

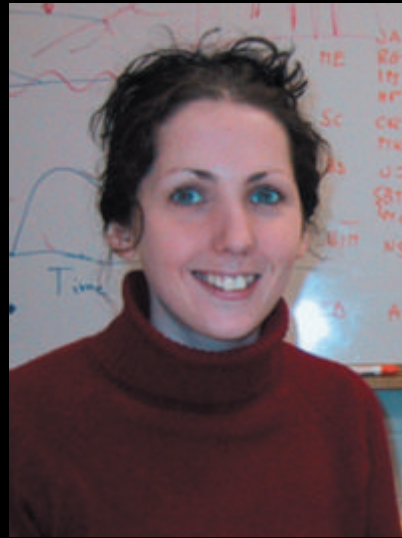
The Interactive Learning Toolkit: technology and the classroom

Canadian Association of Physicists Congress
Université Laval
Québec, QC, 10 June 2008





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and also....

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Prof. Catherine Crouch (Swarthmore)
Prof. Clifford V. Johnson (USC)**

...and hundreds students in dozens of courses

Large lectures



Large lectures

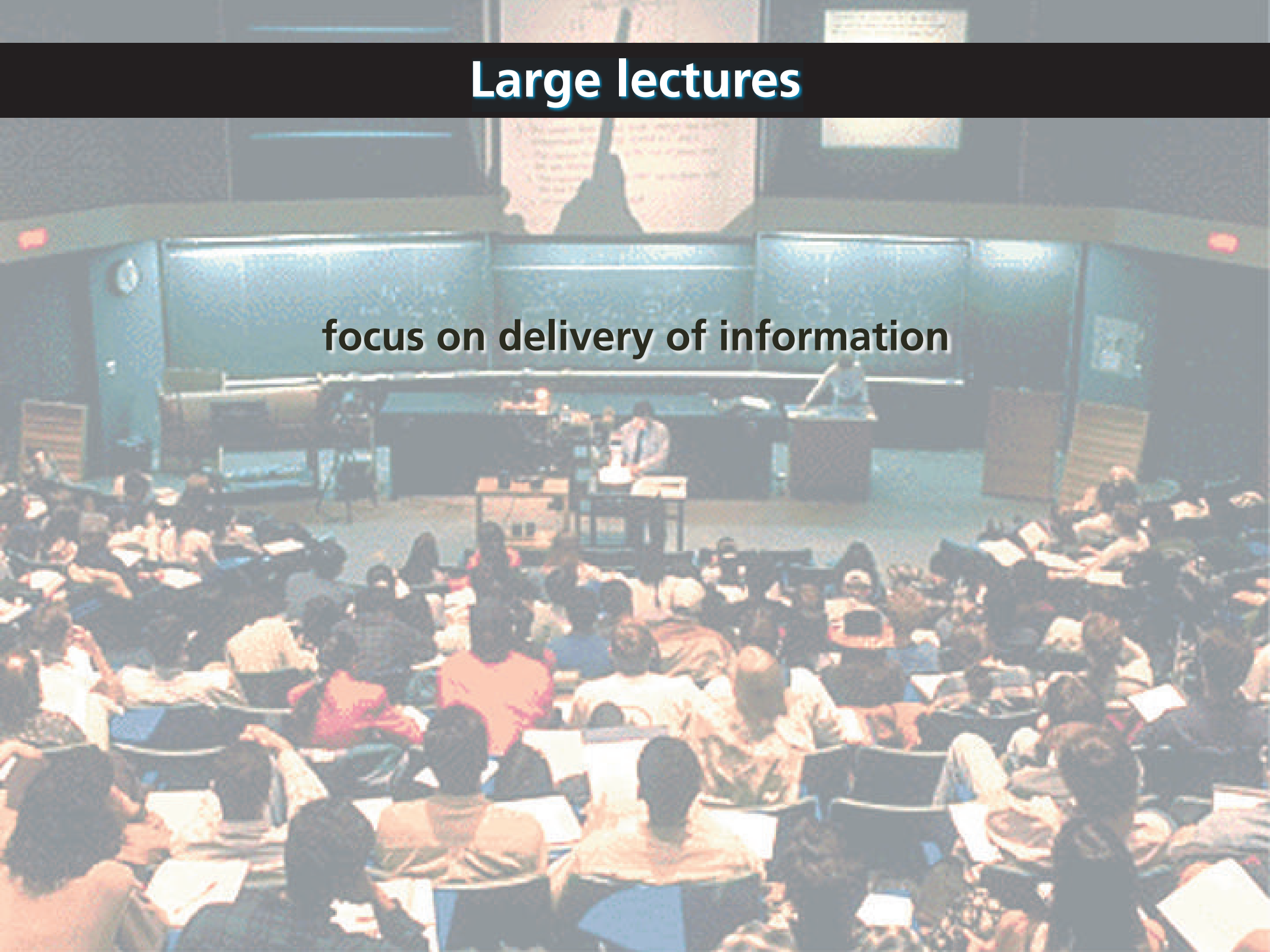
universally loathed by students and faculty alike

(but here to stay!)



Large lectures

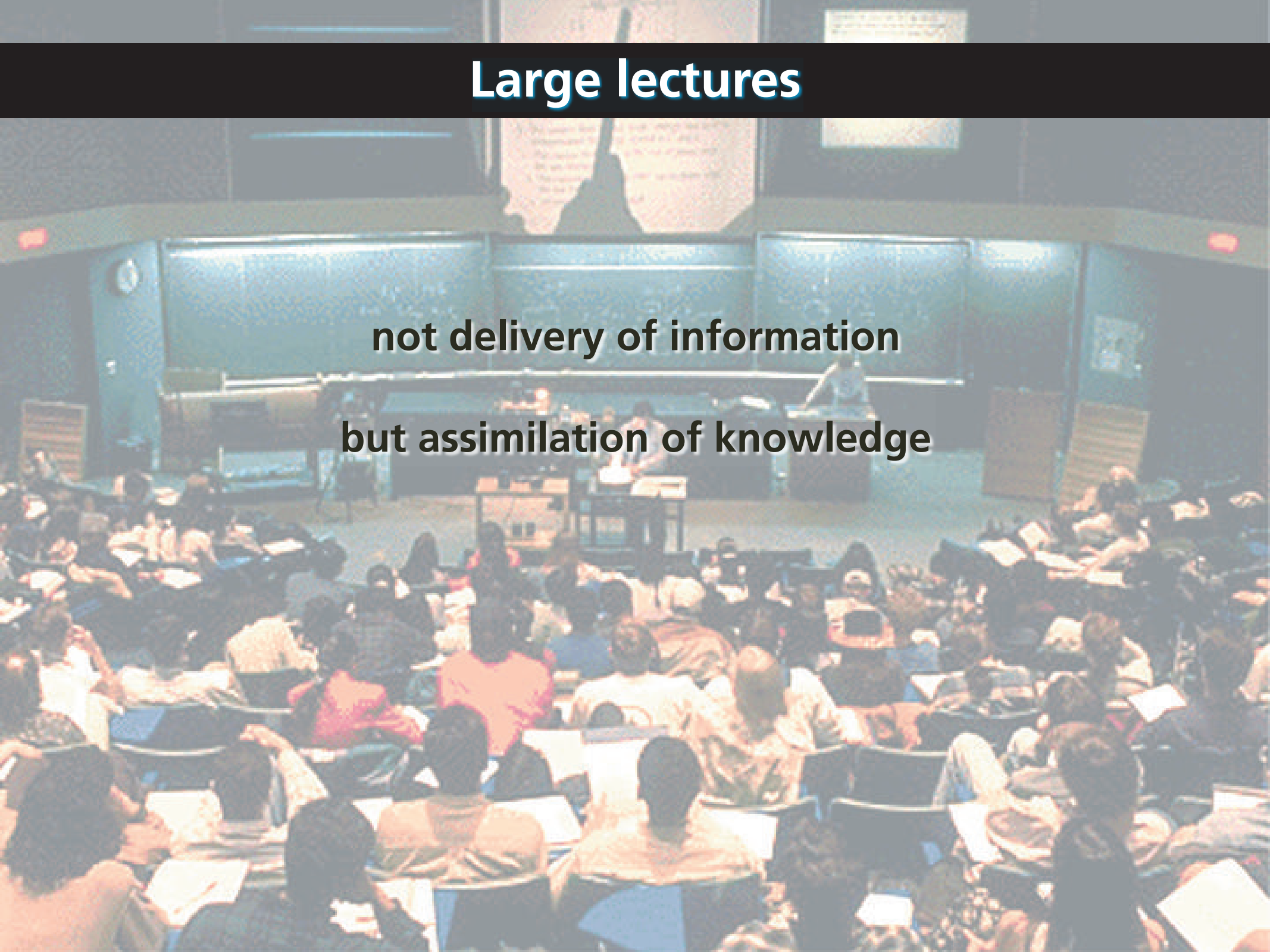
focus on delivery of information



Large lectures

not delivery of information

but assimilation of knowledge



Large lectures

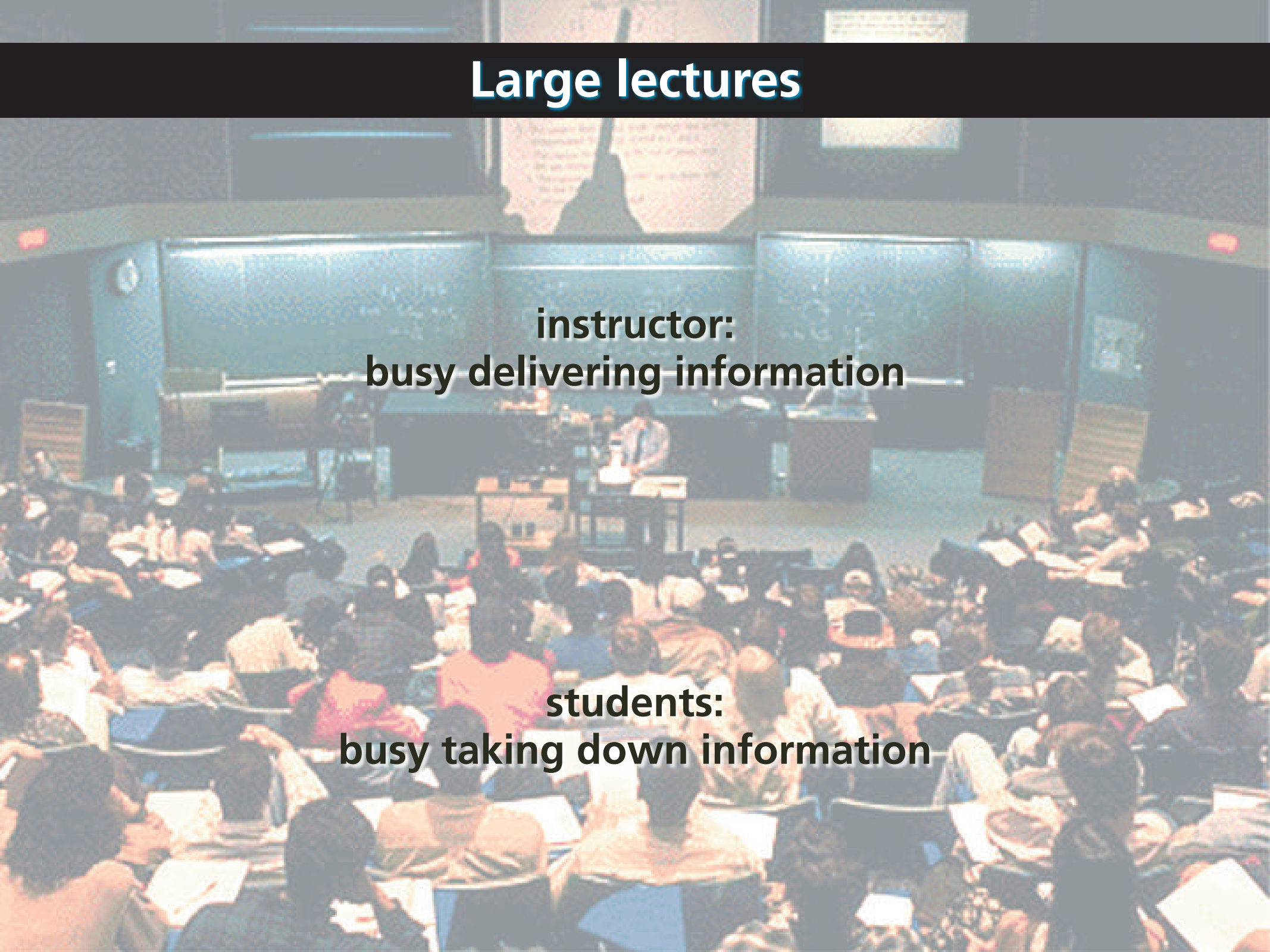
**instructor:
busy delivering information**

A photograph of a large lecture hall. An instructor is standing at a podium at the front of the room, facing a large audience of students seated at desks. The room has a curved wall with several large windows or screens. The lighting is somewhat dim, and the overall atmosphere is that of a formal academic setting.

Large lectures

**instructor:
busy delivering information**

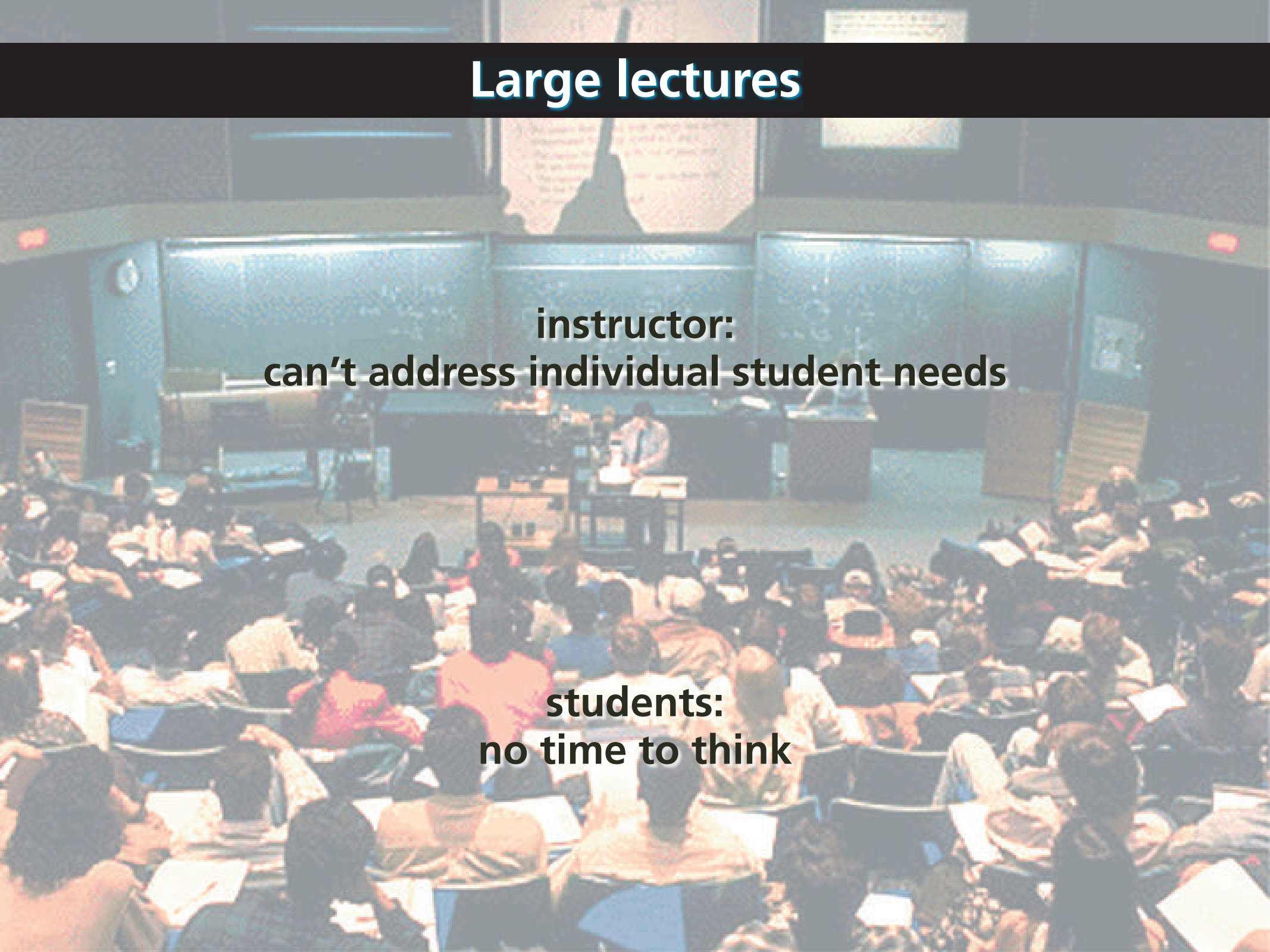
**students:
busy taking down information**



Large lectures

**instructor:
can't address individual student needs**

**students:
no time to think**



Technology



Technology

not a magic bullet

Technology

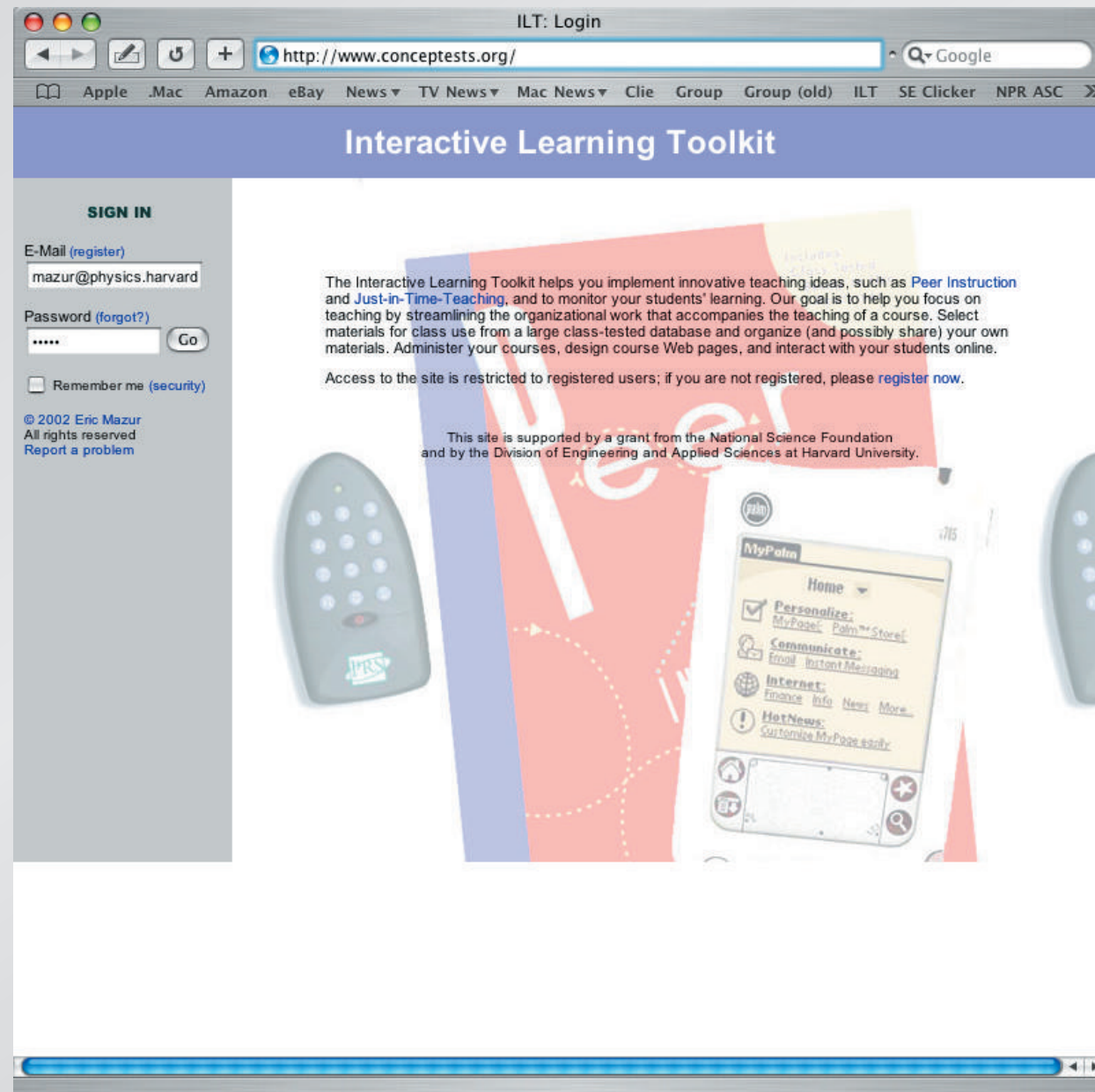
new method for delivering old content

Interactive Learning Toolkit

Use technology to

- **facilitate new modes of learning**
- **increase interaction**
- **help instructor address student needs**

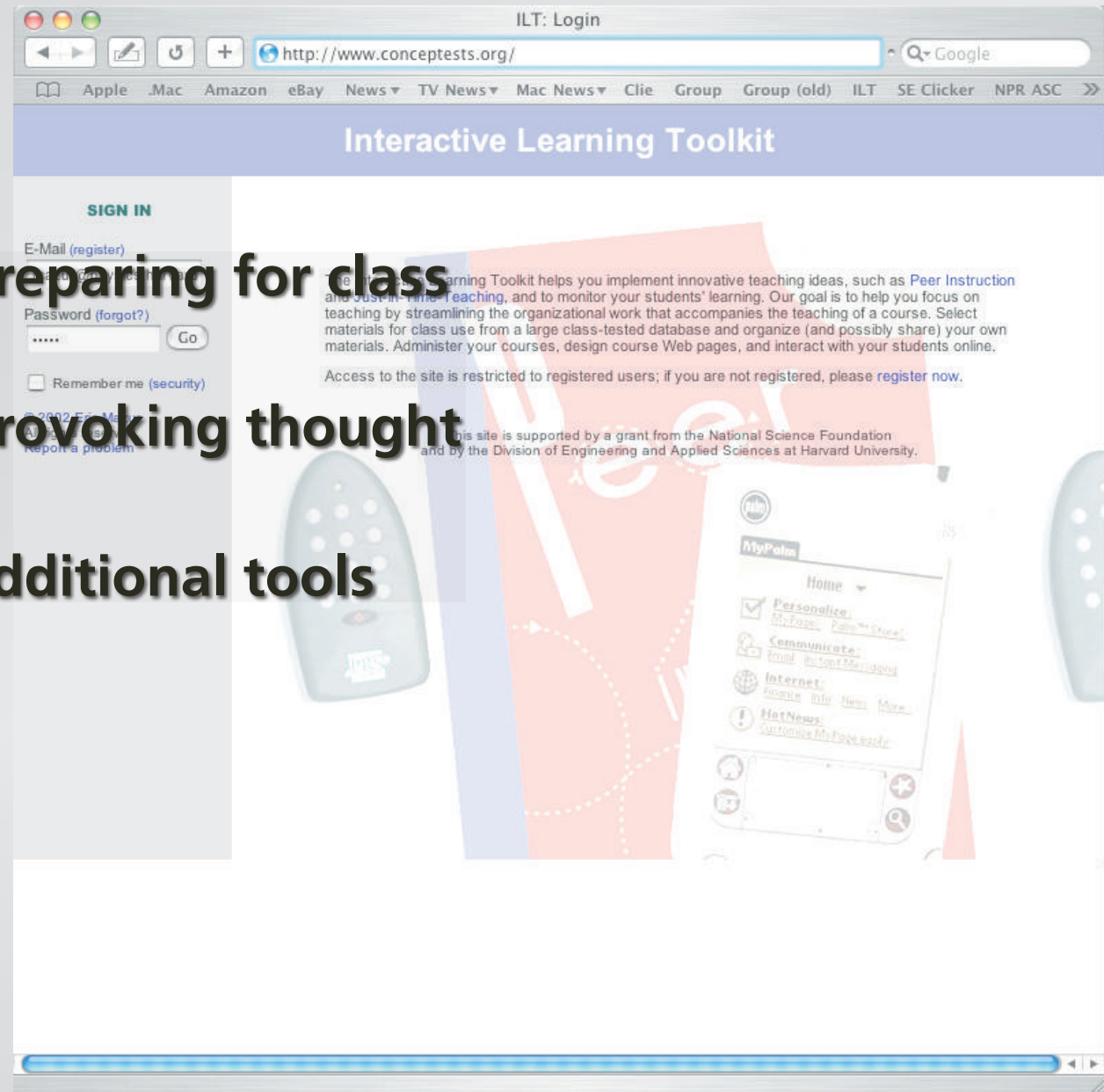
Interactive Learning Toolkit



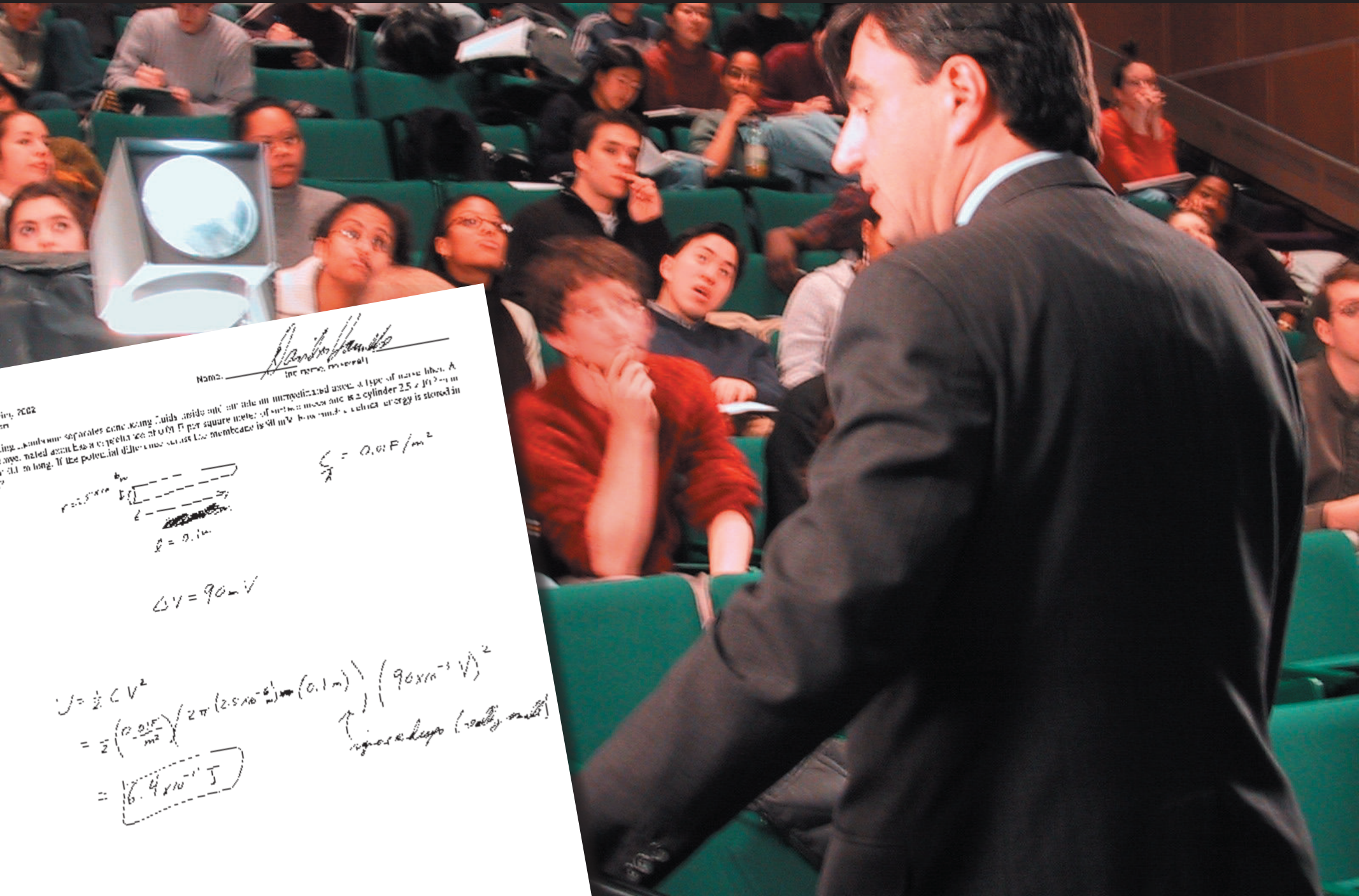
The screenshot shows a web browser window titled "ILT: Login" with the URL "http://www.concepttests.org/". The browser's address bar and search bar are visible. Below the browser window, the website's header features the title "Interactive Learning Toolkit" in a blue banner. On the left side, there is a "SIGN IN" section with a form for "E-Mail" (containing "mazur@physics.harvard") and "Password" (masked with dots), a "Go" button, and a "Remember me" checkbox. Below the sign-in form, there is a copyright notice: "© 2002 Eric Mazur, All rights reserved. Report a problem". The main content area contains a large graphic with a red and blue background, featuring a stylized "e" and a "Palm" logo. Text on the page describes the toolkit's purpose: "The Interactive Learning Toolkit helps you implement innovative teaching ideas, such as Peer Instruction and Just-in-Time-Teaching, and to monitor your students' learning. Our goal is to help you focus on teaching by streamlining the organizational work that accompanies the teaching of a course. Select materials for class use from a large class-tested database and organize (and possibly share) your own materials. Administer your courses, design course Web pages, and interact with your students online." It also states: "Access to the site is restricted to registered users; if you are not registered, please register now." At the bottom, it mentions support from the National Science Foundation and the Division of Engineering and Applied Sciences at Harvard University. The browser's status bar at the bottom shows a blue progress bar.

Outline

- preparing for class
- provoking thought
- additional tools

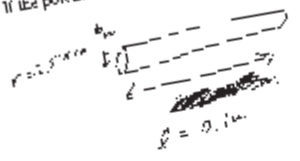


Preparing for class



Name: Daniel Daniels
(the name is correct)

... 2002
...
... separates conducting fluids inside and outside an uncharged wire. A
... coated with a dielectric of permittivity $\epsilon_0 \epsilon_r$ per square meter. The cylinder is 2.5×10^{-2} m
... long. If the potential difference across the membrane is 90 mV, how much electrical energy is stored in



$$\Delta V = 90 \text{ mV}$$

$$\epsilon = 0.01 \text{ F/m}^2$$

$$U = \frac{1}{2} C V^2$$
$$= \frac{1}{2} \left(\frac{0.01 \text{ F}}{\text{m}^2} \right) \left(2\pi (2.5 \times 10^{-2} \text{ m}) (0.1 \text{ m}) \right) \left(90 \times 10^{-3} \text{ V} \right)^2$$

↑ ignore depth (really small)

$$= \boxed{6.4 \times 10^{-11} \text{ J}}$$

Preparing for class

nameless faces

Name: Daniel Daniels
the name is correct

... separates conducting fluids inside and outside an uncharged capacitor. A large, flat area has a capacitance of 0.01 F per square meter. The cylinder is $2.5 \times 10^{-2} \text{ m}$ in diameter. If the potential difference across the membrane is 90 mV , how much electrical energy is stored in the capacitor?

$\epsilon = 0.01 \text{ F/m}^2$

$d = 0.1 \text{ m}$

$\Delta V = 90 \text{ mV}$

$U = \frac{1}{2} C V^2$

$= \frac{1}{2} \left(\frac{0.01 \text{ F}}{\text{m}^2} \right) \left(2.5 \times 10^{-2} \text{ m} \right)^2 \left(0.1 \text{ m} \right) \left(90 \times 10^{-3} \text{ V} \right)^2$

$= 16.4 \times 10^{-11} \text{ J}$

ignore depth (really small)

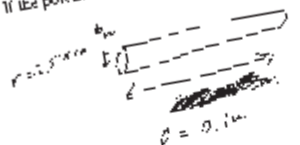
Preparing for class

nameless faces

faceless names

Name: Stanley Daniels
(the name is correct)

... 2002
...
... separates two conductors into an unneutralized space, a type of noise filter. A
... coated area has a capacitance of ... per square meter. The innermost wire is a cylinder 2.5×10^{-2} m
... 0.1 m long. If the potential difference between the wires is 90 mV, how much electrical energy is stored in



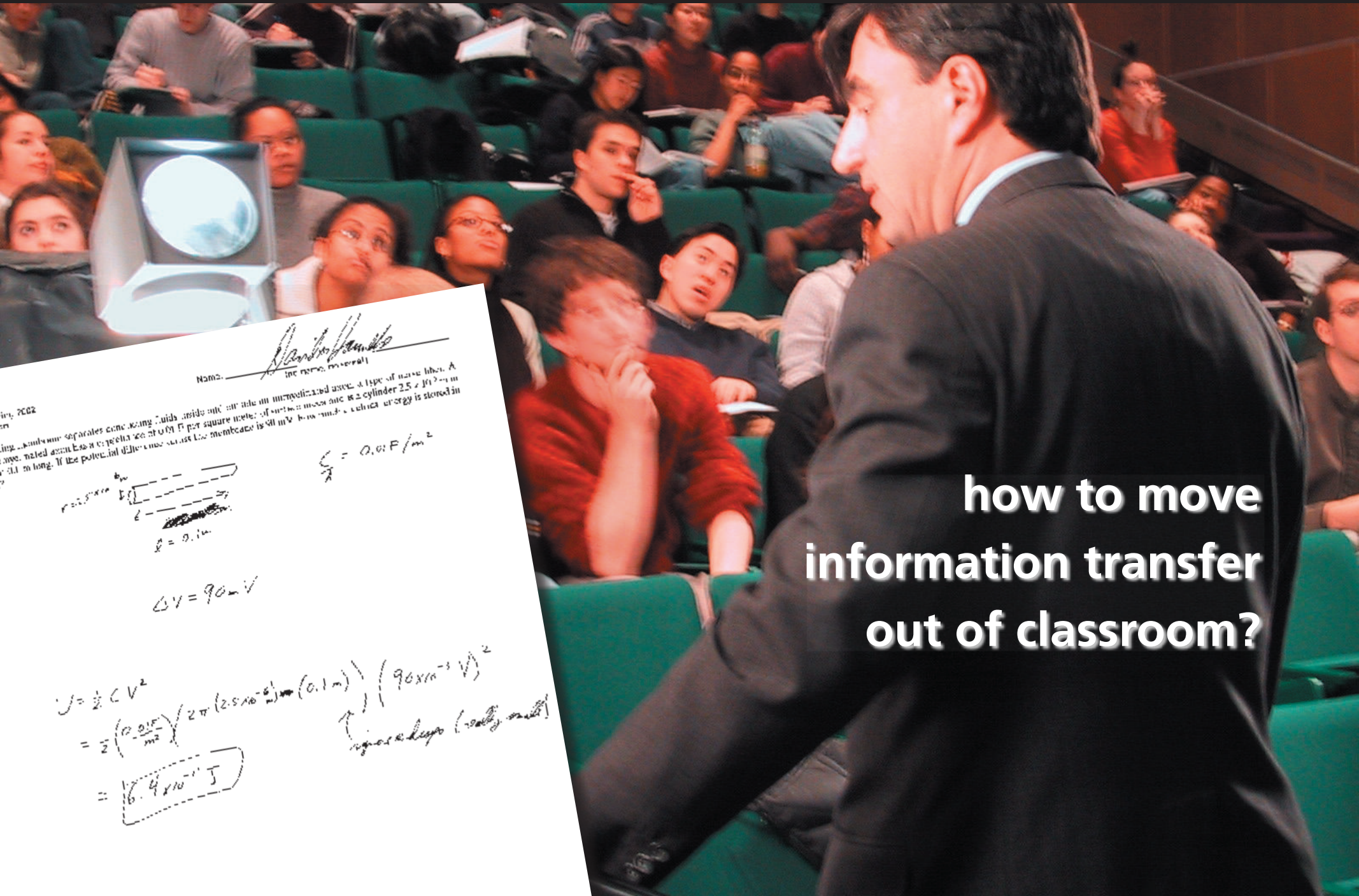
$$\Delta V = 90 \text{ mV}$$

$$U = \frac{1}{2} C V^2$$
$$= \frac{1}{2} \left(\frac{0.015}{\text{m}^2} \right) / 2\pi (2.5 \times 10^{-2}) (0.1 \text{ m}) \left(90 \times 10^{-3} \text{ V} \right)^2$$

↑ ignore depth (really small)

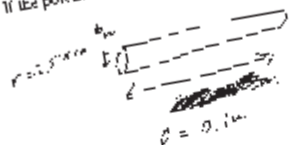
$$= \boxed{6.4 \times 10^{-11} \text{ J}}$$

Preparing for class



Name: Daniel Daniels
(the name is correct)

Phys 2002
A dielectric separates two conducting plates of area A and separation d . The dielectric constant is ϵ_r . The electric field is E . The potential difference across the membrane is 90 mV . How much electrical energy is stored in the capacitor?



$$\Delta V = 90 \text{ mV}$$

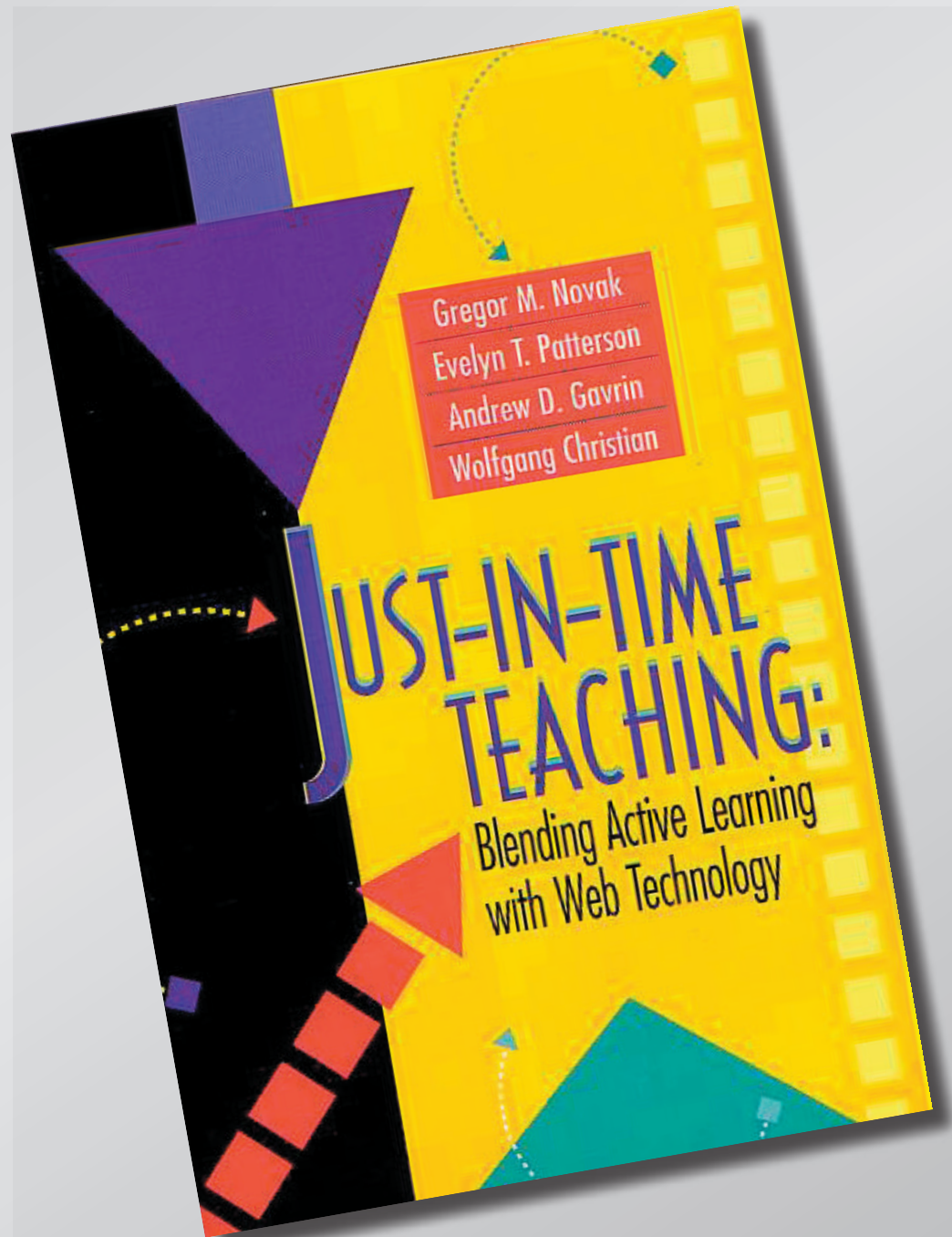
$$\epsilon = 0.01 \text{ F/m}^2$$

$$U = \frac{1}{2} C V^2$$
$$= \frac{1}{2} \left(\frac{0.01 \text{ F}}{\text{m}^2} \right) \left(2\pi (2.5 \times 10^{-2} \text{ m}) (0.1 \text{ m}) \right) \left(90 \times 10^{-3} \text{ V} \right)^2$$
$$= \boxed{6.4 \times 10^{-11} \text{ J}}$$

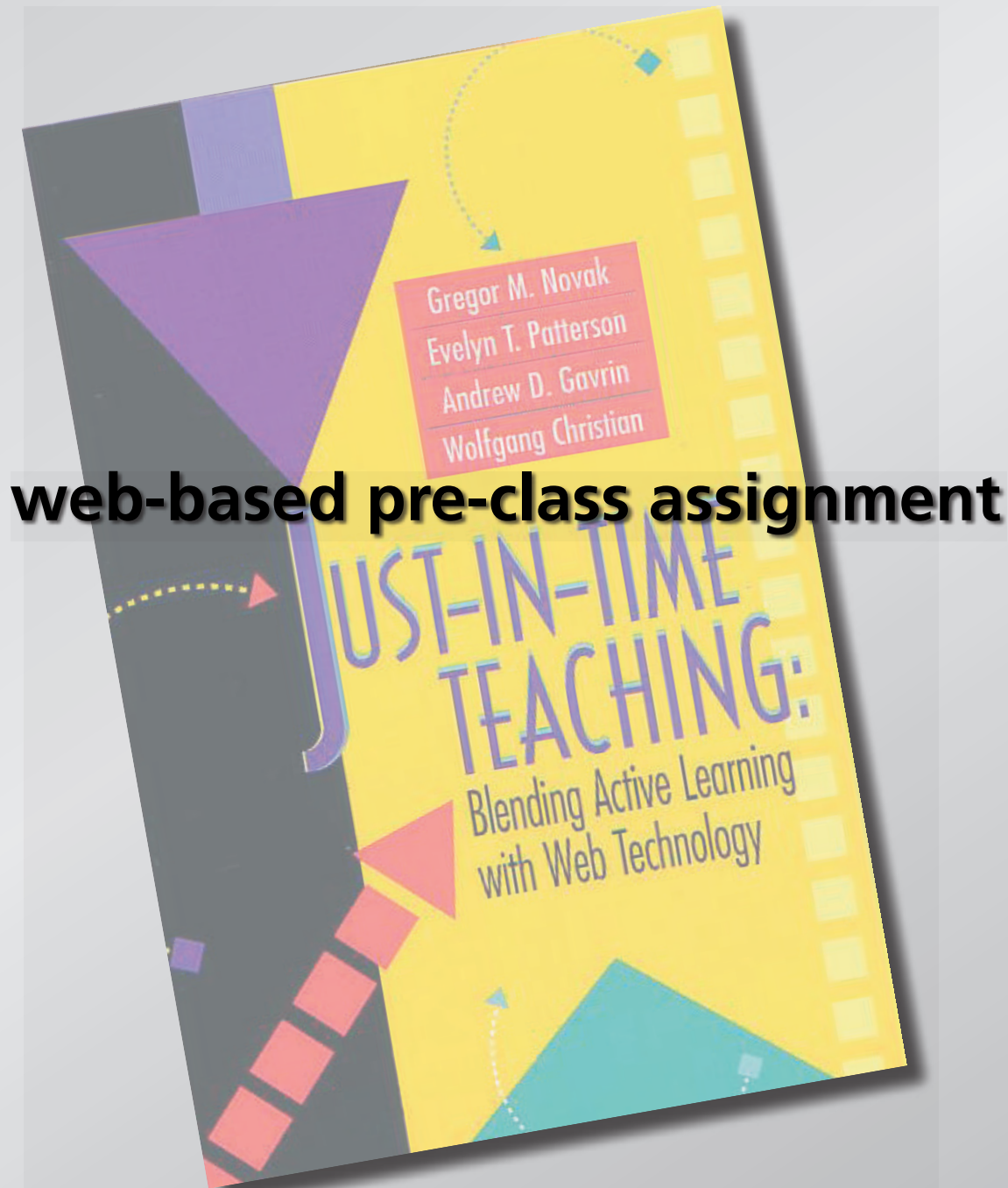
↑ ignore depth (really small)

how to move
information transfer
out of classroom?

Preparing for class



Preparing for class



Preparing for class

The screenshot shows a web browser window titled "ILT: Students" with the URL "http://www.conceptest.org/". The browser's address bar and navigation buttons are visible. The website's navigation menu includes "HOME", "READING", "LECTURES", "ASSIGNMENTS", "FORUMS", "NEWS", and "HANDOUTS". The user is logged in as "Eric Mazur".

The main content area is titled "Physics 1b" and shows a forum post for "Changing magnetic fields II". The post asks students to identify a single point of the reading that was most difficult or confusing. Below the post, there are controls for flagging similarities (set to 60) and navigation for 1-100 of 153 answers. A summary states "Total of 7 responses sent to students for this assignment".

A table displays the responses:

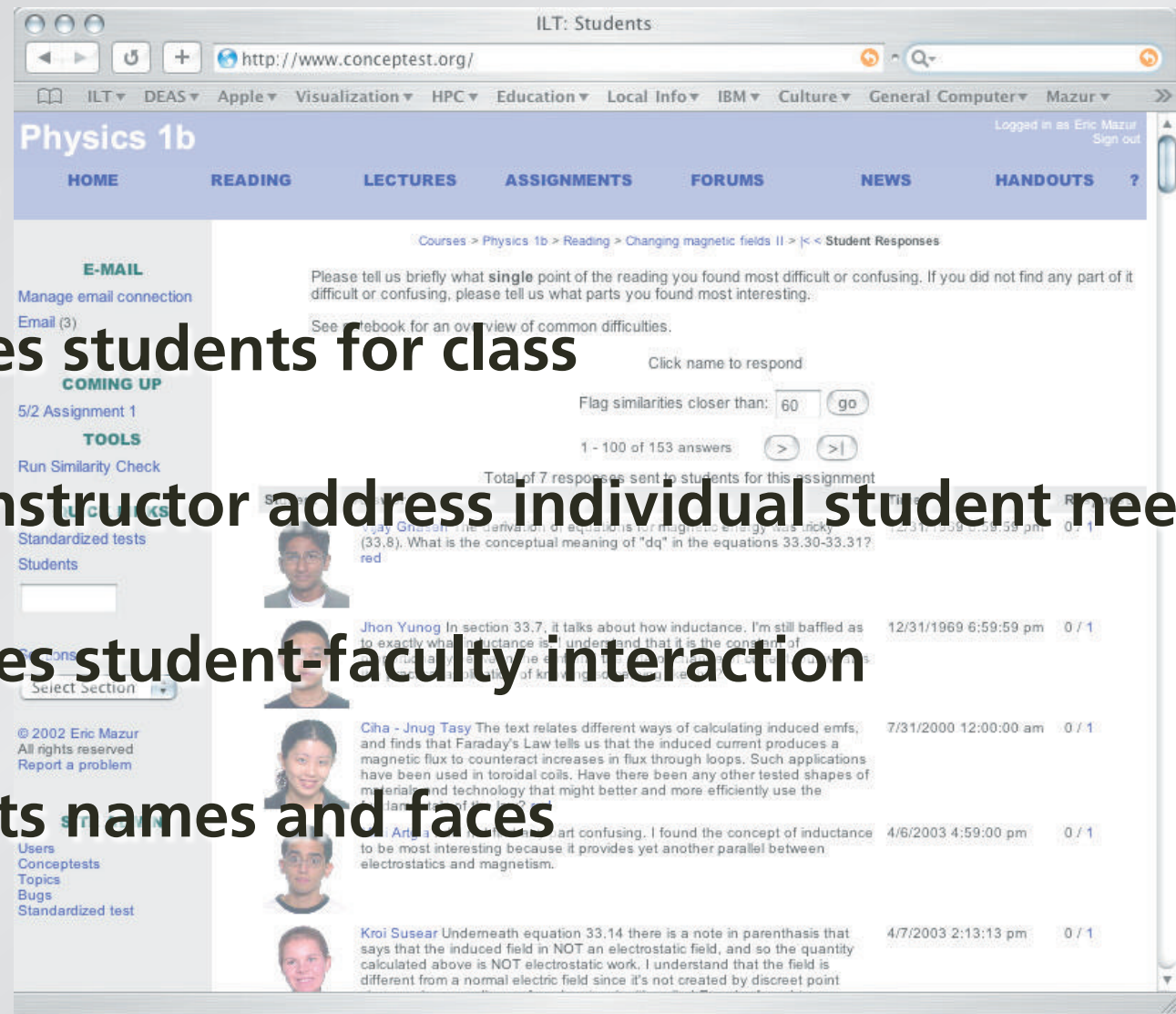
Student	Answer	Time	Response
	Vijay Gnaseh The derivation of equations for magnetic energy was tricky (33.8). What is the conceptual meaning of "dq" in the equations 33.30-33.31? red	12/31/1969 6:59:59 pm	0 / 1
	Jhon Yunog In section 33.7, it talks about how inductance. I'm still baffled as to exactly what inductance is. I understand that it is the constant of proportionality between the emf and the rate of change of current, but what is the practical application of knowing something like this?	12/31/1969 6:59:59 pm	0 / 1
	Ciha - Jnug Tasy The text relates different ways of calculating induced emfs, and finds that Faraday's Law tells us that the induced current produces a magnetic flux to counteract increases in flux through loops. Such applications have been used in toroidal coils. Have there been any other tested shapes of materials and technology that might better and more efficiently use the fundamentals of the law? red	7/31/2000 12:00:00 am	0 / 1
	Mici Artgia I did not find any part confusing. I found the concept of inductance to be most interesting because it provides yet another parallel between electrostatics and magnetism.	4/6/2003 4:59:00 pm	0 / 1
	Kroi Susear Undemeath equation 33.14 there is a note in parenthesis that says that the induced field in NOT an electrostatic field, and so the quantity calculated above is NOT electrostatic work. I understand that the field is different from a normal electric field since it's not created by discreet point	4/7/2003 2:13:13 pm	0 / 1

The left sidebar contains sections for "E-MAIL", "COMING UP", "TOOLS", "QUICK LINKS", and "SITE ADMIN".

Preparing for class

Benefits:

- prepares students for class
- helps instructor address individual student needs
- increases student-faculty interaction
- connects names and faces



The screenshot shows a web browser window titled "ILT: Students" with the URL "http://www.conceptest.org/". The page is for "Physics 1b" and is logged in as "Eric Mazur". The navigation menu includes HOME, READING, LECTURES, ASSIGNMENTS, FORUMS, NEWS, and HANDOUTS. The main content area displays a question about magnetic fields and a list of student responses. Each response includes a student's name, profile picture, text of their answer, and a timestamp.

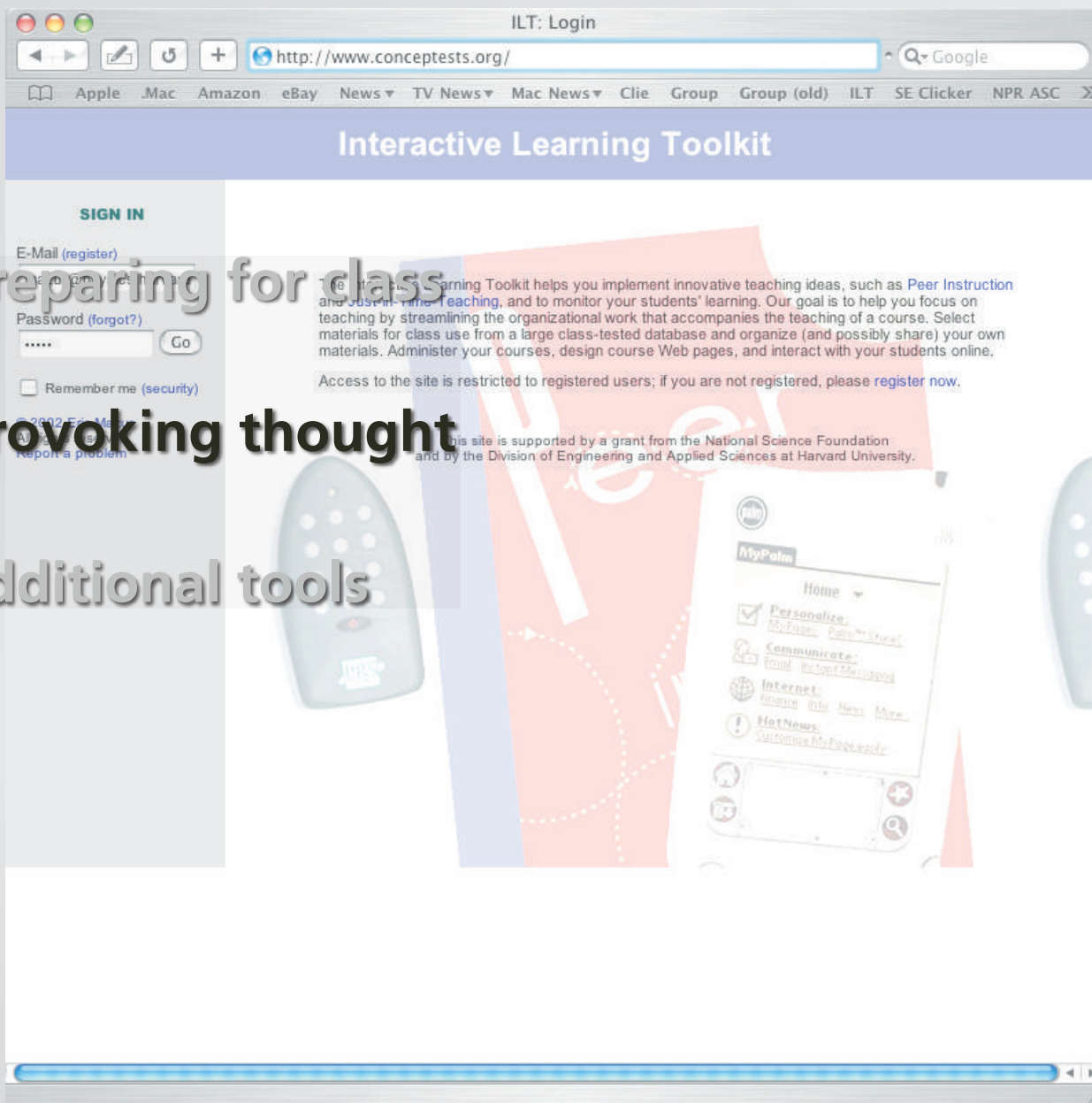
Student Name	Response Text	Timestamp	Score
red	What is the conceptual meaning of "dq" in the equations 33.30-33.31?	12/31/1998 8:59:59 pm	0 / 1
Jhon Yunog	In section 33.7, it talks about how inductance. I'm still baffled as to exactly what inductance is, and that it is the constant of proportionality between the induced emf and the rate of change of magnetic flux.	12/31/1969 6:59:59 pm	0 / 1
Ciha - Jnug Tasy	The text relates different ways of calculating induced emfs, and finds that Faraday's Law tells us that the induced current produces a magnetic flux to counteract increases in flux through loops. Such applications have been used in toroidal coils. Have there been any other tested shapes of material and technology that might better and more efficiently use the induced current?	7/31/2000 12:00:00 am	0 / 1
Arturo	What is the most interesting part confusing. I found the concept of inductance to be most interesting because it provides yet another parallel between electrostatics and magnetism.	4/6/2003 4:59:00 pm	0 / 1
Kroi Susear	Underneath equation 33.14 there is a note in parenthesis that says that the induced field is NOT an electrostatic field, and so the quantity calculated above is NOT electrostatic work. I understand that the field is different from a normal electric field since it's not created by discrete point charges.	4/7/2003 2:13:13 pm	0 / 1

Outline

- preparing for class

- provoking thought

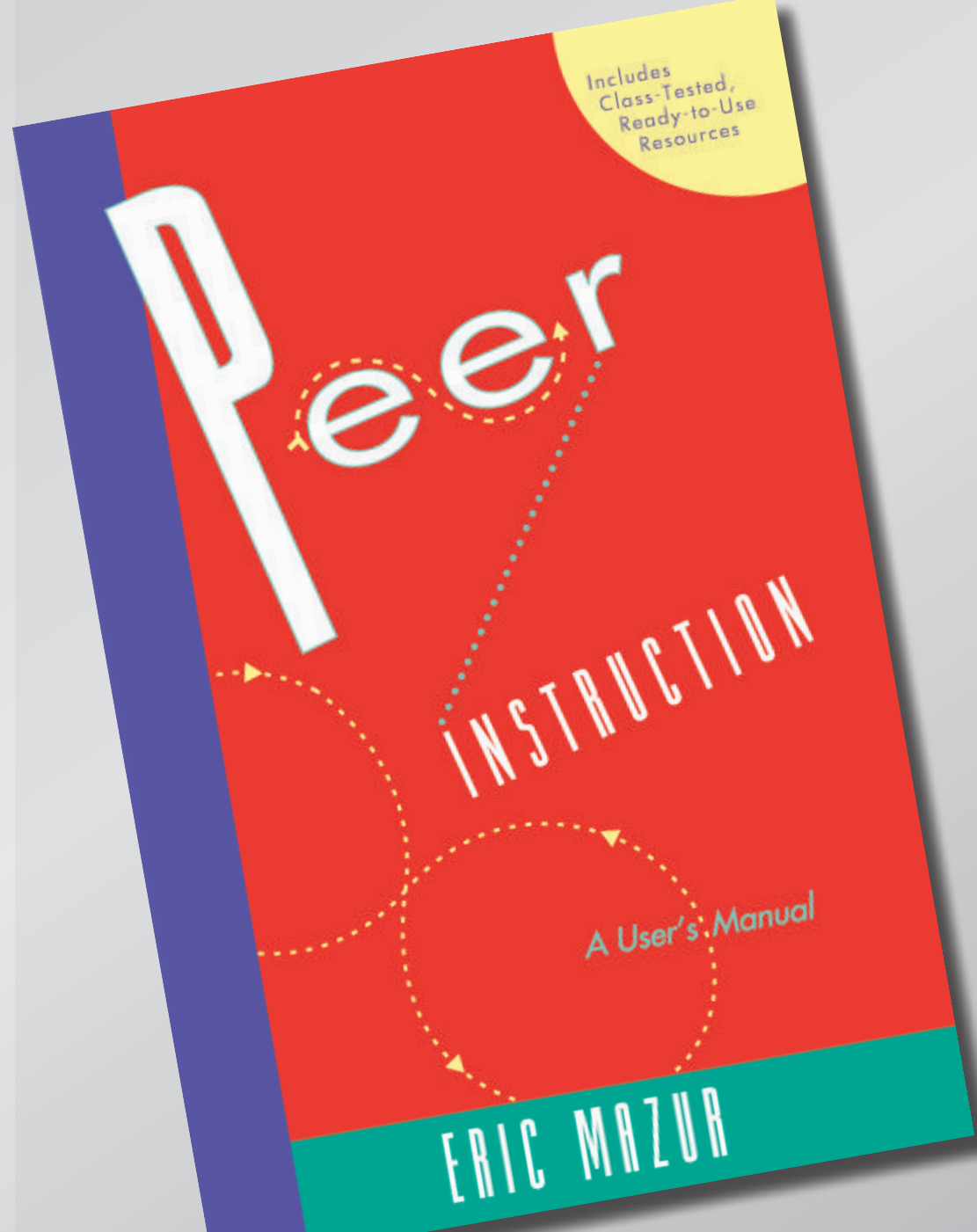
- additional tools



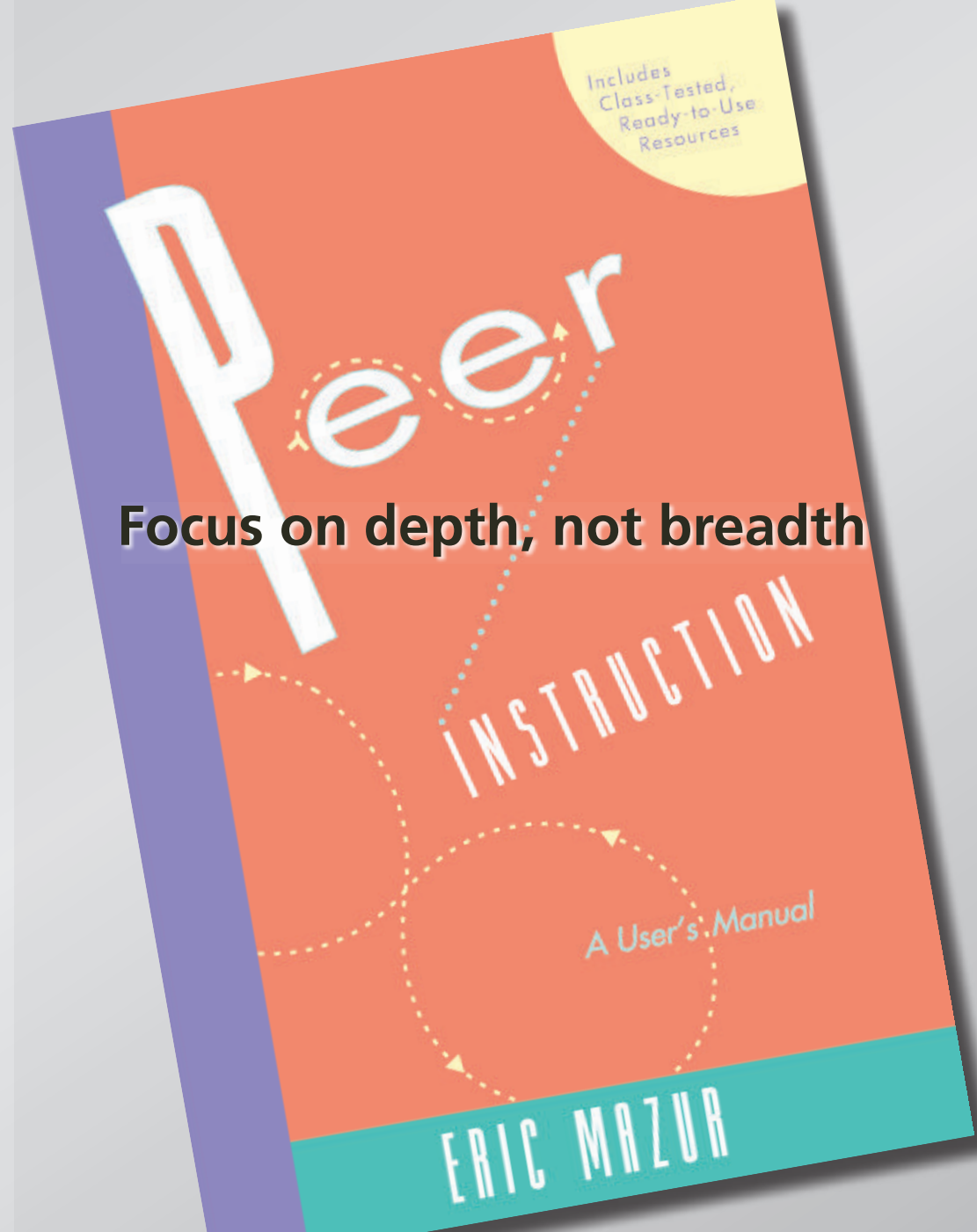
Provoking thought

What to do in class?

Provoking thought



Provoking thought



Focus on depth, not breadth

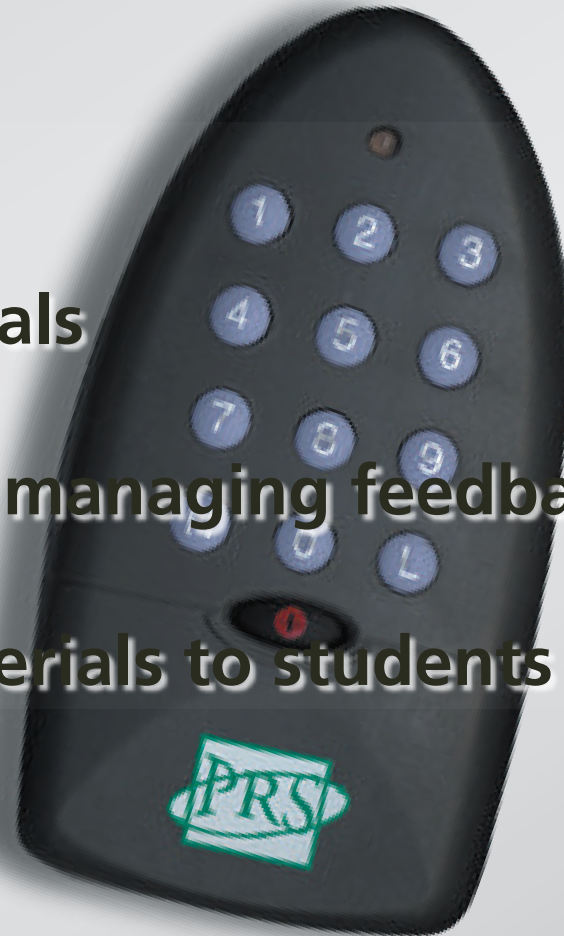
Provoking thought



Provoking thought

Some hurdles:

- finding materials
- collecting and managing feedback
- providing materials to students



Provoking thought

ILT: Manage

http://www.conceptest.org

ILT: Login local ILT: Lecture ILT: Reading

Physics 1b Logged in as Eric Mazur Sign out

HOME READING LECTURES ASSIGNMENTS FORUMS NEWS HANDOUTS ?

Courses > Physics 1b > Lectures > |< < Changing magnetic fields II 4/8 > >|

edit clone ↑↓ Physics > Introductory Electromagnetism > Magnetism > CT: 3691
October 25, 2001 00:55:08 am

1. A permanent magnet is dropped through a long aluminum tube, as shown. As the magnet drops, electric currents are induced around the tube. Compared to a freely-falling magnet, the magnet through the tube drops



1. more slowly.
2. exactly the same way.
3. faster.
4. Need more information.


Hint: consider the effects of induced currents through strips ahead of and behind the dropped magnet.

Answer: 1. In a loop of the aluminum tube just below the magnet, the flux is increasing as the magnet gets nearer. This induces a counterclockwise current producing an opposing magnetic field which repels the magnet. In a loop above the magnet, the flux is decreasing, so a clockwise current is induced, producing a magnetic field in the same direction as the magnet's field, thus attracting the magnet upward. So the net effect is to slow the magnet down.

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edit clone ↑↓ Physics > Introductory Electromagnetism > Magnetism > CT: 3756
October 12, 2001 05:55:06 pm

2. Consider the arrangement shown below. Conducting rod AB is lying on a U-shaped conductor, making good electrical contact. The arrangement is placed in a magnetic field (into page).



Provoking thought

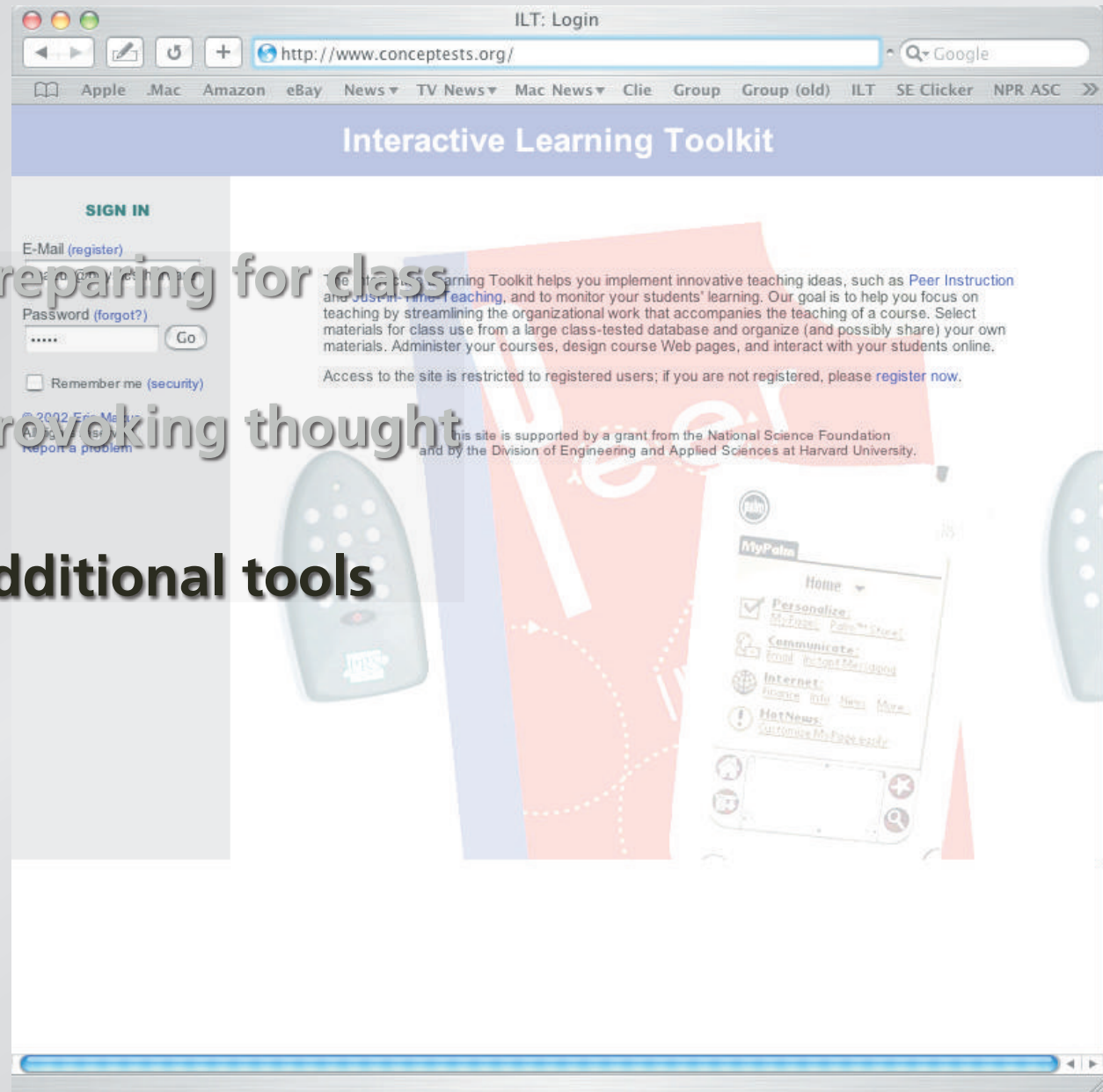
Benefits:

- easy preparation
- automatic student Web page generation
- management of data

The screenshot shows a web browser window titled "ILT: Manage" with the URL "http://www.concepttest.org". The page is for "Physics 1b" and has a navigation menu with "HOME", "READING", "LECTURES", "ASSIGNMENTS", "FORUMS", "NEWS", and "HANDOUTS". The main content area displays a lecture titled "Changing magnetic fields II 4/8" with a question: "1. A permanent magnet is dropped through a long aluminum tube, as shown. As the magnet drops, electric currents are induced around the tube. Compared to a freely-falling magnet, the magnet through the tube drops". Below the question is a diagram of a magnet falling through a tube with a magnetic field vector B pointing downwards. The diagram shows the magnet's field lines and the induced current in the tube. The answer options are: 1. more slowly, 2. exactly the same way, 3. faster. A hint is provided: "Hint: consider the effects of induced currents through strips ahead of and behind the dropped magnet." The answer is: "Answer: 1. In a loop of the aluminum tube just below the magnet, the flux is increasing as the magnet gets nearer. This induces a counterclockwise current producing an opposing magnetic field which repels the magnet. In a loop above the magnet, the flux is decreasing, so a clockwise current is induced, producing a magnetic field in the same direction as the magnet's field, thus attracting the magnet upward. So the net effect is to slow the magnet down." The page also includes a copyright notice: "Copyright © 2000, Eric Mazur. Unpublished copyrighted material." and a second question: "2. Consider the arrangement shown below. Conducting rod AB is lying on a U-shaped conductor, making good electrical contact. The arrangement is placed in a magnetic field (into page)." The diagram shows a rod AB on a U-shaped conductor in a magnetic field B pointing into the page.

Outline

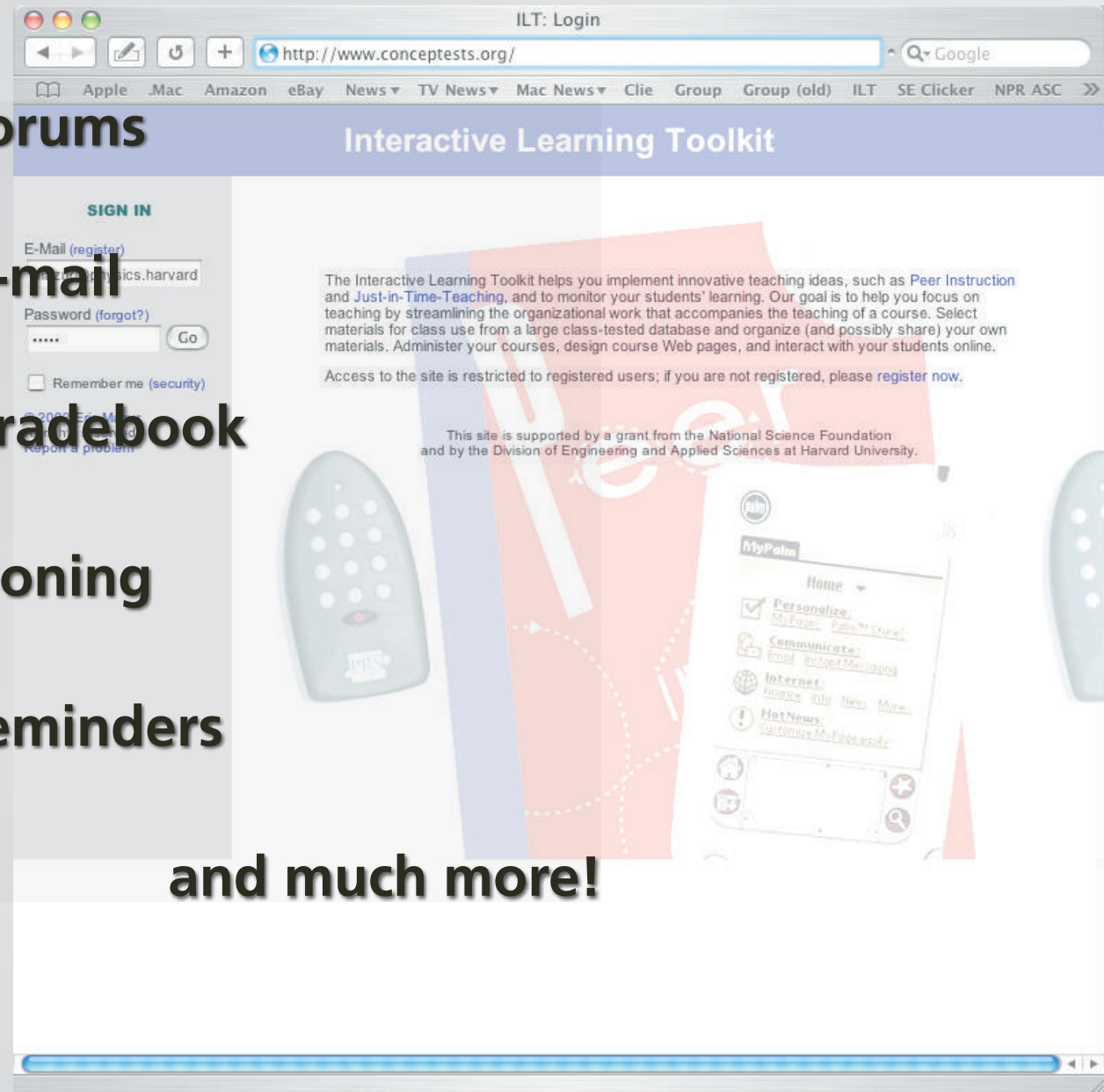
- preparing for class
- provoking thought
- additional tools



Additional tools

- forums
- e-mail
- gradebook
- cloning
- reminders

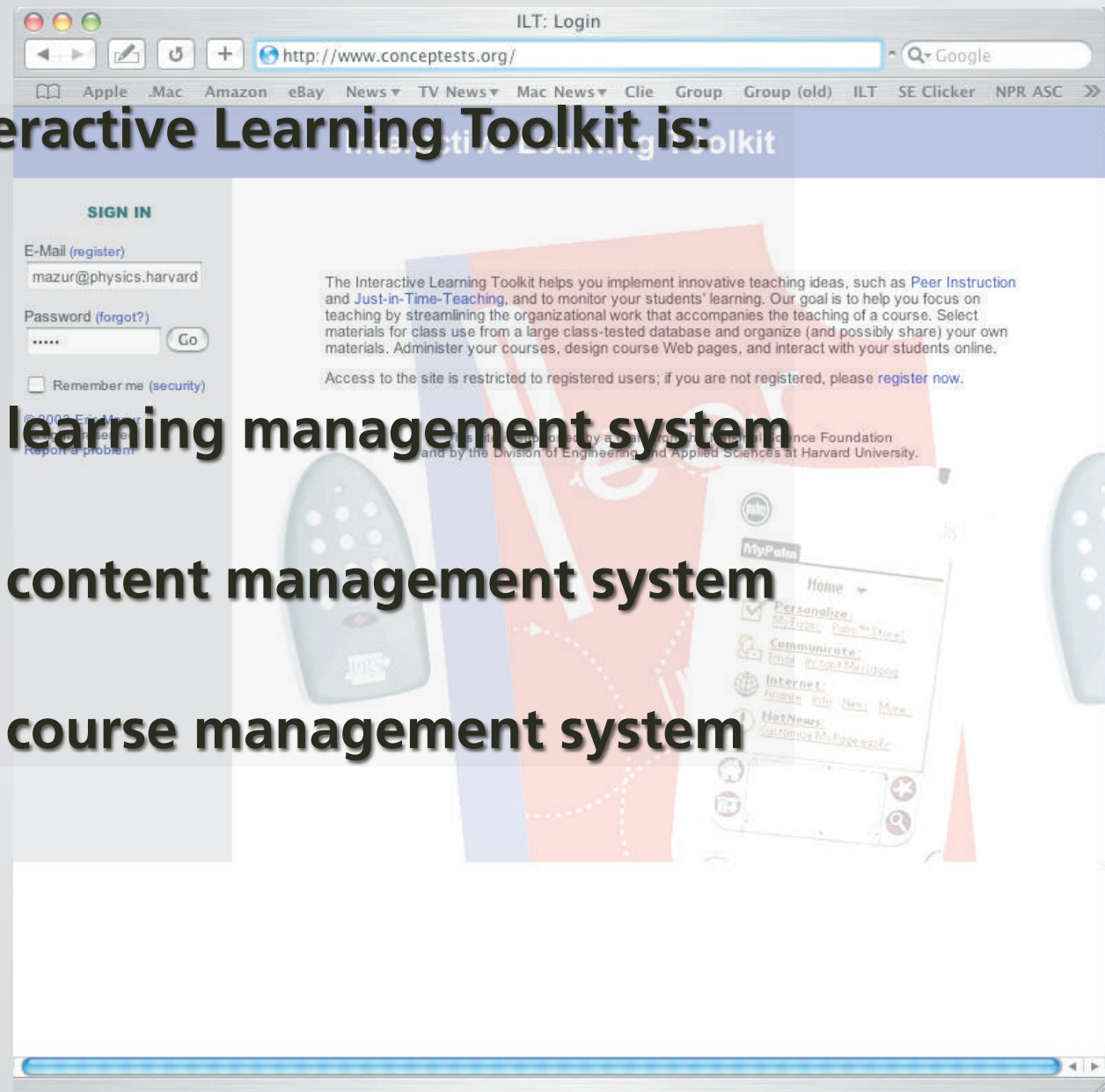
and much more!



Additional tools

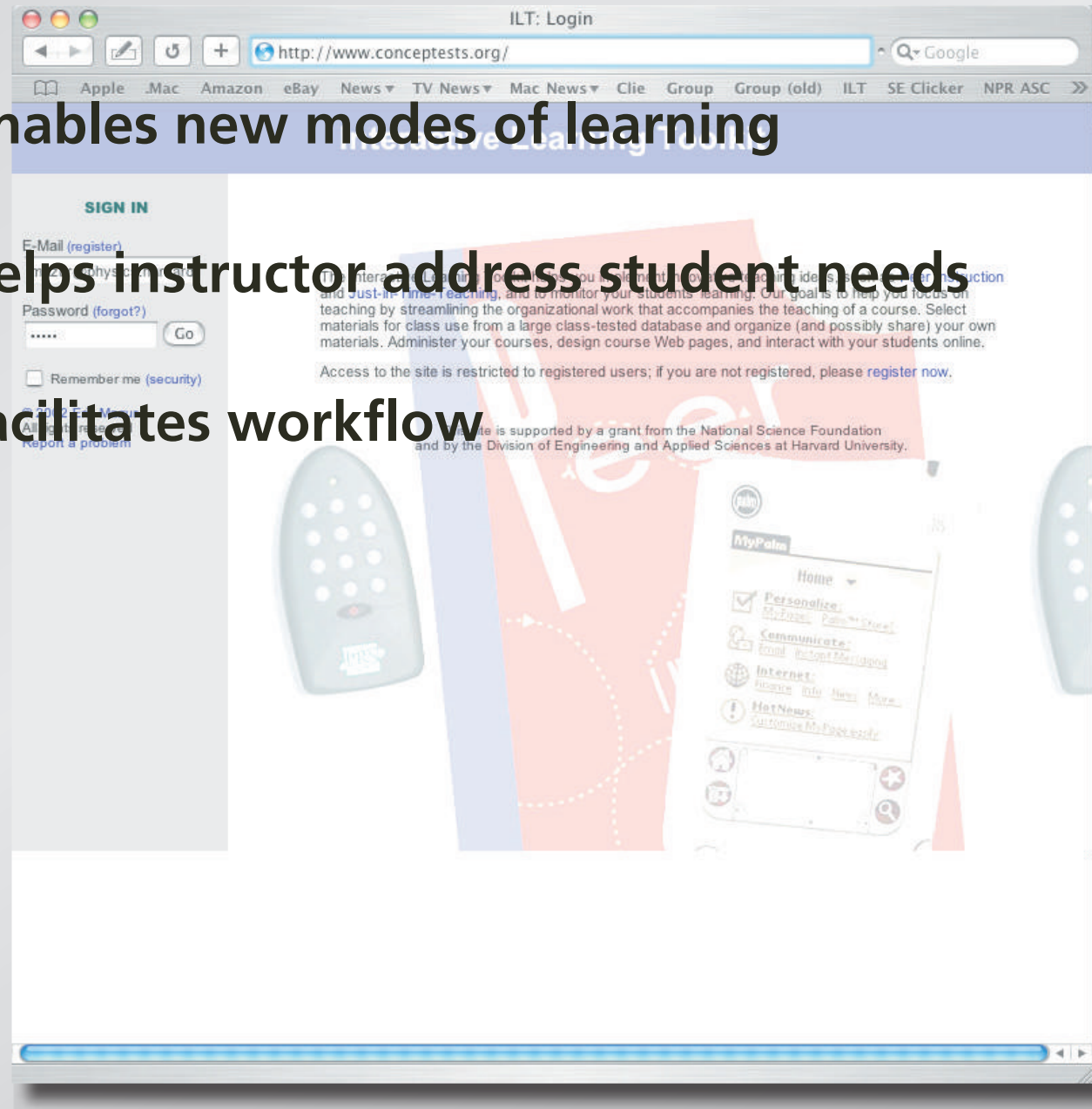
Interactive Learning Toolkit is:

- a learning management system
- a content management system
- a course management system

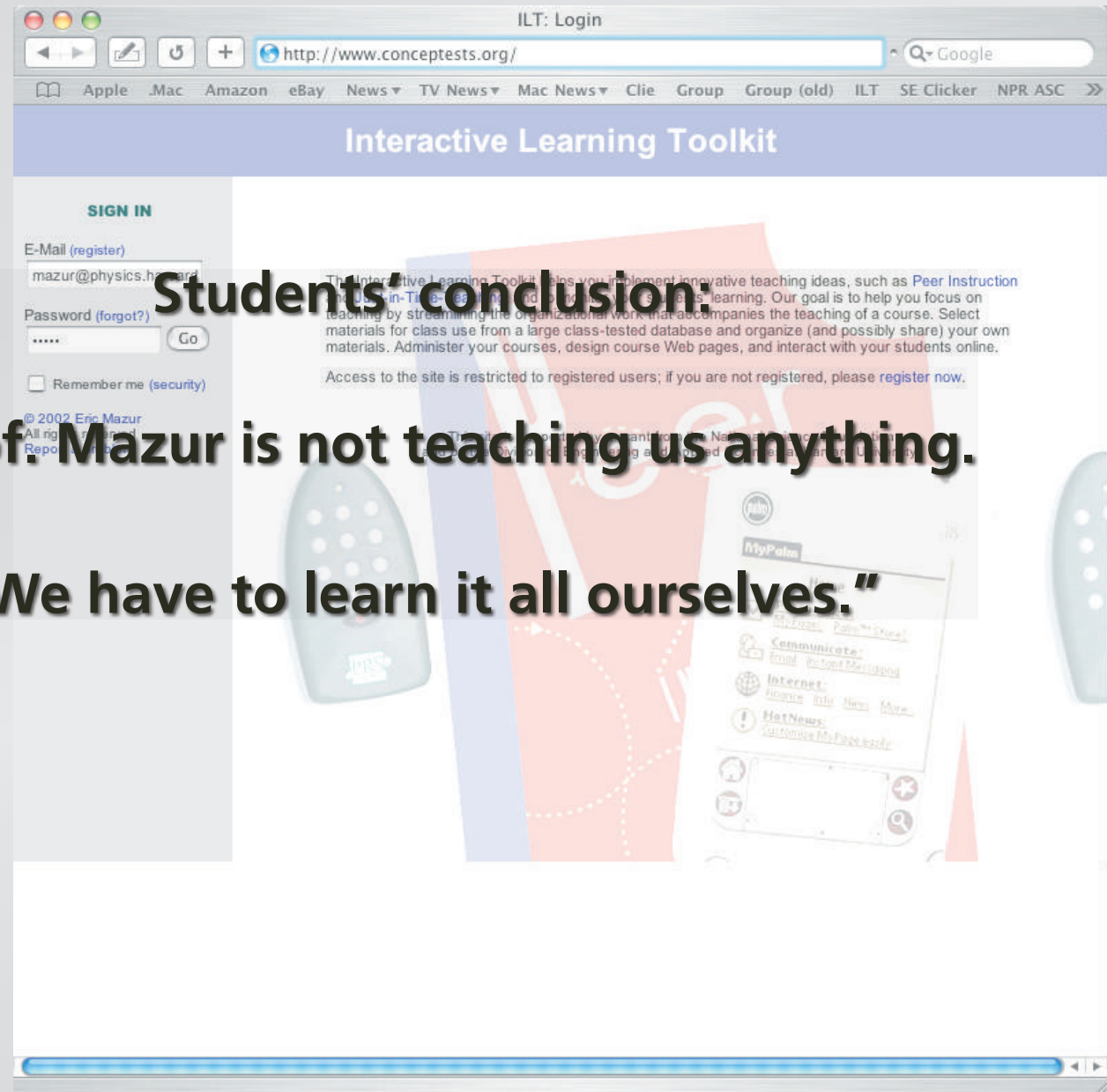


Summary

- enables new modes of learning
- helps instructor address student needs
- facilitates workflow



Summary



Students' conclusion:

"Prof. Mazur is not teaching us anything.

We have to learn it all ourselves."

Support:

Davis Foundation
National Science Foundation
Harvard SEAS Information Technology Group
Pearson/Prentice Hall
Apple Computer

for a copy of this presentation:

<http://mazur-www.harvard.edu>

