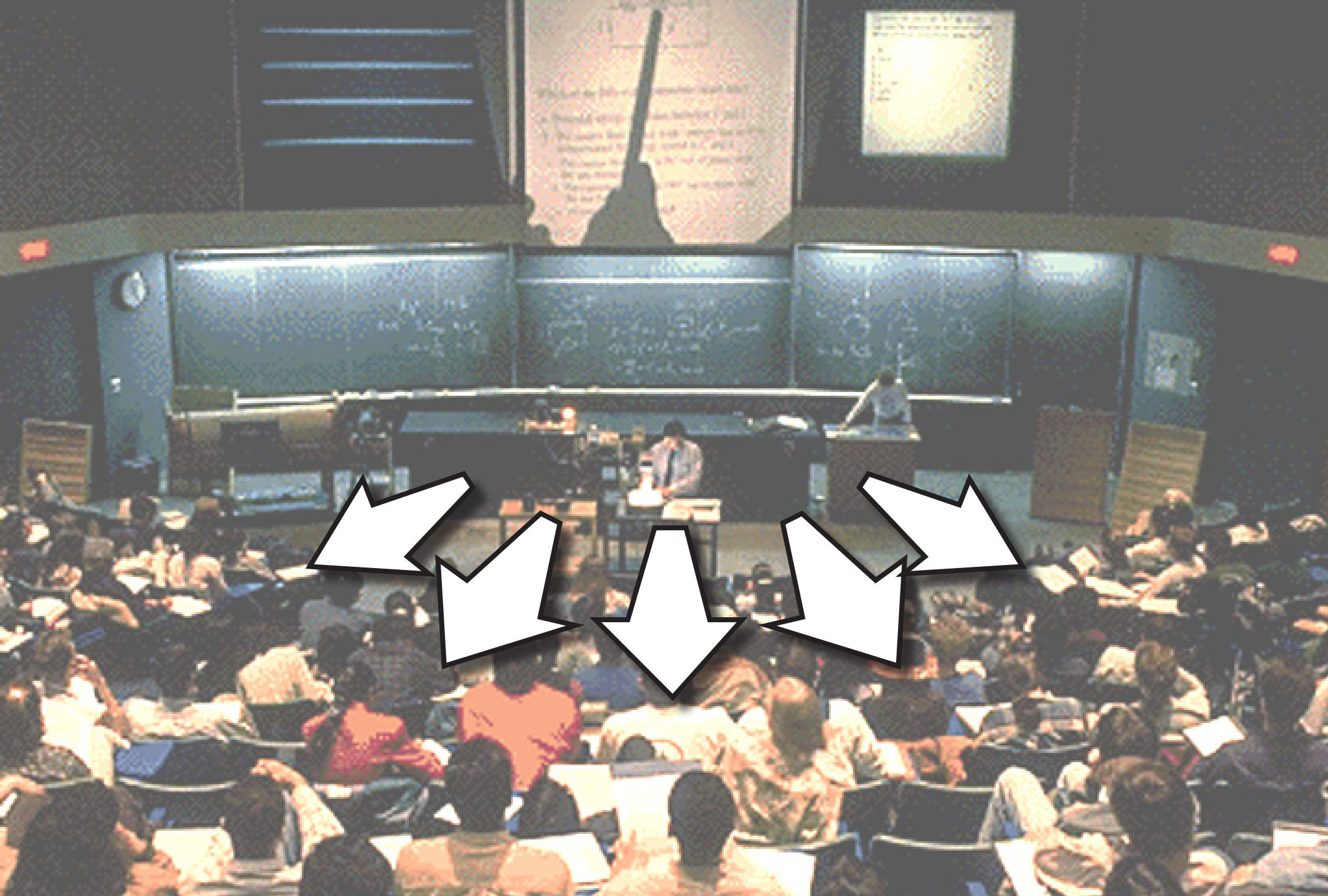
@eric\_mazur

Singapore Polytechnic  
Singapore, 16 March 2015



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question

1 education

2 PI

question



think

question



think



poll



**question**



**think**



**poll**



**discuss**

**question**



**think**



**poll**



**discuss**



**repoll**

**question**



**think**



**poll**



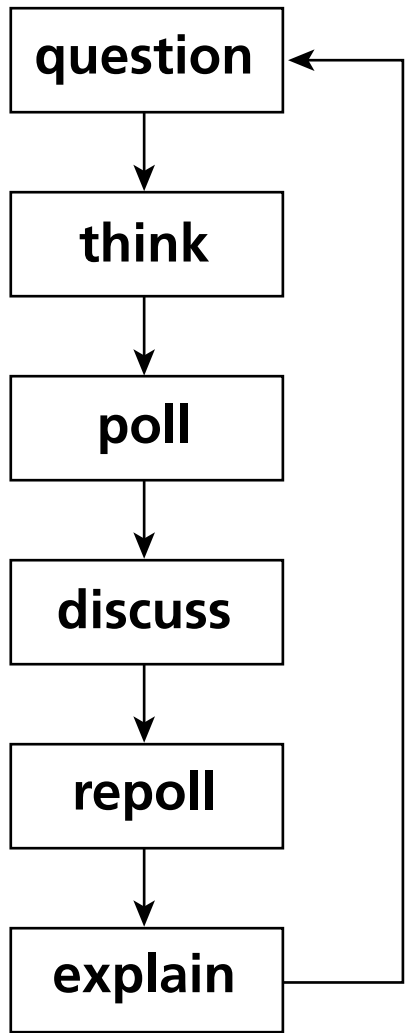
**discuss**

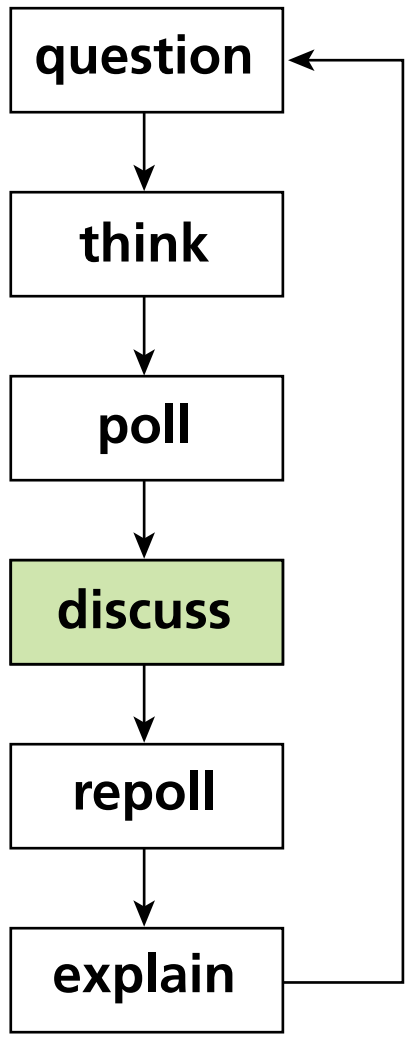


**repoll**



**explain**





Let's try it!

QUESTION

think

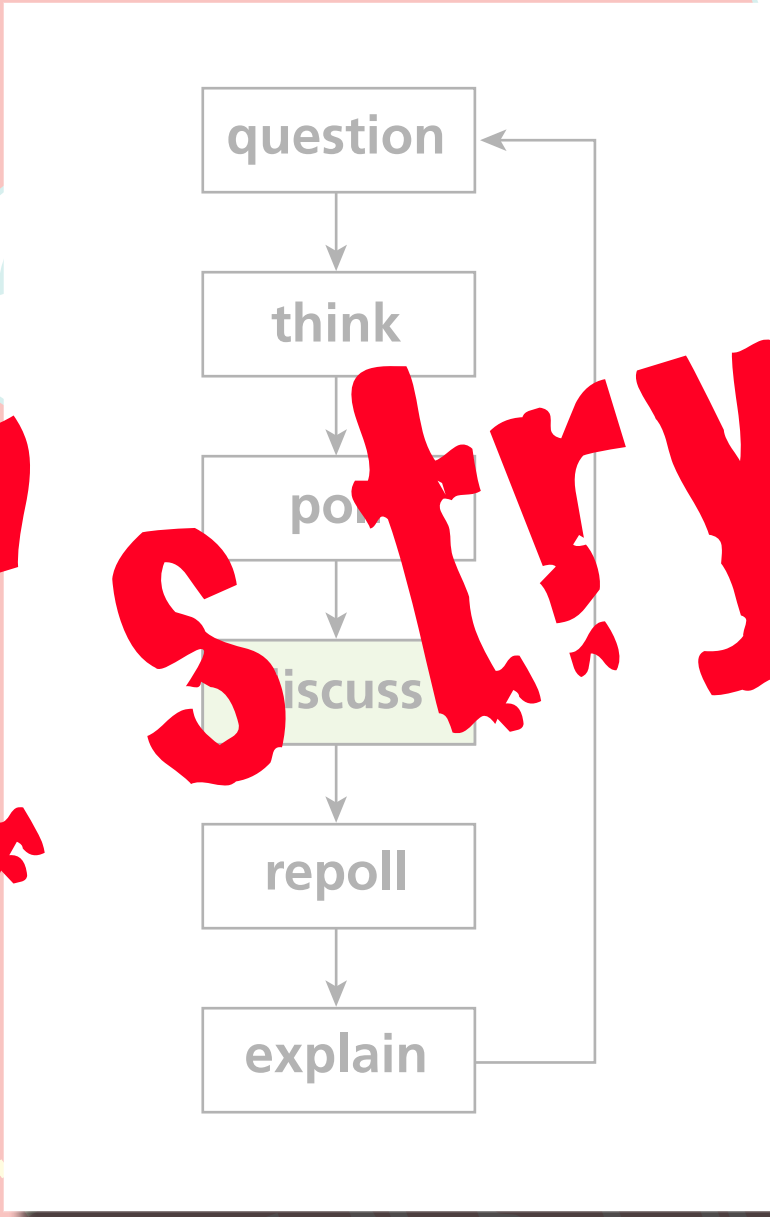
poll

discuss

repoll

explain

ACTION



1 education

2 PI

# Archimedes' Principle

1 lecture

2 PI

3 test

**An object submerged either fully or partially in a fluid experiences an upward buoyant force the magnitude of which is equal to the magnitude of the force of gravity exerted on the fluid displaced by the object.**

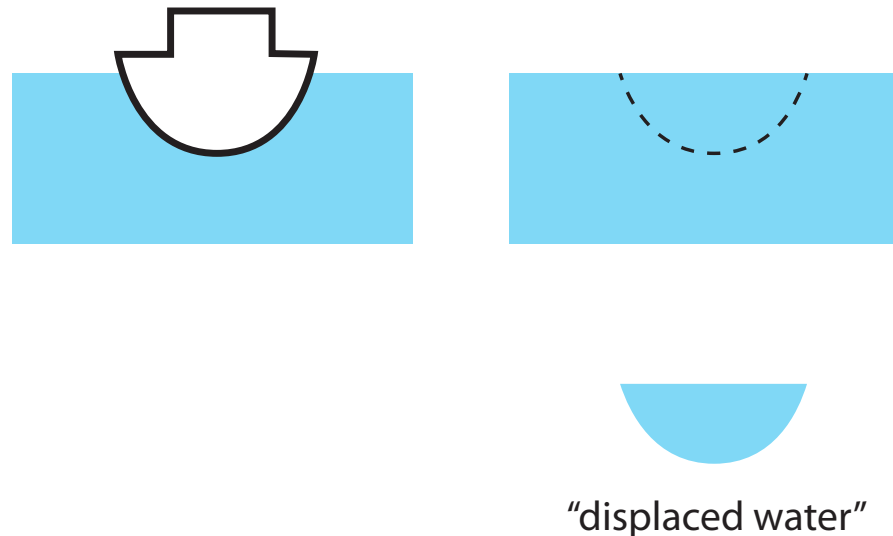


**An object submerged either fully or partially in a fluid experiences an upward buoyant force the magnitude of which is equal to the magnitude of the force of gravity exerted on the fluid displaced by the object. The volume of displaced fluid is equal to the volume of the submerged portion of the object.**

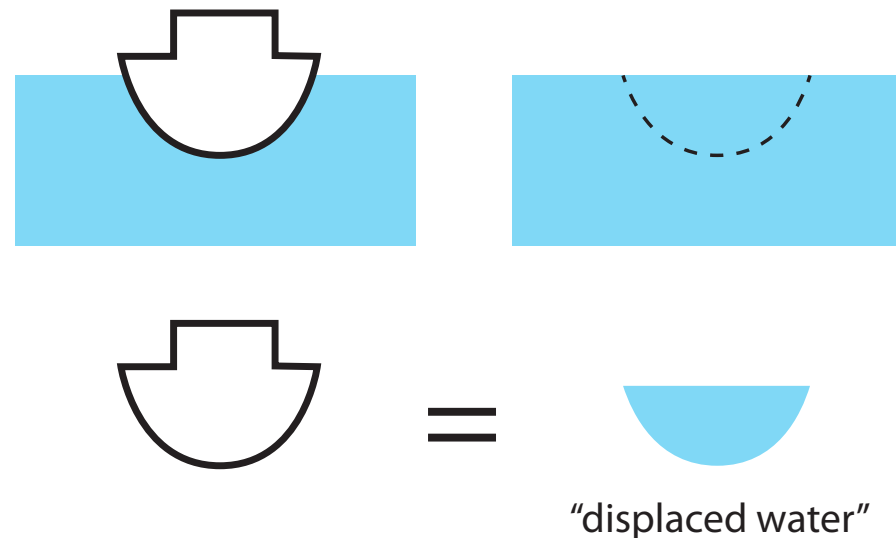
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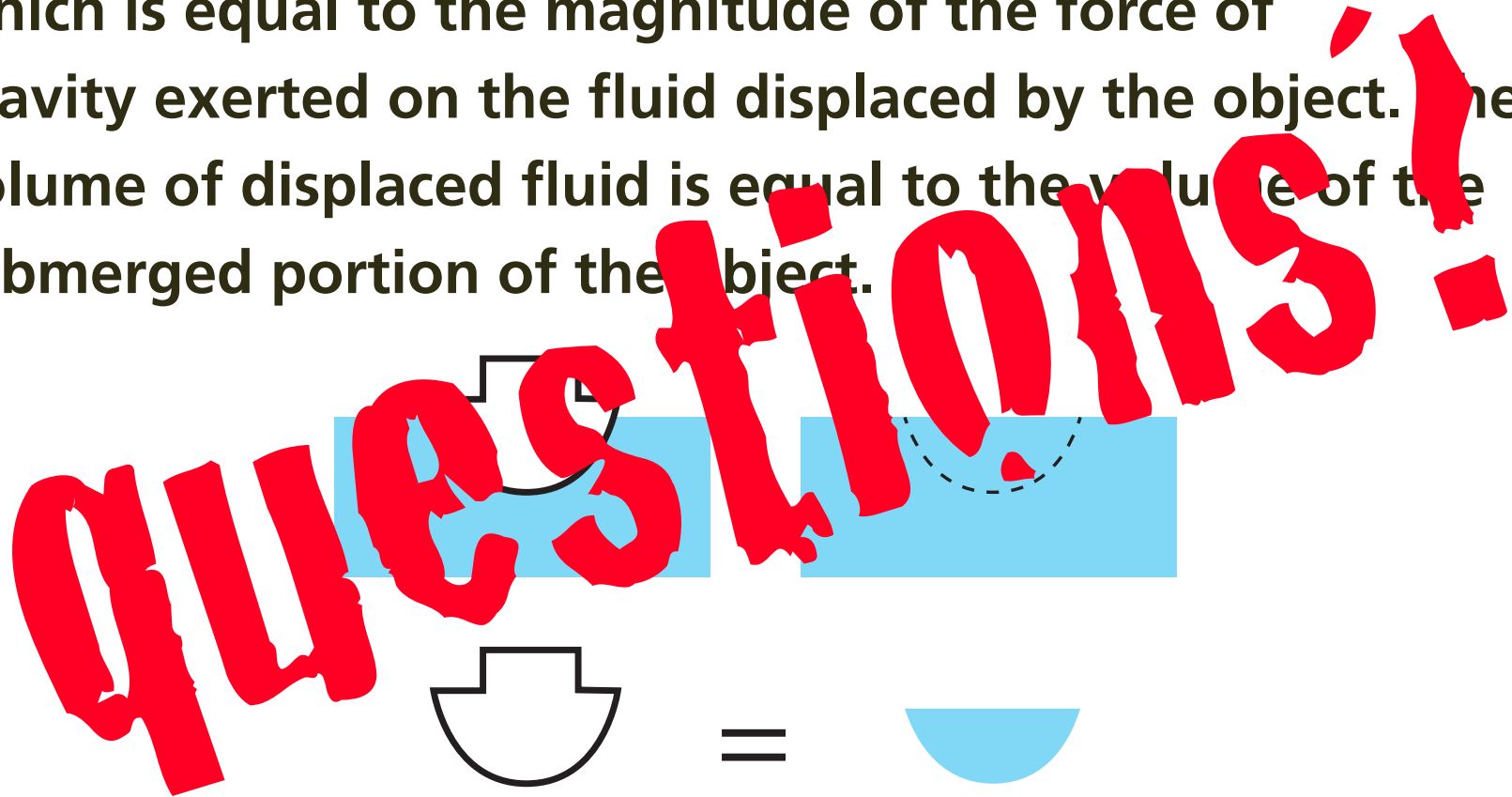
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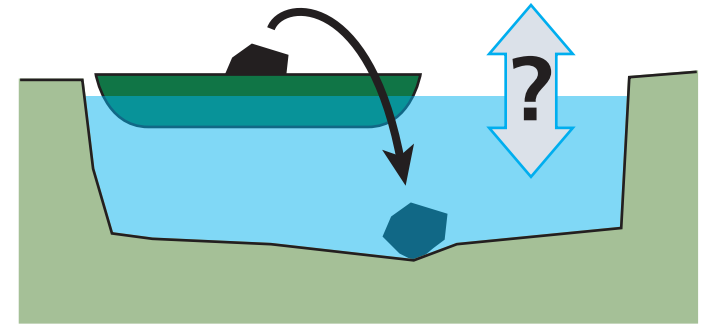


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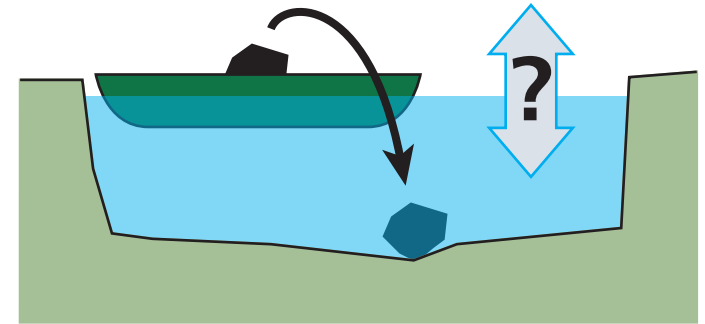


"displaced water"

A boat carrying a large boulder is floating on a small pond. The boulder is thrown overboard and sinks to the bottom of the pond.



A boat carrying a large boulder is floating on a small pond. The boulder is thrown overboard and sinks to the bottom of the pond.

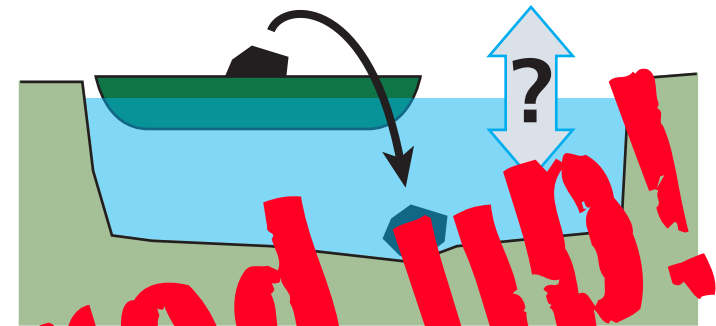


After the boulder sinks to the bottom of the pond, the level of the water in the pond is

1. higher than
2. the same as
3. lower than

it was when the boulder was in the boat.

A boat carrying a large boulder is floating on a small pond. The boulder is thrown overboard and sinks to the bottom of the pond.



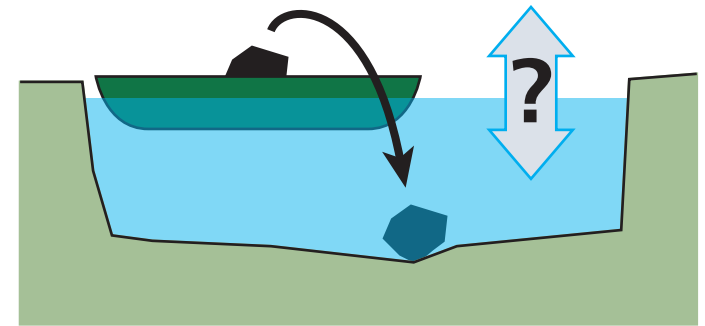
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After the boulder sinks to the bottom of the pond, the level of the water in the pond is

1. higher than
2. the same as
3. lower than

it was when the boulder was in the boat.

**Before I tell you the answer...**

**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**

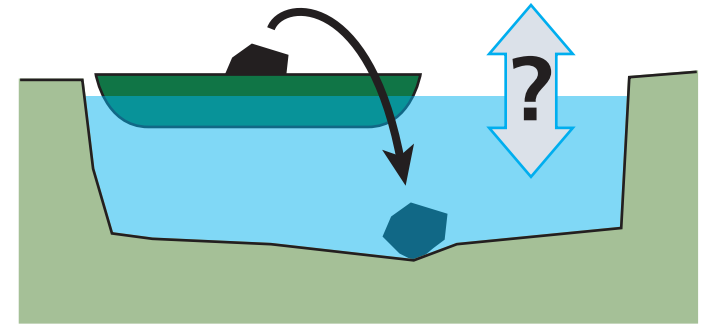
**Before I tell you the answer, let's analyze what happened.**

**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**



A boat carrying a large boulder is floating on a small pond. The boulder is thrown overboard and sinks to the bottom of the pond.

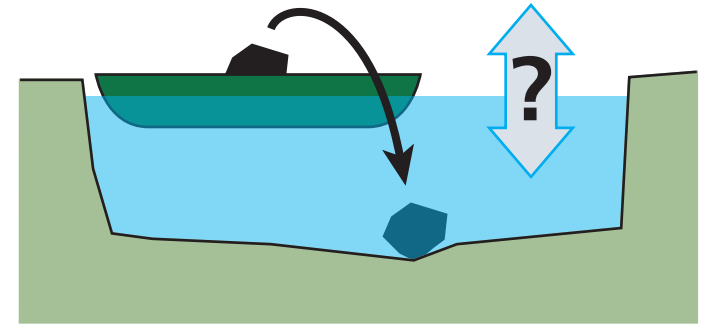


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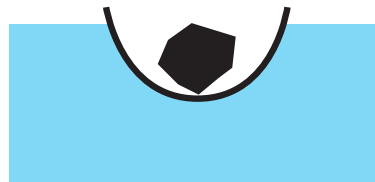
After the boulder sinks to the bottom of the pond, the level of the water in the pond is

1. higher than
2. the same as
3. lower than ✓

it was when the boulder was in the boat.

**remember: amount of displaced water**

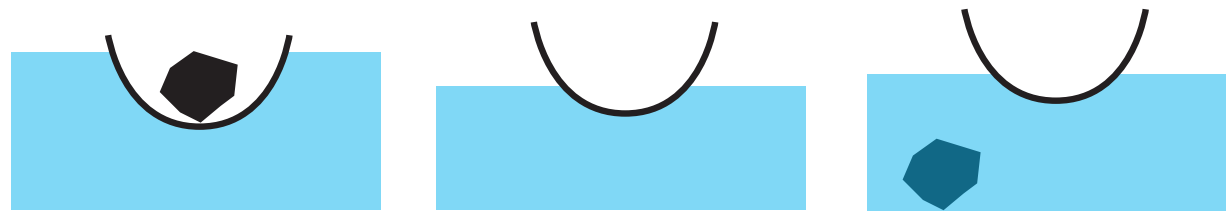
remember: amount of displaced water



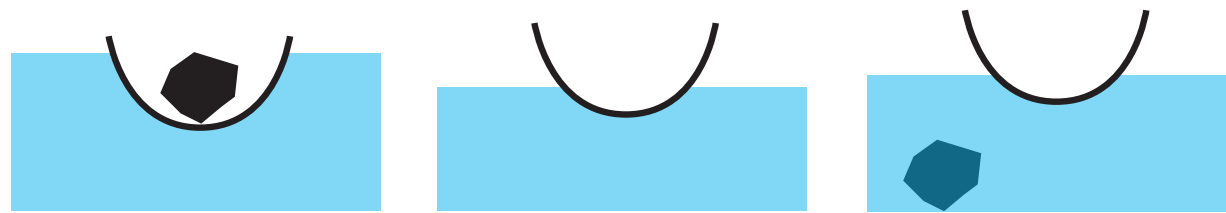
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remember: amount of displaced water

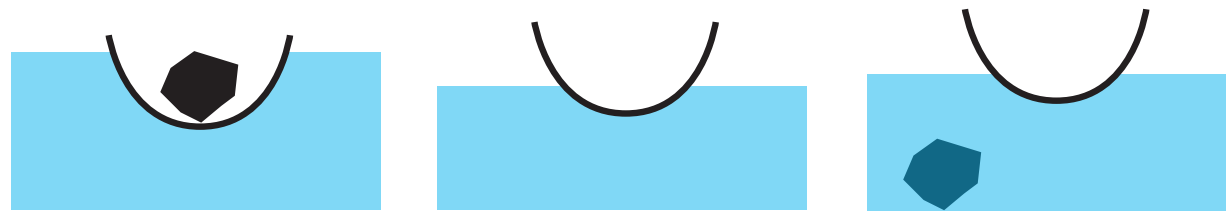


remember: amount of displaced water



displaced  
water

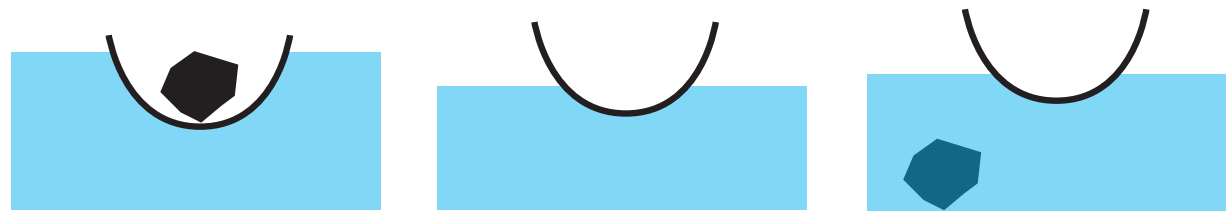
remember: amount of displaced water



displaced  
water  = weight  
of rock



remember: amount of displaced water



displaced  
water



= weight  
of rock



= volume  
of rock

remember: amount of displaced water

**you won't forget this**



**feedback**

**1** lecture

**2** PI

**3** PI 2.0



1991



1 lecture

2 PI

3 PI 2.0



1993

A black handheld remote control is shown at an angle. It features a numeric keypad with buttons for digits 1 through 9, 0, and a red power 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. a business plan
  - 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%
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5. In order to start an online business, an individual would need all but which of the following:

business model

## Sample question types:

- direction
- expression
- long answer, short answer, word cloud (fill in text)
- multiple-choice, many-choice
- numerical (enter a number)
- ranking
- region (select point on image)
- sketch

**Think of something you are good at**

***How did you become good at this?***

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**Became good at it by:**

- 1. trial and error**
- 2. lectures**
- 3. practicing**
- 4. apprenticeship**
- 5. other**

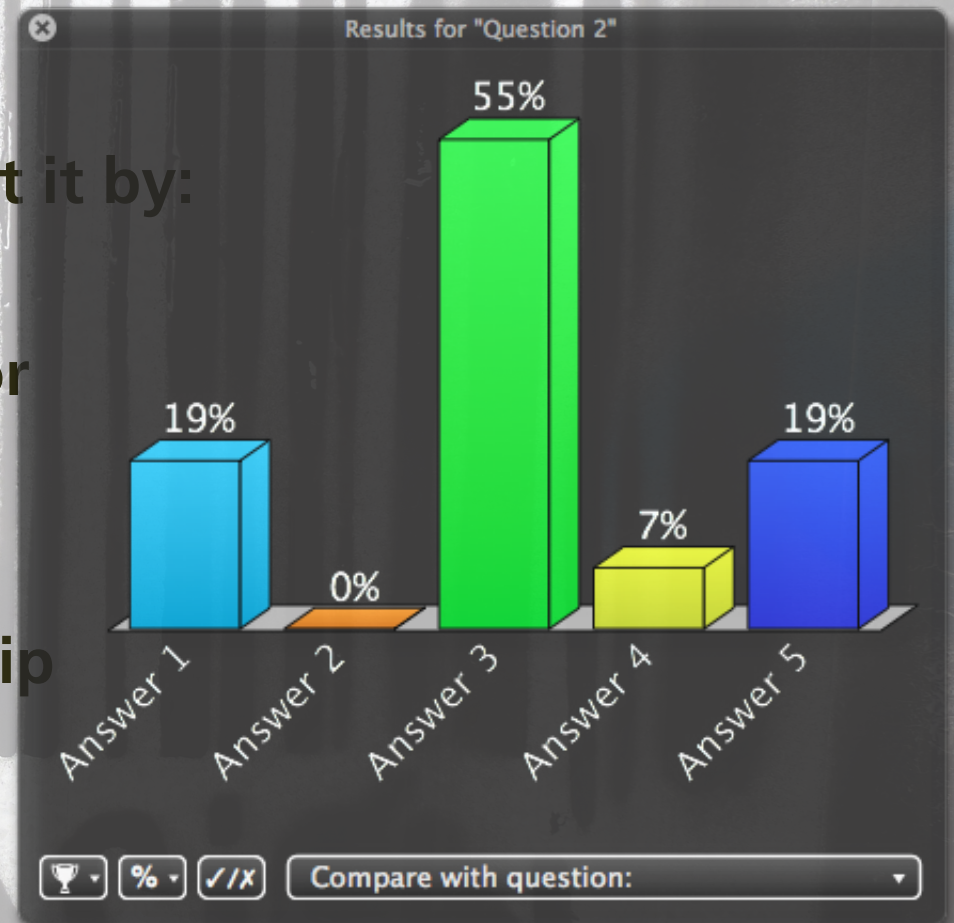
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Became good at it by:

1. trial and error
2. lectures
3. practicing
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5. other





Carrier



10:24 PM



Leave

session 123456

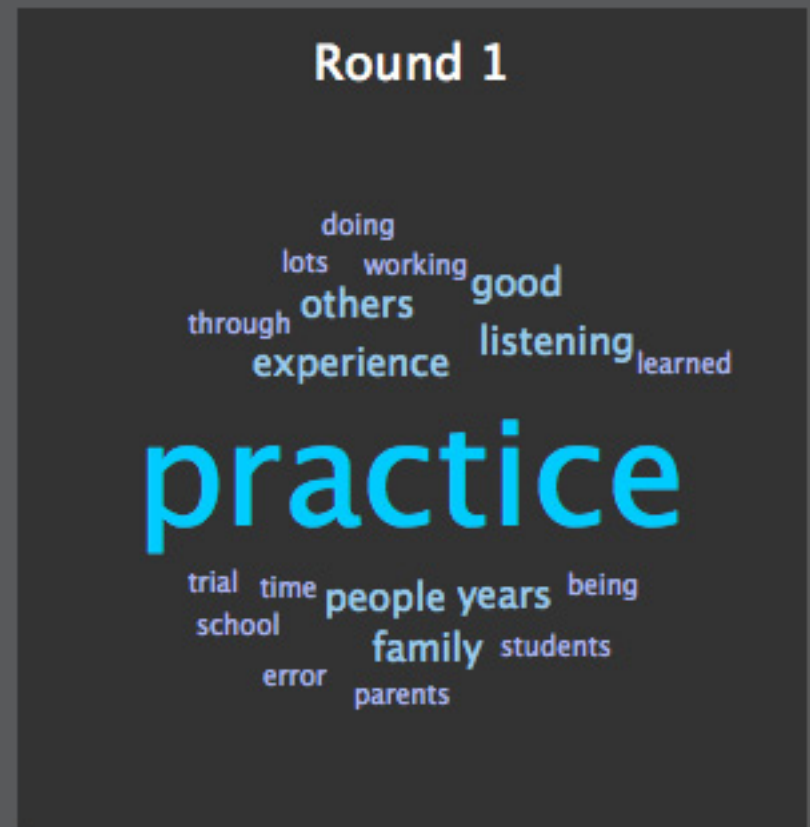
Logout

Now describe in a couple of words how you became good at whatever it is you entered in the previous question.

Submit response

## Class session: 123456

Now describe in a couple of words how you became good at whatever it is you entered in the previous question.





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4. direction  
prevailing

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

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



1 educa

3 PI 2.0

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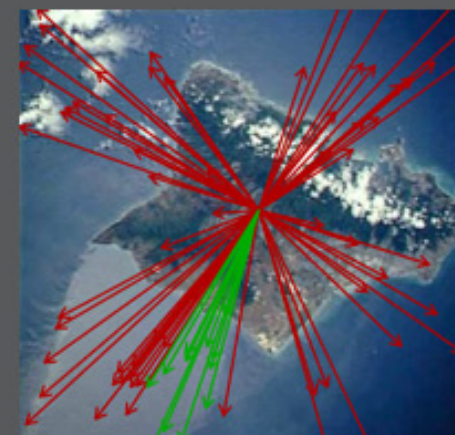
4. direction  
prevailing

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

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Round 1

77 responses, 16% correct



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



1 educa

3 PI 2.0

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optics i

current session: **766079** | 69 students

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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

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6 7 8 9 10 11 12 13 14 15

perpendicular mirrors as shown below.

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1 lecture

3 PI 2.0



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current session: **766079** | 69 students

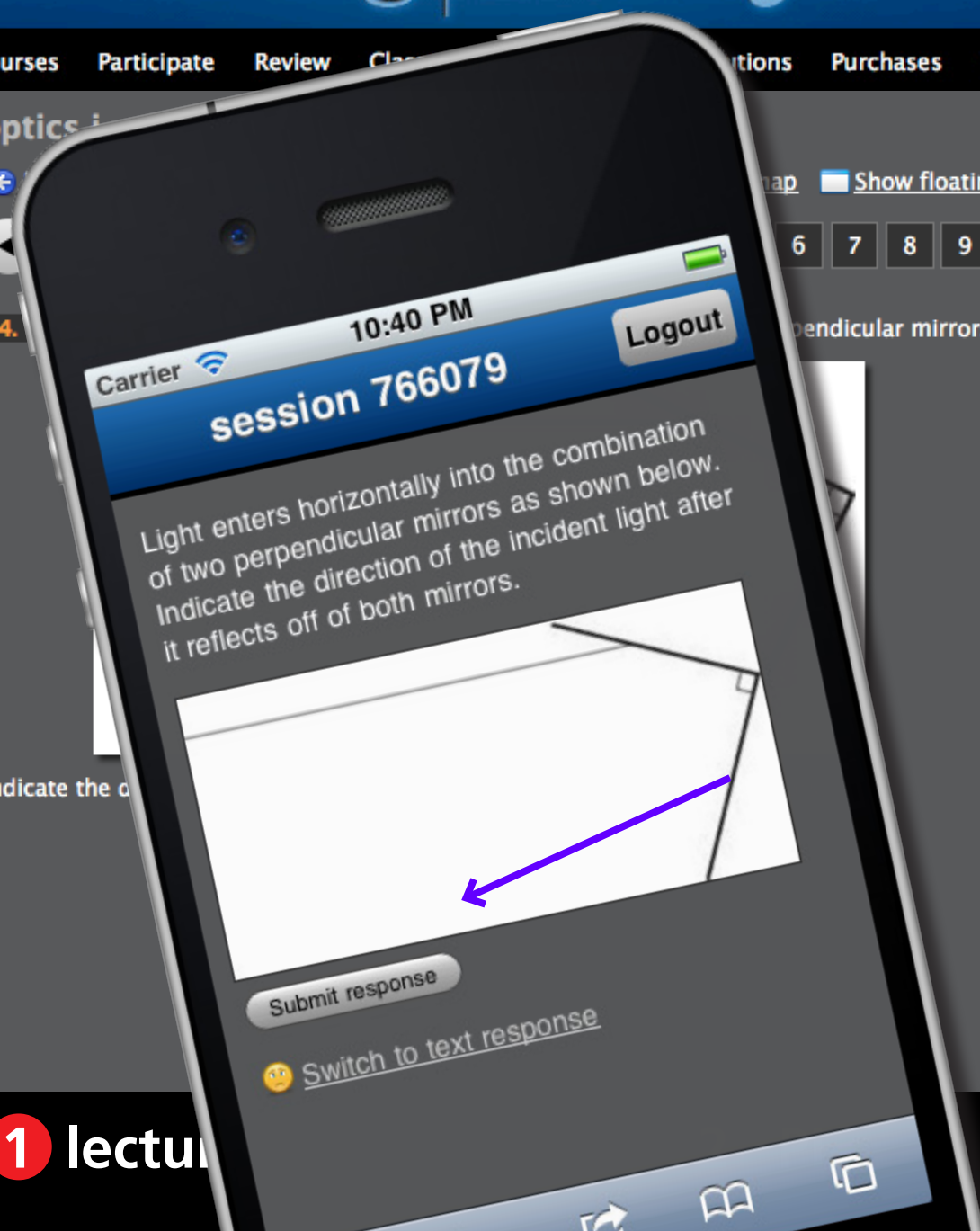
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6 7 8 9 10 11 12 13 14 15

perpendicular mirrors as shown below.

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1 lecture

3 PI 2.0

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current session: **766079** | 69 students

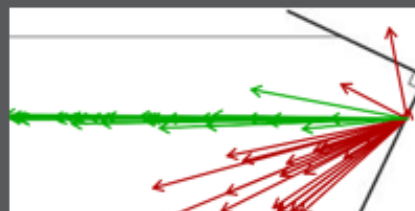
[Map](#) [Show floating session ID](#) [Edit](#) [Delete](#)

6 7 8 9 10 11 12 13 14 15

perpendicular mirrors as shown below.

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Round 1     
● 57 responses, 58% correct



 [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

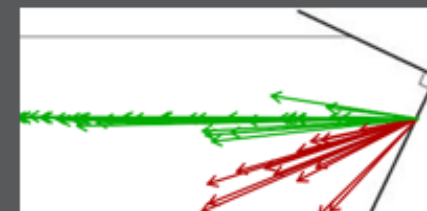
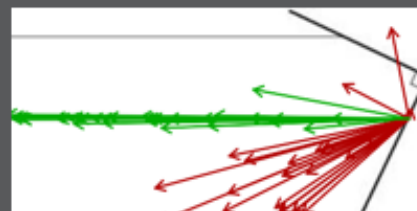


perpendicular mirrors as shown below.

Deliver  Show all results

Round 1     
● 57 responses, 58% correct

Round 2     
● 51 responses, 73% correct



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

feedback & support



1 lecture

3 PI 2.0

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

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## transformations of parabolas

current session: **773885** | 9 students

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Jump to ▾

1

2

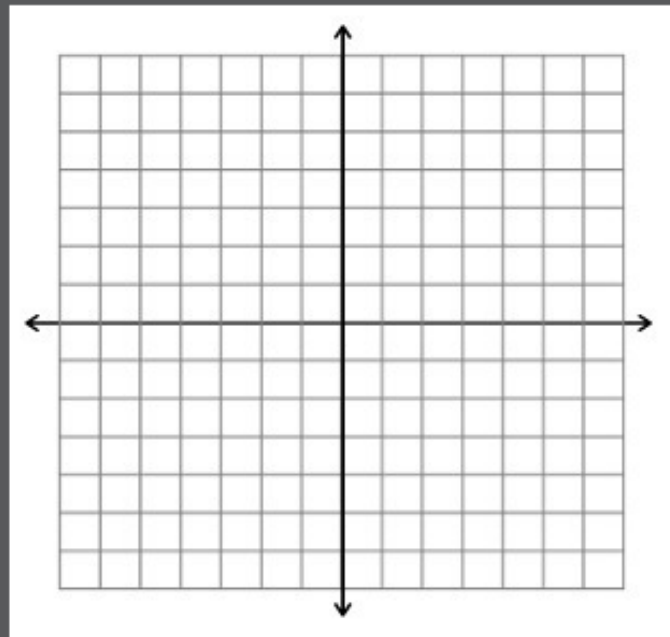
3

4



4. sketch Sketch a graph of the function  $f(x) = (x - 3)^2 + 2$ .

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1 education

2 PI

3 PI 2.0

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## transformations of parabolas

current session: **773885** | 9 students

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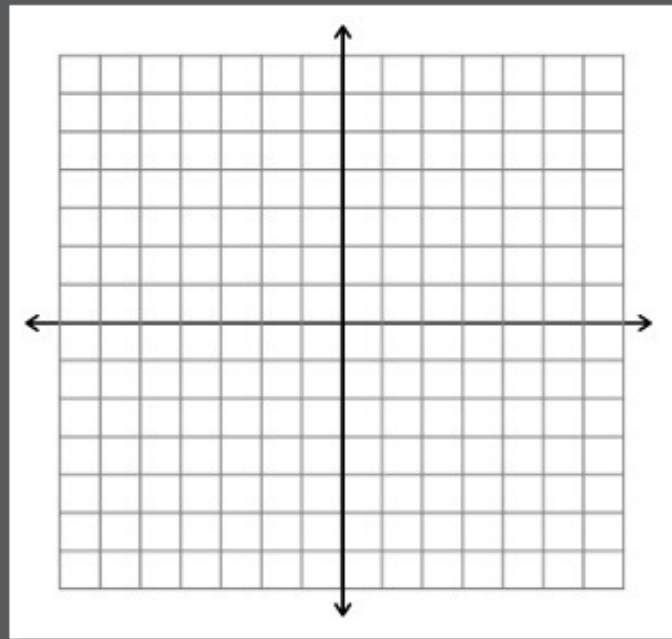


Jump to 1 2 3 4



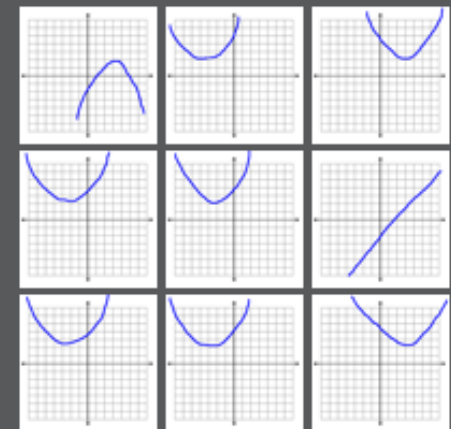
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### Round 1

9 responses



1 education

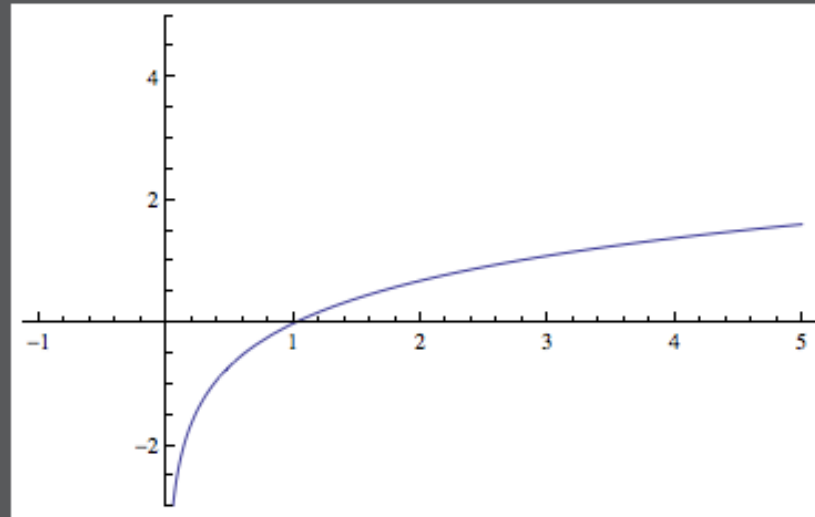
2 PI

3 PI 2.0

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



1 education

2 PI

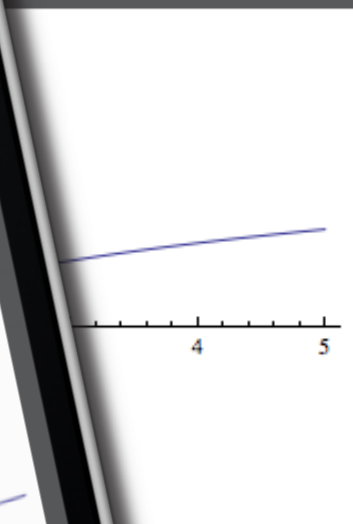
3 PI 2.0

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



**1** education

**3** PI 2.0



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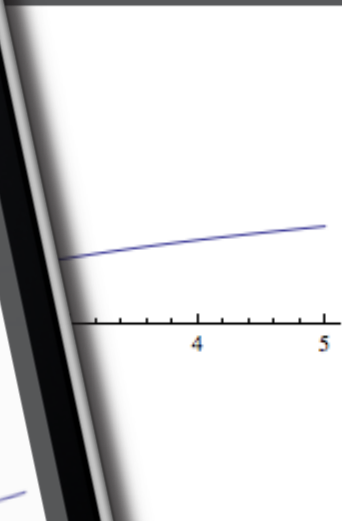
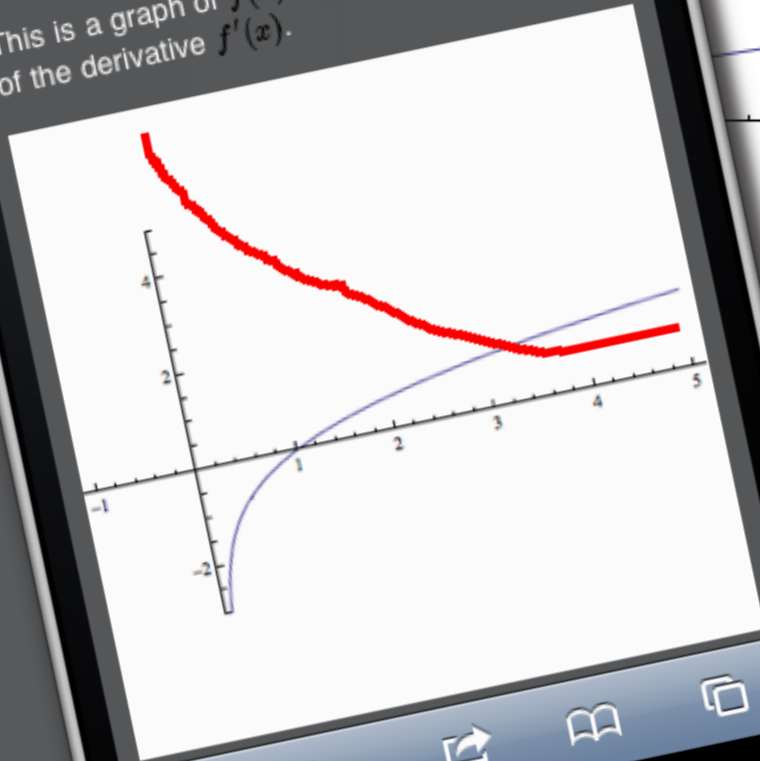
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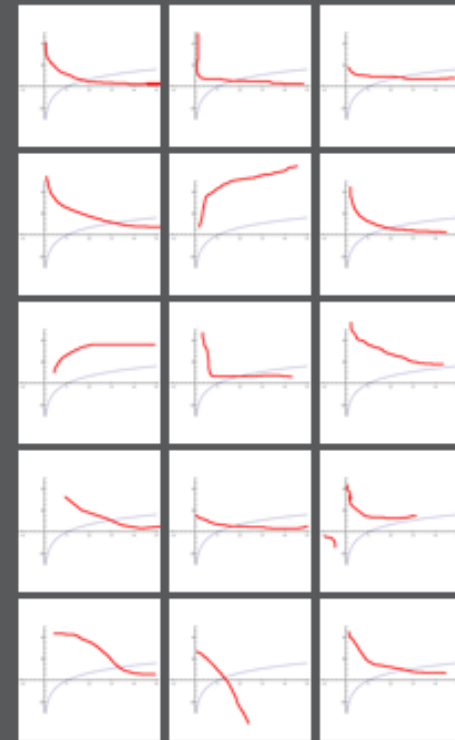


This is a graph of  $f(x) = \ln x$ . Sketch a graph of the derivative  $f'(x)$ .



Round 1

15 responses



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

1 education

3 PI 2.0

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1. highlighting What do you see as the most important part of this Shakespeare sonnet? [Stop delivery](#) [Deliver again](#) [Assign groups](#) [Show all results](#)

For shame! deny that thou bear'st love to any,  
Who for thyself art so unprovident.  
Grant, if thou wilt, thou art beloved of many,  
But that thou none lovest is most evident;  
For thou art so possess'd with murderous hate  
That 'gainst thyself thou stick'st not to conspire.  
Seeking that beauteous roof to ruinate  
Which to repair should be thy chief desire.  
O, change thy thought, that I may change my mind!  
Shall hate be fairer lodged than gentle love?  
Be, as thy presence is, gracious and kind,  
Or to thyself at least kind-hearted prove:  
Make thee another self, for love of me,  
That beauty still may live in thine or thee.

1 education

2 PI

3 PI 2.0

# learning | catalytics

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1. highlighting  
sonnet?

this Shakespeare

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For shame  
Who for t  
Grant, if t  
But that th  
For thou a  
That 'gainst  
Seeking that  
Which to rep  
O, change th  
Shall hate be  
Be, as thy pres  
Or to thyself a  
Make thee ano  
That beauty stil

What do you see as the most important part of this Shakespeare sonnet?

Highlight the passage below by clicking or tapping once to set the beginning of your highlight, and then clicking or tapping again to set the end.

For shame! deny that thou bear'st love to any,  
Who for thyself art so unprovident.  
Grant, if thou wilt, thou art beloved of many,  
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Which to repair should be thy chief desire.  
O, change thy thought, that I may change my  
mind

1 educa

3 PI 2.0

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1. highlighting  
sonnet?

this Shakespeare

[Stop delivery](#)

[Deliver again](#)

[Assign groups](#)

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## Round 1

3 responses

For shame! deny that thou bear'st  
love to any,  
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unprovident.

Grant, if thou wilt, thou art  
beloved of many,

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evident;

For thou art so possess'd with  
murderous hate

That 'gainst thyself thou stick'st  
not to conspire.

**Seeking that beauteous roof to  
ruinate**

Which to repair should be thy  
chief desire.

O, change thy thought, that I may  
change my mind!

Shall hate be fairer lodged than  
gentle love?

Be, as thy presence is, gracious  
and kind,



What do you see as the most important part  
of this Shakespeare sonnet?

**Highlight the passage below by clicking or  
tapping once to set the beginning of your  
highlight, and then clicking or tapping  
again to set the end.**

For shame! deny that thou bear'st love to any,  
Who for thyself art so unprovident.  
Grant, if thou wilt, thou art beloved of many,  
But that thou none lovest is most evident;  
For thou art so possess'd with murderous hate  
That 'gainst thyself thou stick'st not to  
conspire.

**Seeking that beauteous roof to ruinate  
Which to repair should be thy chief desire.**

O, change thy thought, that I may change my  
mind!

**1** educa

**3** PI 2.0

## Sample question types:

- direction
- expression
- long answer, short answer, word cloud (fill in text)
- multiple choice, many choice
- numerical (enter a number)
- ranking
- region (select point on image)
- sketch

**data analytics**



1 lecture

2 PI

3 PI 2.0



# human interaction

1 lecture

2 PI

3 PI 2.0

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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 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



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



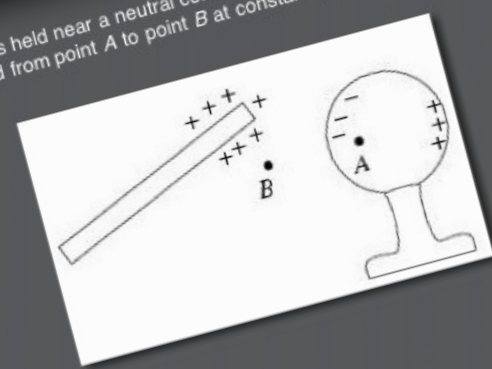
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Search: \_\_\_\_\_

1 lecture

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1 lecture

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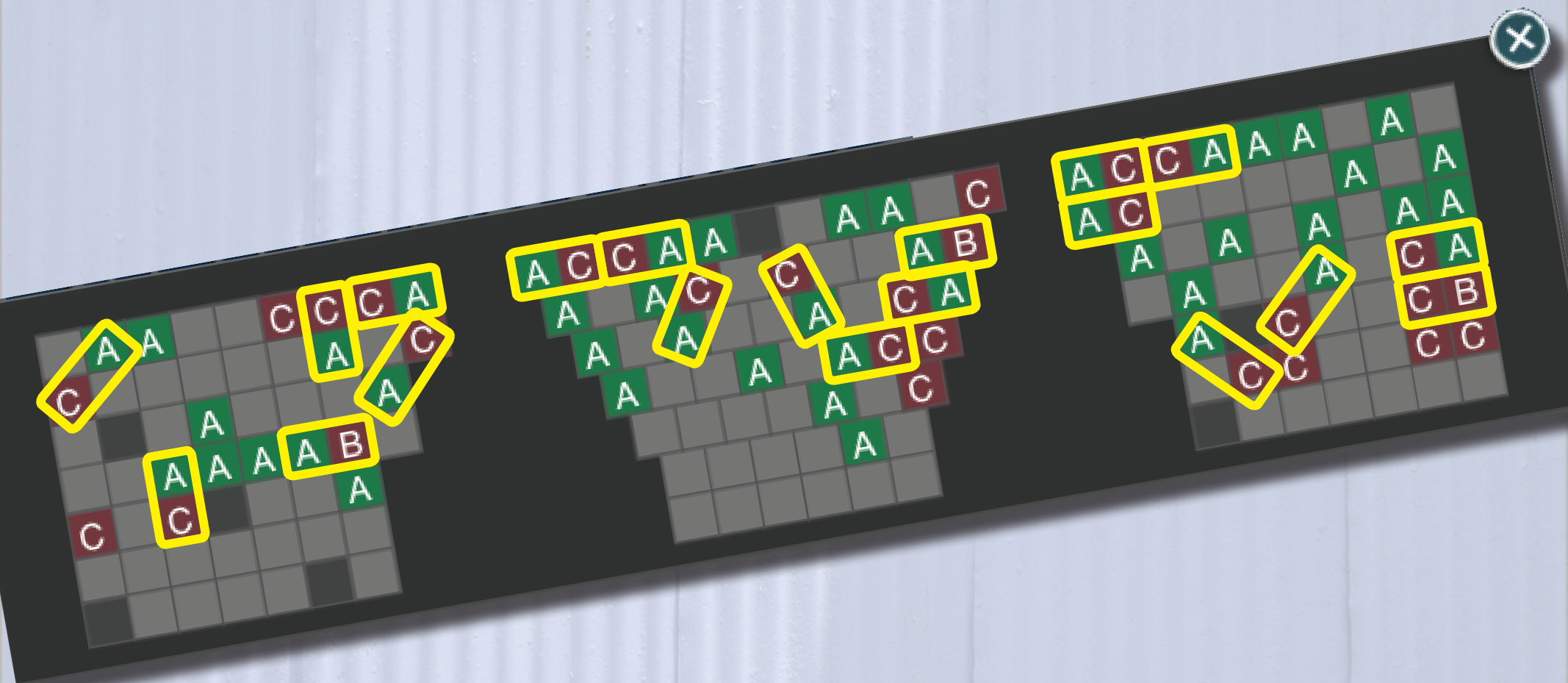
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1 lecture

2 PI

3 PI 2.0

let system manage pairing



1 lecture

2 PI

3 PI 2.0

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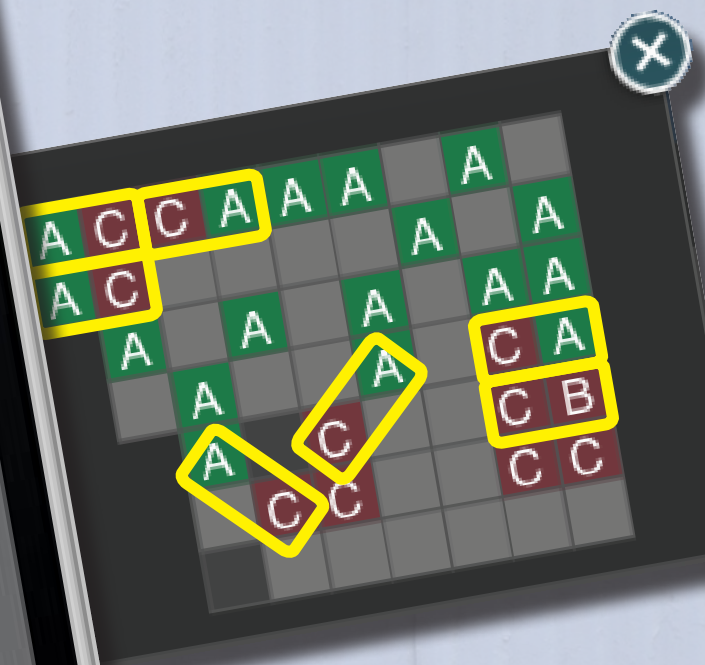
A positively charged rod is held near a neutral conducting sphere as illustrated below. A positively charged particle is moved from point A to point B at constant speed. The mechanical work required to cause this motion is



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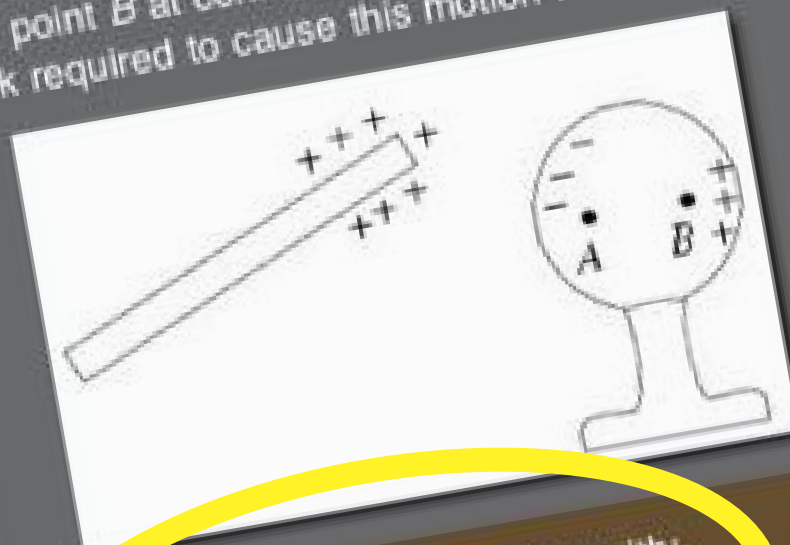
- Brian Lukoff (to your left)

I am talking to this person/people



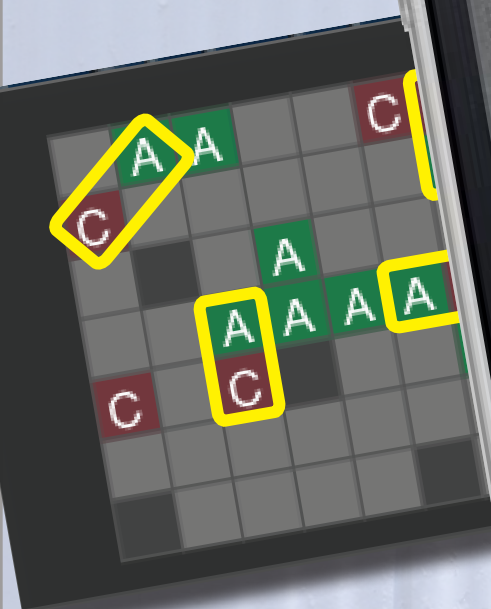
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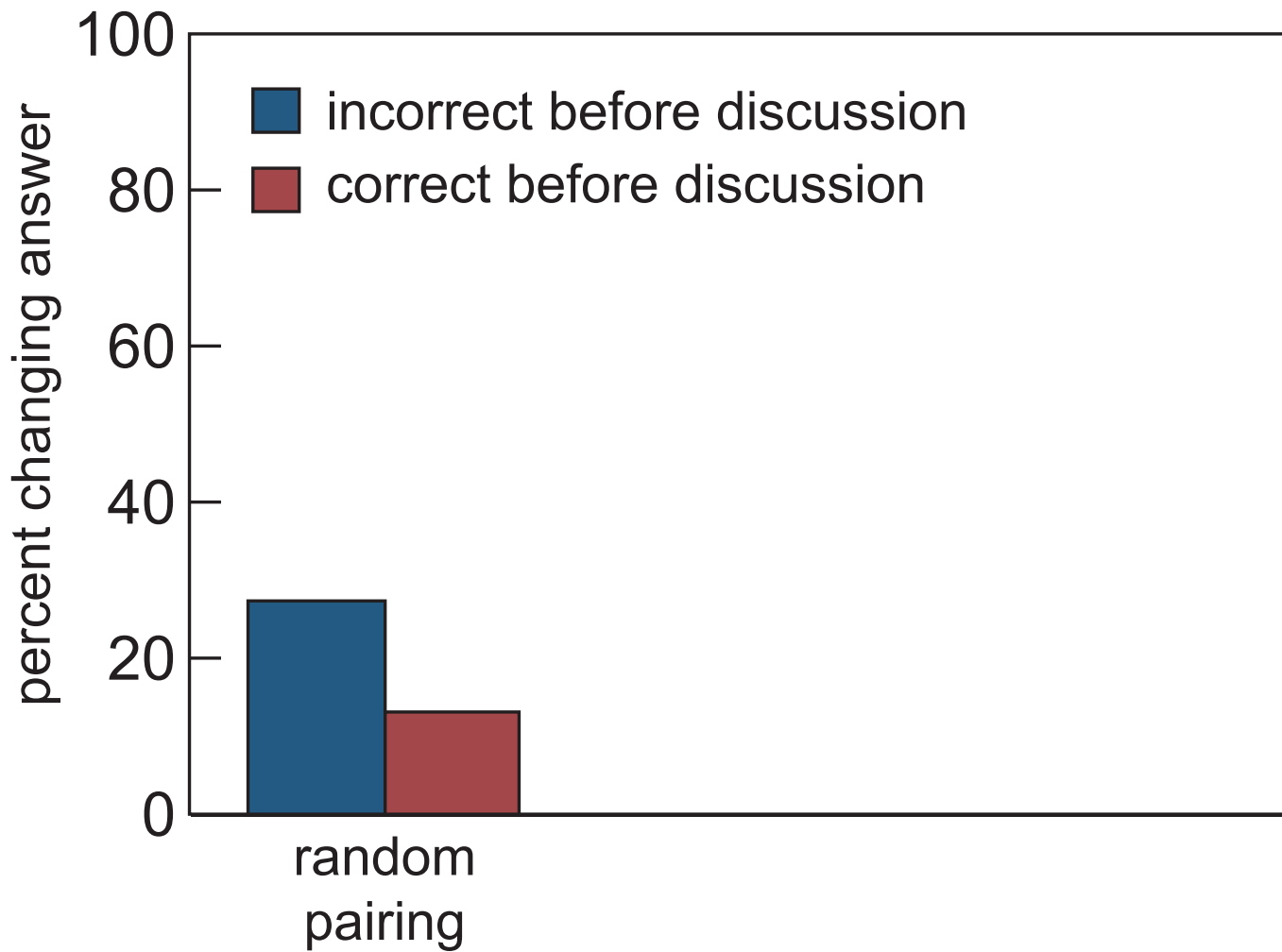
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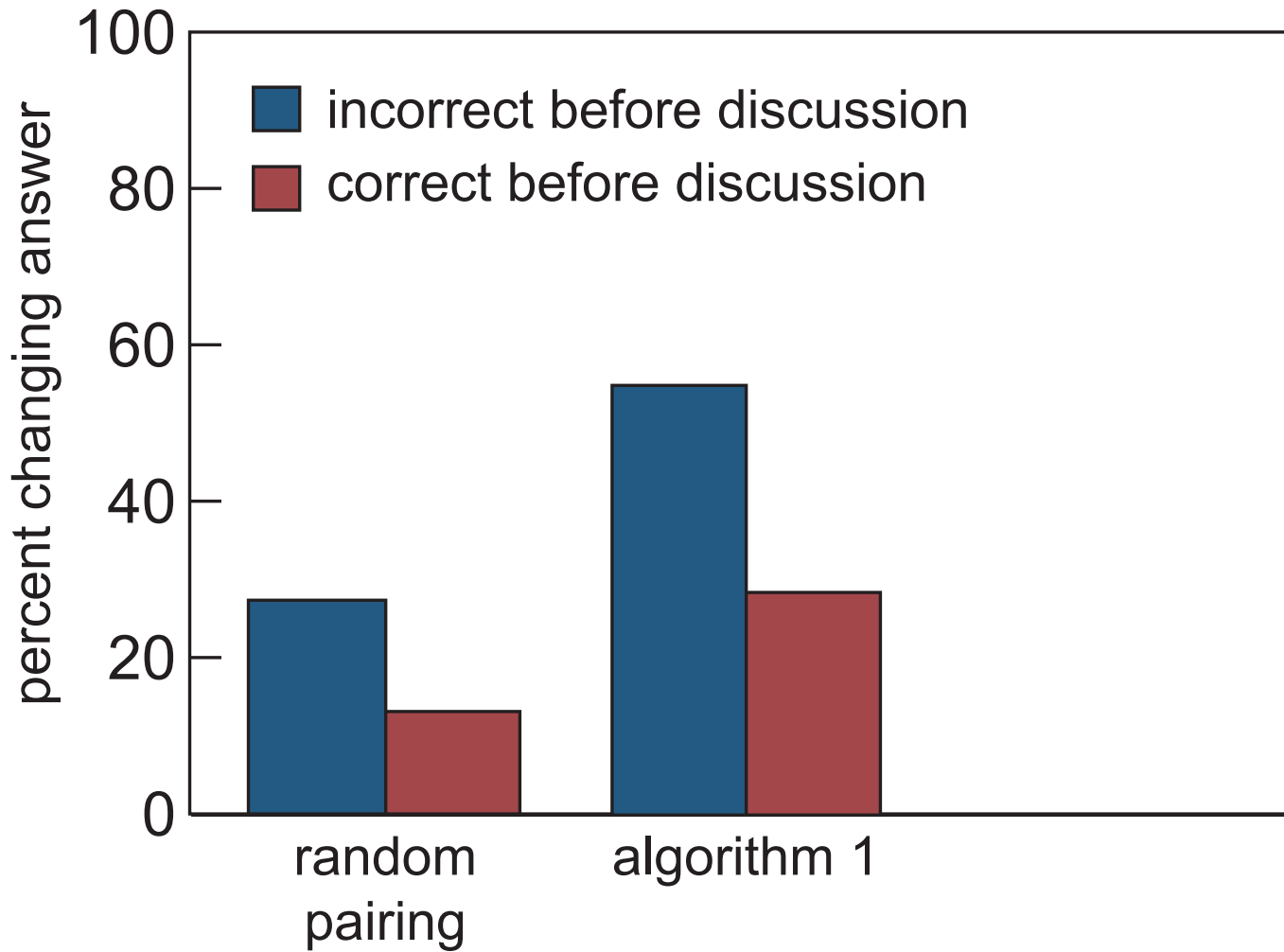
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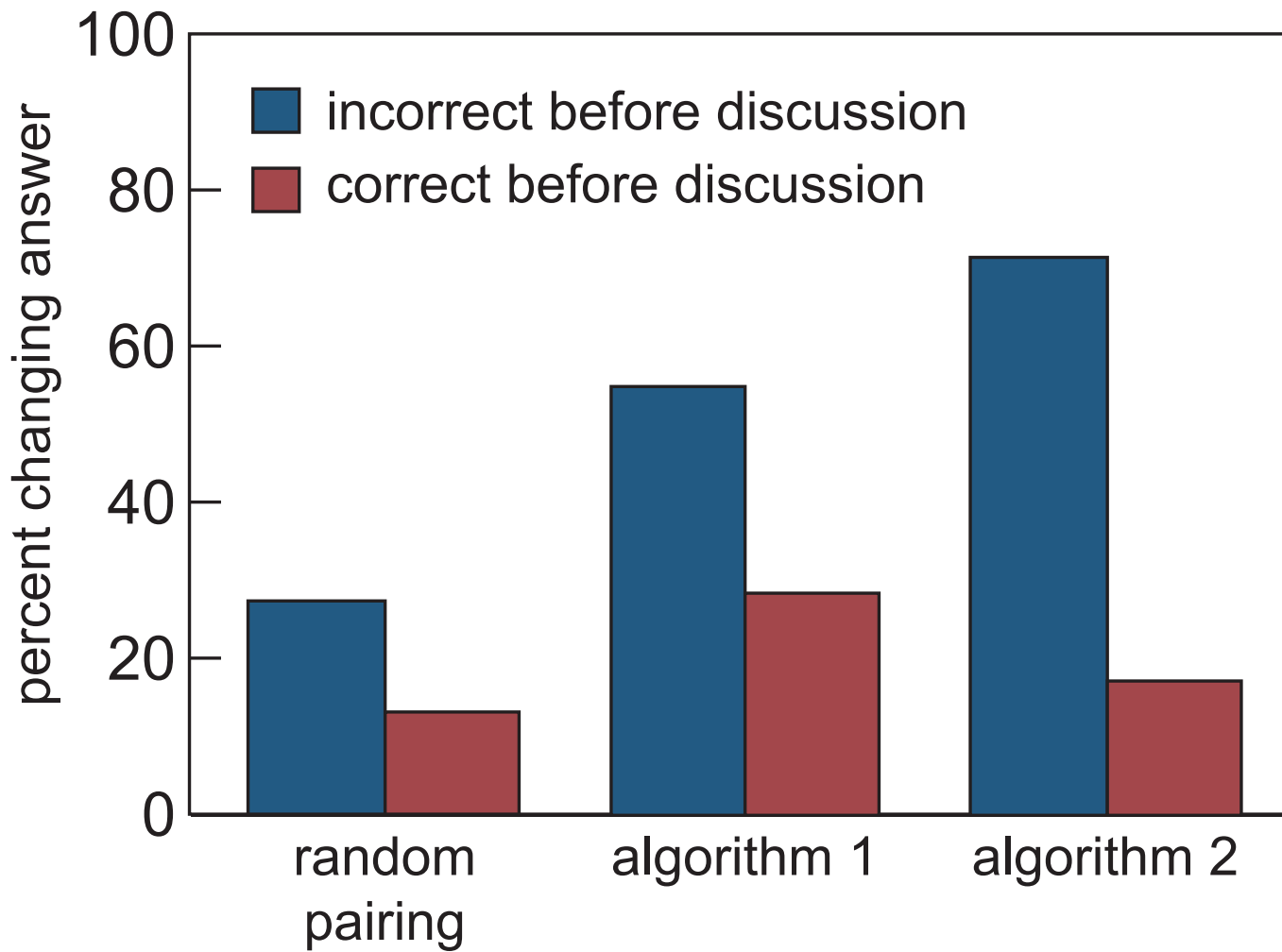
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**1** education

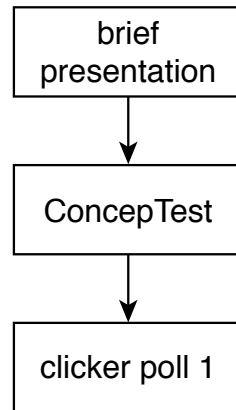
**2** PI

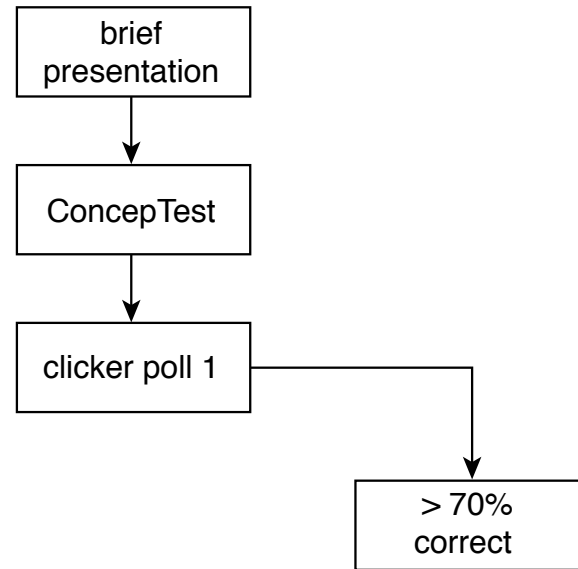
**3** PI 2.0

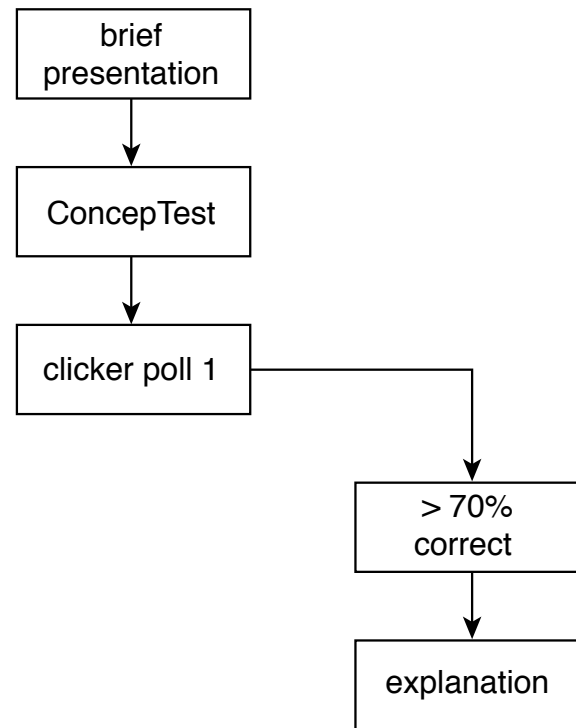
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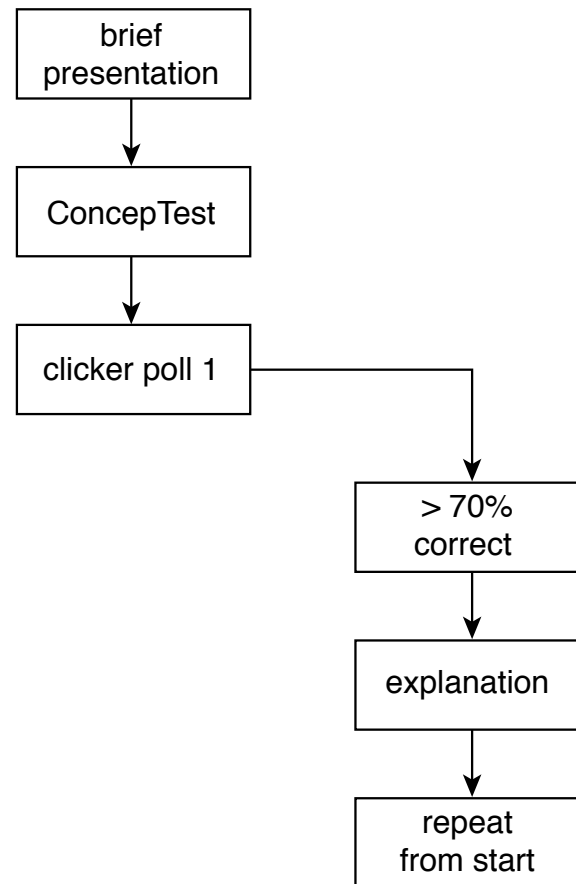


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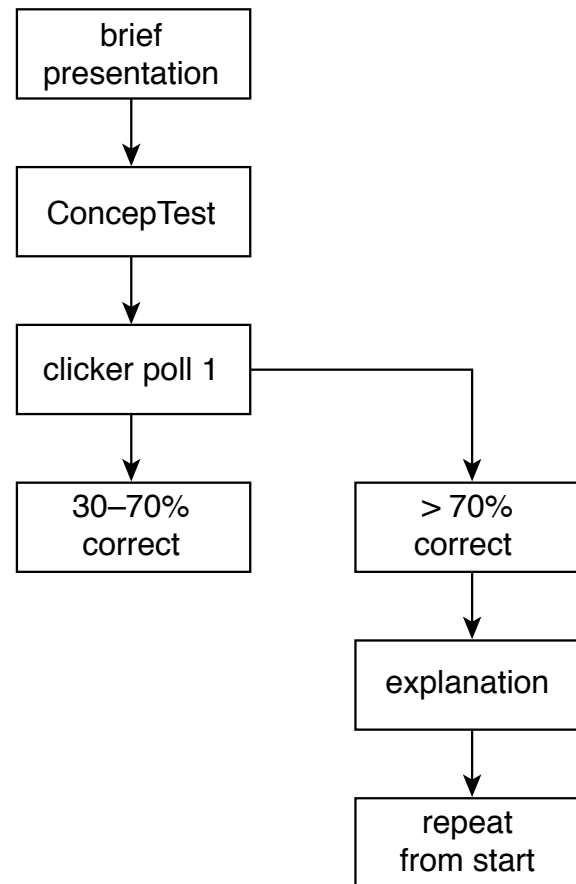


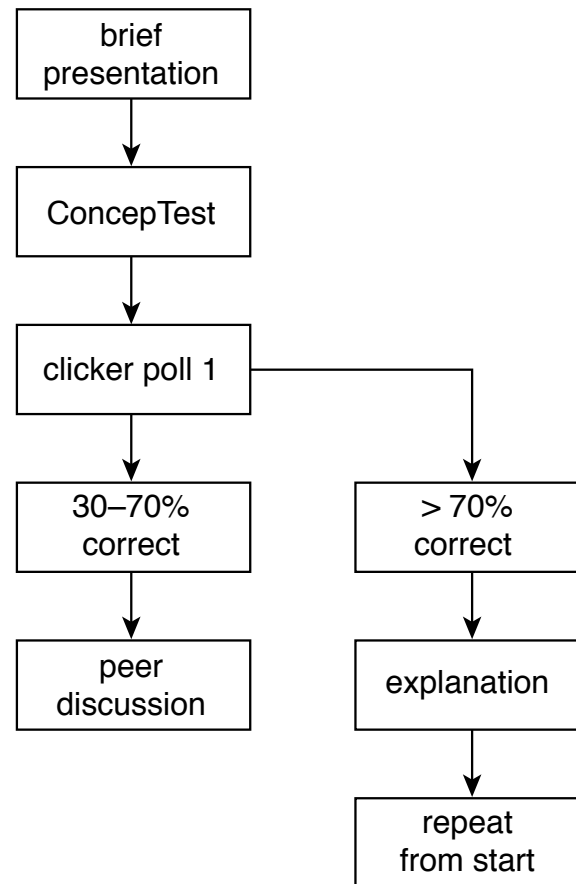


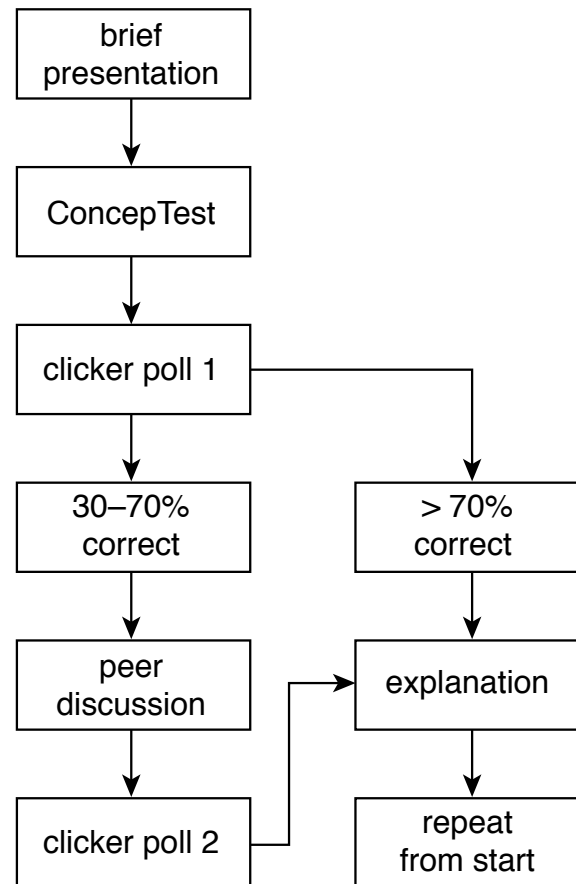


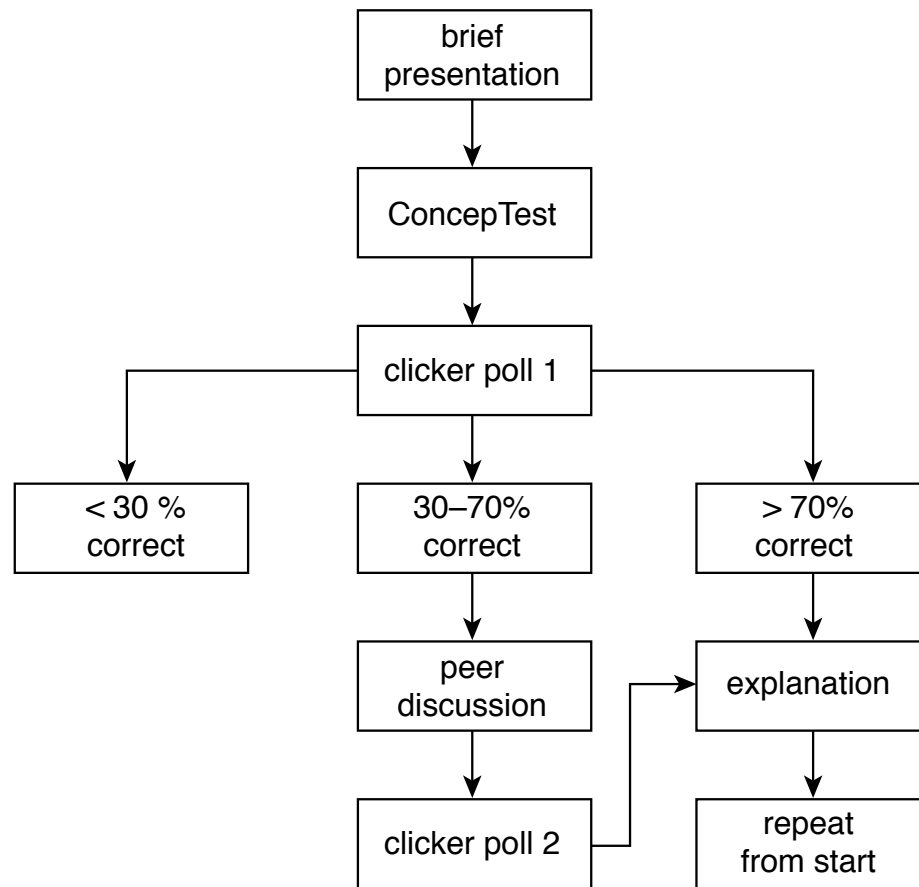


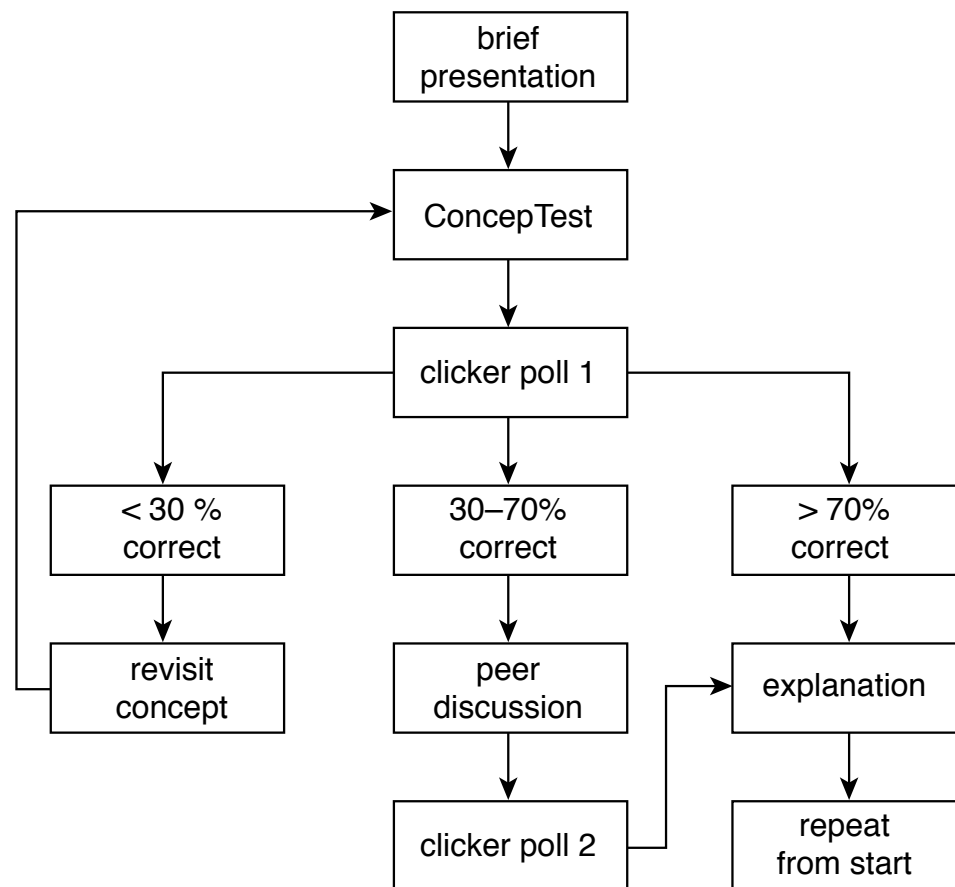


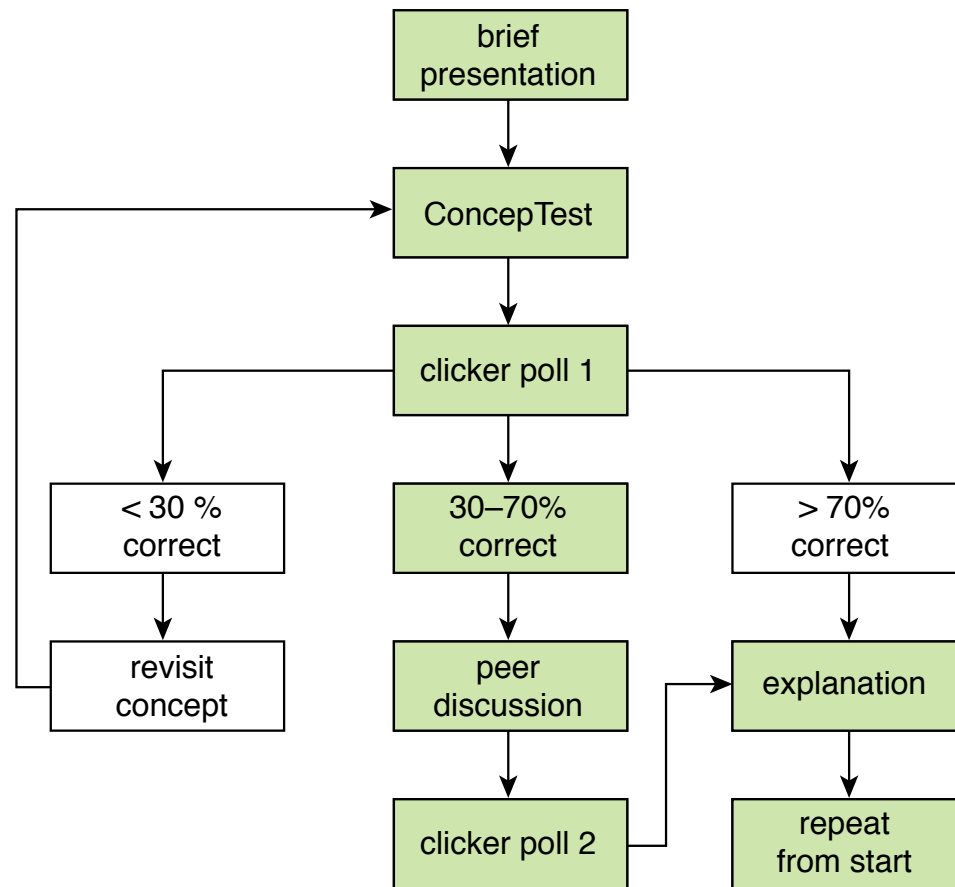


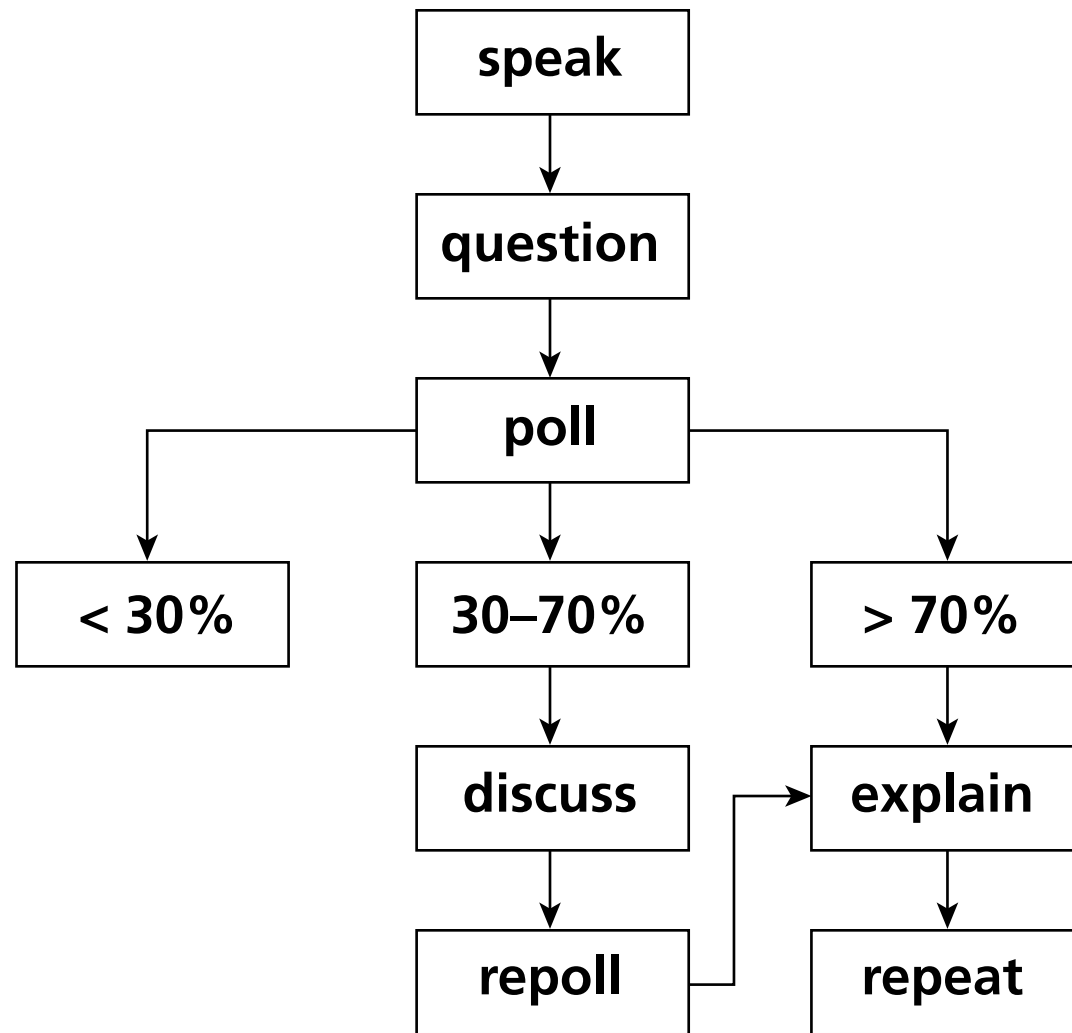


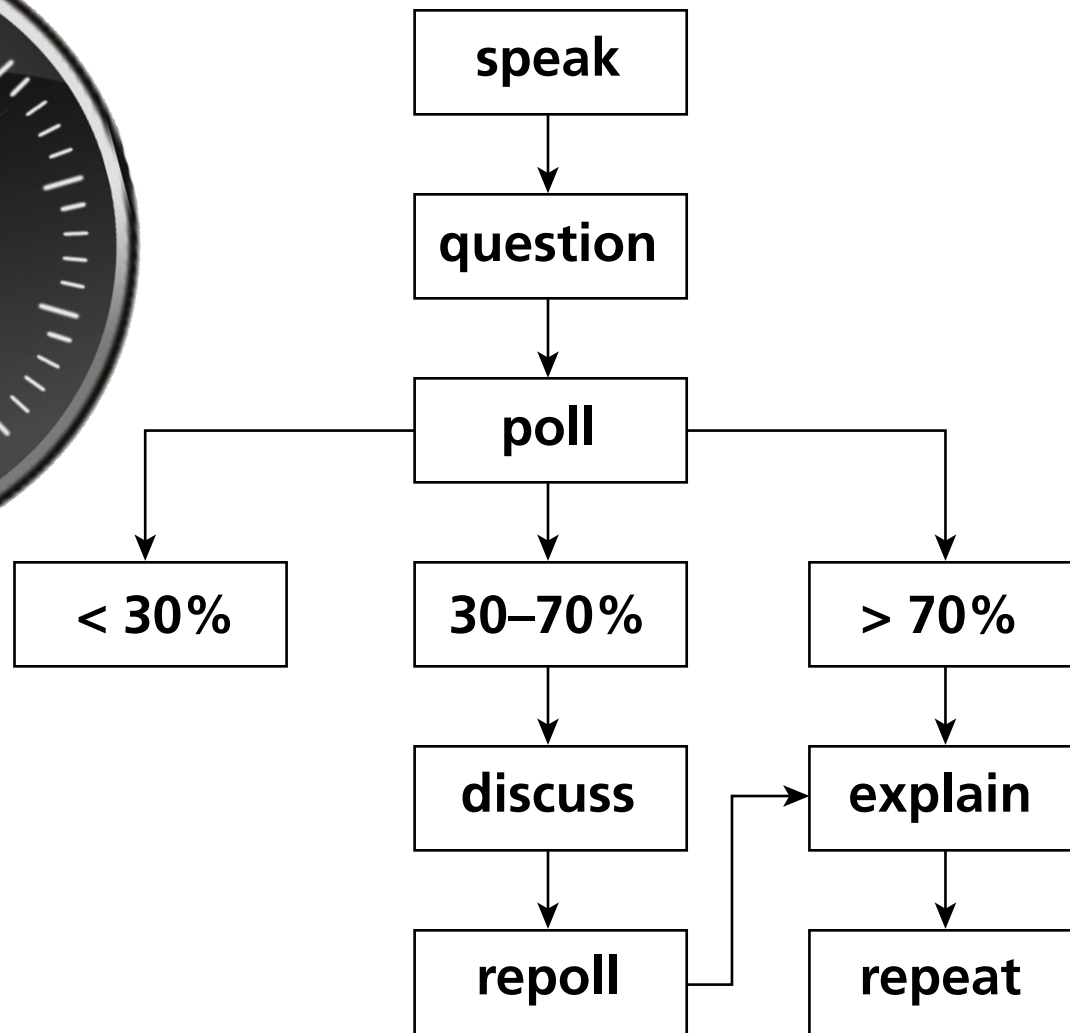
















**1** lecture

**2** PI

**3** PI 2.0



**1** education

**2** PI

**3** PI 2.0



## Learning Catalytics:

- implement proven, researched pedagogy



## Learning Catalytics:

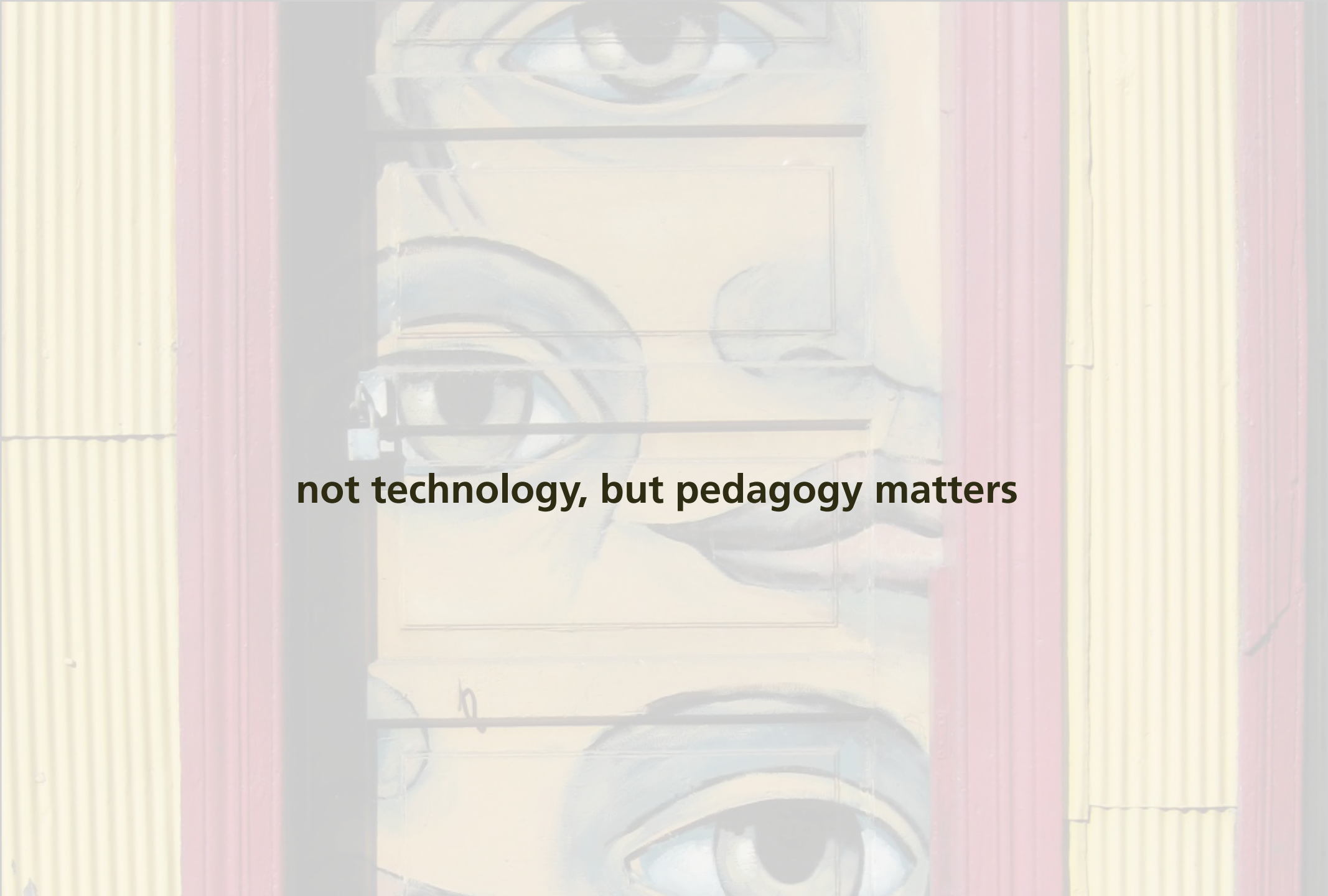
- implement proven, researched pedagogy
- use consumer devices

## **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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