

Using education technology to engage students

Pearson Education Instructor Tools Workshop
Boston, MA, 18 August 2009



My point

Technology is not a magic bullet

Introduction

A brief history of Information Technology

- blackboard
- overhead projector
- television
- computer

Introduction

What's wrong with old methods for presenting content?



Book of Hours, Valencia, c. 1460



Belles Heures du Duc de Berry
1408-09
The Way to Calvary

subleantur. Similiter et facta bona manifesta sunt: et que aliter se habent abscondi non possunt. **VI.**

Divitijs sunt sub iugo serui dñs suos quā honore dignos arbitrantur: ne nomine dñi & doctrina blasphemetur. Qui autē fideles habent dños nō detrahunt quia fides sunt: sed magis feruēt q̄a fideles sunt & dilecti: q̄a beneficij participes sunt hęc dōce: & regnare. Si q̄a aliter doceat: & nō acquiescat sanis sermōibus dñi nr̄i ihesu cristi. et ei que sūd in pietatē ē doctrine: superbus nichil scietis sed languēs circa questiones & pugnas verbore: ex quibus oriuntur inuidie & tentationes blasphemie suspiciones male-diffidationes hominū in parte corruptorū & q̄ veritate priuati sūt: existimatiū questū esse pietatē. Est autē quest⁹ magnus: pietas cum sufficiens. Nichil enī intulim⁹ in hunc mūdū: hanc dubiū q̄a nec auferre nō possum⁹. Inhabētes autē alimēta et q̄bus regant: hīs dētū sum⁹. Nā q̄ volunt diuites fieri: incidūt in tentationē & in la-

ditia unū: q̄ solus habet immortalitatem & lucē inhabitat inaccessibilē: quē null⁹ hominū vidit sed nec videre potest: cui honor & imperiū sempiternū erunt.

Divites hui⁹ seculi p̄cipe nō subleant sapere: neq̄ sperare in iucato diuitiarū sed in deo vno q̄ p̄stat nobis oīa abūde ad fruendū: bene agere: diuites fieri in bonis oprib⁹: facile tabuete & inuicere: thesaurizare sibi sūd amentū bonū in futuro: ut apphētēt veram vitā. In thimothee depositū custodi: deuitas phanas vocū nouitates et oppositiones falli nōis sciētis: quā quidā prouitētes circa fidem ceciderūt. *Oratio tecū amē.*

Exphat epistola prima ad thimothē.

Incipit exhortatiō in epistolā secundā

texti thimothee scribit de reprobatione in artibus & omnis regule veritatis: & qd̄ futurus sit tēporib⁹ nouissimis. & de sua passione: scilicet a roma. Exphat argumentū in epistolā secundā ad thimothē.

Paulus apostol⁹ hęc

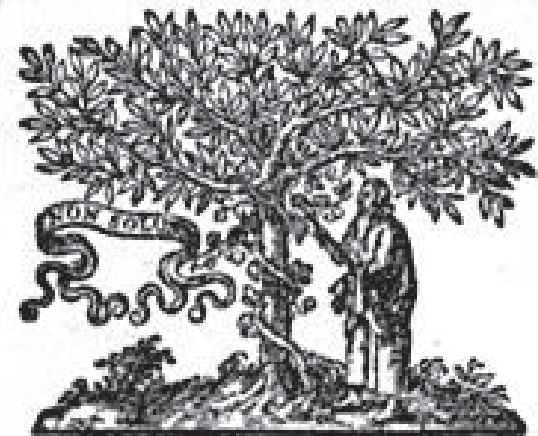
*ihesu cristi p̄ uolūta-
tem dei sedim. p̄missi.*

DISCORSI
E
DIMOSTRAZIONI
MATEMATICHE,
intorno à due nuoue scienze

Attenenti alla
MECANICA & i MOVIMENTI LOCALI,

del Signor
GALILEO GALILEI LINCEO,
Filosofo e Matematico primario del Serenissimo
Grand Duca di Toscana.

Con vna Appendice del centro di grauità d'alcuni Solidi.

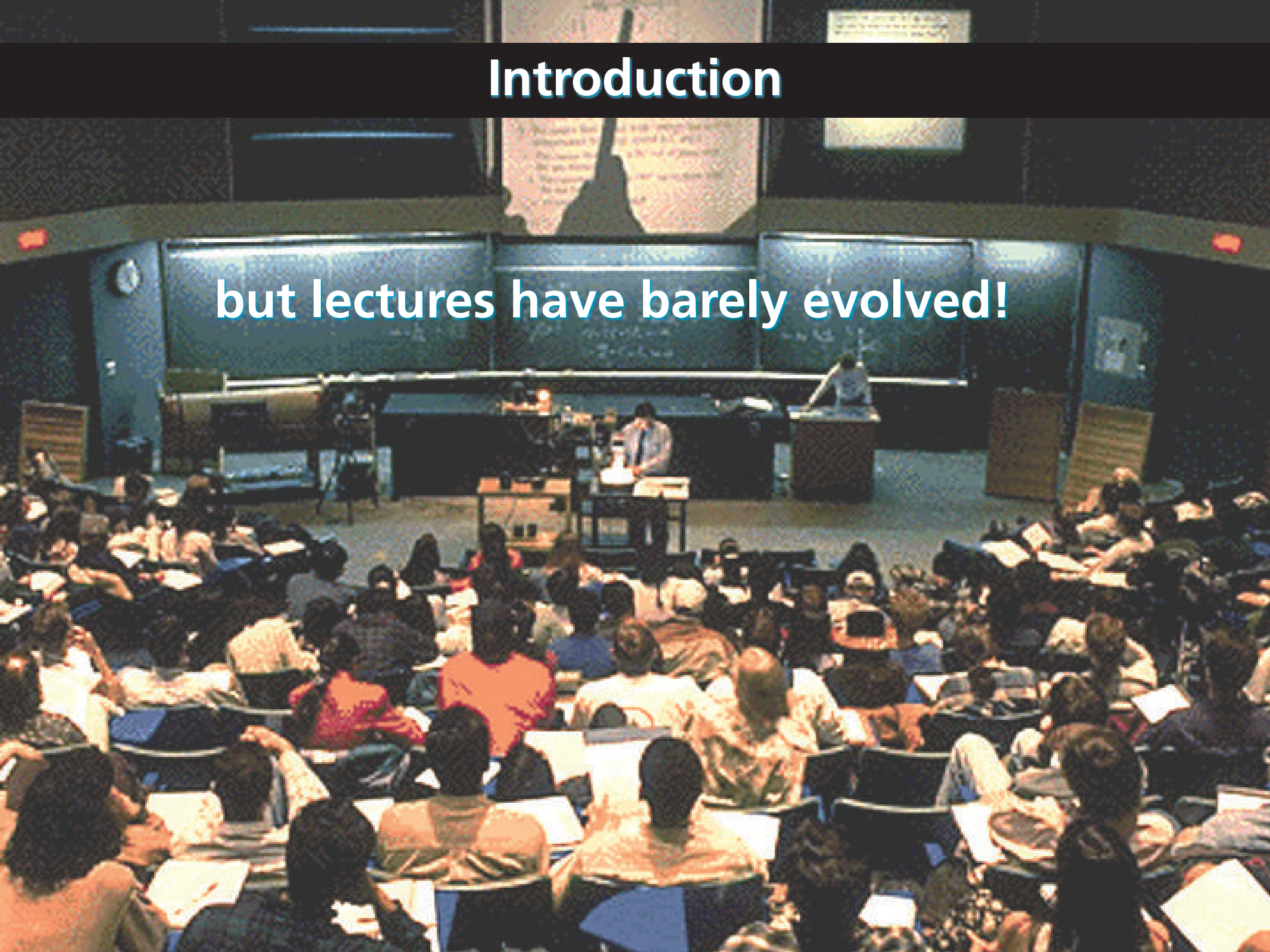


IN LEIDA,
Appresso gli Elsevirii. M. D. C. XXXVIII.



Introduction

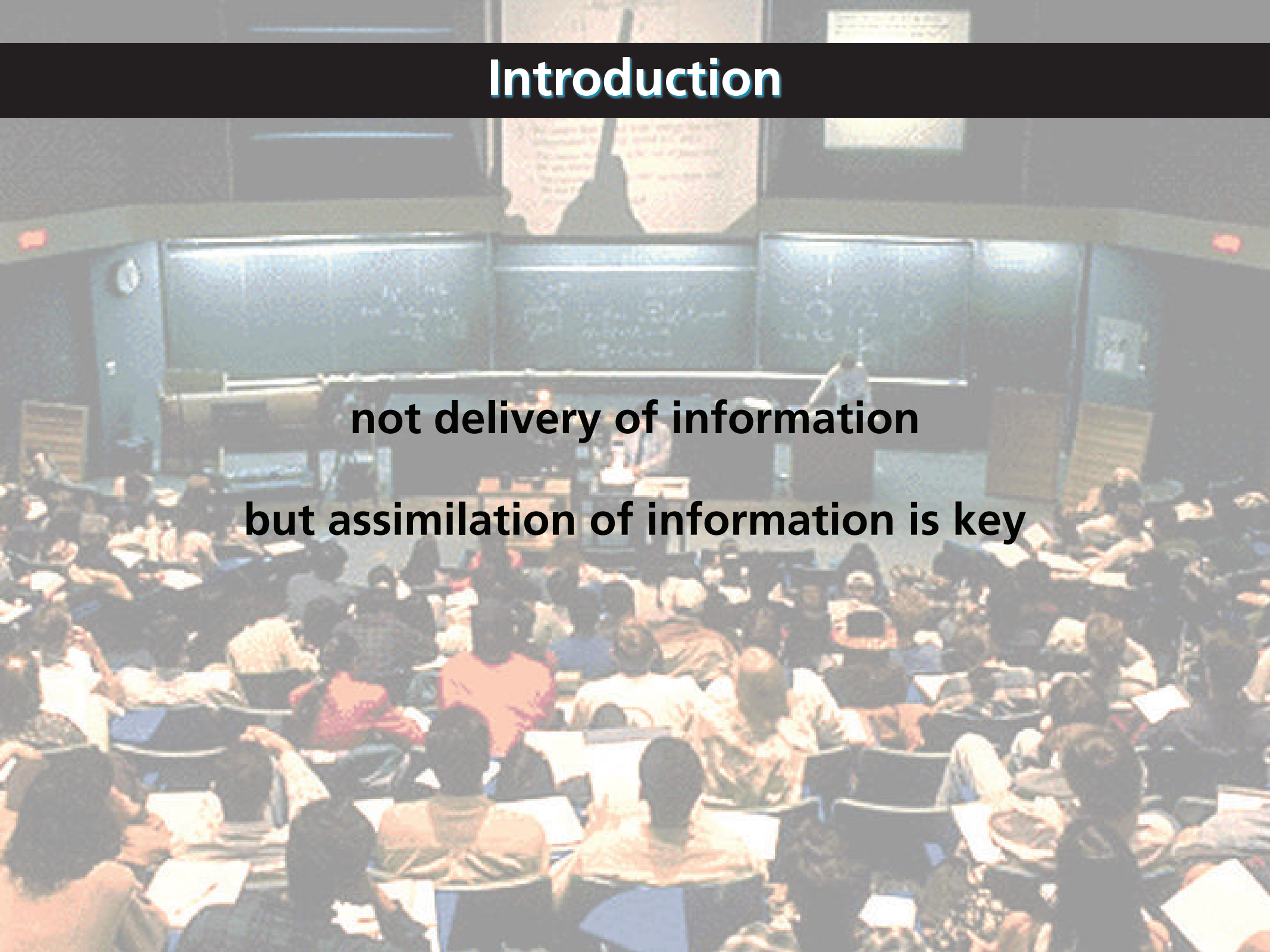
but lectures have barely evolved!



Introduction

not delivery of information

but assimilation of information is key



Introduction

think about educational goals
before introducing technology



Introduction

What constitutes effective use of technology?

- **furtheres educational goals**
- **facilitates new modes of learning**
- **investment commensurate with returns**
- **reusable and flexible**

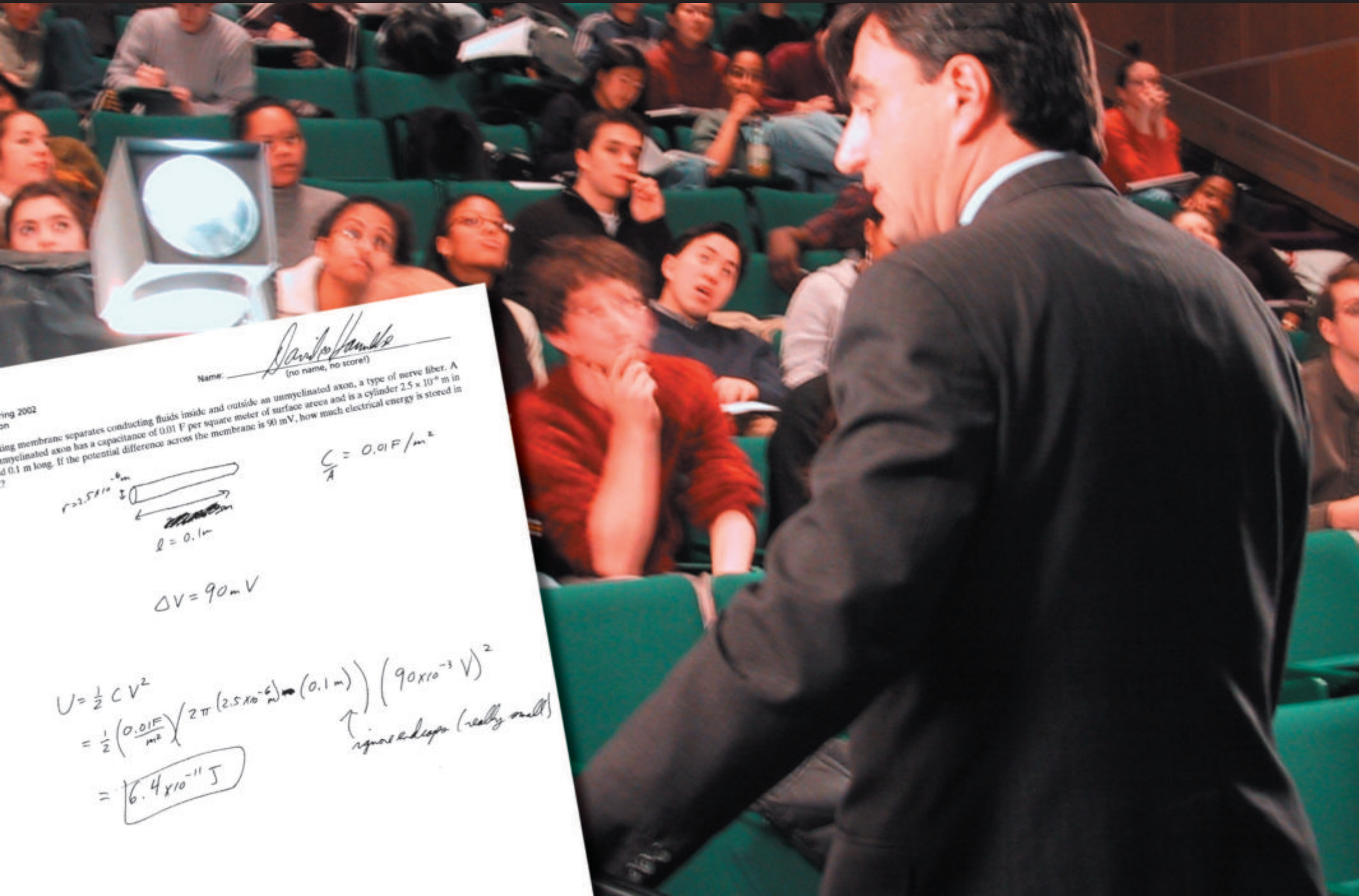
Outline



Outline

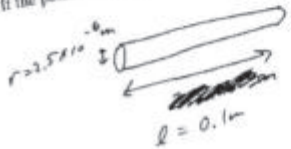
- **Personalizing instruction**
- **Promoting thinking**
- **Integrating instruction**

Personalizing instruction



Name: David Hanks
(no name, no score!)

ing 2002
on
ing membrane separates conducting fluids inside and outside an unmyelinated axon, a type of nerve fiber. A
unmyelinated axon has a capacitance of 0.01 F per square meter of surface area and is a cylinder $2.5 \times 10^{-6} \text{ m}$ in
d 0.1 m long. If the potential difference across the membrane is 90 mV , how much electrical energy is stored in
?



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

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

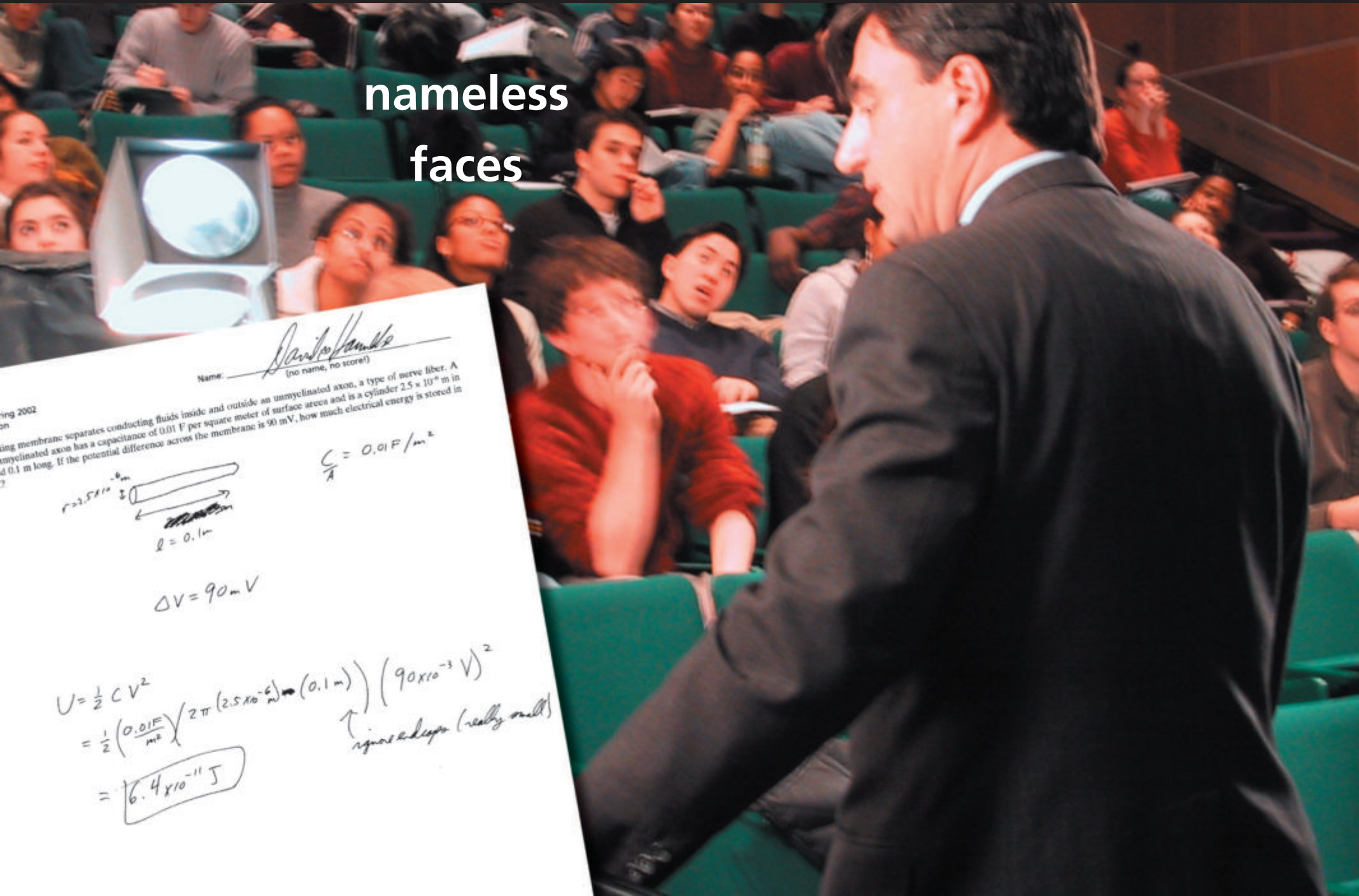
$$U = \frac{1}{2} C V^2$$
$$= \frac{1}{2} (0.01 \frac{\text{F}}{\text{m}^2}) (2\pi (2.5 \times 10^{-6} \text{ m}) (0.1 \text{ m})) (90 \times 10^{-3} \text{ V})^2$$

↑ ignore edge (really small)

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

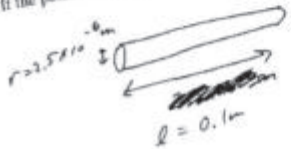
Personalizing instruction

nameless
faces



Name: David Hanks
(no name, no score!)

ing 2002
on
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$$C = 0.01 \text{ F/m}^2$$

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

$$U = \frac{1}{2} C V^2$$
$$= \frac{1}{2} \left(\frac{0.01 \text{ F}}{\text{m}^2} \right) \left(2\pi (2.5 \times 10^{-6} \text{ m}) (0.1 \text{ m}) \right) (90 \times 10^{-3} \text{ V})^2$$

↑ ignore edge (really small)

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

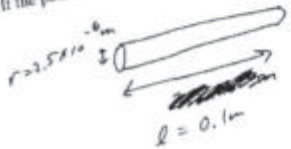
Personalizing instruction

nameless
faces

faceless
names

Name: David Hanks
(no name, no score!)

ing 2002
on
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$$\Delta V = 90 \text{ mV}$$

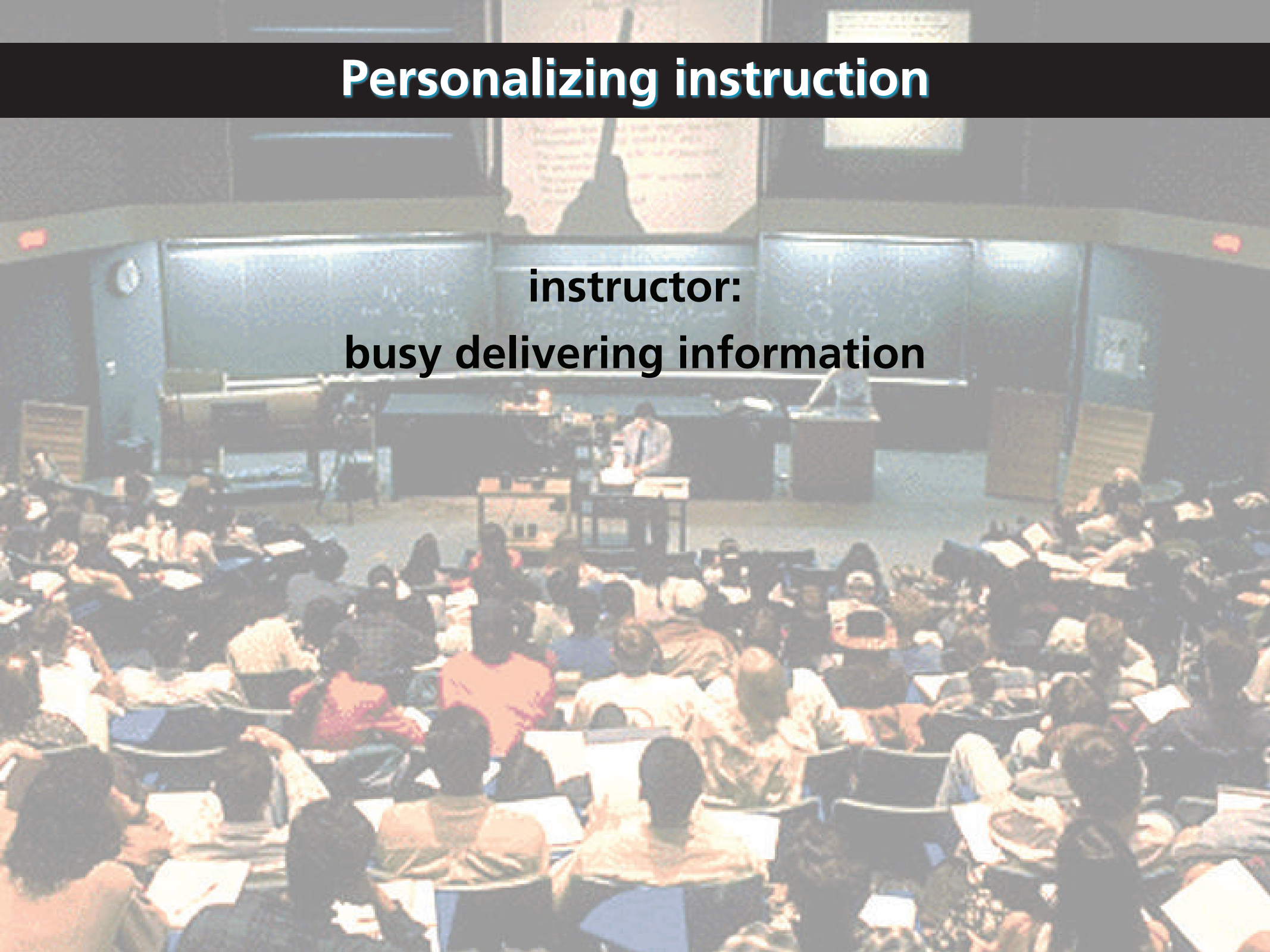
$$U = \frac{1}{2} C V^2$$
$$= \frac{1}{2} \left(\frac{0.01 \text{ F}}{\text{m}^2} \right) \left(2\pi (2.5 \times 10^{-6} \text{ m}) (0.1 \text{ m}) \right) (90 \times 10^{-3} \text{ V})^2$$

↑ ignore shape (really small)

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

Personalizing instruction

**instructor:
busy delivering information**



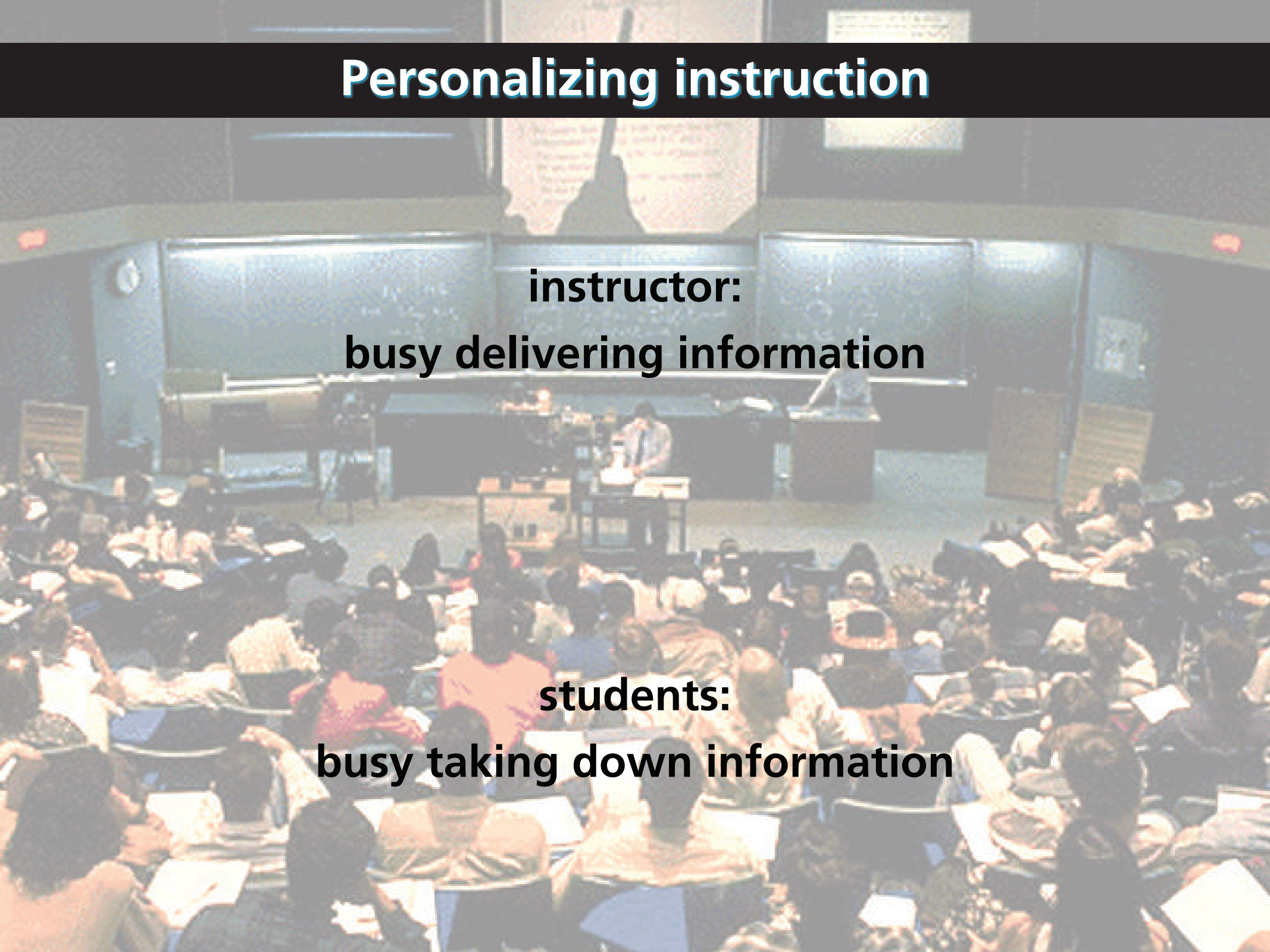
Personalizing instruction

instructor:

busy delivering information

students:

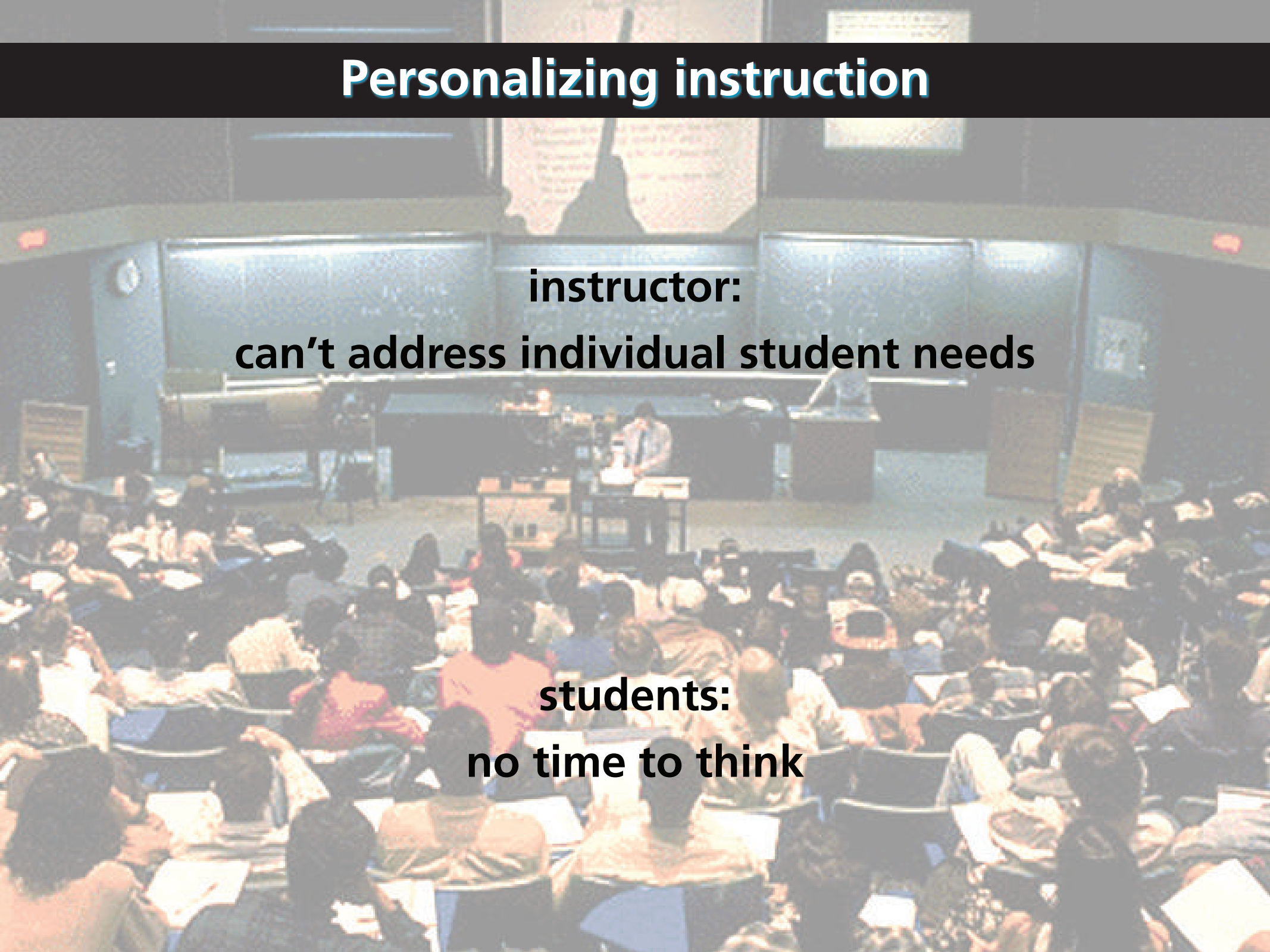
busy taking down information



Personalizing instruction

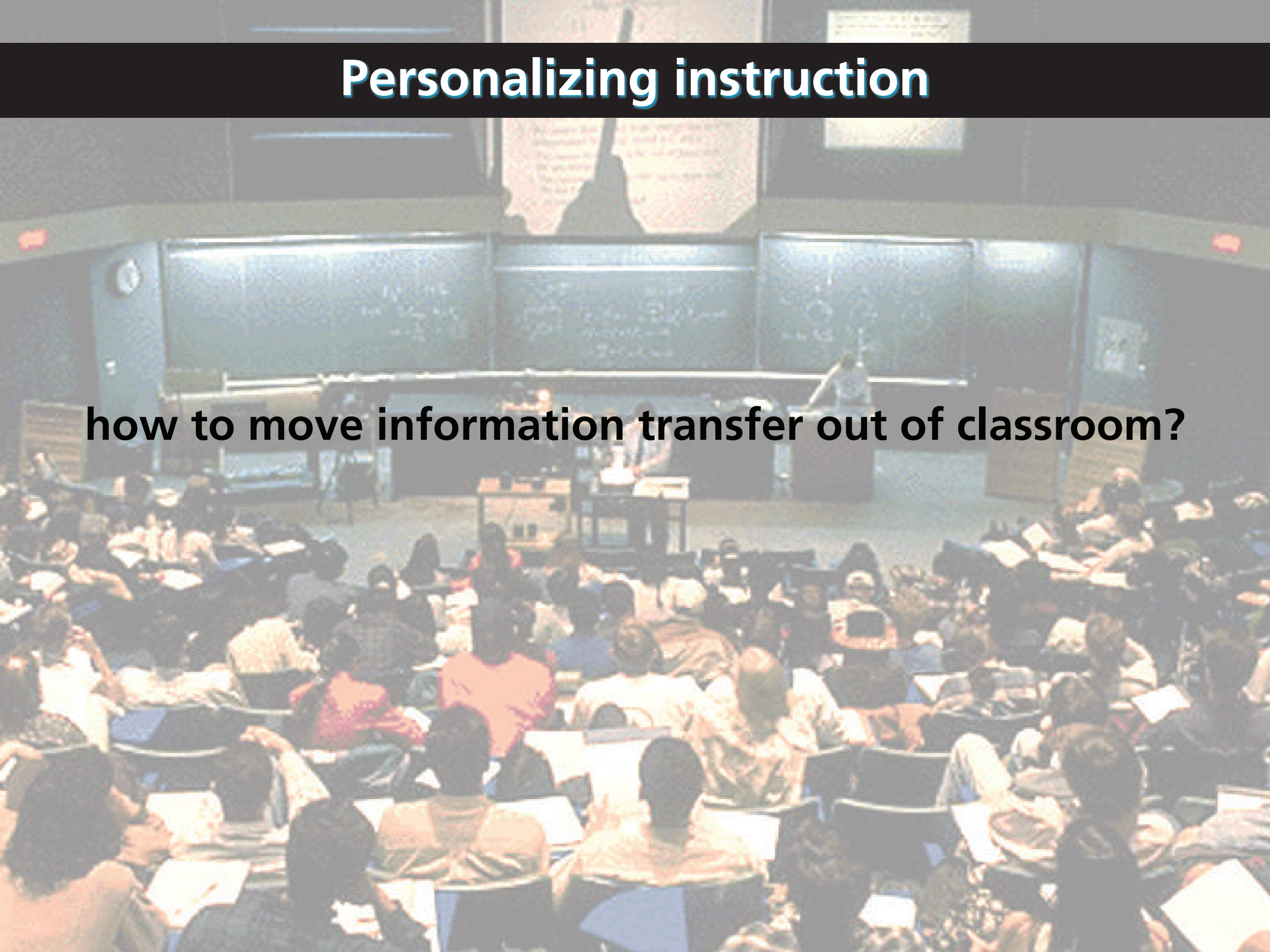
instructor:
can't address individual student needs

students:
no time to think



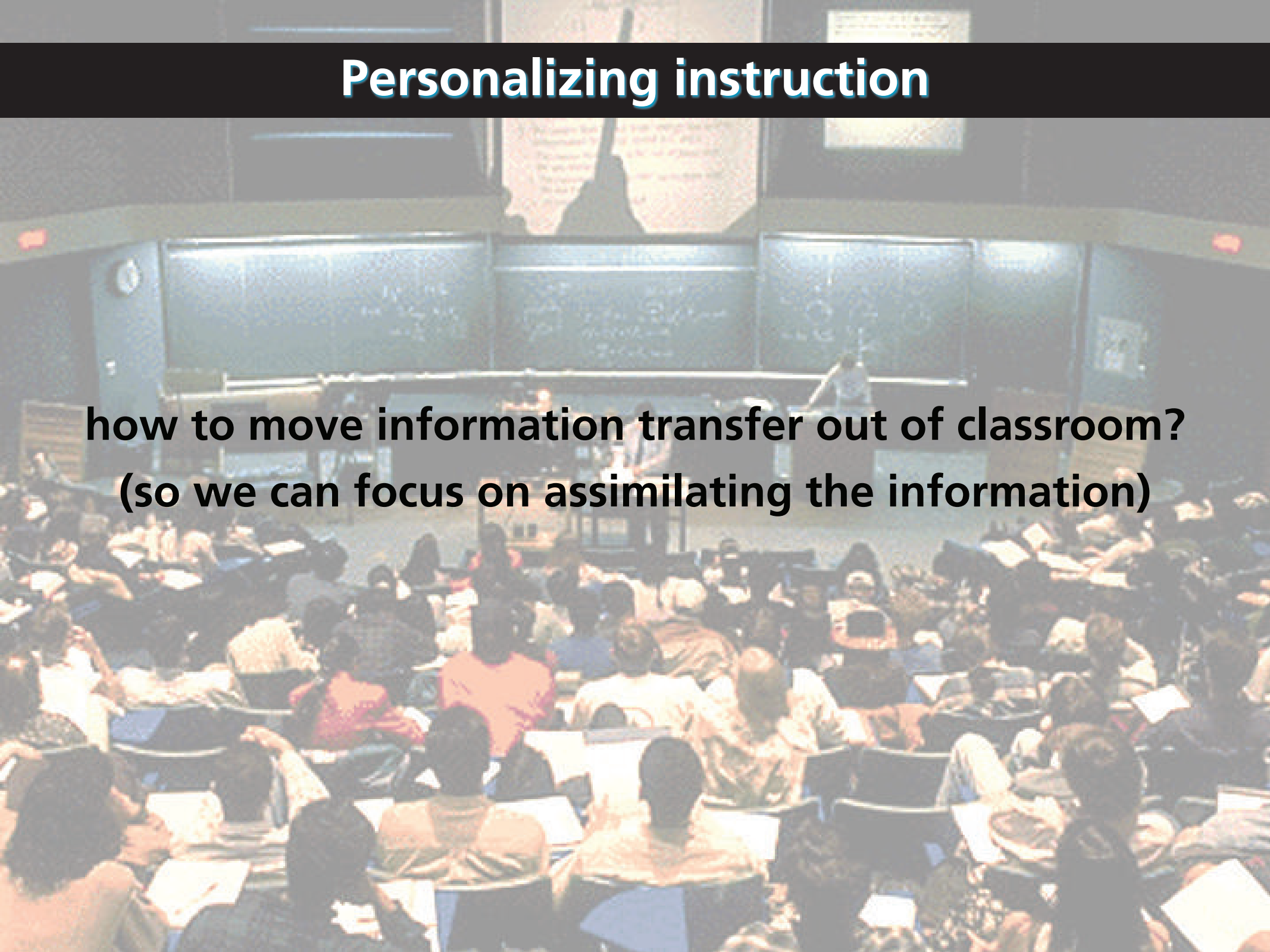
Personalizing instruction

how to move information transfer out of classroom?

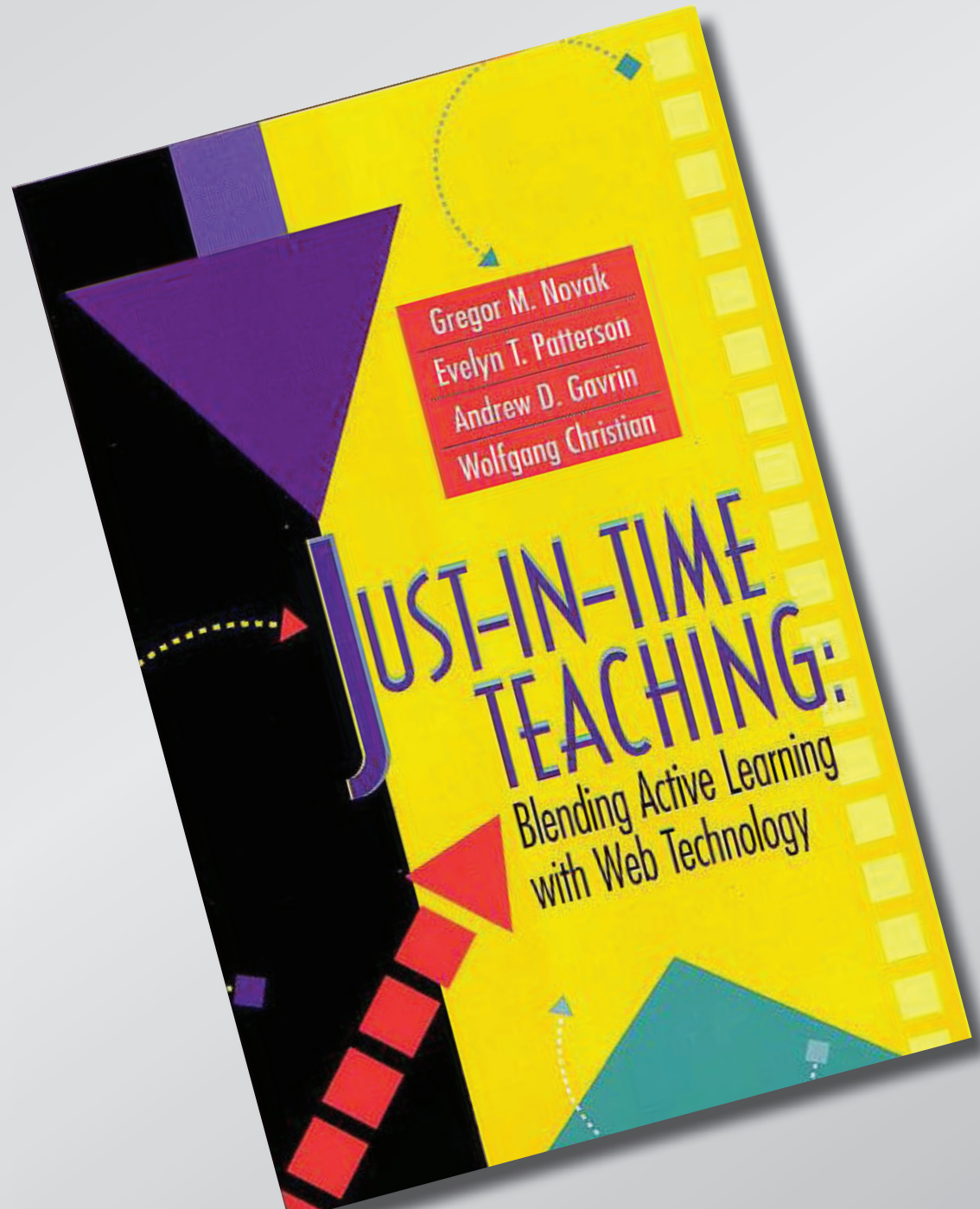


Personalizing instruction

**how to move information transfer out of classroom?
(so we can focus on assimilating the information)**

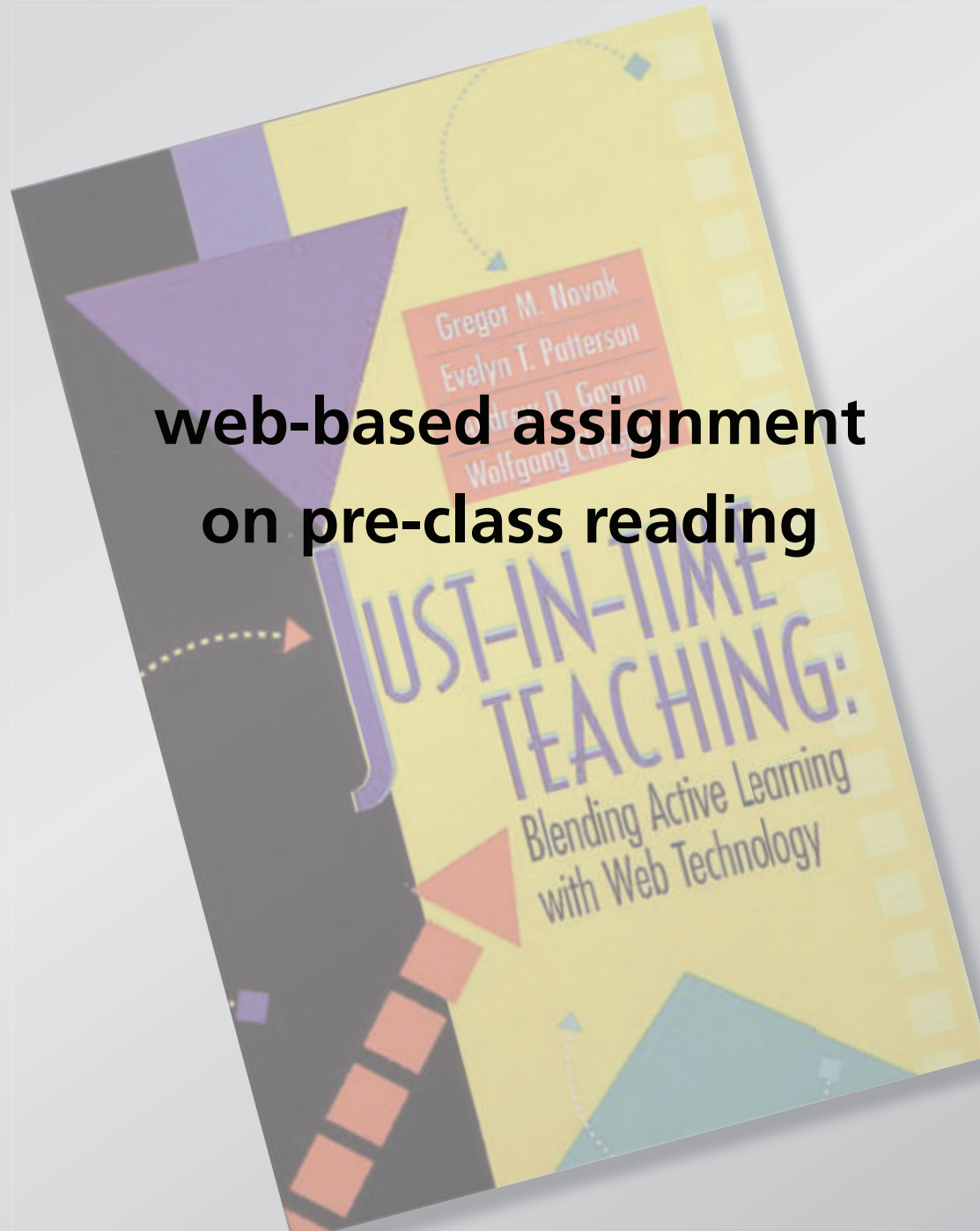


Personalizing instruction



Personalizing instruction

**web-based assignment
on pre-class reading**



Personalizing instruction

The screenshot shows a web browser window titled "ILT: Students" with the URL "http://www.concepttest.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 current page is "Student Responses" for the assignment "Changing magnetic fields II".

The main content area contains the following text:

Please tell us briefly what **single** point of the reading you found most difficult or confusing. If you did not find any part of it difficult or confusing, please tell us what parts you found most interesting.






See notebook for an overview of common difficulties.

Click name to respond

Flag similarities closer than:

1 - 100 of 153 answers

Total of 7 responses sent to students for this assignment

Student	Answer	Time	Response
	Vjay 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
	Cha - 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 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 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.

Personalizing instruction

Benefits

- connects names and faces
- prepares students for class
- “asynchronous” instruction
- more focused class time

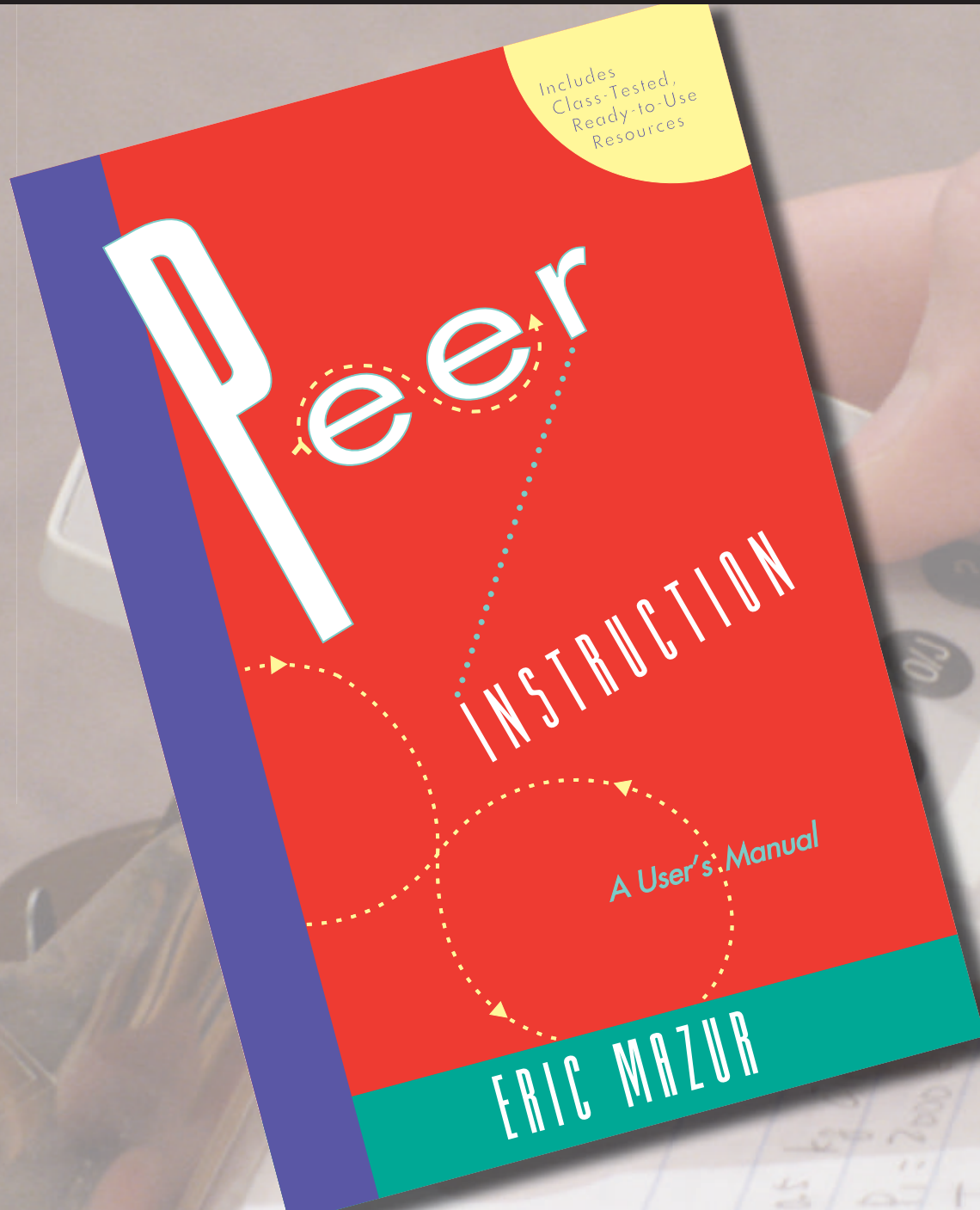
The screenshot shows a web browser window titled "ILT: Students" with the URL "http://www.conceptest.org/". The page is for a "Physics 1b" course, specifically a reading assignment on "Changing magnetic fields II". It displays a list of student responses to a question about magnetic energy. The responses are shown in a table with columns for Student, Answer, Time, and Response. Each response includes a small profile picture of the student and their text-based answer.

Student	Answer	Time	Response
	The equations for magnetic energy was tricky. The meaning of "dq" in the equations 33.30-33.31?	12/31/1969 6:59:59 pm	0 / 1
	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? Knowing something like this?	12/31/1969 6:59:59 pm	0 / 1
	The two most 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?	7/31/2009 12:00:00 am	0 / 1
	I did not find any part confusing. I found the concept of inductance to be interesting because it provides yet another parallel between systems.	4/6/2003 4:59:00 pm	0 / 1
	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	4/7/2009 2:13:13 pm	0 / 1

Outline

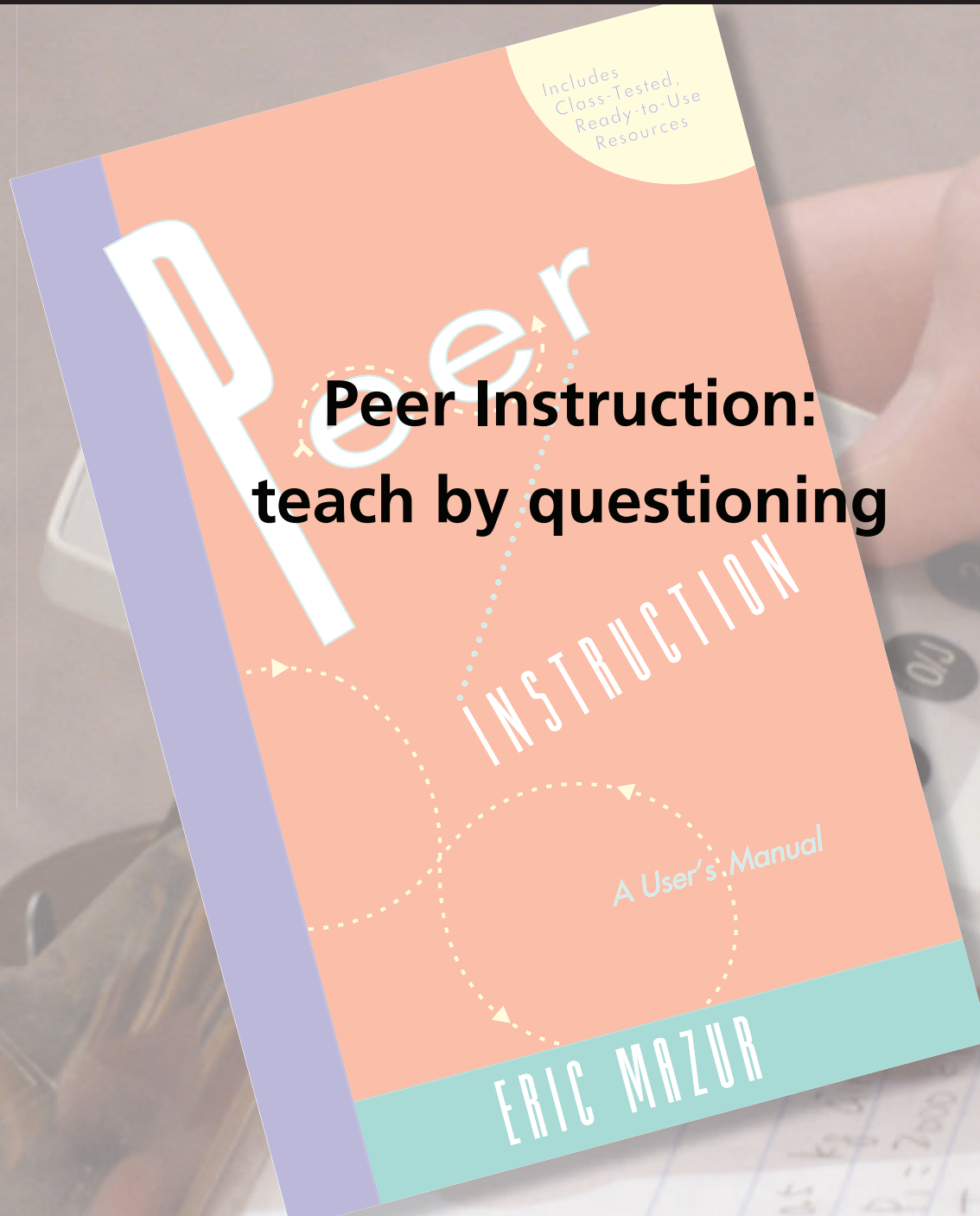
- Personalizing instruction
- **Promoting thinking**
- Integrating instruction

Promoting thinking



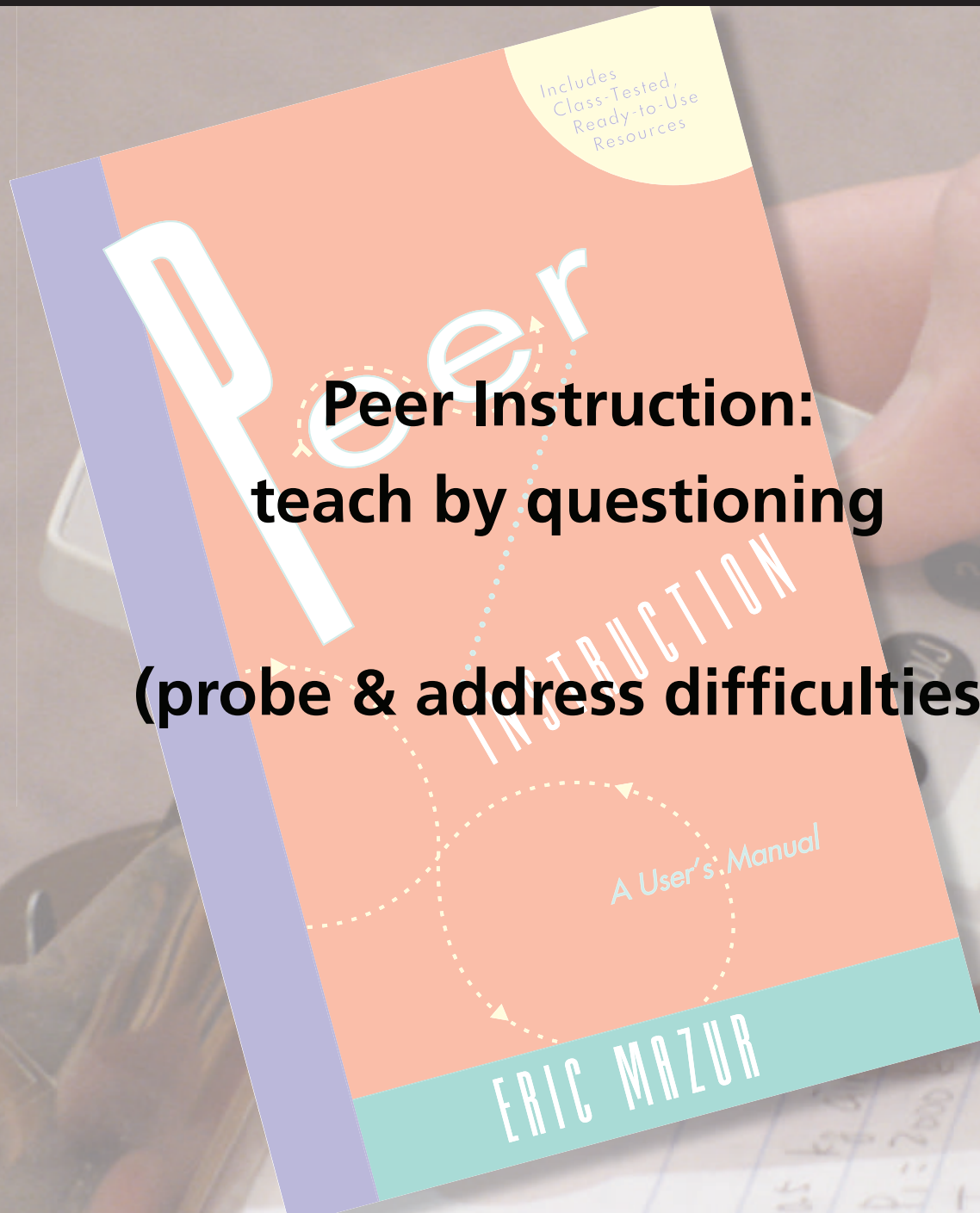
at 1000
 $P = 2000$
 $T = 1000 \text{ K}$
 $T_a = 400 \text{ K}$
Pressure of

Promoting thinking



**Peer Instruction:
teach by questioning**

Promoting thinking

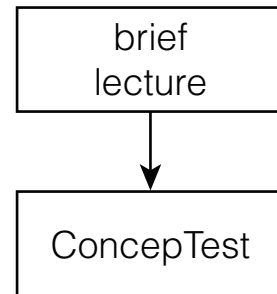


**Peer Instruction:
teach by questioning
(probe & address difficulties)**

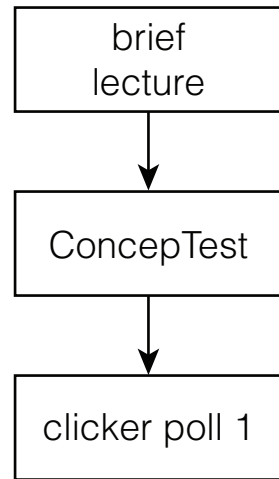
Promoting thinking

brief
lecture

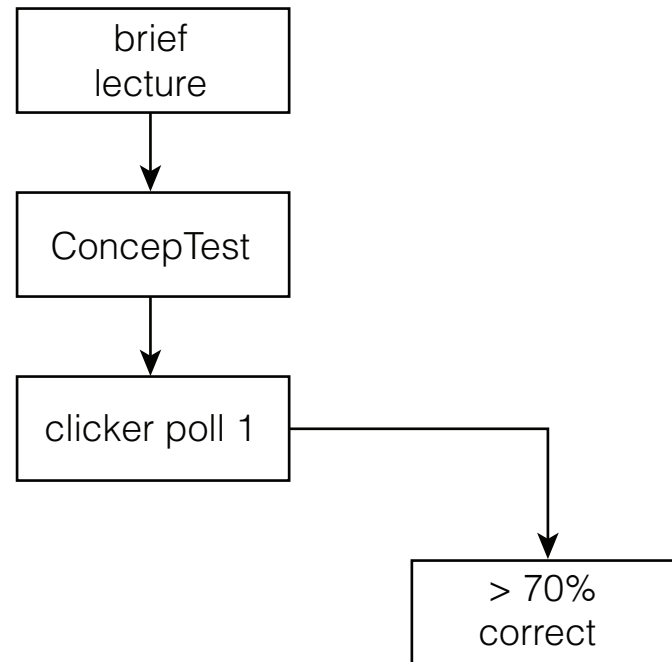
Promoting thinking



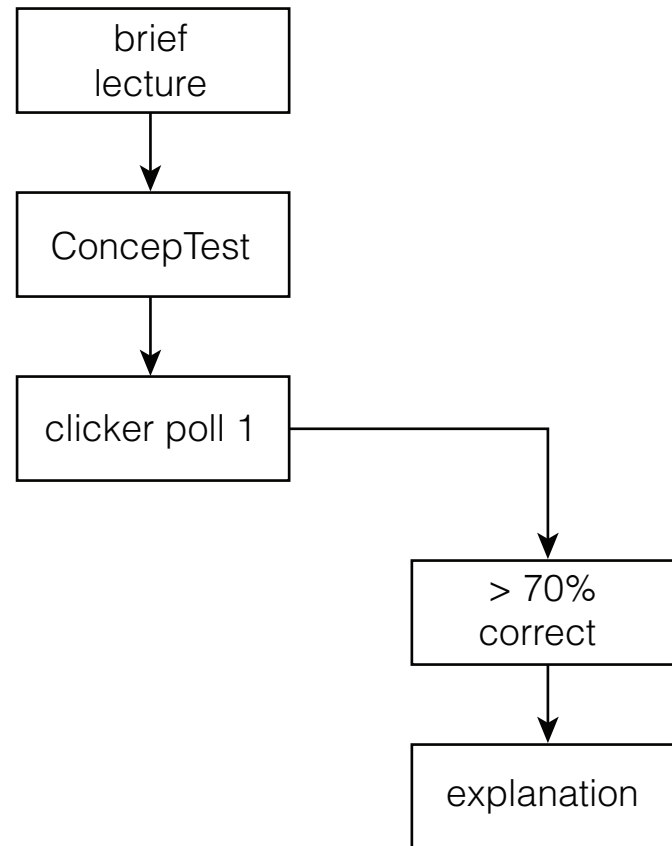
Promoting thinking



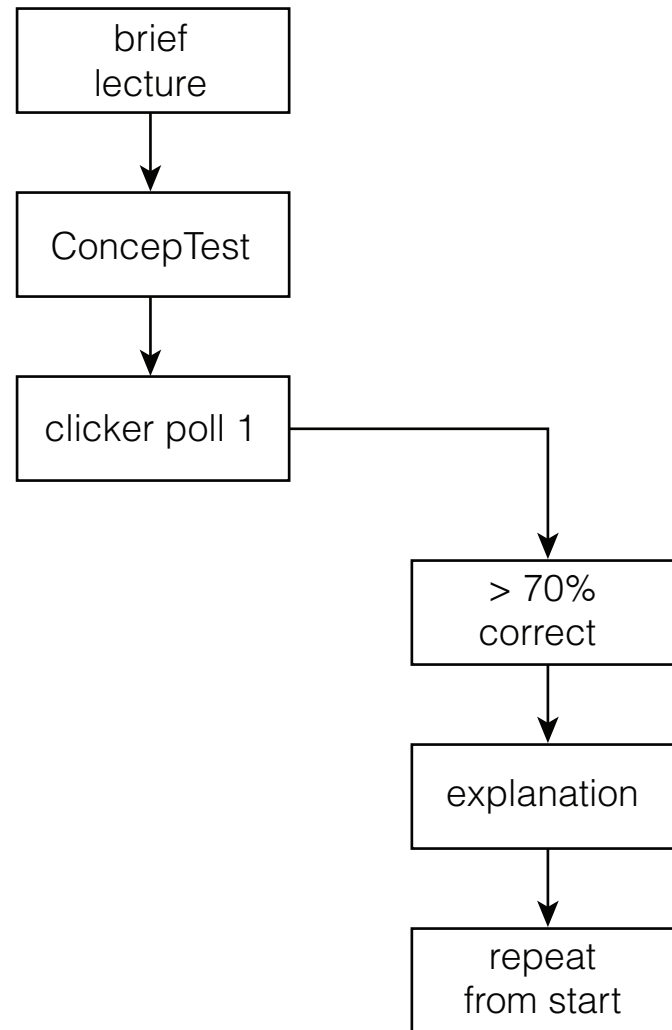
Promoting thinking



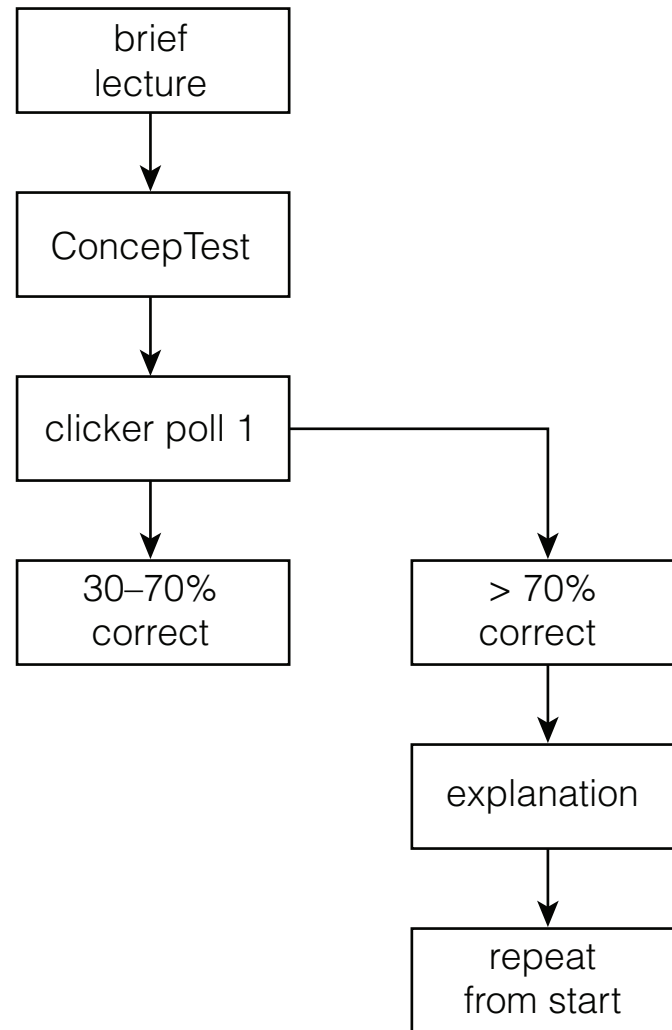
Promoting thinking



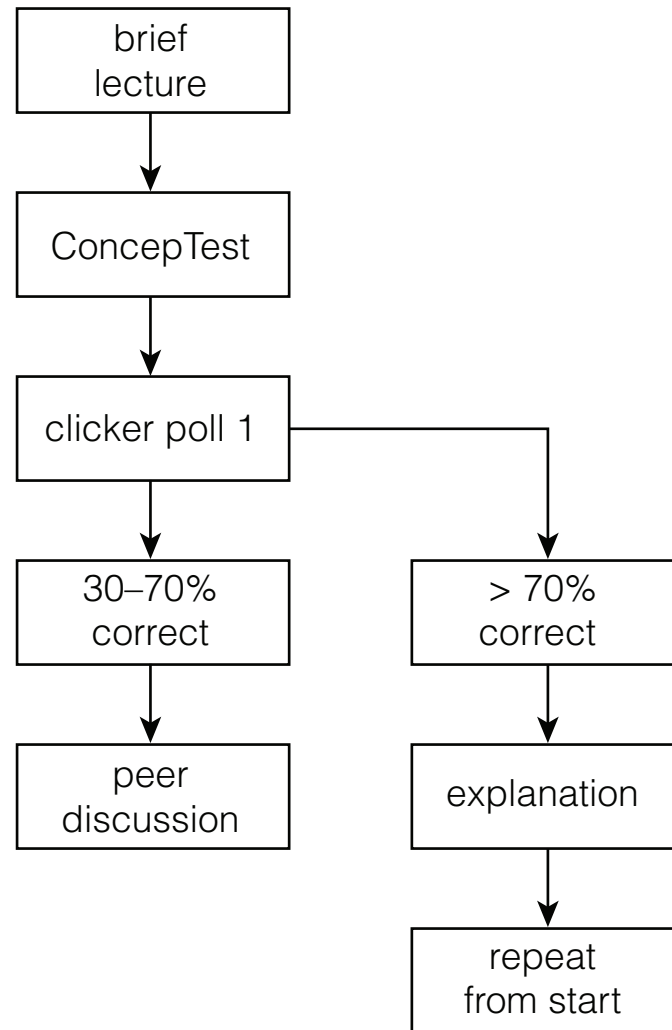
Promoting thinking



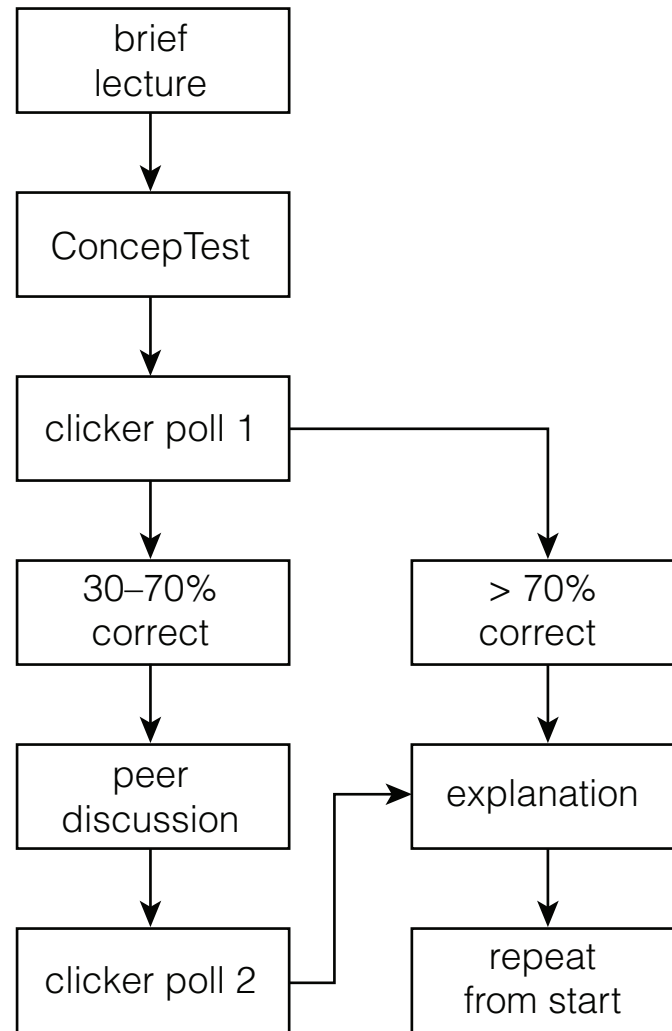
Promoting thinking



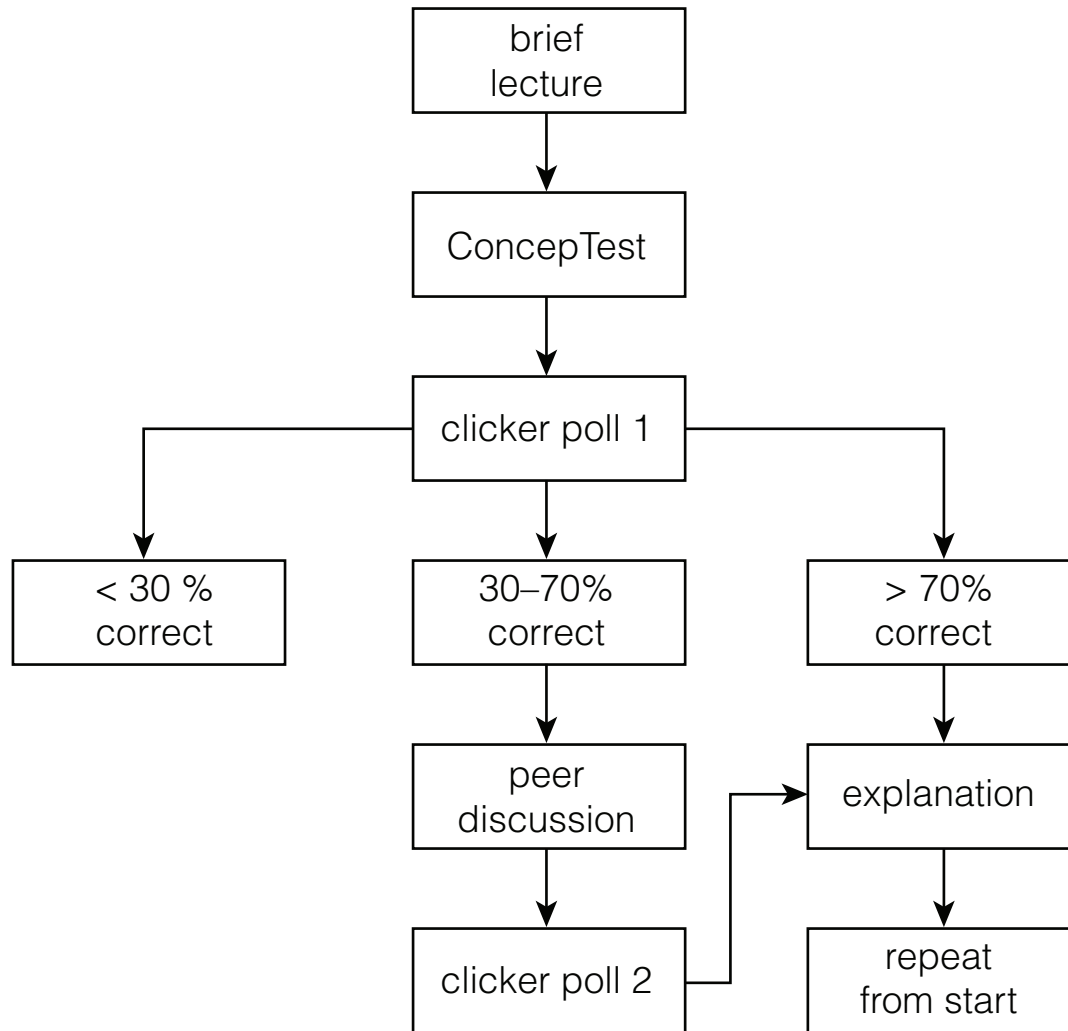
Promoting thinking



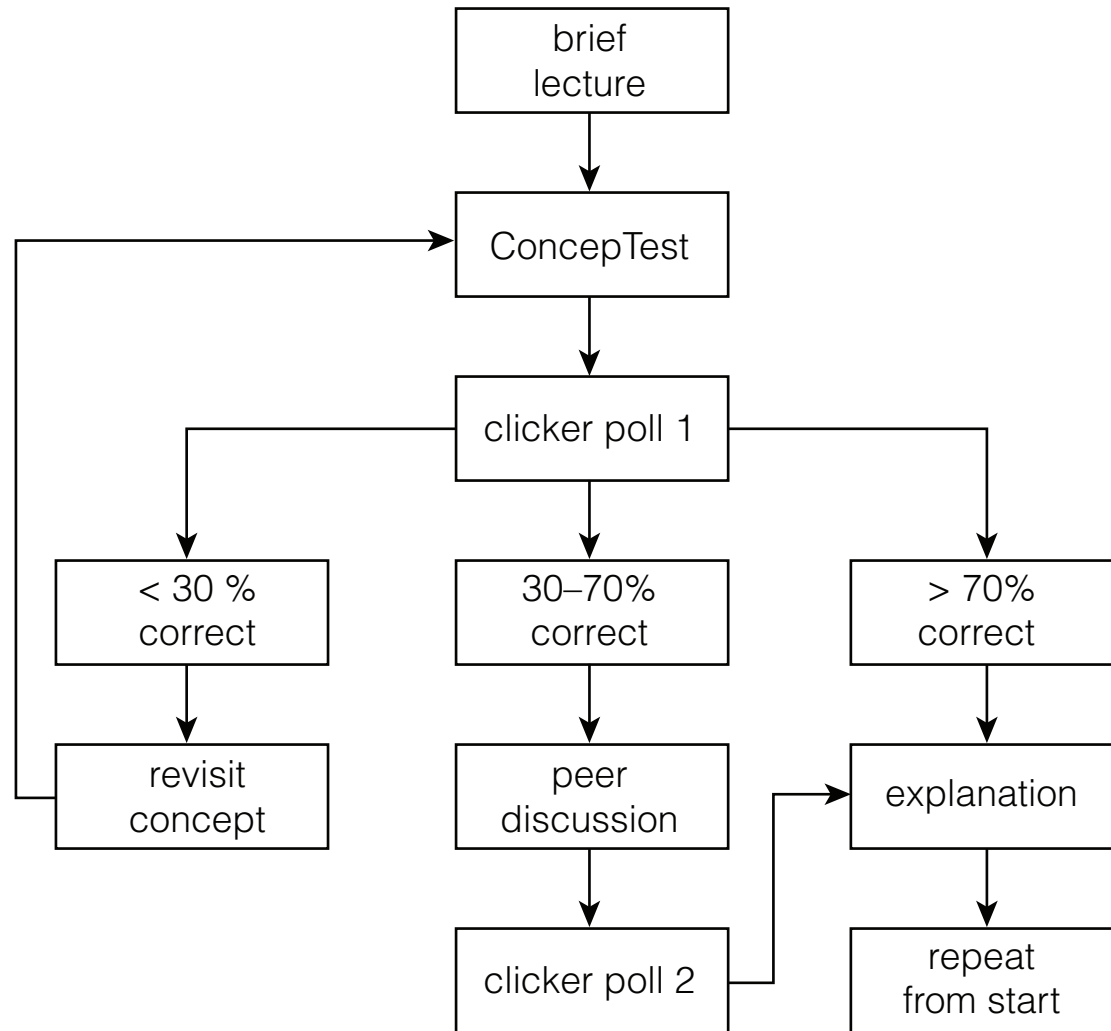
Promoting thinking



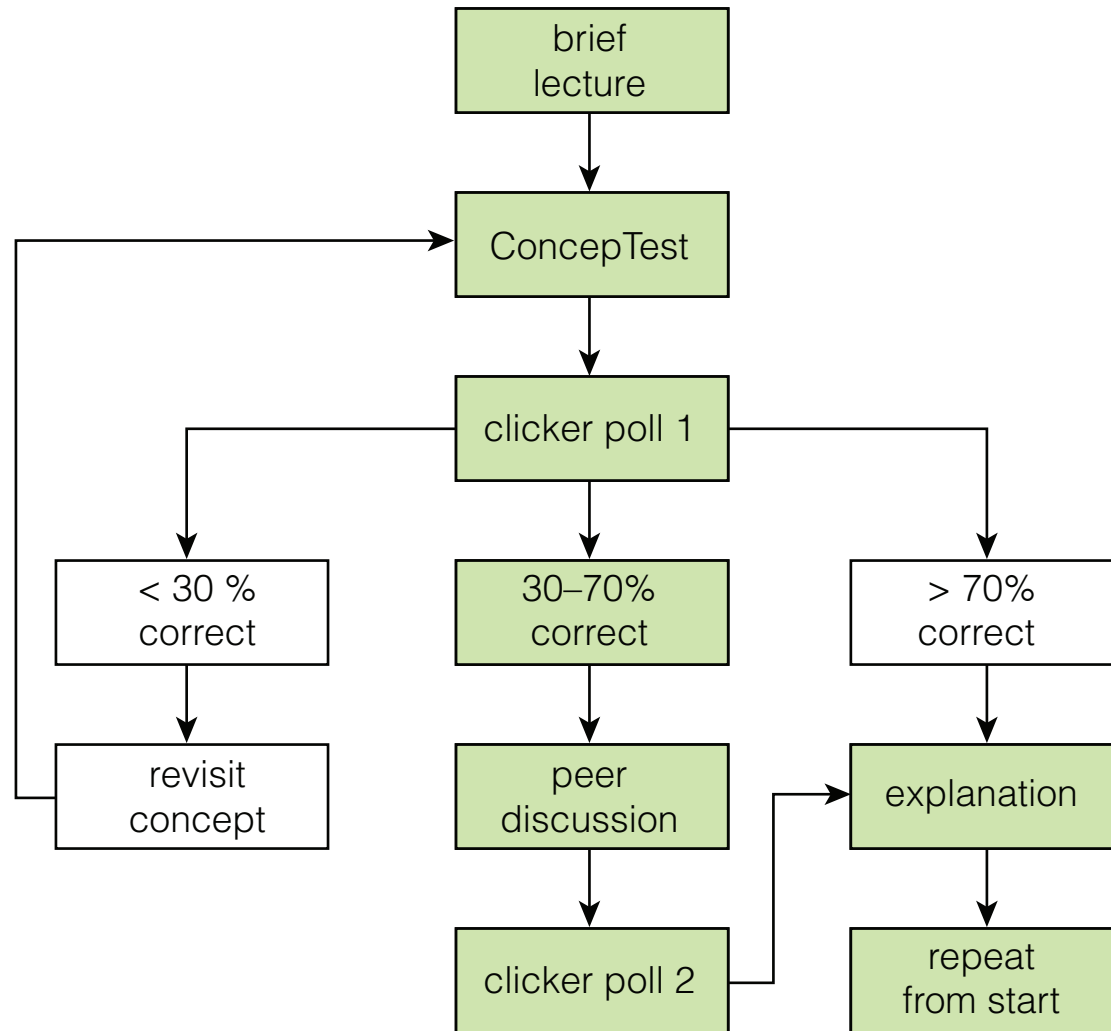
Promoting thinking



Promoting thinking

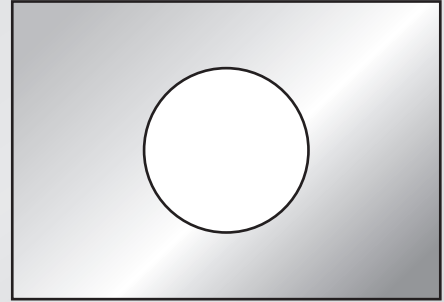


Promoting thinking



Promoting thinking

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

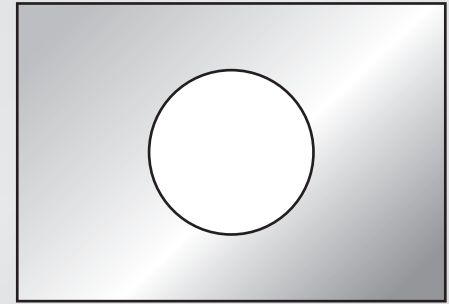


Promoting thinking

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

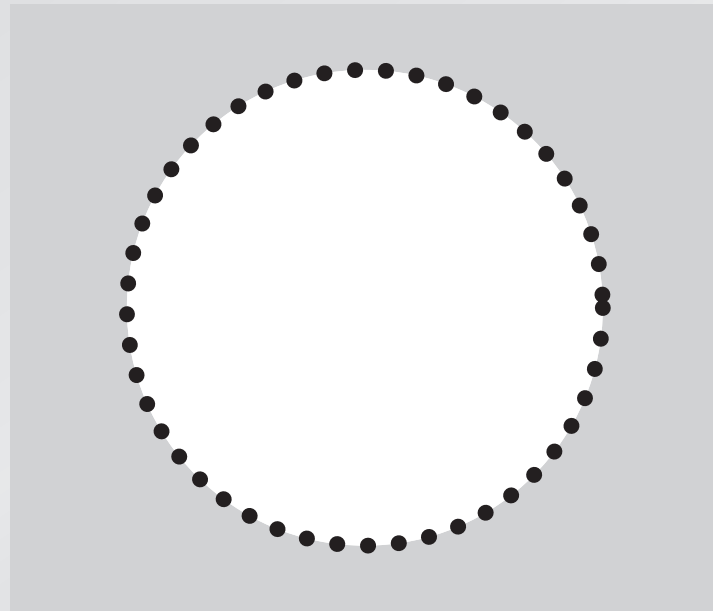
When the plate is uniformly heated, the diameter of the hole

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



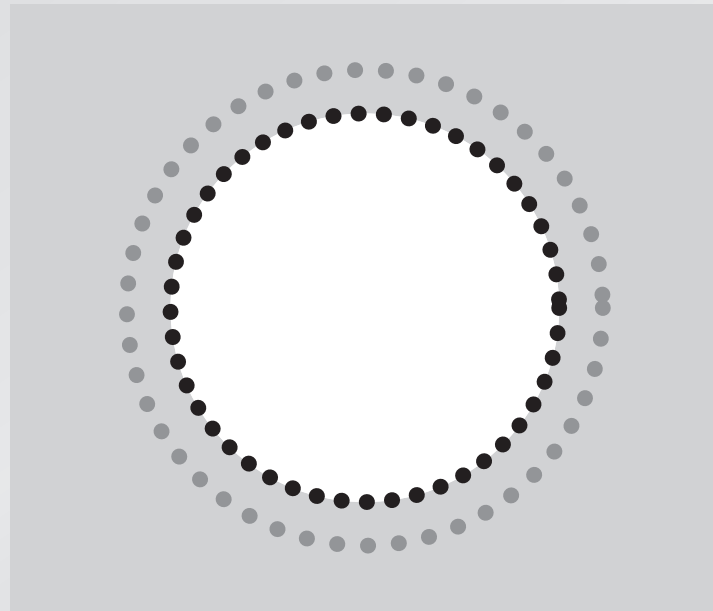
Promoting thinking

consider the atoms at the rim of the hole



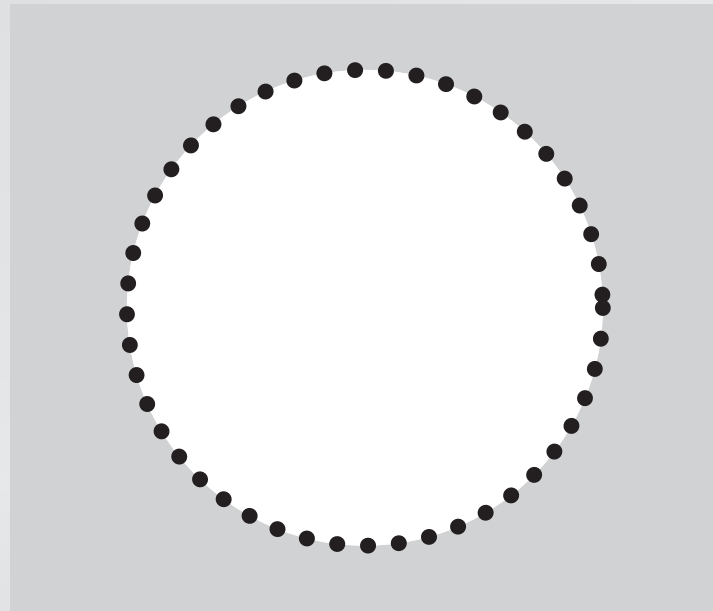
Promoting thinking

consider the atoms at the rim of the hole



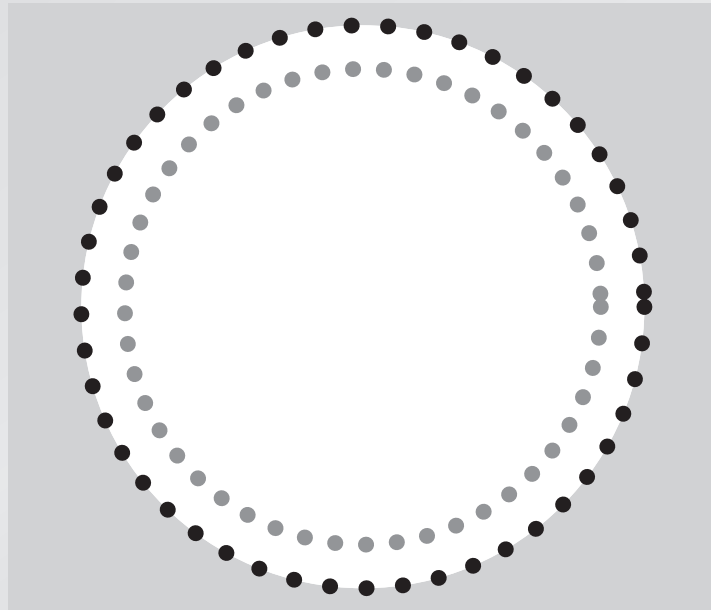
Promoting thinking

consider the atoms at the rim of the hole



Promoting thinking

consider the atoms at the rim of the hole



Promoting thinking

you all got engaged!

Promoting thinking

Benefits:

- engages students
- gets students to collaborate
- provides real-time feedback



Promoting thinking

Some hurdles:

- finding materials
- collecting and managing feedback
- making questions available to students

The screenshot shows a web browser window with the title 'ILT: Manage' and the URL 'http://www.conceptest.org'. The page content includes a navigation menu (HOME, READING, LECTURES, ASSIGNMENTS, FORUMS, NEWS, HANDOUTS), a sidebar with 'E-MAIL', 'COMING UP', 'TOOLS', and 'QUICK LINKS', and a main content area with a physics problem. The problem asks for the order of a magnet falling through an aluminum tube. The answer is: 1. more slowly, 2. exactly the same way, 3. faster. The page also includes a diagram of a magnet falling through a tube and a diagram of a rod AB in a U-shaped conductor in a magnetic field.

Outline

- Personalizing instruction
- Promoting thinking
- Integrating instruction

Integrating instruction

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 header reads "Interactive Learning Toolkit".

SIGN IN

E-Mail ([register](#))
mazur@physics.harvard

Password ([forgot?](#))

Remember me ([security](#))

© 2002 Eric Mazur
All rights reserved
[Report a problem](#)

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.

Access to the site is restricted to registered users; if you are not registered, please [register now](#).

This site is supported by a grant from the National Science Foundation and by the Division of Engineering and Applied Sciences at Harvard University.

The background features a large graphic with the word "Peer" in a stylized font, overlaid on a red and blue background. To the right, there is an illustration of a mobile phone displaying a "MyPage" menu with options like "Personalize", "Communicate", "Interact", and "HotNews".

Integrating instruction

- forums
- email
- gradebook
- scheduling and cloning
- workflow reminders

The screenshot shows a web browser window titled "ILT: Login" with the URL "http://www.concepttests.org/". The page features a "SIGN IN" section on the left with fields for "E-Mail" (containing "mazur@physics.harvard") and "Password", a "Go" button, and a "Remember me" checkbox. The main content area is titled "Interactive Learning Toolkit" and contains a paragraph describing 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." Below this is a note: "Access to the site is restricted to registered users; if you are not registered, please register now." At the bottom, it states: "This site is supported by a grant from the National Science Foundation and by the Division of Engineering and Applied Sciences at Harvard University." The background of the page features a stylized graphic of a hand holding a tablet displaying a list of items.

and much more!

Integrating instruction

online assessment module

- easy to administer
- easy to implement
- easy results!

The screenshot shows a web browser window titled "ILT-BQ: Results" with the URL "http://qemp.deas.harvard.edu". 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 "Details of the student responses by question" for "Physics Background Questionnaire > Results".

Question 1: The figure below shows a boy swinging on a rope, starting at a point higher than P. Consider the following distinct forces:

1. A downward force of gravity.
2. A force exerted by the rope pointing from P to O.
3. A force in the direction of the boy's motion.
4. A force pointing from O to P.

Which of the above forces is (are) acting on the boy when he is at position P?

The bar chart for Question 1 shows the following distribution of responses: 4 for option 1, 126 for option 2, 32 for option 3, and 9 for option 4.

Question 2: An elevator is being lifted up an elevator shaft at a constant speed by a steel cable as shown in the figure below. All frictional effects are negligible. In this situation, forces on the elevator are such that:

- A. the upward force by the cable is greater than the downward force of gravity.
- B. the upward force by the cable is equal to the downward force of gravity.
- C. the upward force by the cable is smaller than the downward force of gravity.
- D. the upward force by the cable is greater than the sum of the downward force of gravity and downward force due to the air.
- E. none of the above. (The elevator goes up because the cable is being shortened, not because an upward force is exerted on the elevator by the cable.)

The bar chart for Question 2 shows the following distribution of responses: 59 for option B, 105 for option C, and 7 for option E.

Integrating instruction

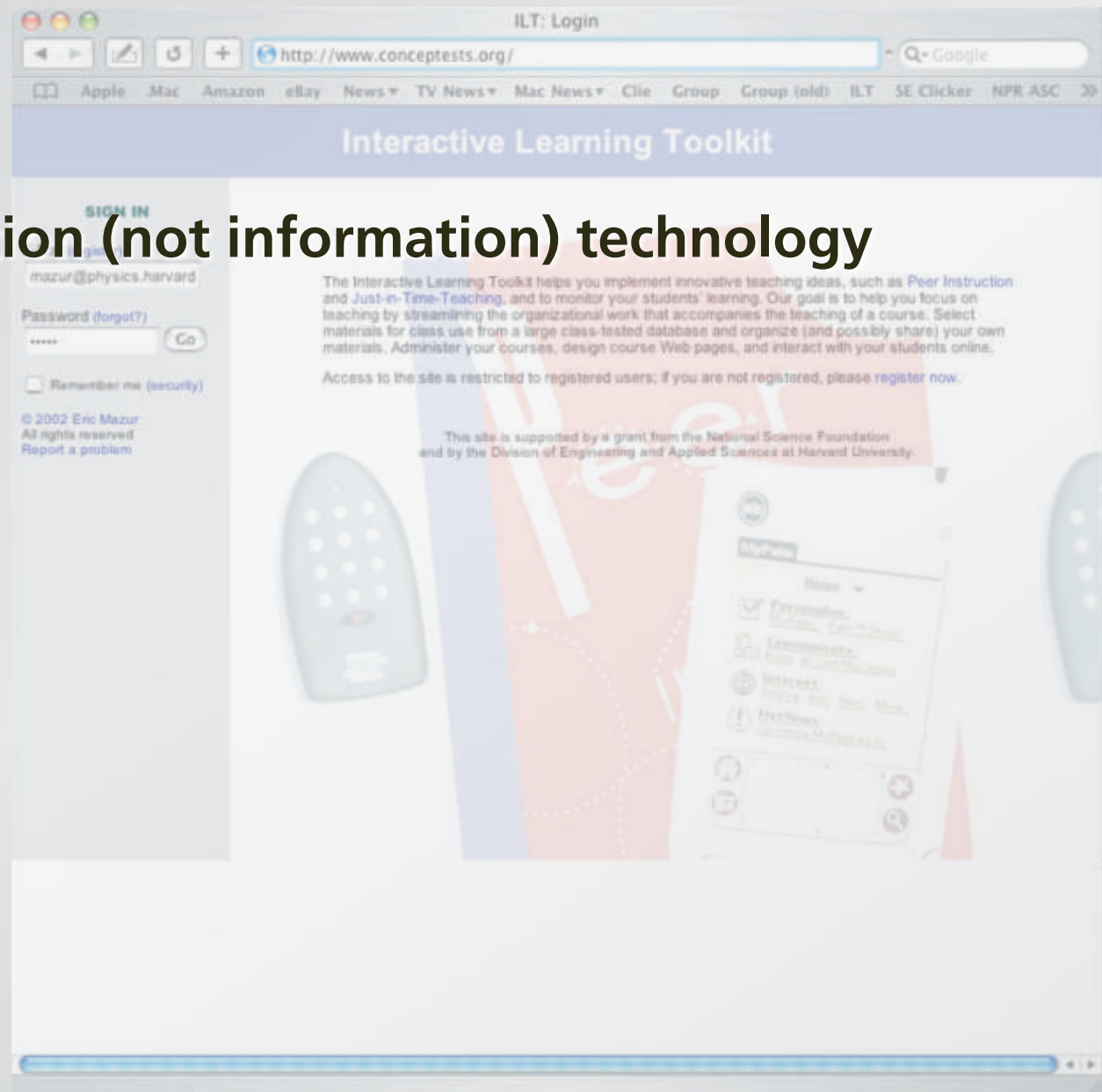
Available assessment instruments

- **Force Concept Inventory**
- **Conceptual Survey on Electricity and Magnetism**
- **Lawson's test for scientific reasoning**
- **Astronomy Diagnostic Test**
- **Maryland Physics Expectation Test**

over 25,000 students tested!

Summary

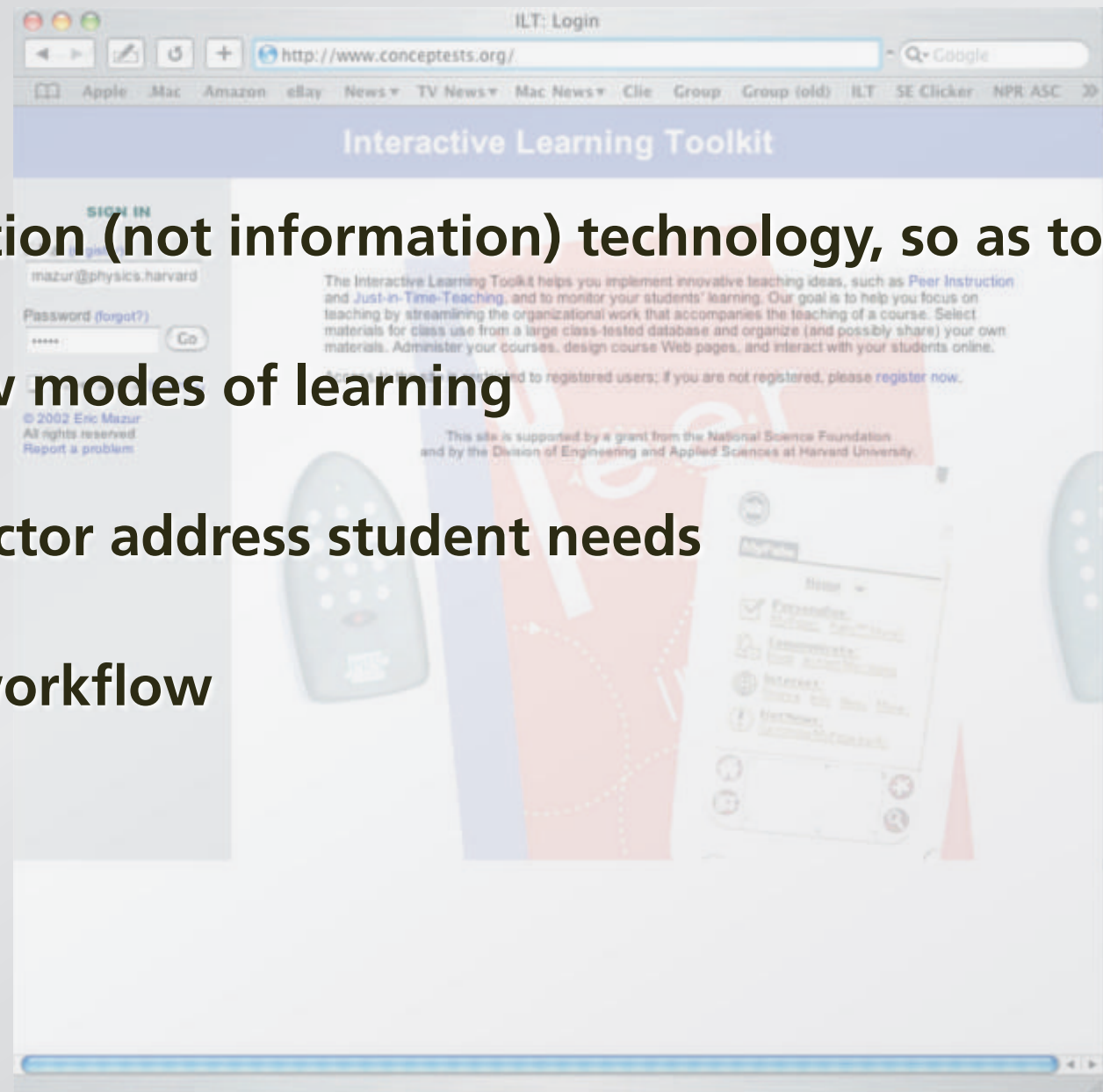
we need education (not information) technology



Summary

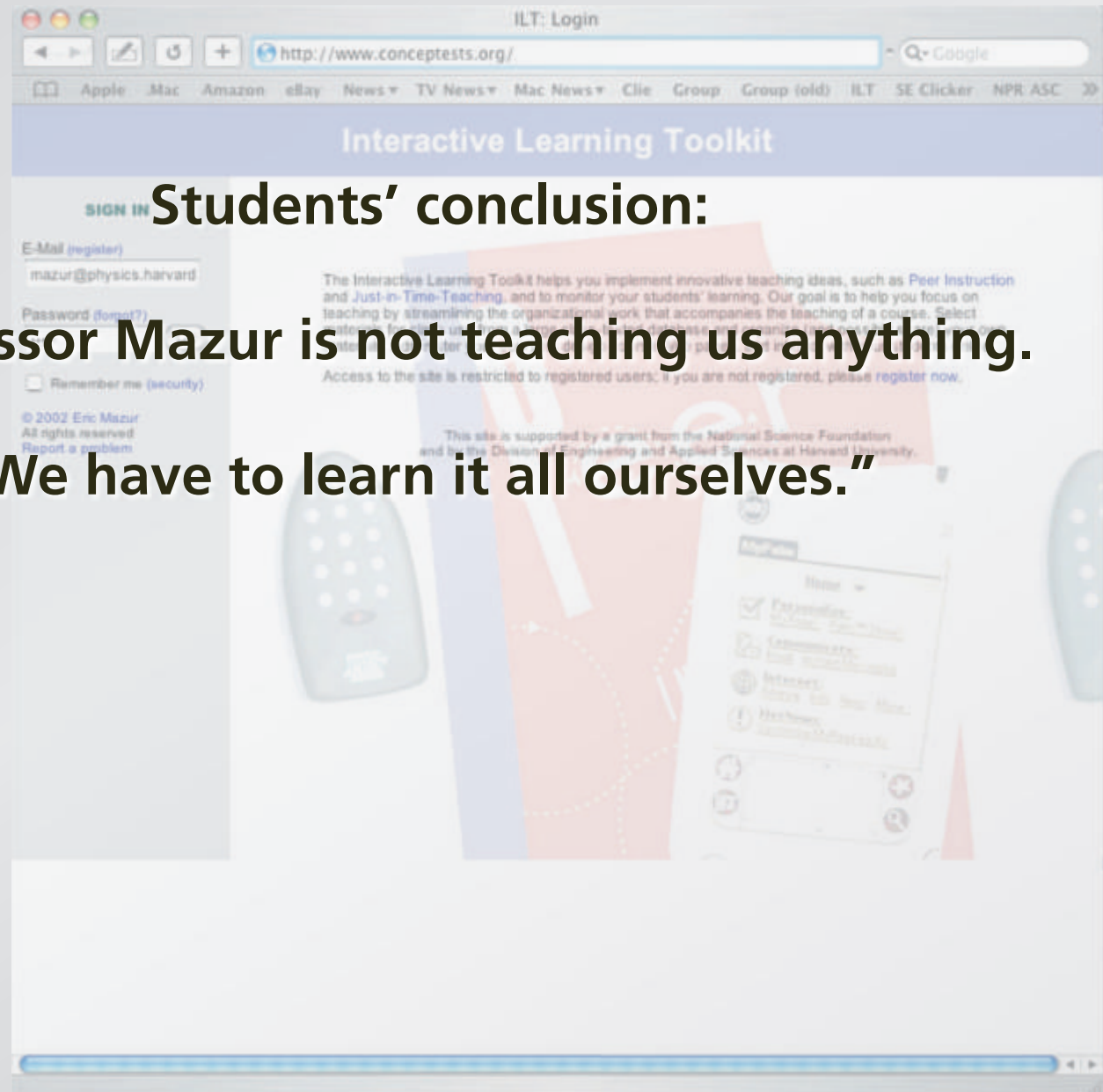
we need education (not information) technology, so as to:

- enable new modes of learning
- help instructor address student needs
- facilitate workflow



Summary

Students' conclusion:
**"Professor Mazur is not teaching us anything.
We have to learn it all ourselves."**



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