# Confessions of a converted lecturer

Colorado State University Pueblo
Pueblo, CO, 2 May 2016

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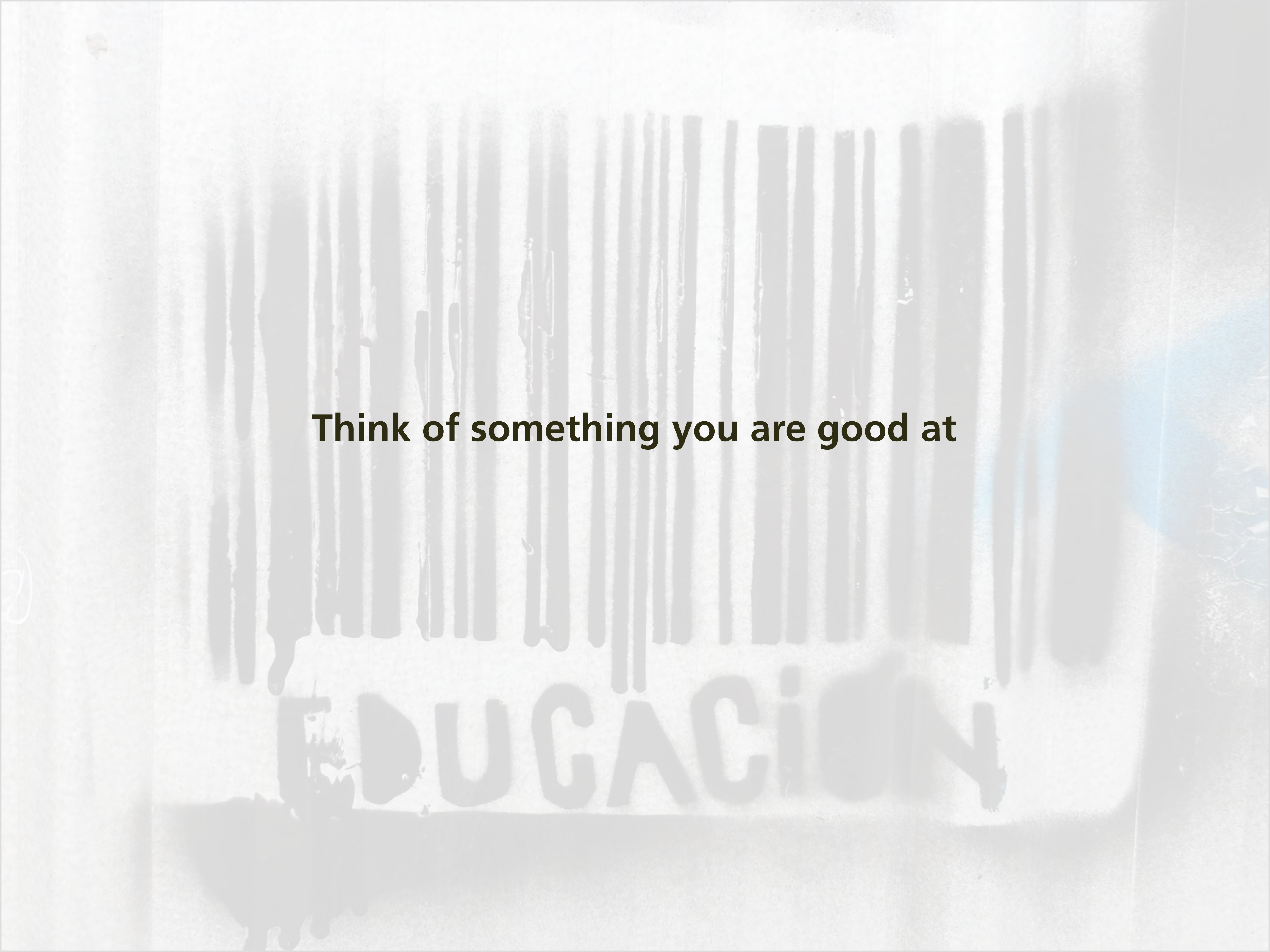
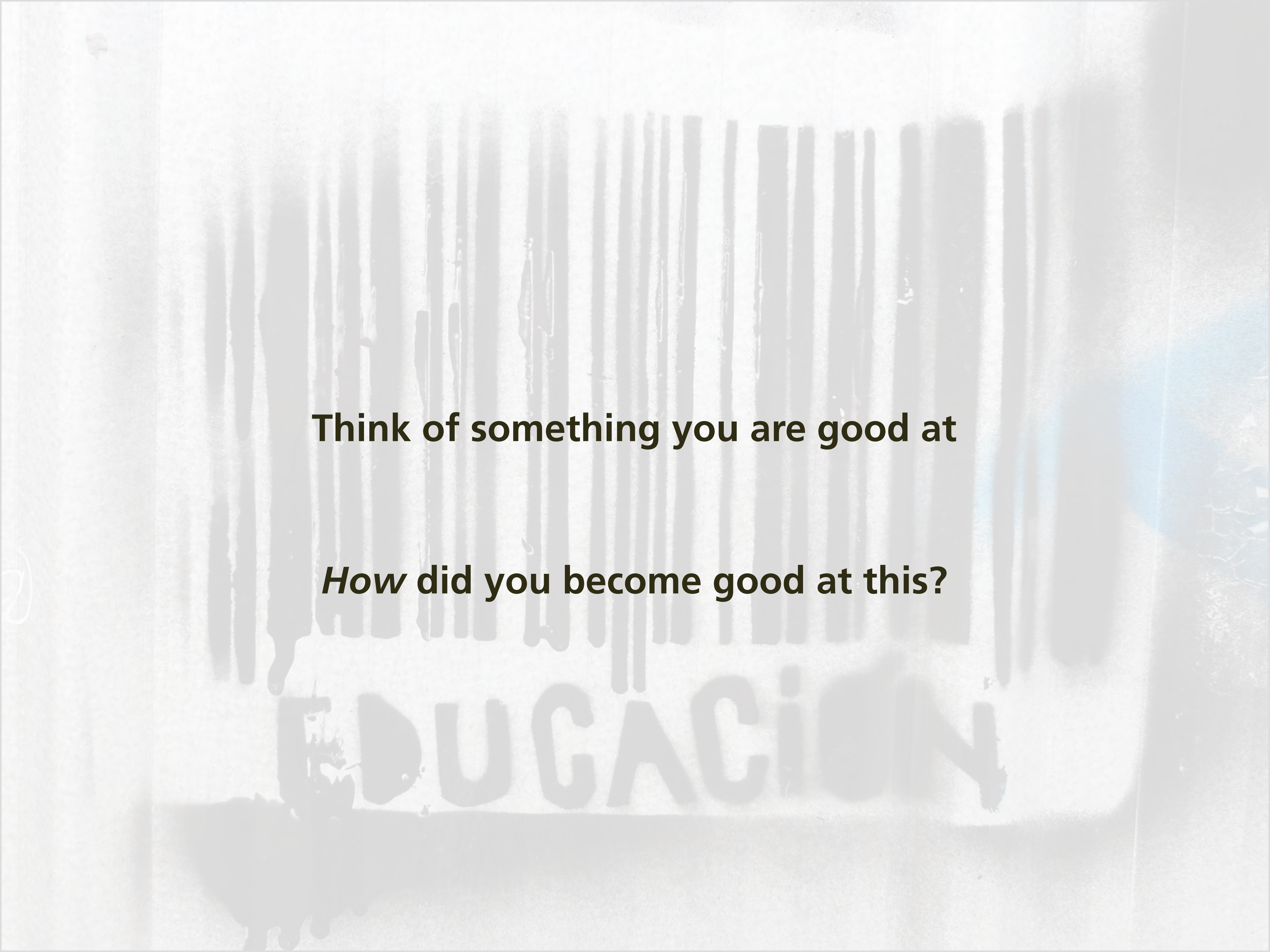


Think of something you are good at



**Think of something you are good at**

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

Became good at it by:

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

① education

① **education**

② **PI**

① education

② PI

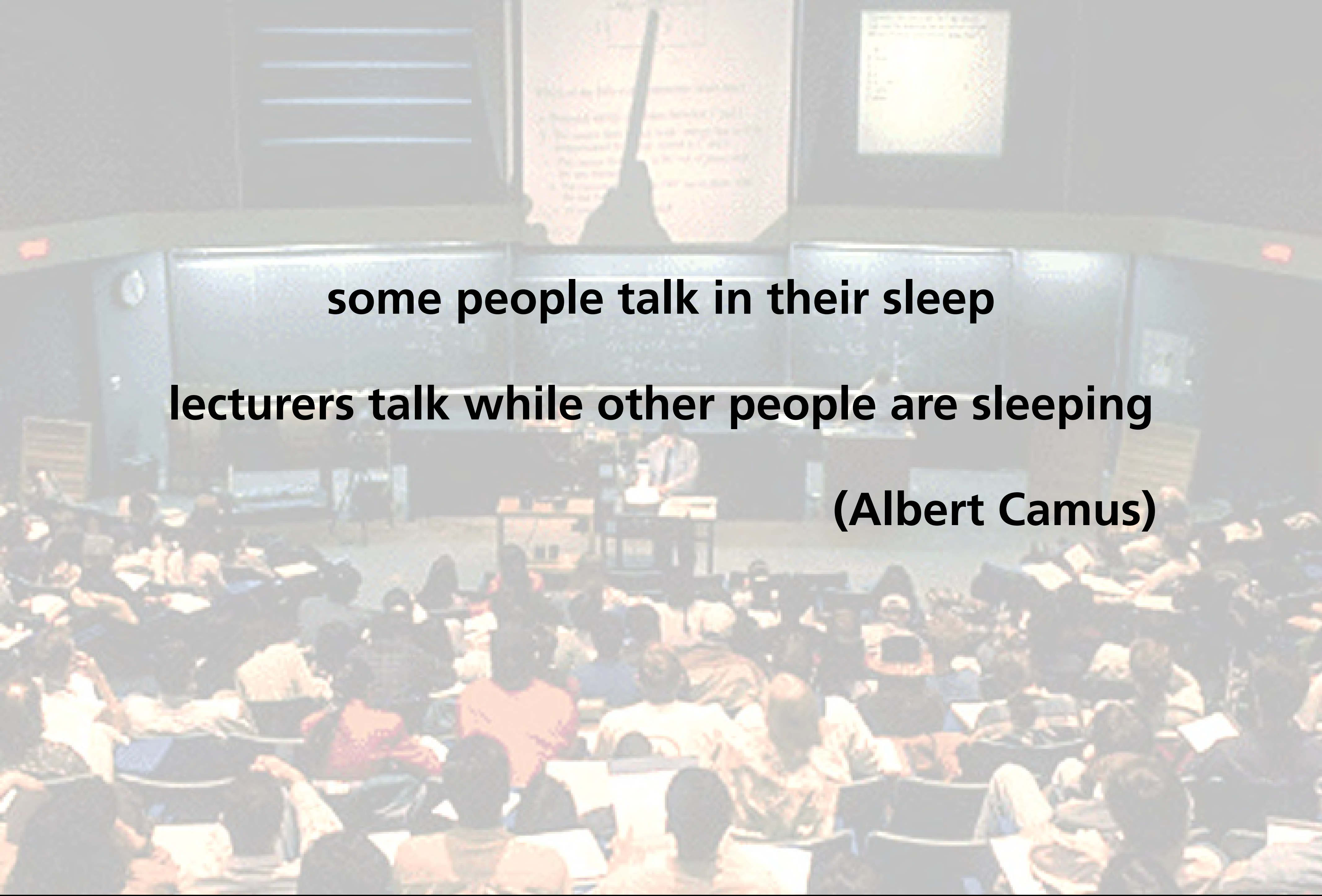
③ test

① education ② PI ③ test

# What happens in a lecture?

1 education

some people talk in their sleep

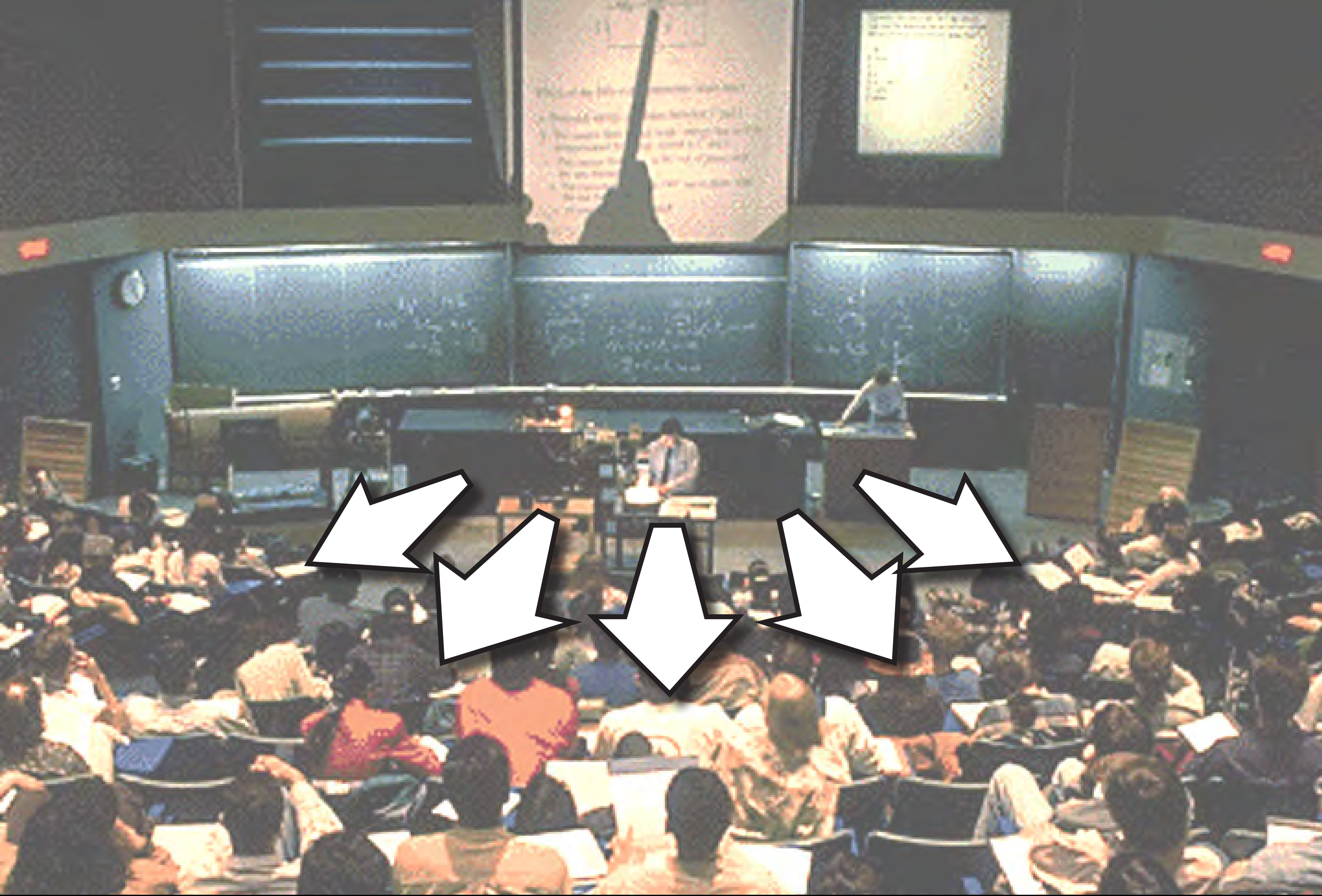


some people talk in their sleep

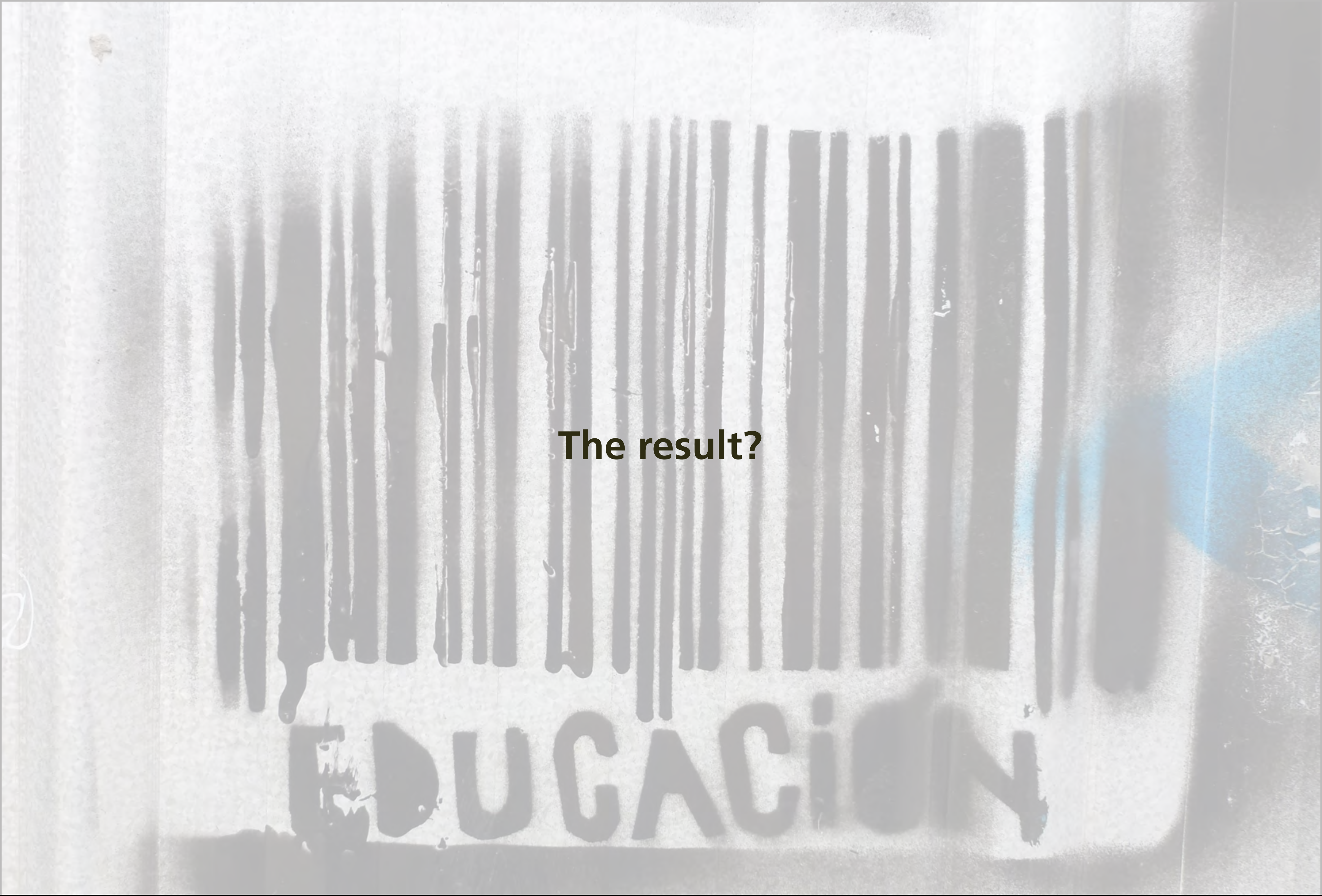
lecturers talk while other people are sleeping

(Albert Camus)

① education



1 education



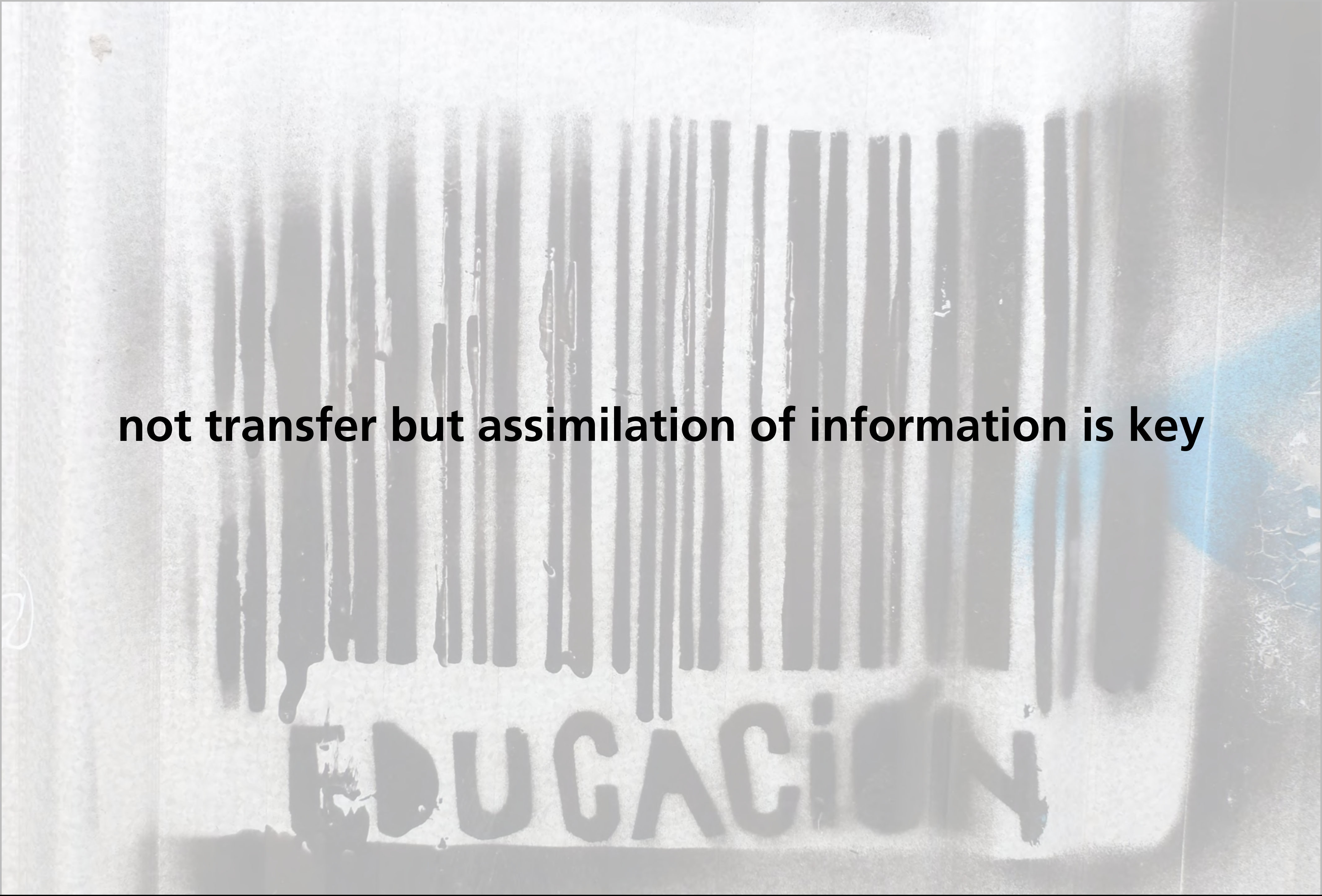
The result?

# Lack of learning

## 1 education

Lack of learning

Lack of retention

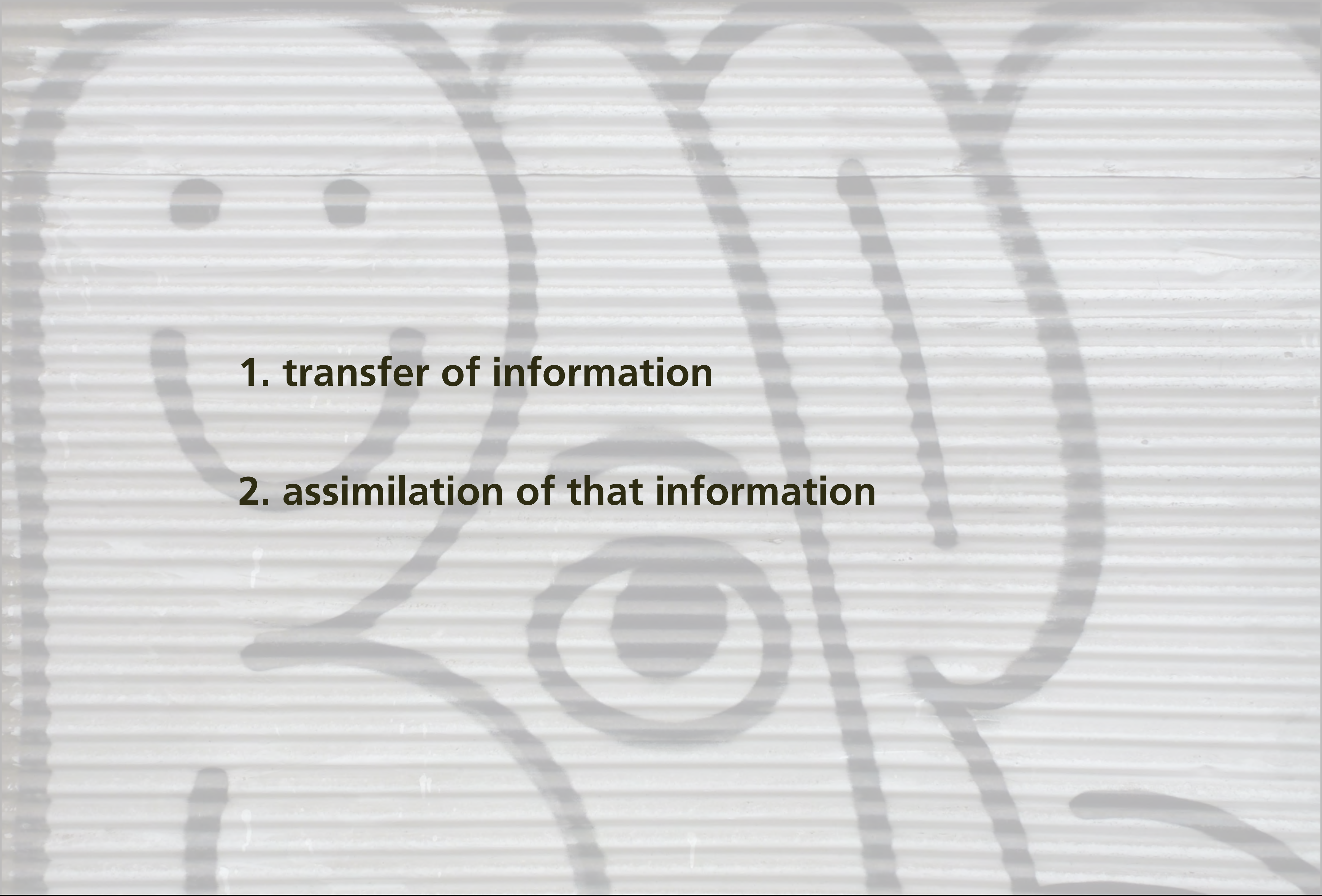


**not transfer but assimilation of information is key**

❶ education

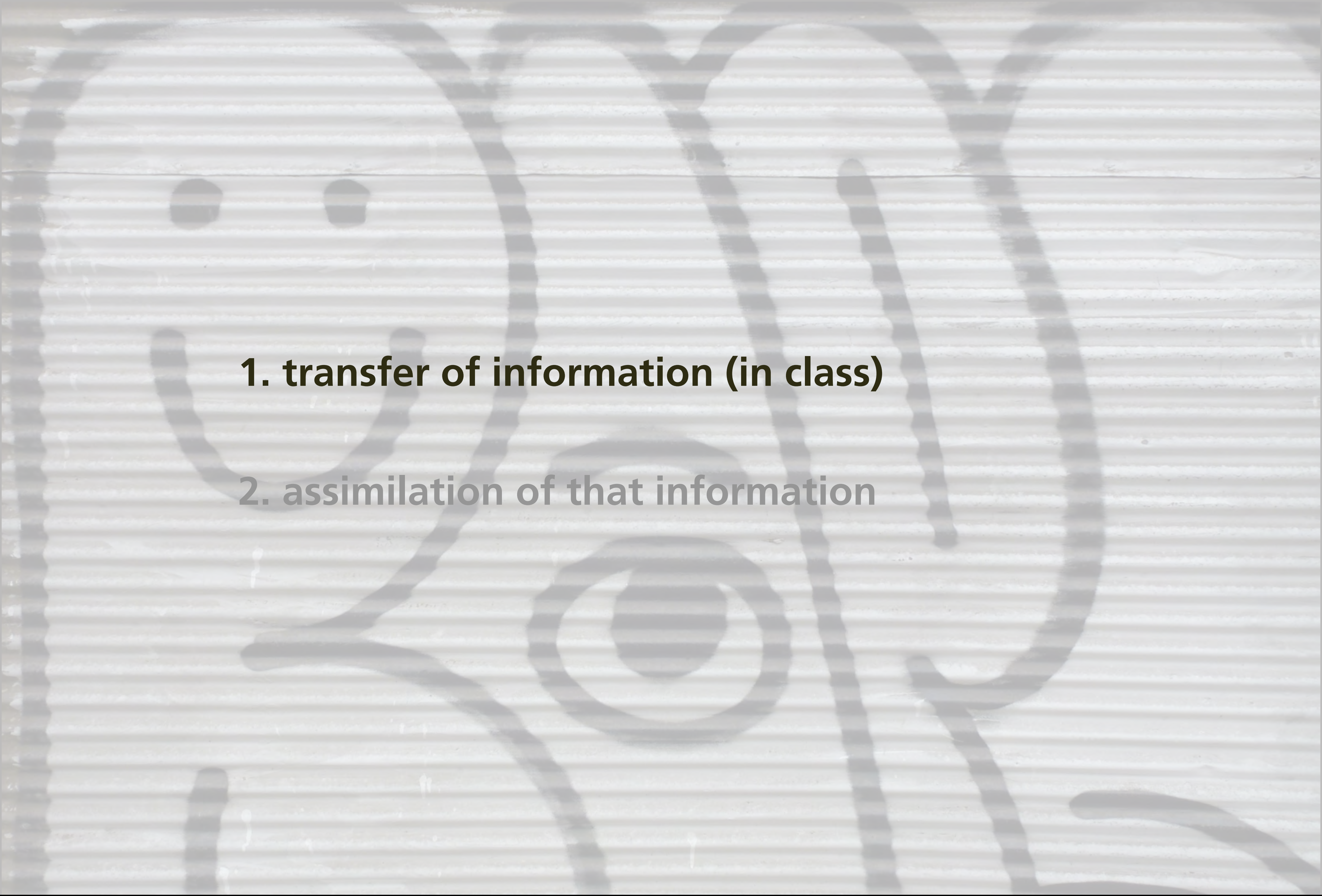
❷ PI

1. transfer of information

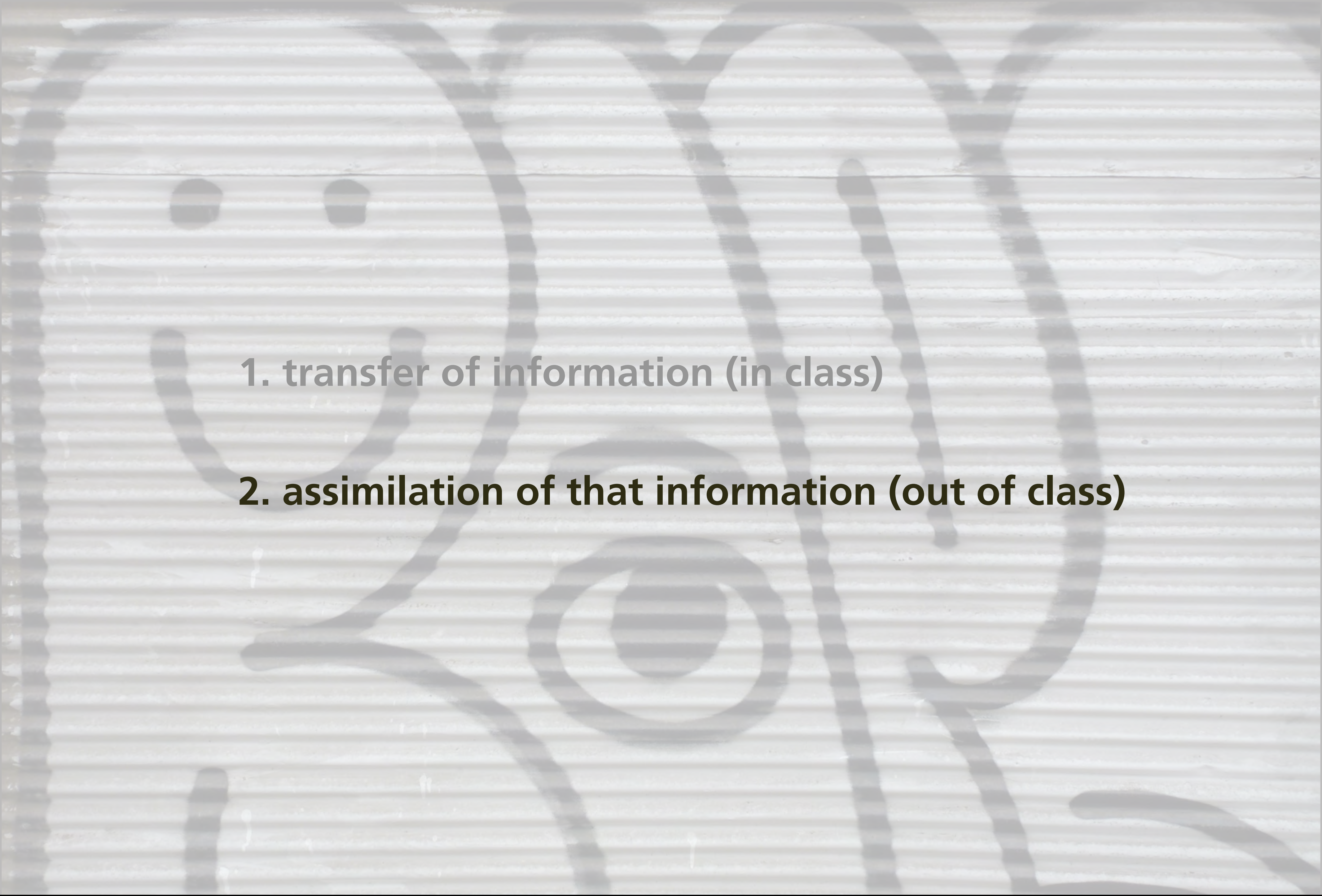


1. transfer of information

2. assimilation of that information

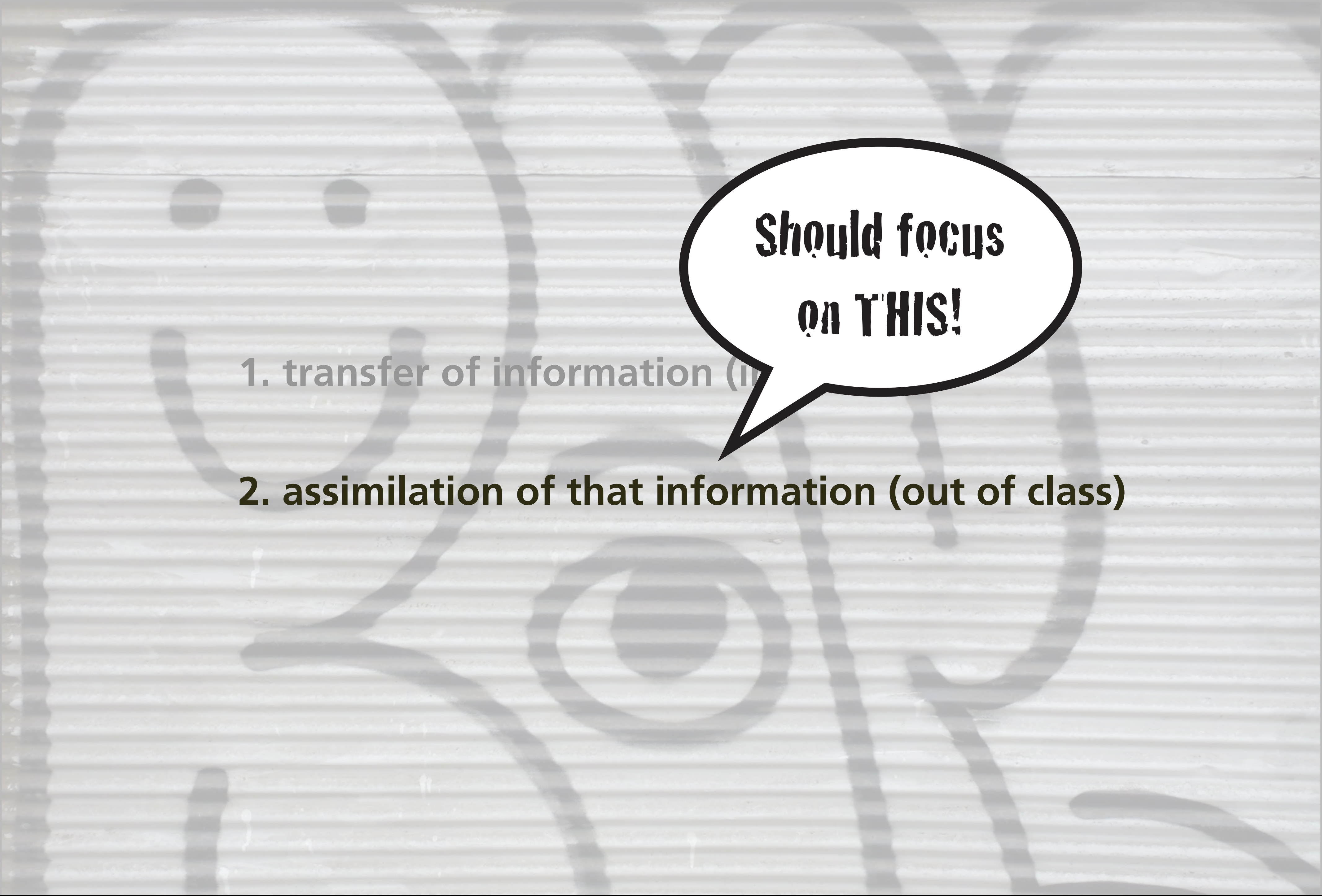


1. transfer of information (in class)
2. assimilation of that information



1. transfer of information (in class)

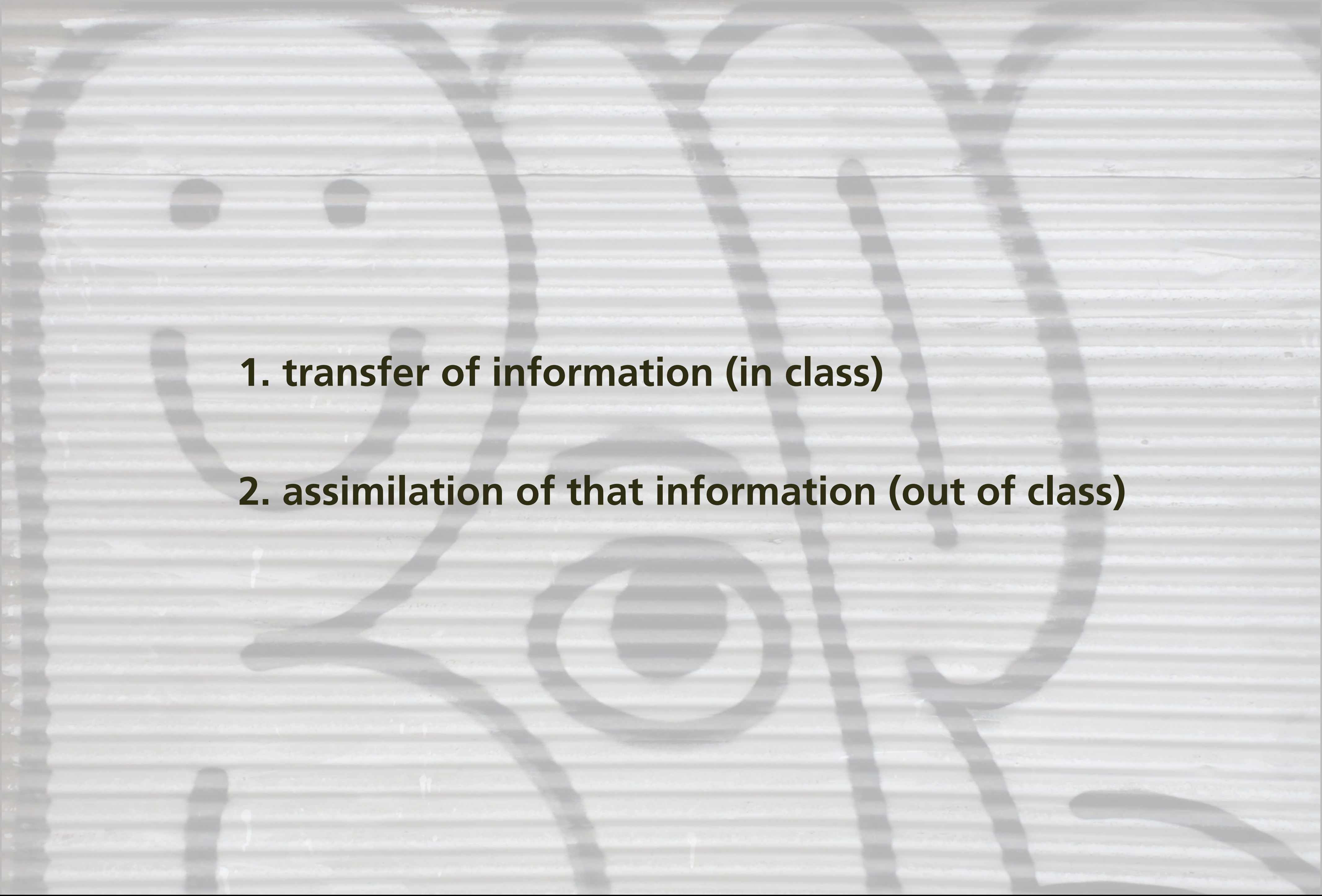
2. **assimilation of that information (out of class)**



Should focus on THIS!

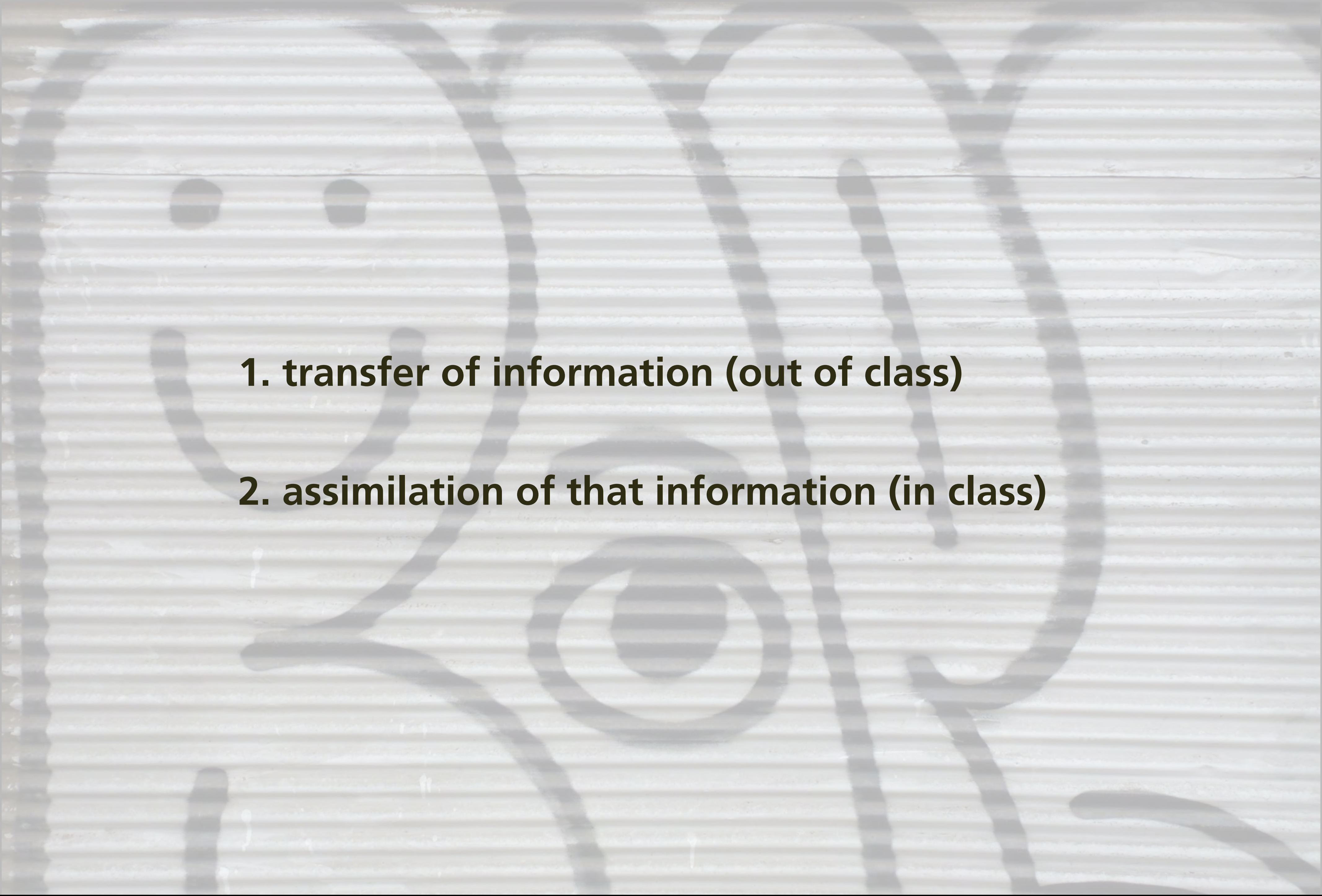
1. transfer of information (i

2. assimilation of that information (out of class)



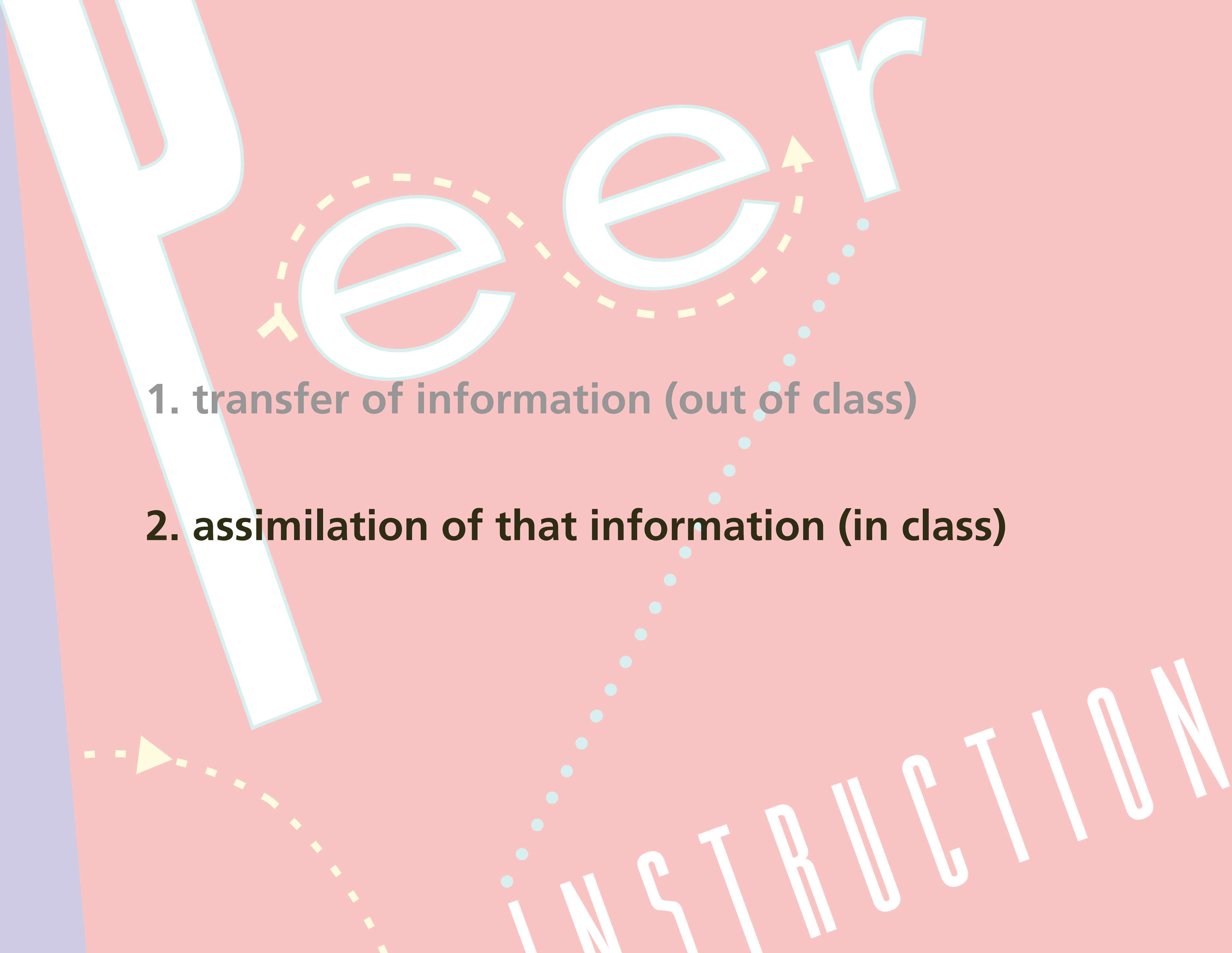
1. transfer of information (in class)

2. assimilation of that information (out of class)



1. transfer of information (out of class)

2. assimilation of that information (in class)

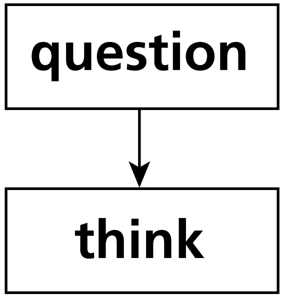


1. transfer of information (out of class)

2. assimilation of that information (in class)

**question**

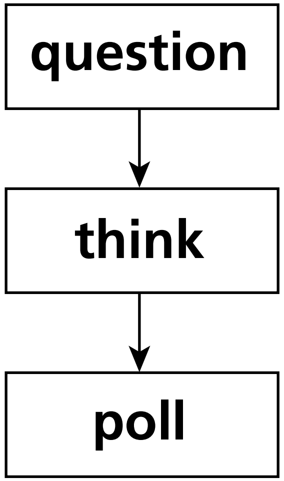
① **education** ② **PI**



question

think

① education ② PI



question

think

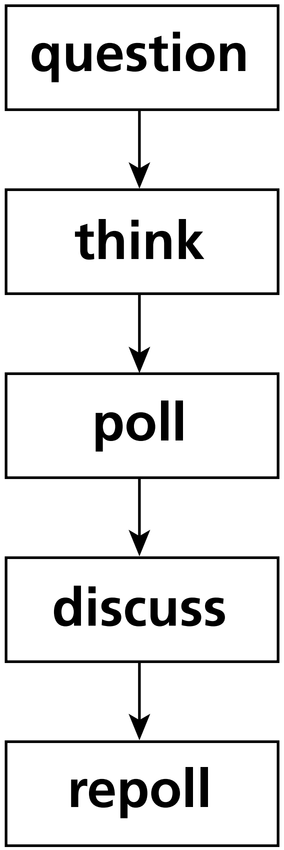
poll

question

think

poll

discuss



question

think

poll

discuss

repoll

question

↓

think

↓

poll

↓

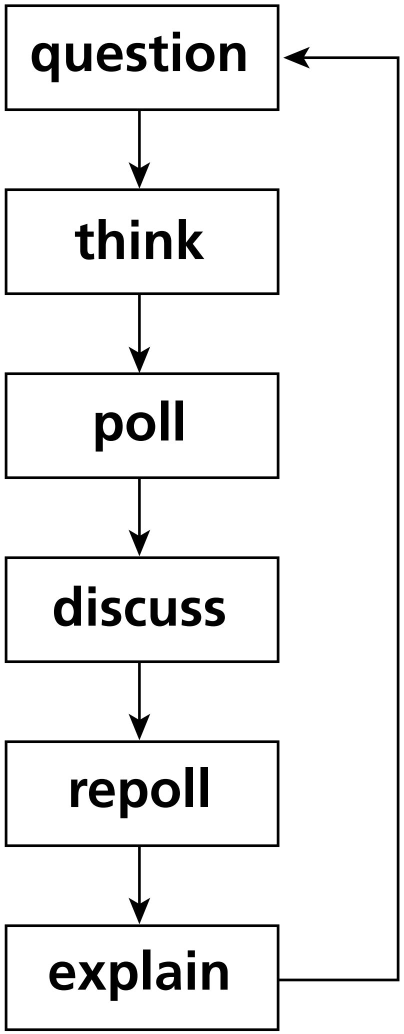
discuss

↓

repoll

↓

explain



question

think

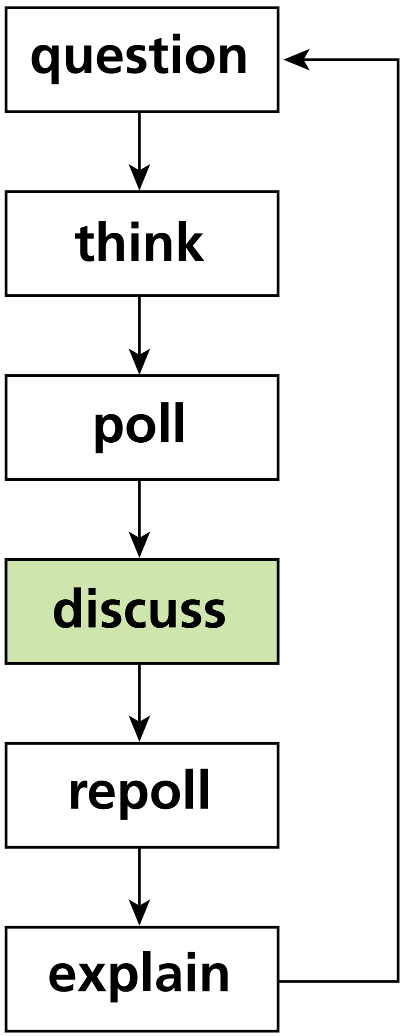
poll

discuss

repoll

explain

① education ② PI



question

think

poll

discuss

repoll

explain

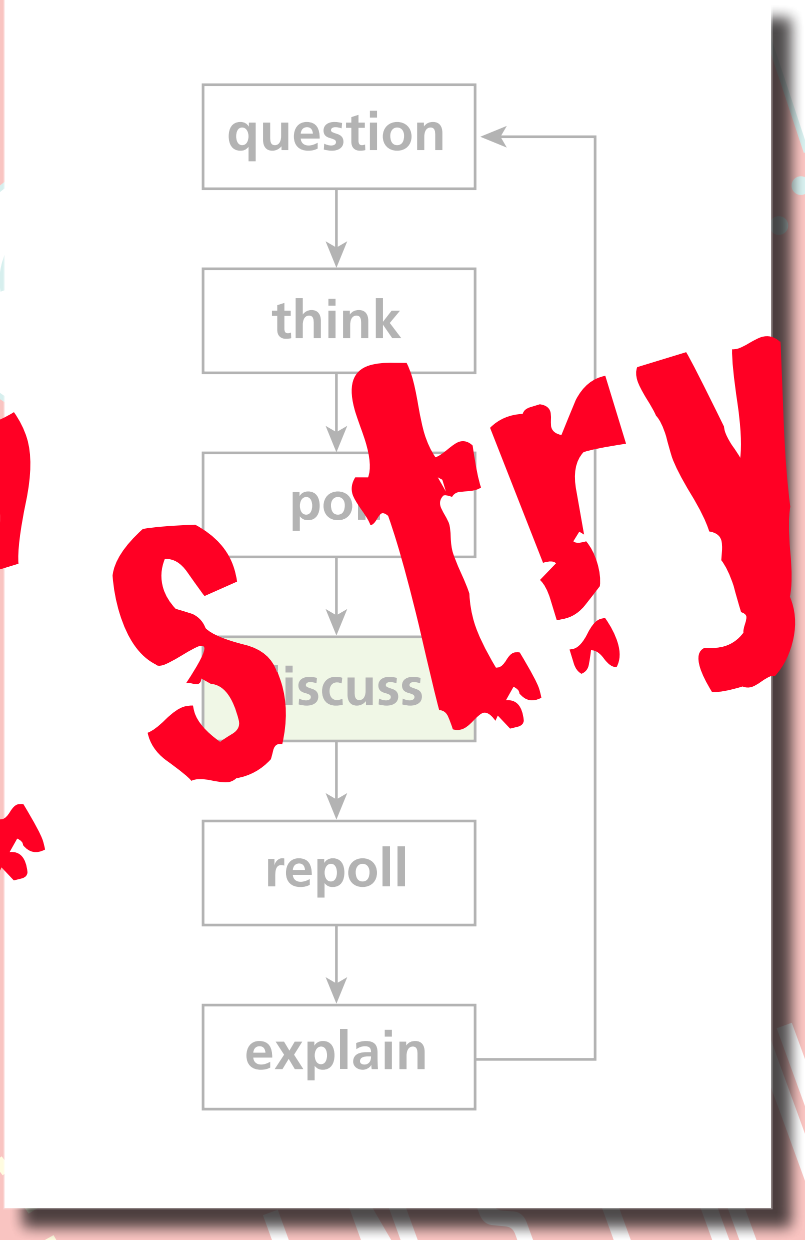
① education

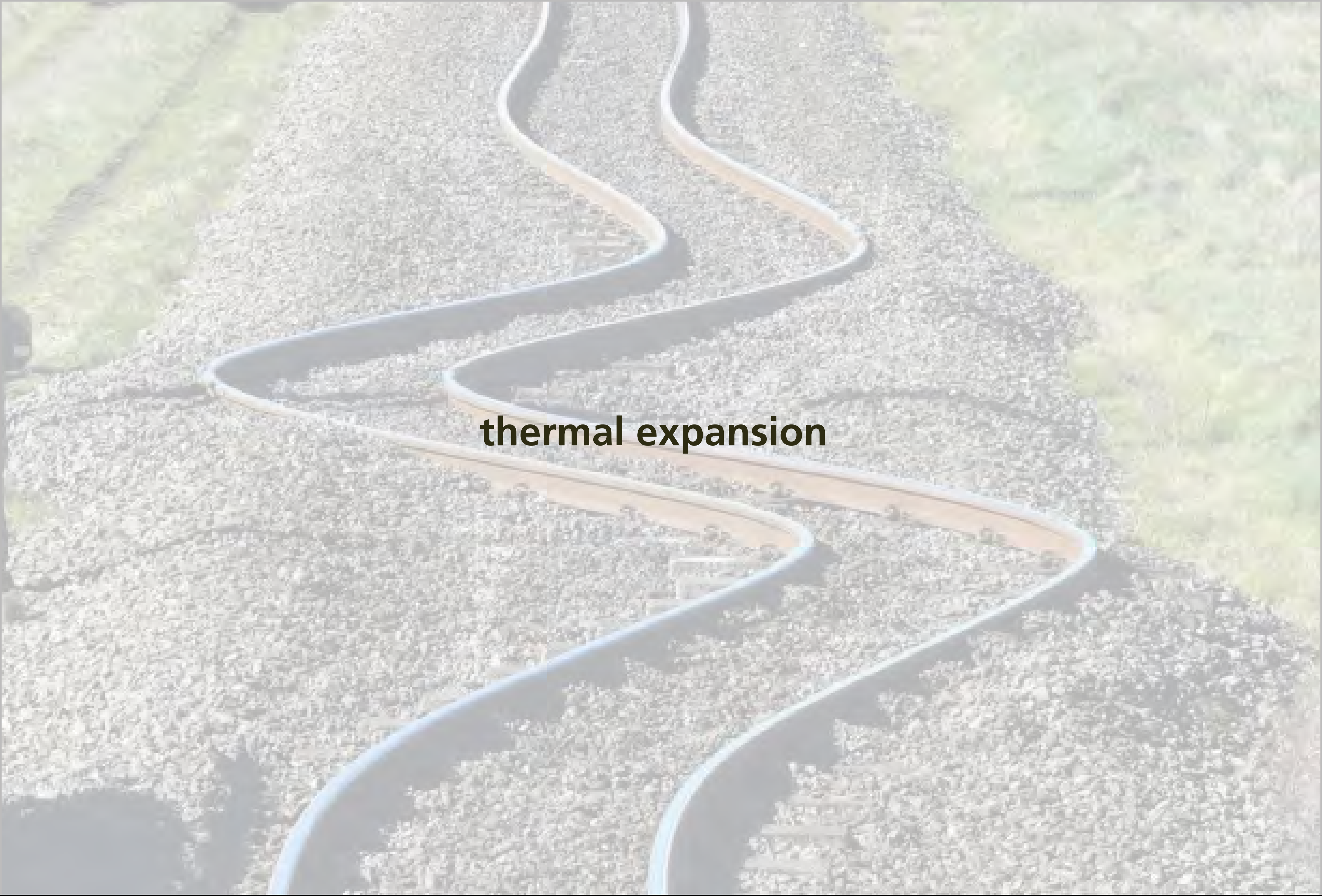
② PI

① education

② PI

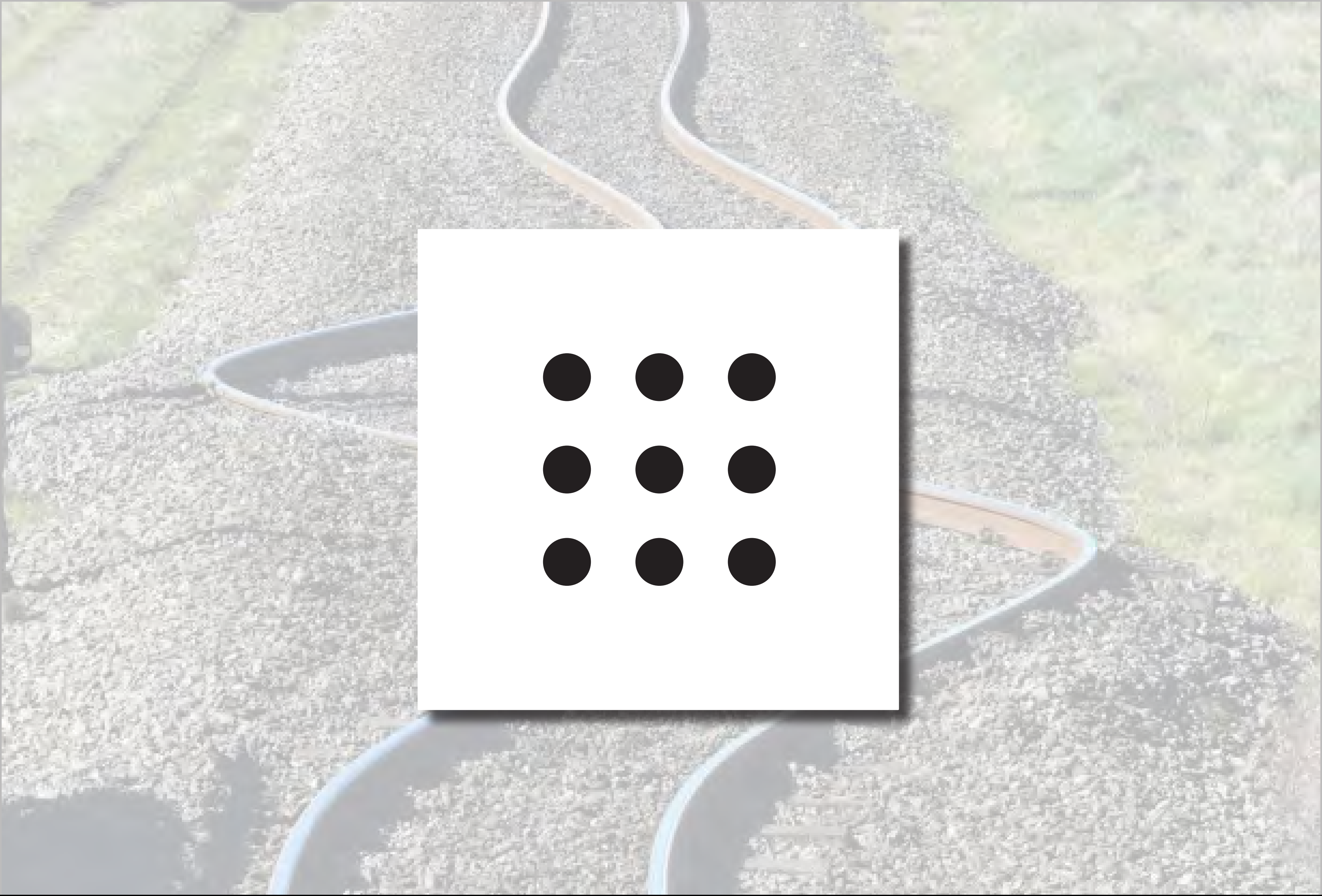
# Let's try it!



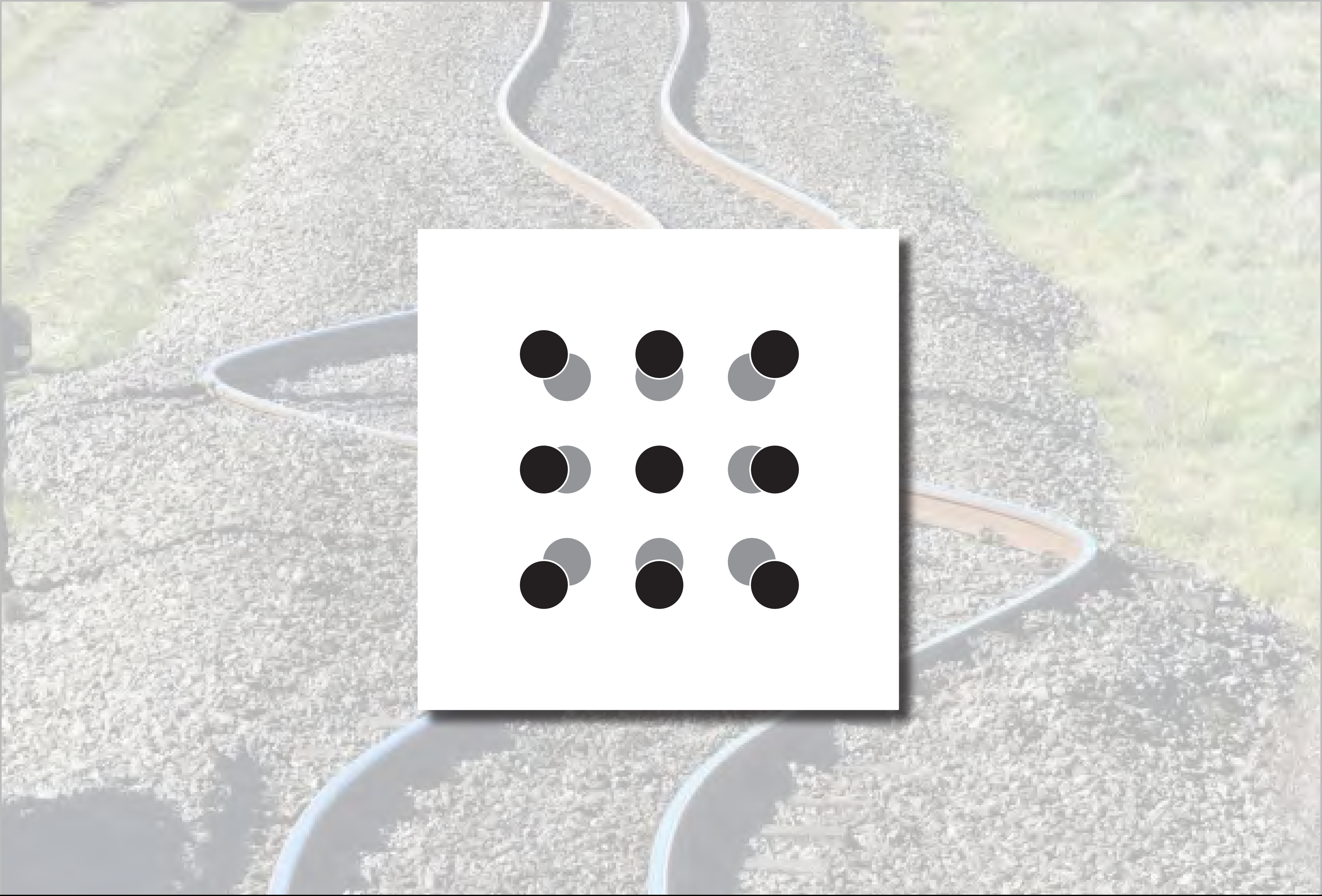


thermal expansion

① education ② PI



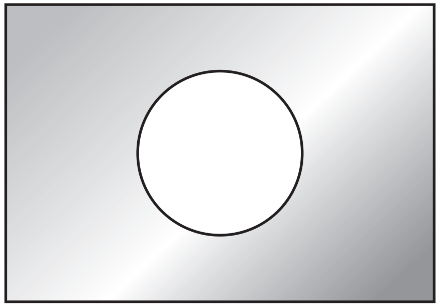
① **education** ② **PI**



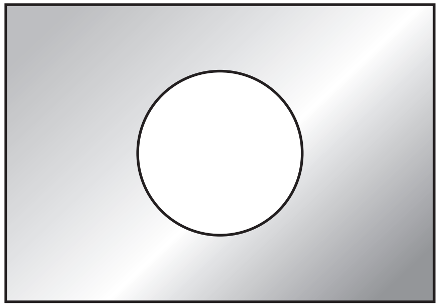
① **education** ② **PI**

① education ② PI

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



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

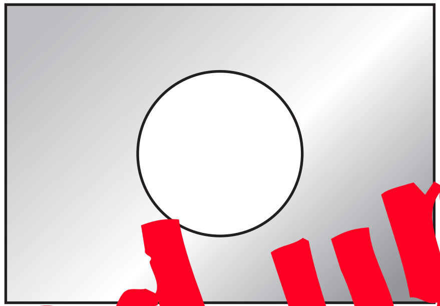


When the plate is uniformly heated, the diameter of the hole

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

① education ② PI ③ test

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

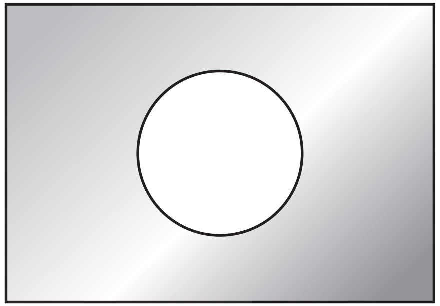


When the plate is uniformly heated, the diameter of the hole

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.

① education ② PI ③ test

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…

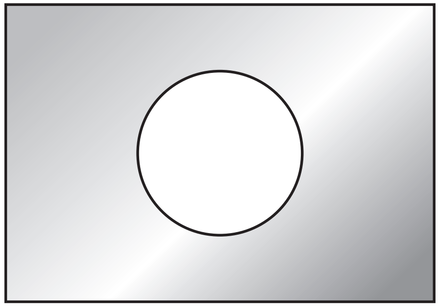
1. made a commitment
2. externalized your answer
3. moved from the answer/fact to reasoning

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

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



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① education ② PI ③ test

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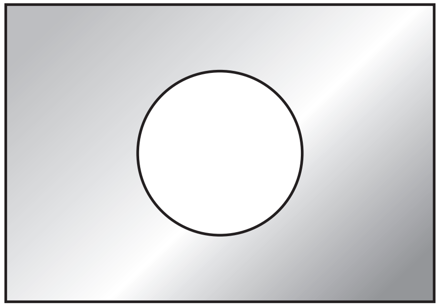
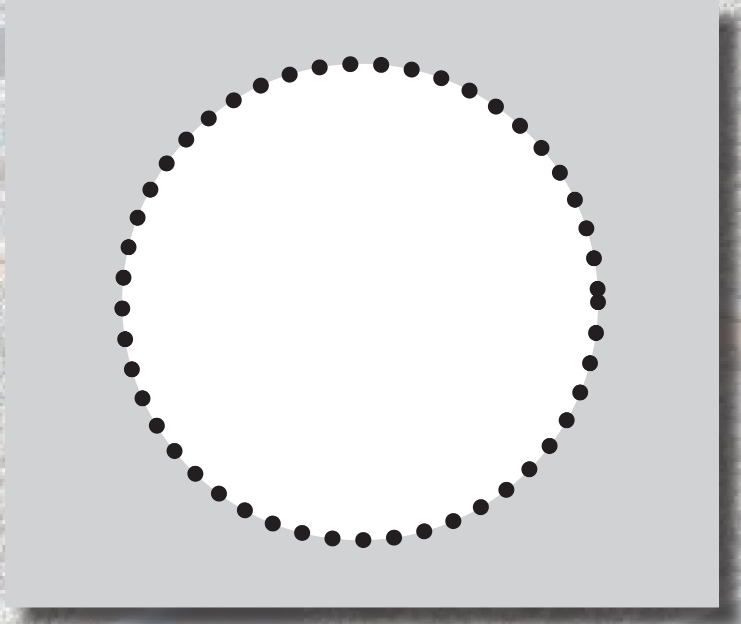


When the plate is uniformly heated, the diameter of the hole

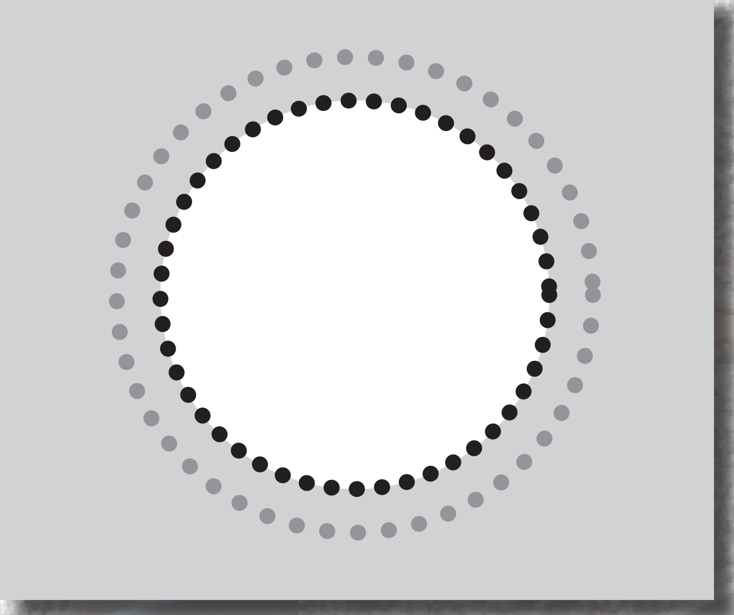
1. increases. ✓
2. stays the same.
3. decreases.

① education ② PI ③ test

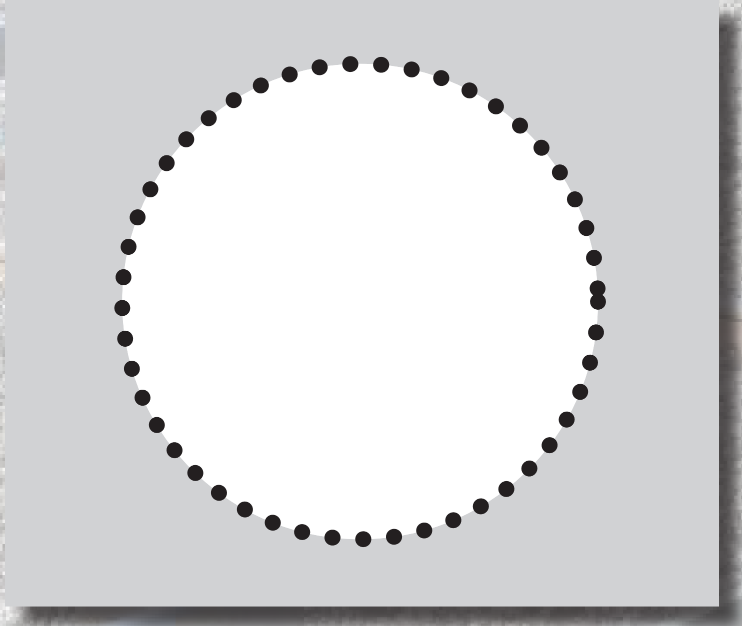
consider atoms at rim of hole



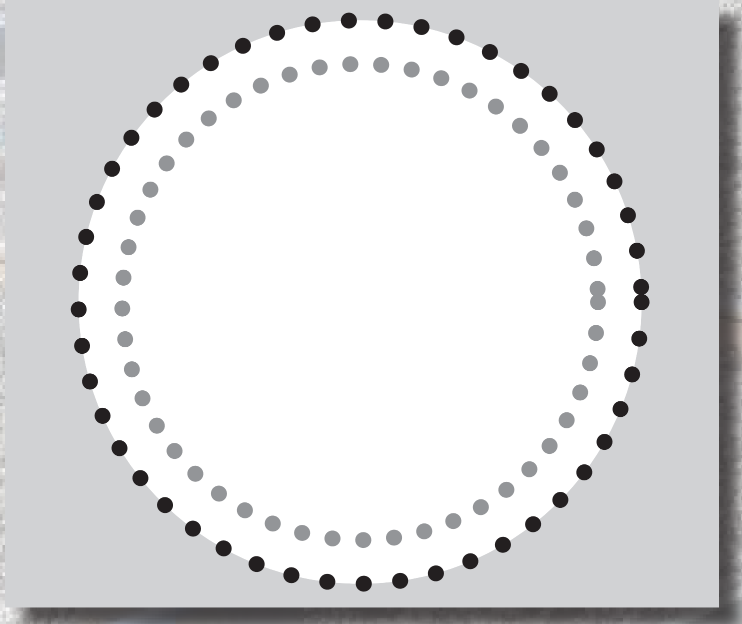
consider atoms at rim of hole



consider atoms at rim of hole



consider atoms at rim of hole



consider atoms at rim of hole

you won't forget this

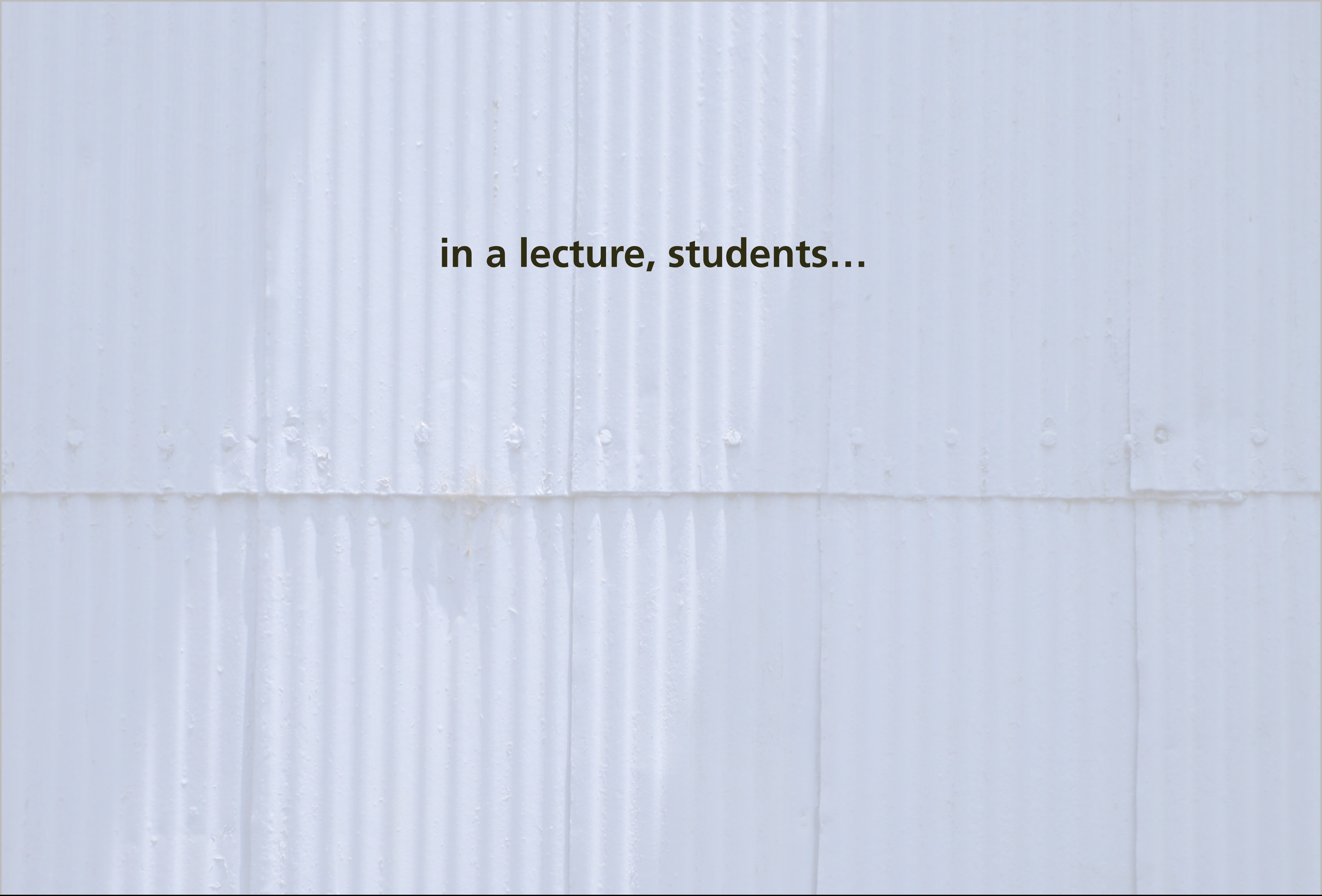

Peer
back to PI
INSTRUCTION

Greater learning gains

Greater learning gains

Better retention

① education ② PI ③ test



in a lecture, students…

in a lecture, students…

1. don’t pay utmost attention

## in a lecture, students…

1. don’t pay utmost attention
2. think they know it

in a lecture, students…

1. don’t pay utmost attention

2. think they know it

3. are not confronted with misconceptions

in a lecture, students…

1. don’t pay utmost attention

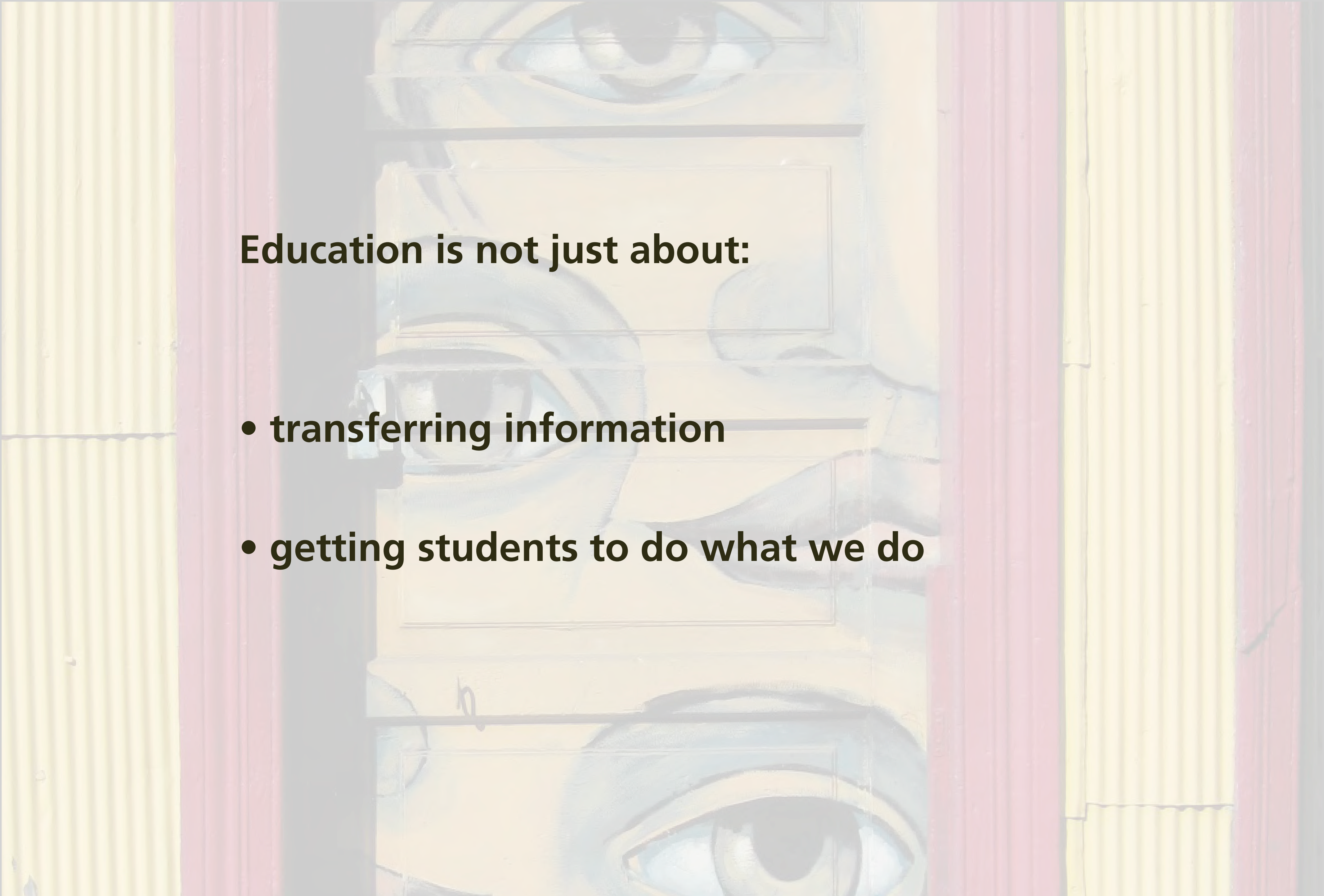
2. think they know it

3. are not confronted with misconceptions

**false sense of security**

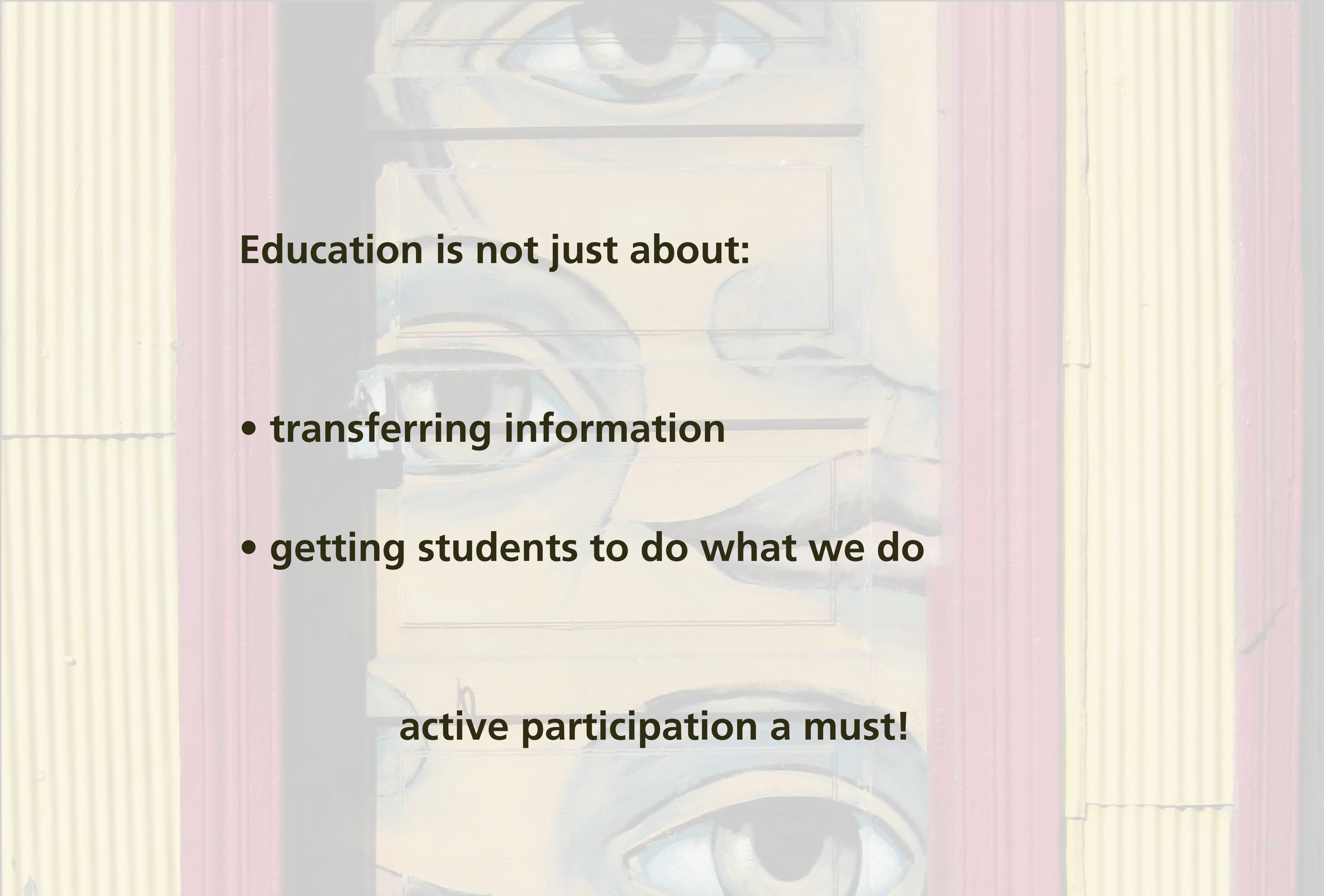
① education ② PI ③ test

# an illusion. . .



## 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

active participation a must!

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① education ② PI ③ test

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# Getting every student prepared for every class

@eric_mazur

Colorado State University Pueblo
Pueblo, CO, 2 May 2016

**CLASS** **ROOM**

1st exposure

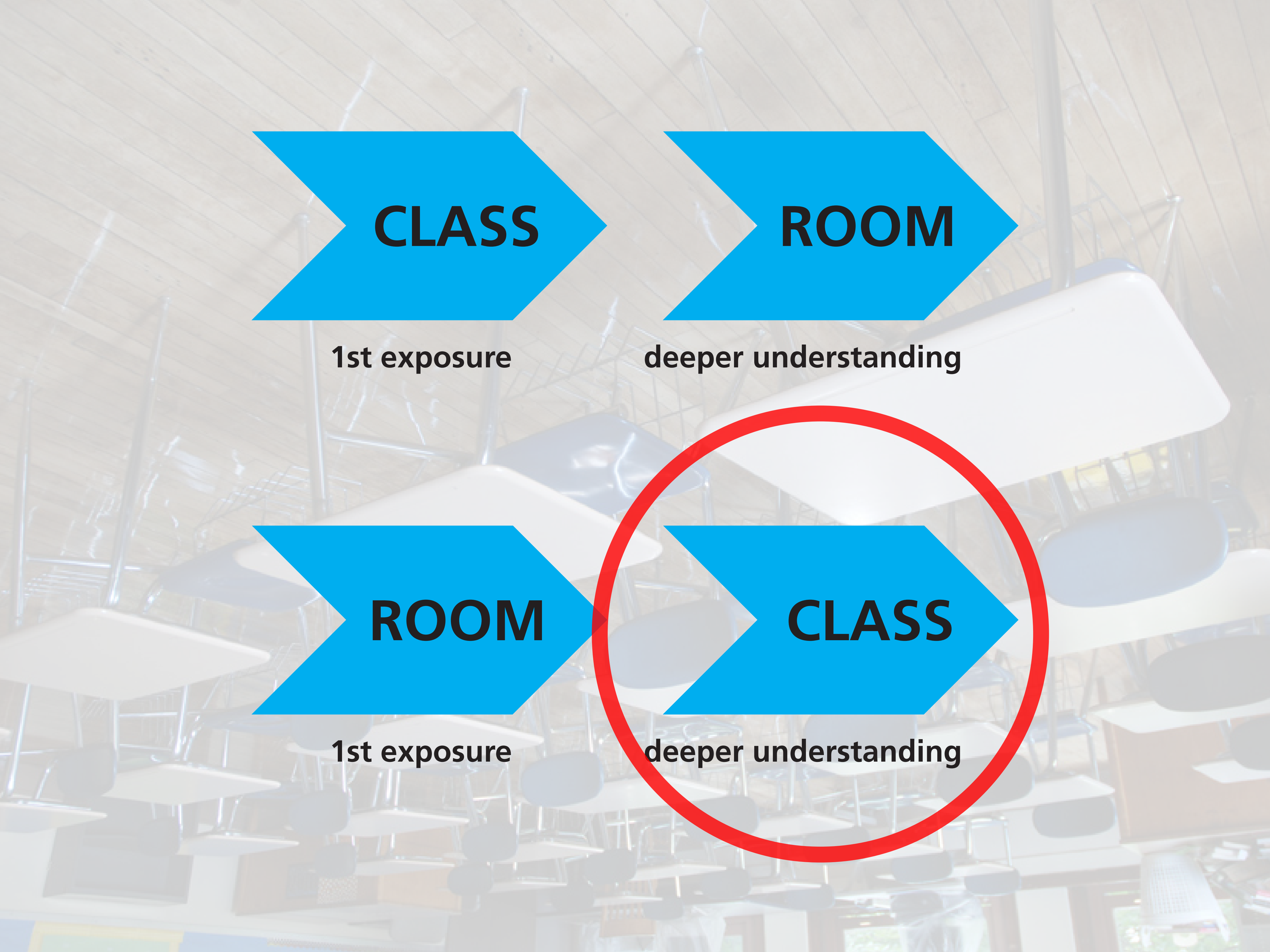
deeper understanding

**CLASS** **ROOM**

1st exposure deeper understanding

**ROOM** **CLASS**

1st exposure deeper understanding

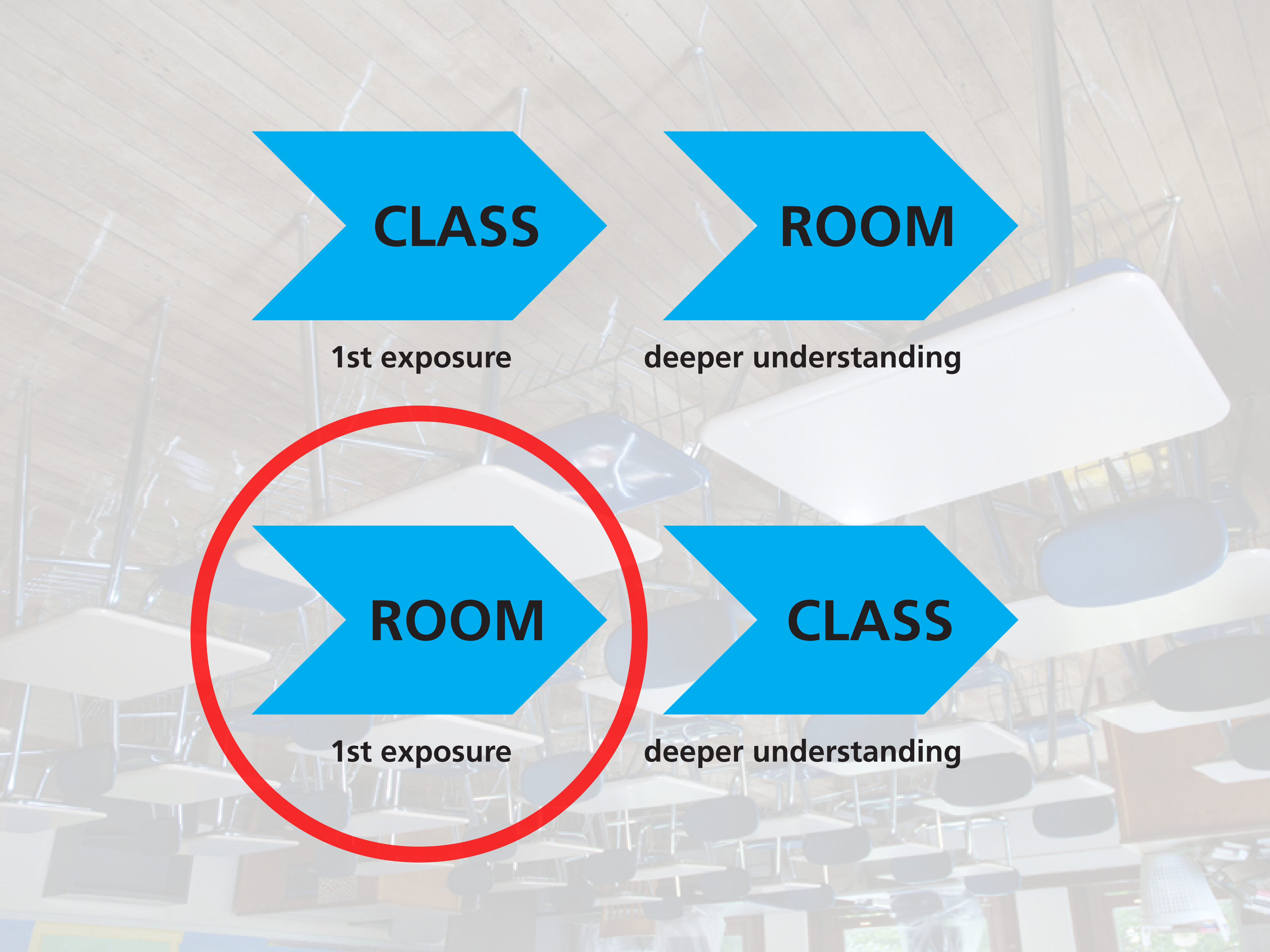


**CLASS** **ROOM**

1st exposure deeper understanding

**ROOM** **CLASS**

1st exposure deeper understanding



CLASS

1st exposure

ROOM

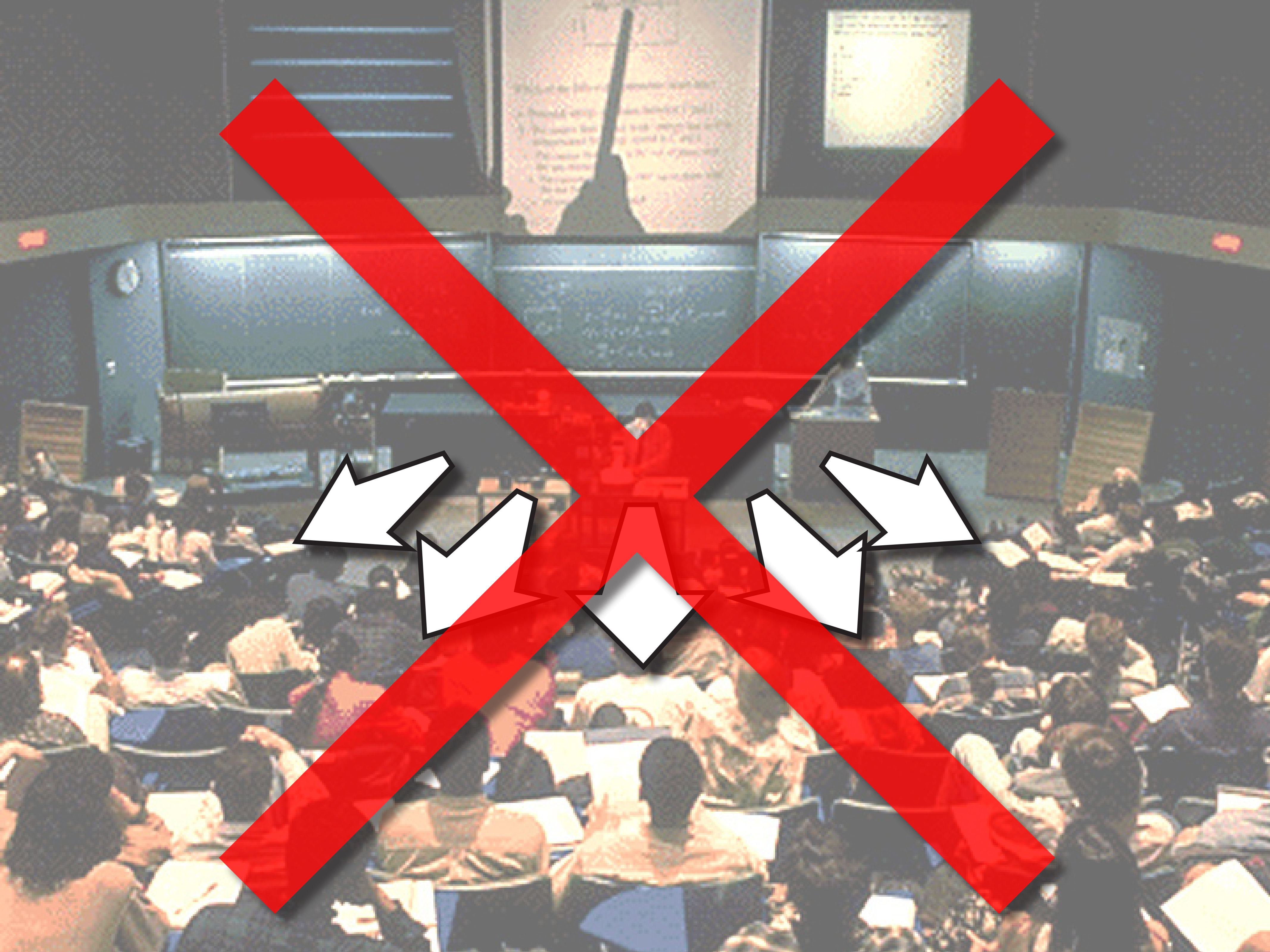
deeper understanding

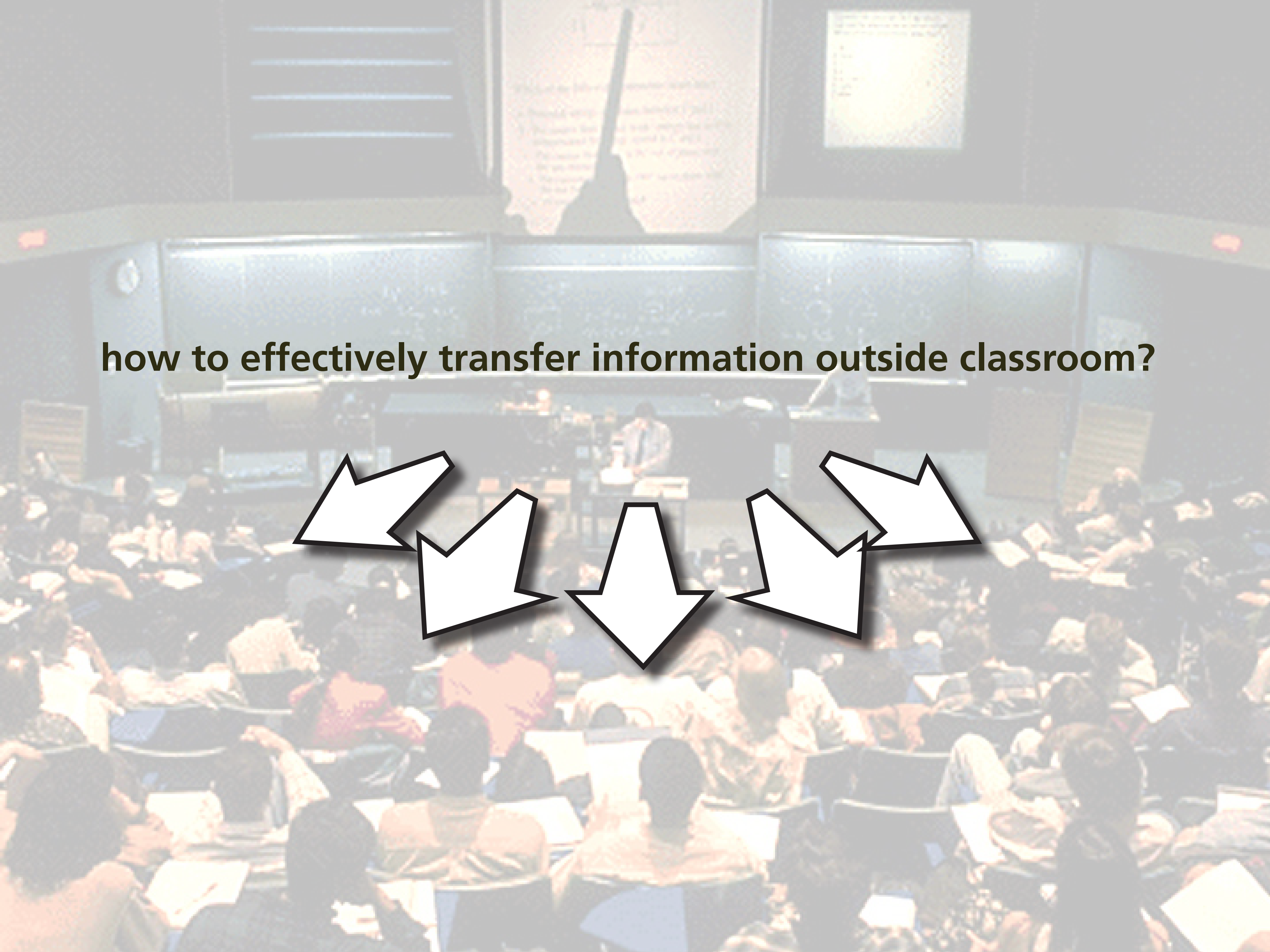
ROOM

1st exposure

CLASS

deeper understanding

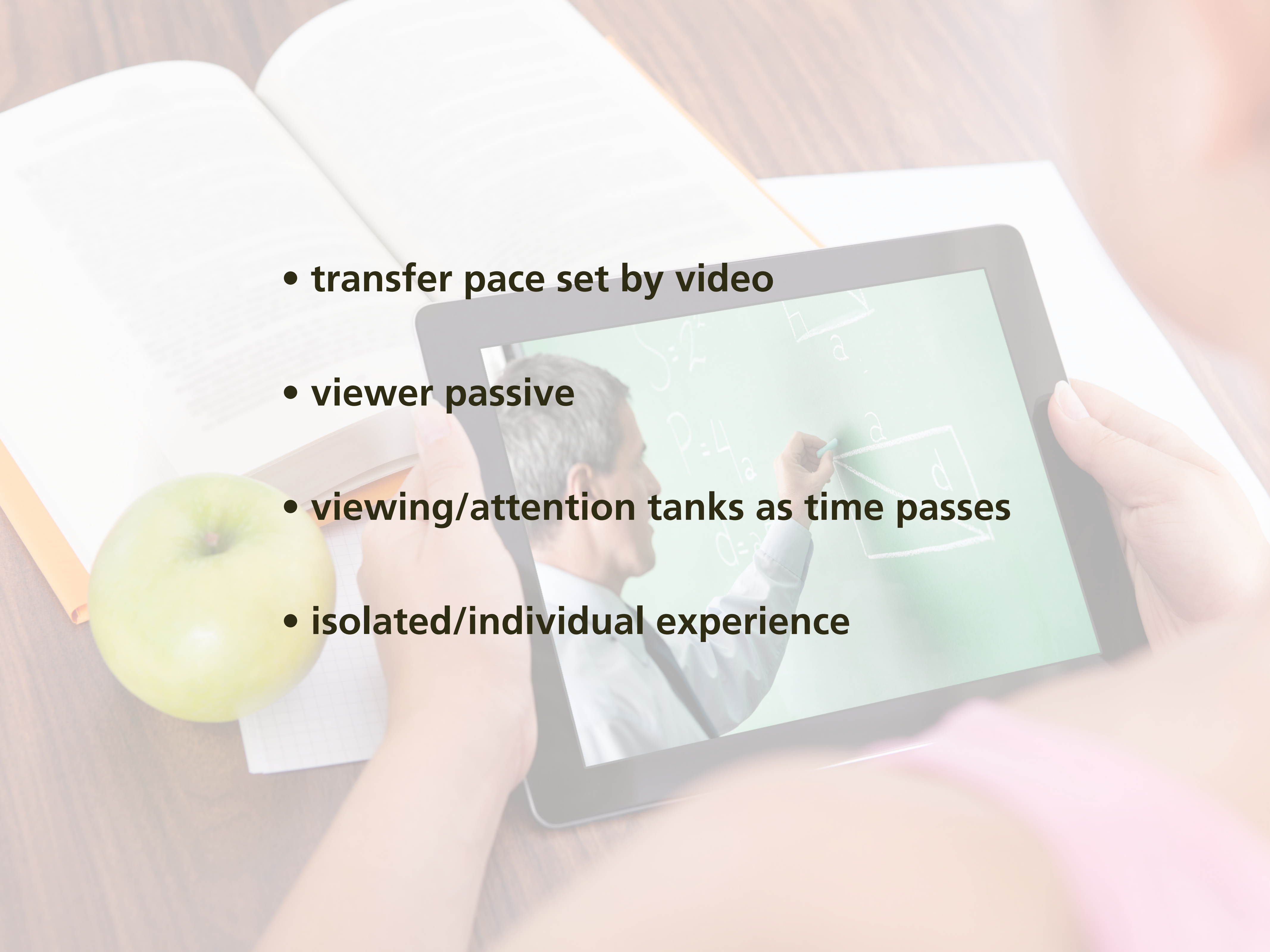




how to effectively transfer information outside classroom?


P=4a
a
a
d

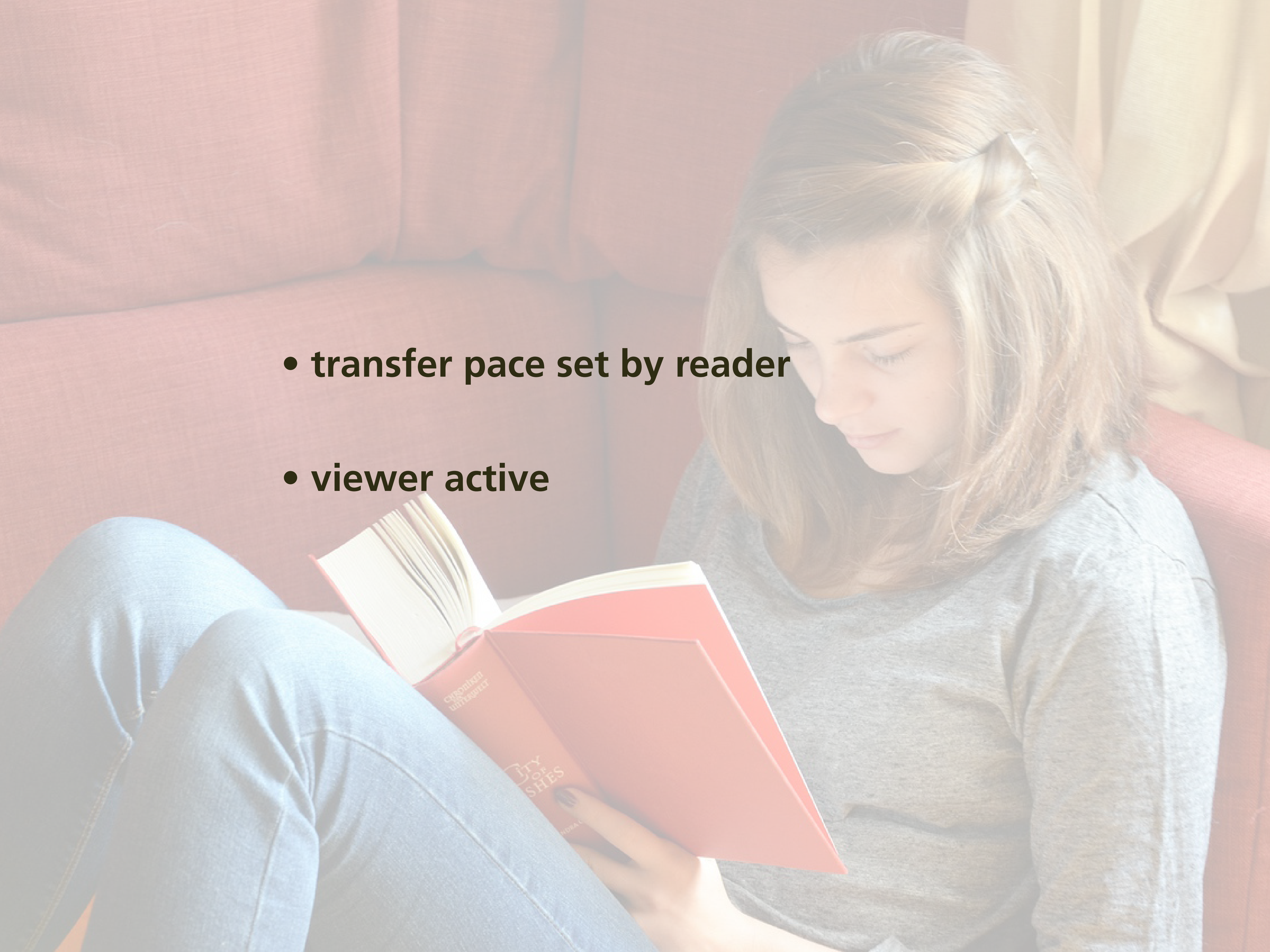
but…



- transfer pace set by video
- viewer passive
- viewing/attention tanks as time passes
- isolated/individual experience

we’re simply moving this outside classroom!


CHRONIKEN DER UNTERWELT
CITY OF
SHES

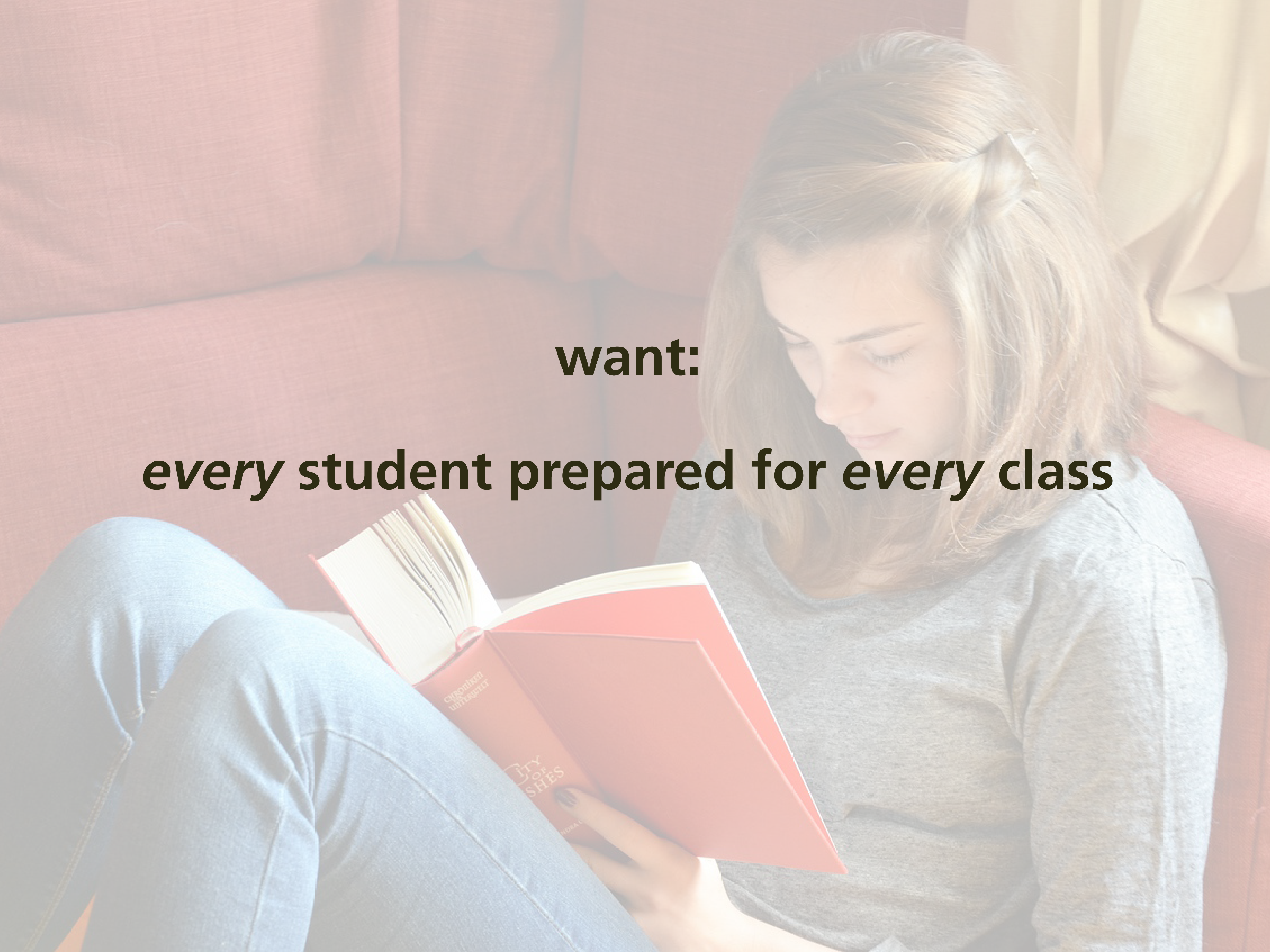


- **transfer pace set by reader**
- **viewer active**

# but…

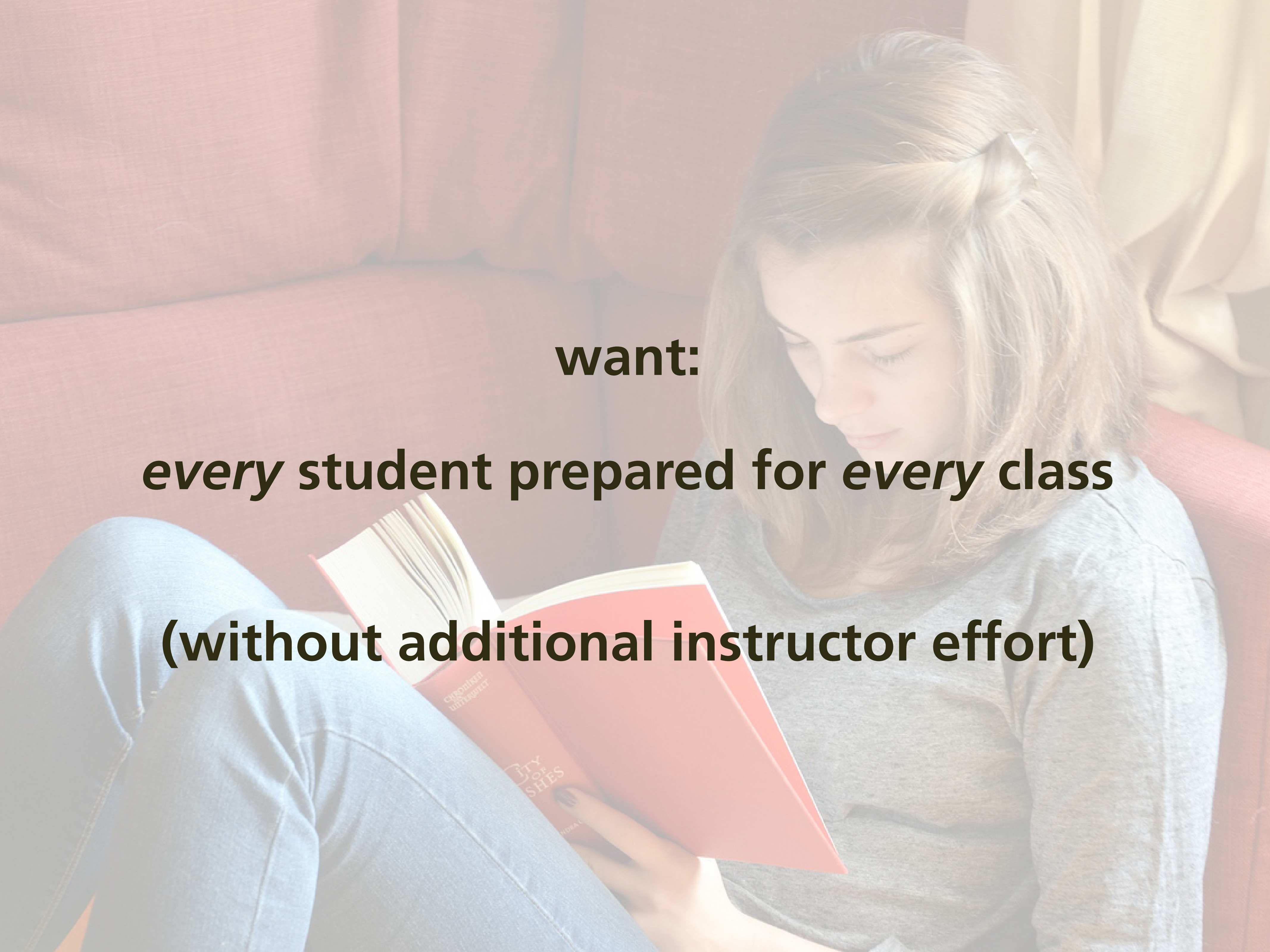
**isolated/individual experience &**

**no real accountability**



want:

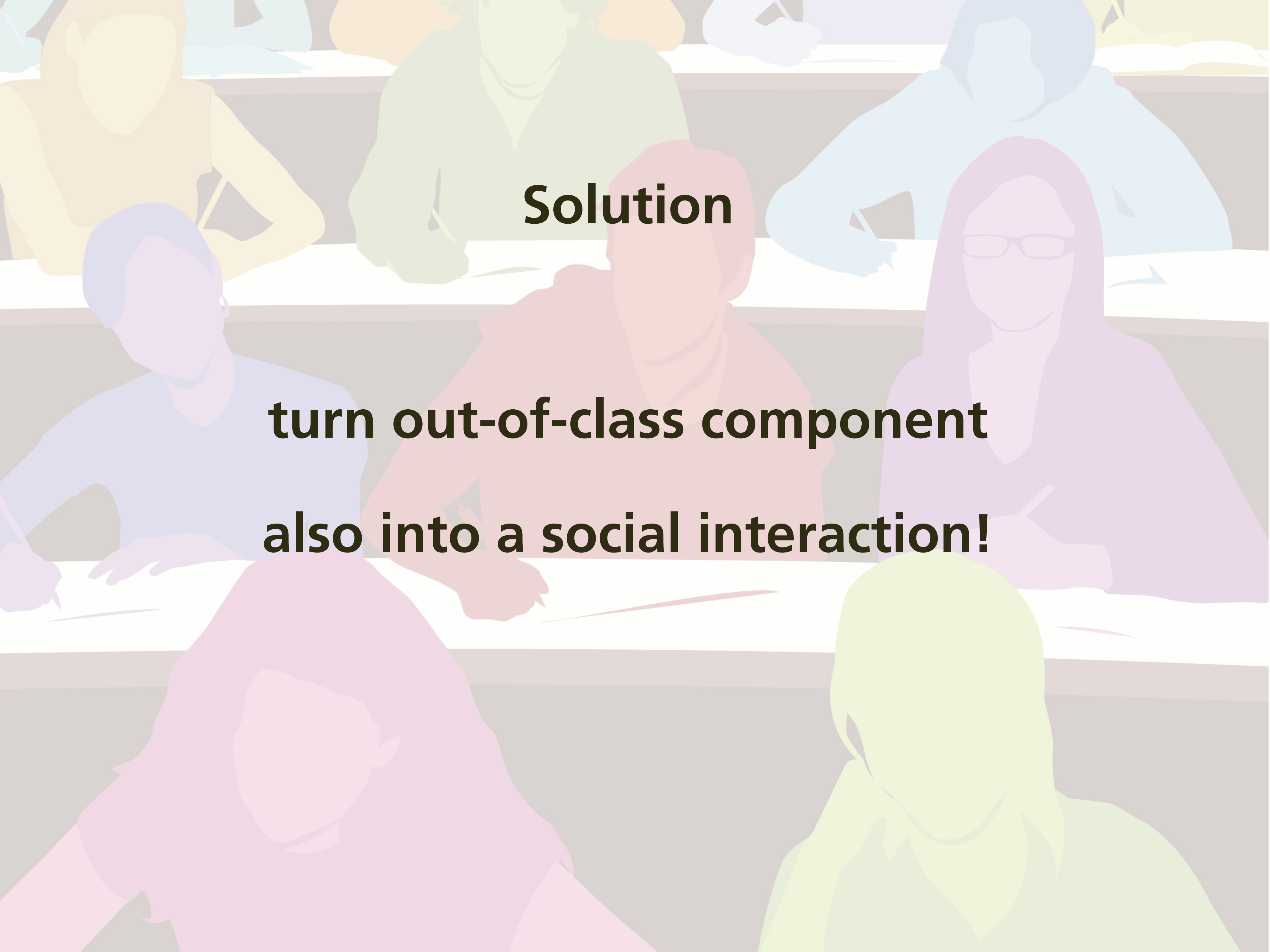
*every* student prepared for *every* class



want:

*every* student prepared for *every* class

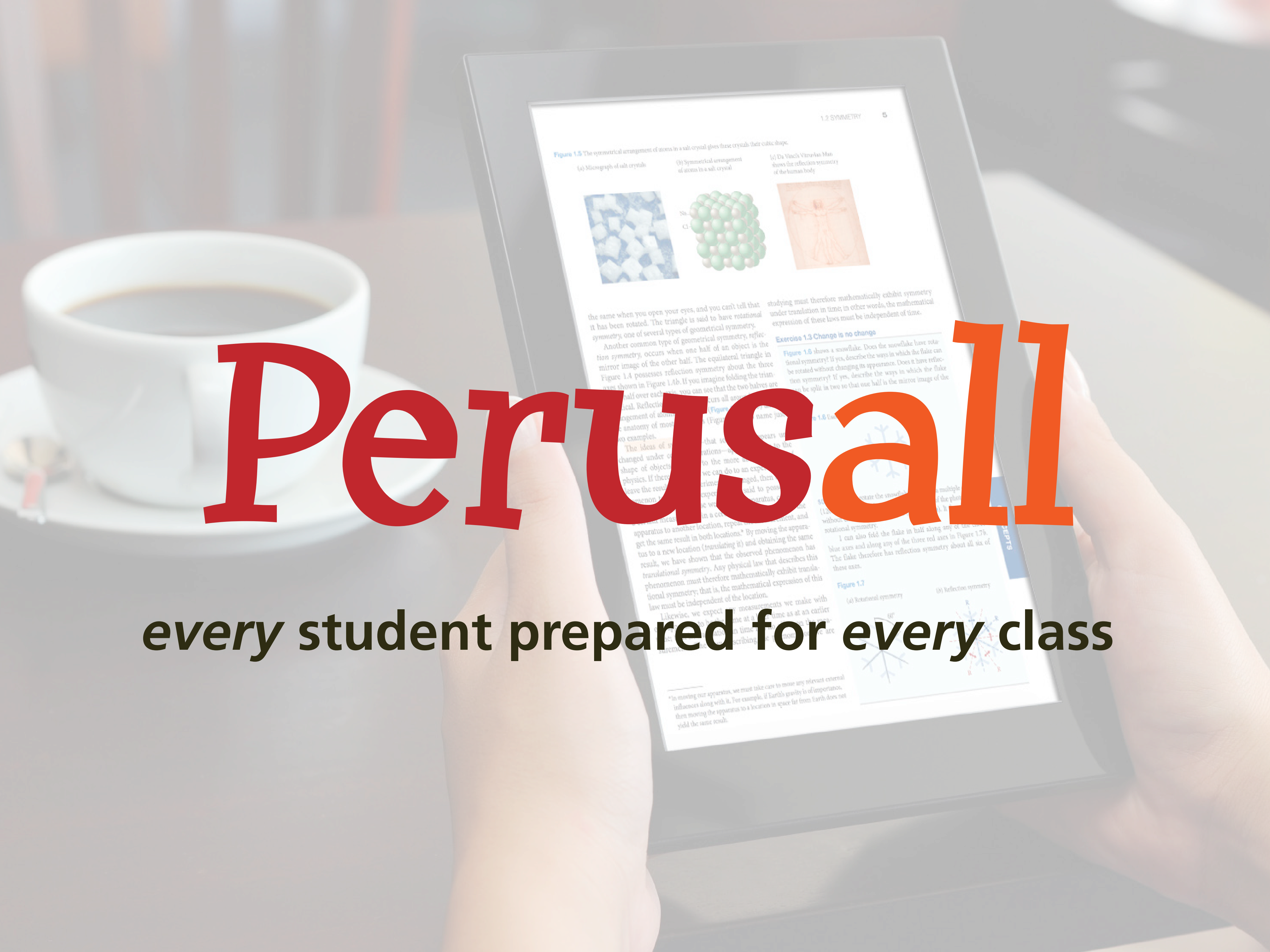
(without additional instructor effort)



# Solution

turn out-of-class component

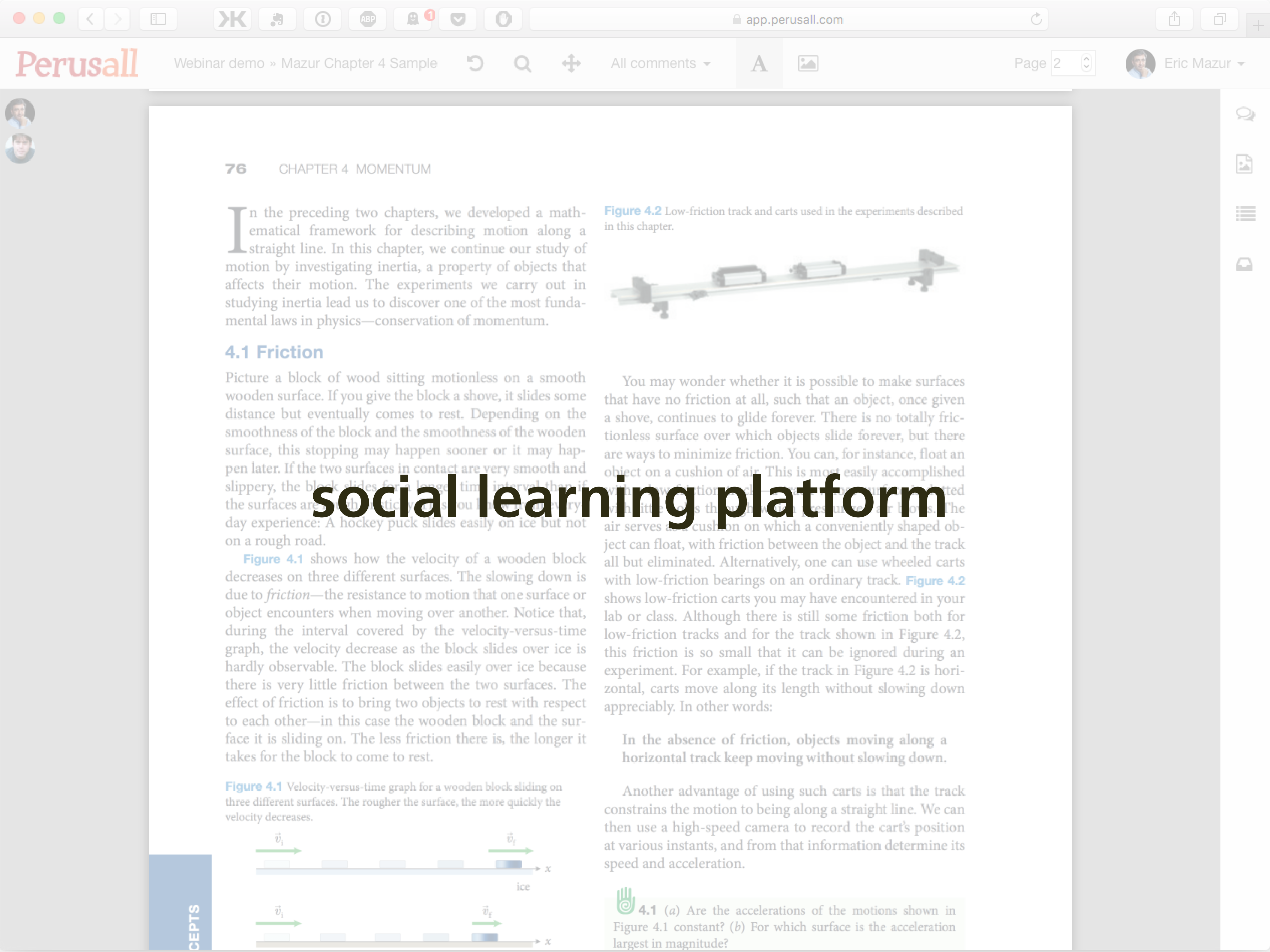
also into a social interaction!



# Perusall

*every* student prepared for *every* class

# social learning platform



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, as 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.

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

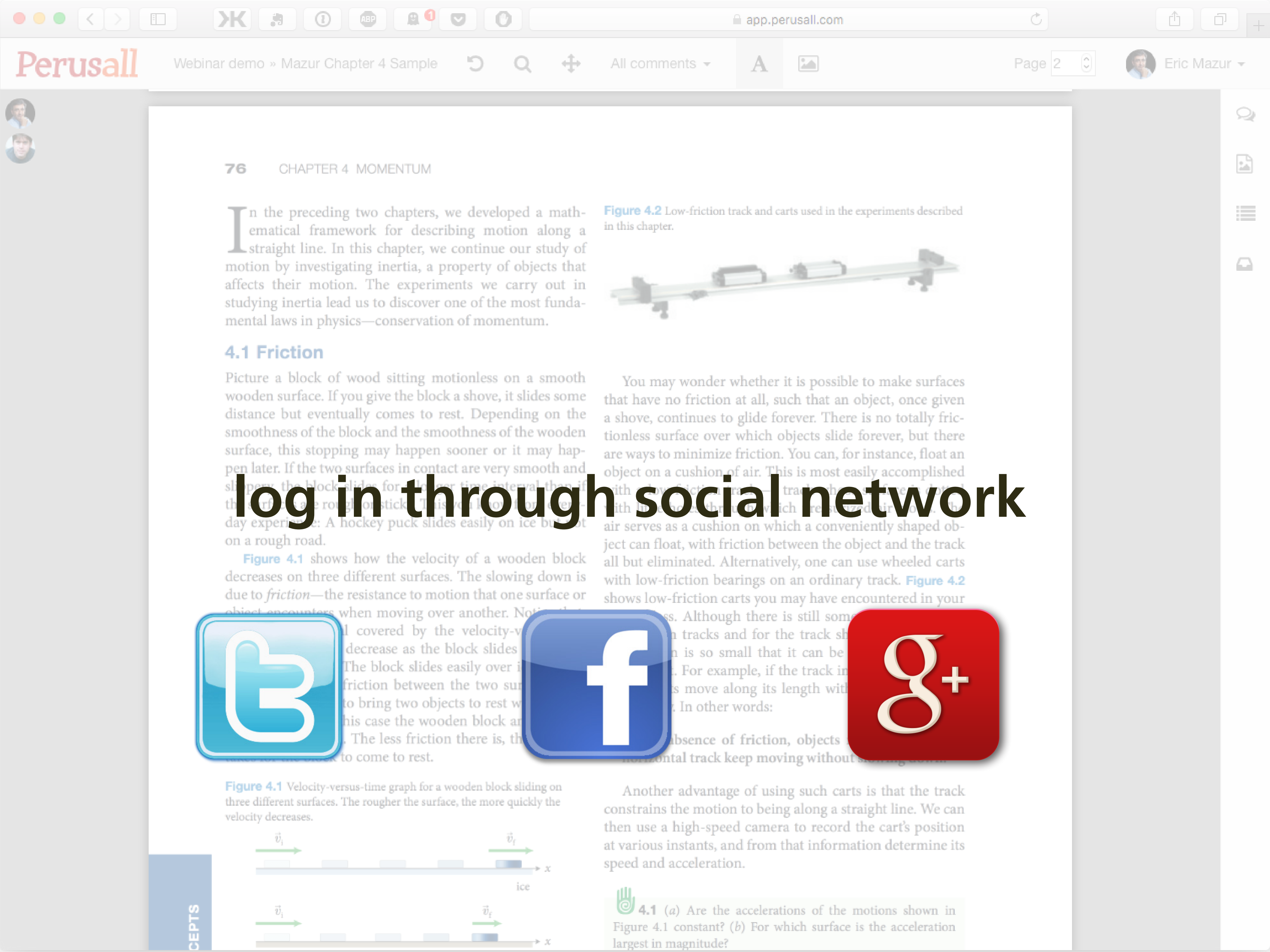
You may wonder whether it is possible to make surfaces that have no friction at all, such that an object, once given a shove, continues to glide forever. There is no totally frictionless surface over which objects slide forever, but there are ways to minimize friction. You can, for instance, float an object on a cushion of air. This is most easily accomplished with a low-friction track—a track whose surface is dotted with little holes through which pressurized air blows. The 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?

# log in through social network



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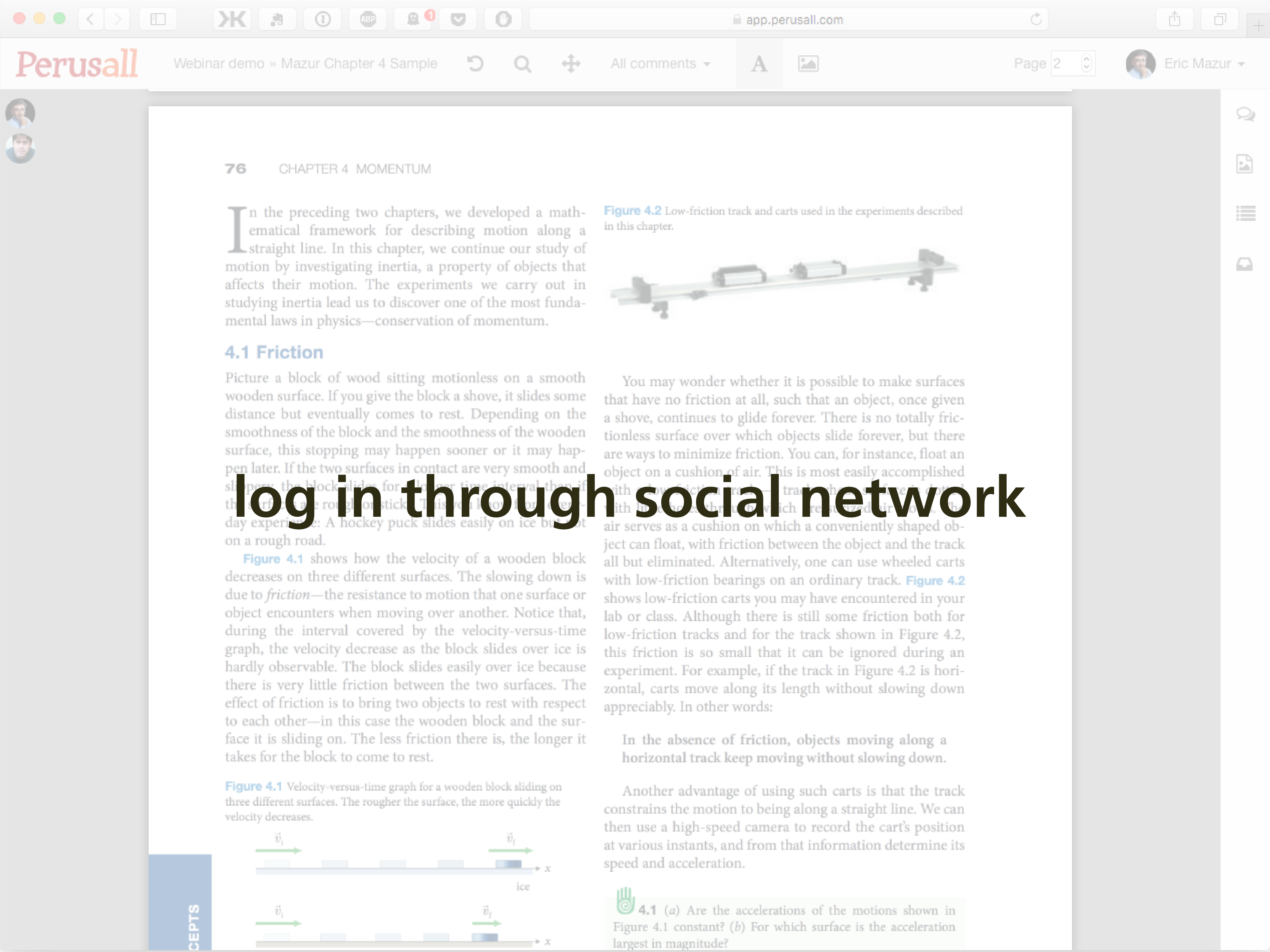

76 CHAPTER 4 MOMENTUM

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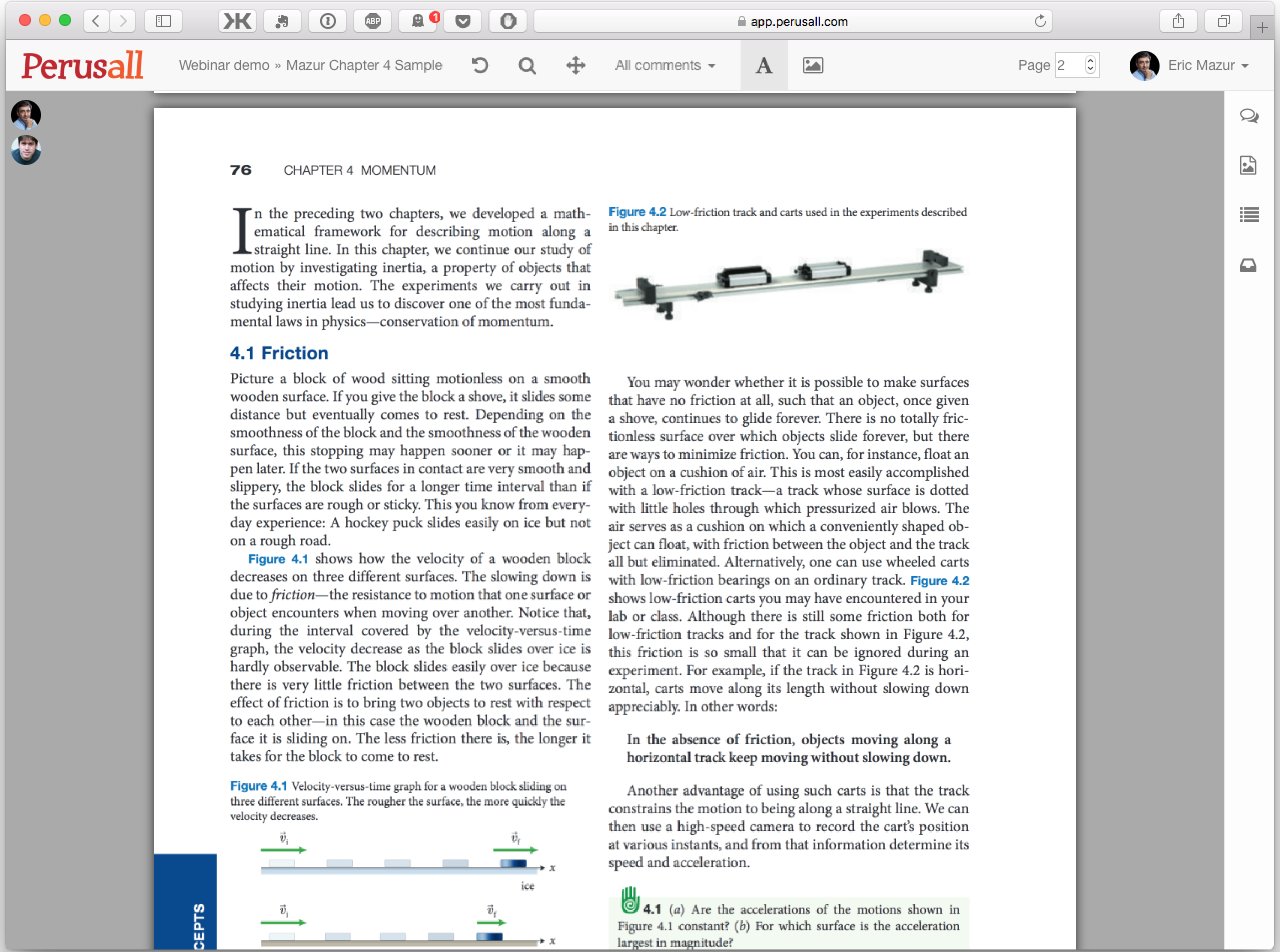

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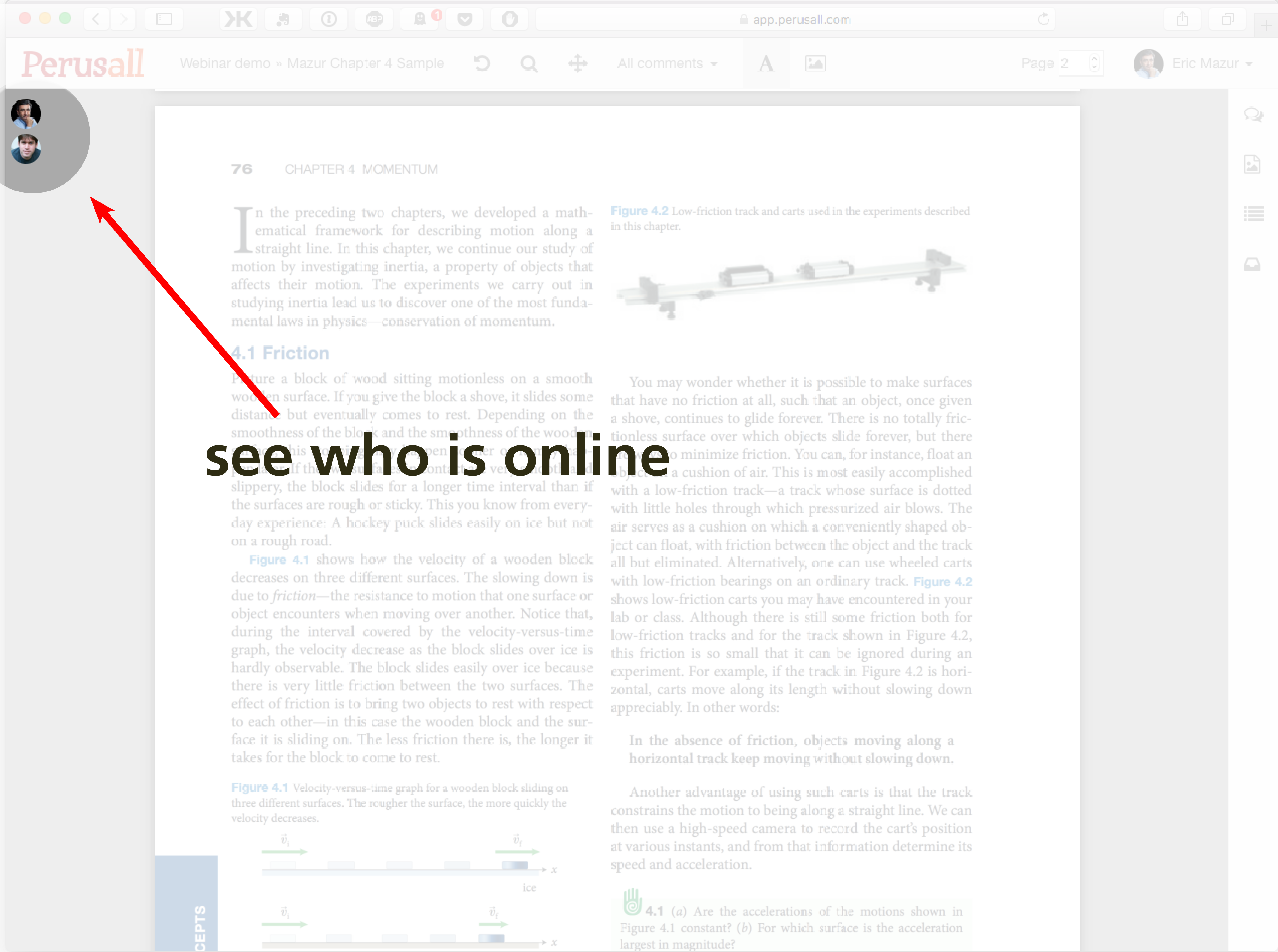

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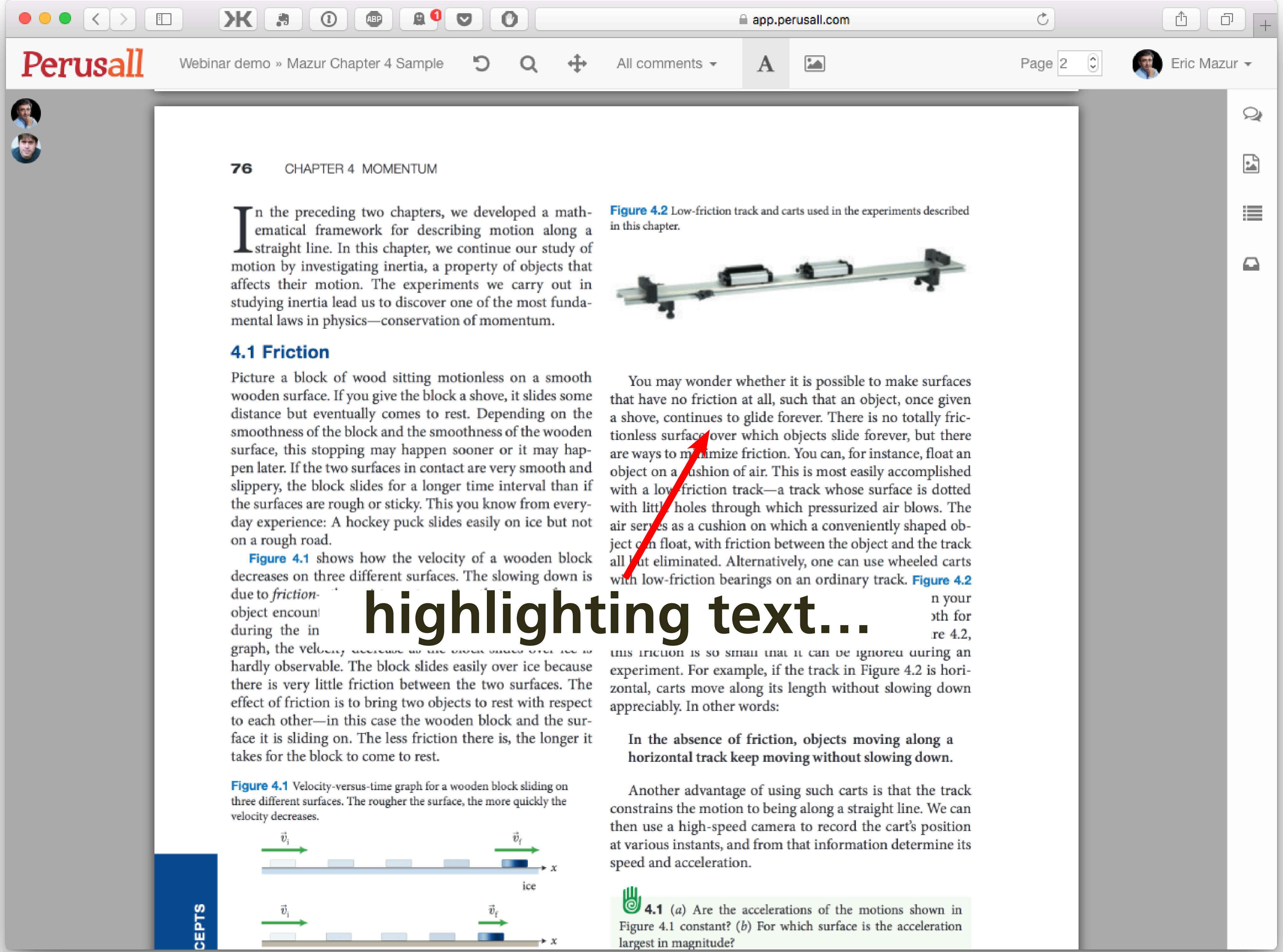

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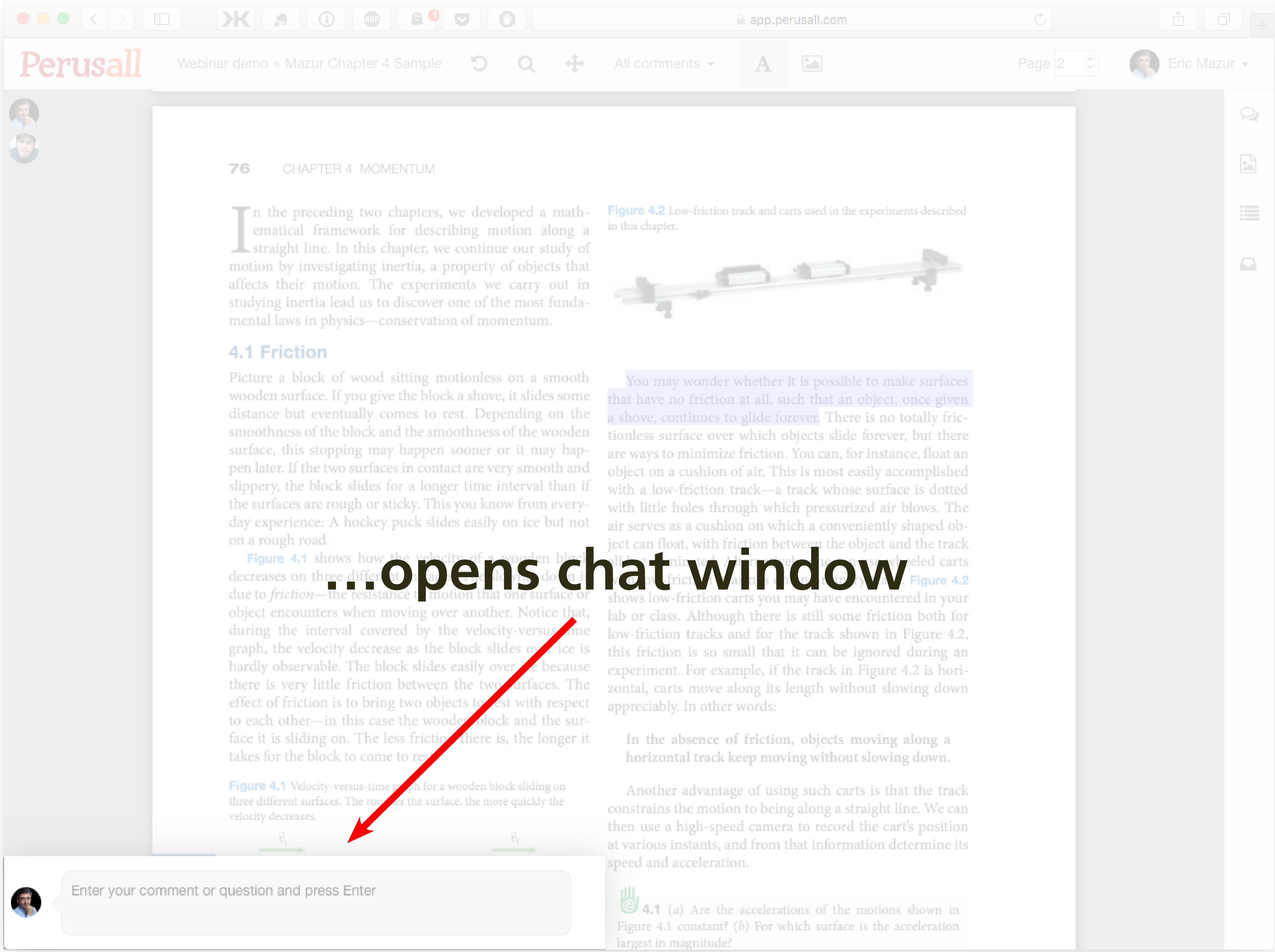

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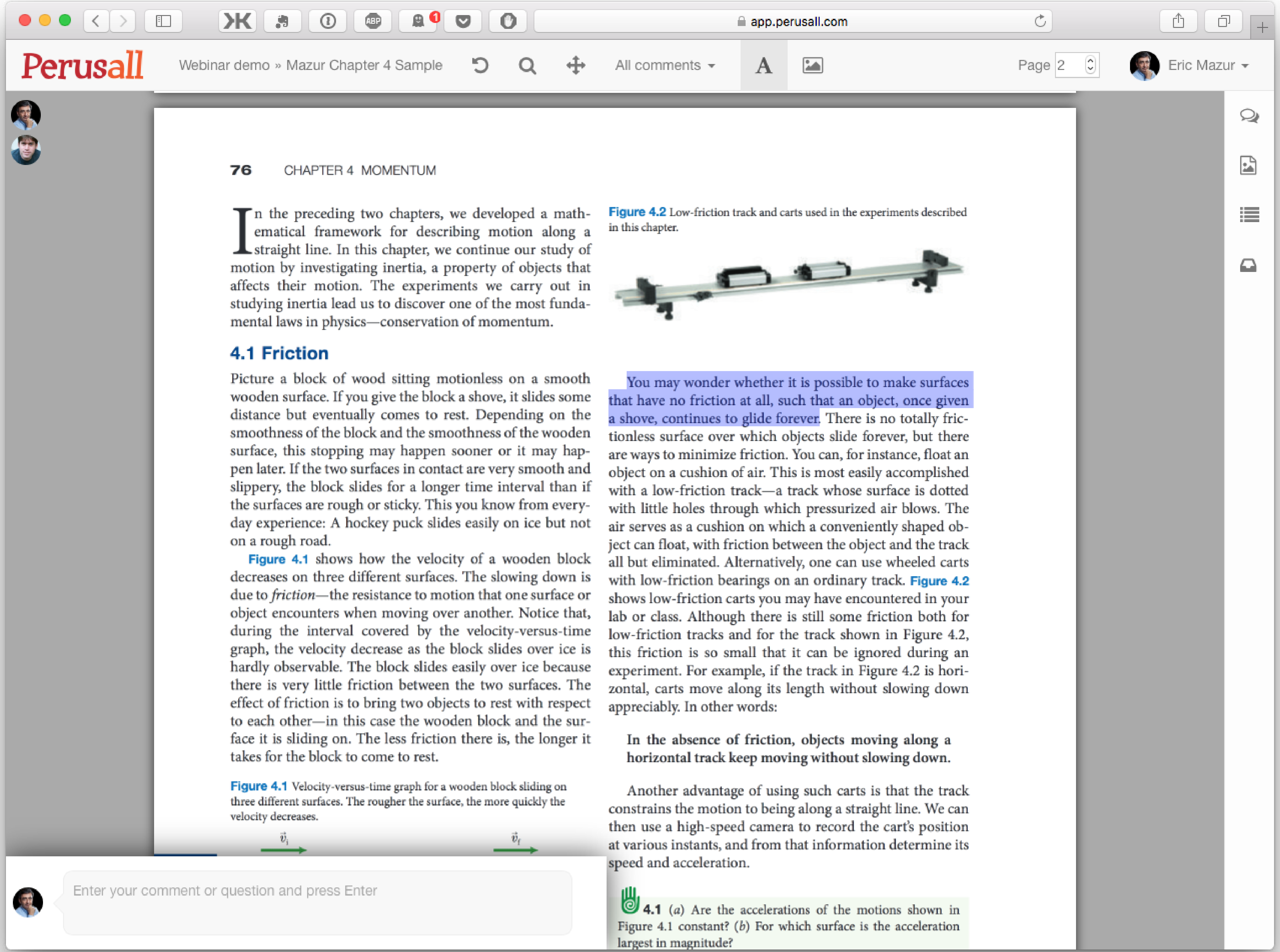

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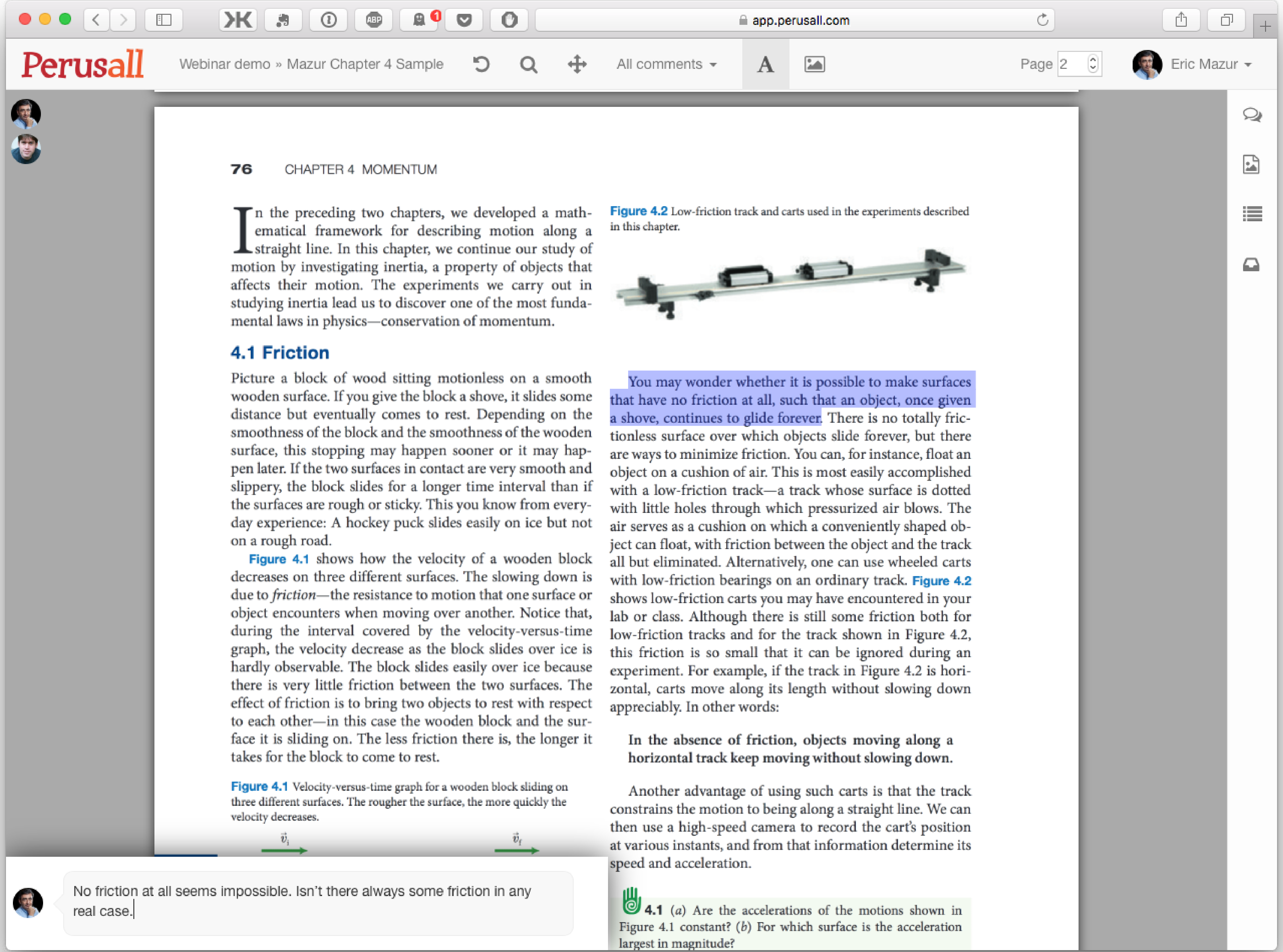

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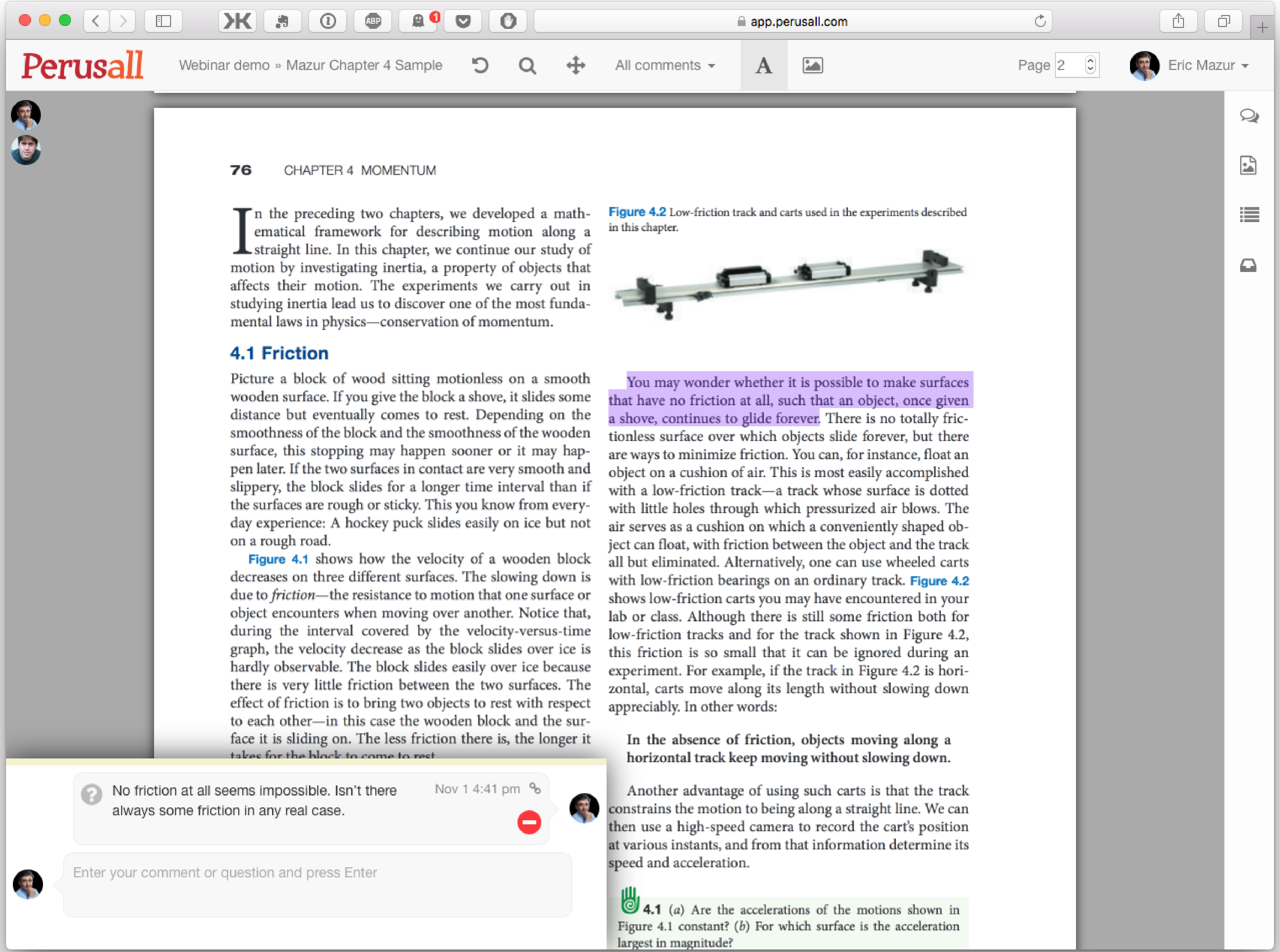

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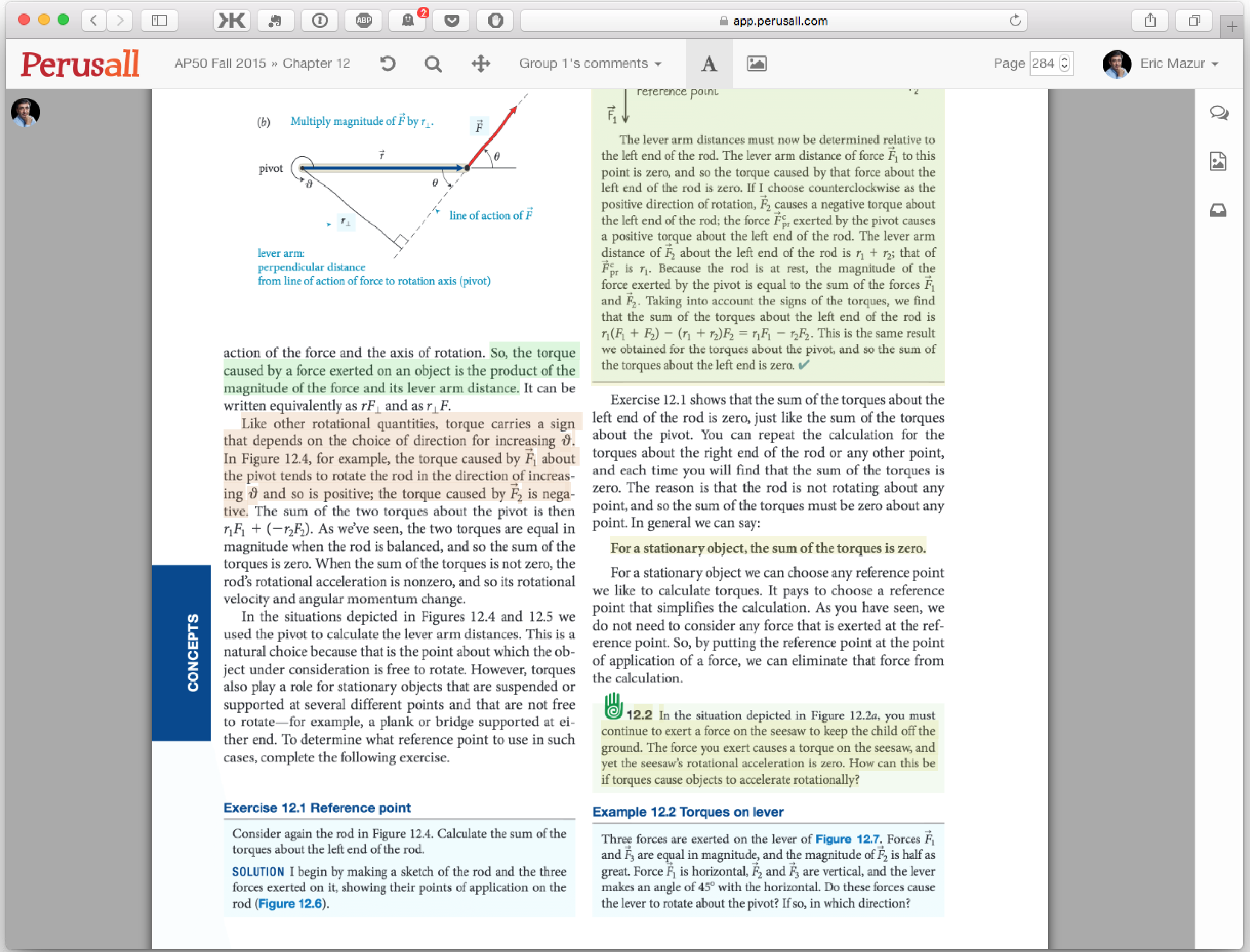

action of the force and the axis of rotation. So, the torque caused by a force exerted on an object is the product of the magnitude of the force and its lever arm distance. It can be written equivalently as $rF_\perp$ and as $r_\perp F$.

Like other rotational quantities, torque carries a sign that depends on the choice of direction for increasing $\vartheta$. 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 $\vartheta$ 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.

### 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**).

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. ✔

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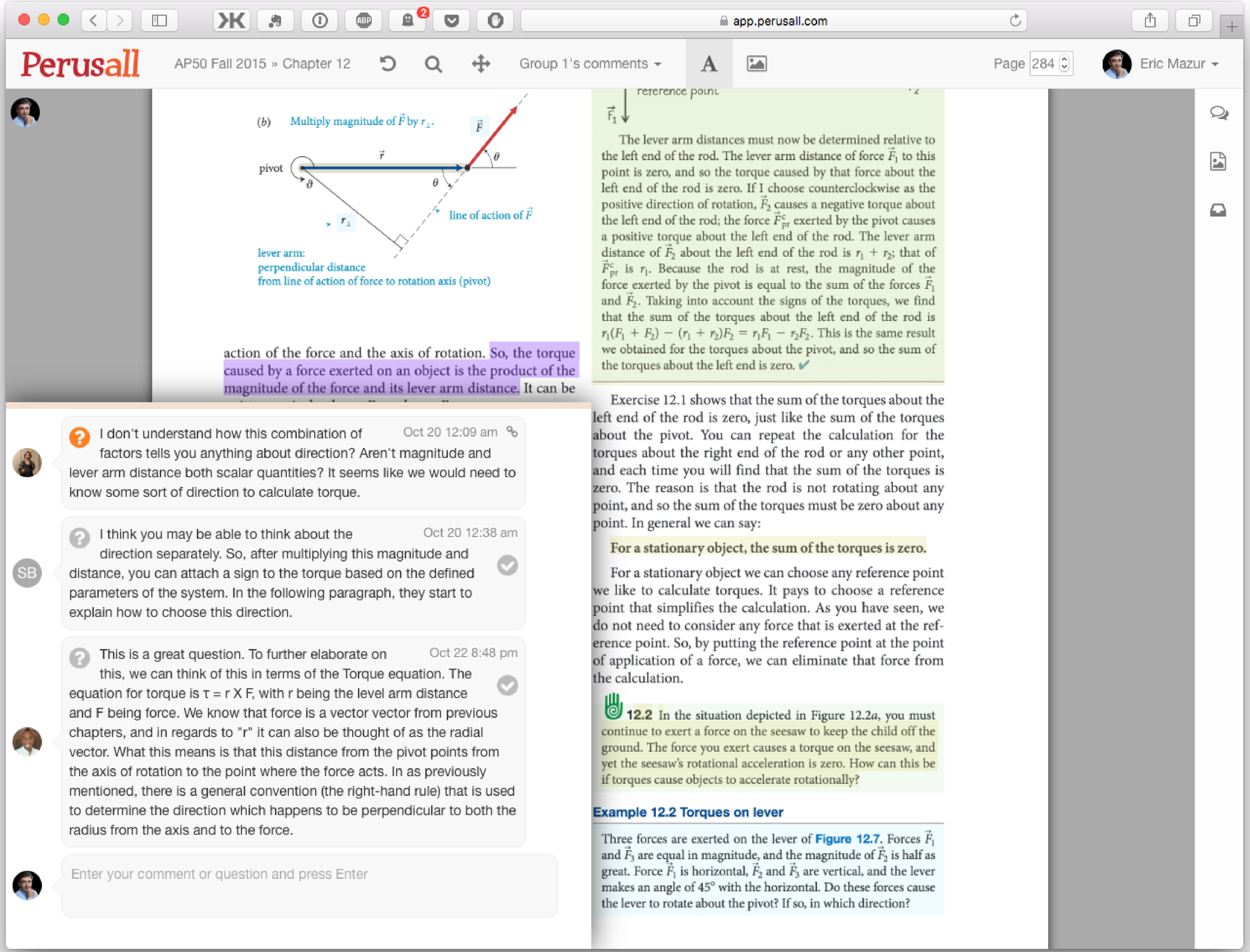

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Oct 20 12:09 am

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Oct 22 8:48 pm

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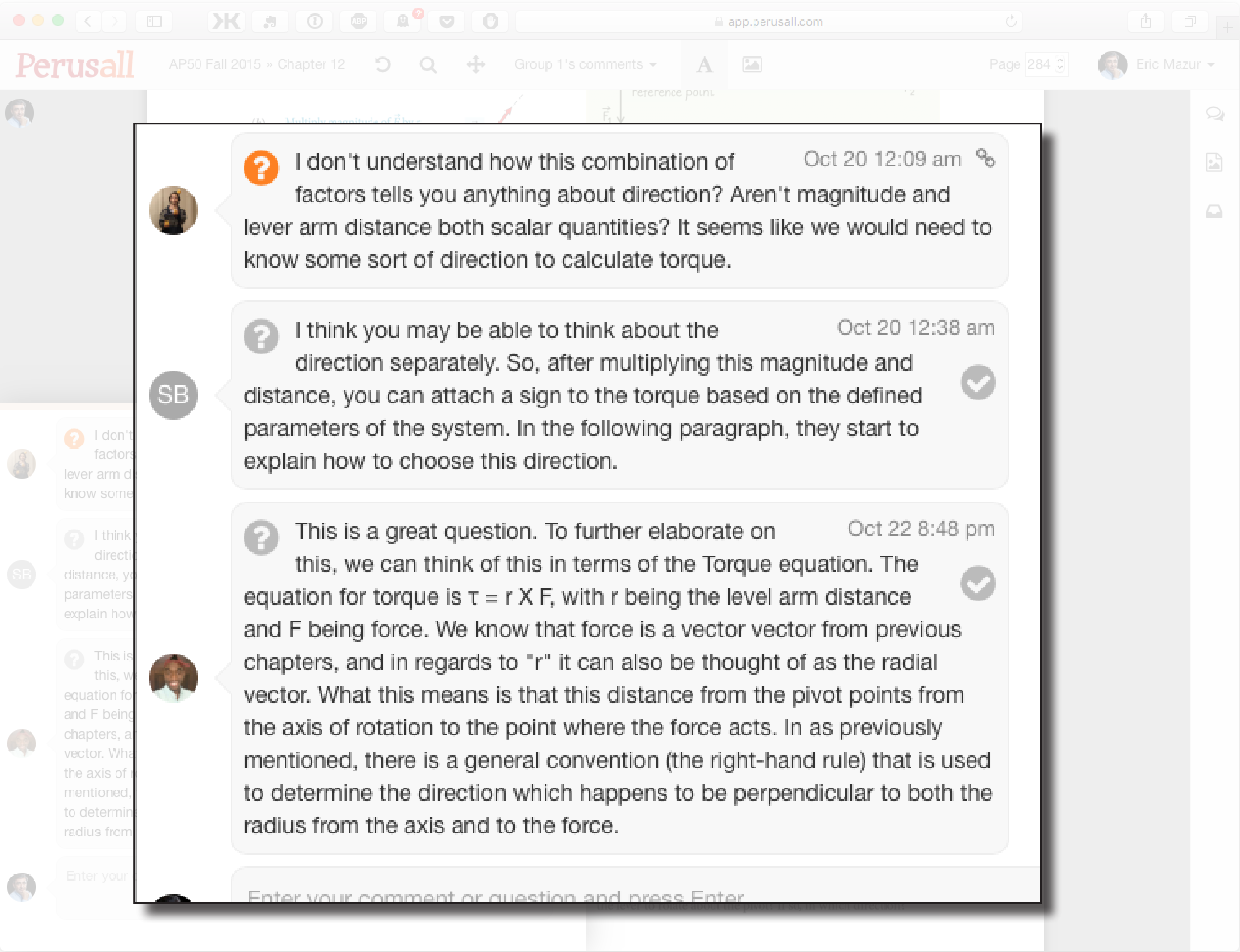

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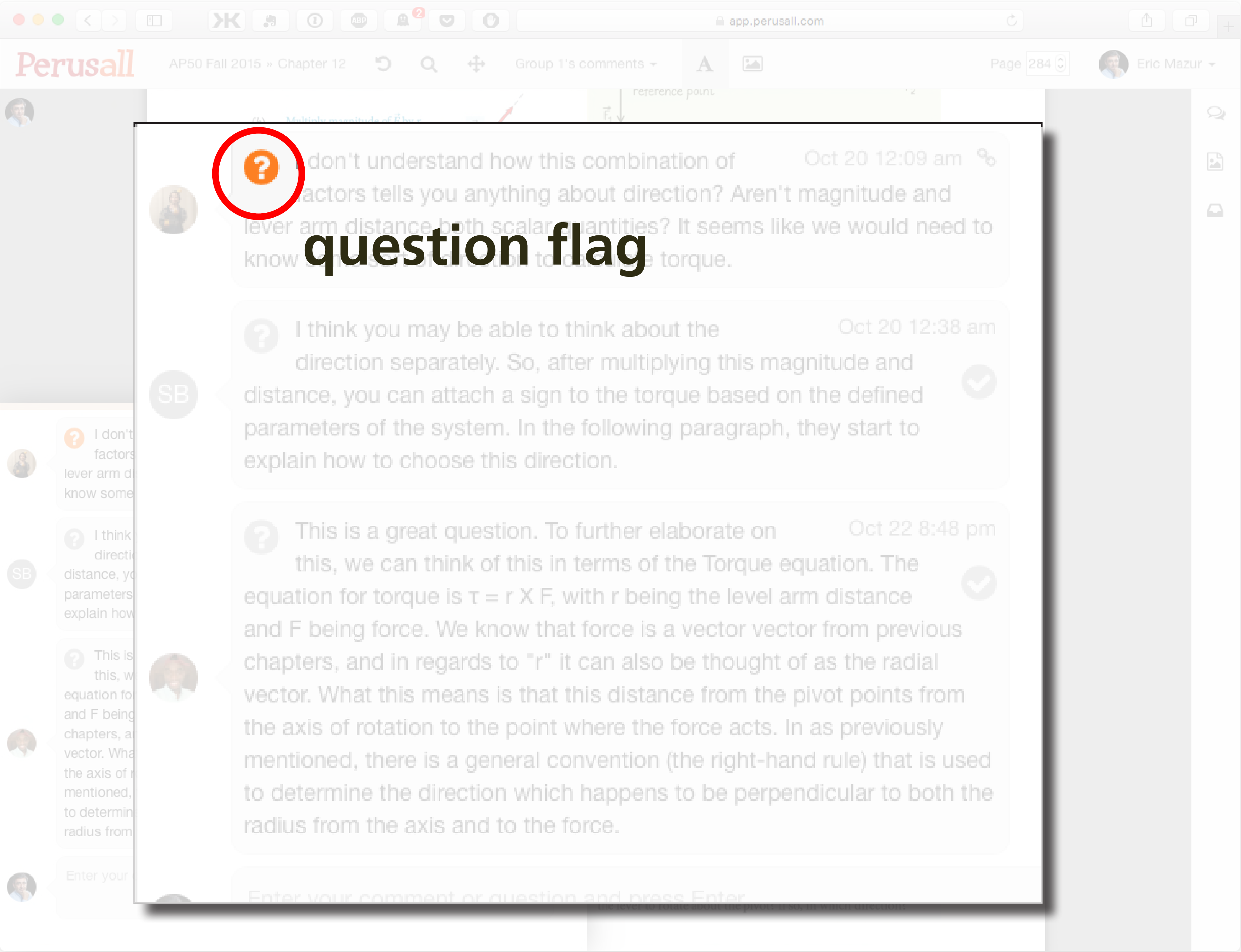

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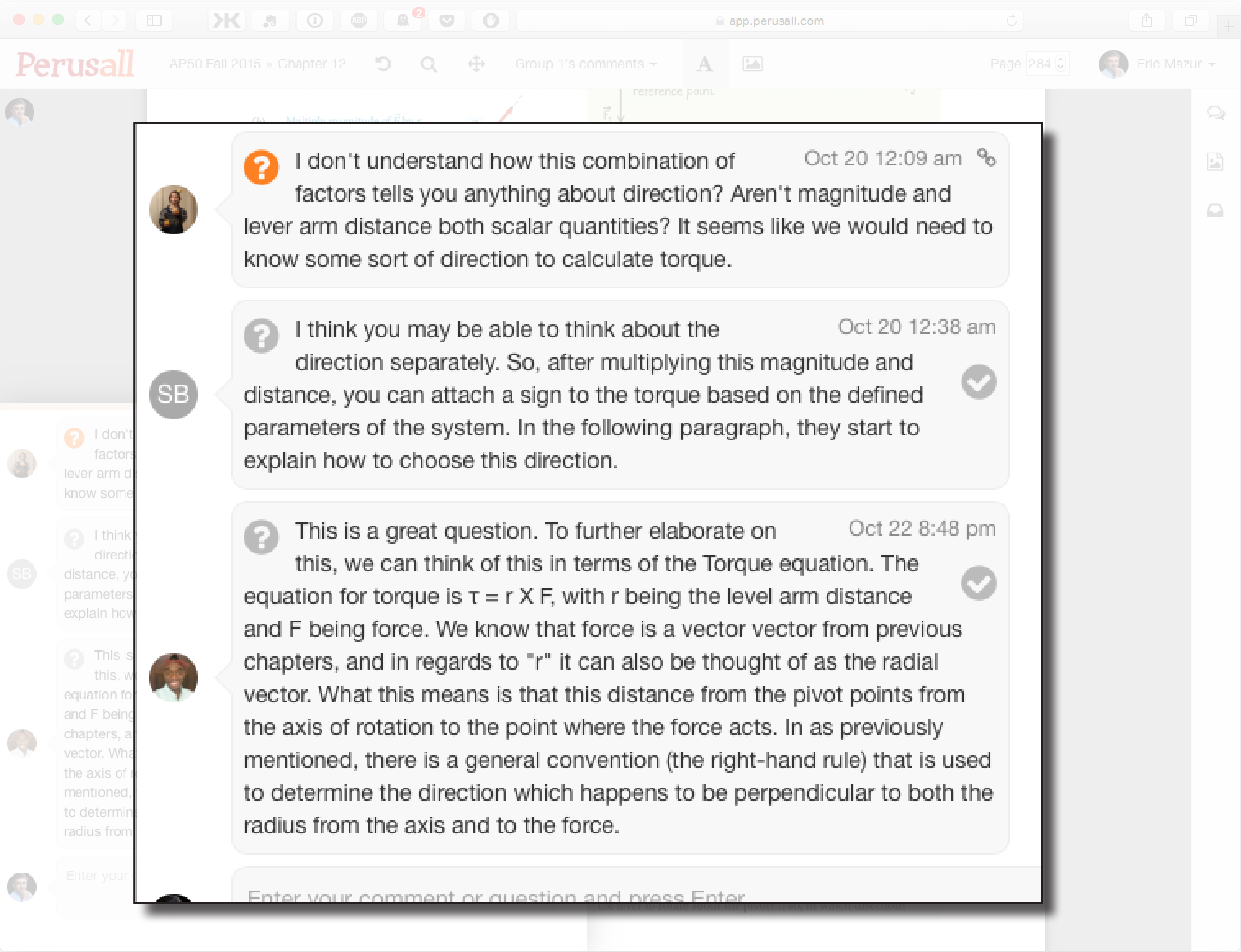

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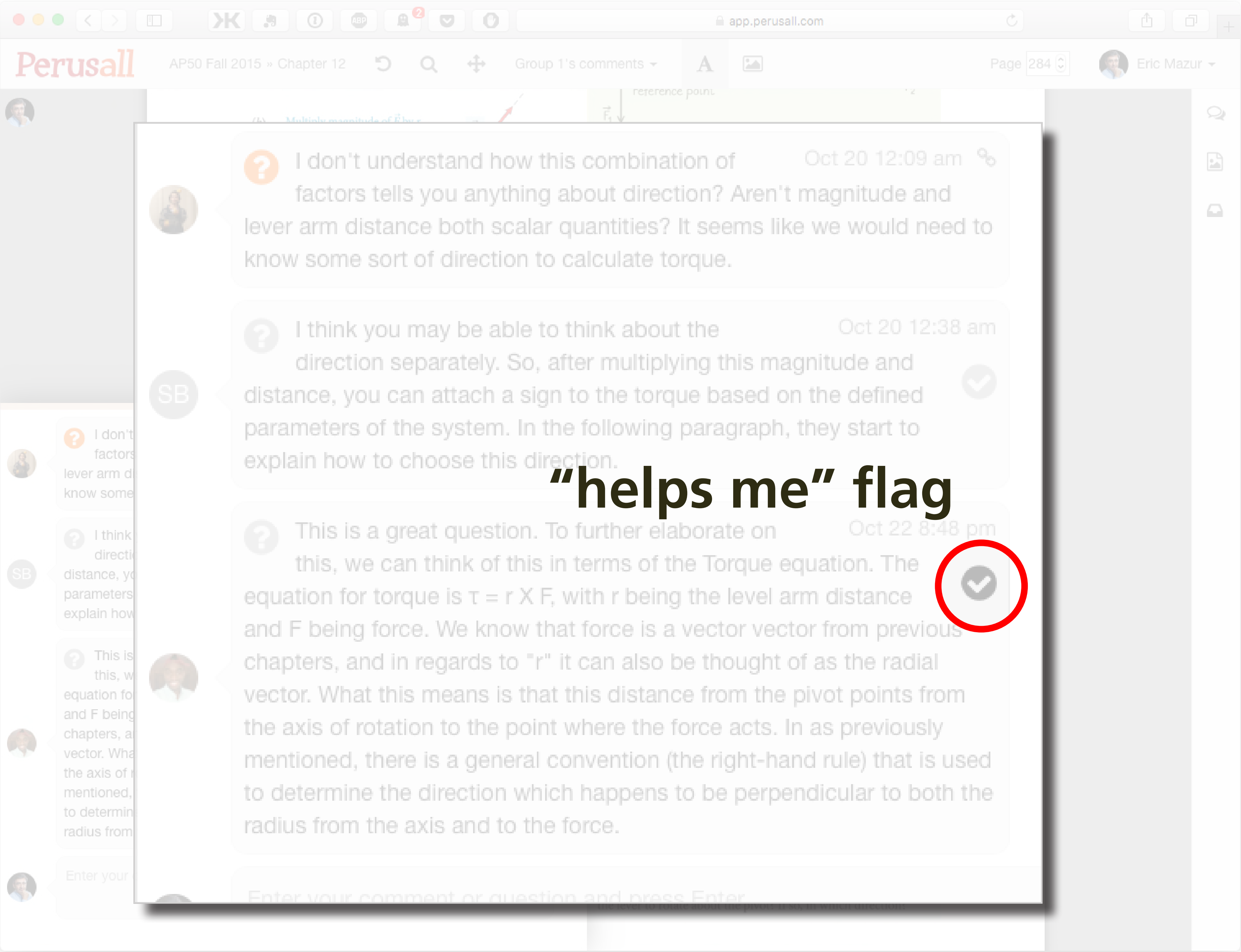

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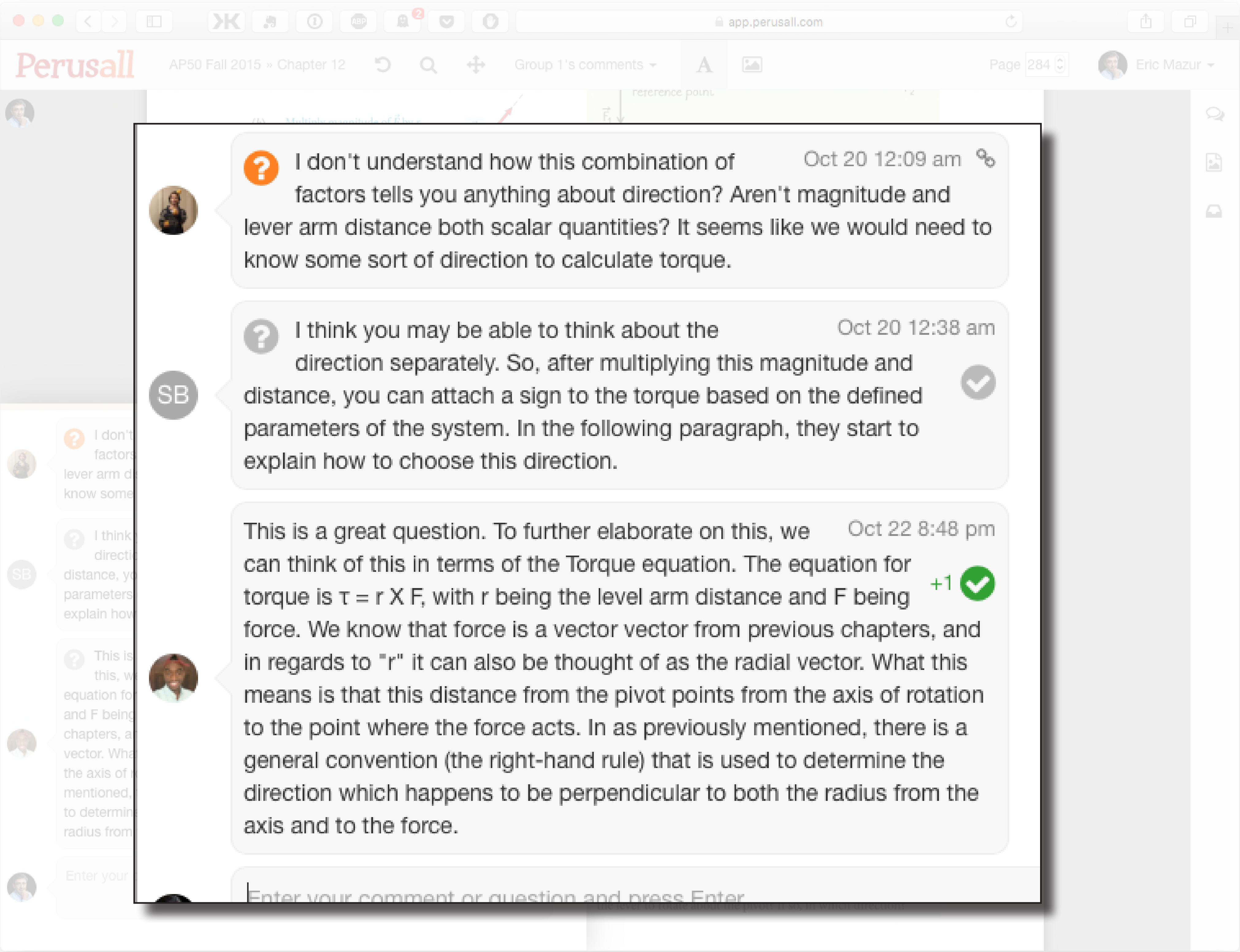

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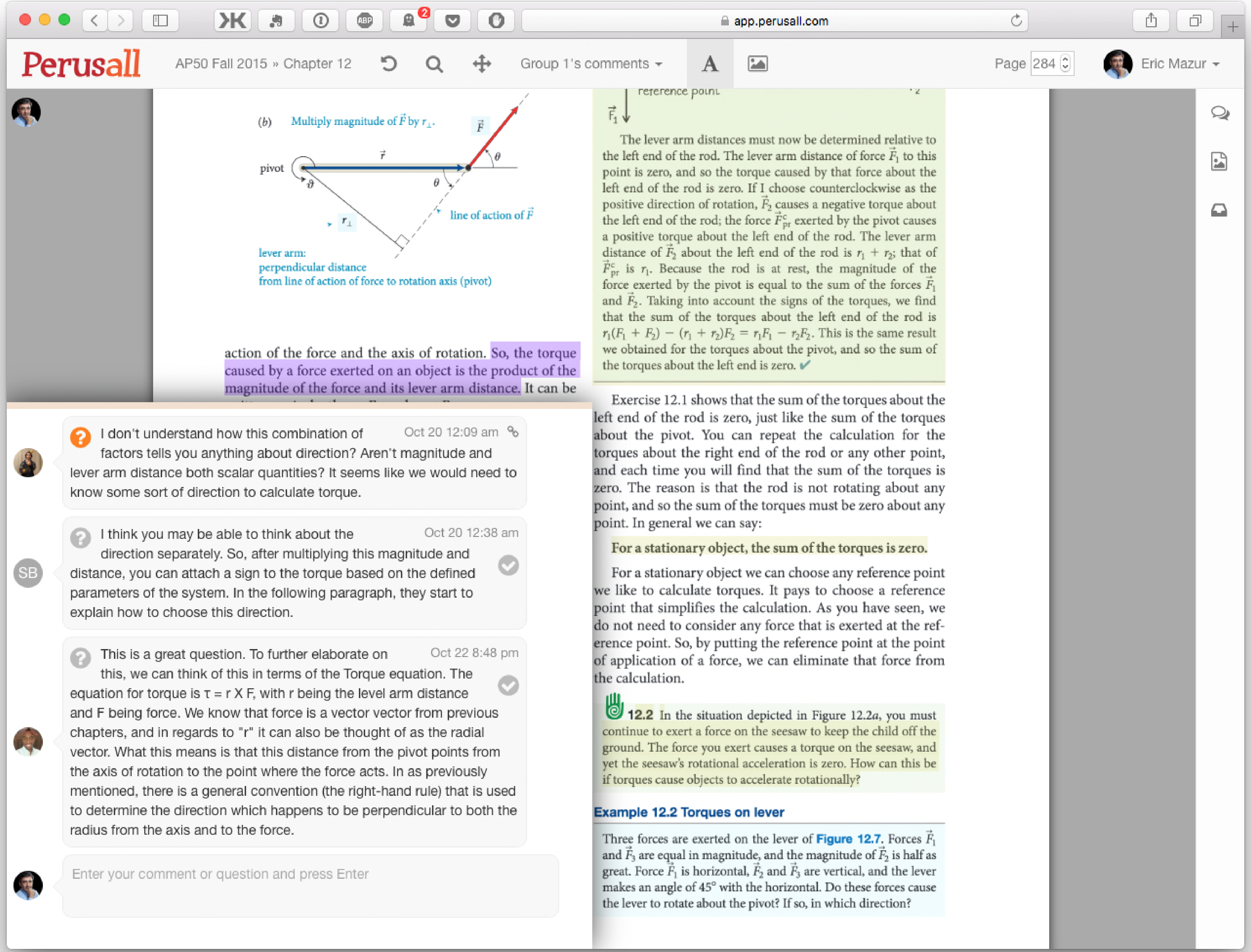

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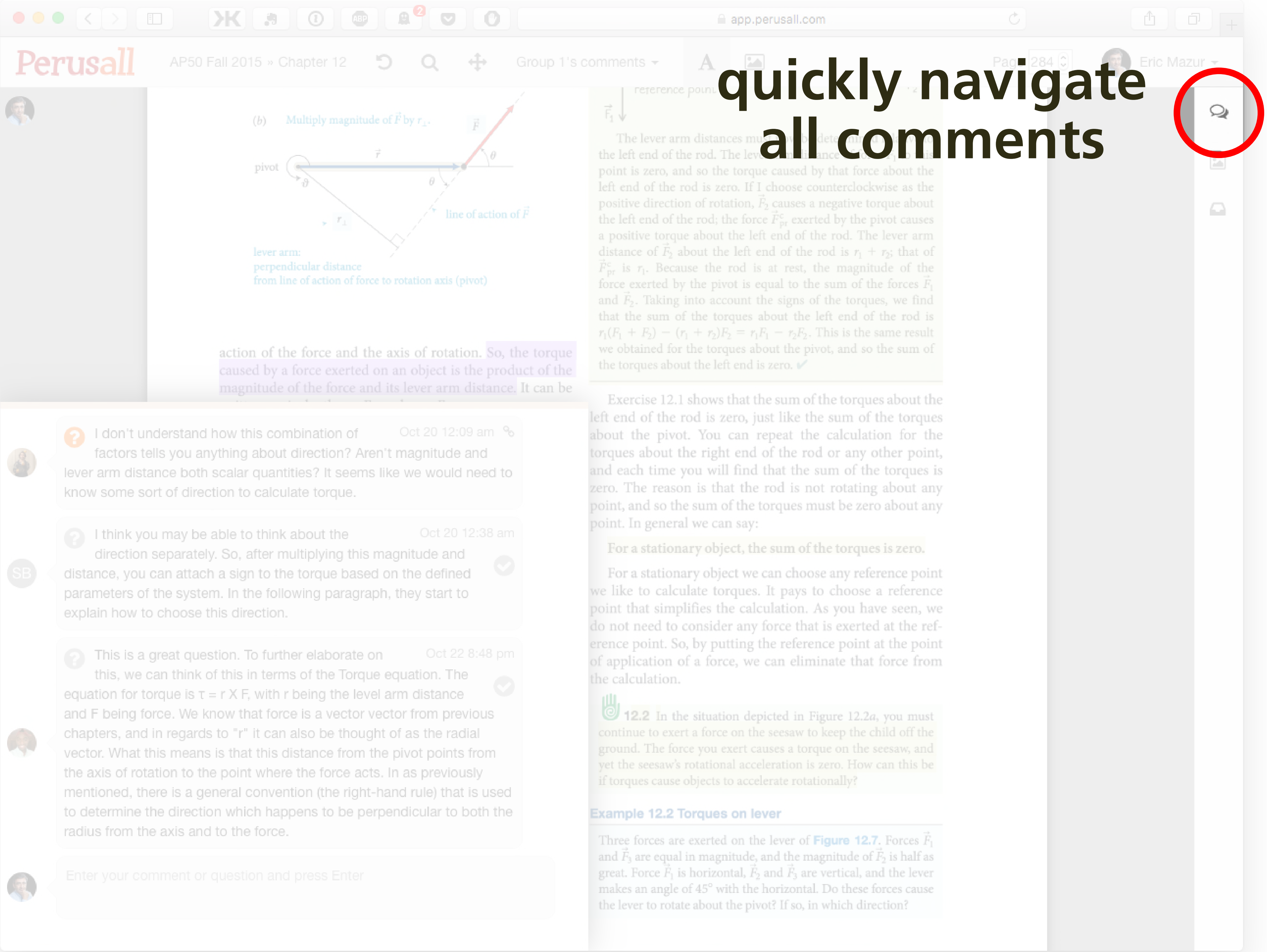

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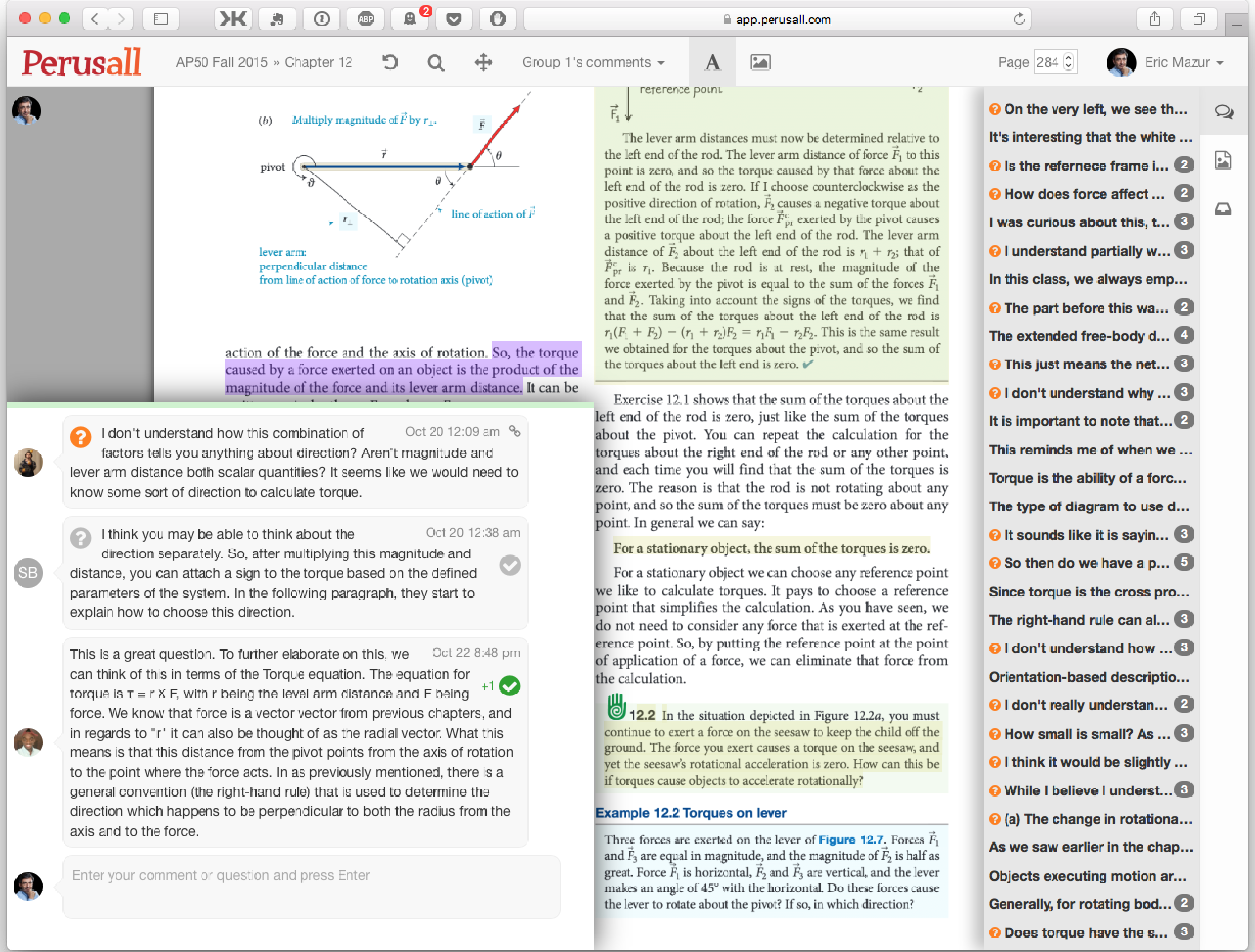

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- ? On the very left, we see th...
- It's interesting that the white ...
- ? Is the refernece frame i... 2
- ? How does force affect ... 2
- I was curious about this, t... 3
- ? I understand partially w... 3
- In this class, we always emp...
- ? The part before this wa... 2
- The extended free-body d... 4
- ? This just means the net... 3
- ? I don't understand why ... 3
- It is important to note that... 2
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- Torque is the ability of a forc...
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- ? So then do we have a p... 5
- Since torque is the cross pro...
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- Orientation-based descriptio...
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- ? (a) The change in rotationa...
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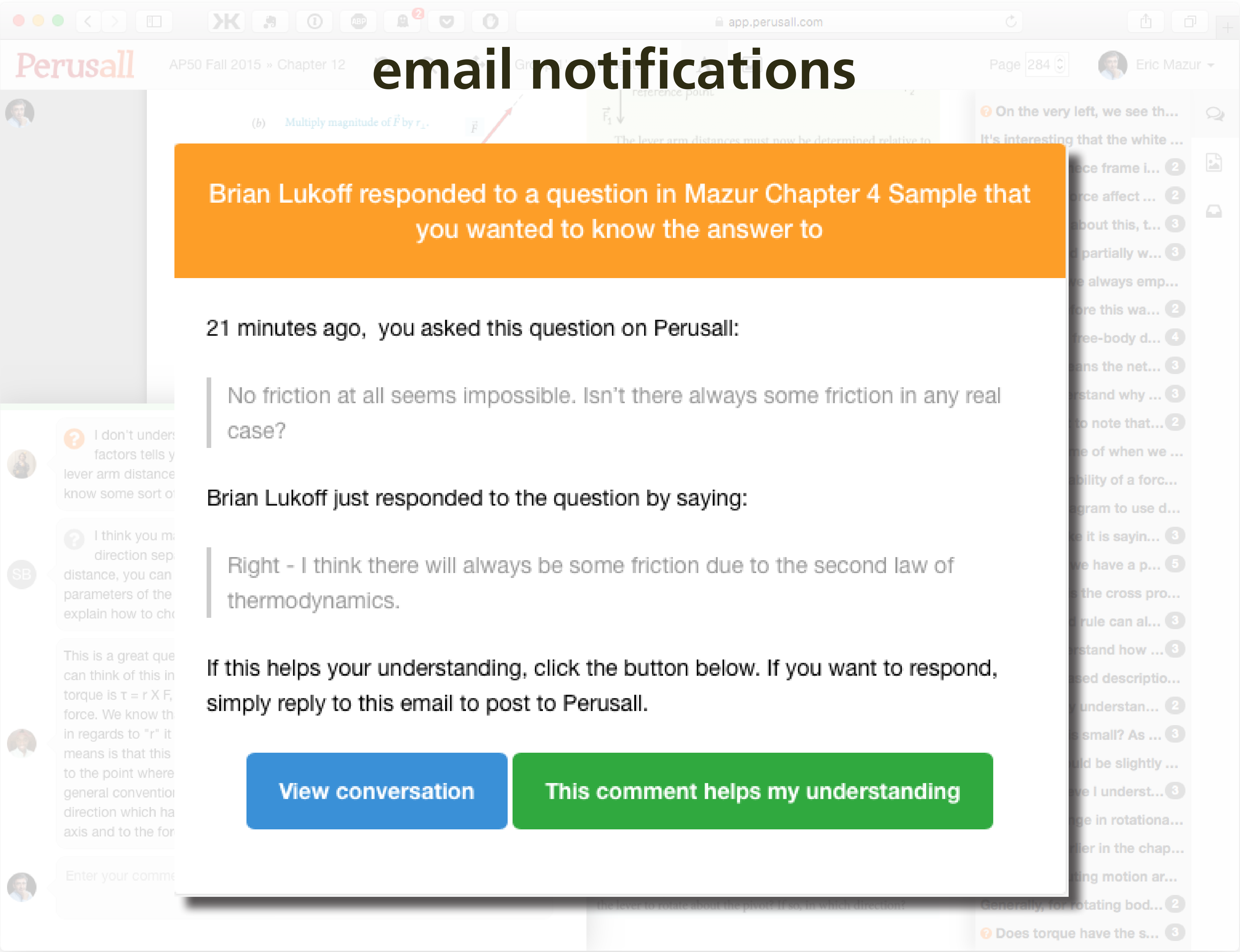

**Brian Lukoff responded to a question in Mazur Chapter 4 Sample that you wanted to know the answer to**

21 minutes ago, you asked this question on Perusall:

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

Brian Lukoff just responded to the question by saying:

> Right - I think there will always be some friction due to the second law of thermodynamics.

If this helps your understanding, click the button below. If you want to respond, simply reply to this email to post to Perusall.

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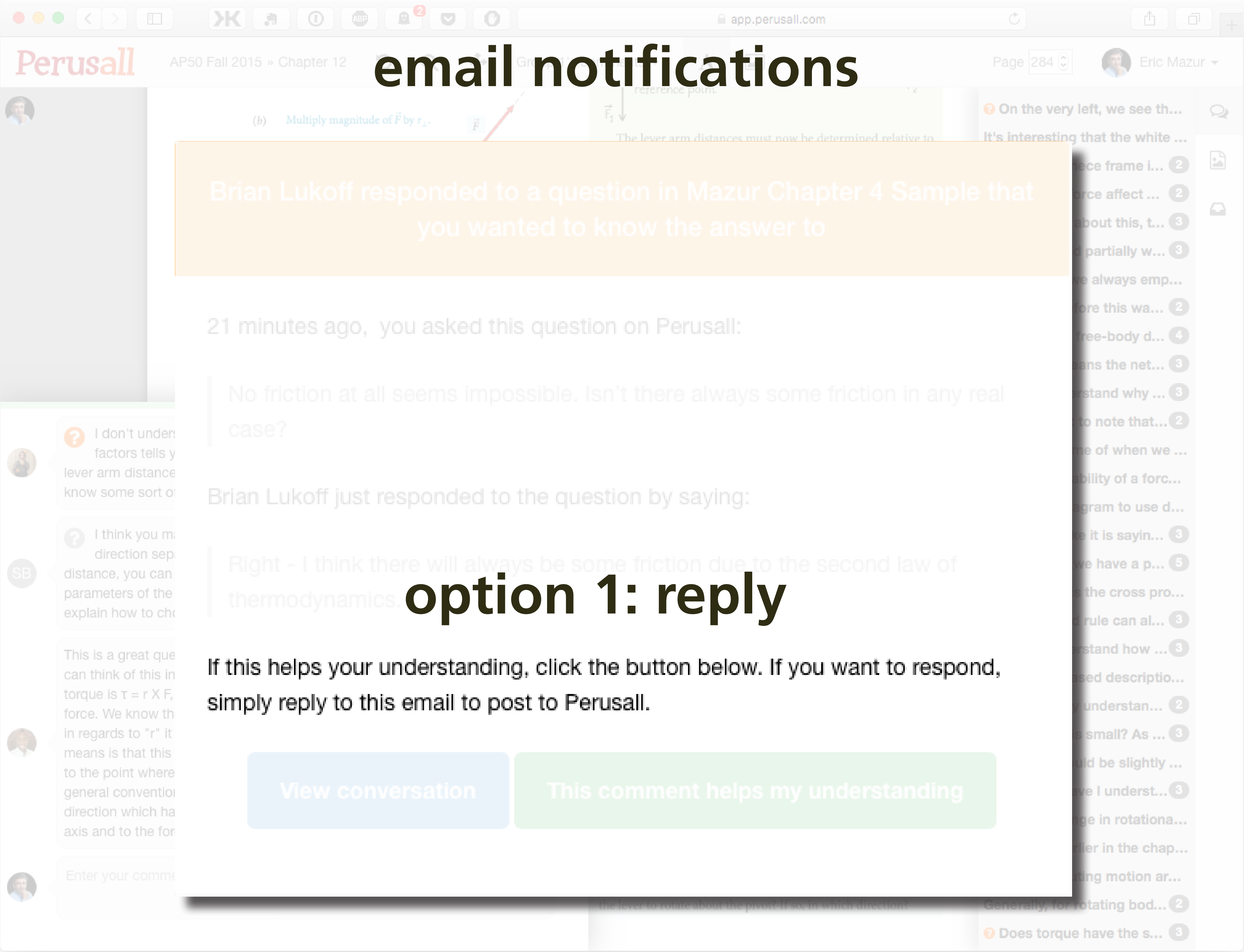

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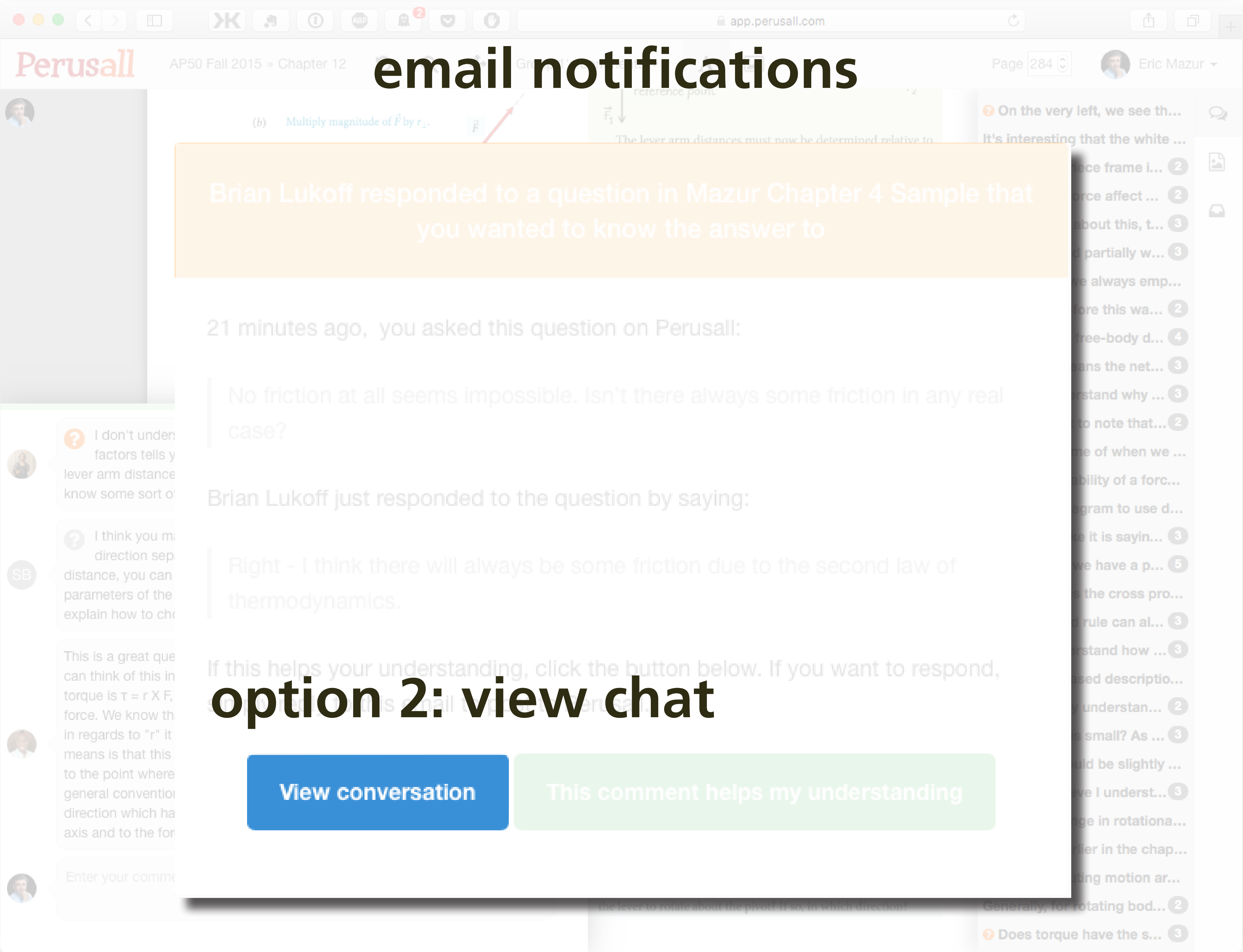

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> No friction at all seems impossible. Isn't there always some friction in any real case?

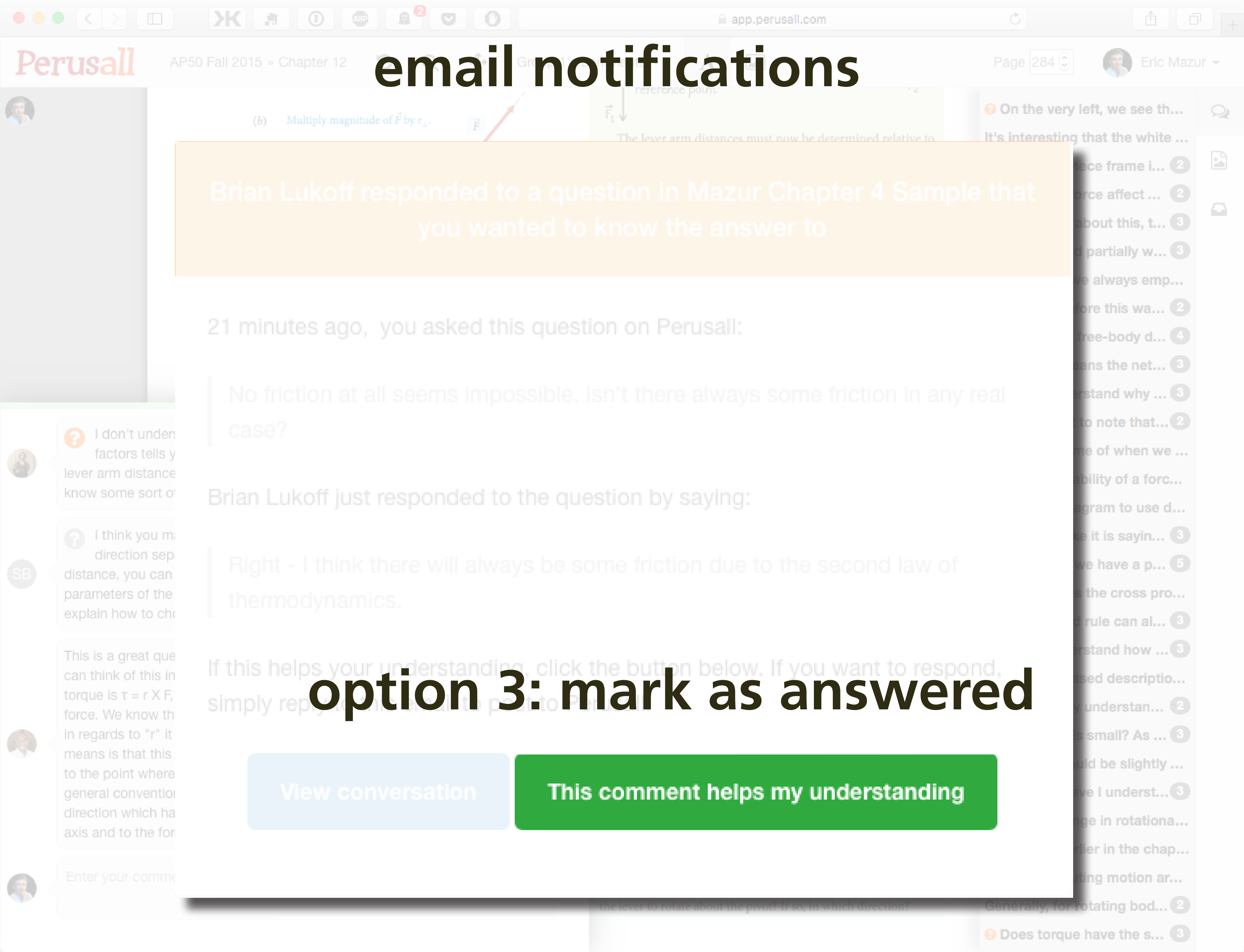
Brian Lukoff just responded to the question by saying:

> Right - I think there will always be some friction due to the second law of thermodynamics.

If this helps your understanding, click the button below. If you want to respond, simply reply to this email to post it to Perusall.

## option 2: view chat

# email notifications



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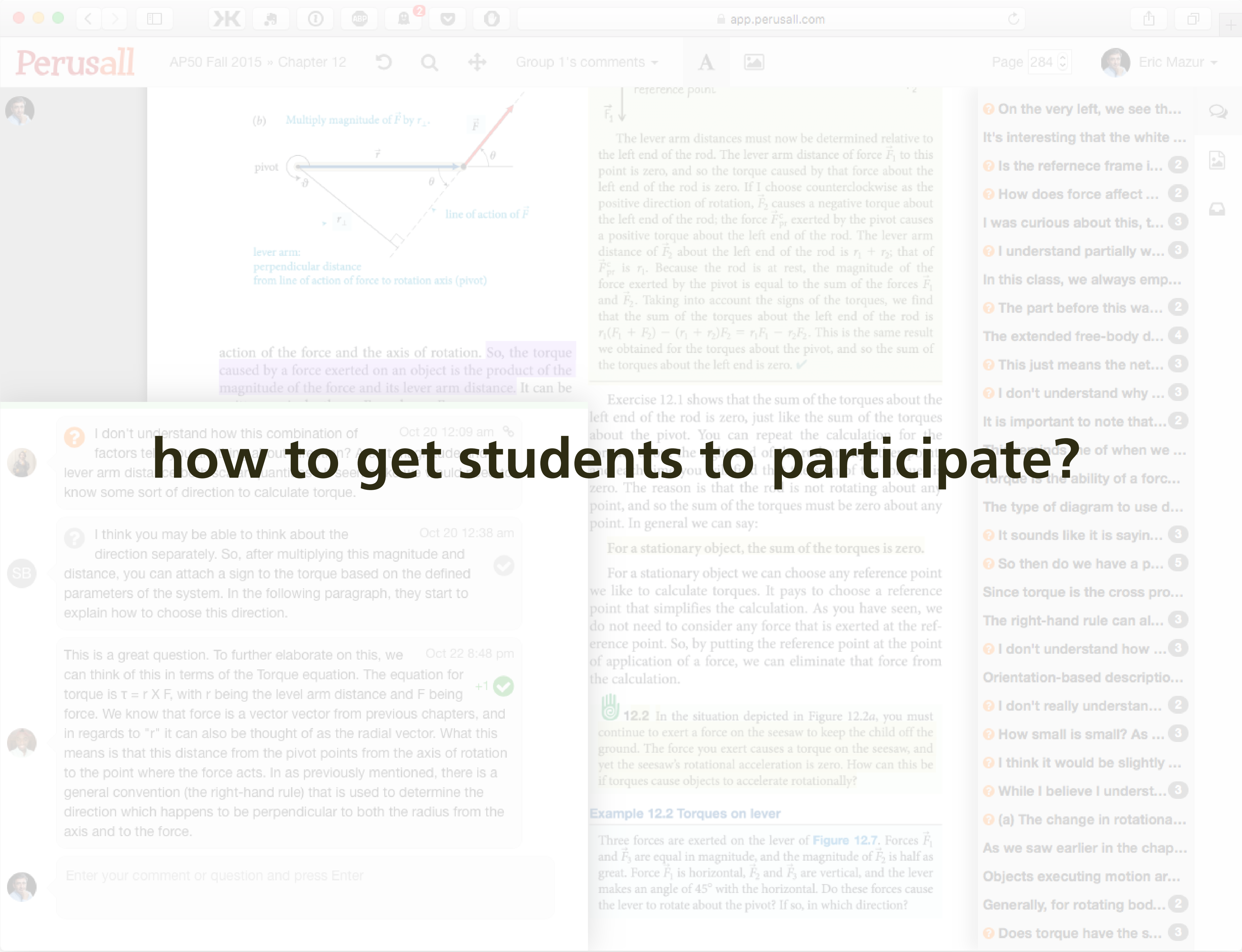
option 3: mark as answered

# how to get students to participate?



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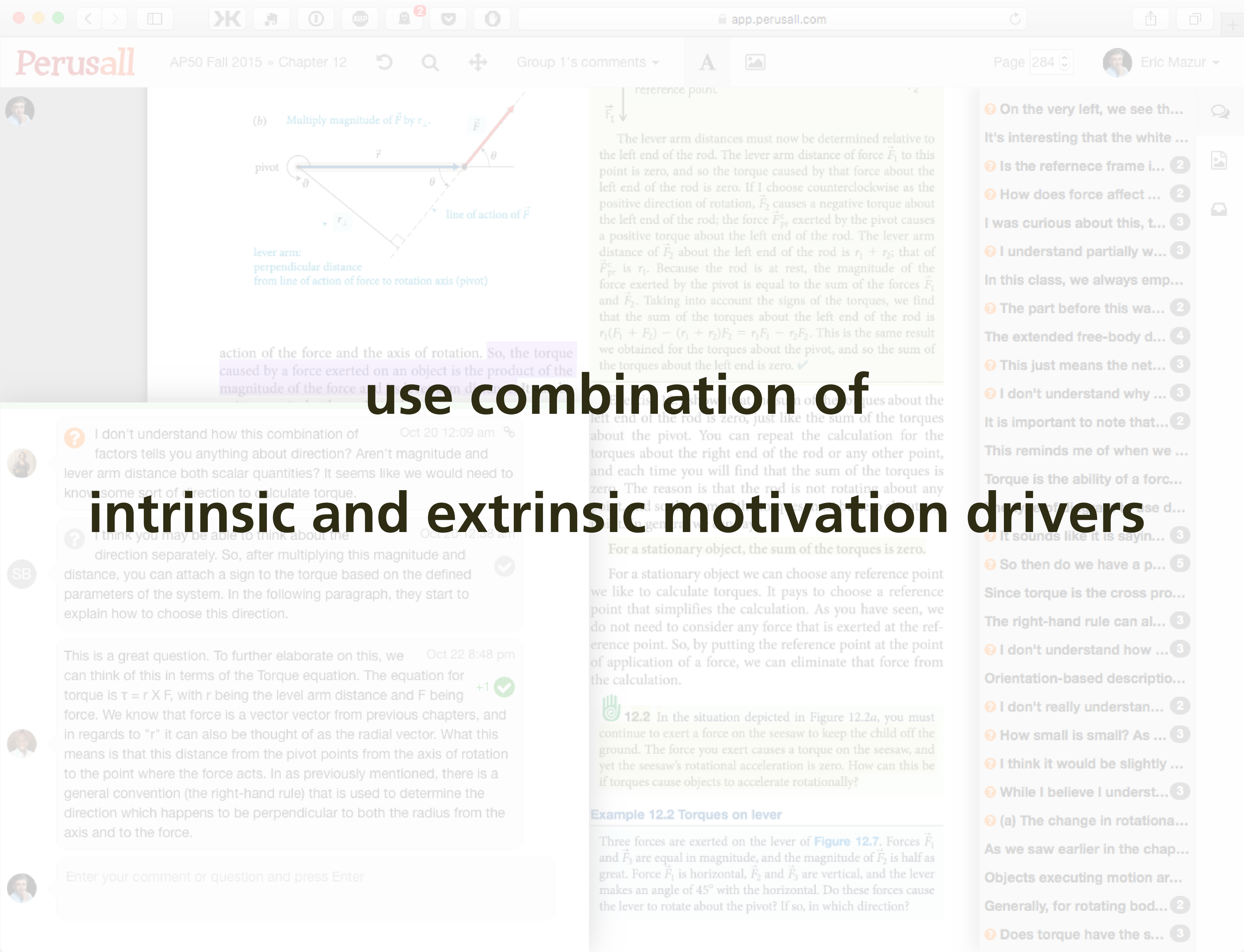

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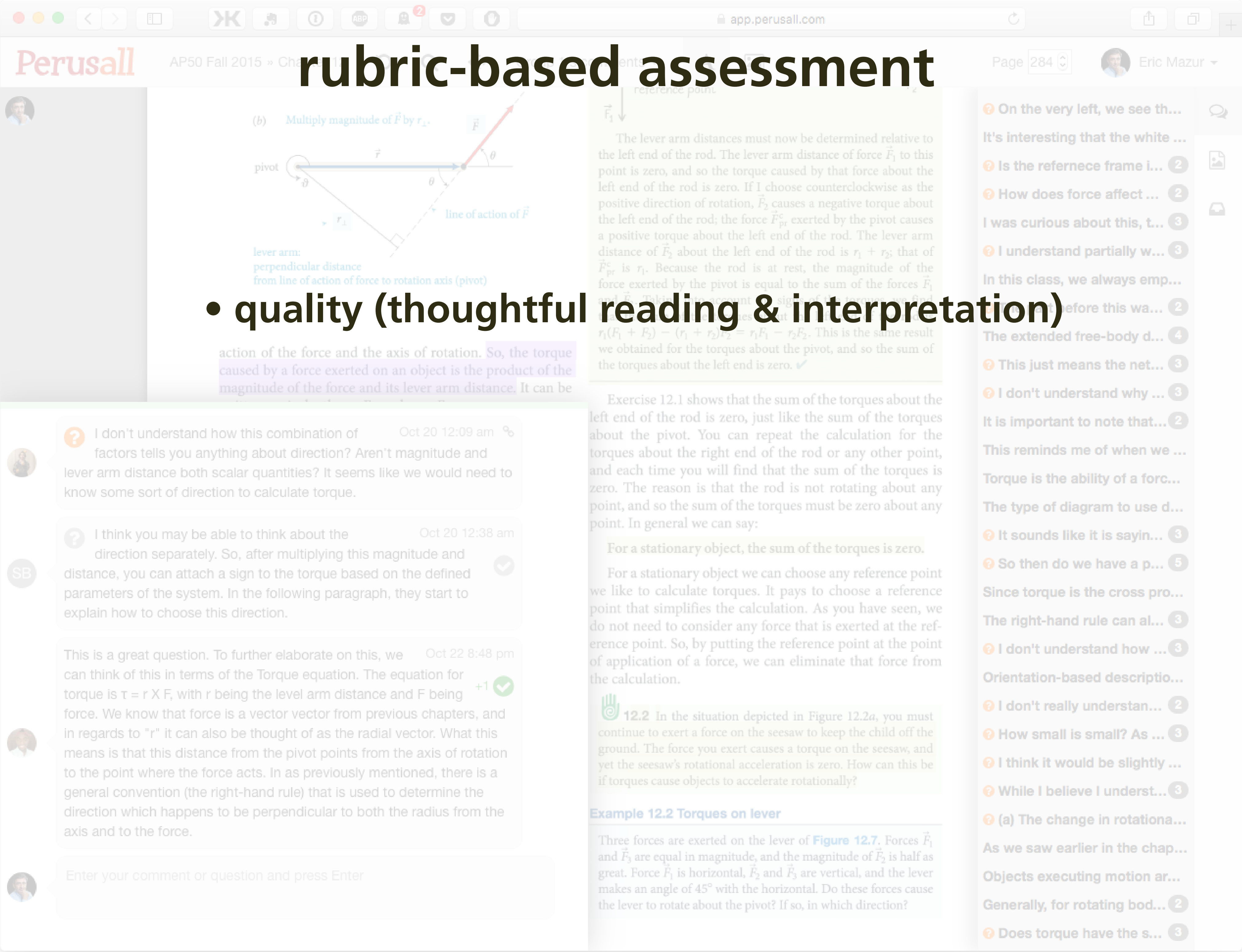
# rubric-based assessment

- quality (thoughtful reading & interpretation)



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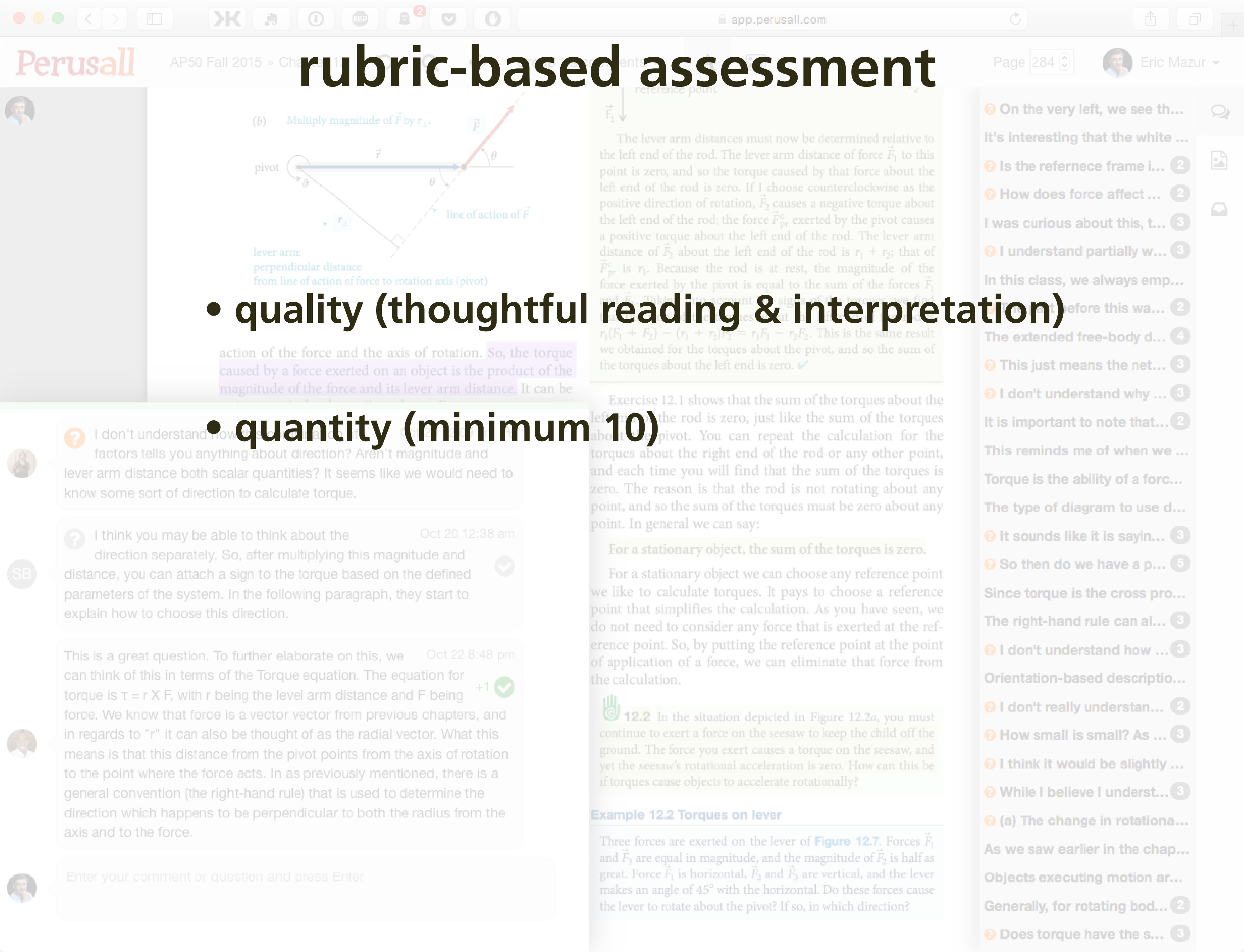

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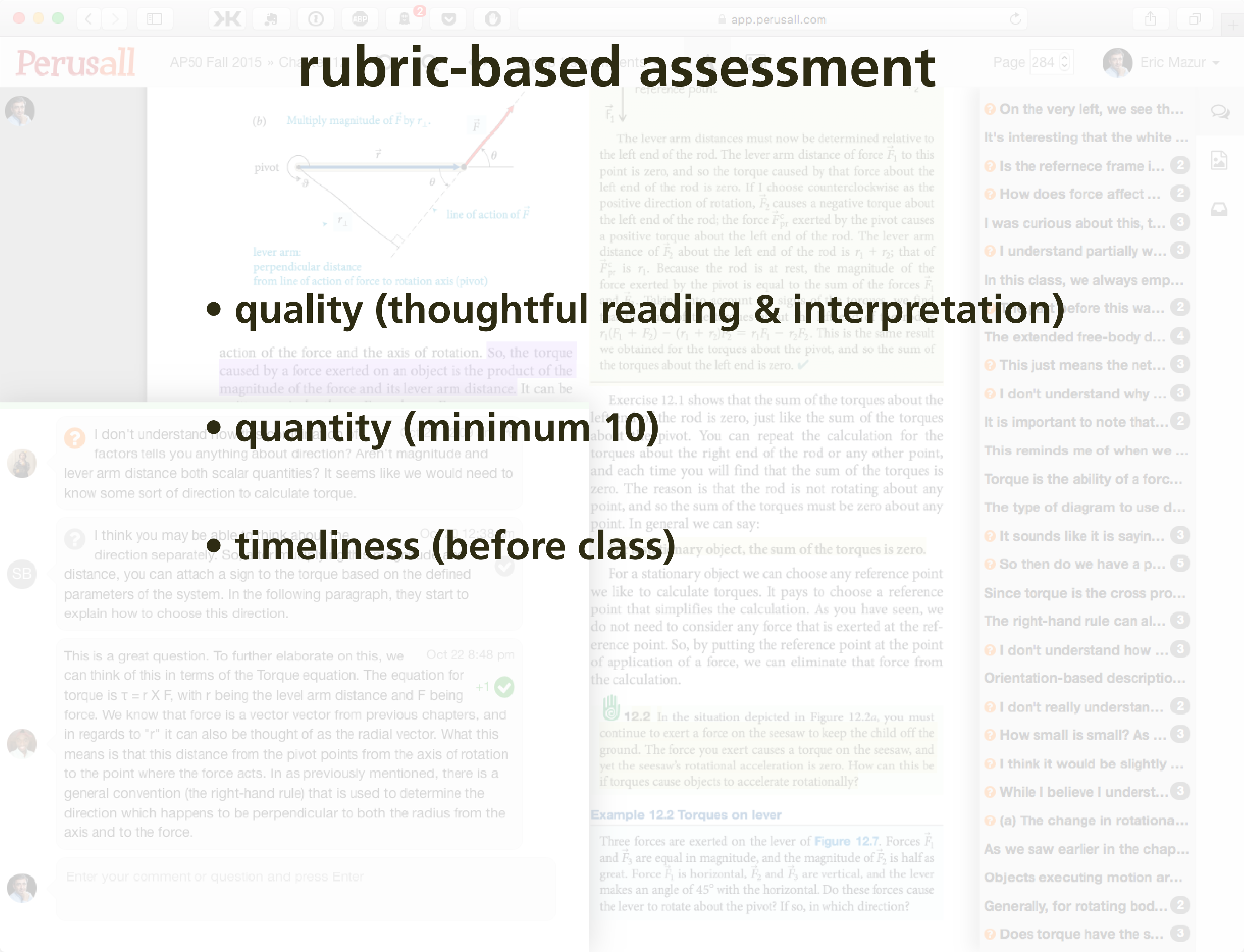
- quantity (minimum 10)
- timeliness (before class)



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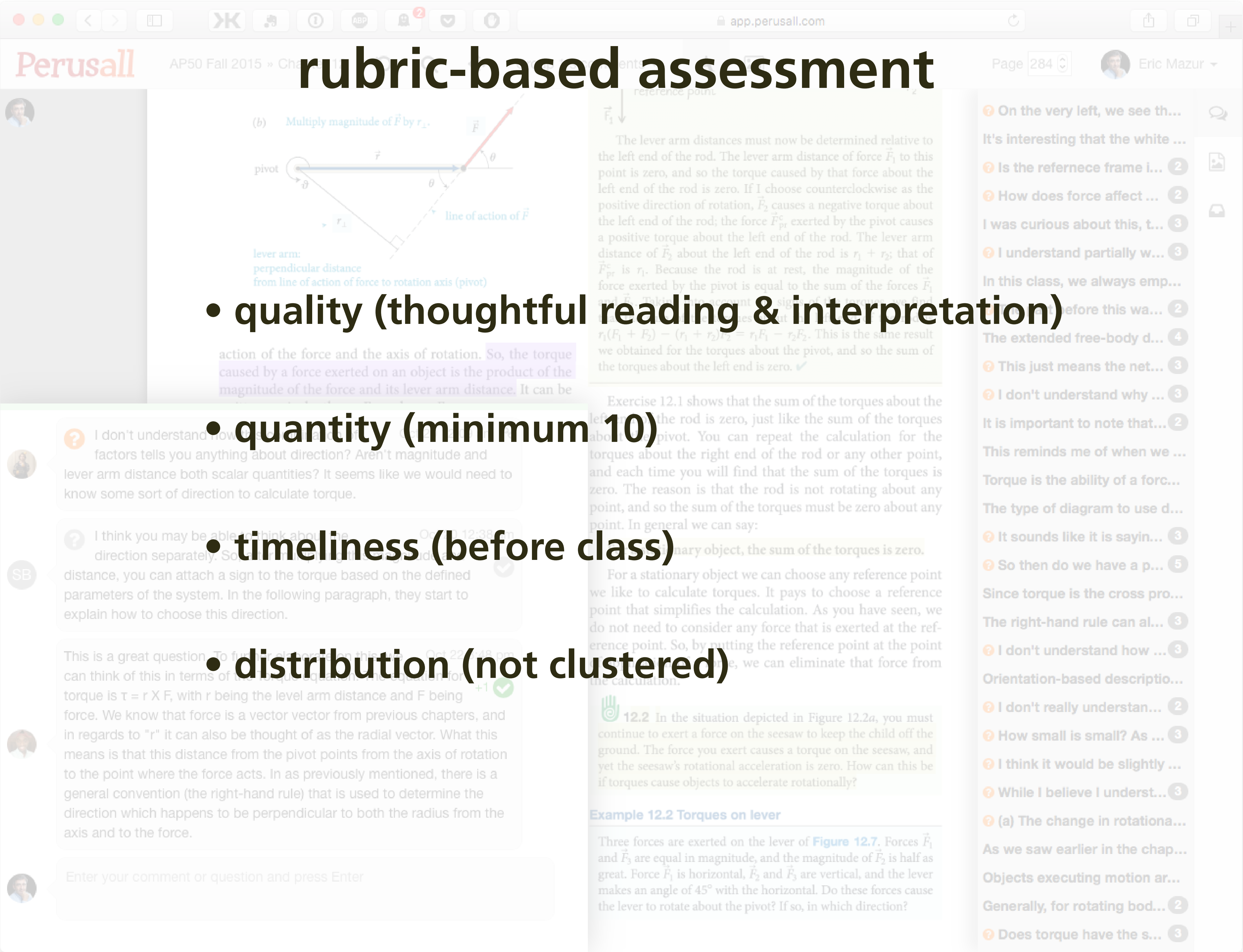

- quality (thoughtful reading & interpretation)
- quantity (minimum 10)
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- distribution (not clustered)

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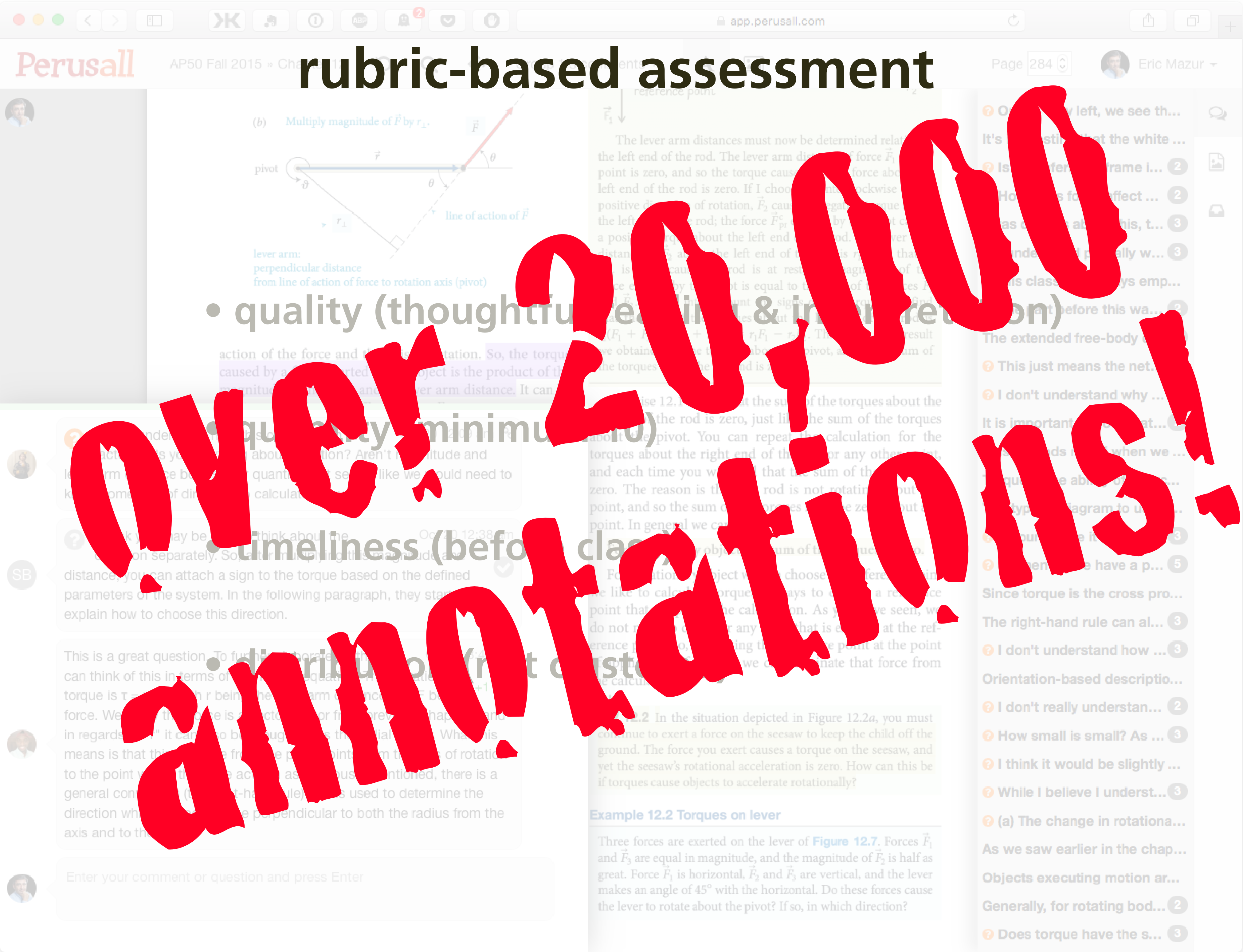

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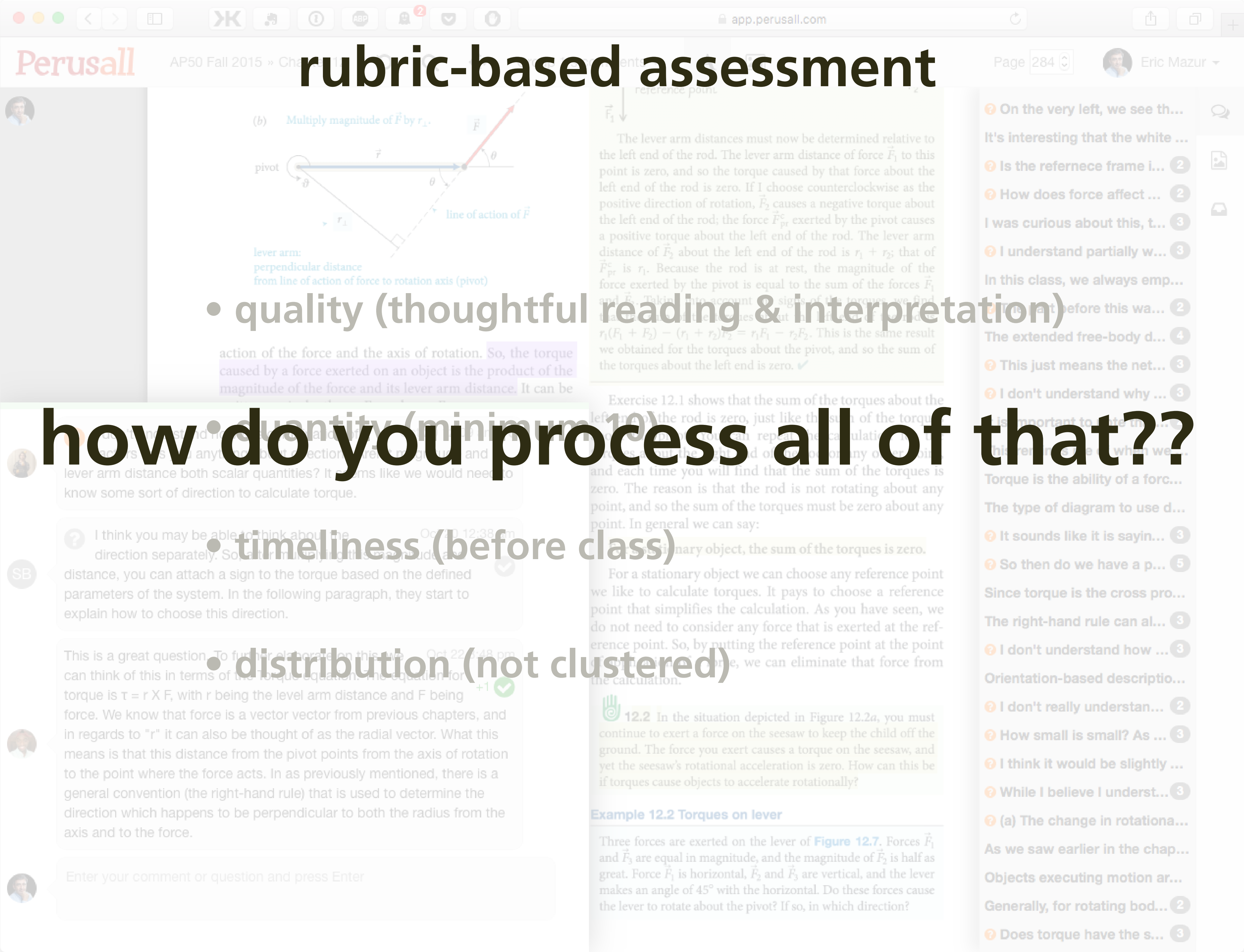

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- quality (thoughtful reading & interpretation)
- quantity (minimum 10)
- timeliness (before class)
- distribution (not clustered)

# how do you process all of that??

# rubric-based assessment

- quality (thoughtful interpretation)
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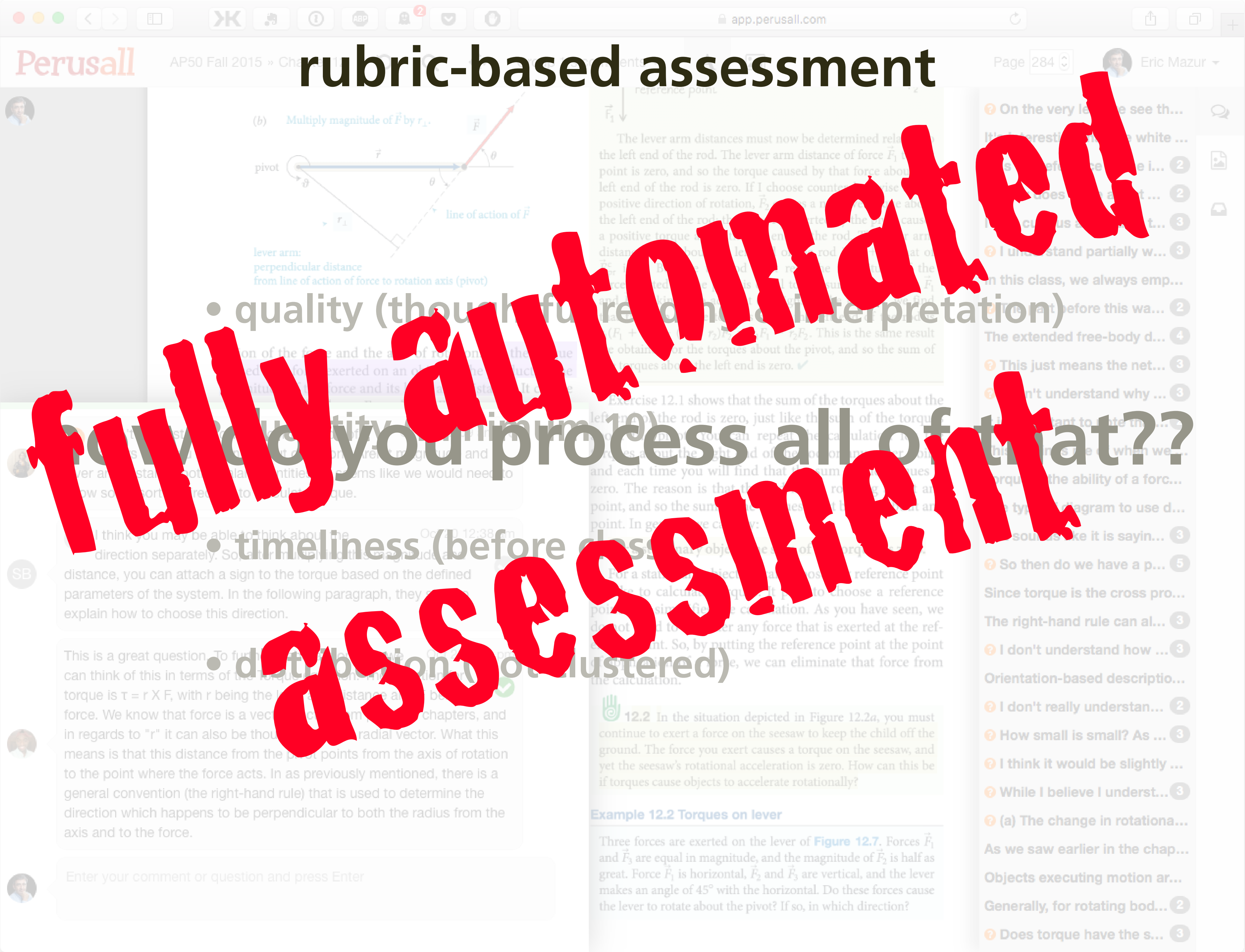
how do you process all of that??

fully automated assessment



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Page 284

Eric Mazur

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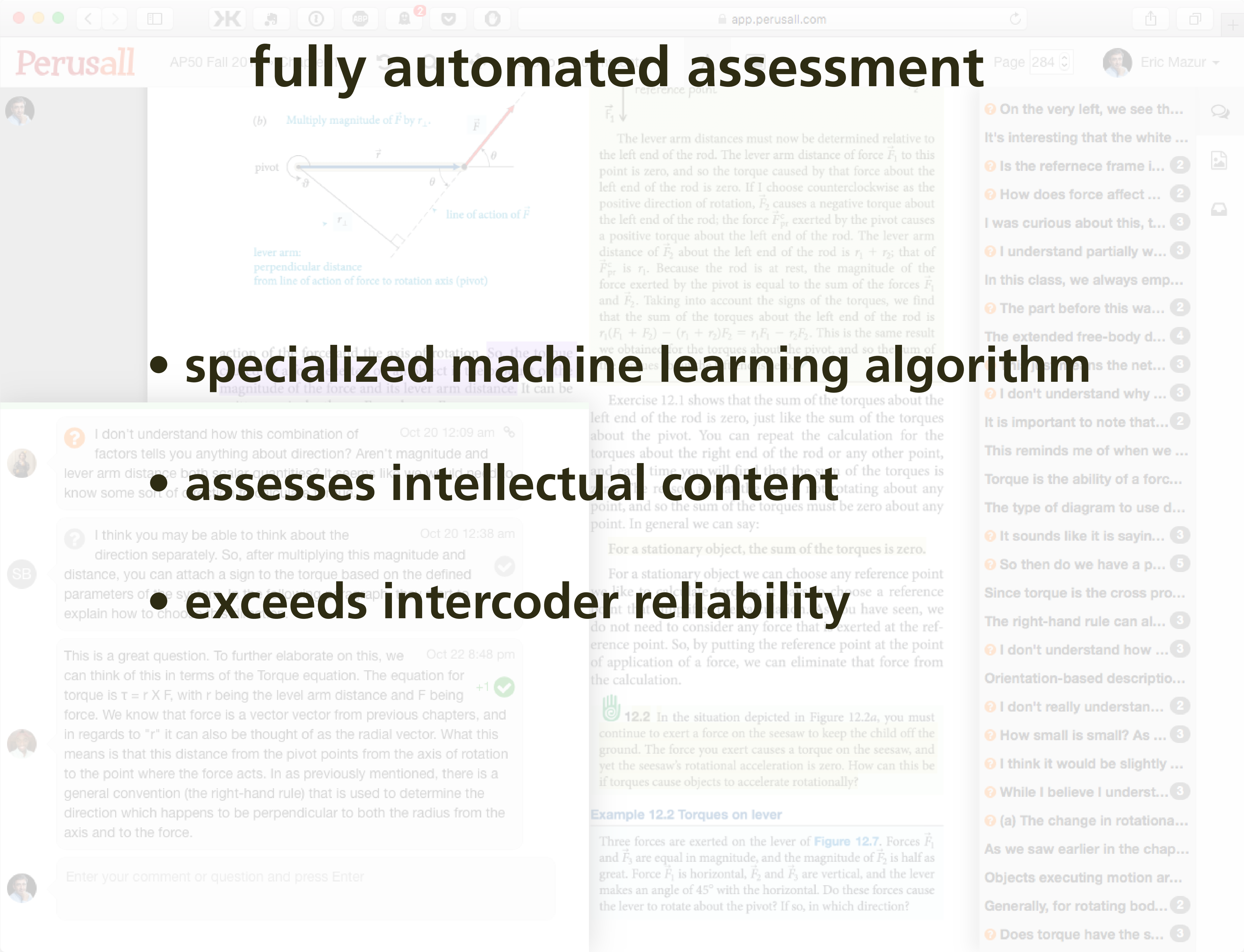
# fully automated assessment

- specialized machine learning algorithm
- assesses intellectual content
- exceeds intercoder reliability



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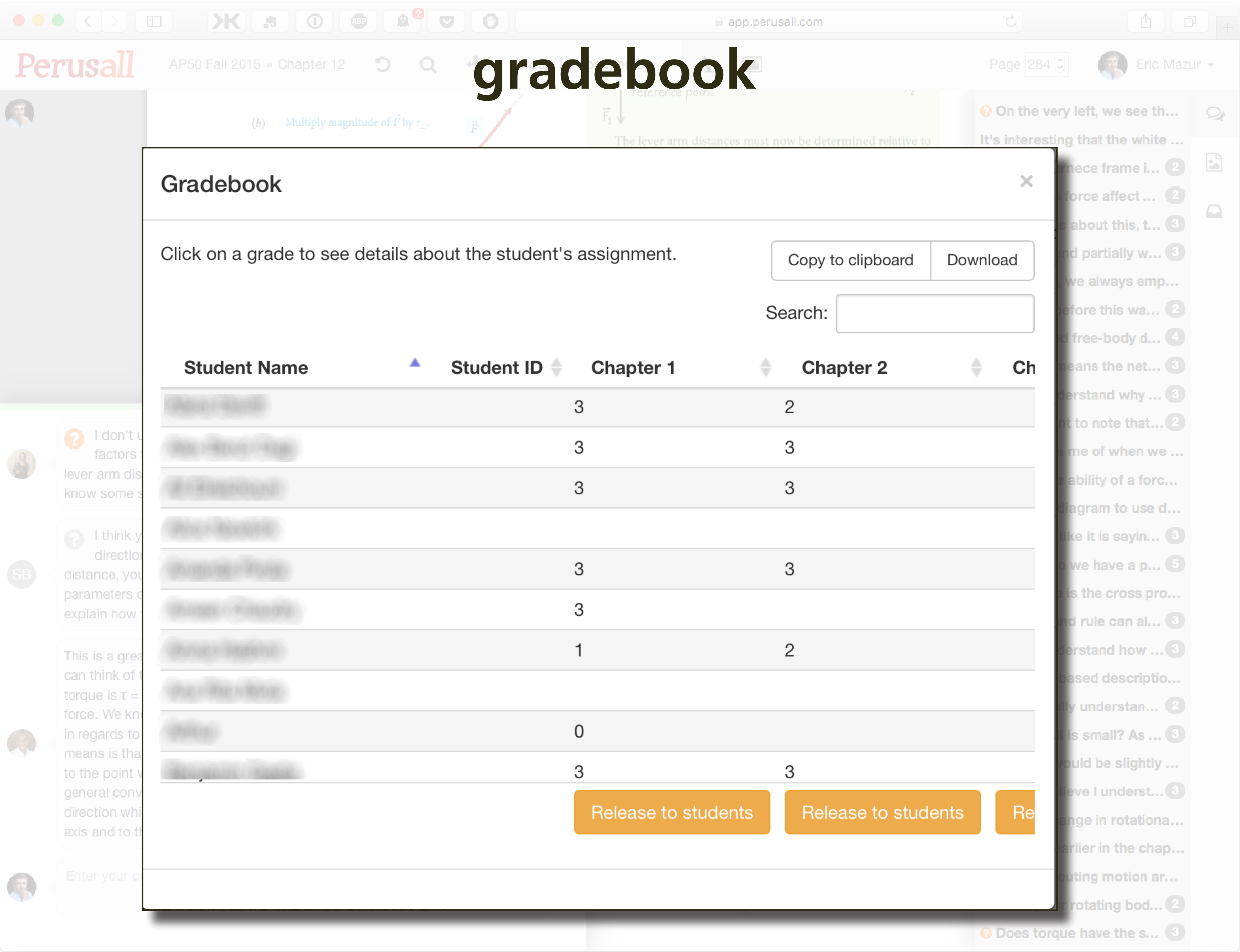
# gradebook



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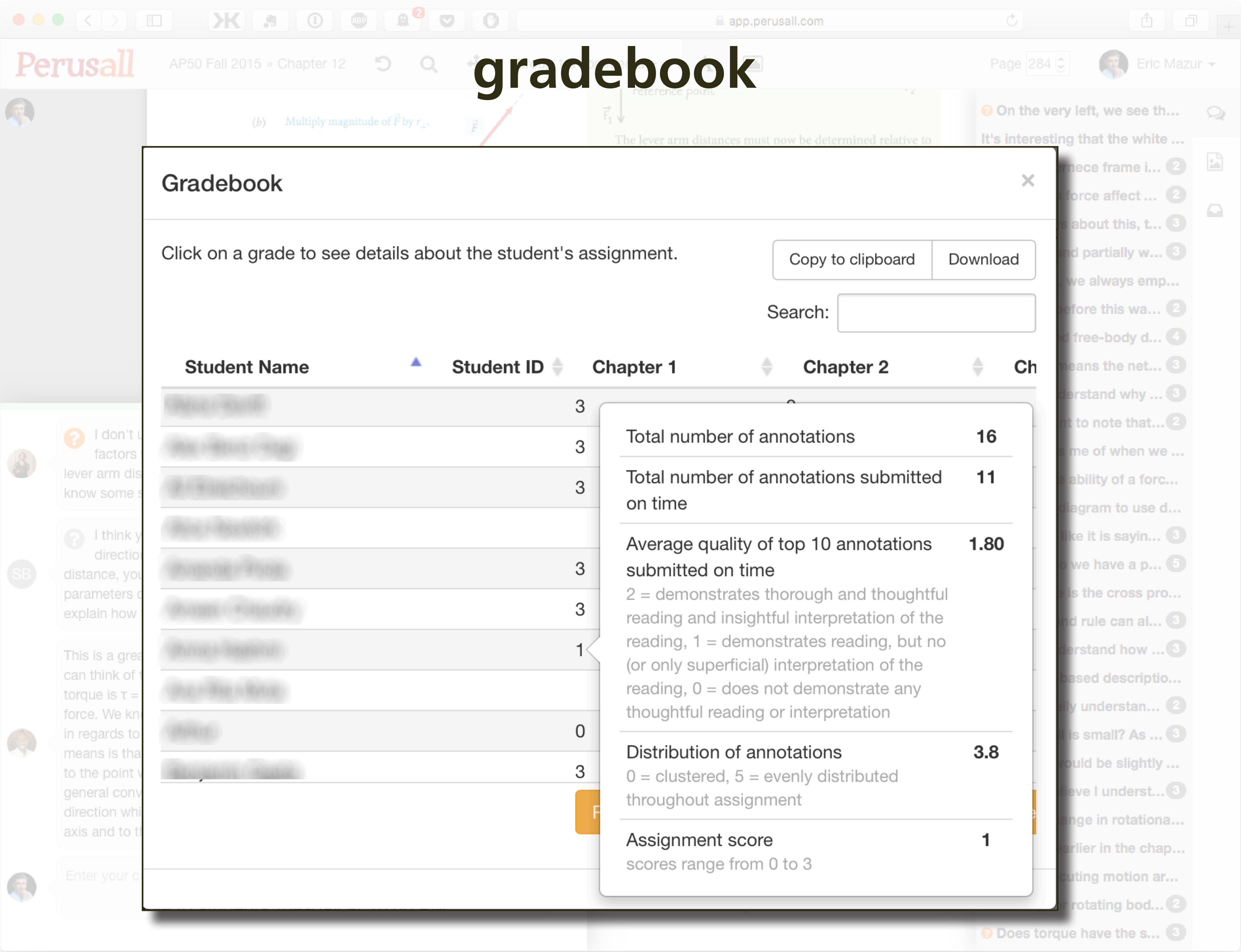

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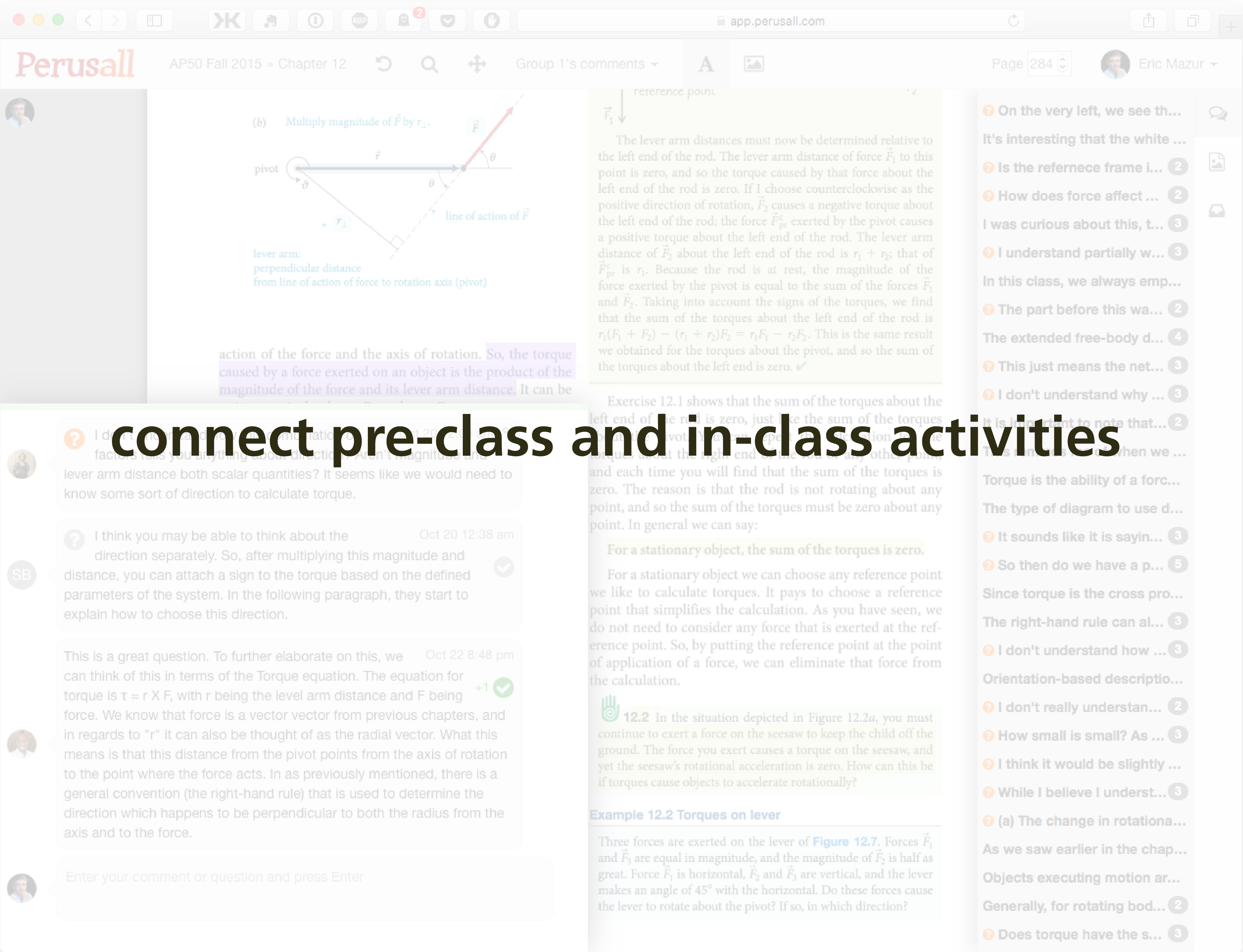
| Total number of annotations | 16 |
| Total number of annotations submitted on time | 11 |
| Average quality of top 10 annotations submitted on time<br>2 = demonstrates thorough and thoughtful reading and insightful interpretation of the reading, 1 = demonstrates reading, but no (or only superficial) interpretation of the reading, 0 = does not demonstrate any thoughtful reading or interpretation | 1.80 |
| Distribution of annotations<br>0 = clustered, 5 = evenly distributed throughout assignment | 3.8 |
| Assignment score<br>scores range from 0 to 3 | 1 |

# connect pre-class and in-class activities



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Oct 22 8:48 pm

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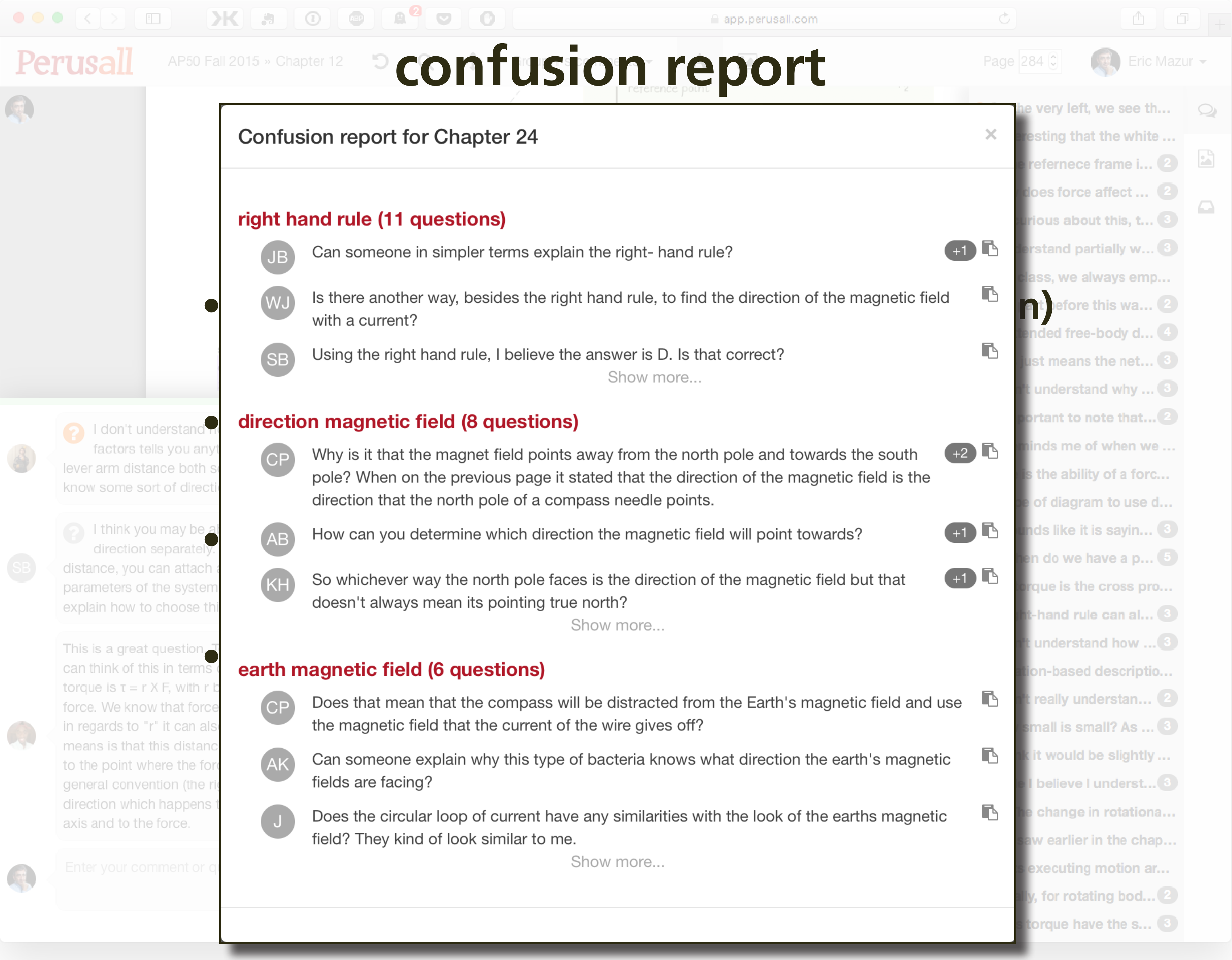
# confusion report



## Confusion report for Chapter 24

### right hand rule (11 questions)

- JB: Can someone in simpler terms explain the right- hand rule? +1
- WJ: Is there another way, besides the right hand rule, to find the direction of the magnetic field with a current?
- SB: Using the right hand rule, I believe the answer is D. Is that correct?

Show more...

### direction magnetic field (8 questions)

- CP: Why is it that the magnet field points away from the north pole and towards the south pole? When on the previous page it stated that the direction of the magnetic field is the direction that the north pole of a compass needle points. +2
- AB: How can you determine which direction the magnetic field will point towards? +1
- KH: So whichever way the north pole faces is the direction of the magnetic field but that doesn't always mean its pointing true north? +1

Show more...

### earth magnetic field (6 questions)

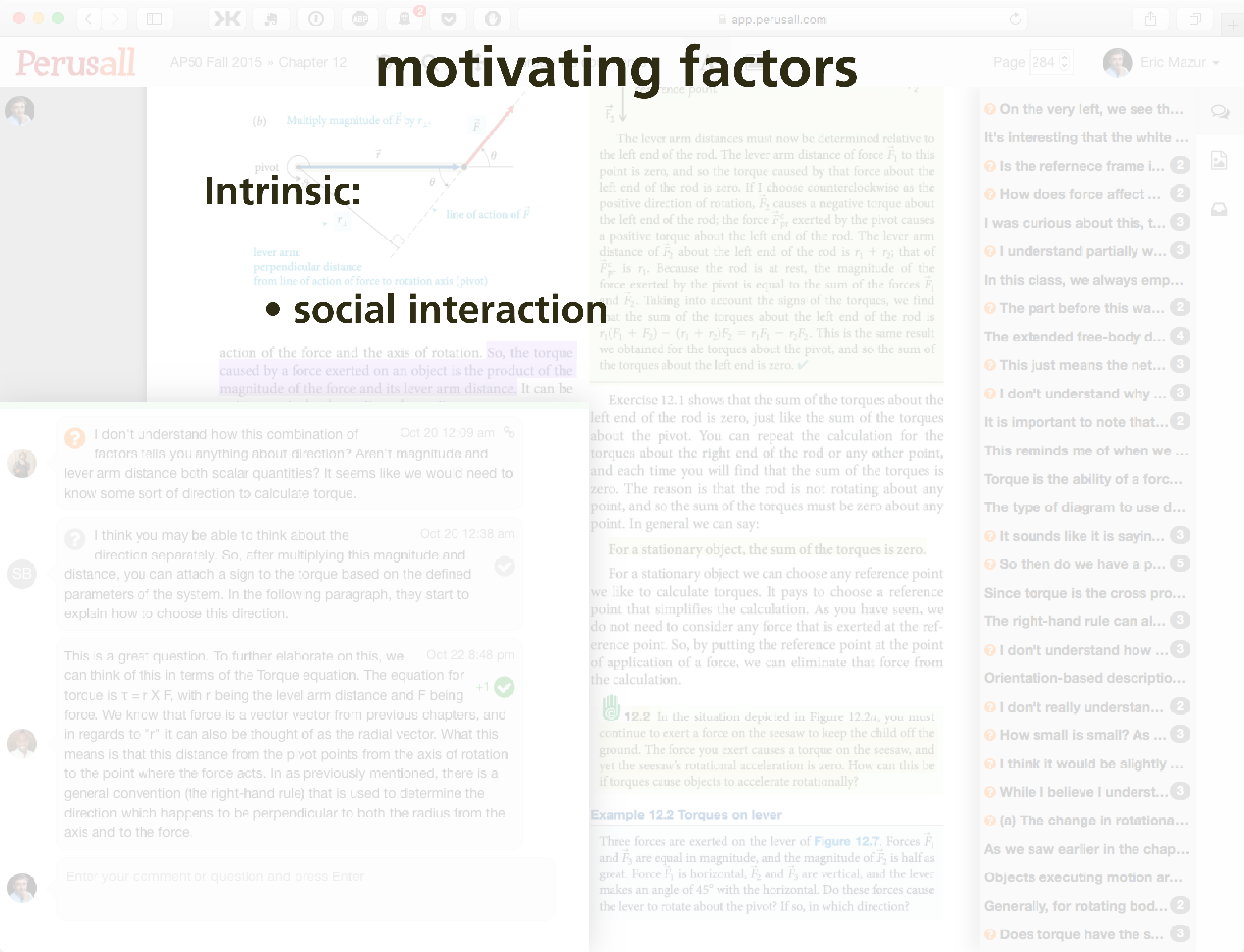
- CP: Does that mean that the compass will be distracted from the Earth's magnetic field and use the magnetic field that the current of the wire gives off?
- AK: Can someone explain why this type of bacteria knows what direction the earth's magnetic fields are facing?
- J: Does the circular loop of current have any similarities with the look of the earths magnetic field? They kind of look similar to me.

Show more...

# motivating factors

**Intrinsic:**

- social interaction



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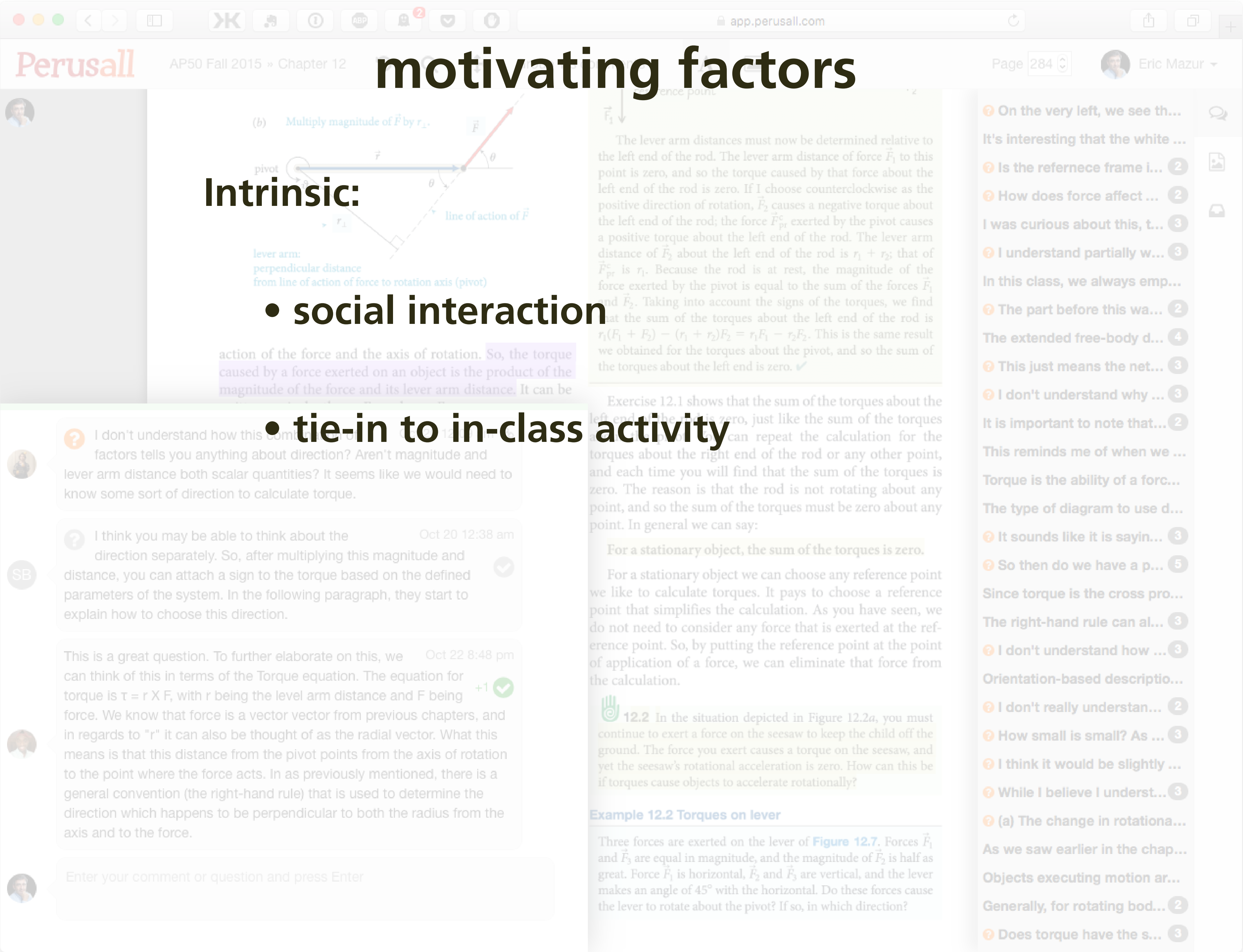
# motivating factors

Intrinsic:

- social interaction
- tie-in to in-class activity



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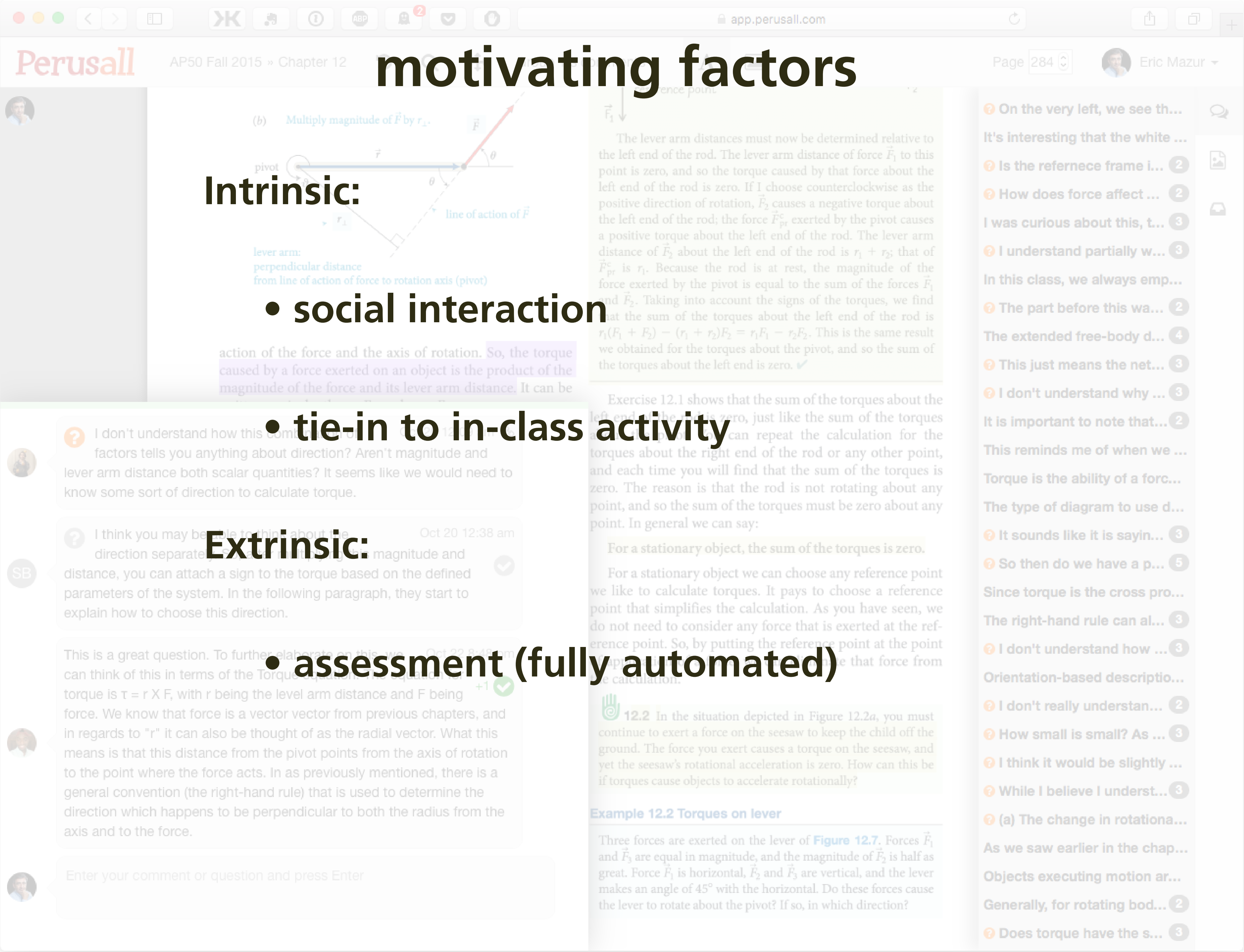
# motivating factors

**Intrinsic:**

- social interaction
- tie-in to in-class activity

**Extrinsic:**

- assessment (fully automated)



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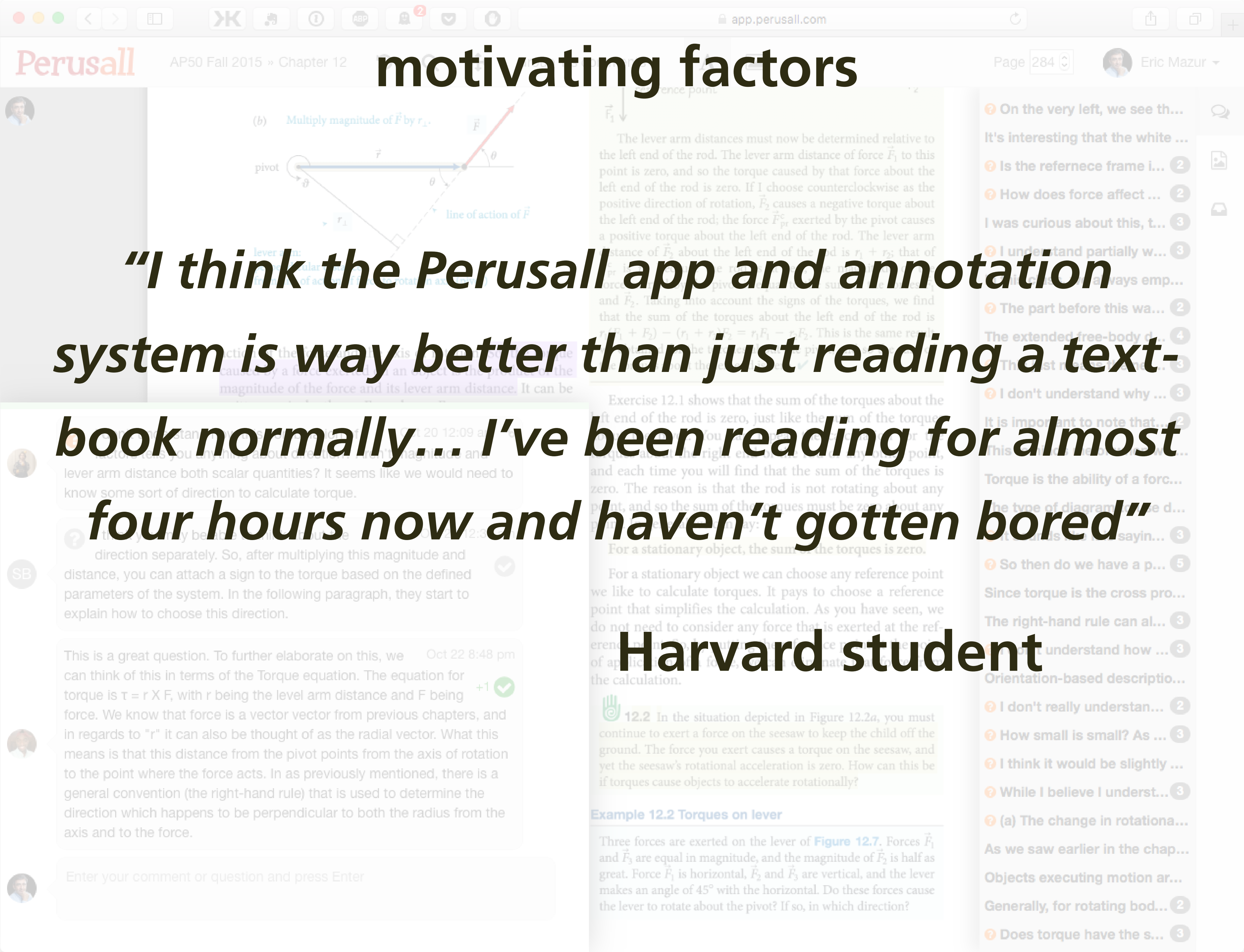
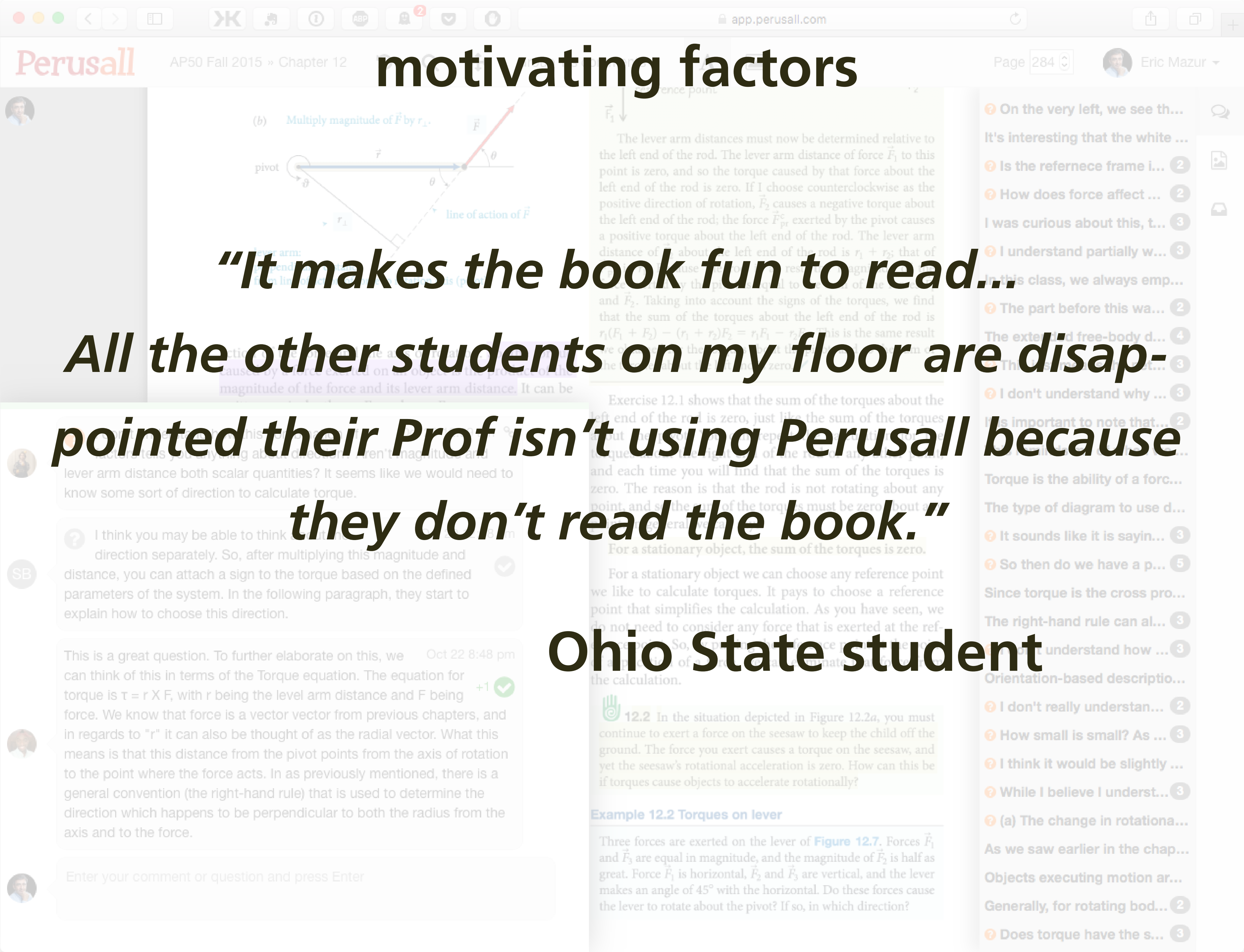


# motivating factors

*"I think the Perusall app and annotation system is way better than just reading a text-book normally… I've been reading for almost four hours now and haven't gotten bored"*

**Harvard student**

# motivating factors

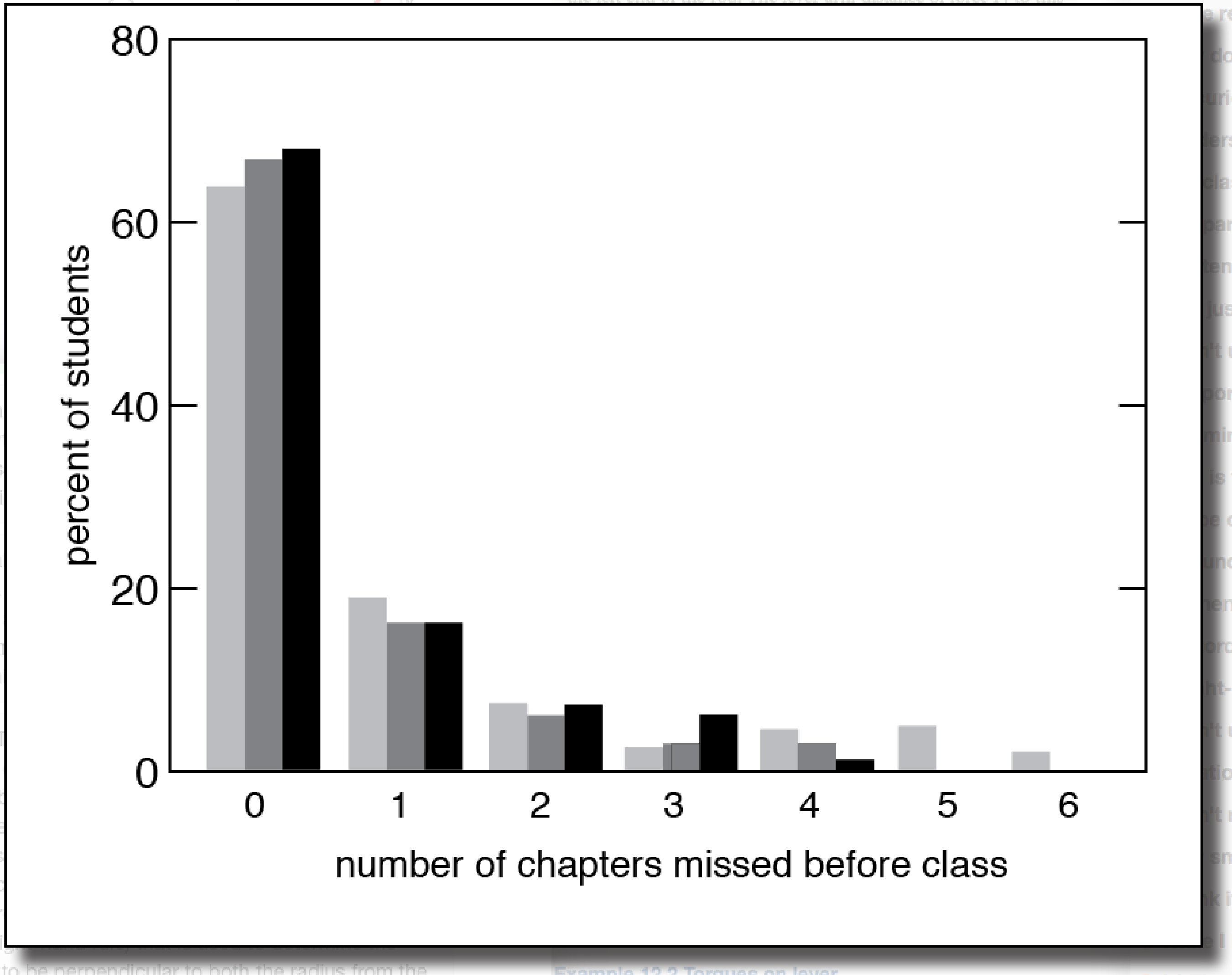


*"It makes the book fun to read...*

*All the other students on my floor are disappointed their Prof isn't using Perusall because they don't read the book."*

Ohio State student

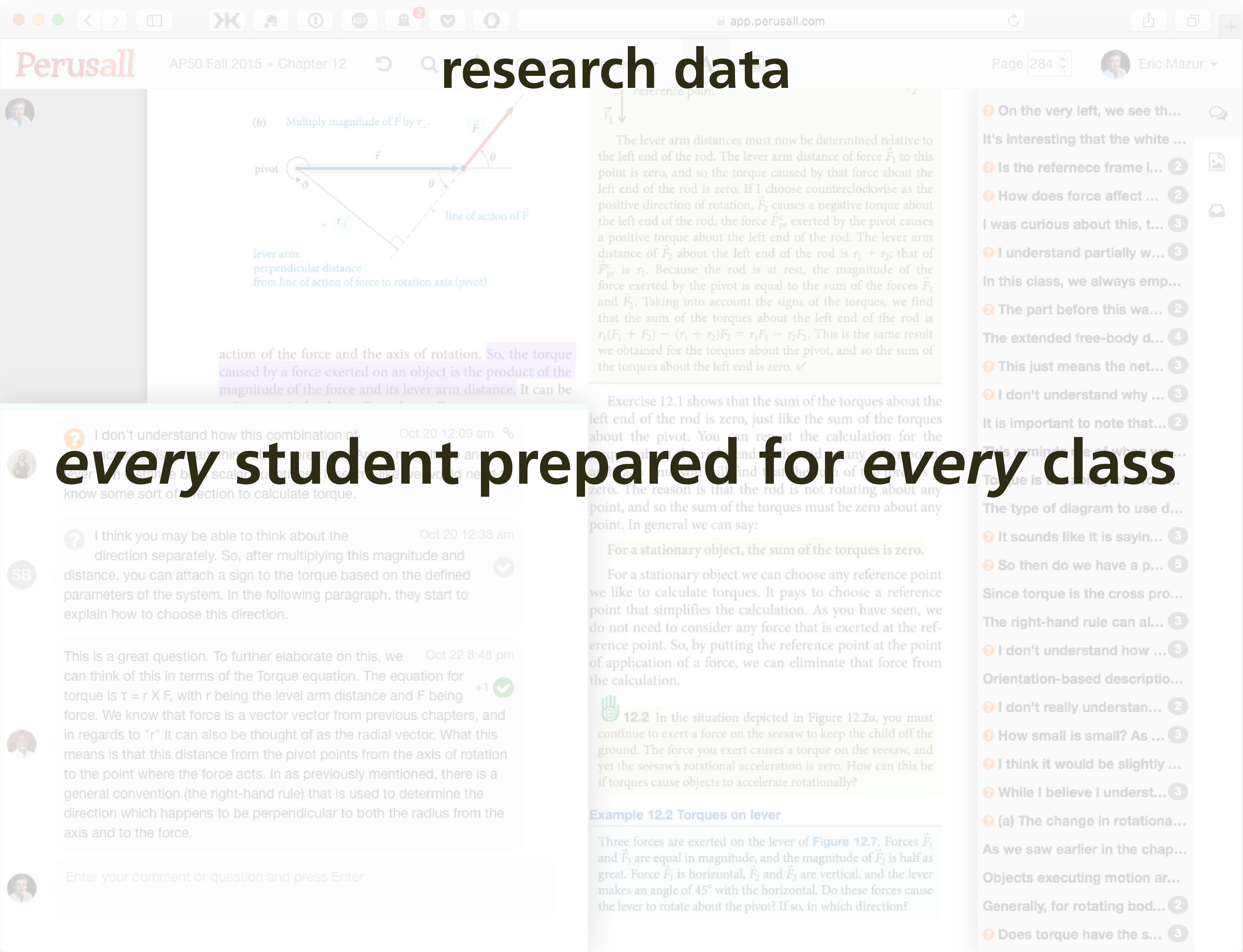
# research data



# research data

close to 95%!

# research data



## *every* student prepared for *every* class

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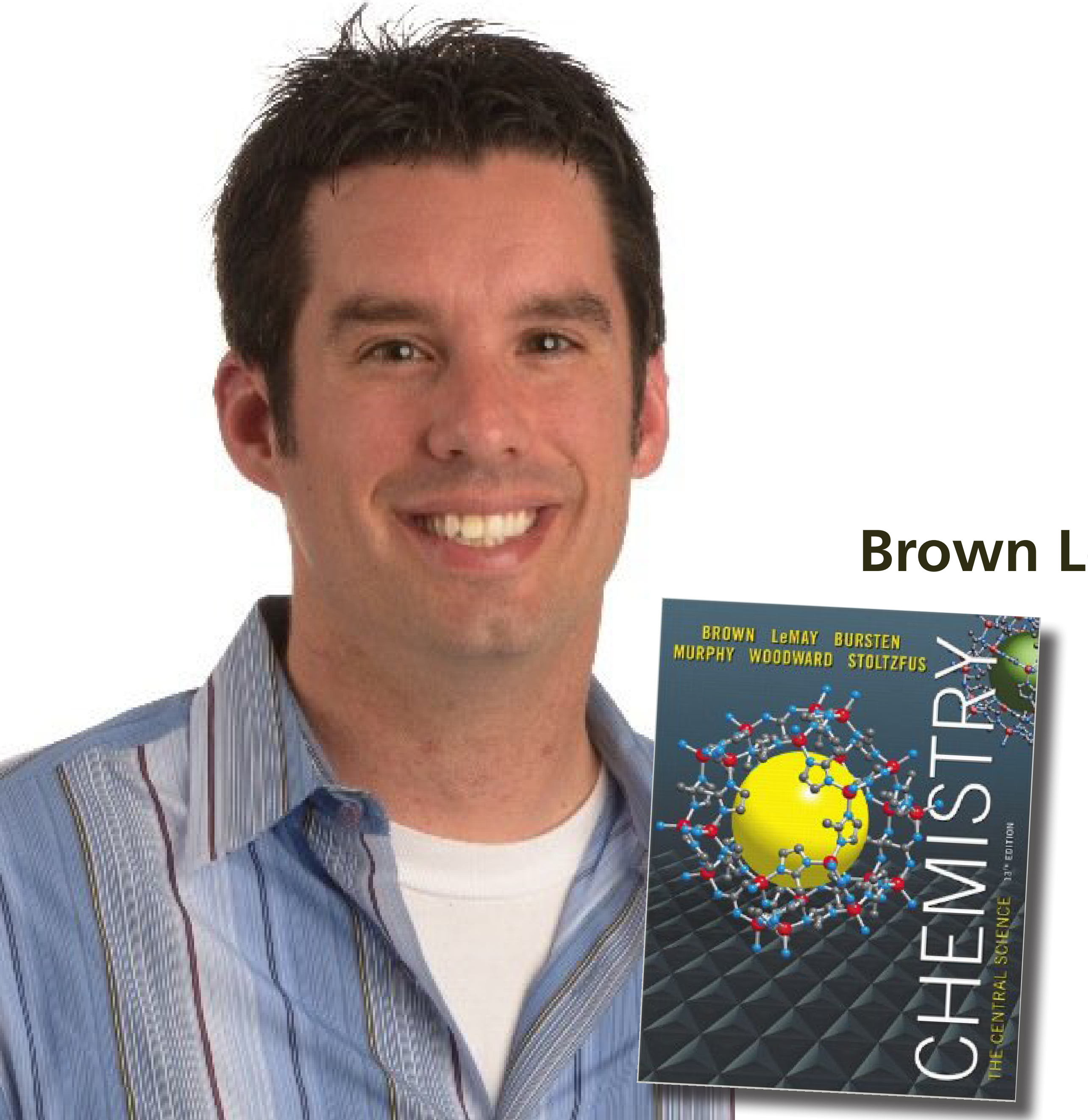


**Matt Stoltzfus**

**Ohio State University**

**525 students**

**Brown Lemay 13th ed (Pearson)**

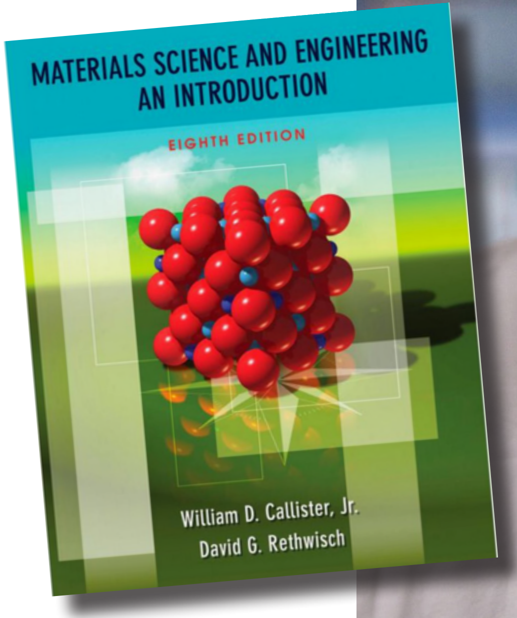
# MSE220 : Introduction to Materials and Manufacturing

**Steve Yalisove**

**University Michigan**

**74 students**

**McCallister 8th ed (Wiley)**



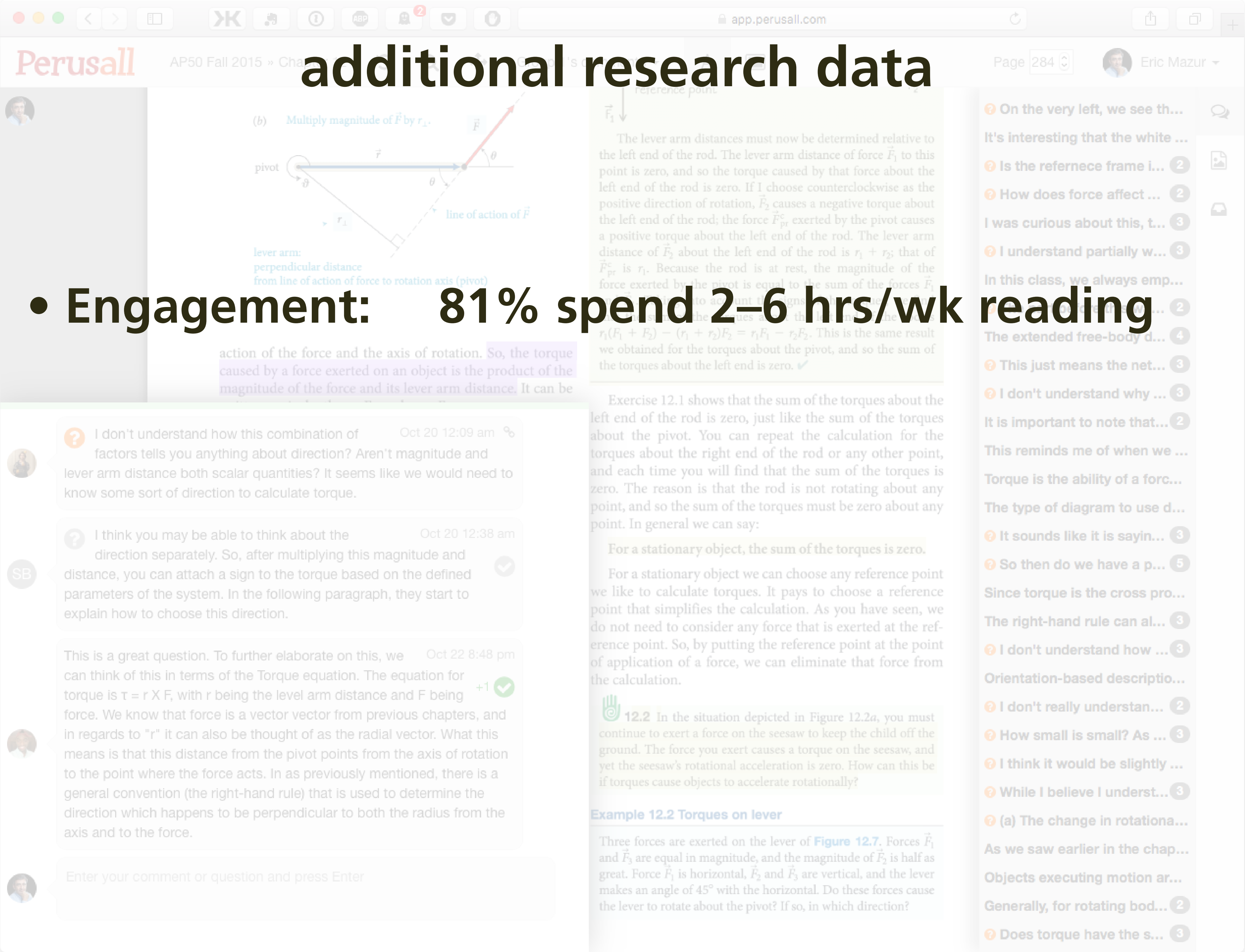
MATERIALS SCIENCE AND ENGINEERING
AN INTRODUCTION

EIGHTH EDITION

William D. Callister, Jr.
David G. Rethwisch

# additional research data

- **Engagement:** 81% spend 2–6 hrs/wk reading



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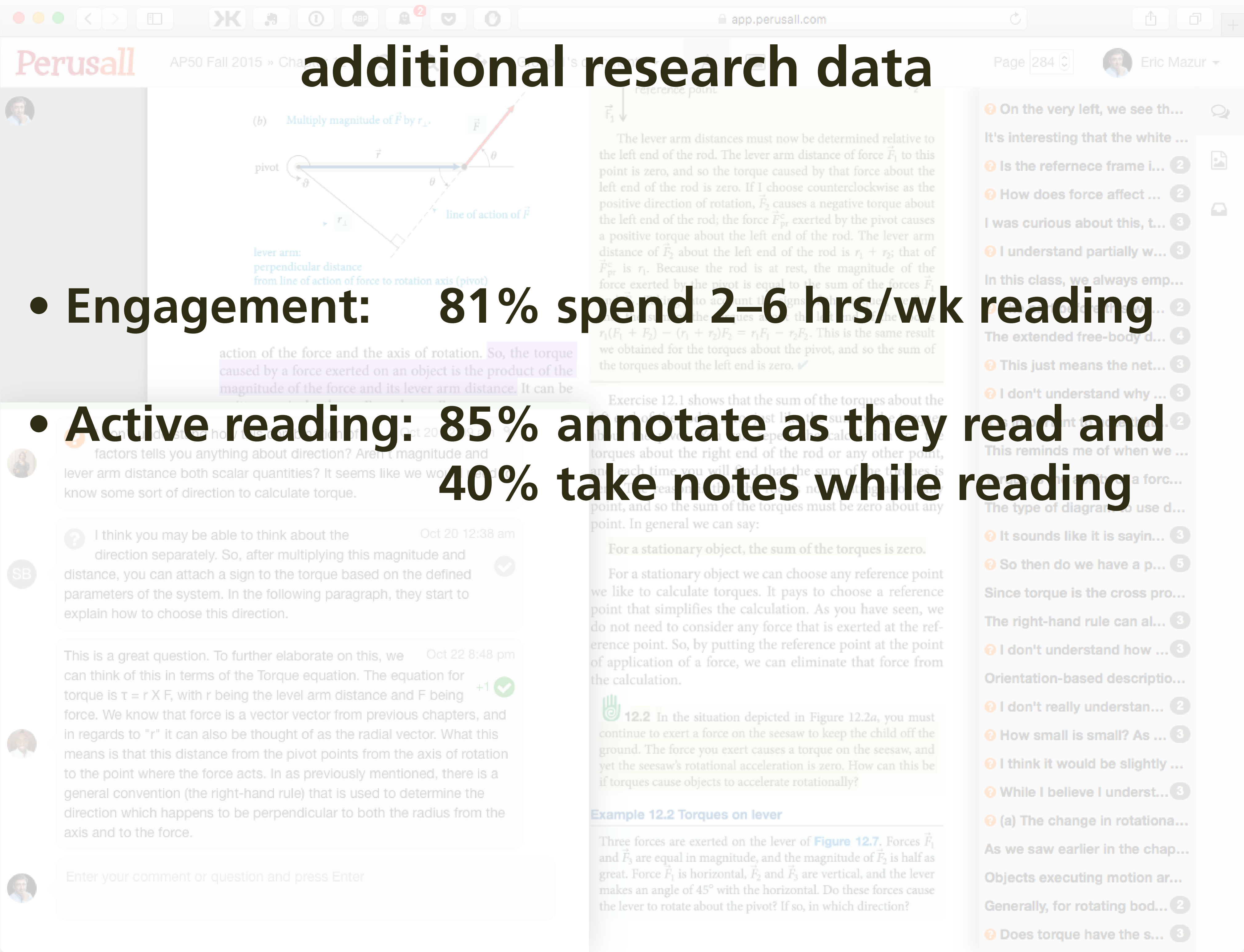

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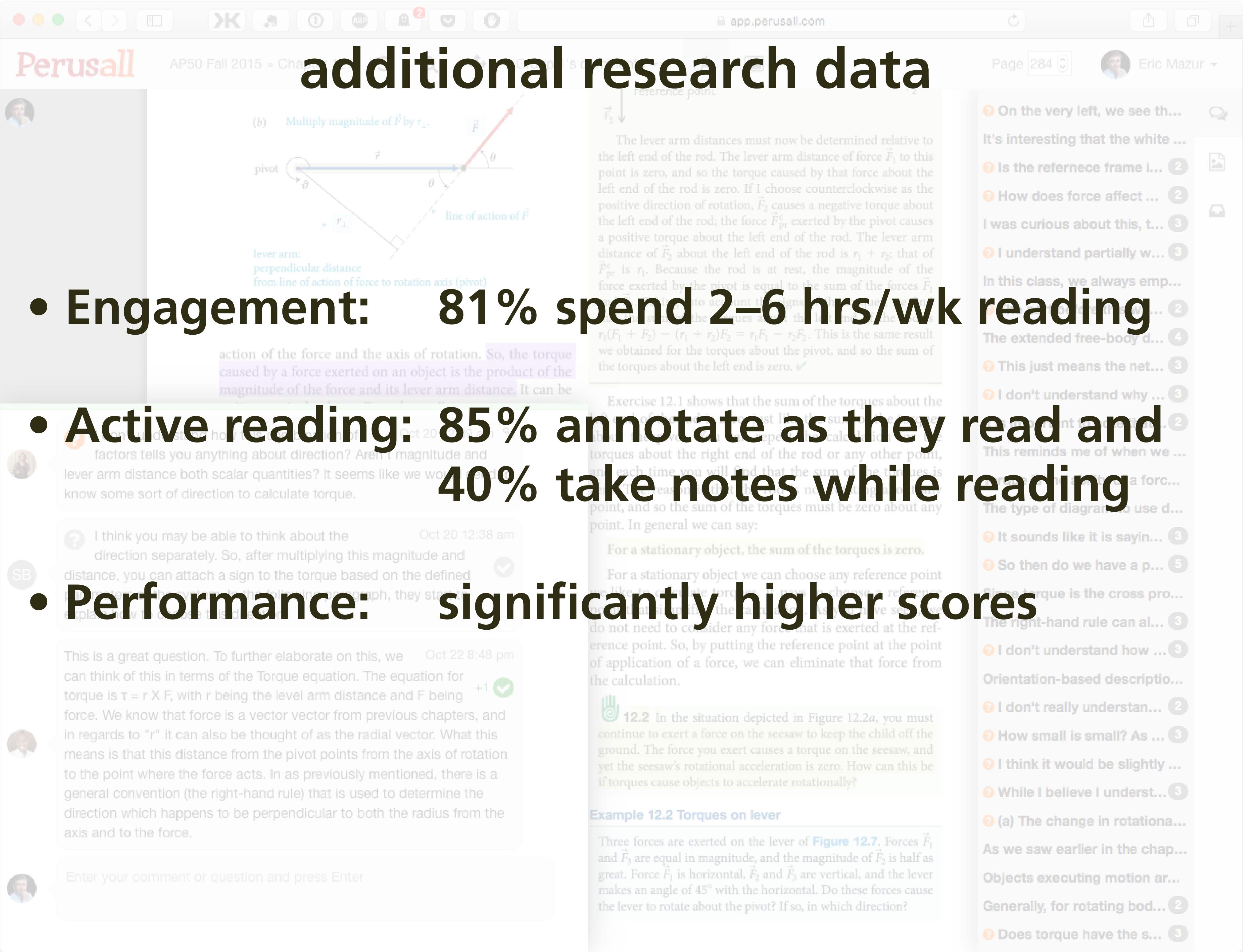

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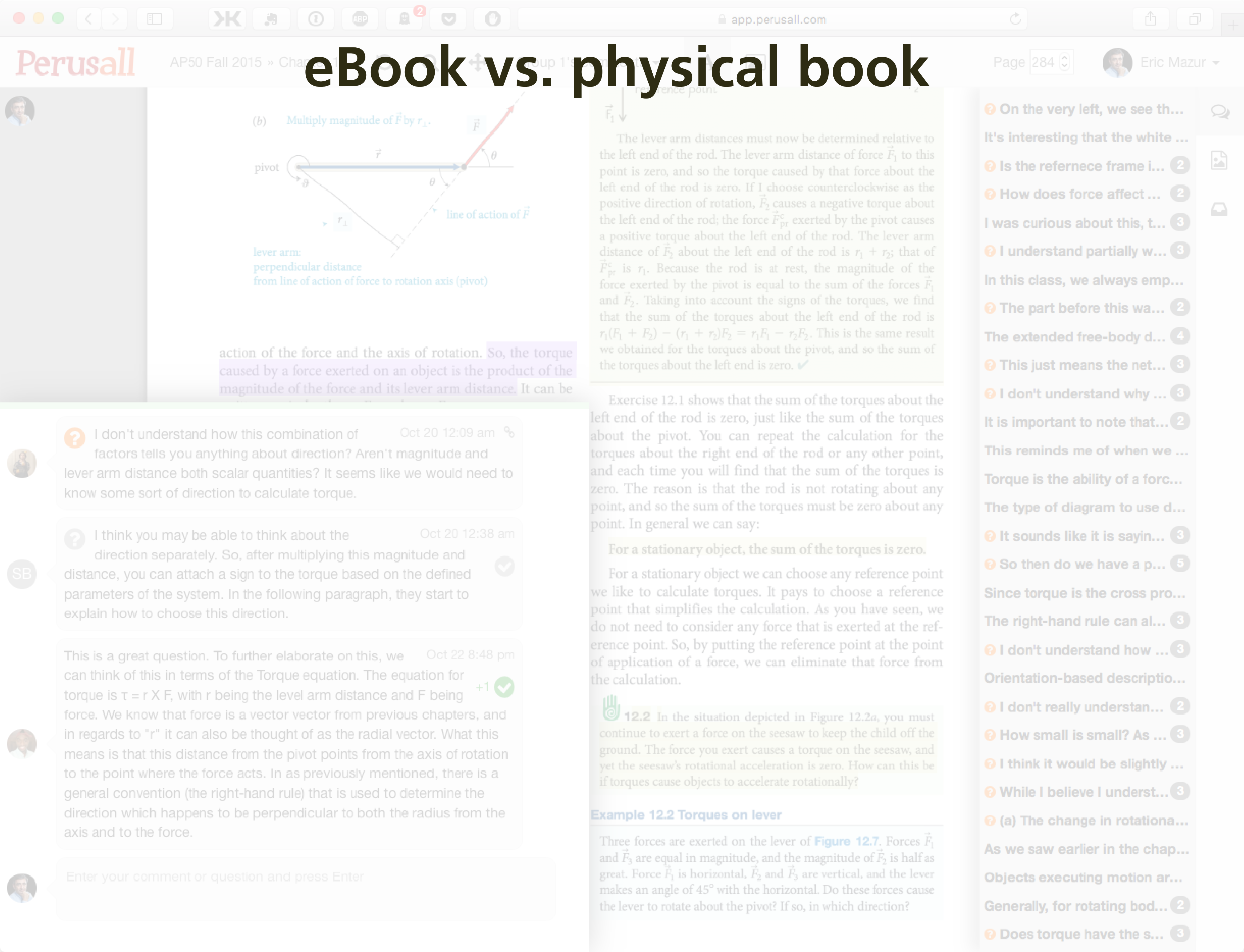
# eBook vs. physical book



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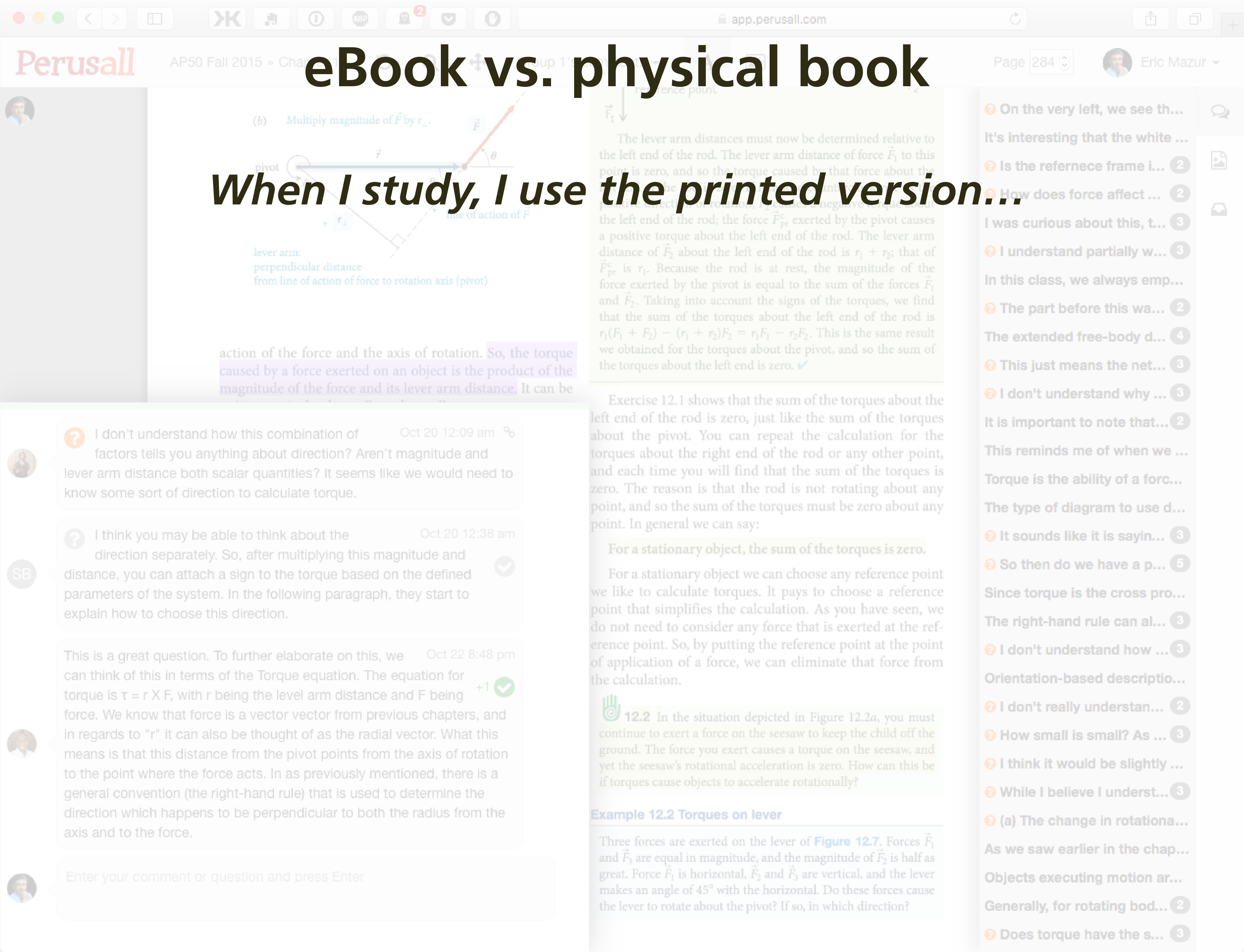

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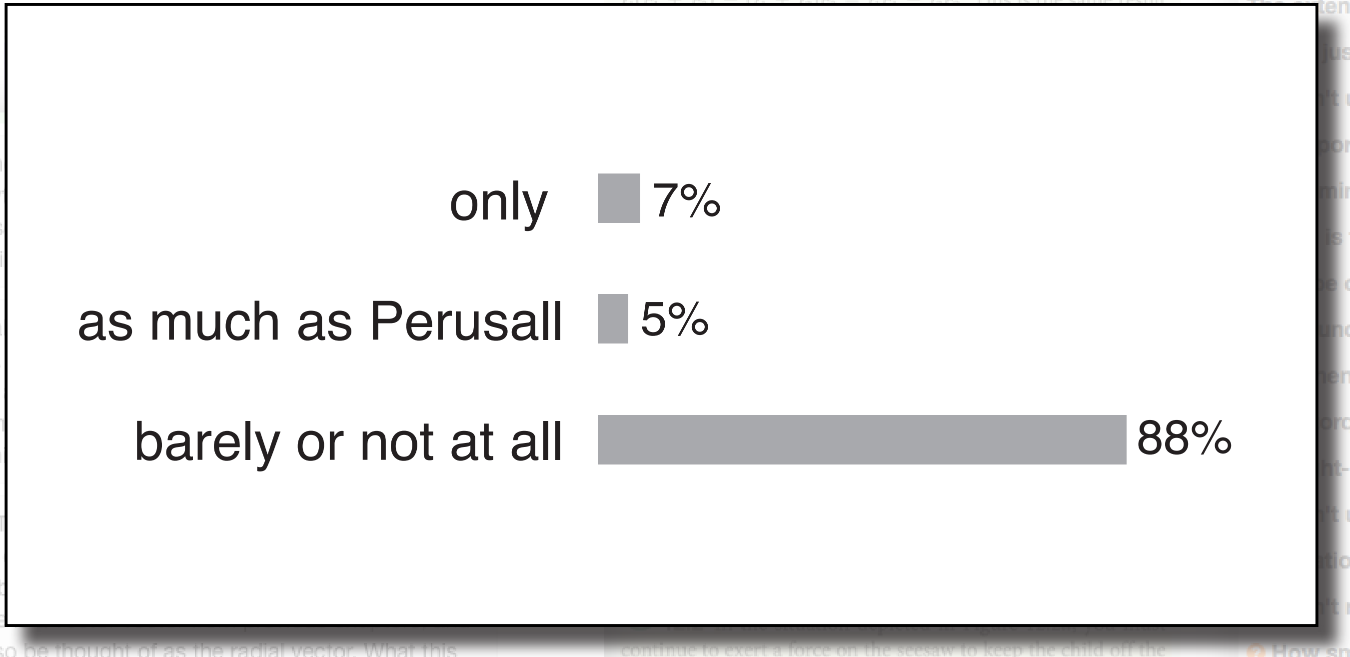

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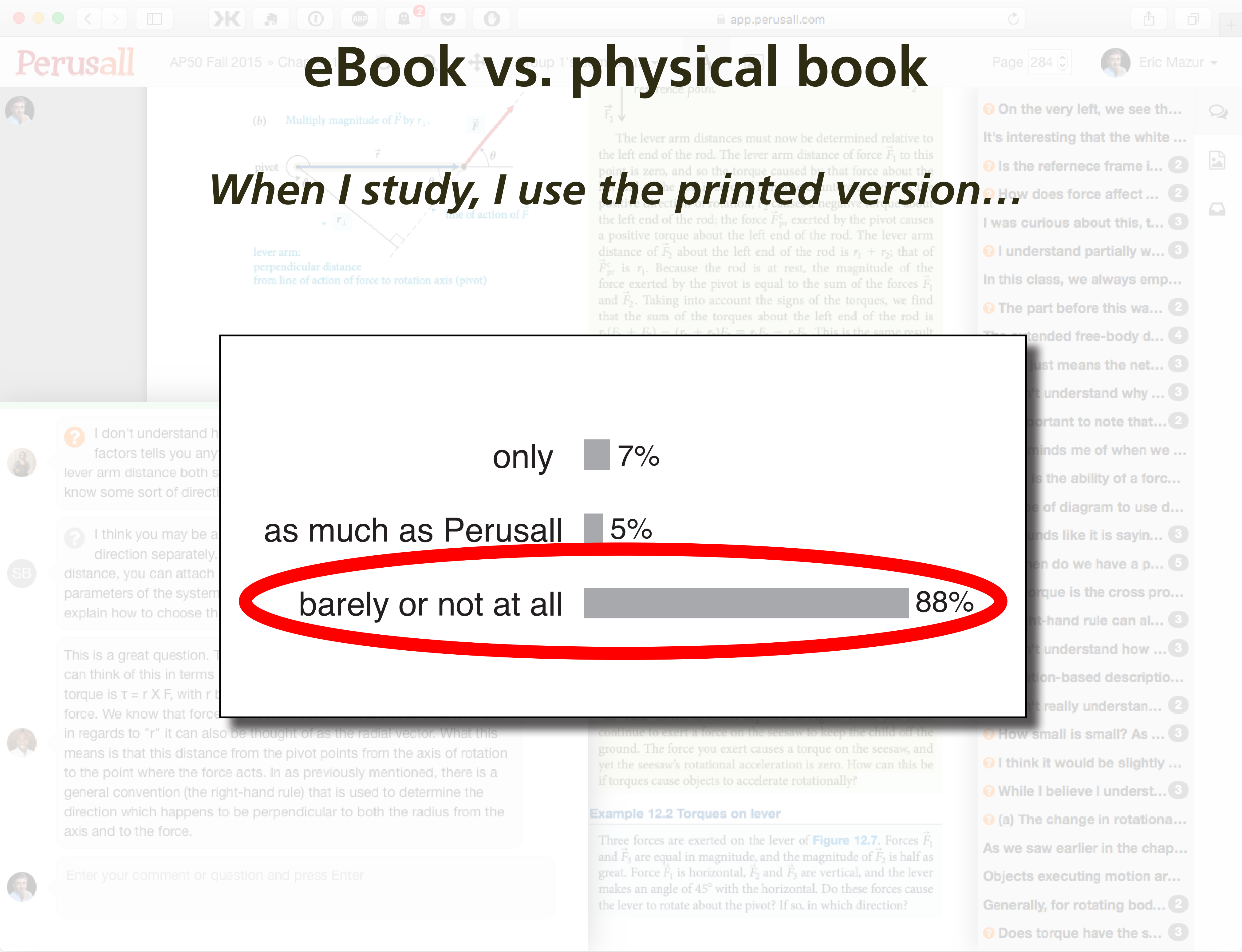

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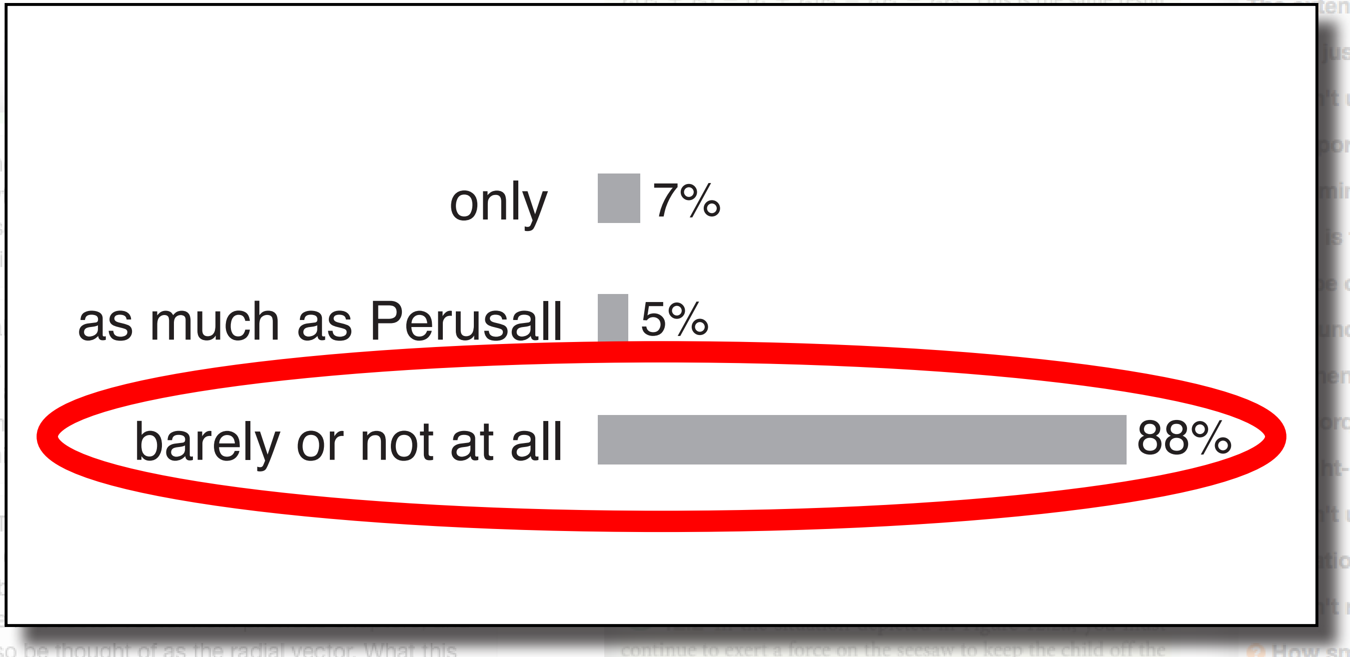

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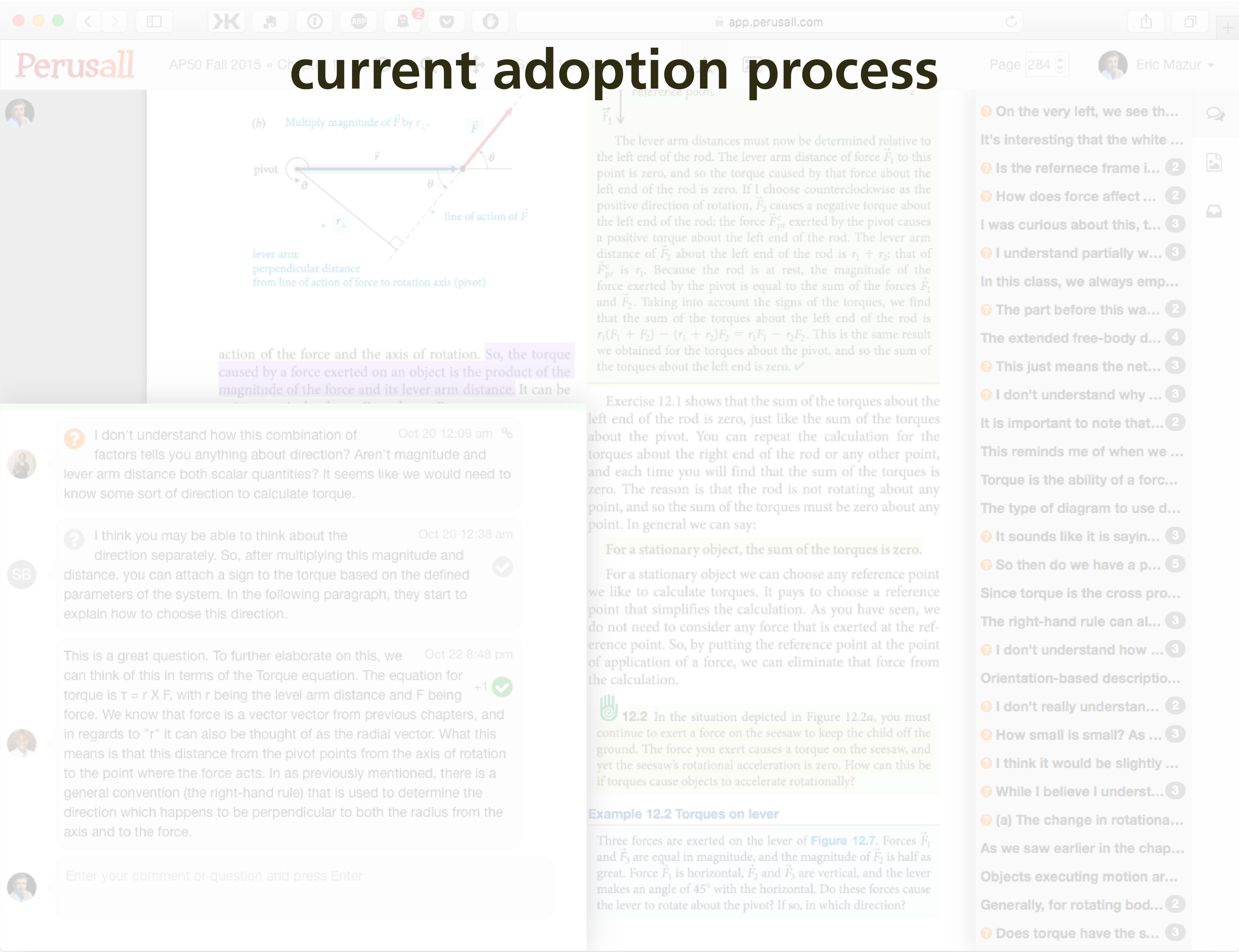

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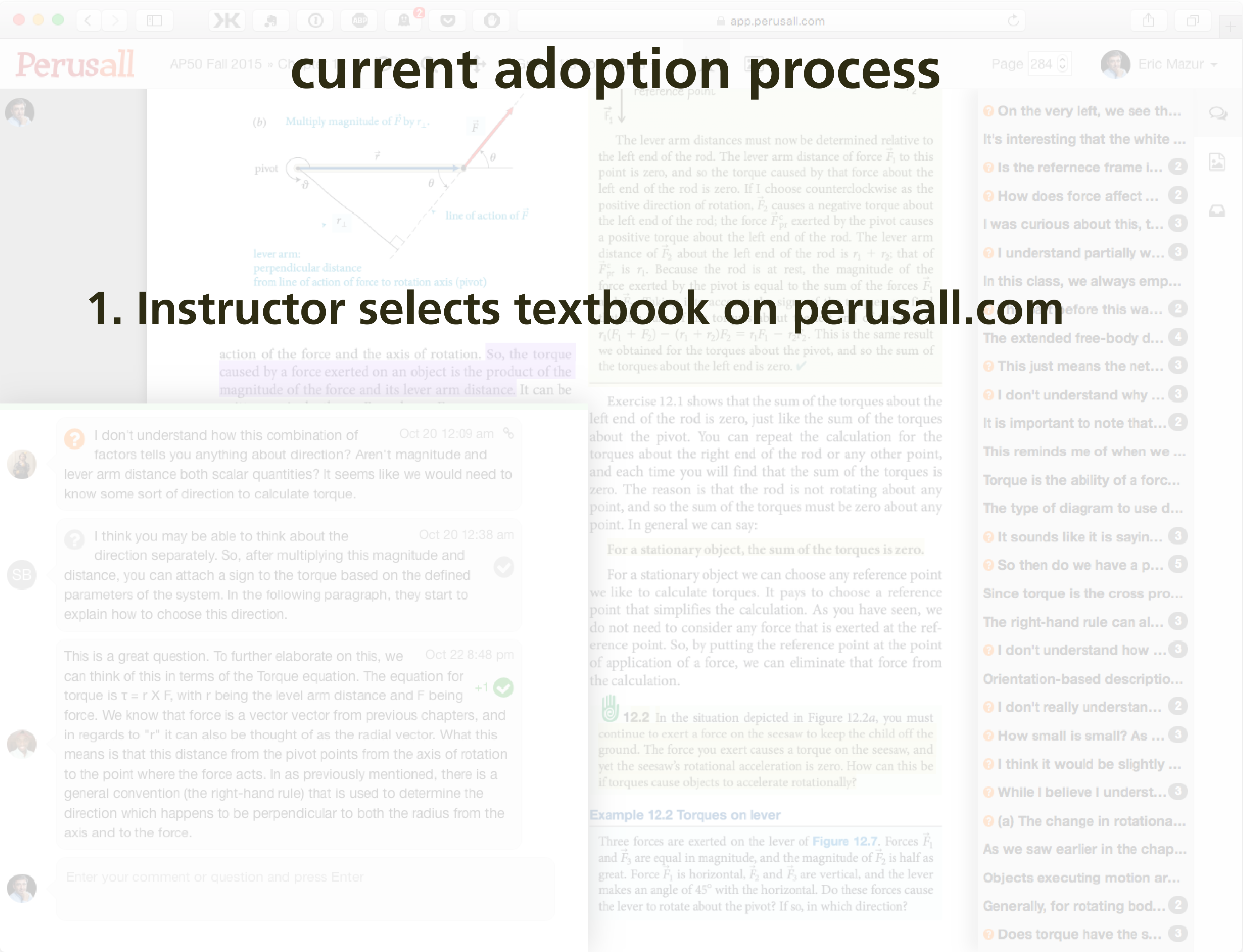

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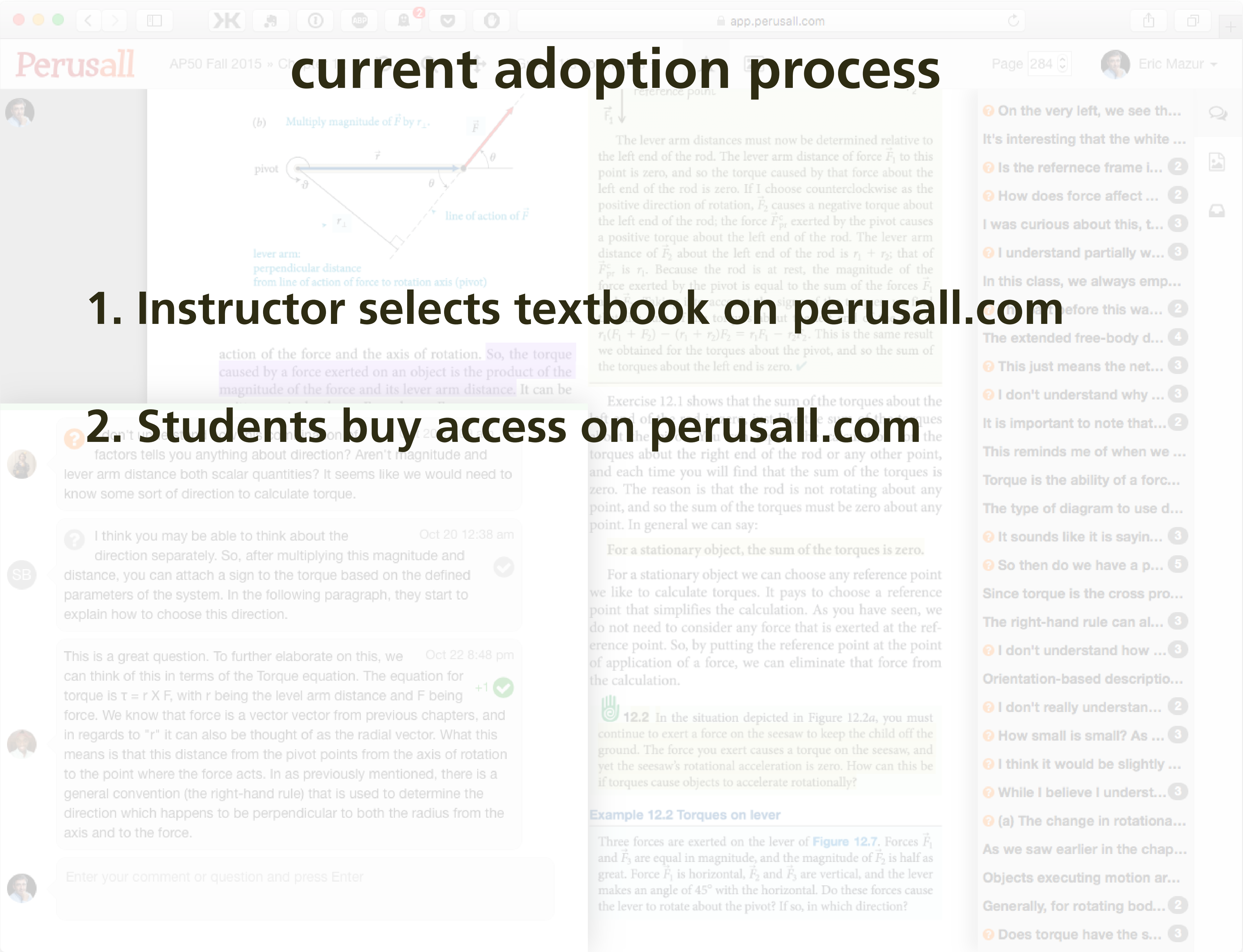

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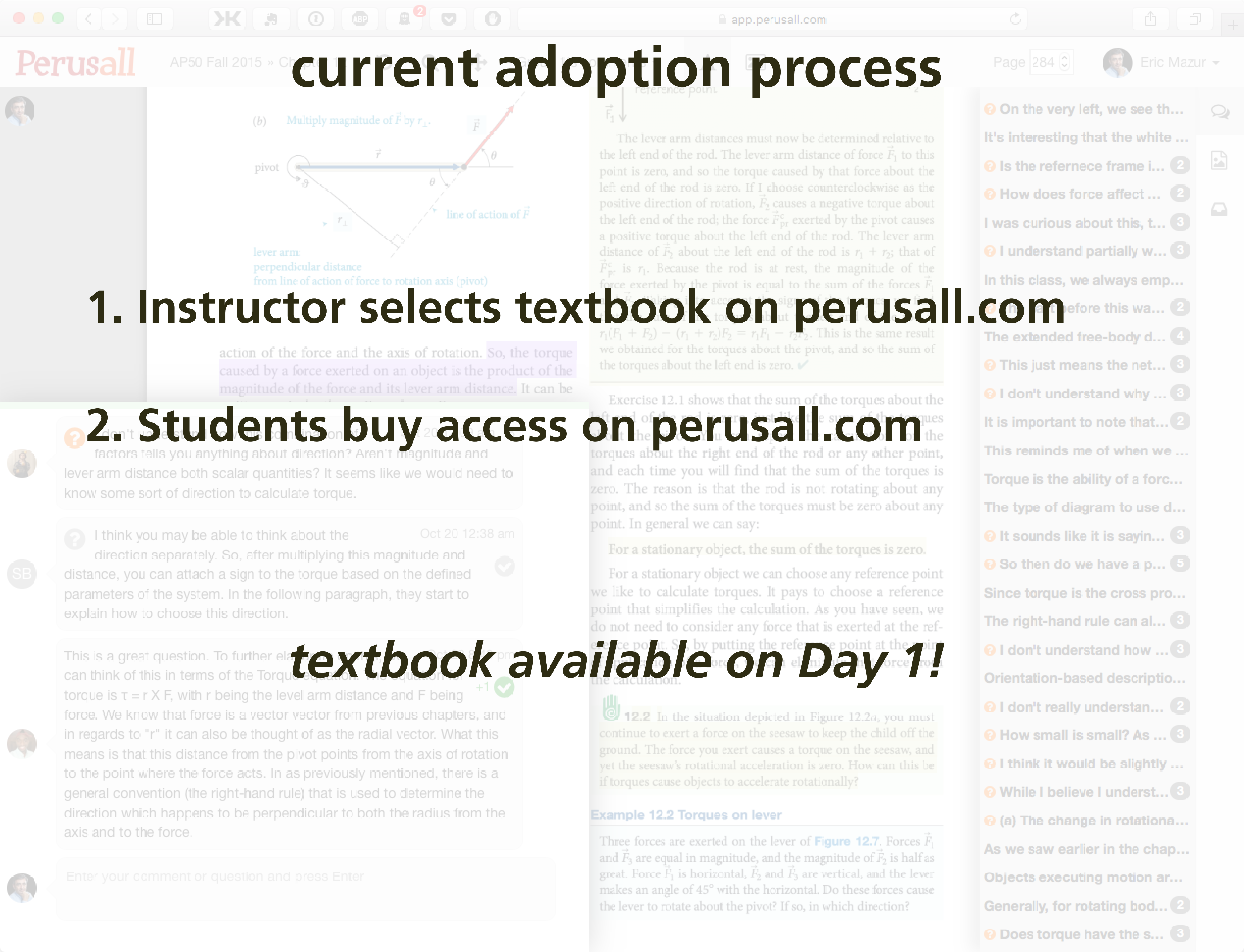

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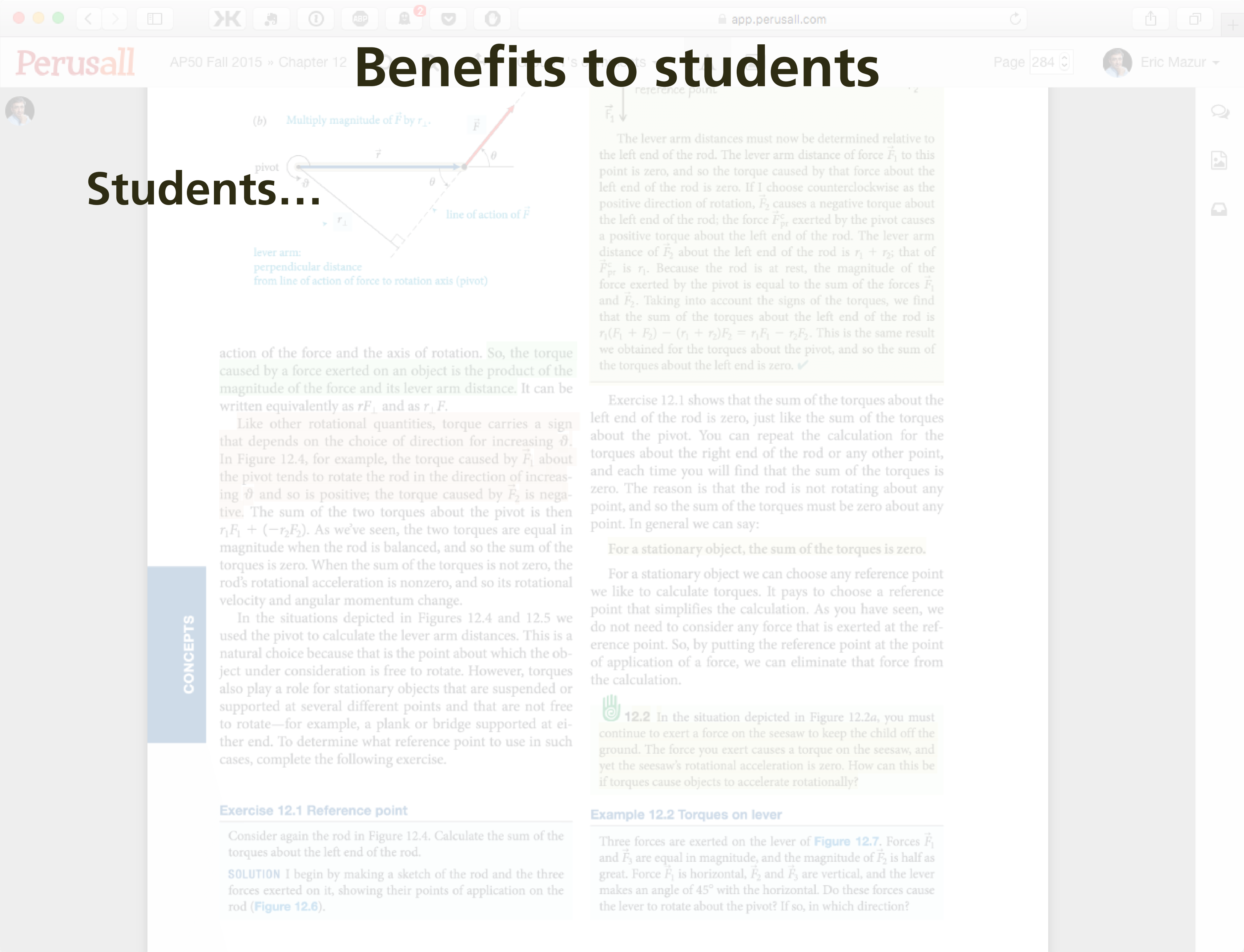
? On the very left, we see th...
It's interesting that the white ...
? Is the refernece frame i... 2
? How does force affect ... 2
I was curious about this, t... 3
? I understand partially w... 3
In this class, we always emp...
? ...efore this wa... 2
The extended free-body d... 4
? This just means the net... 3
? I don't understand why ... 3
It is important to note that... 2
This reminds me of when we ...
Torque is the ability of a forc...
The type of diagram to use d...
? It sounds like it is sayin... 3
? So then do we have a p... 5
Since torque is the cross pro...
The right-hand rule can al... 3
? I don't understand how ... 3
Orientation-based descriptio...
? I don't really understan... 2
? How small is small? As ... 3
? I think it would be slightly ...
? While I believe I underst... 3
? (a) The change in rotationa...
As we saw earlier in the chap...
Objects executing motion ar...
Generally, for rotating bod... 2
? Does torque have the s... 3

# Benefits to students

Students…



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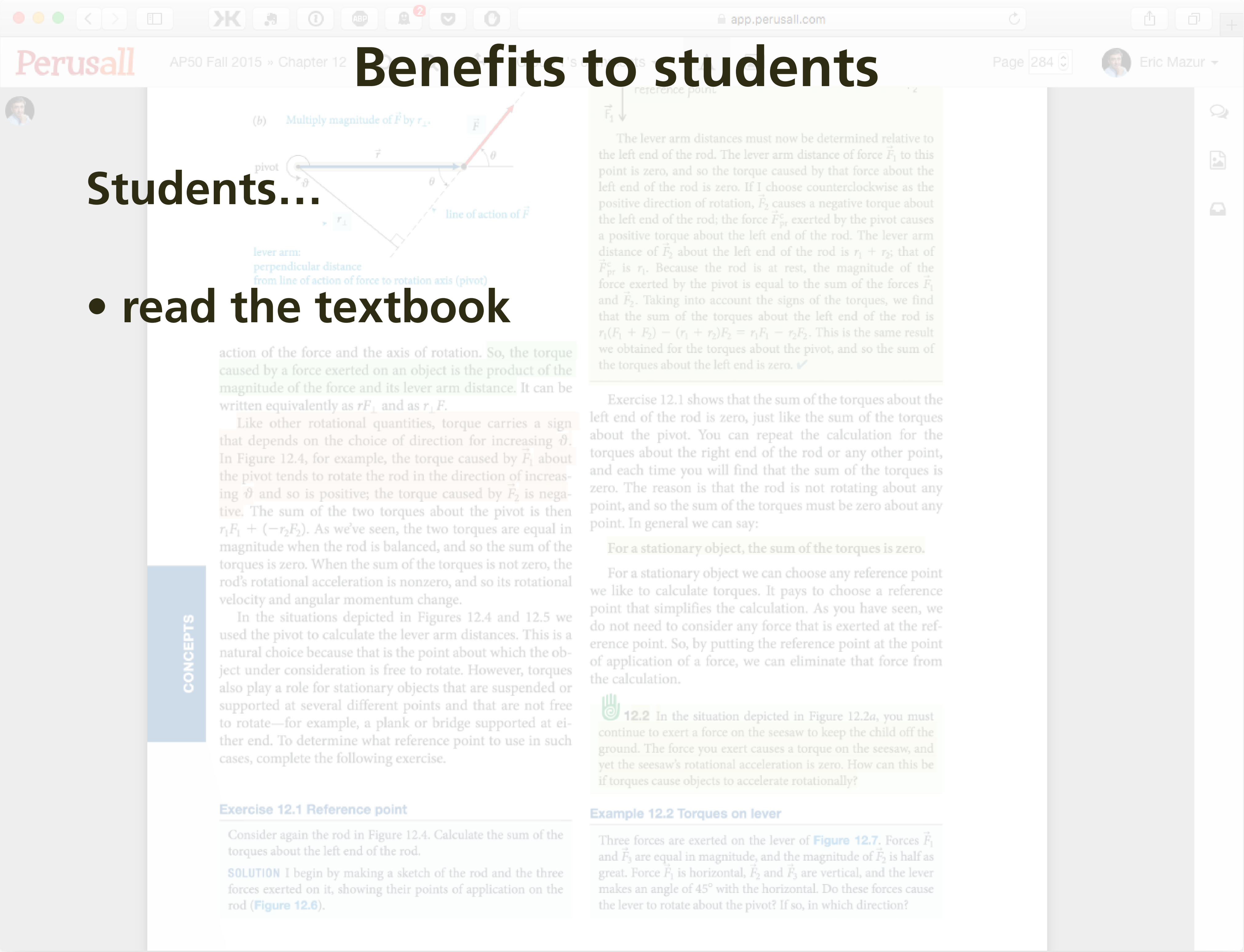
# Benefits to students

Students…

- read the textbook



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# Benefits to students

Students…

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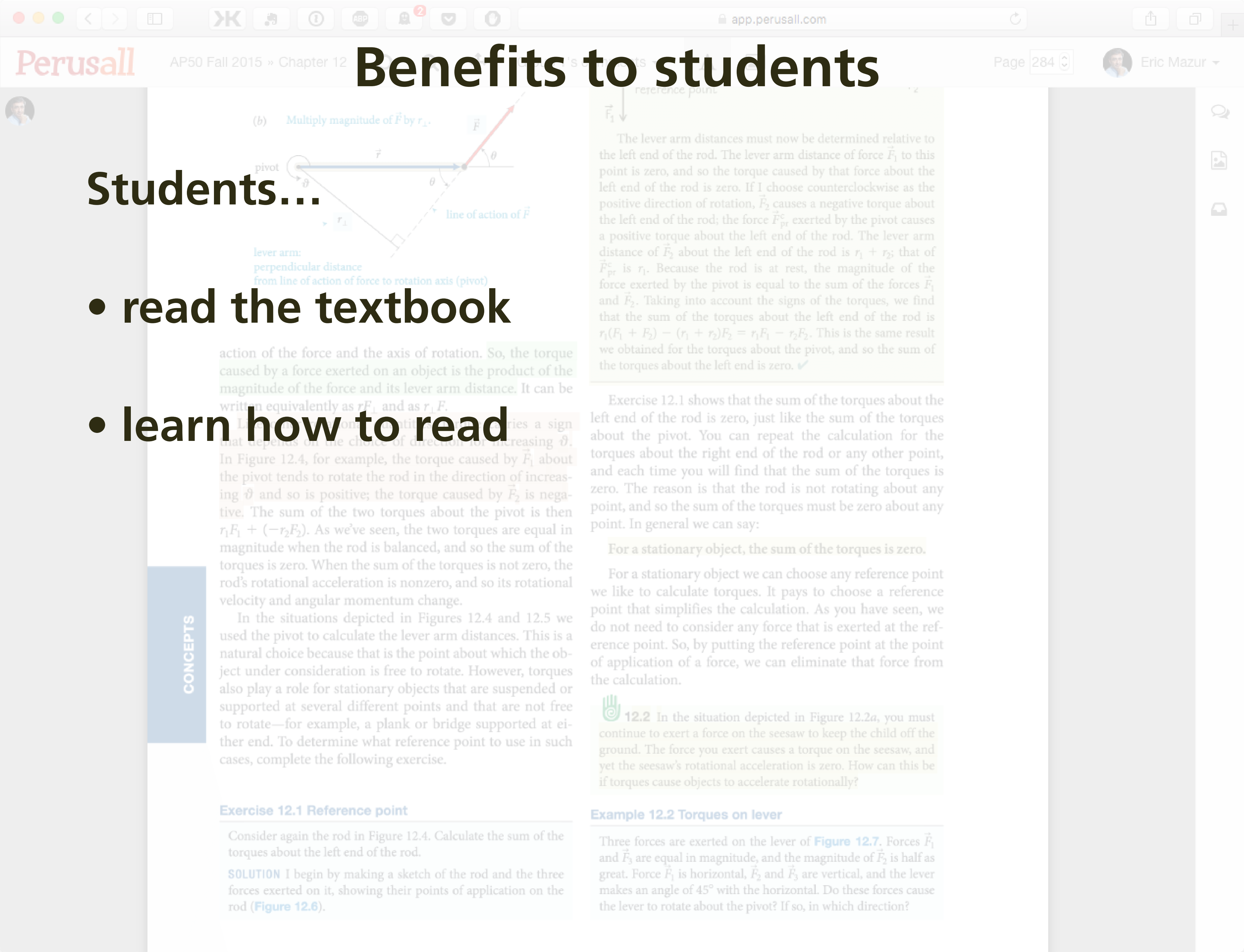
- learn how to read



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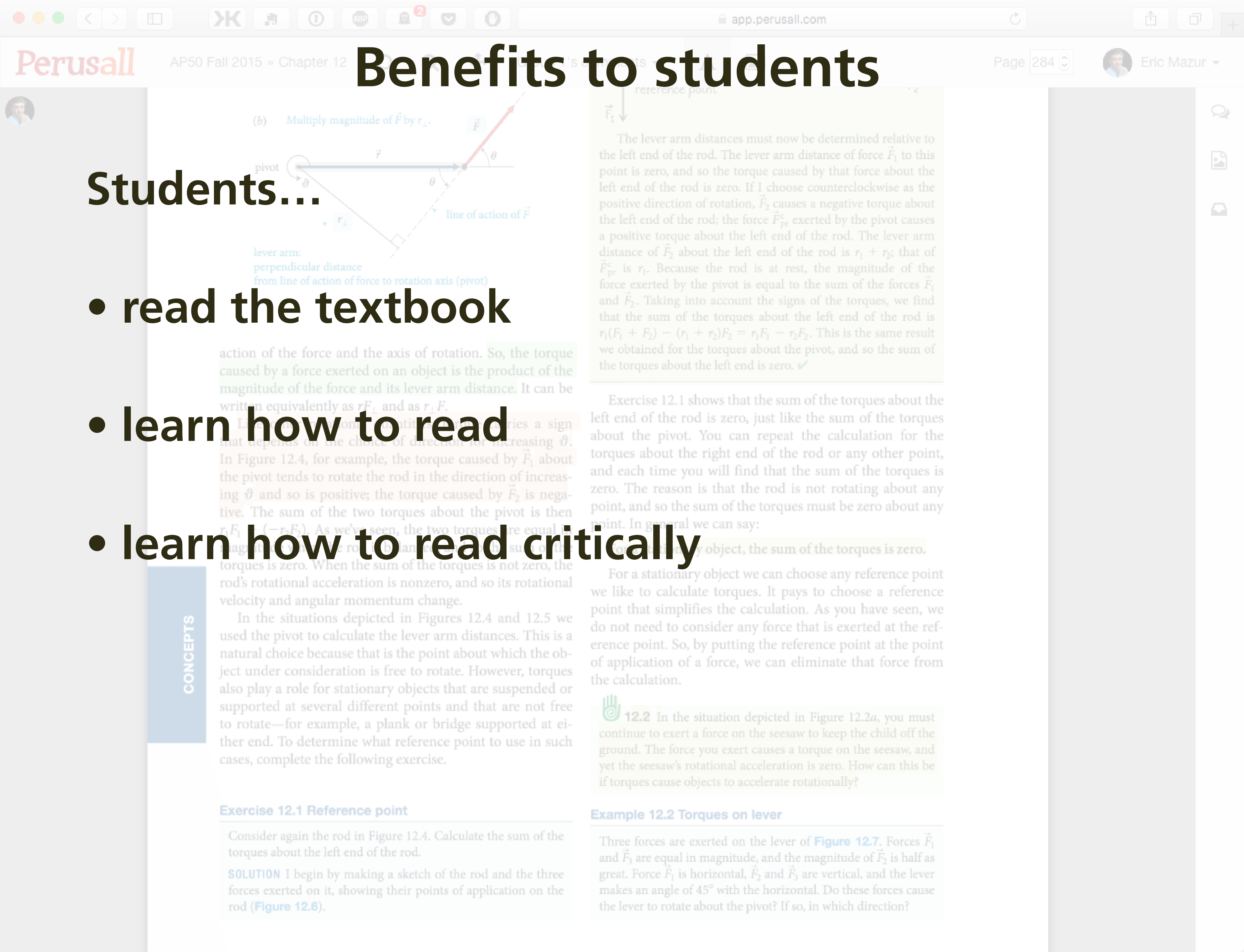
# Benefits to students

Students…

- read the textbook
- learn how to read
- learn how to read critically



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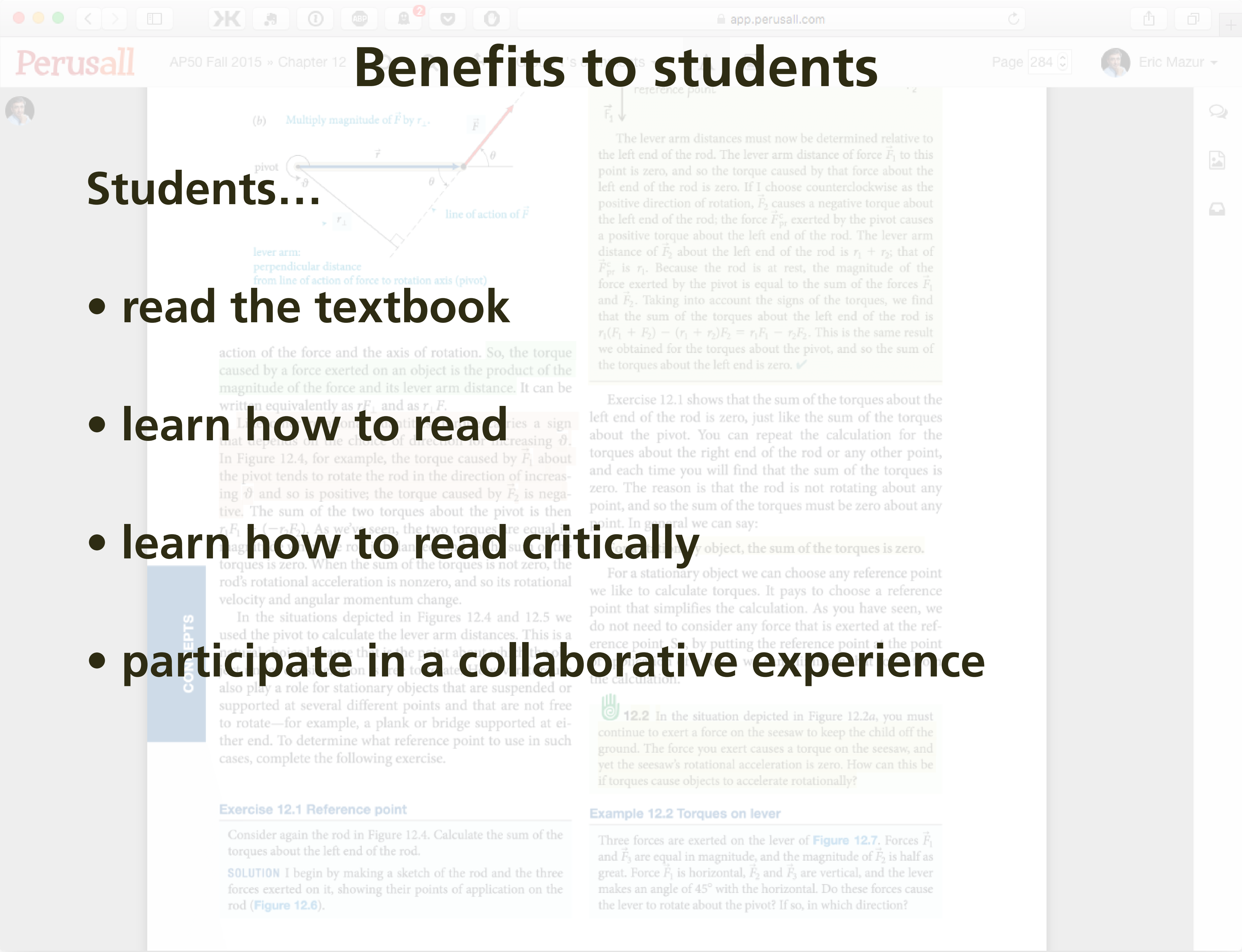
# Benefits to students



Students…

- read the textbook
- learn how to read
- learn how to read critically
- participate in a collaborative experience

# Benefits to students

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- read the textbook
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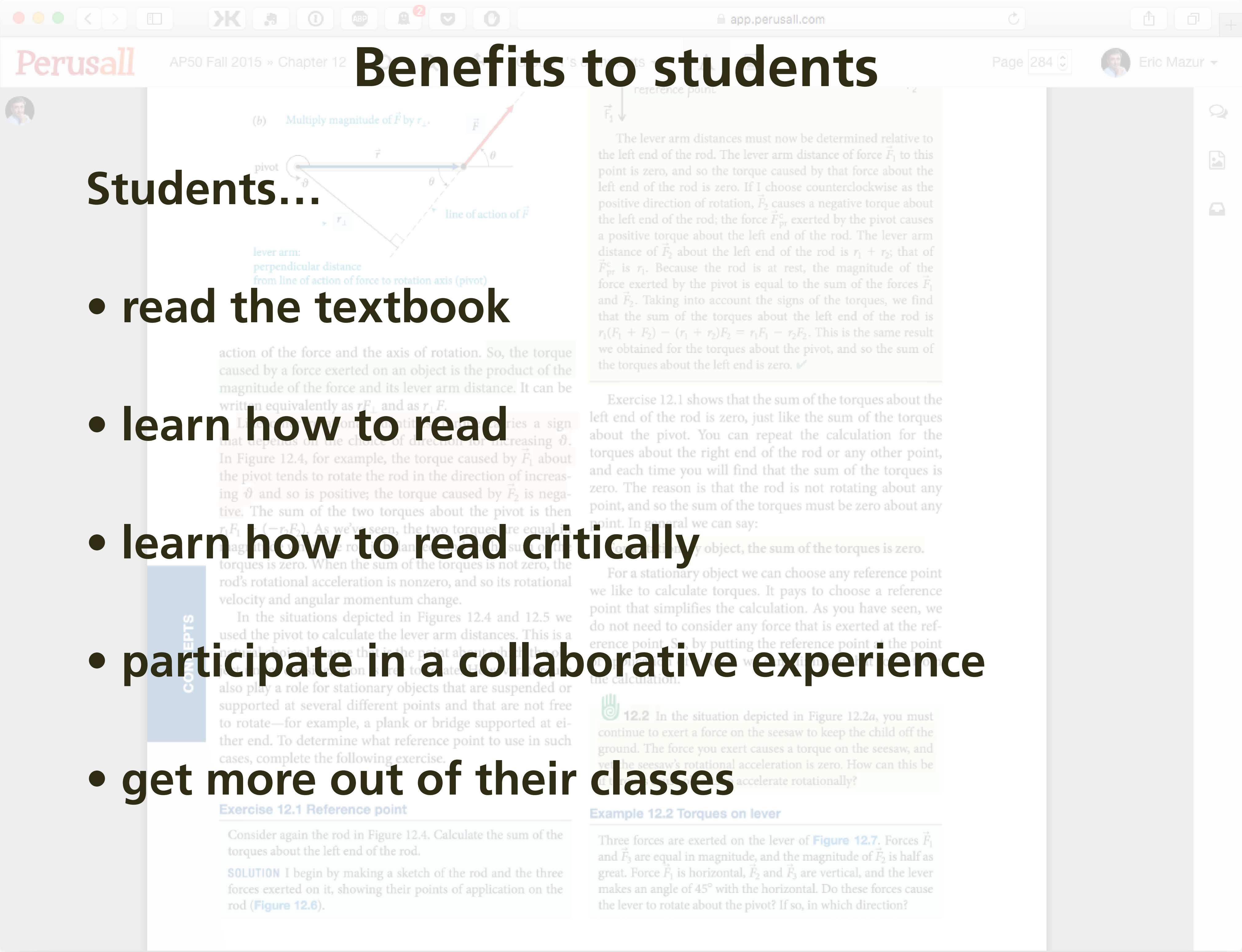
- participate in a collaborative experience
- get more out of their classes



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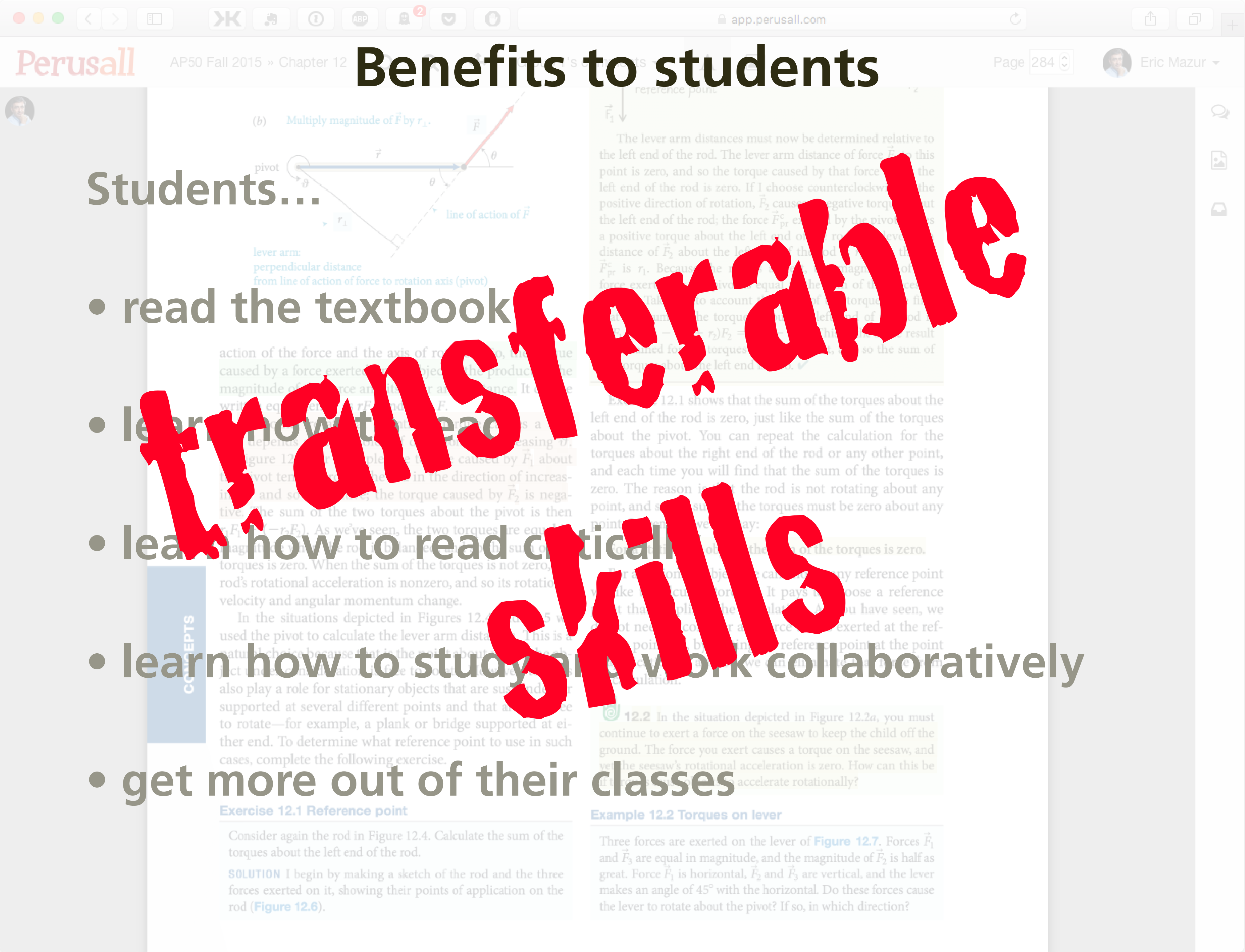

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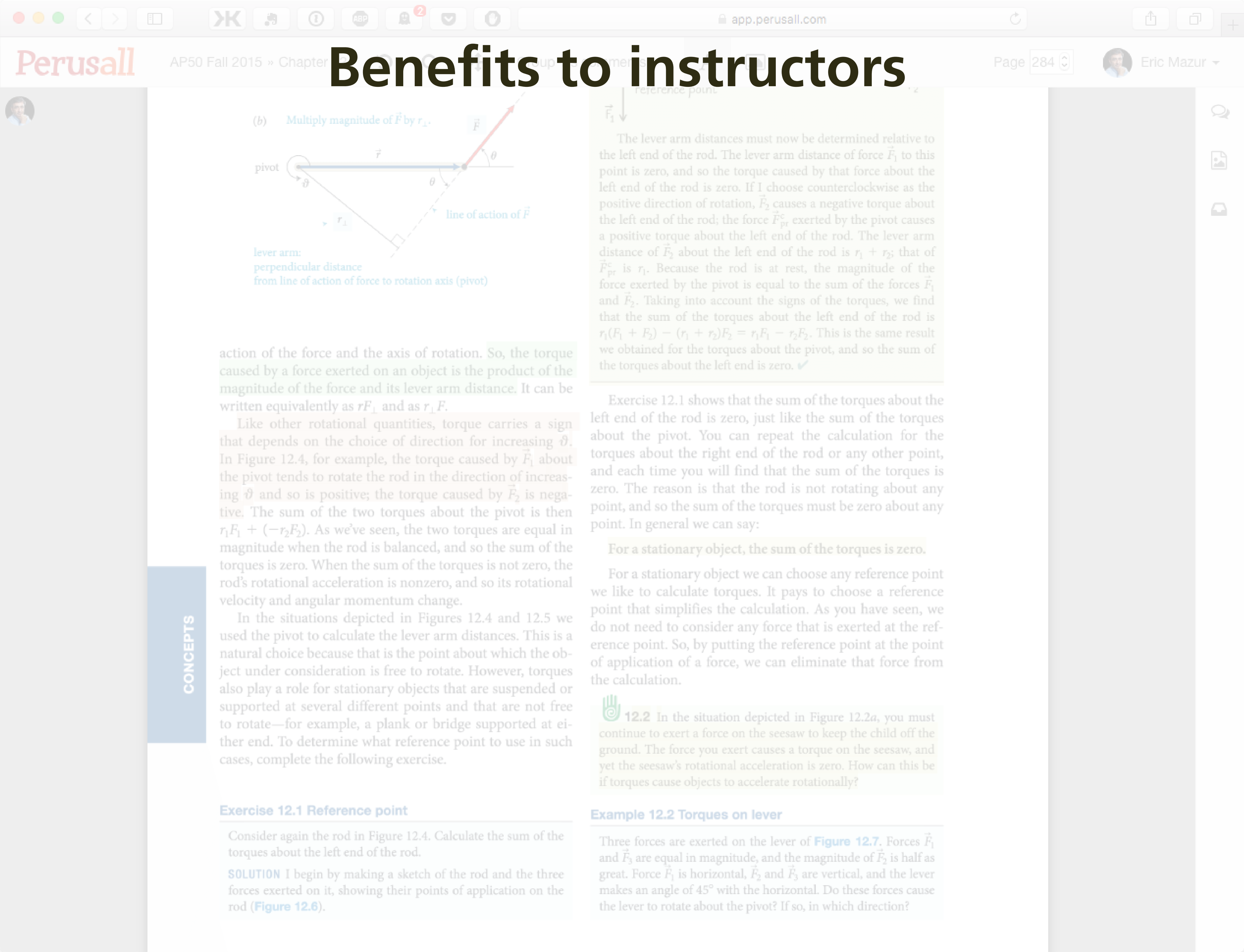
- read the textbook
- learn how to read
- learn how to read critically
- learn how to study and work collaboratively
- get more out of their classes

transferable skills

# Benefits to instructors



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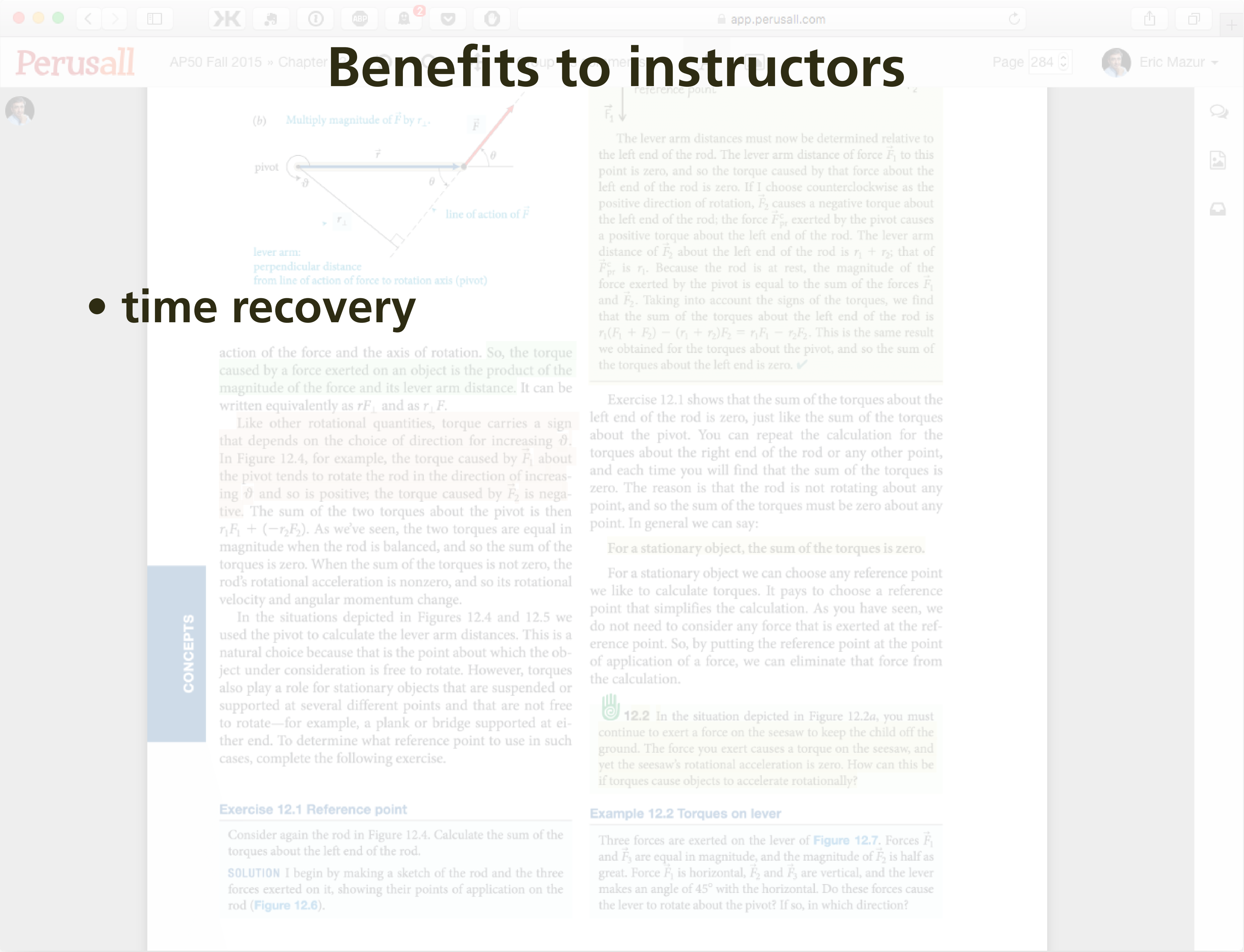
**Example 12.2 Torques on lever**

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?

# Benefits to instructors

- time recovery



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 $r_\perp F$.

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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.

**Exercise 12.1 Reference point**

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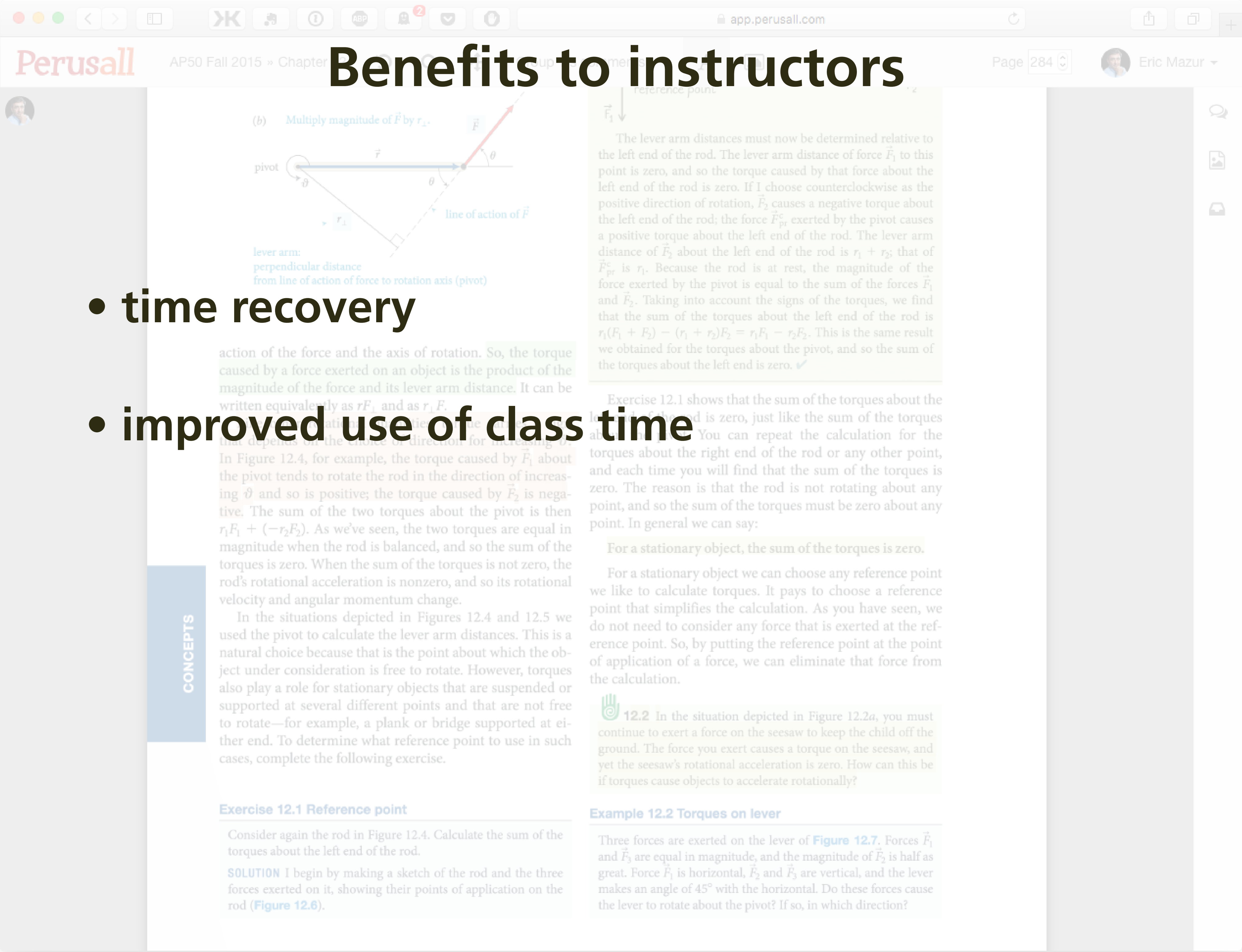
# Benefits to instructors

- time recovery
- improved use of class time



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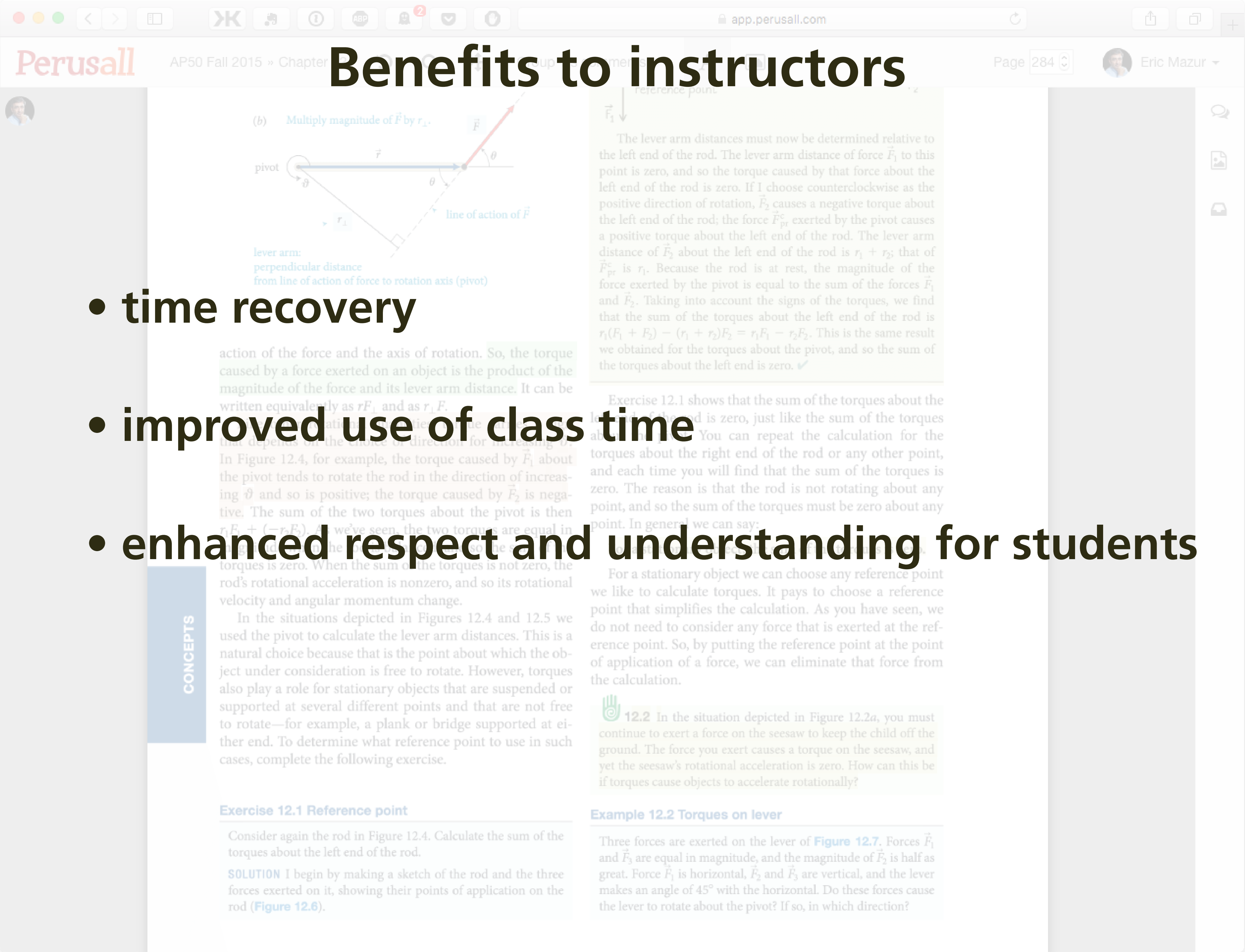

- time recovery
- improved use of class time
- enhanced respect and understanding for students

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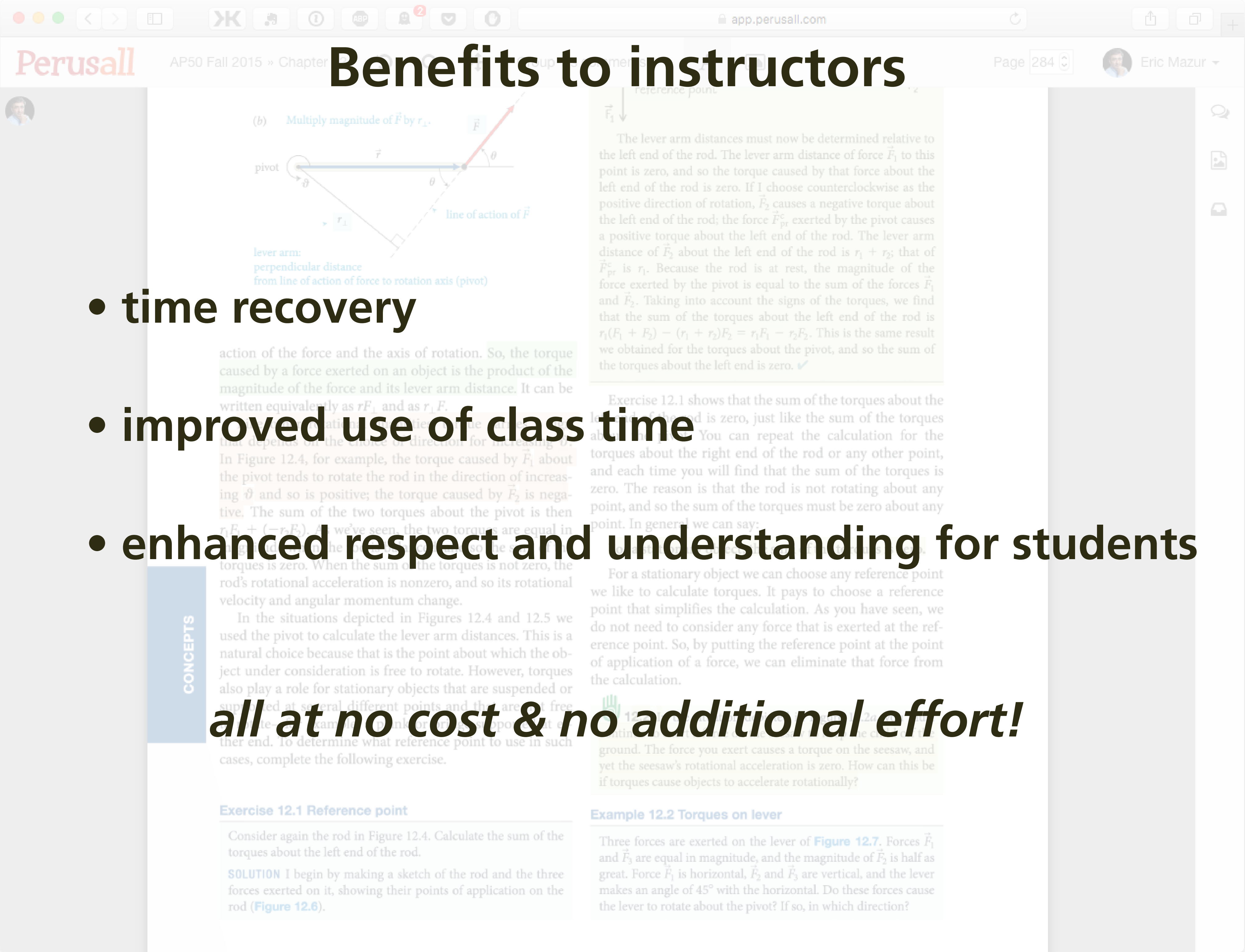

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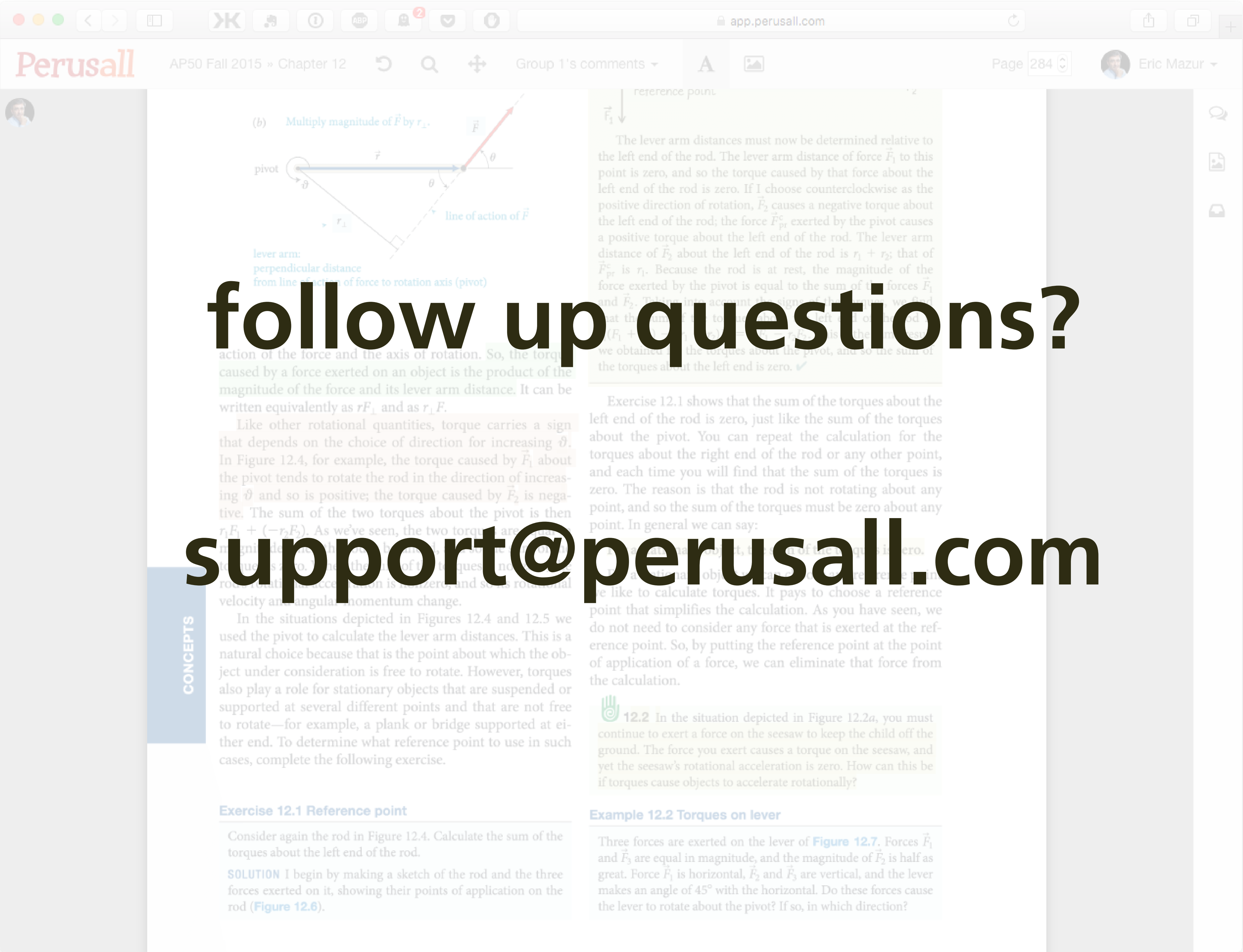
*all at no cost & no additional effort!*

# follow up questions?

# support@perusall.com



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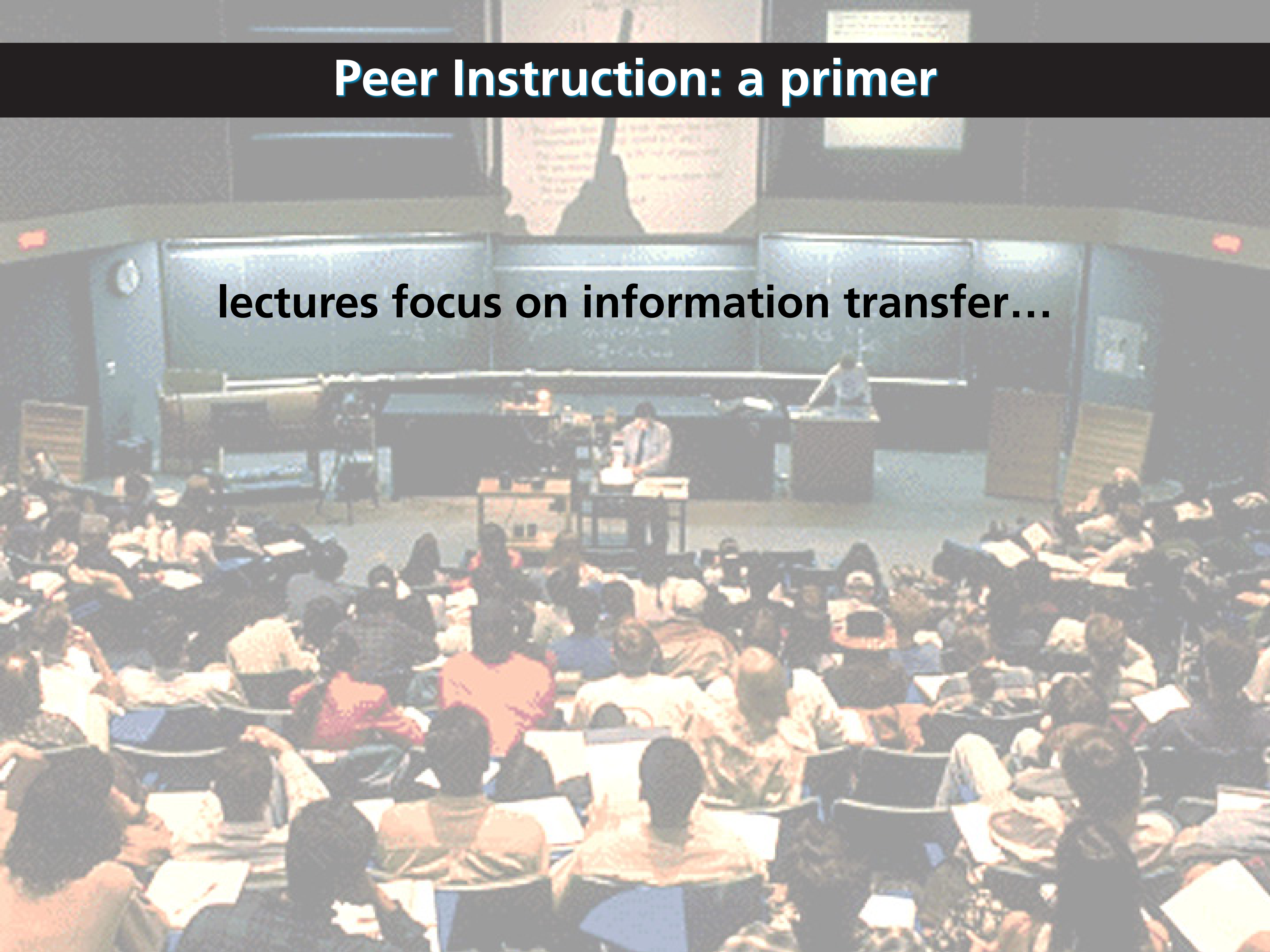
# Hands-on with Peer Instruction

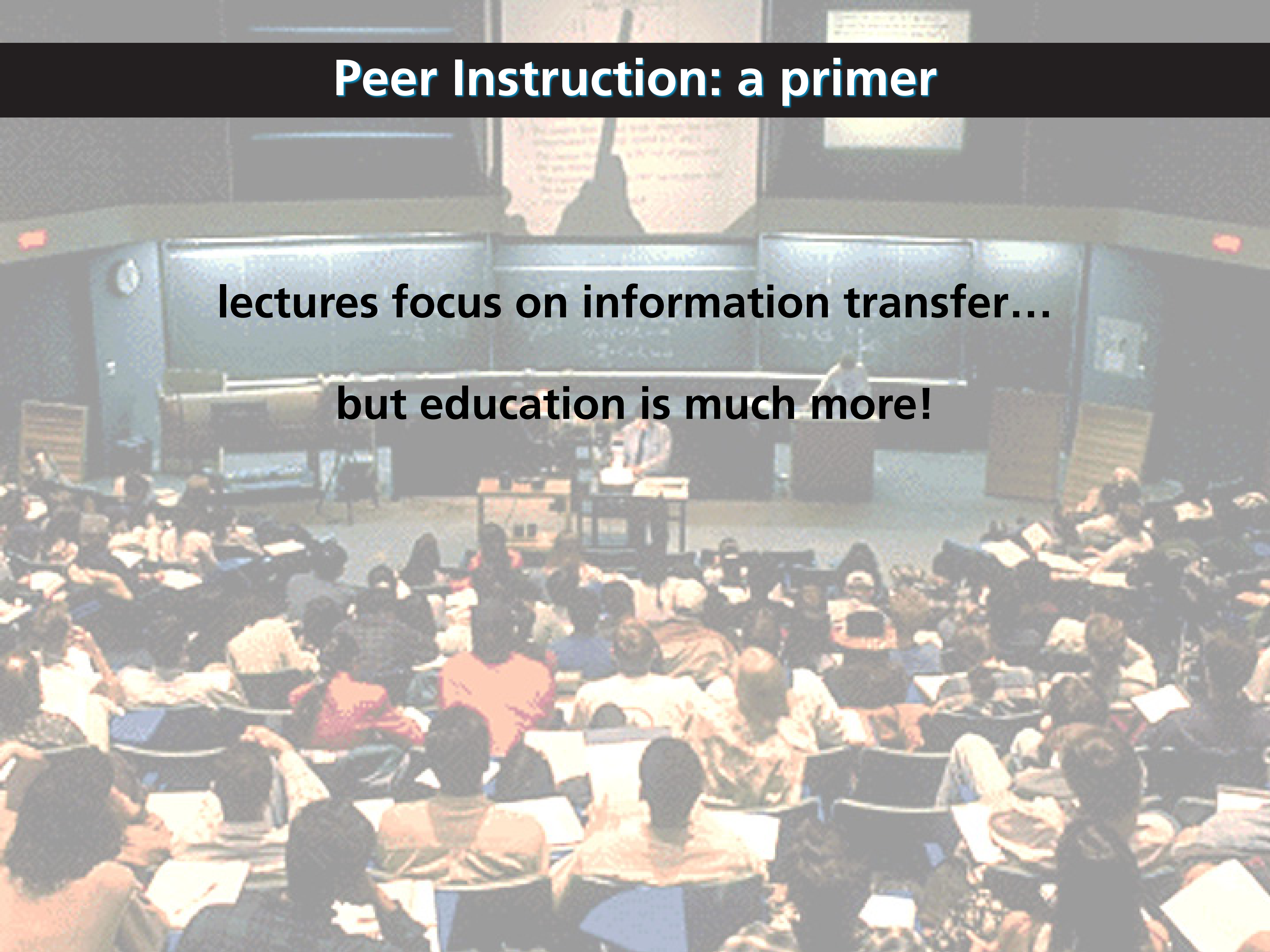
Colorado State University Pueblo
Pueblo, CO, 2 May 2016

# Peer Instruction: a primer



lectures focus on information transfer…

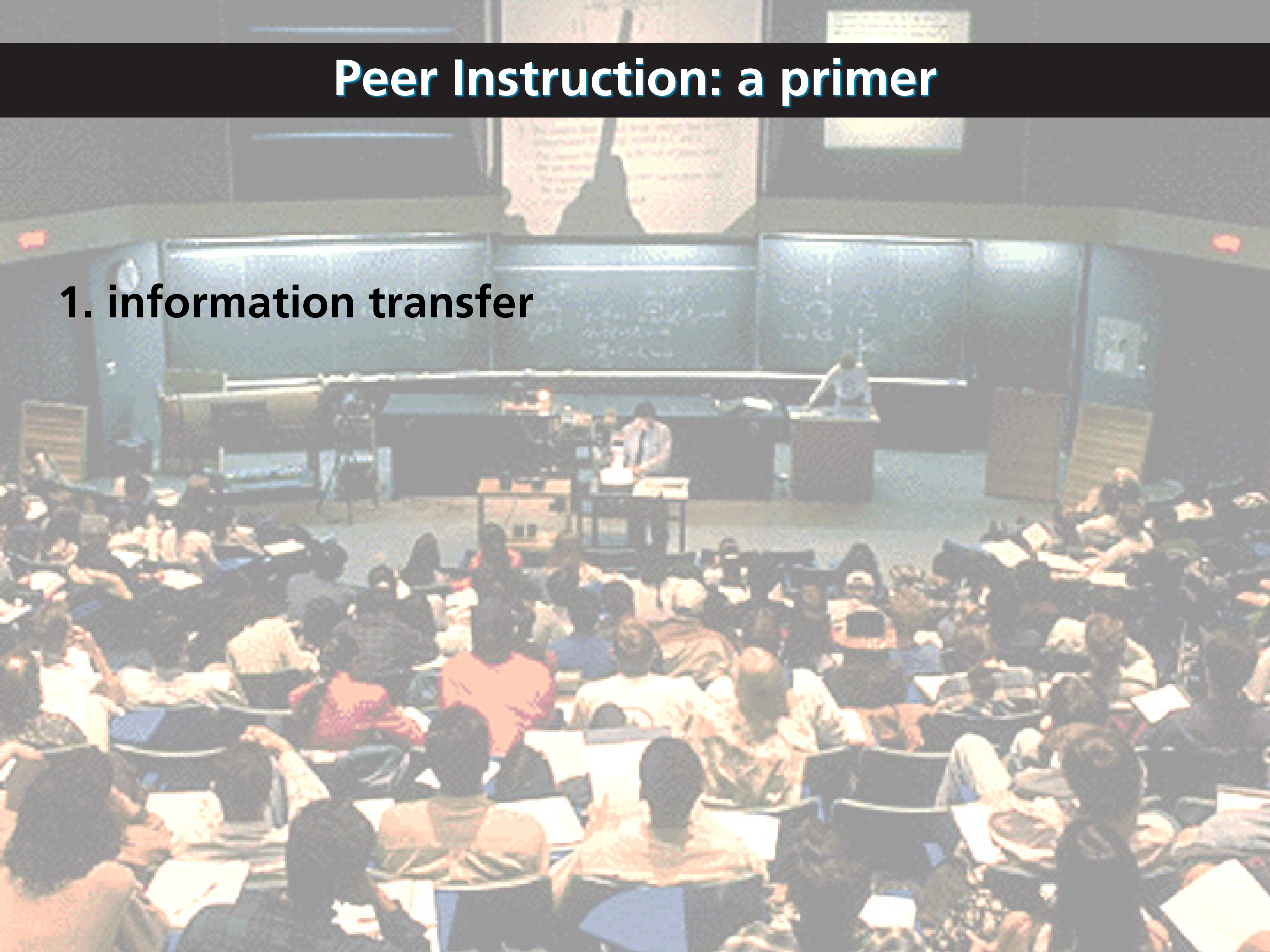
# Peer Instruction: a primer



lectures focus on information transfer…

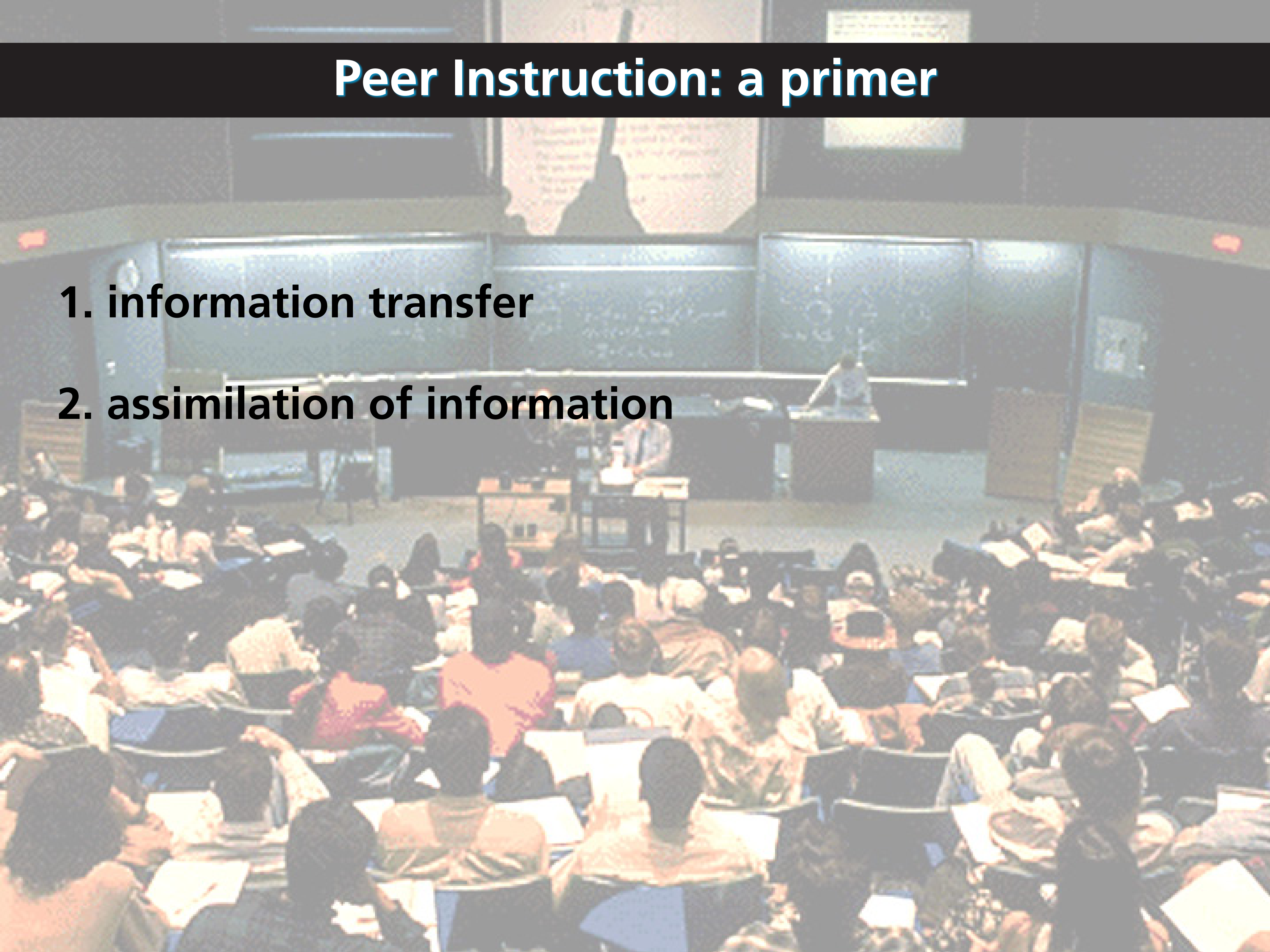
but education is much more!

# Peer Instruction: a primer



1. information transfer

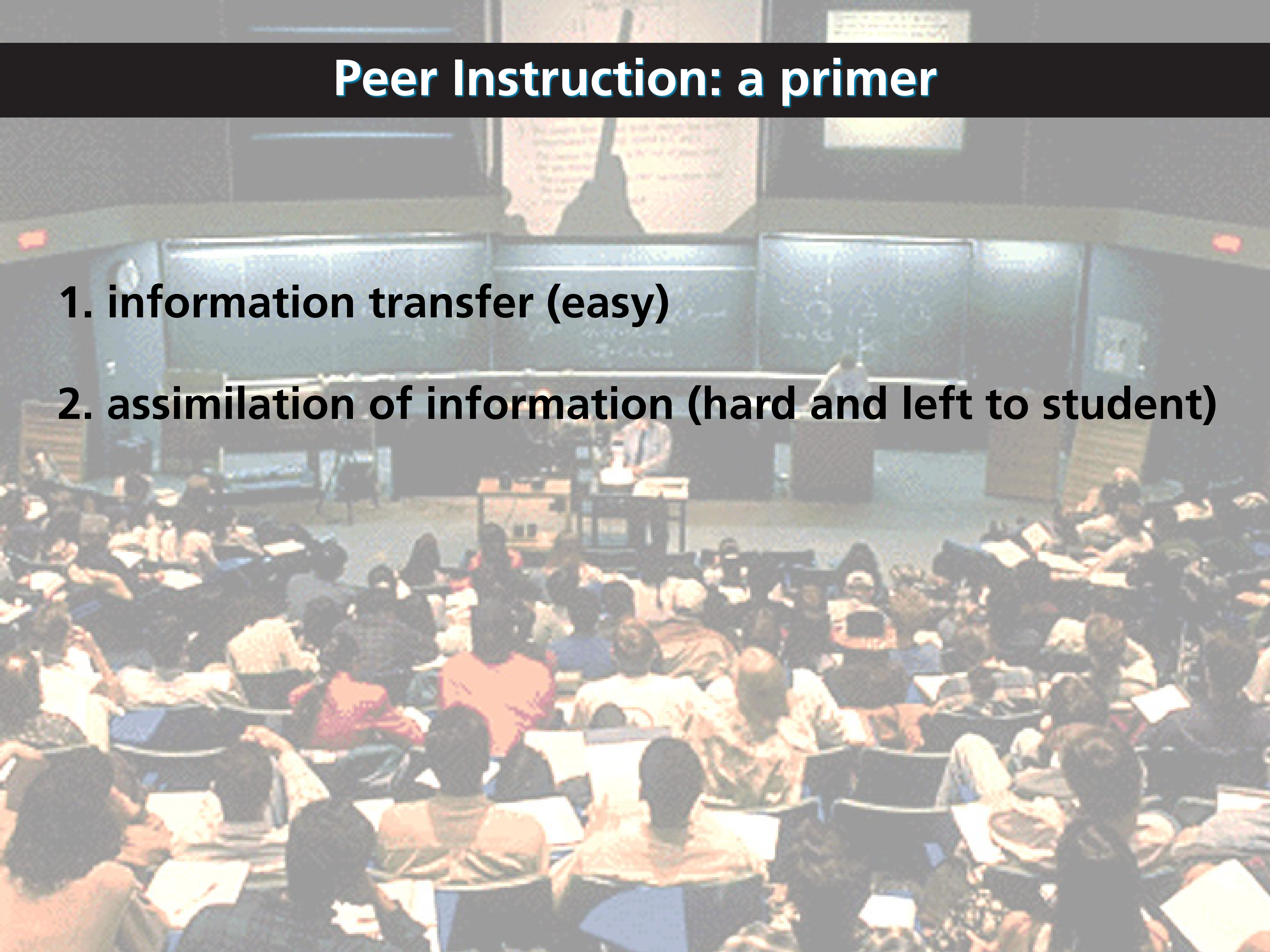
# Peer Instruction: a primer



1. information transfer

2. assimilation of information

# Peer Instruction: a primer



1. information transfer (easy)

2. assimilation of information (hard and left to student)

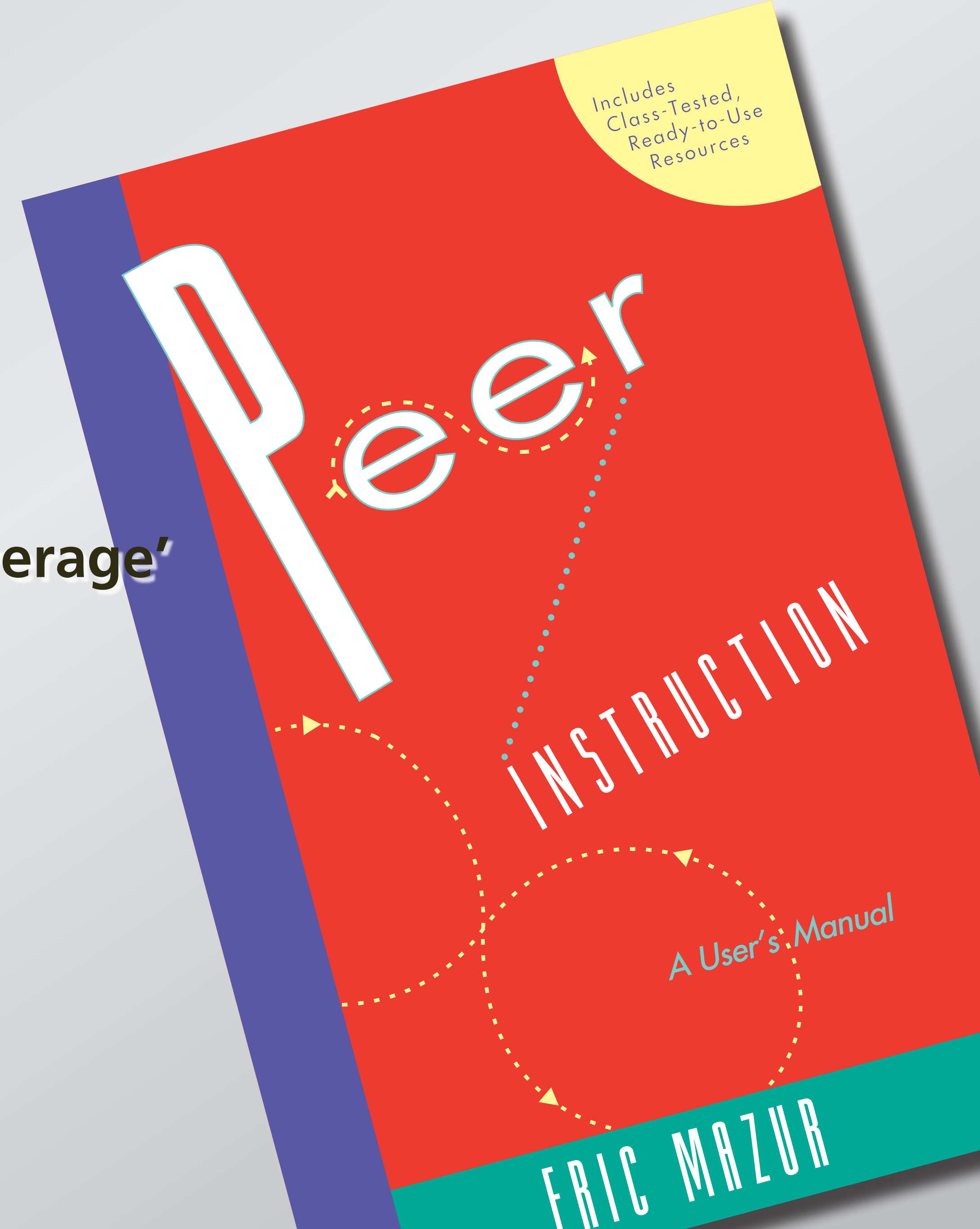
# Peer Instruction: a primer

**Solution: move information transfer out of classroom!**

# Peer Instruction: a primer

Main features:

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



# Peer Instruction: a primer

brief presentation

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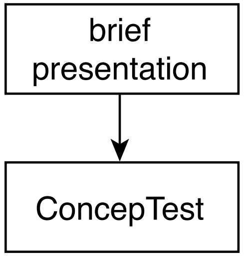

brief presentation

ConcepTest

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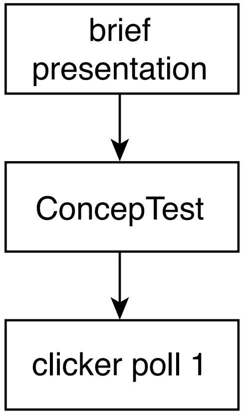

brief presentation

ConcepTest

clicker poll 1

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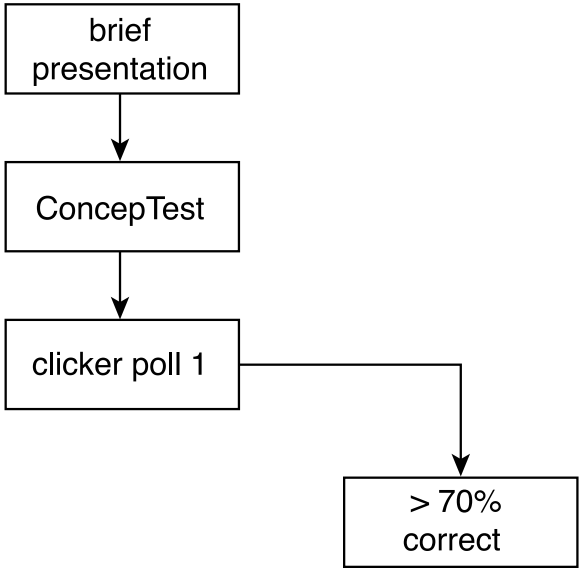

brief presentation

ConcepTest

clicker poll 1

> 70% correct

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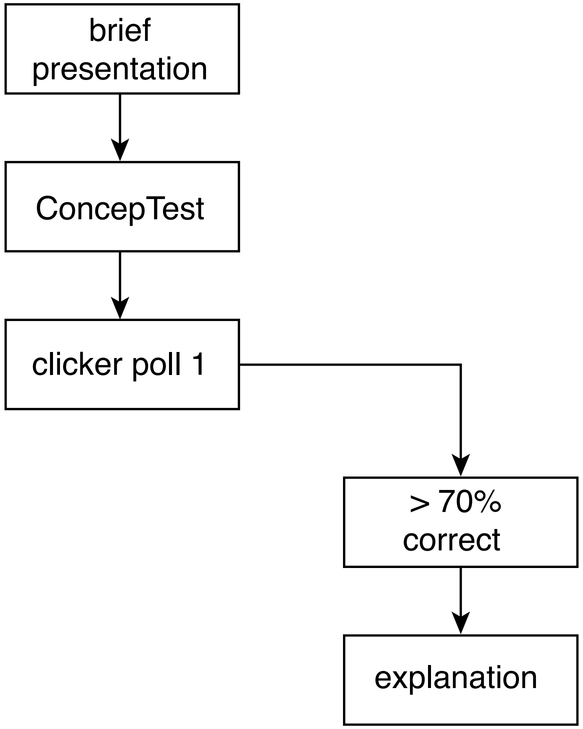

brief presentation

ConcepTest

clicker poll 1

> 70% correct

explanation

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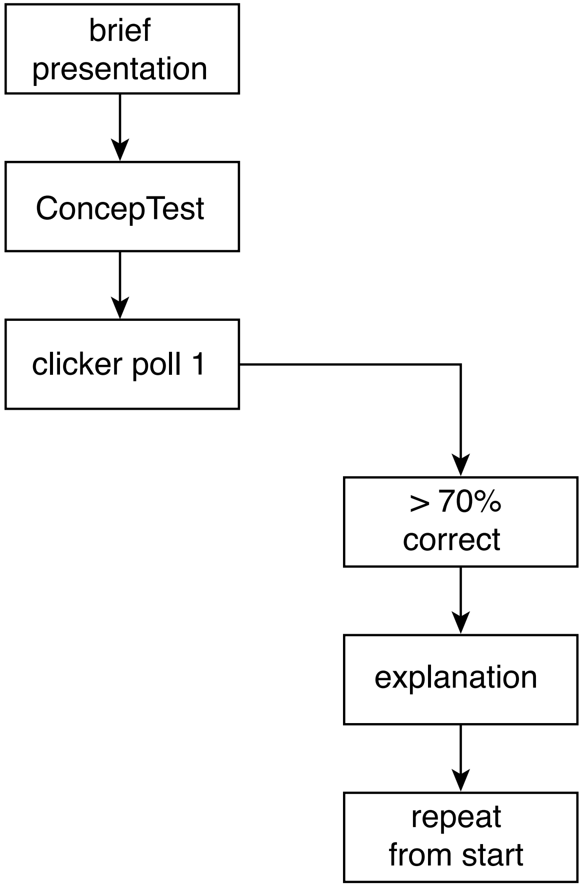


brief presentation

ConcepTest

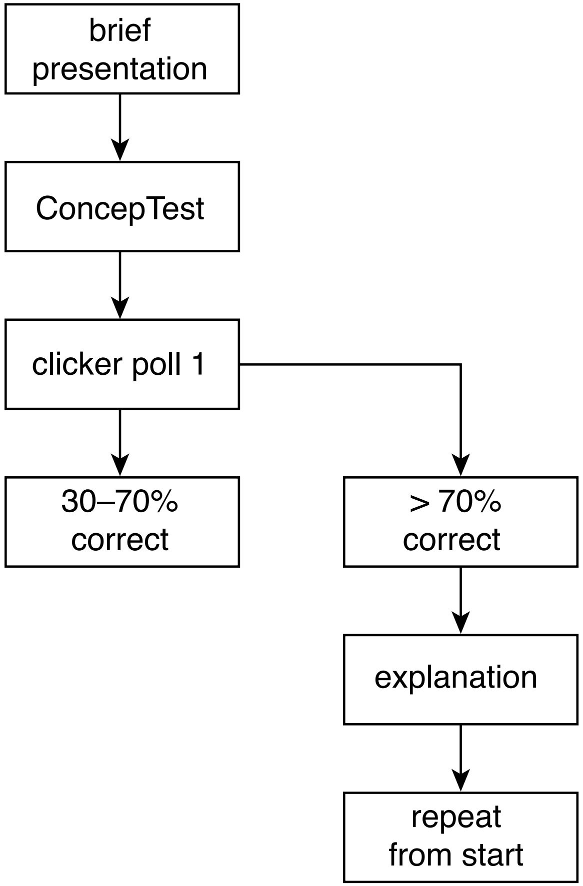
clicker poll 1

> 70% correct

explanation

repeat from start

# Peer Instruction: a primer



brief presentation

ConcepTest

clicker poll 1

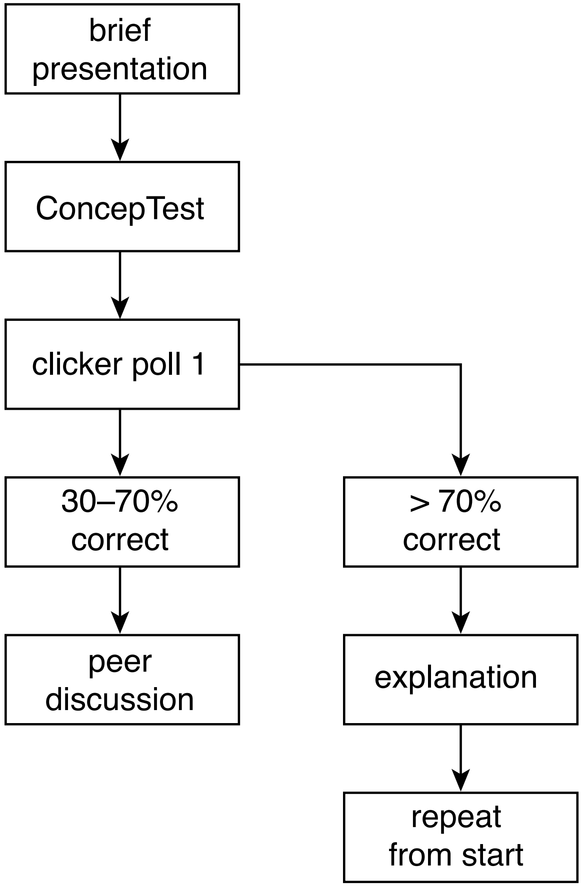
30–70% correct

> 70% correct

explanation

repeat from start

# Peer Instruction: a primer



brief presentation

ConcepTest

clicker poll 1

30–70% correct

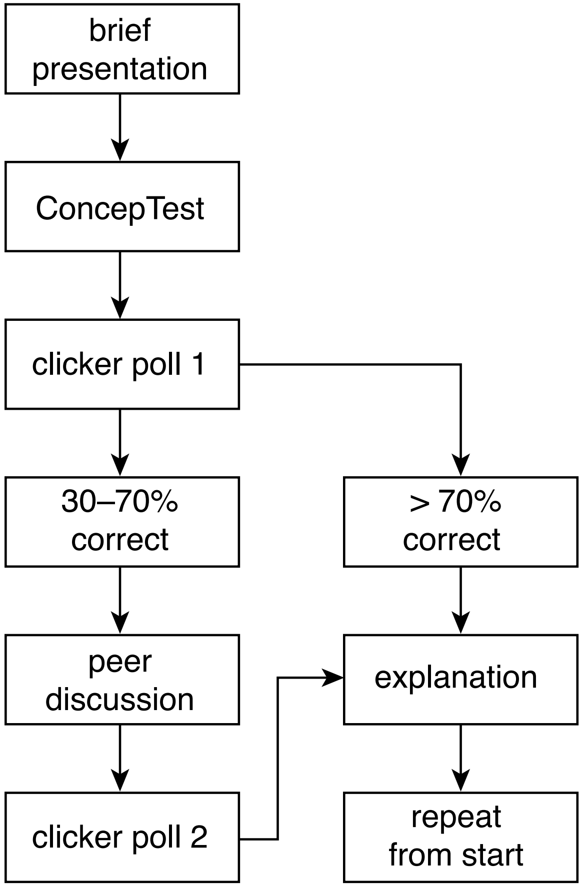
peer discussion

> 70% correct

explanation

repeat from start

# Peer Instruction: a primer


brief presentation

ConcepTest

clicker poll 1

30–70% correct

> 70% correct

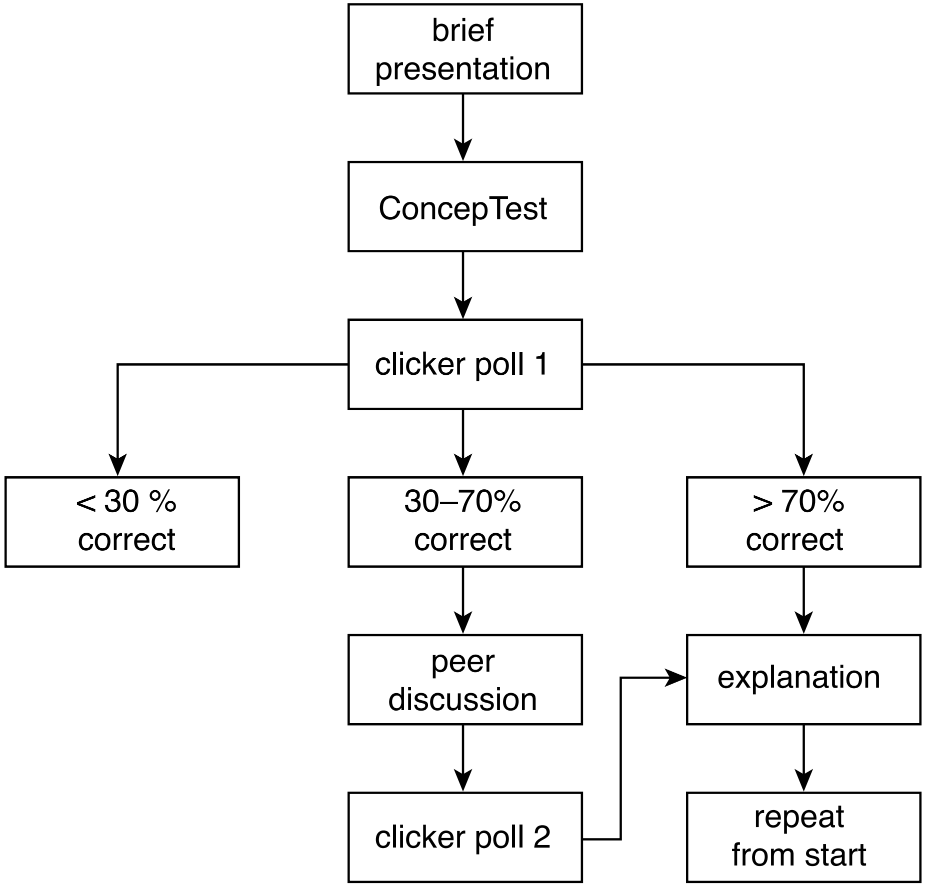
peer discussion

explanation

clicker poll 2

repeat from start

# Peer Instruction: a primer



brief presentation

ConcepTest

clicker poll 1

< 30 % correct

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> 70% correct

peer discussion

explanation

clicker poll 2

repeat from start

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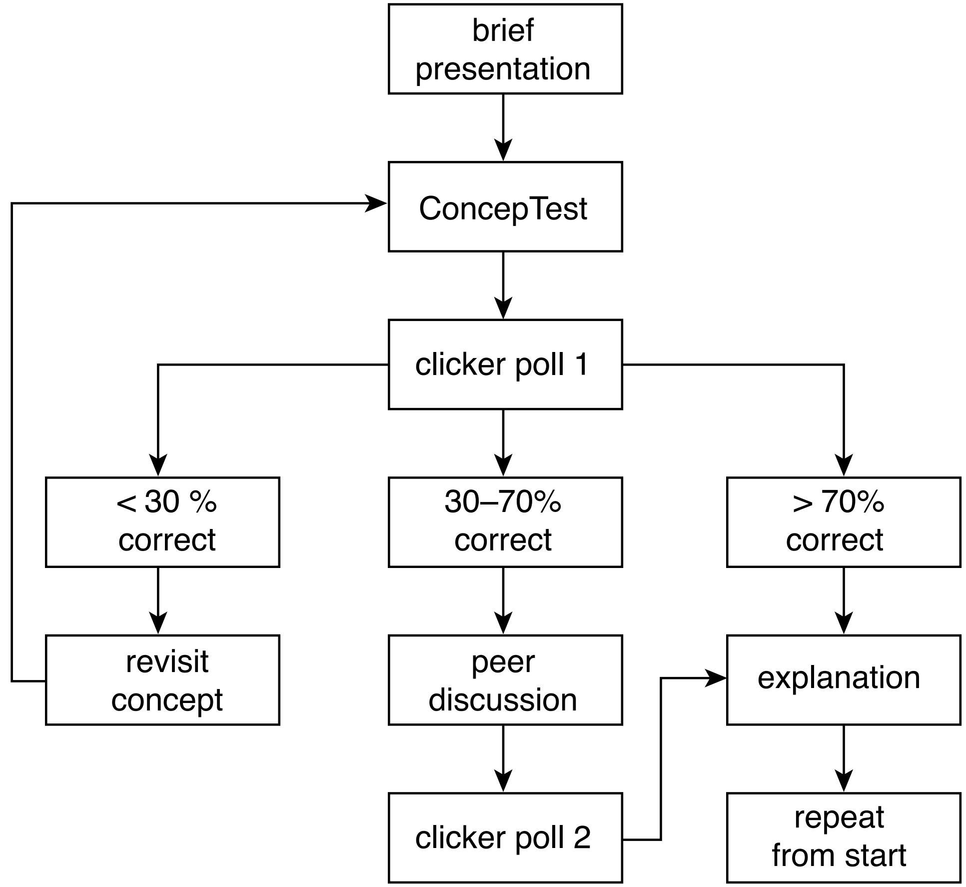

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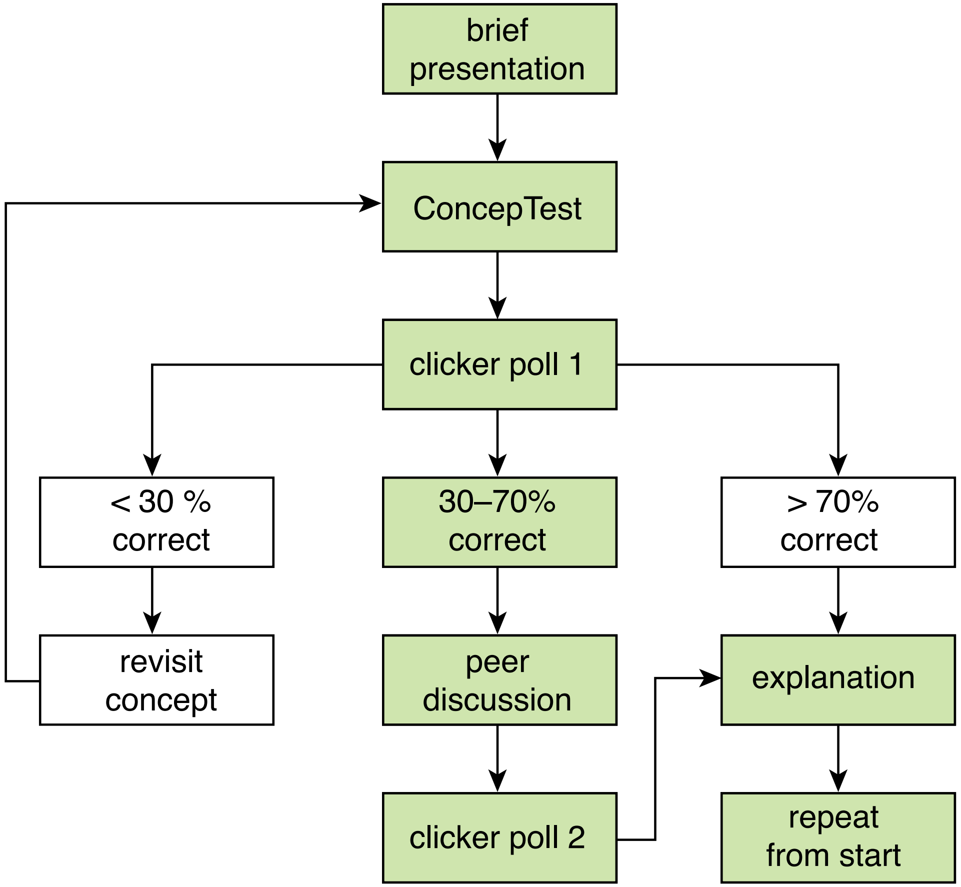


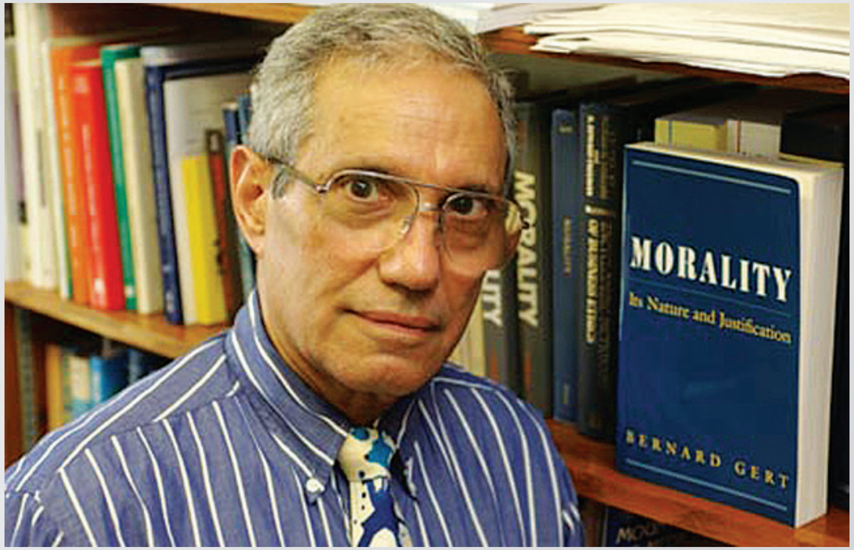
# Frequently Asked Questions

*“Can this method be used in my class,*

*where questions don’t necessarily have right answers?”*

# Let's try it!

**Bernard Gert (1934 – 2011)**



**Moral philospher**

**Professor at Dartmouth**

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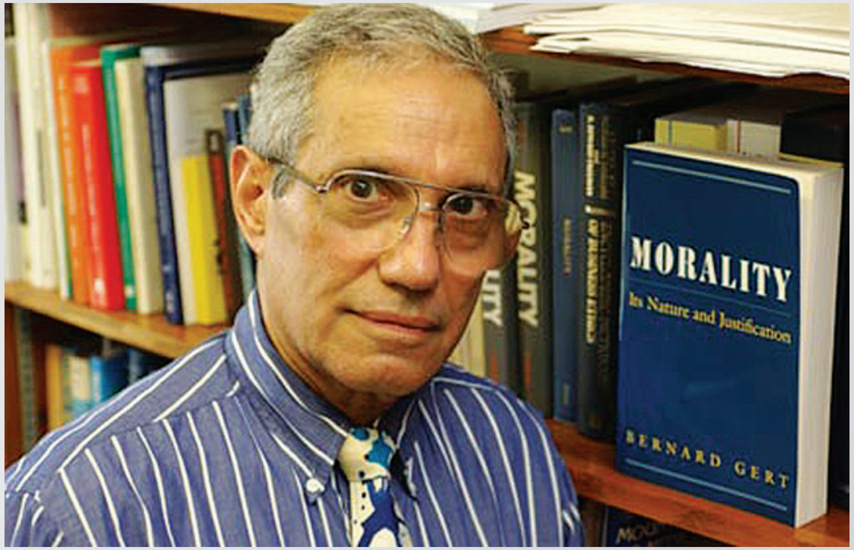

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**“Morality is an informal public system applying to all rational persons, governing behavior that affects others, and includes what are commonly known as the moral rules, ideals, and virtues and has the lessening of evil or harm as its goal.”**

# Let’s try it!

Bernard Gert’s moral system created by 10 rules:

1. Do not kill
2. Do not cause pain
3. Do not disable
4. Do not deprive of freedom
5. Do not deprive of pleasure
6. Do not deceive
7. Keep your promises
8. Do not cheat
9. Obey the law
10. Do your duty (as required by job, circumstances).

# Let’s try it!

Heinz’s wife was near death, and her only hope was a drug that had been discovered by a pharmacist who was selling it for an exorbitant price. The drug cost $20,000 to make, and the pharmacist was selling it for $200,000. Heinz could only raise $50,000 and insurance wouldn’t make up the difference. He offered what he had to the pharmacist, and when his offer was rejected, Heinz said he would pay the rest later. Still the pharmacist refused. In desperation, Heinz broke into the store and stole the drug.

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Should Heinz have broken into the store to steal the drug for his wife?

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**Should Heinz have broken into the store to steal the drug for his wife?**

1. Yes
2. No

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9. Obey the law
10. Do your duty (as required by job, circumstances).

**Should Heinz have broken into the store to steal the drug for his wife?**

1. Yes
2. No

you got all engaged!

# Frequently Asked Questions

*"How do I move information transfer out of classroom?"*

# Frequently Asked Questions

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

# Getting students to read

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

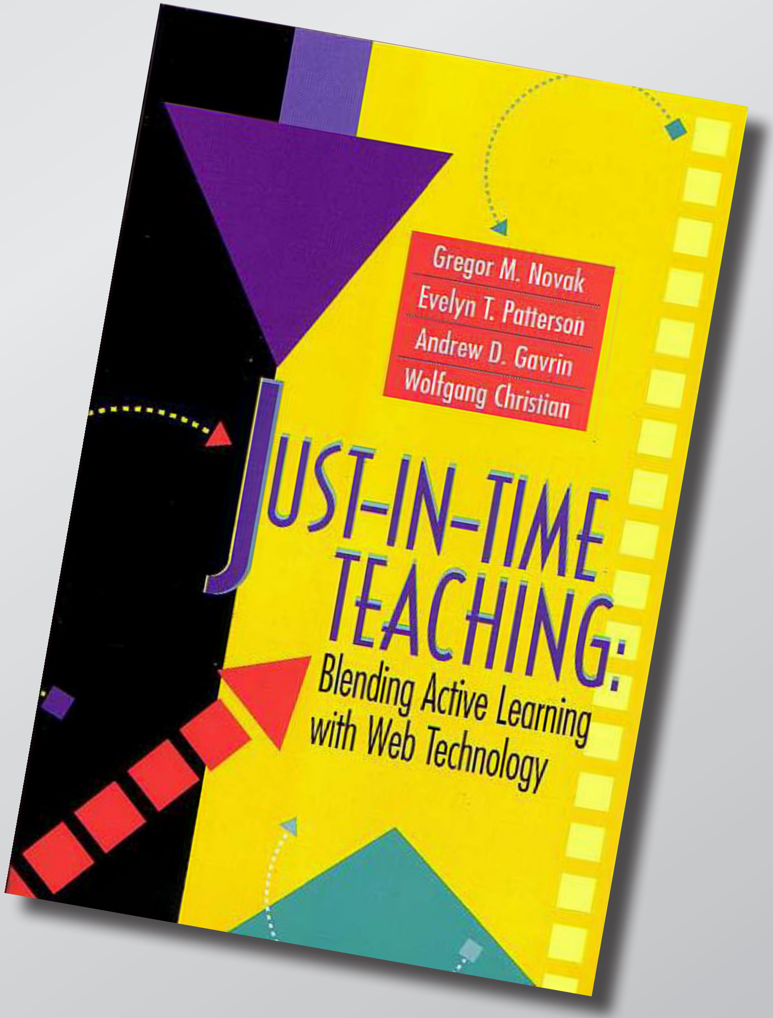
1. they don’t have time.
2. they are not motivated to learn.
3. their instructors take away the incentive.
4. they do not have the requisite skills.
5. of some other reason.
6. They do come prepared in my class!

(select what you consider to be the main reason)

# Getting students to read

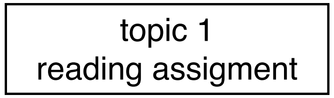
Just-in-time-Teaching (JiTT)

www.jitt.org



# Getting students to read

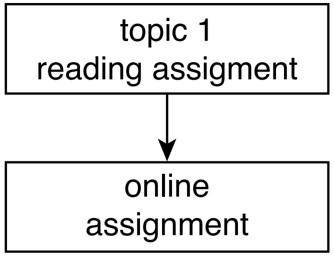
## JiTT workflow



topic 1
reading assigment

# Getting students to read

## JiTT workflow

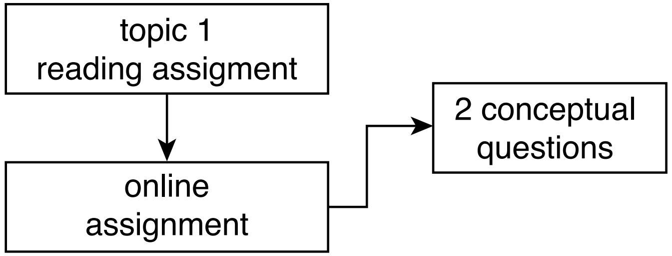


topic 1
reading assigment

online
assignment

# Getting students to read

## JiTT workflow

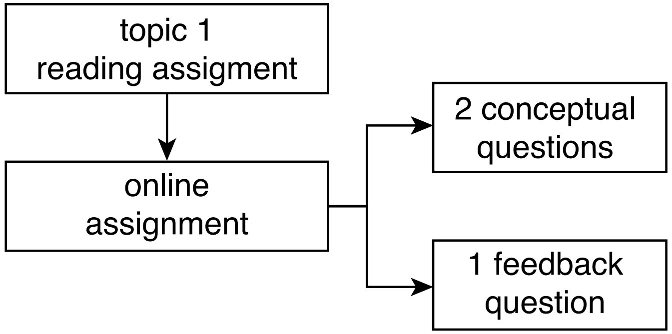

topic 1
reading assigment

online
assignment

2 conceptual
questions

# Getting students to read

## JiTT workflow



topic 1
reading assigment

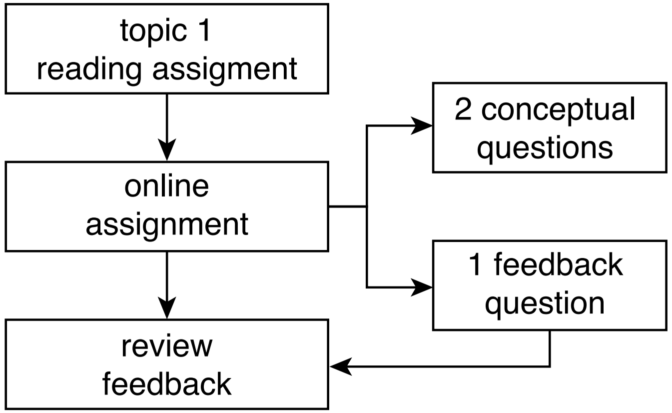
online
assignment

2 conceptual
questions

1 feedback
question

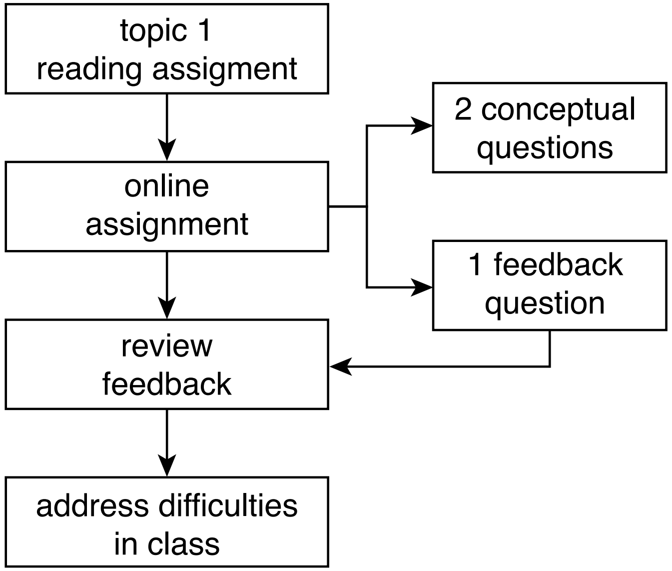
# Getting students to read

## JiTT workflow



# Getting students to read

## JiTT workflow



topic 1
reading assigment

online
assignment

2 conceptual
questions

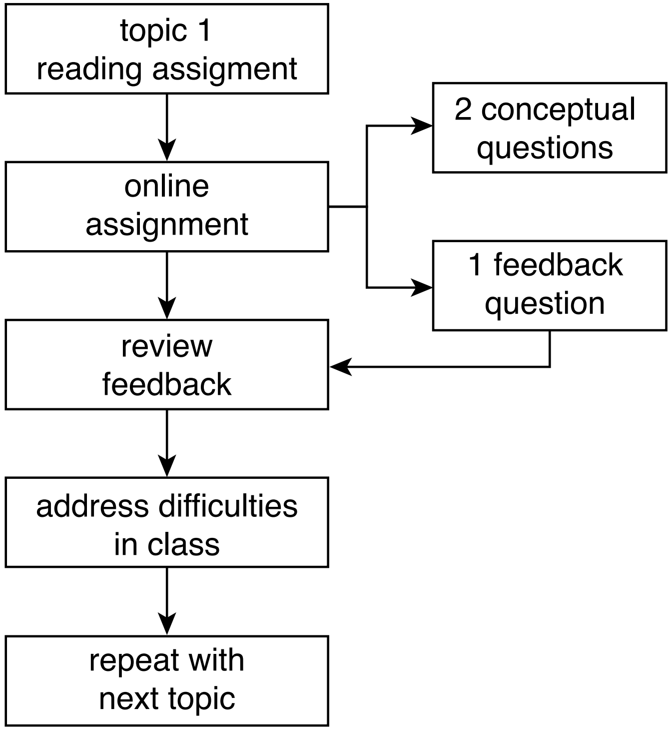
1 feedback
question

review
feedback

address difficulties
in class

# Getting students to read

## JiTT workflow



topic 1
reading assigment

online
assignment

2 conceptual
questions

1 feedback
question

review
feedback

address difficulties
in class

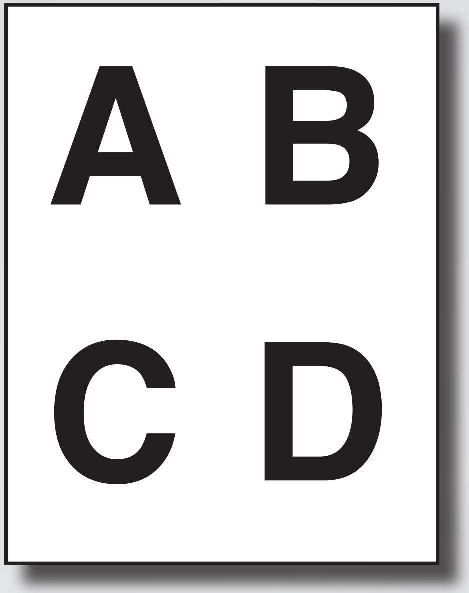
repeat with
next topic

# Frequently Asked Questions

*“Do I need clickers?”*

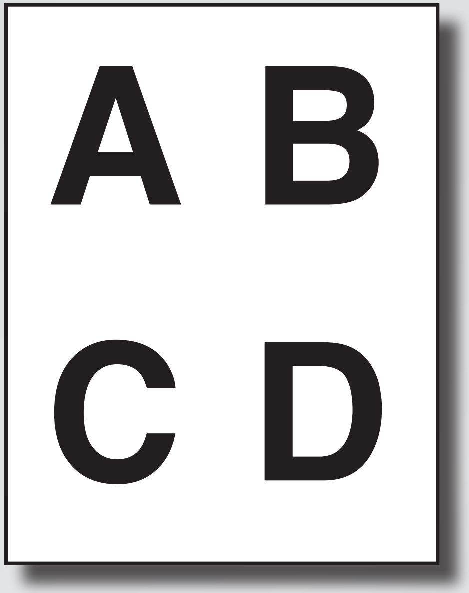
# Clickers necessary?

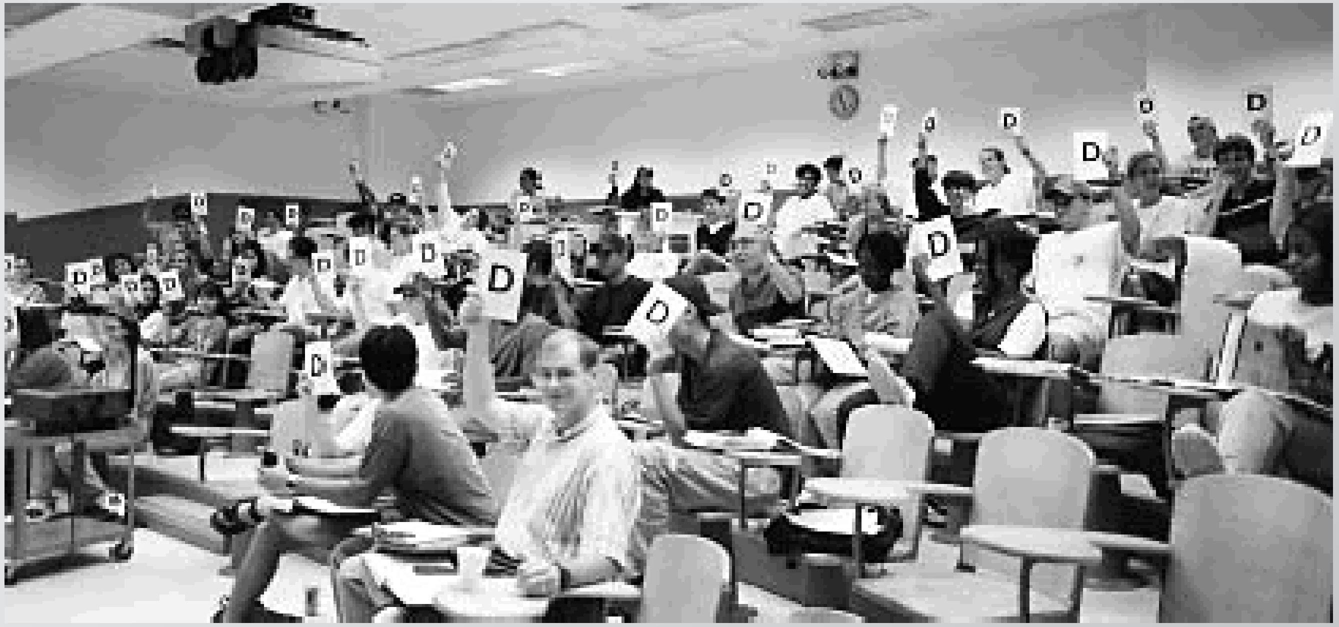
**Flashcards: simple and effective**



# Clickers necessary?

Flashcards: simple and effective





Meltzer and Mannivanan, South Eastern Louisiana University

# Clickers necessary?

circumference

# Clickers necessary?

circumference

of a circle of radius $R$ is $2\pi R$

# Clickers necessary?

Imagine a rope that fits snugly along the equator.

# Clickers necessary?

Imagine a rope that fits snugly along the equator.

Suppose the rope is cut and 1 m of rope is inserted between the cut ends. If the rope were to maintain a circular shape, how far off the surface of the Earth would it float?

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

# Clickers necessary?

*You all got fired up!*

# Clickers necessary?

*You all got fired up!*

(WITHOUT CLICKERS!)

# Clickers necessary?

Imagine a rope that fits snugly along the equator.

Suppose the rope is cut and 1 m of rope is inserted between the cut ends. If the rope were to maintain a circular shape, how far off the surface of the Earth would it float?

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3. about 0.15 m ✓
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5. more than 1 m

# Clickers necessary?

**circumference at the equator:**

$$2\pi R_E$$

# Clickers necessary?

**circumference at the equator:**

$$2\pi R_{\mathrm{E}}$$

**new circumference:**

$$2\pi R_{\mathrm{E}} + 1\ \mathrm{m}$$

# Clickers necessary?

**circumference at the equator:**

$$2\pi R_\mathrm{E}$$

**new circumference:**

$$2\pi R_\mathrm{E} + 1\ \mathrm{m}$$

**radius of circle with new circumference:**

$$2\pi R = 2\pi R_\mathrm{E} + 1\ \mathrm{m}, \quad \textbf{and so} \quad R = R_\mathrm{E} + \frac{1\ \mathrm{m}}{2\pi}.$$

# Clickers necessary?

It’s not the technology, but the pedagogy!

# Clickers necessary?

It’s not the technology, but the pedagogy!

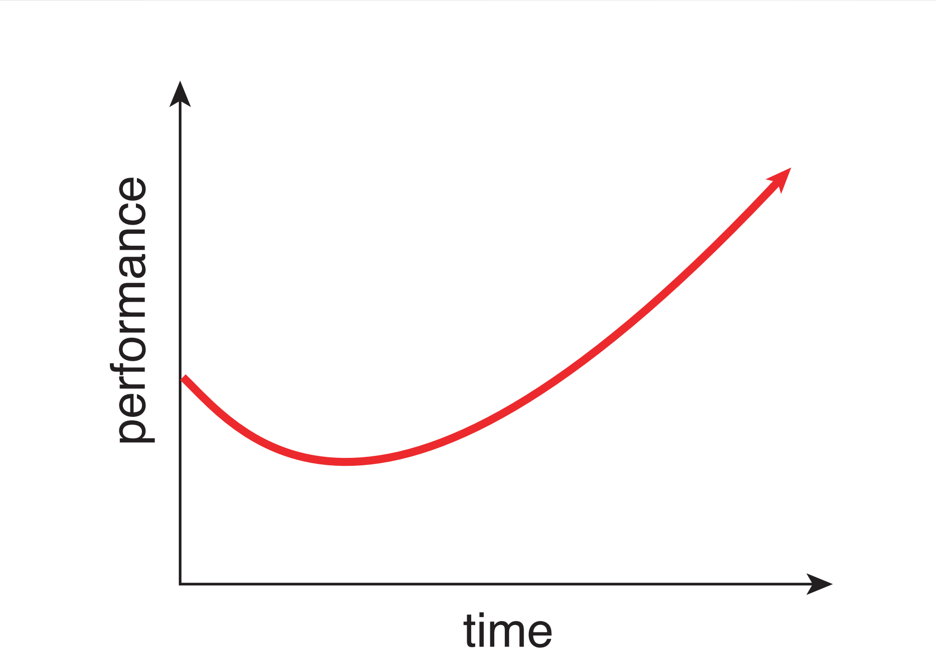
(but clickers do offer advantages)

# Frequently Asked Questions

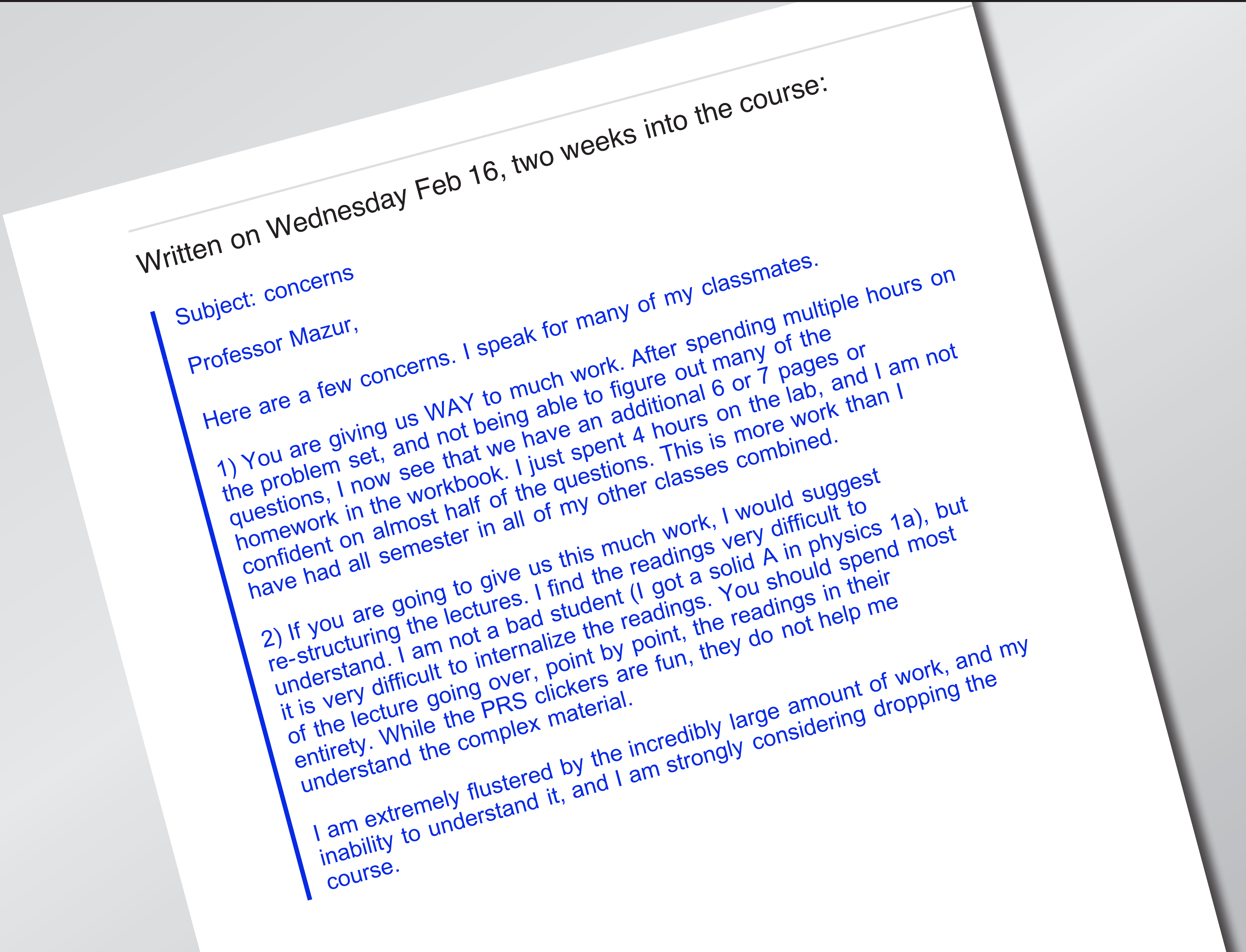
*"How do I deal with students who resist this new approach to studying?"*

# Student resistance

**After changing, things might get *worse* before they get better!**



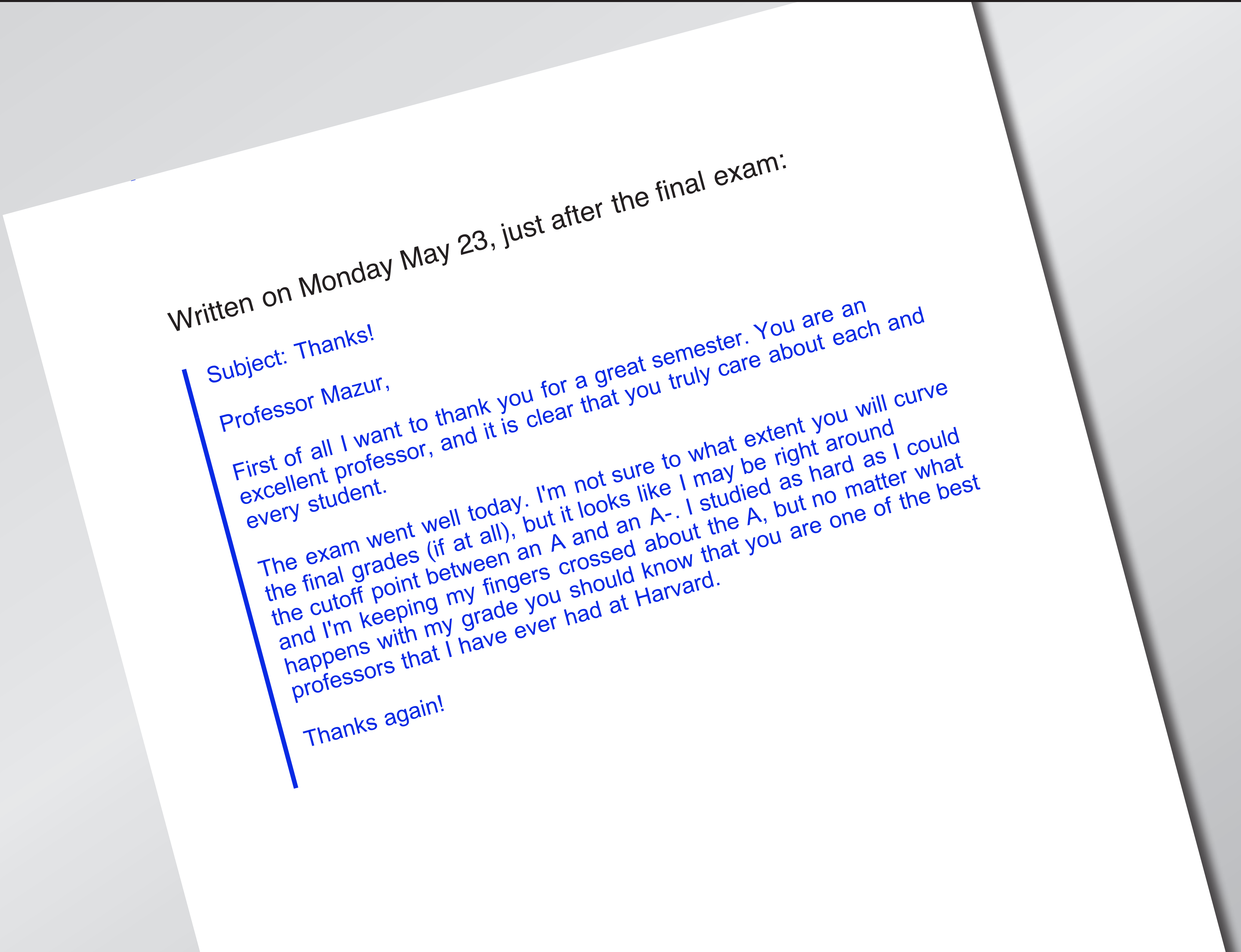
# Student resistance



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.

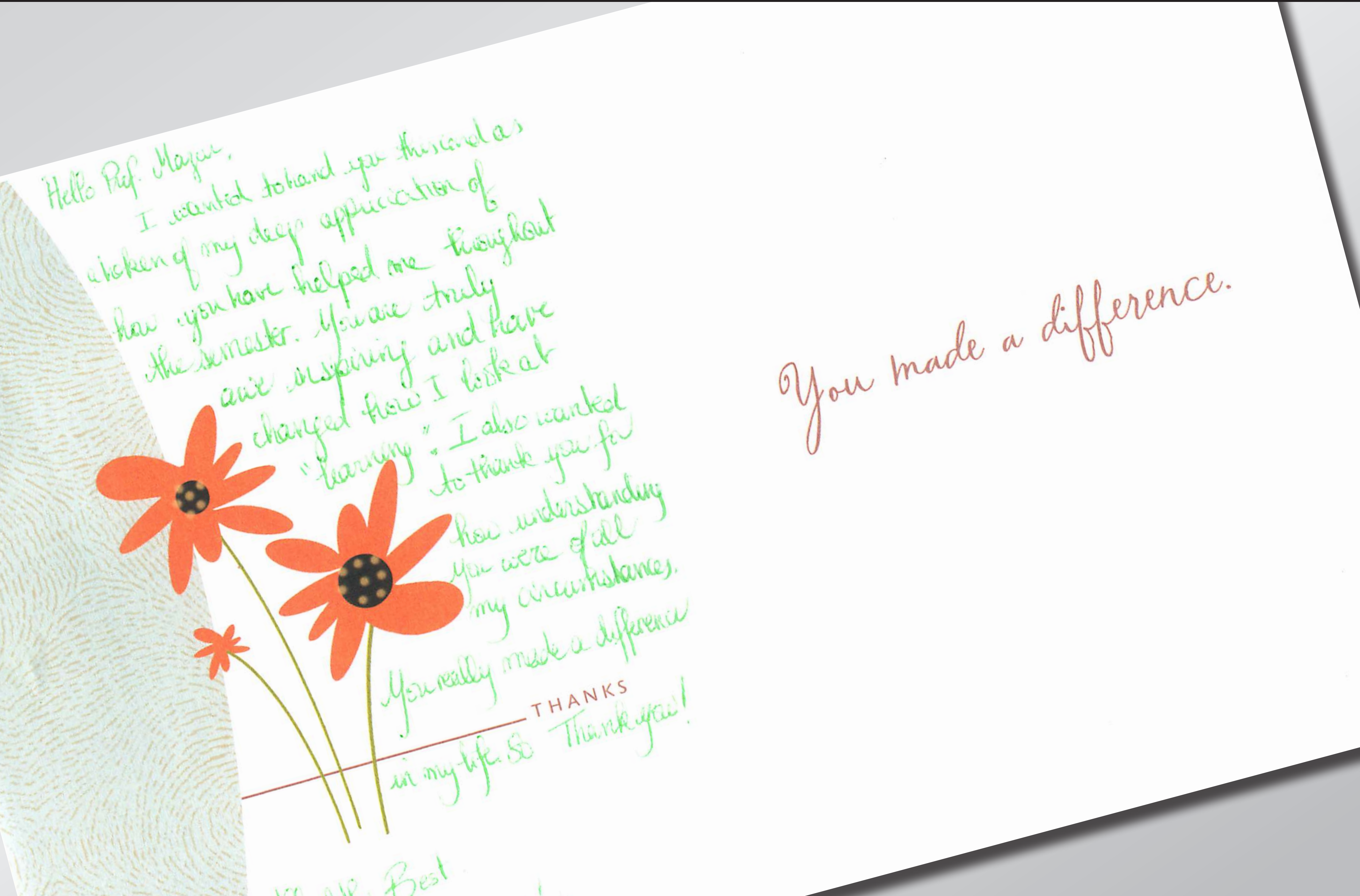
# Student resistance



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!

# Student resistance



Hello Prof. Mazur,

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 are 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

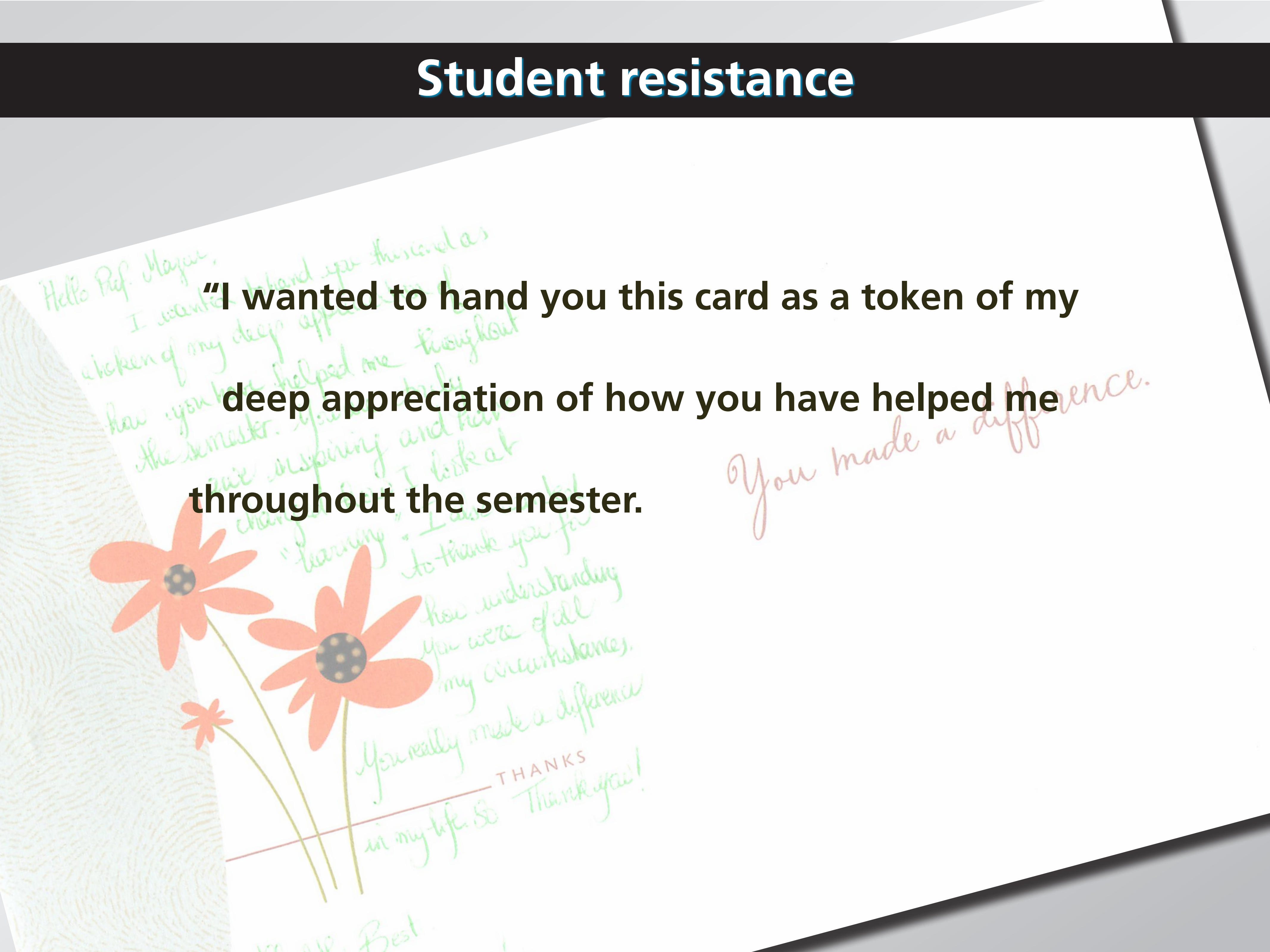
Thank you!

Best

You made a difference.

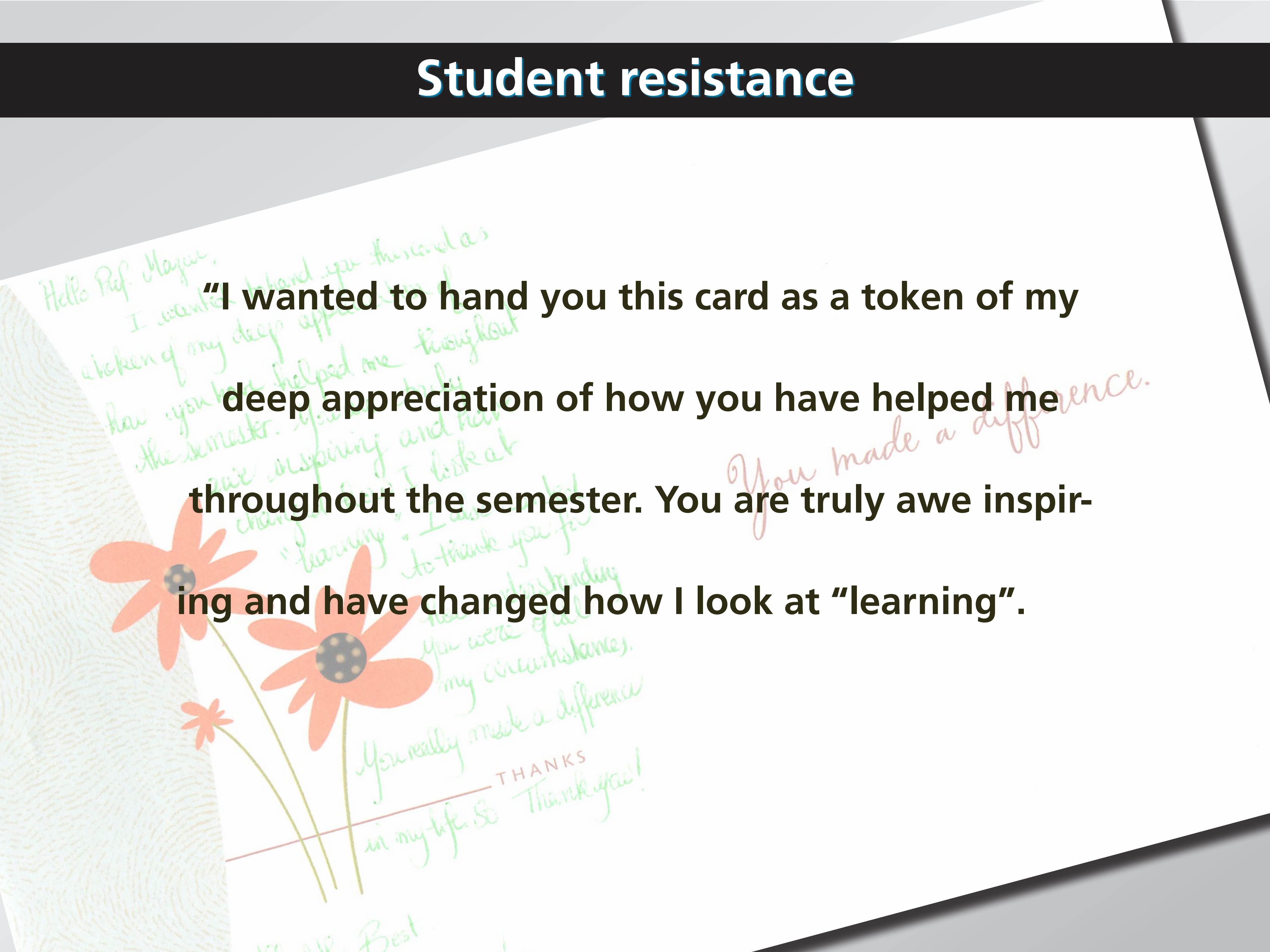
# Student resistance

"I wanted to hand you this card as a token of my deep appreciation of how you have helped me throughout the semester.



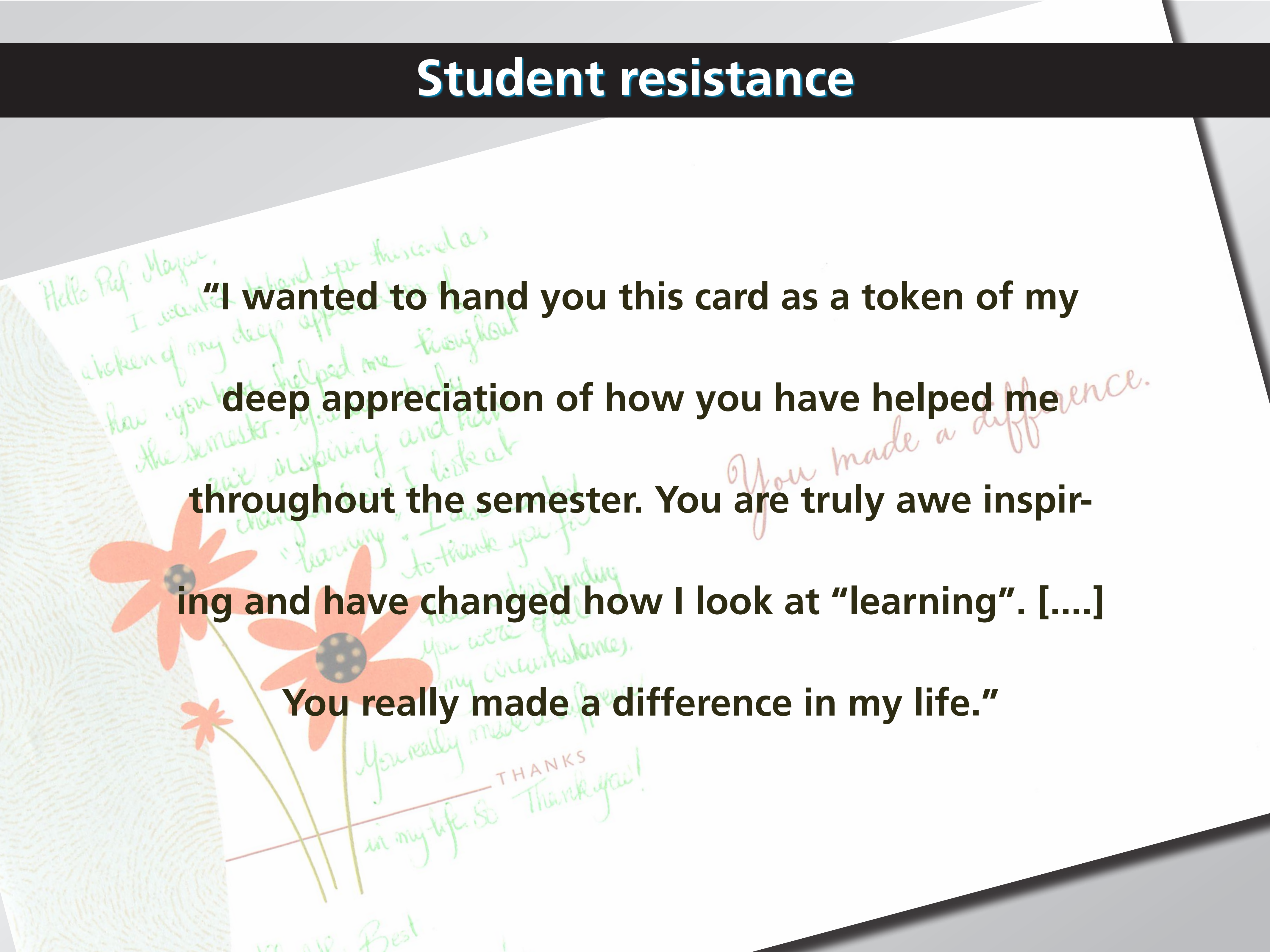
Hello Prof. Mayer,
I wanted to hand you this card as
a token of my deep appreciation of
how you have helped me throughout
the semester. You [illegible]
were inspiring and have
changed how I look at
"learning". I also wanted
to thank you for
how understanding
you were of all
my circumstances.
You really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

# Student resistance



"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".

# Student resistance



"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."

# Student resistance

and don’t forget…

# Student resistance

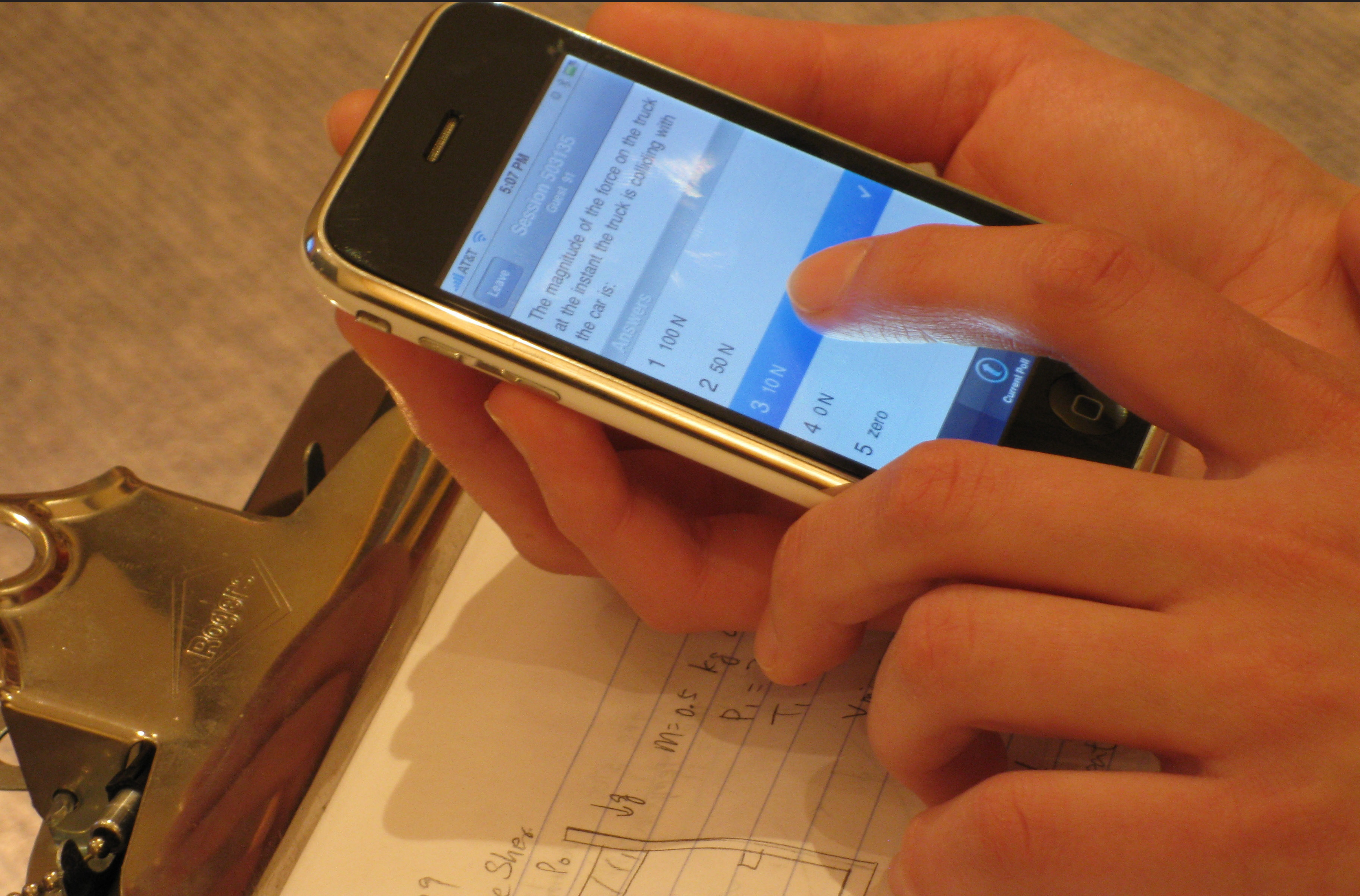
and don’t forget…

PI leads to better learning and retention!

# Getting started

*"I still need help getting started…"*

# Summary



The magnitude of the force on the truck at the instant the truck is colliding with the car is:

Answers

1 100 N

2 50 N

3 10 N

4 0 N

5 zero

# Summary

PI easy to implement (and improves learning gains)

# Summary

PI easy to implement (and improves learning gains)

technology facilitates active engagement (but not required)

**Funding:**

**National Science Foundation**

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