Promoting Social Interactions in (Remote) Education

NSF-Harvard Virtual Workshop: Building a Network to Support and Improve High-School Physics Education

July 15, 2020

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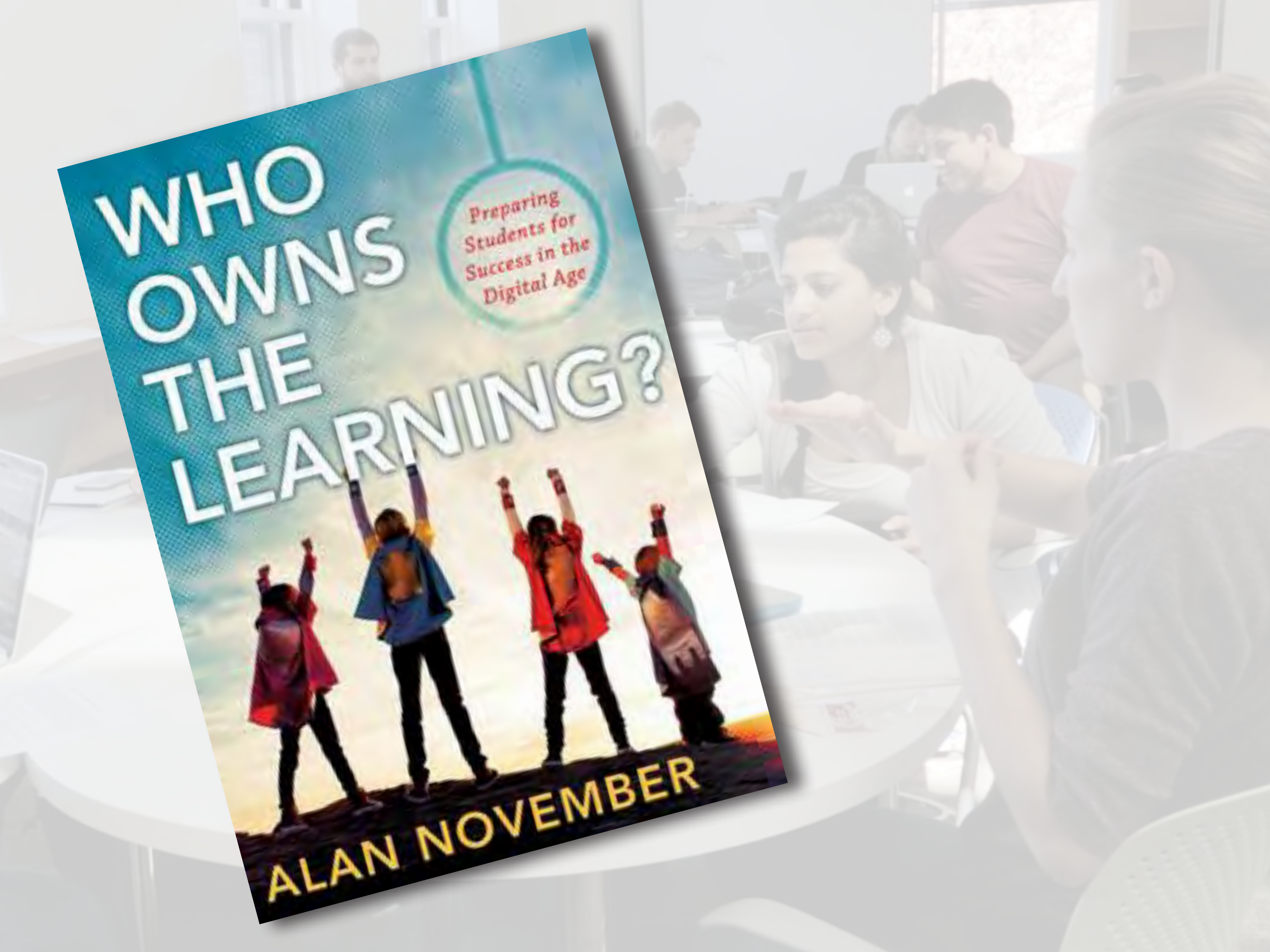
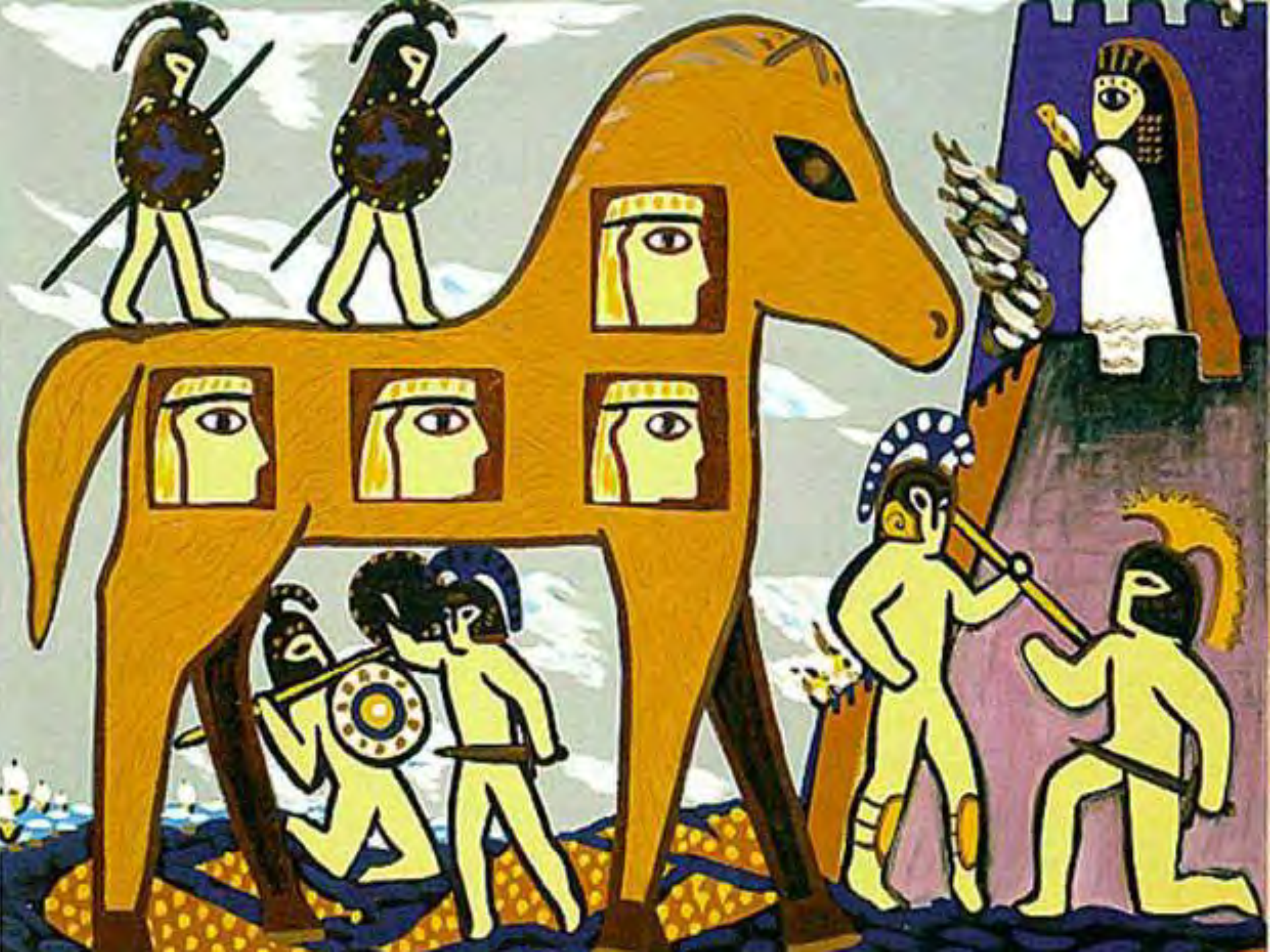

WHO OWNS THE LEARNING?
Preparing Students for Success in the Digital Age
ALAN NOVEMBER

Ownership of learning *physics*?



team & project-based approach


an illusion. . .

Archimedes Principle

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.

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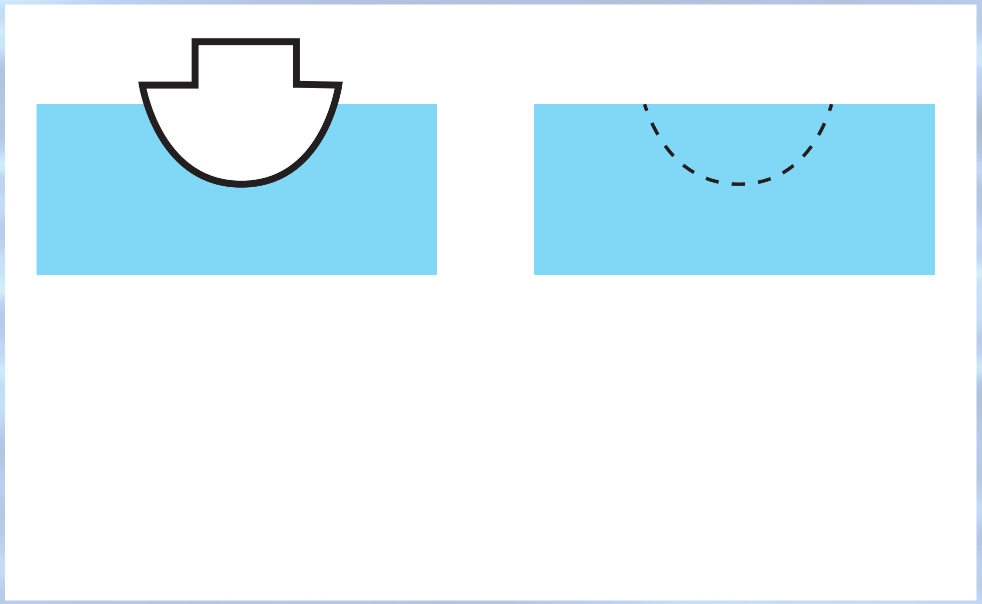

The volume of displaced fluid is equal to the volume of the submerged portion of the object.

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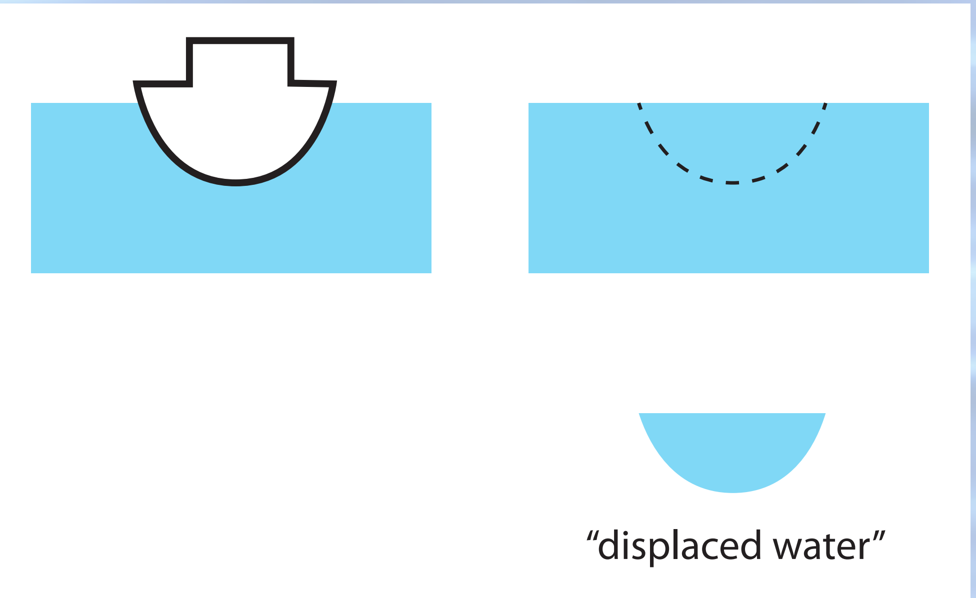

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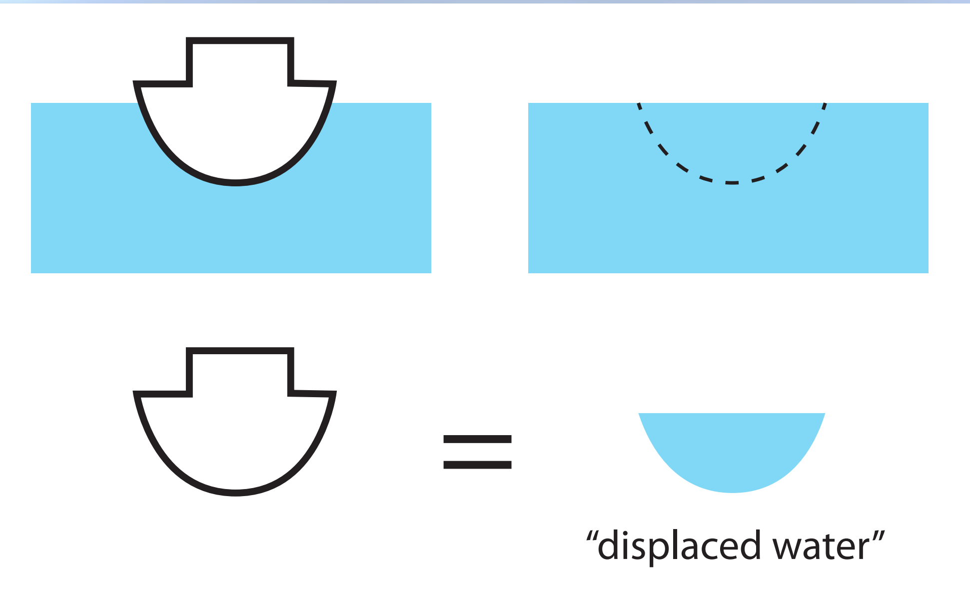

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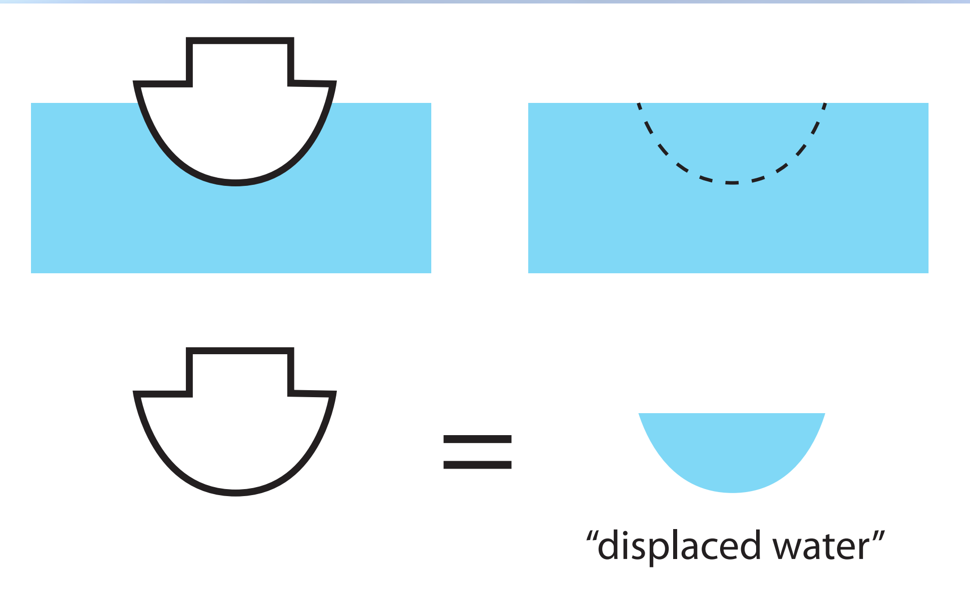

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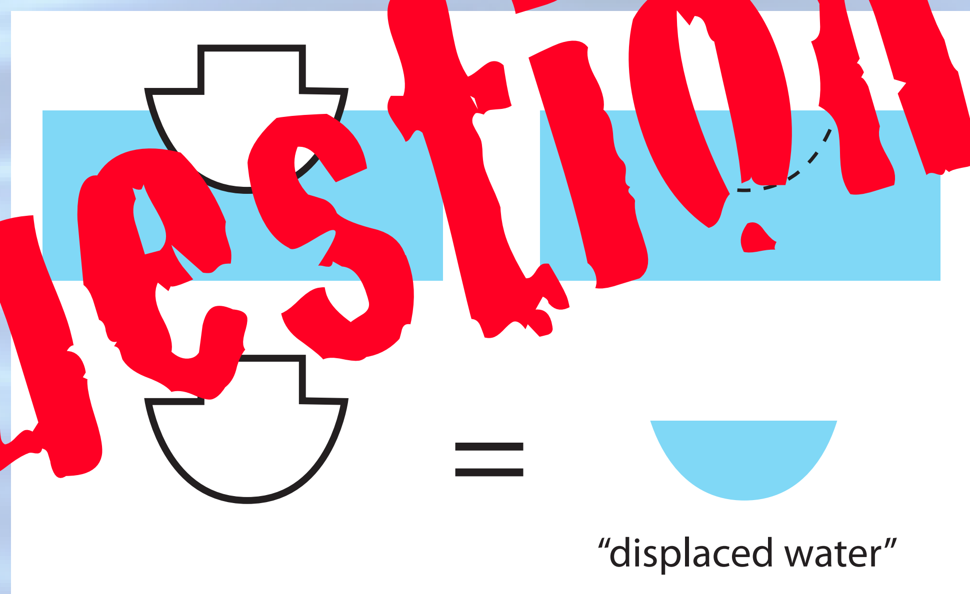


questions?

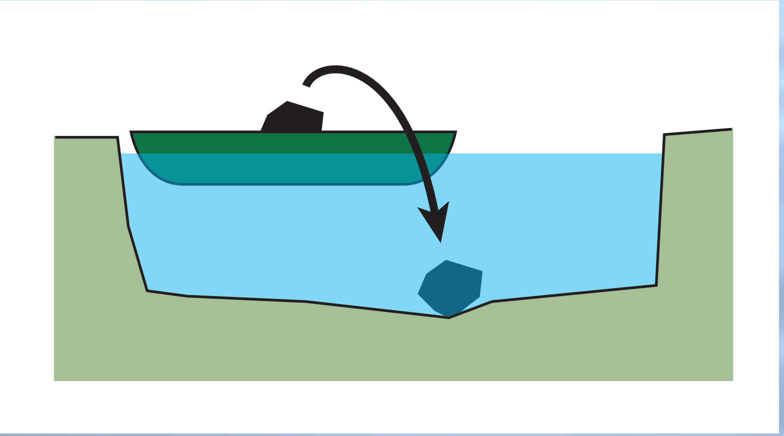
The volume of displaced fluid is equal to the volume of the submerged portion of the object.

1. Go to: http://bit.ly/NSFHSPhys

2. Enter info

3. Join Session ID: 40796710

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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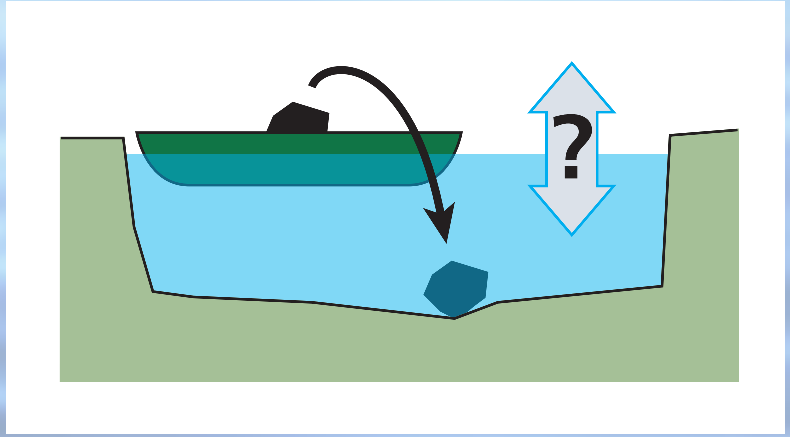

After the boulder sinks to the bottom of the pond, the level of the water in the pond is

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

it was when the boulder was in the boat.

❶ bit.ly/NSFHSPhys ❷ enter info ❸ join 40796710

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2. the same as
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it was when the boulder was in the boat.

you got all fired up!

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

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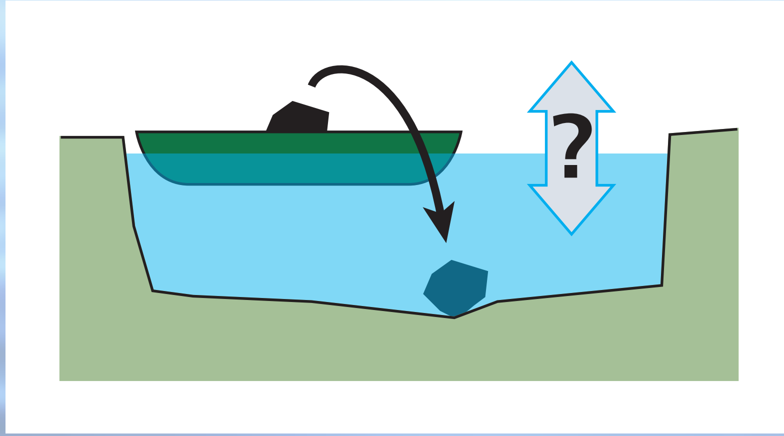

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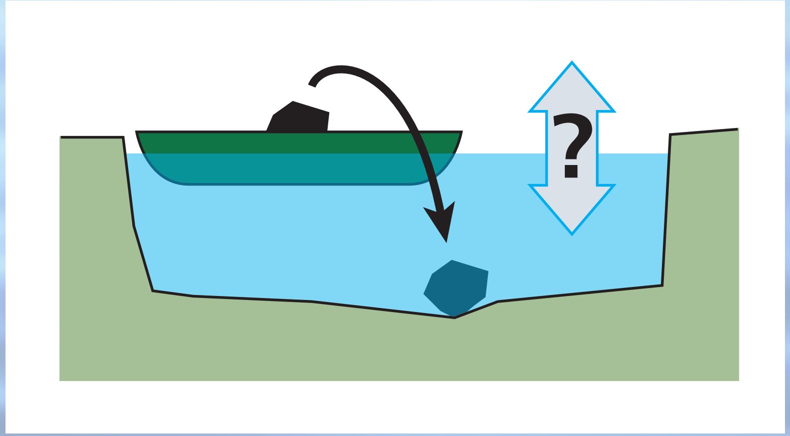

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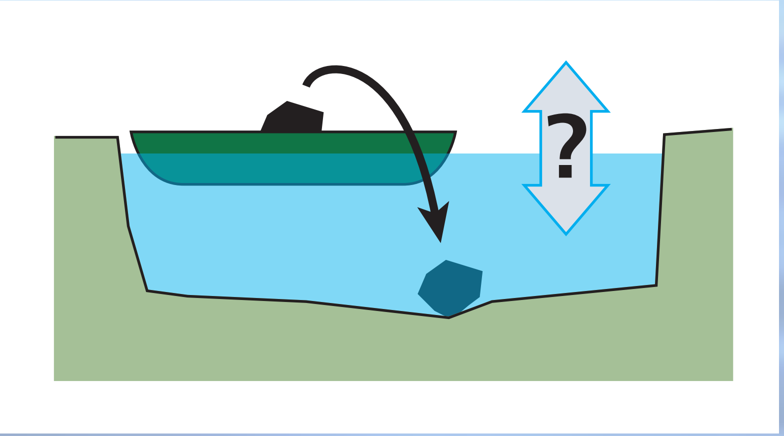

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2. the same as
3. lower than ✔

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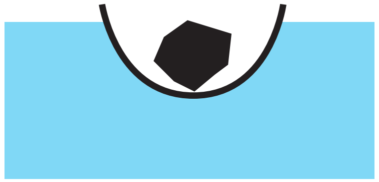
remember: amount of displaced water



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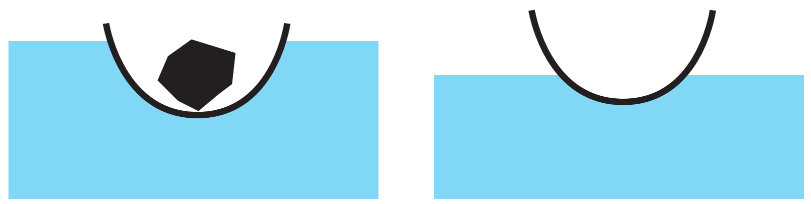

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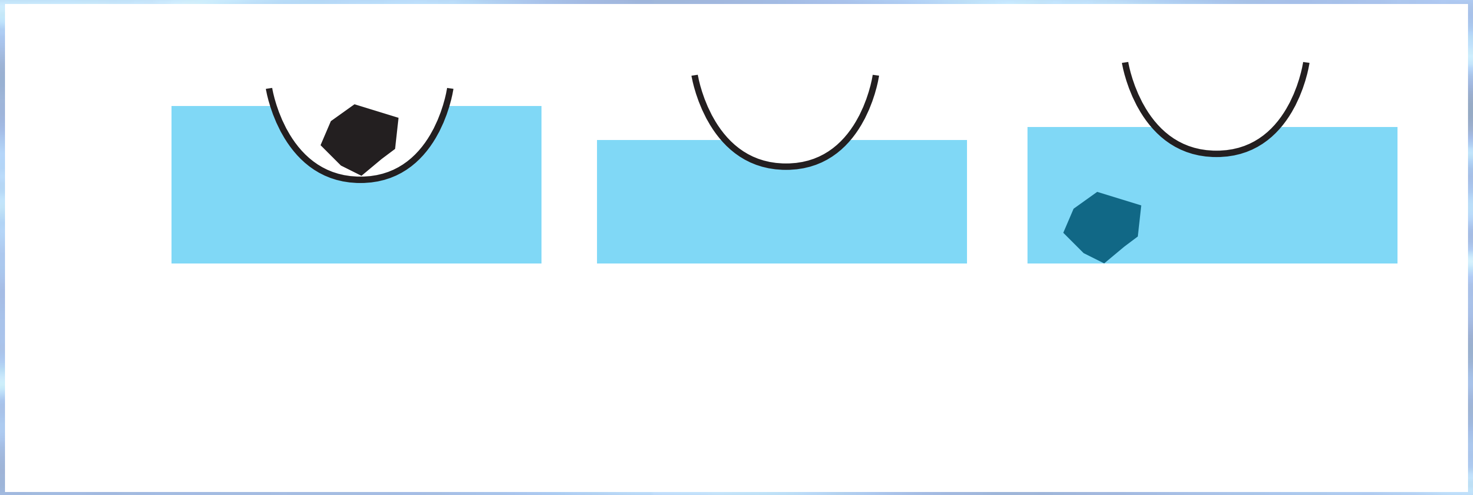

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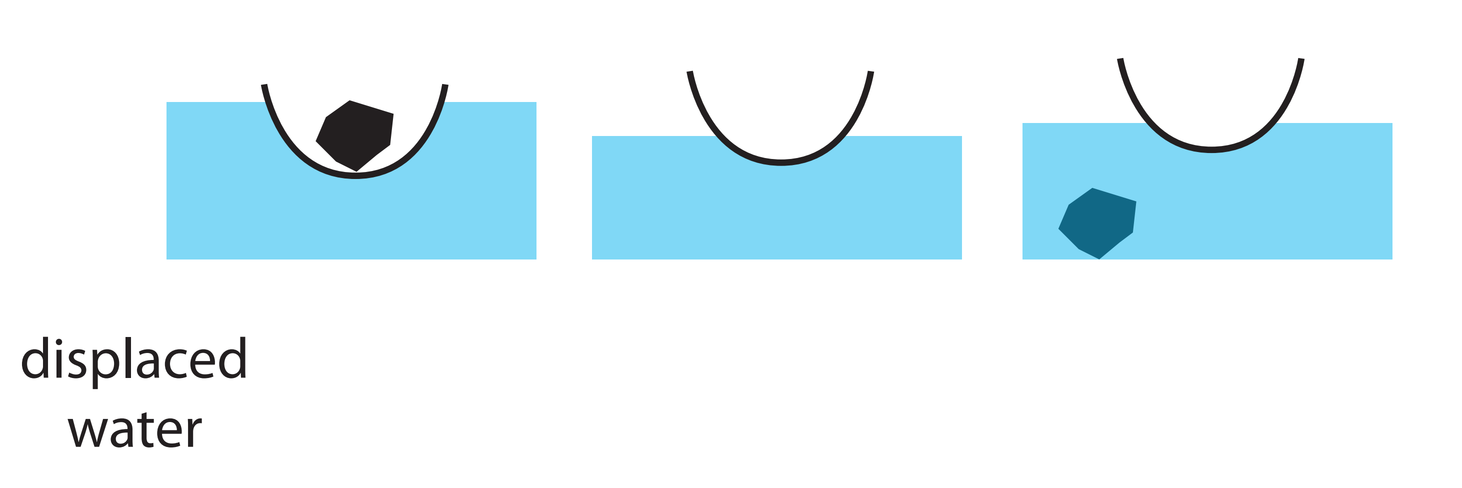

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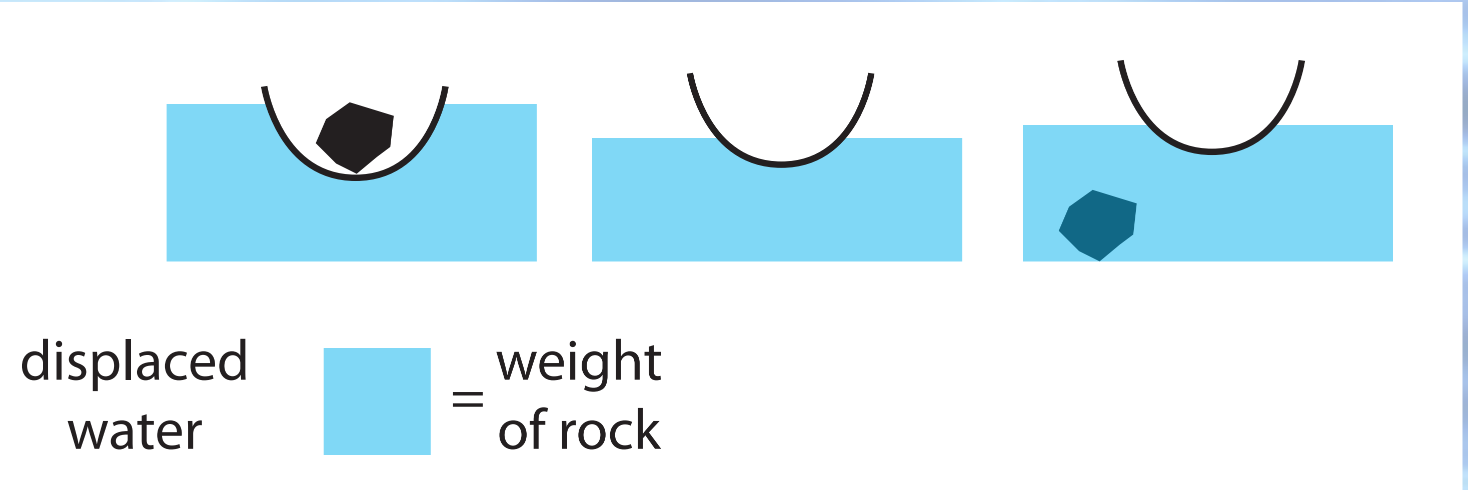

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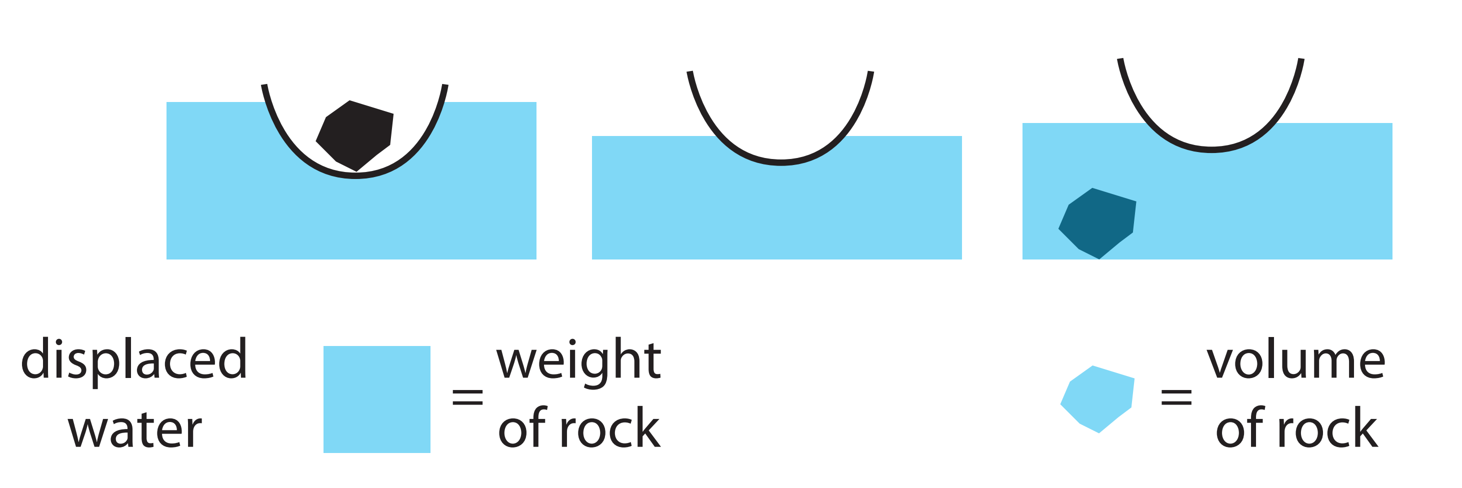
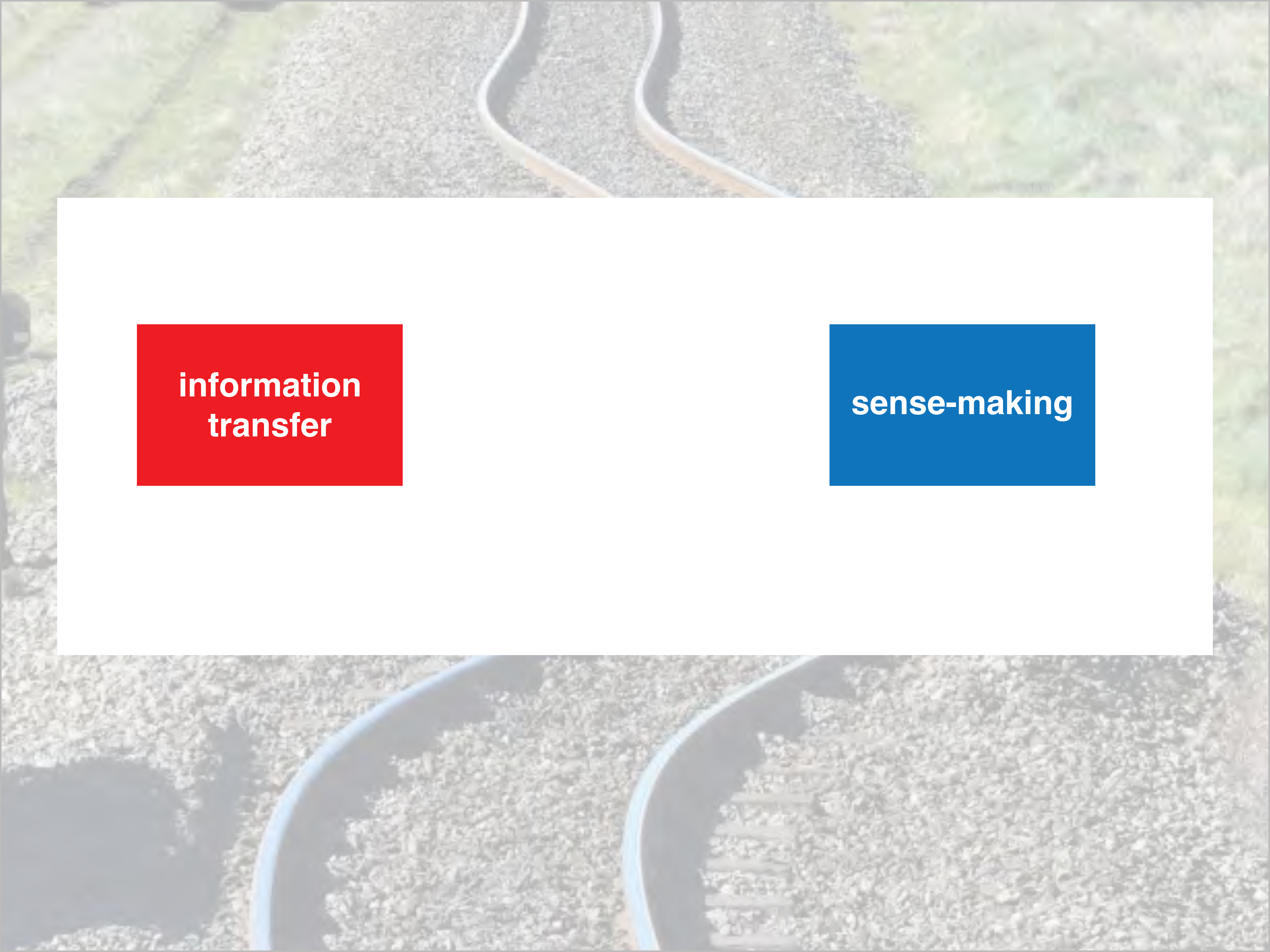


remember: amount of displaced water

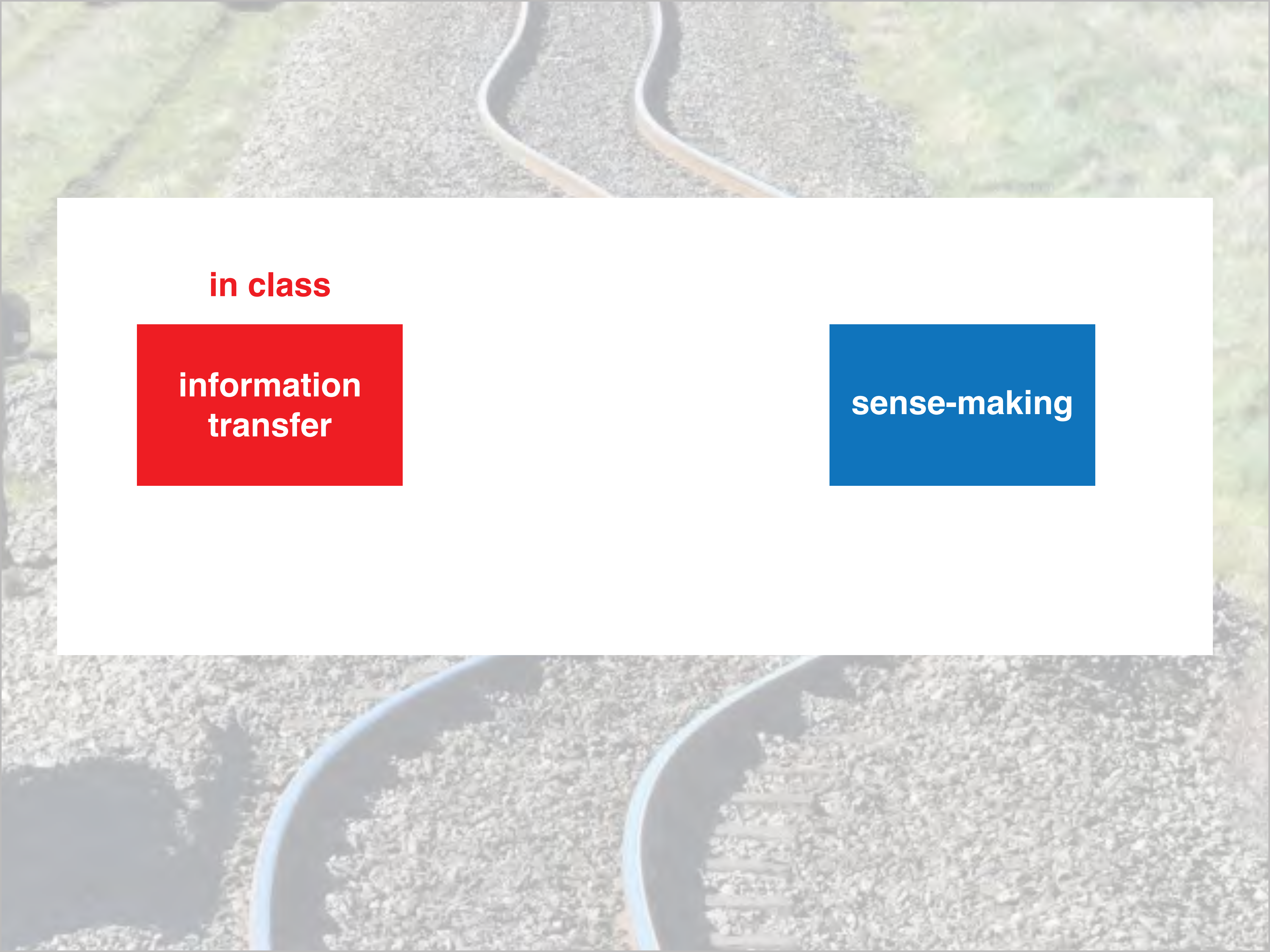
points worth noting

- my “clear” lecture wasn’t very good
- discussion promoted “aha” moments



information transfer

sense-making



in class

information transfer

sense-making

in class

information transfer

out of class

sense-making

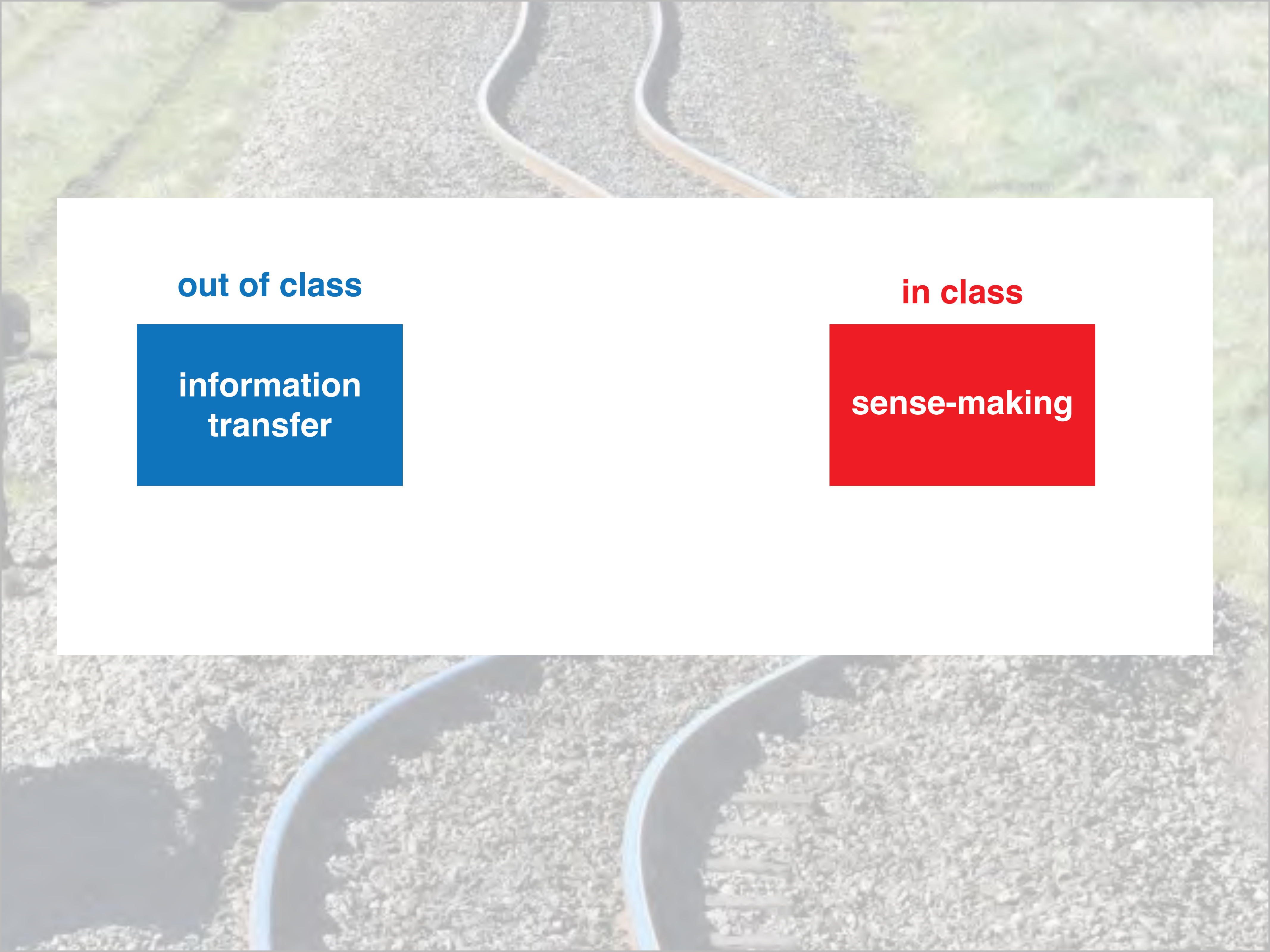
Should focus on THIS!

in class

information transfer

out of class

sense-making



out of class

information transfer

in class

sense-making

out of class

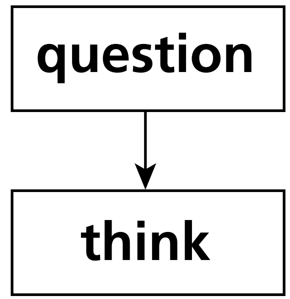
information transfer

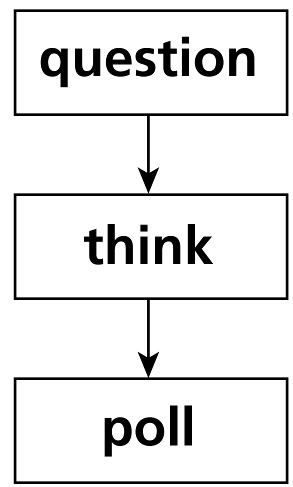
in class

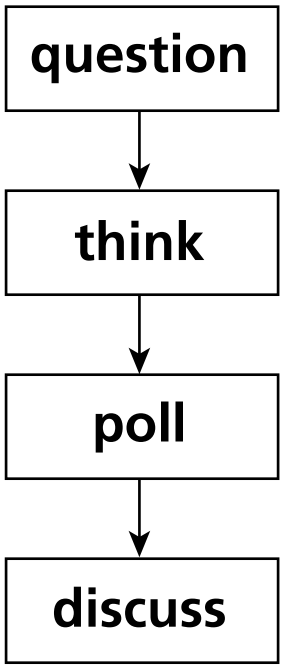
sense-making

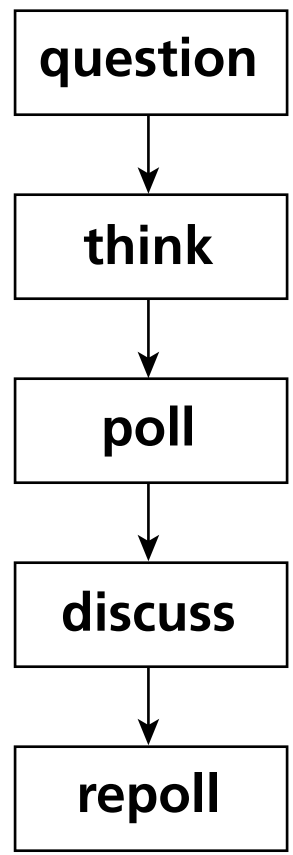
Peer Instruction

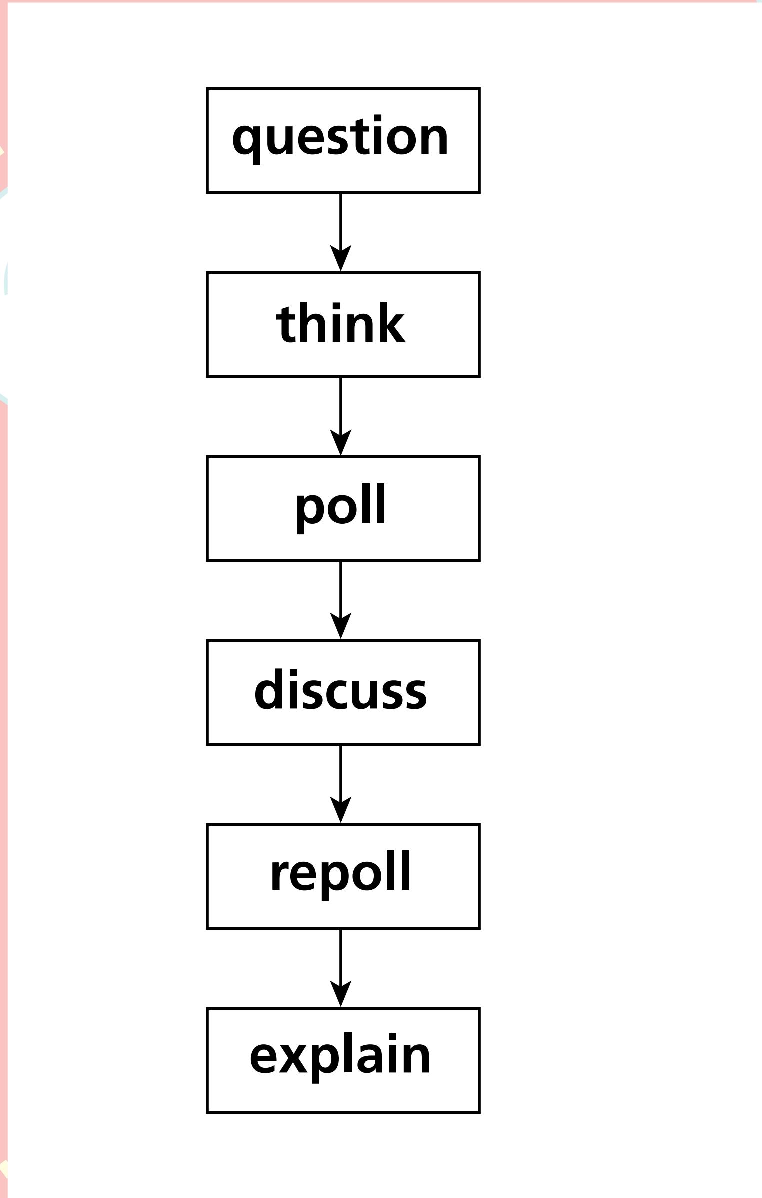
question

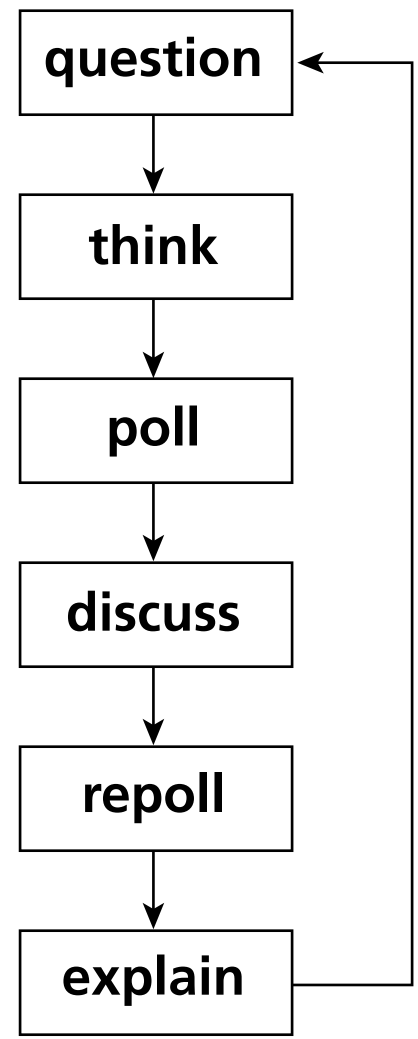

question
think

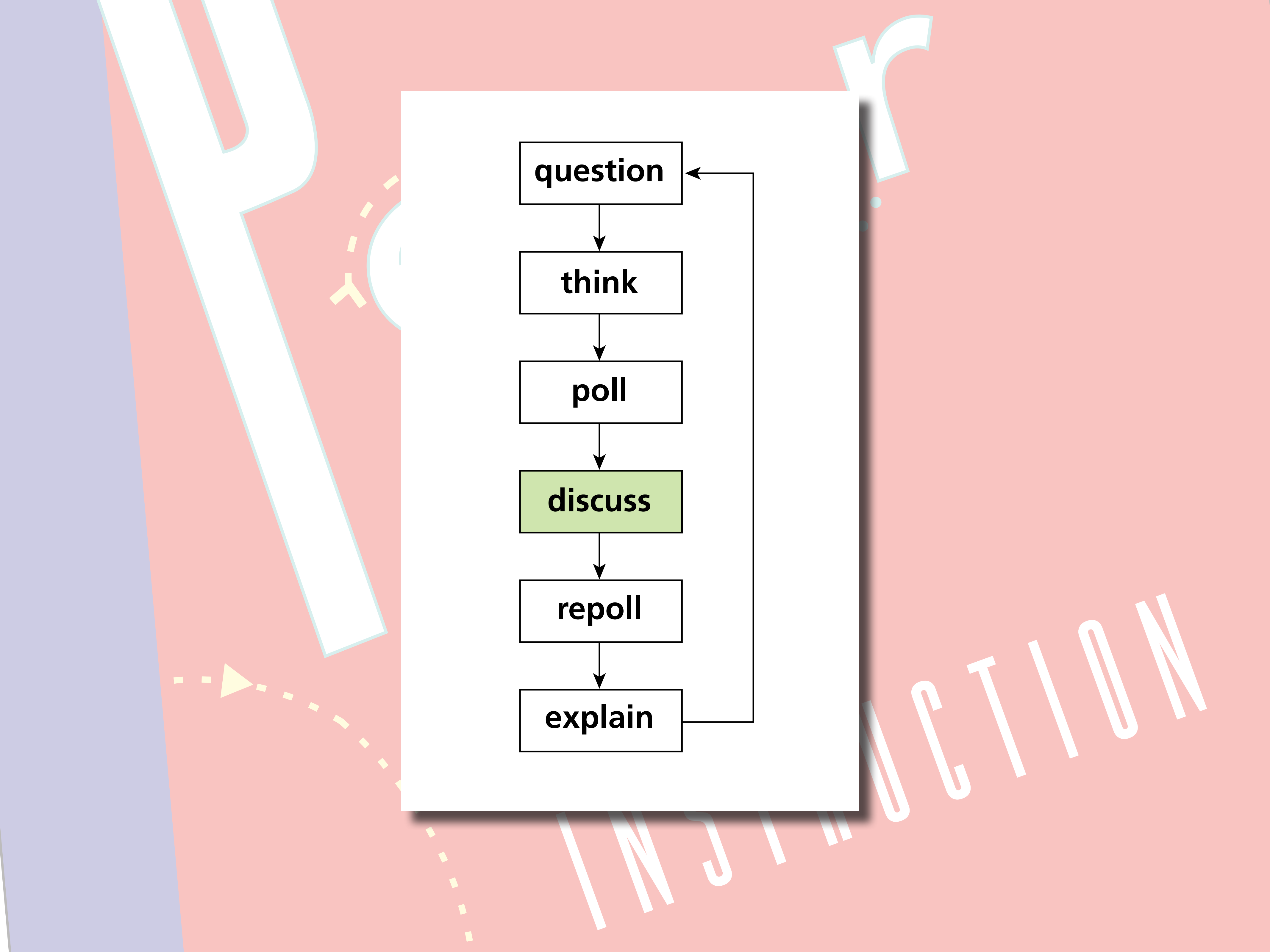

question
think
poll


question
think
poll
discuss


question
think
poll
discuss
repoll

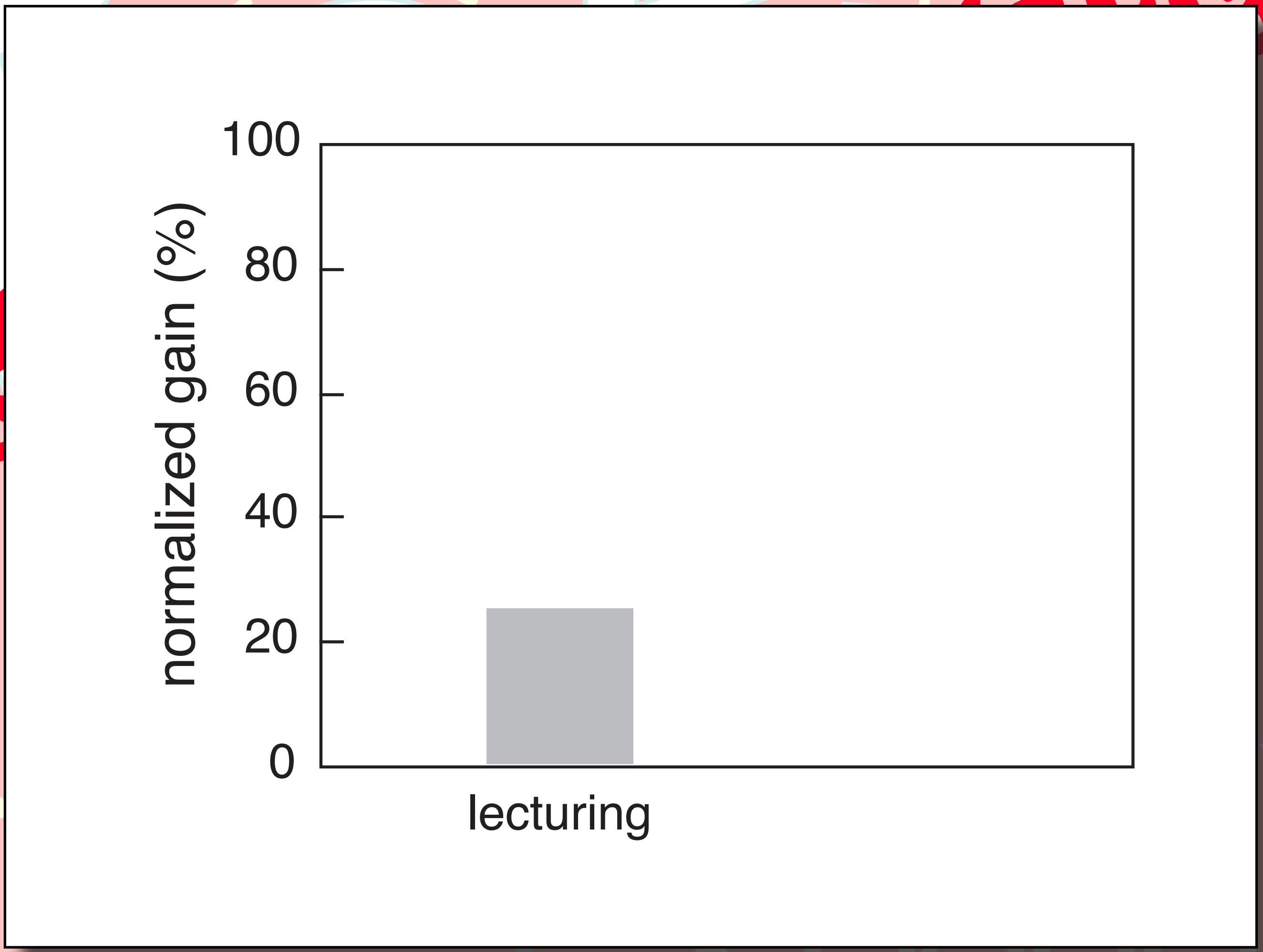

question
think
poll
discuss
repoll
explain


question
think
poll
discuss
repoll
explain

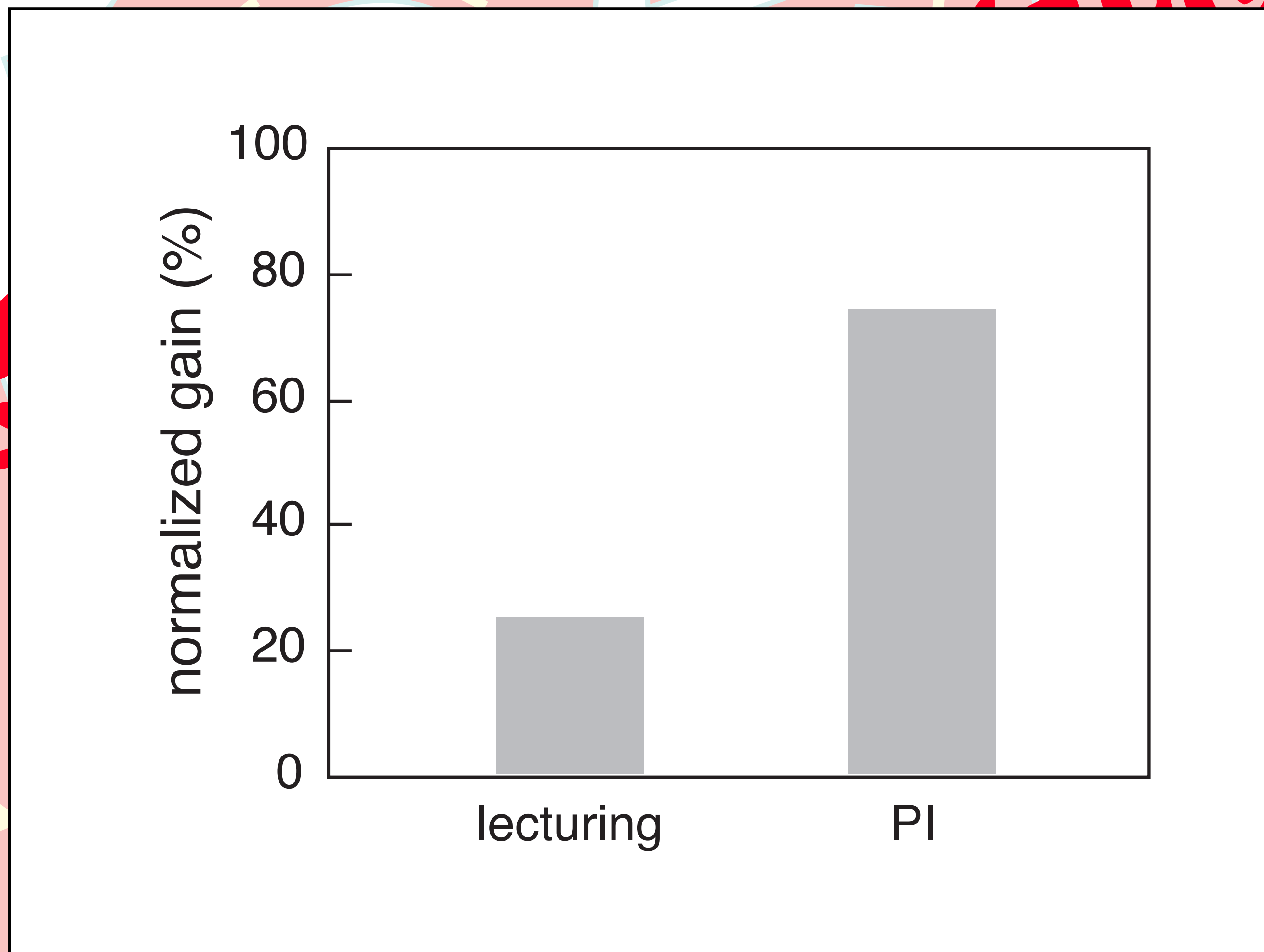


question
think
poll
discuss
repoll
explain


Peer
INSTRUCTION
Higher learning gains



100
80
60
40
20
0
normalized gain (%)
lecturing


normalized gain (%)
100
80
60
40
20
0
lecturing
PI


Peer
Higher learning gains
Better retention
INSTRUCTION

You are a triage nurse in a pediatric urgent care clinic and the following patients are waiting:

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1. 3-yr old F with a FUO and T = 40 °C who is riding a tricycle in the waiting room
2. 6-wk old term M, cc: fussy breast, T = 38.6 °C
3. 14-yr old M with hx of epilepsy who had a seizure at home lasting 5 minutes about half hour ago

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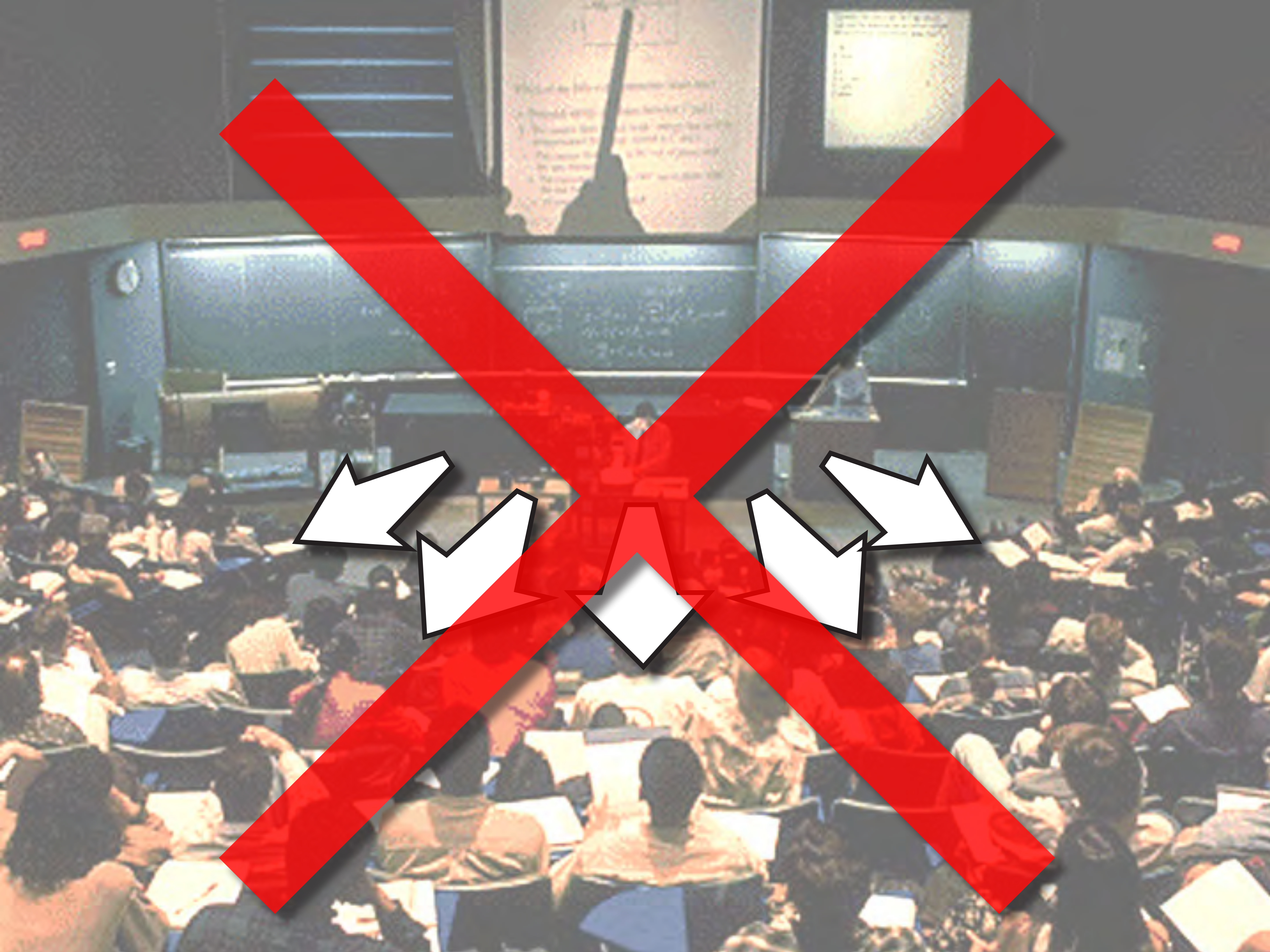
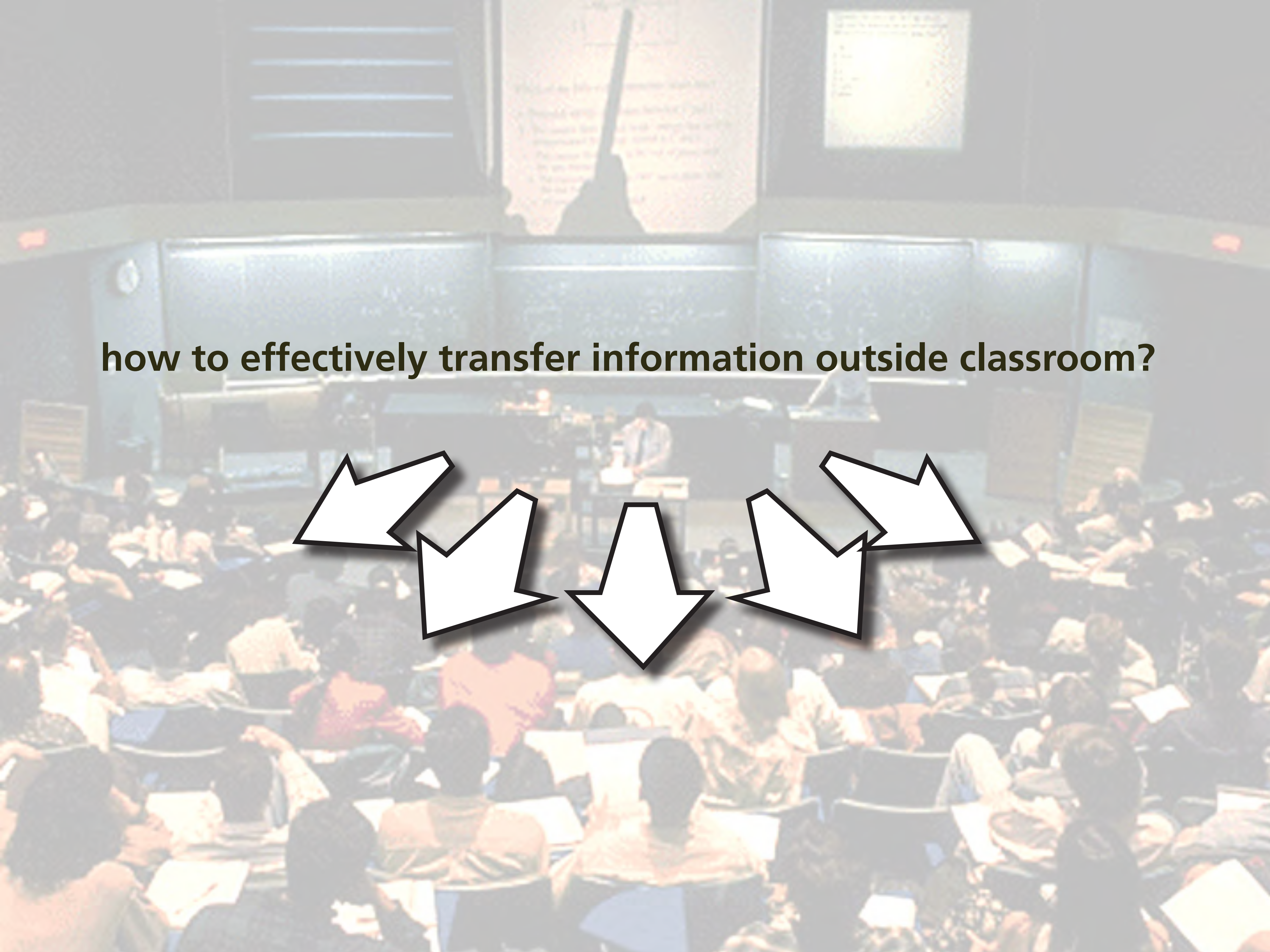
Whom would you triage first?

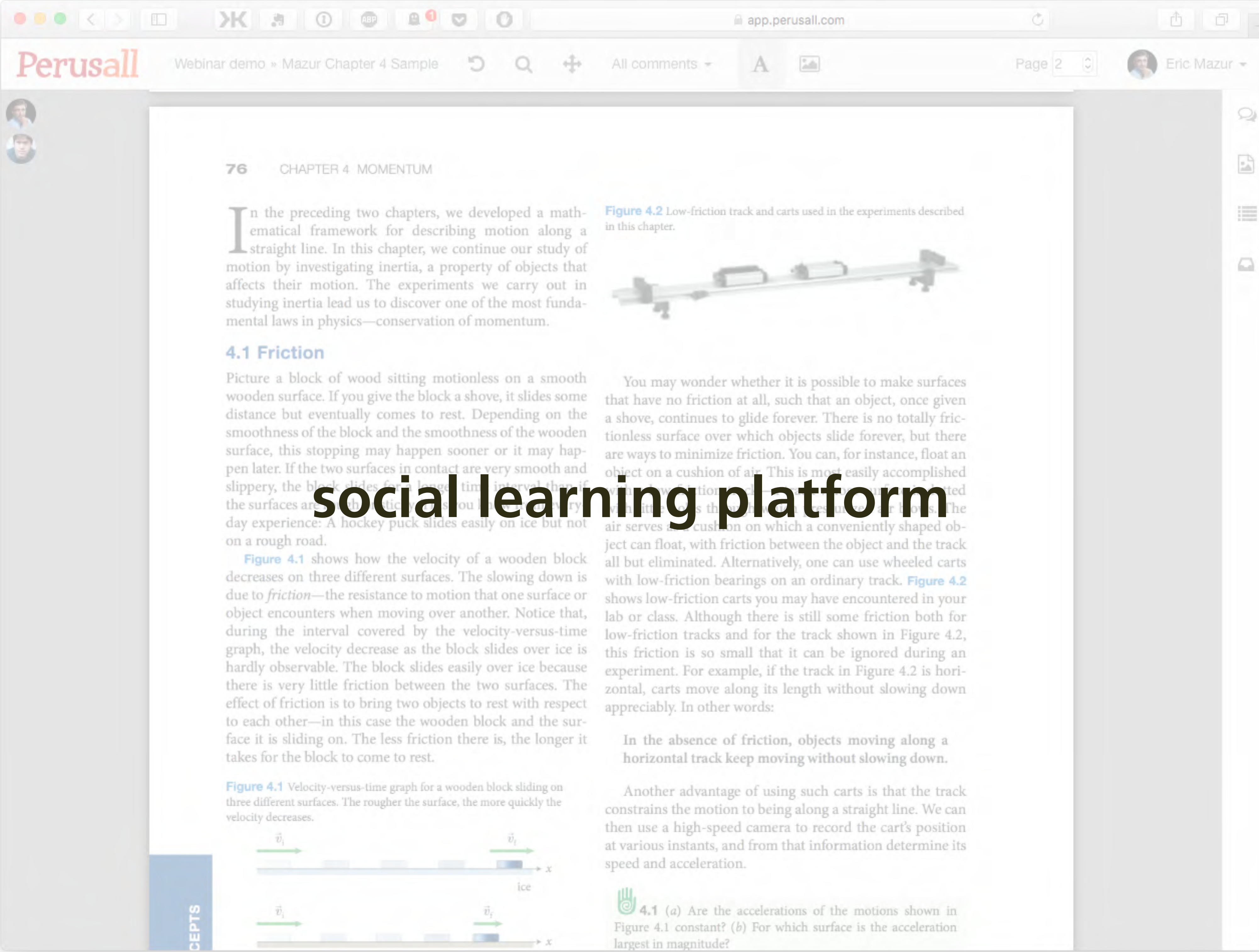



how to effectively transfer information outside classroom?

Solution

turn out-of-class component

also into a social interaction!



76 CHAPTER 4 MOMENTUM

In the preceding two chapters, we developed a mathematical framework for describing motion along a straight line. In this chapter, we continue our study of motion by investigating inertia, a property of objects that affects their motion. The experiments we carry out in studying inertia lead us to discover one of the most fundamental laws in physics—conservation of momentum.

4.1 Friction

Picture a block of wood sitting motionless on a smooth wooden surface. If you give the block a shove, it slides some distance but eventually comes to rest. Depending on the smoothness of the block and the smoothness of the wooden surface, this stopping may happen sooner or it may happen later. If the two surfaces in contact are very smooth and slippery, the block slides for a longer time interval than if the surfaces are [illegible] you know from everyday experience: A hockey puck slides easily on ice but not on a rough road.

Figure 4.1 shows how the velocity of a wooden block decreases on three different surfaces. The slowing down is due to *friction*—the resistance to motion that one surface or object encounters when moving over another. Notice that, during the interval covered by the velocity-versus-time graph, the velocity decrease as the block slides over ice is hardly observable. The block slides easily over ice because there is very little friction between the two surfaces. The effect of friction is to bring two objects to rest with respect to each other—in this case the wooden block and the surface it is sliding on. The less friction there is, the longer it takes for the block to come to rest.

Figure 4.1 Velocity-versus-time graph for a wooden block sliding on three different surfaces. The rougher the surface, the more quickly the velocity decreases.

$\vec{v}_i$ $\vec{v}_f$ x ice

Figure 4.2 Low-friction track and carts used in the experiments described in this chapter.

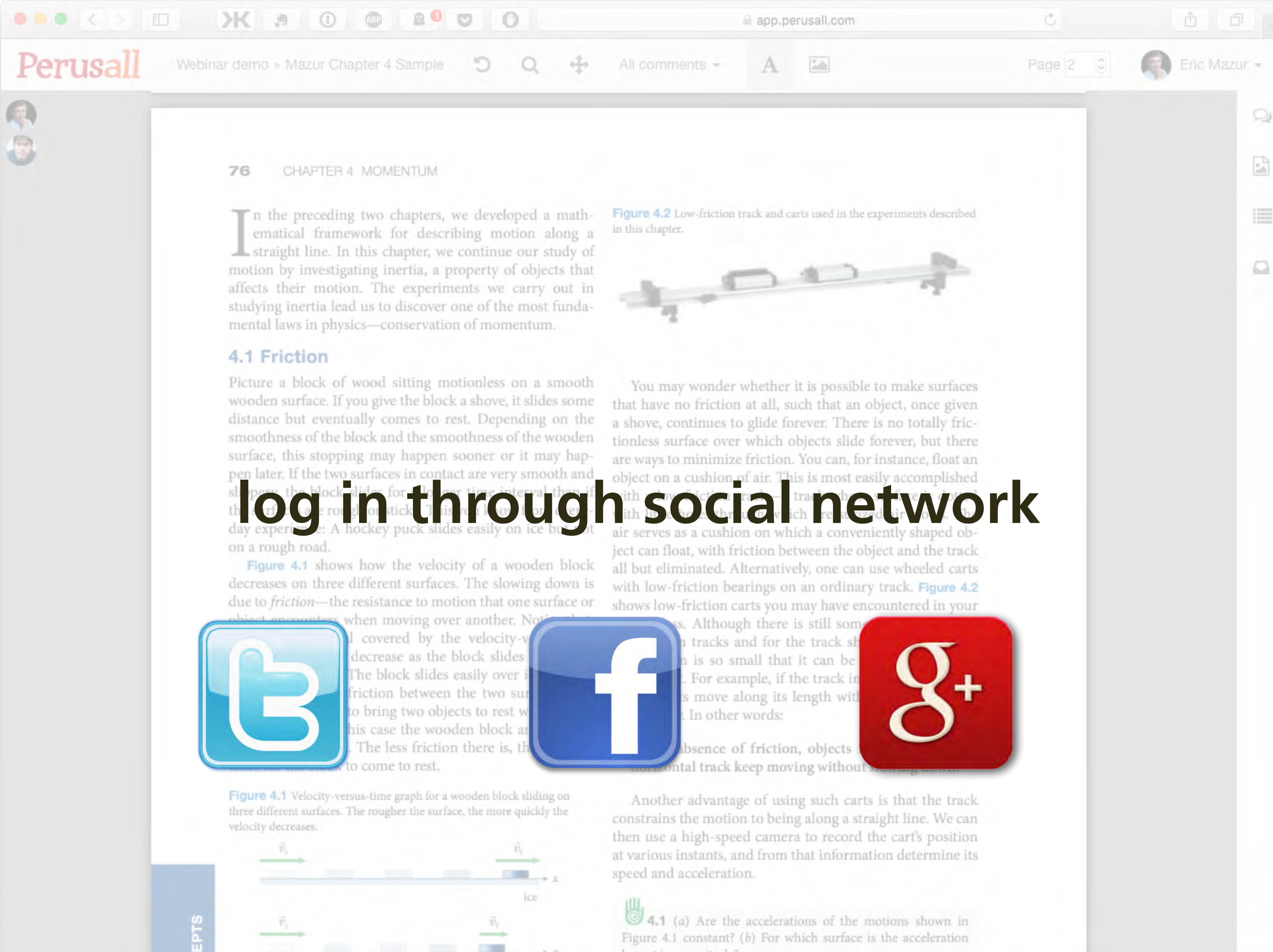
You may wonder whether it is possible to make surfaces that have no friction at all, such that an object, once given a shove, continues to glide forever. There is no totally frictionless surface over which objects slide forever, but there are ways to minimize friction. You can, for instance, float an object on a cushion of air. This is most easily accomplished [illegible] air serves as a cushion on which a conveniently shaped object can float, with friction between the object and the track all but eliminated. Alternatively, one can use wheeled carts with low-friction bearings on an ordinary track. Figure 4.2 shows low-friction carts you may have encountered in your lab or class. Although there is still some friction both for low-friction tracks and for the track shown in Figure 4.2, this friction is so small that it can be ignored during an experiment. For example, if the track in Figure 4.2 is horizontal, carts move along its length without slowing down appreciably. In other words:

In the absence of friction, objects moving along a horizontal track keep moving without slowing down.

Another advantage of using such carts is that the track constrains the motion to being along a straight line. We can then use a high-speed camera to record the cart's position at various instants, and from that information determine its speed and acceleration.

4.1 (*a*) Are the accelerations of the motions shown in Figure 4.1 constant? (*b*) For which surface is the acceleration largest in magnitude?

social learning platform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All comments
Page 2
Eric Mazur
76 CHAPTER 4 MOMENTUM
4.1 Friction
log in through social network

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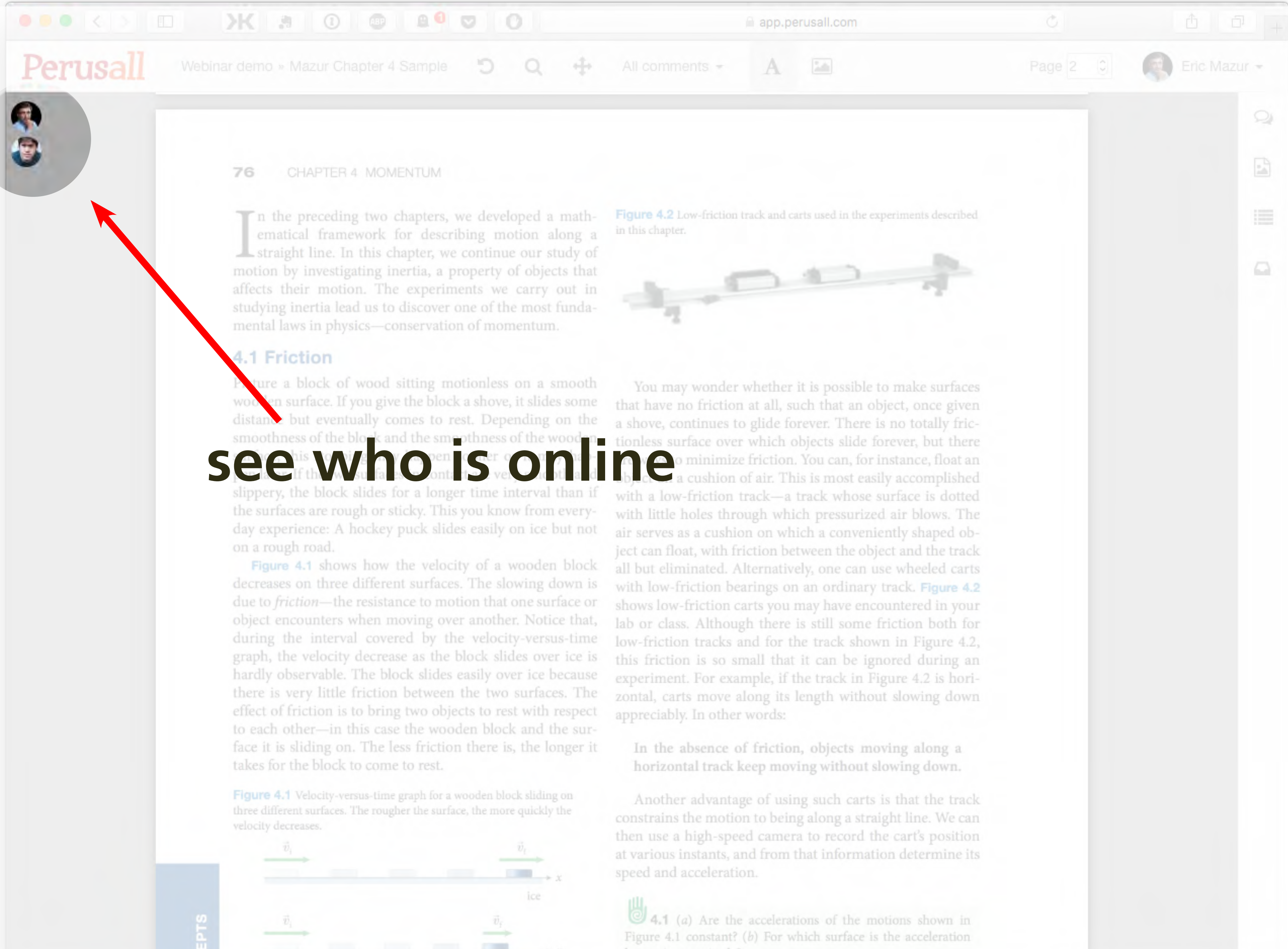

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highlighting text…

Figure 4.1 Velocity-versus-time graph for a wooden block sliding on three different surfaces. The rougher the surface, the more quickly the velocity decreases.

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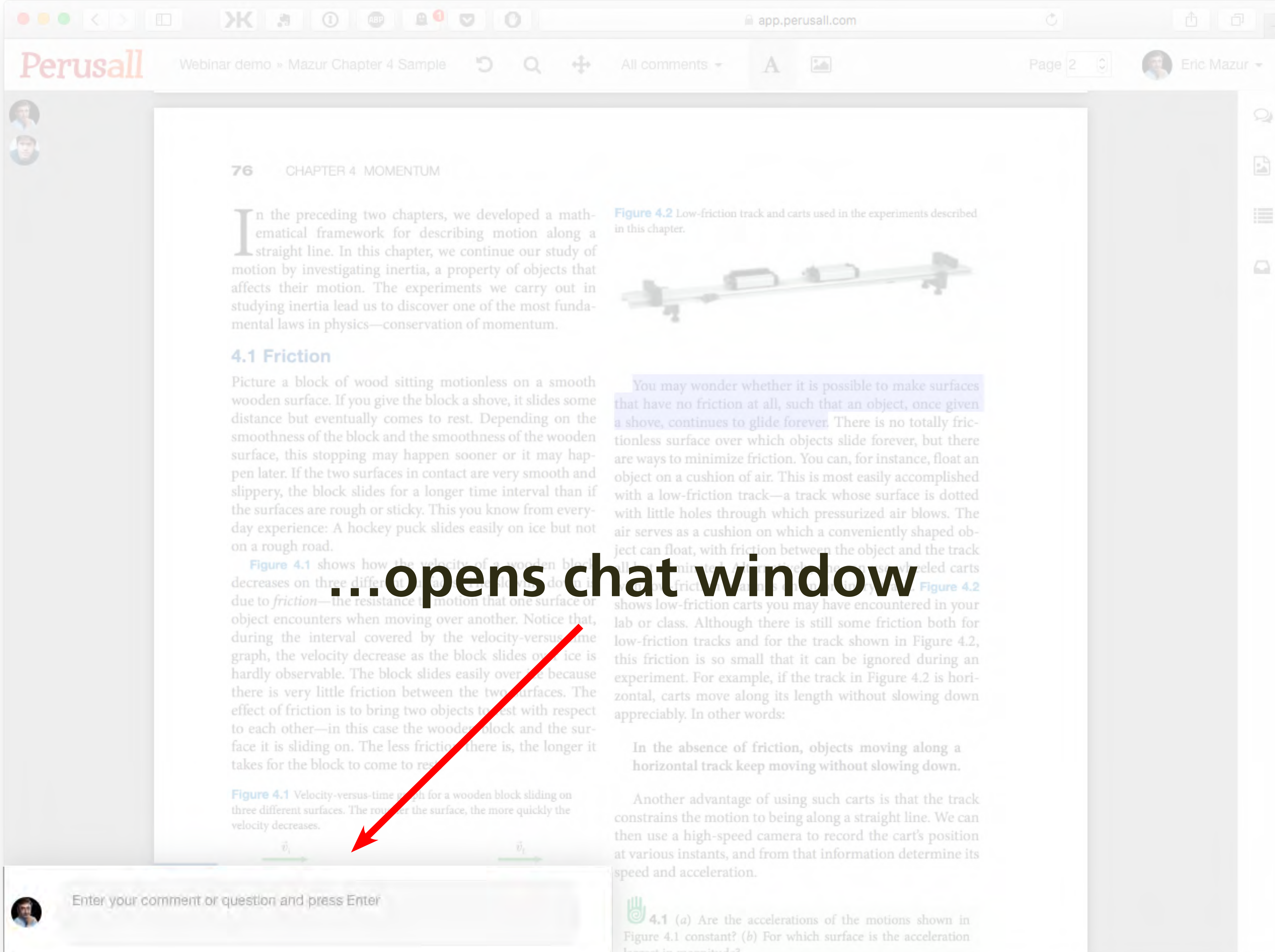
4.1 (*a*) Are the accelerations of the motions shown in Figure 4.1 constant? (*b*) For which surface is the acceleration largest in magnitude?

CEPTS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app.perusall.com
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Webinar demo » Mazur Chapter 4 Sample
All comments
Page 2
Eric Mazur
76 CHAPTER 4 MOMENTUM
In the preceding two chapters, we developed a mathematical framework for describing motion along a straight line. In this chapter, we continue our study of motion by investigating inertia, a property of objects that affects their motion. The experiments we carry out in studying inertia lead us to discover one of the most fundamental laws in physics—conservation of momentum.
4.1 Friction
Picture a block of wood sitting motionless on a smooth wooden surface. If you give the block a shove, it slides some distance but eventually comes to rest. Depending on the smoothness of the block and the smoothness of the wooden surface, this stopping may happen sooner or it may happen later. If the two surfaces in contact are very smooth and slippery, the block slides for a longer time interval than if the surfaces are rough or sticky. This you know from everyday experience: A hockey puck slides easily on ice but not on a rough road.
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Enter your comment or question and press Enter

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No friction at all seems impossible. Isn't there always some friction in any real case.

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Perusall Webinar demo » Mazur Chapter 4 Sample All comments Page 2 Eric Mazur

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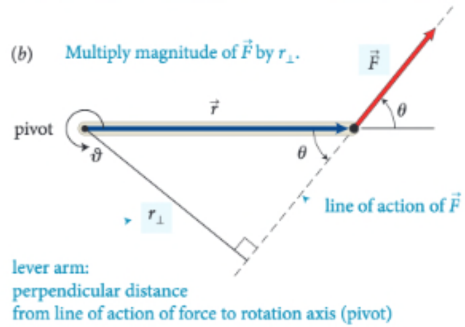
Enter your comment or question and press Enter



action of the force and the axis of rotation. So, the torque caused by a force exerted on an object is the product of the magnitude of the force and its lever arm distance. It can be written equivalently as $rF_\perp$ and as $r_\perp F$.

Like other rotational quantities, torque carries a sign that depends on the choice of direction for increasing ϑ. In Figure 12.4, for example, the torque caused by $\vec{F}_1$ about the pivot tends to rotate the rod in the direction of increasing ϑ and so is positive; the torque caused by $\vec{F}_2$ is negative. The sum of the two torques about the pivot is then $r_1F_1 + (-r_2F_2)$. As we've seen, the two torques are equal in magnitude when the rod is balanced, and so the sum of the torques is zero. When the sum of the torques is not zero, the rod's rotational acceleration is nonzero, and so its rotational velocity and angular momentum change.

In the situations depicted in Figures 12.4 and 12.5 we used the pivot to calculate the lever arm distances. This is a natural choice because that is the point about which the object under consideration is free to rotate. However, torques also play a role for stationary objects that are suspended or supported at several different points and that are not free to rotate—for example, a plank or bridge supported at either end. To determine what reference point to use in such cases, complete the following exercise.

CONCEPTS

Exercise 12.1 Reference point

Consider again the rod in Figure 12.4. Calculate the sum of the torques about the left end of the rod.

SOLUTION I begin by making a sketch of the rod and the three forces exerted on it, showing their points of application on the rod (Figure 12.6).

reference point

$\vec{F}_1$

The lever arm distances must now be determined relative to the left end of the rod. The lever arm distance of force $\vec{F}_1$ to this point is zero, and so the torque caused by that force about the left end of the rod is zero. If I choose counterclockwise as the positive direction of rotation, $\vec{F}_2$ causes a negative torque about the left end of the rod; the force $\vec{F}^c_{pr}$ exerted by the pivot causes a positive torque about the left end of the rod. The lever arm distance of $\vec{F}_2$ about the left end of the rod is $r_1 + r_2$; that of $\vec{F}^c_{pr}$ is r_1. Because the rod is at rest, the magnitude of the force exerted by the pivot is equal to the sum of the forces $\vec{F}_1$ and $\vec{F}_2$. Taking into account the signs of the torques, we find that the sum of the torques about the left end of the rod is $r_1(F_1 + F_2) - (r_1 + r_2)F_2 = r_1F_1 - r_2F_2$. This is the same result we obtained for the torques about the pivot, and so the sum of the torques about the left end is zero. ✔

Exercise 12.1 shows that the sum of the torques about the left end of the rod is zero, just like the sum of the torques about the pivot. You can repeat the calculation for the torques about the right end of the rod or any other point, and each time you will find that the sum of the torques is zero. The reason is that the rod is not rotating about any point, and so the sum of the torques must be zero about any point. In general we can say:

For a stationary object, the sum of the torques is zero.

For a stationary object we can choose any reference point we like to calculate torques. It pays to choose a reference point that simplifies the calculation. As you have seen, we do not need to consider any force that is exerted at the reference point. So, by putting the reference point at the point of application of a force, we can eliminate that force from the calculation.

12.2 In the situation depicted in Figure 12.2*a*, you must continue to exert a force on the seesaw to keep the child off the ground. The force you exert causes a torque on the seesaw, and yet the seesaw's rotational acceleration is zero. How can this be if torques cause objects to accelerate rotationally?

Example 12.2 Torques on lever

Three forces are exerted on the lever of Figure 12.7. Forces $\vec{F}_1$ and $\vec{F}_3$ are equal in magnitude, and the magnitude of $\vec{F}_2$ is half as great. Force $\vec{F}_1$ is horizontal, $\vec{F}_2$ and $\vec{F}_3$ are vertical, and the lever makes an angle of 45° with the horizontal. Do these forces cause the lever to rotate about the pivot? If so, in which direction?

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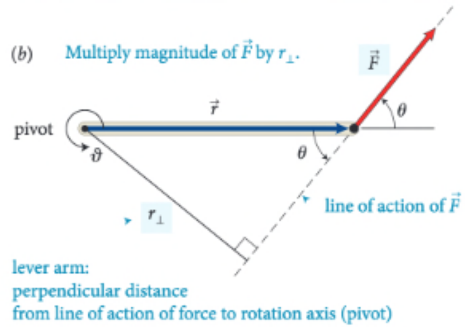
Perusall AP50 Fall 2015 » Chapter 12 Group 1's comments Page 284 Eric Mazur



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I don't understand how this combination of factors tells you anything about direction? Aren't magnitude and lever arm distance both scalar quantities? It seems like we would need to know some sort of direction to calculate torque. Oct 20 12:09 am

SB I think you may be able to think about the direction separately. So, after multiplying this magnitude and distance, you can attach a sign to the torque based on the defined parameters of the system. In the following paragraph, they start to explain how to choose this direction. Oct 20 12:38 am

This is a great question. To further elaborate on this, we can think of this in terms of the Torque equation. The equation for torque is τ = r X F, with r being the level arm distance and F being force. We know that force is a vector vector from previous chapters, and in regards to "r" it can also be thought of as the radial vector. What this means is that this distance from the pivot points from the axis of rotation to the point where the force acts. In as previously mentioned, there is a general convention (the right-hand rule) that is used to determine the direction which happens to be perpendicular to both the radius from the axis and to the force. Oct 22 8:48 pm

Enter your comment or question and press Enter

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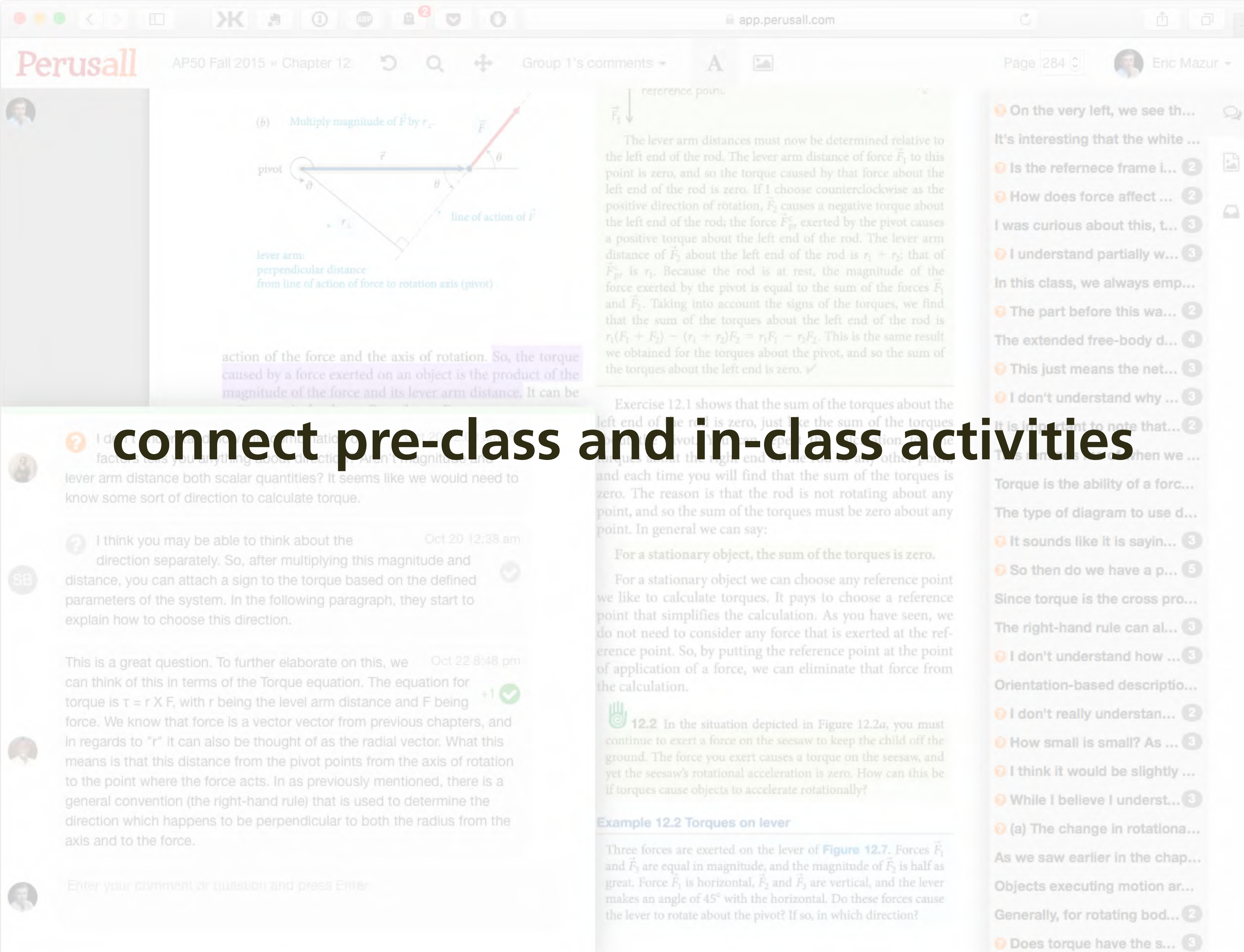
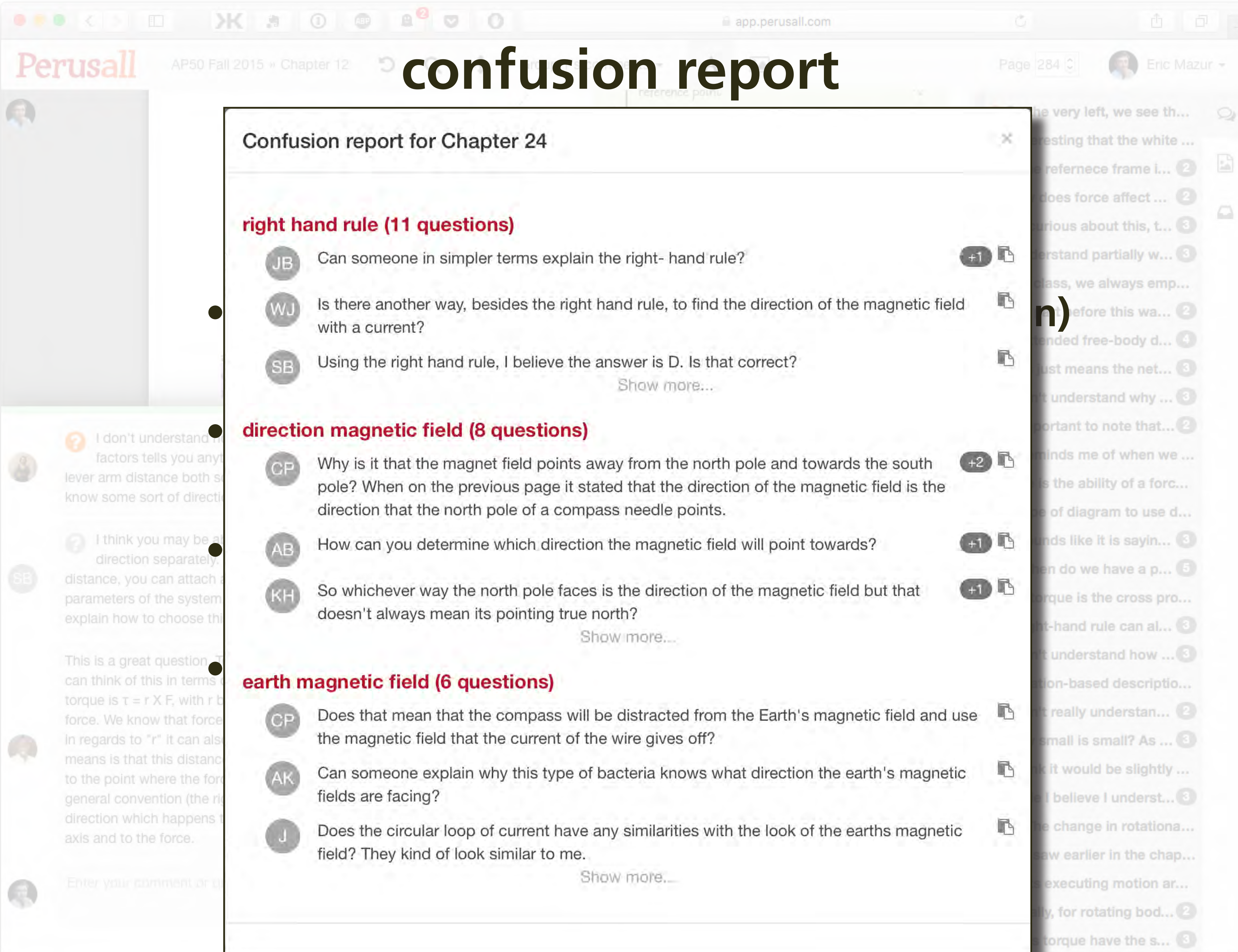
Enter your comment or question and press Enter

connect pre-class and in-class activities



confusion report



out of class

information transfer

Perusall

in class

sense-making

Peer Instruction

Works online!

out of class

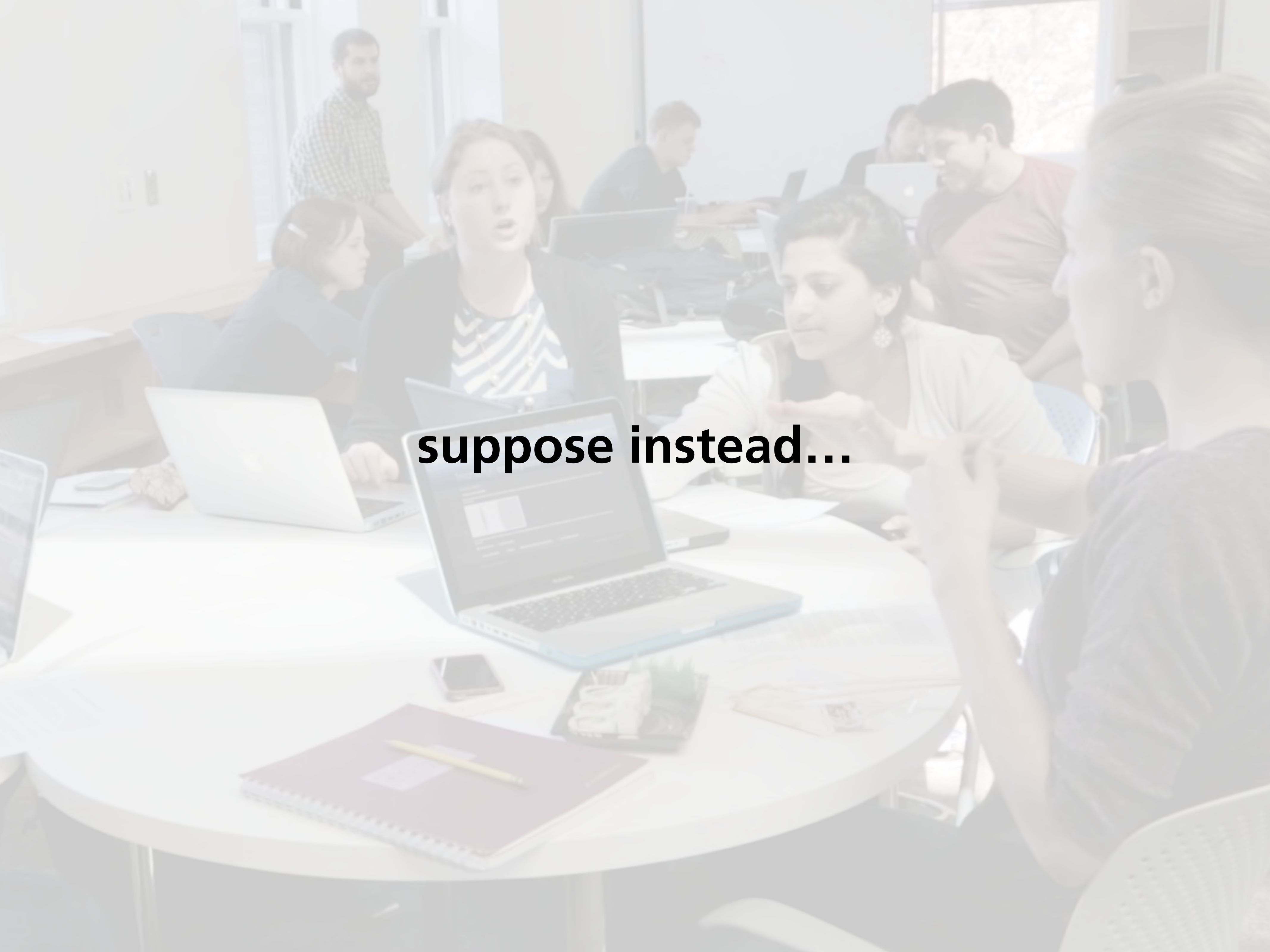
information transfer

Perusall

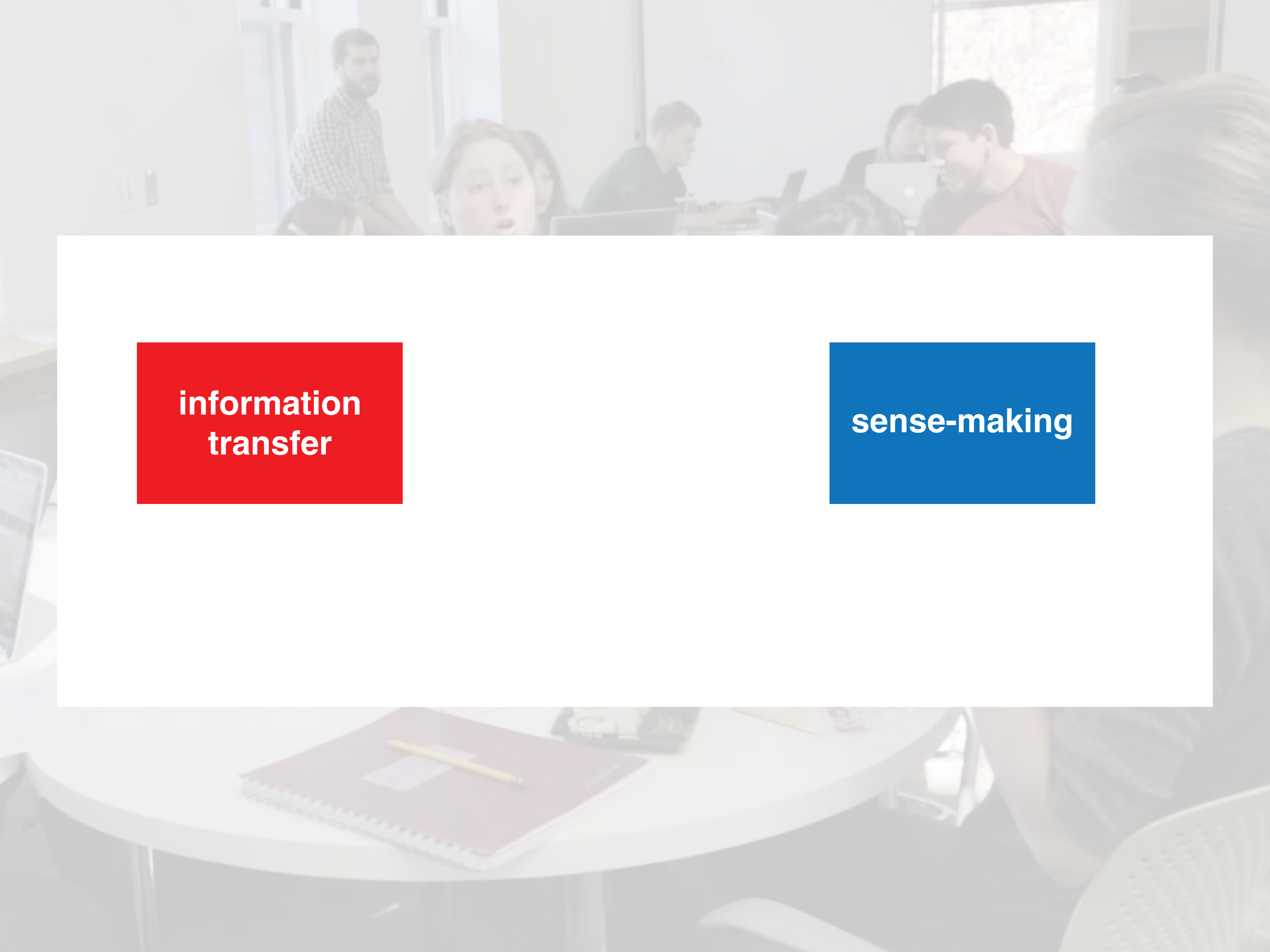
in class

sense-making

Peer Instruction

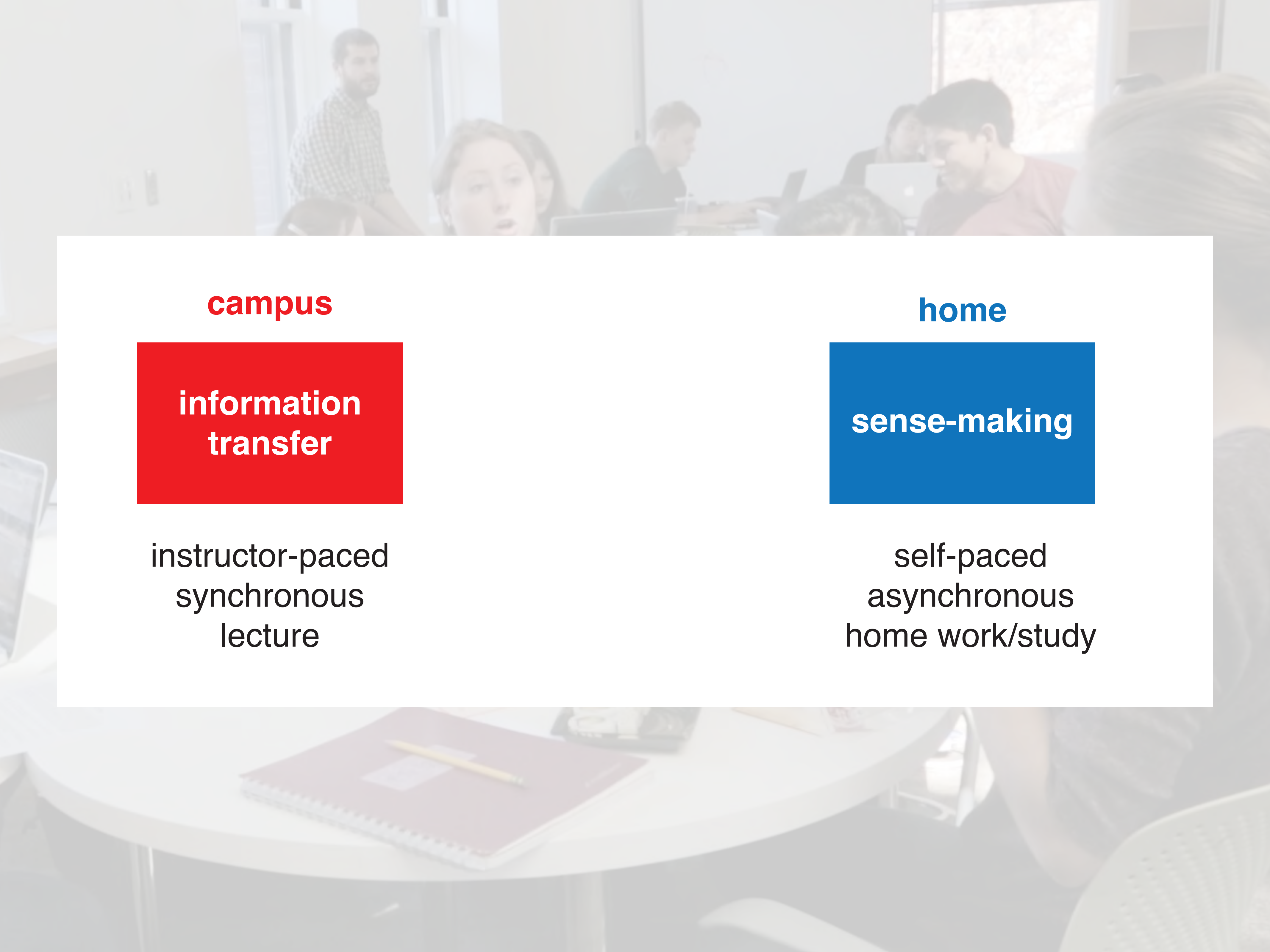


suppose instead…



information transfer

sense-making



campus

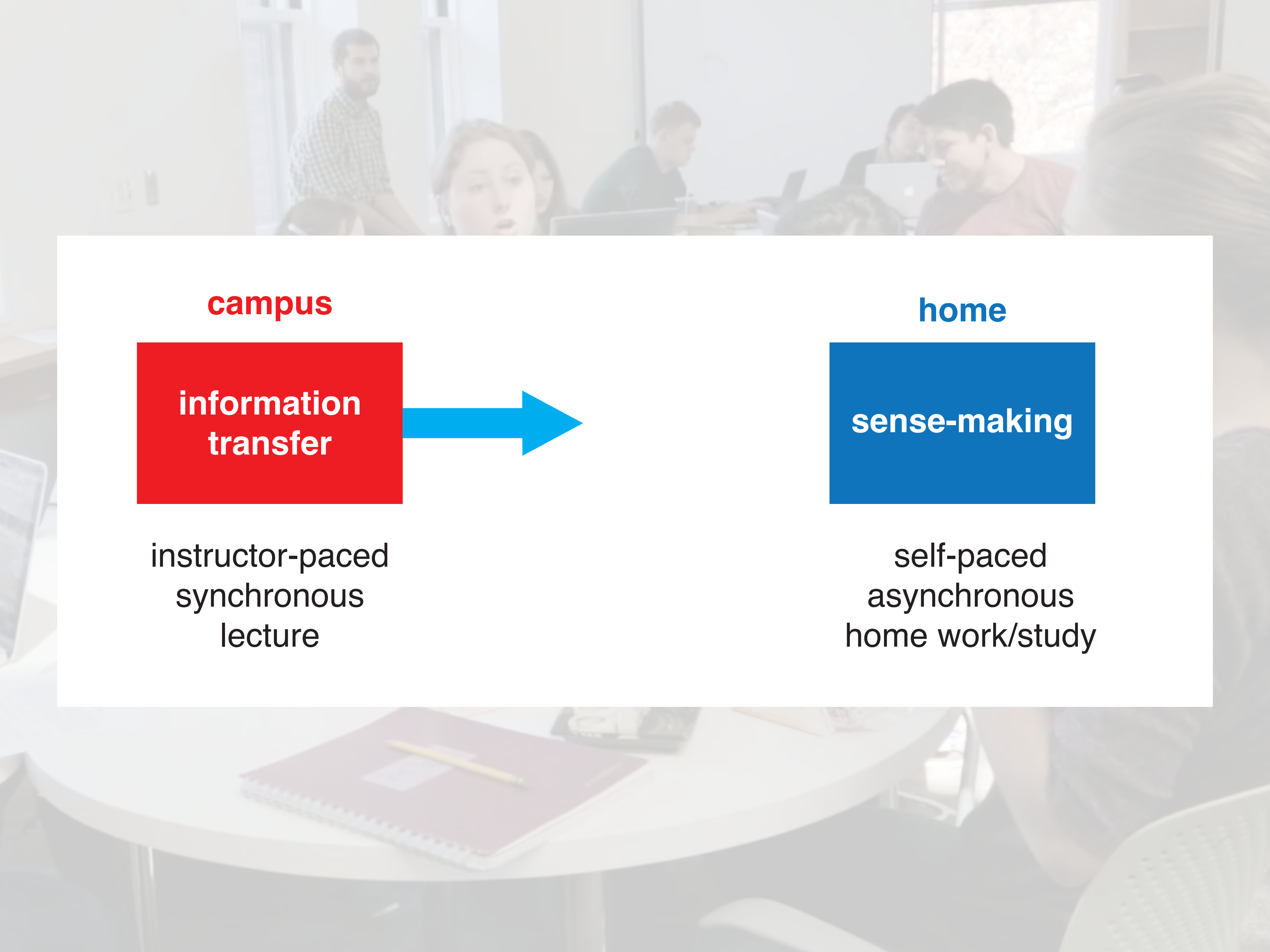
information transfer

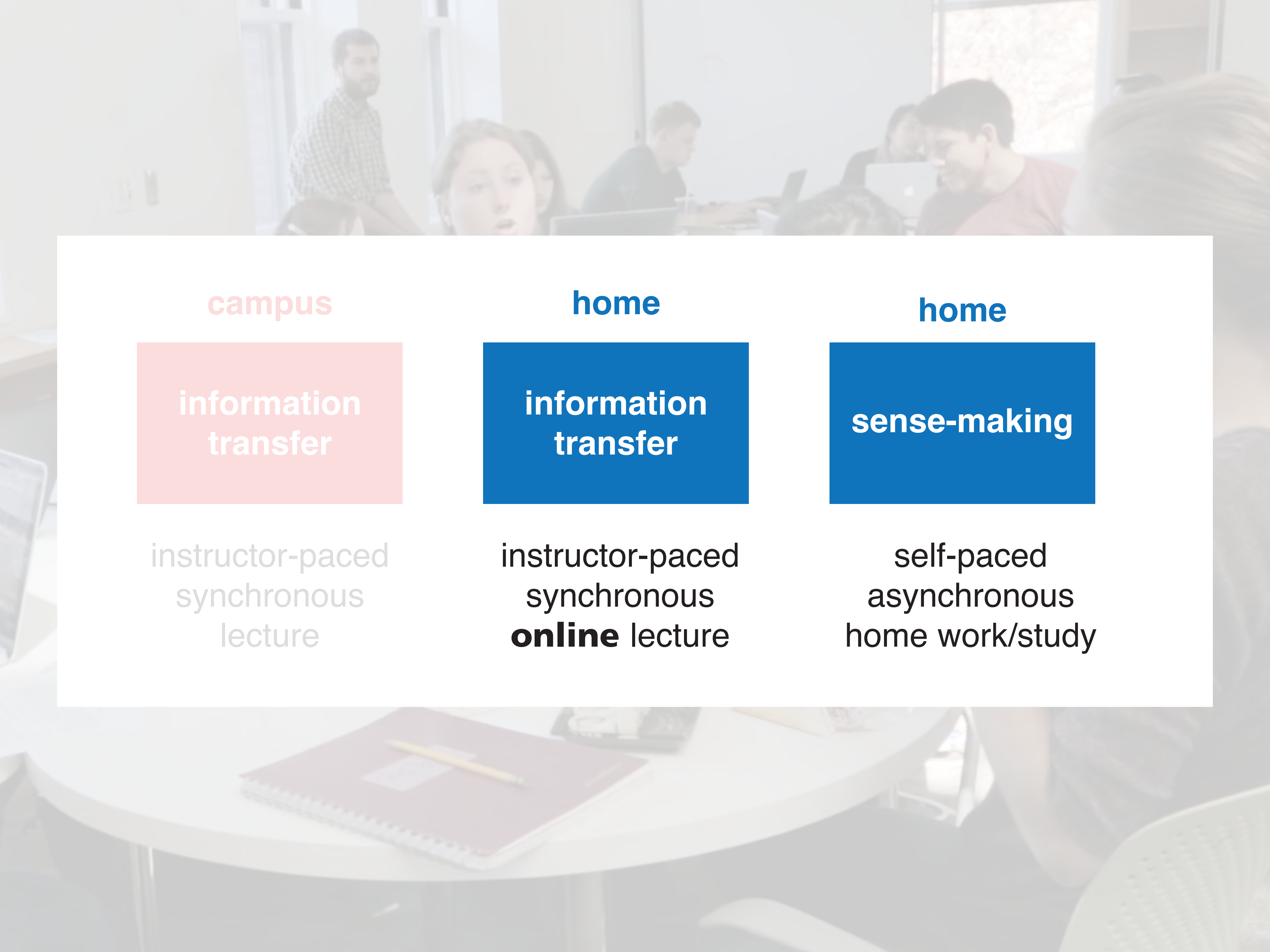
instructor-paced
synchronous
lecture

home

sense-making

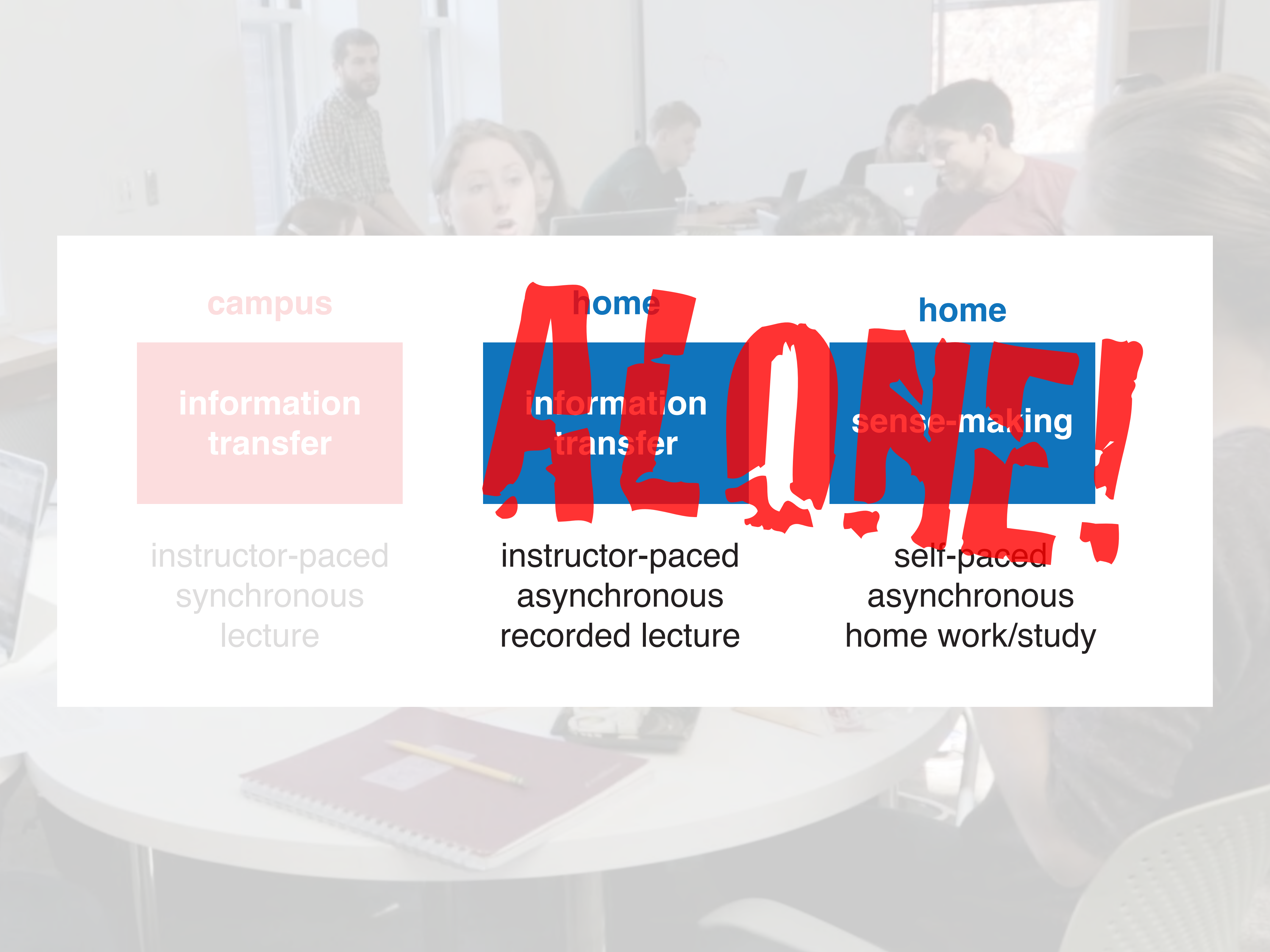
self-paced
asynchronous
home work/study

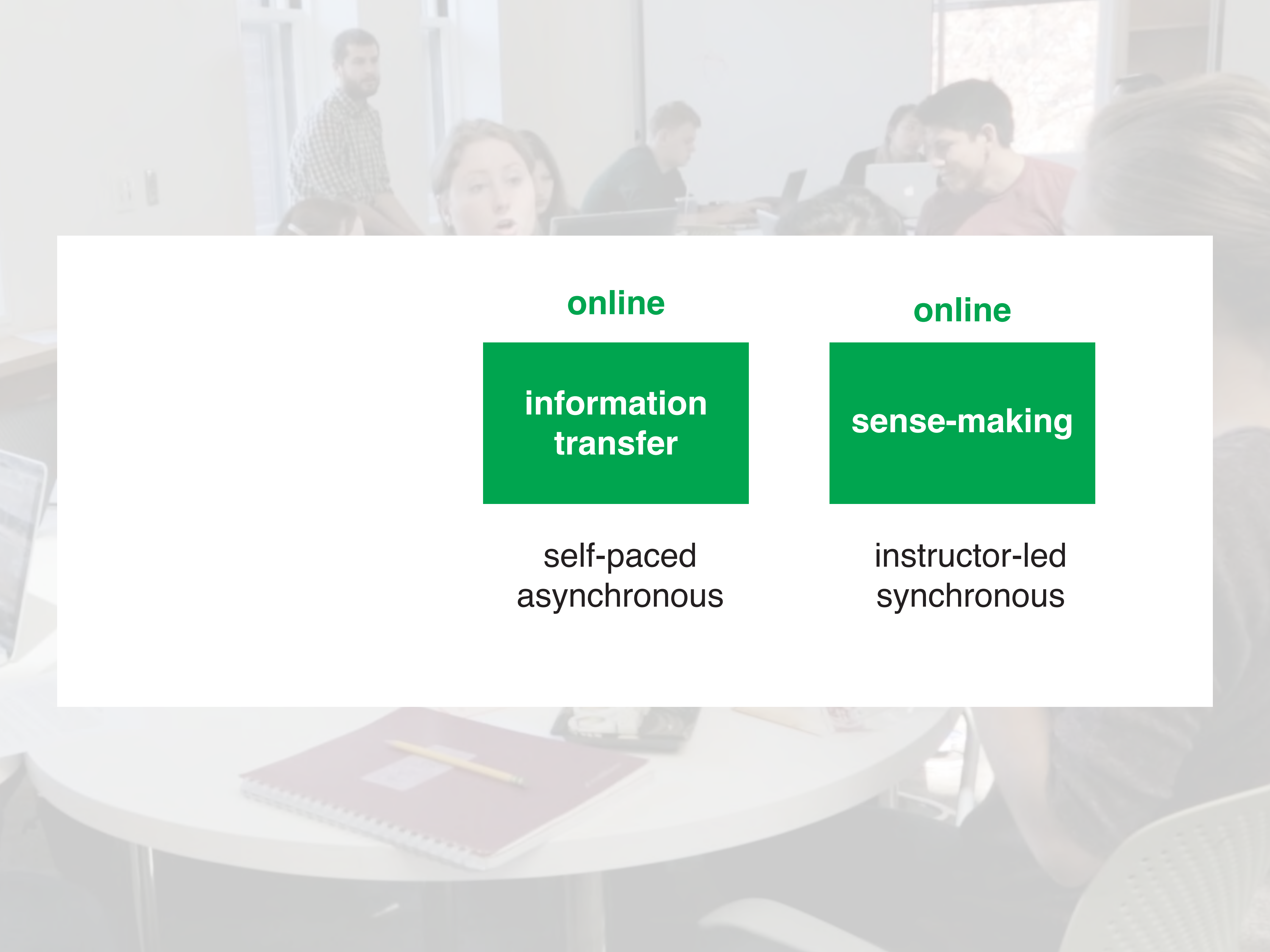

campus
information transfer
instructor-paced
synchronous
lecture
home
sense-making
self-paced
asynchronous
home work/study



campus	home	home
information transfer	**information transfer**	**sense-making**
instructor-paced synchronous lecture	instructor-paced synchronous **online** lecture	self-paced asynchronous home work/study

campus	home	home
information transfer	**information transfer**	**sense-making**
instructor-paced synchronous lecture	instructor-paced **a**synchronous **recorded** lecture	self-paced asynchronous home work/study


campus
information transfer
instructor-paced
synchronous
lecture
home
information transfer
instructor-paced
asynchronous
recorded lecture
home
sense-making
self-paced
asynchronous
home work/study
ALONE!


online
information transfer
self-paced
asynchronous
online
sense-making
instructor-led
synchronous

interactive

online

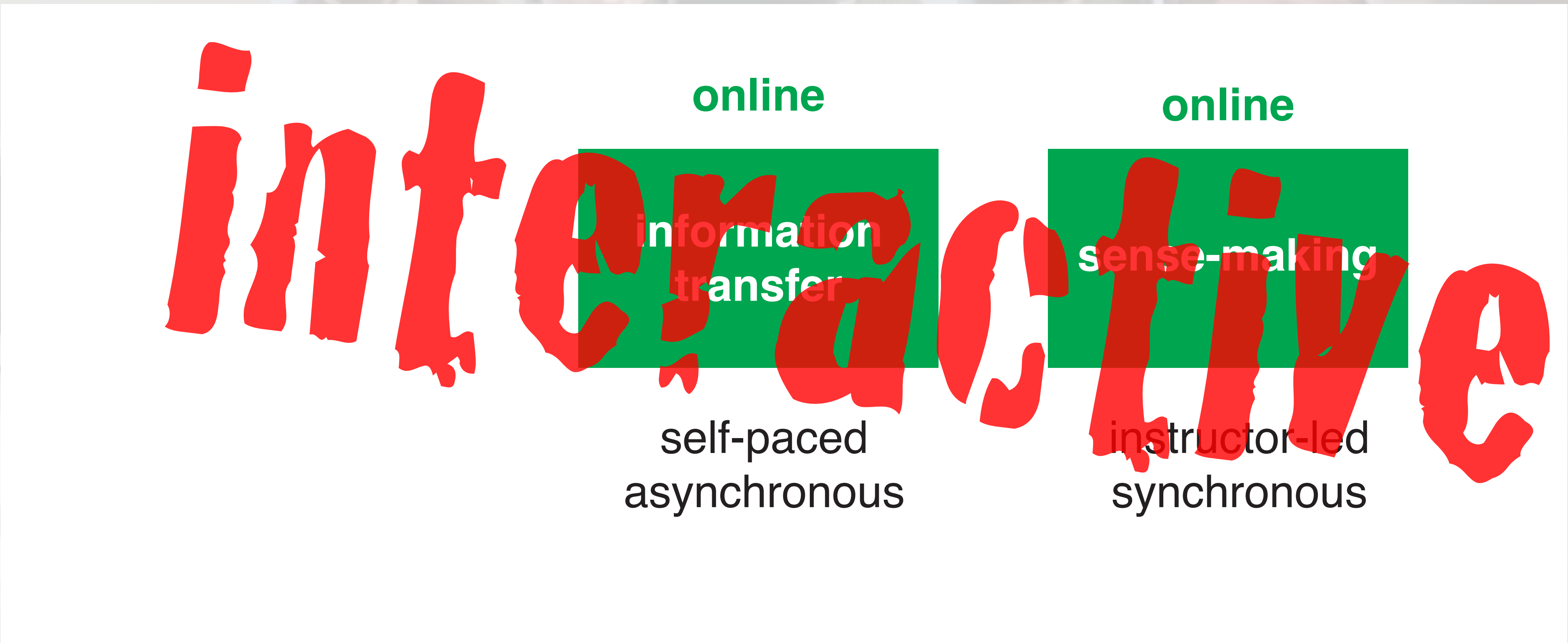
information transfer

self-paced
asynchronous

online

sense-making

instructor-led
synchronous



two *evidence-based* approaches

blend of 6 scaffolded “best practices”

understand

LC: Learning Catalytics — 90 min

- Instructor poses question
- Answer alone
- Discuss in team
- Answer again

bring device

Tutorial — 60 min

- Work on worksheet with team
- Explore concepts
- Discuss with staff

apply

EA: Estimation Activity — 30 min

- Estimate quantities
- Develop individual strategy
- Discuss and solve as team

EDA: Experimental Design Activity — 90 min

- Conduct experiment with team
- Take measurements
- Analyze data
- Carry out simulations

bring device

evaluate

Problem Set & Reflection — 90 min

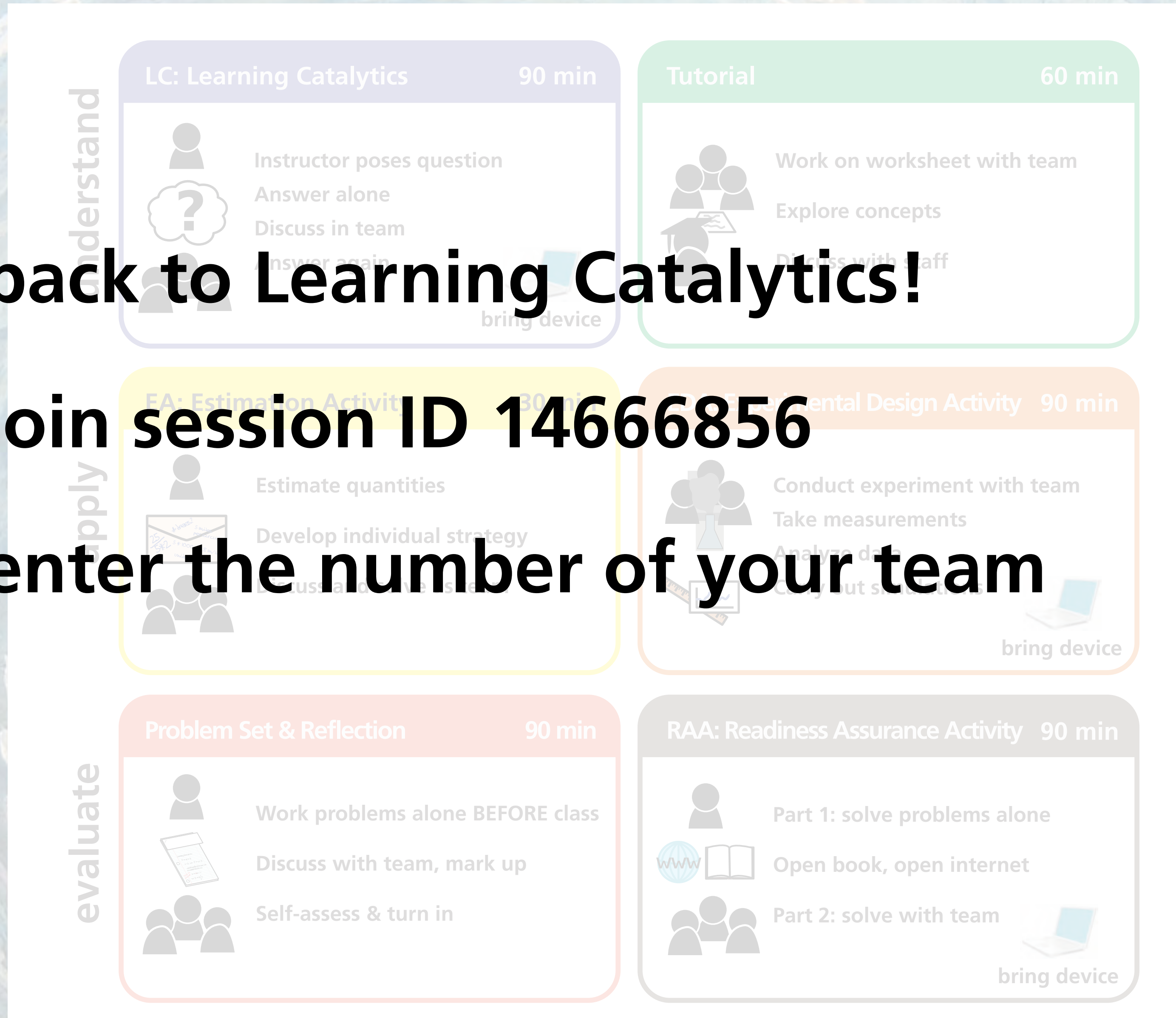
- Work problems alone BEFORE class
- Discuss with team, mark up
- Self-assess & turn in

RAA: Readiness Assurance Activity — 90 min

- Part 1: solve problems alone
- Open book, open internet
- Part 2: solve with team

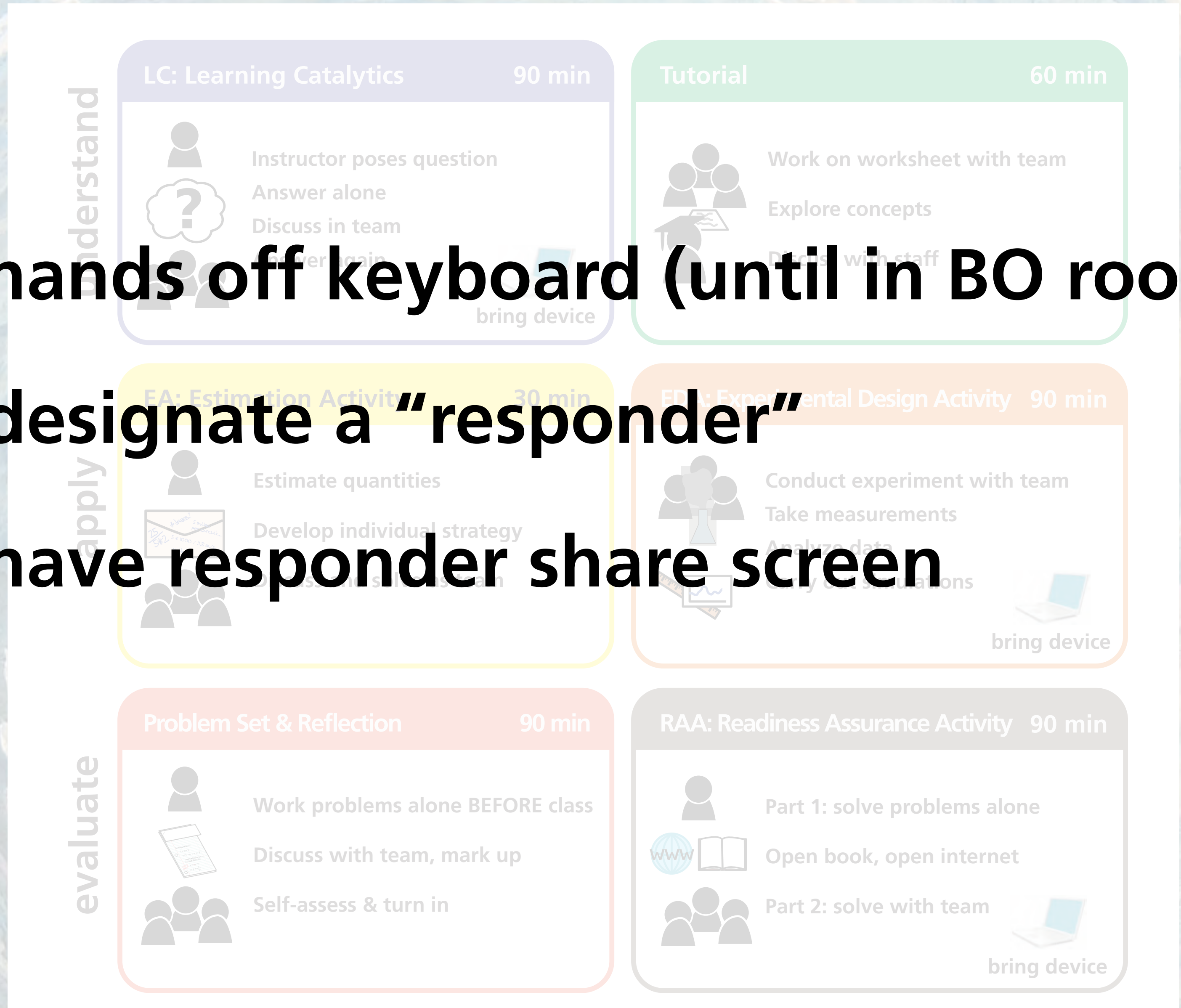
bring device

let’s try an RAA (2-stage exam)



- back to Learning Catalytics!
- join session ID 14666856
- enter the number of your team

team-round instructions



- hands off keyboard (until in BO rooms)
- designate a “responder”
- have responder share screen

scoring summary

LC: Learning Catalytics 90 min

Tutorial 60 min

You have completed all of the questions.

5/5 questions attempted, 18.0/20 possible points in team round Score details

Question	Individual Result	Points	Team Result	Points	Total Points
1	Incorrect	0.0	Correct (on attempt 2)	2.0	1.0
2	Incorrect	0.0	Correct (on attempt 1)	4.0	2.0
3	Correct	4.0	Correct (on attempt 1)	4.0	4.0
4	Incorrect	0.0	Correct (on attempt 1)	4.0	2.0
5	Incorrect	0.0	Correct (on attempt 1)	4.0	2.0
Total		**4.0**		**18.0**	**11.0**

evaluate

Work problems alone BEFORE class

Discuss with team, mark up

Self-assess & turn in

Part 1: solve problems alone

Open book, open internet

Part 2: solve with team

bring device

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

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active engagement/social interaction a must!

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