

# Tecnología educativa para motivar a los estudiantes

Universidad Tecnológica de Panamá  
Panama City, Panama, 18 marzo 2010



# **Mi argumento**

**Tecnología no es una bala mágica**

# Introducción

## Una breve historia de la tecnología de la información

- pizarra
- proyector de transparencias
- televisión
- computador

# Introducción

**¿Qué hay de malo**

**con los viejos métodos para presentar contenido?**







El libro de las horas, Valencia, c. 1460



Belles Heures du Duc de Berry  
1408-09  
El Camino al Calvario

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

**D**ivitijs sunt sub iugo serui dñs suos quā honore dignos arbitrant: ne nomine dñi & doctrina blasphemetur. Qui autē fideles habent dños nō detrahāt quia fides sūt: sed magis feruāt q̄a fideles sūt & dilecti: q̄a beneficii participes sunt hęc dōce: & egrotare. Si q̄a aliter doceat: & nō acquiescat sanis sermōibus dñi nri ihesu cristi. et ei que sūd in pietatē ē doctrine: superbus nichil scietis sed languēs circa questiones & pugnas verbos: ex quibus oriuntur inuidie & tentationes blasphemie suspiciones male- & sollicitationes hominū in parte corruptorū & q̄ veritate privati sūt: existimatiū questū esse pietatē. Est autē questus magnus: pietas cum sufficientia. 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 in habitat inaccessibilē: quē null⁹ hominū vidit sed nec videre potest: cui honor & imperiū sempiternū amittit.

**D**ivitijs hui⁹ seculi p̄cipe nō sublimare sapere: neq̄ sperare in iucato diuitiarū sed in deo vno q̄ p̄stat nobis oīa abūde ad fruendū: bene agere: diuites fieri in bonis opibus: facile tabuete & inuicere: thesaurizare sibi sūd amentū bonū in futurū: ut apphētēt veram vitā. In thimothee depositū custodi: deuitās phanas vocū nouitates et oppositiones falli nōis sciētis: quā quidā p̄mittēt 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: & qd futurus sit temporibus nouissimis. & de sua passione: scilicet a roma. Exphat argumentū in epistolā secundā ad thimothē.*

**M**ulus apostol⁹ hui⁹

ihesu cristi p̄ volūta-  
tem de se ipso p̄missi-





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

Uicūq; sūt sub iugo serui dñi os suos dñm honore dignos arbitrant: ne nōq; dñi & doctrinā hīlāstentur.

Quia nō dētermināt seruiāt q̄a sūt fieri p̄cipere. Si q̄a aliter nō sūt seruū que sōdū p̄cipi nūchil s̄ciens ones & pugnat inuidie dēspiciōne m̄tate corruptū: existimāt

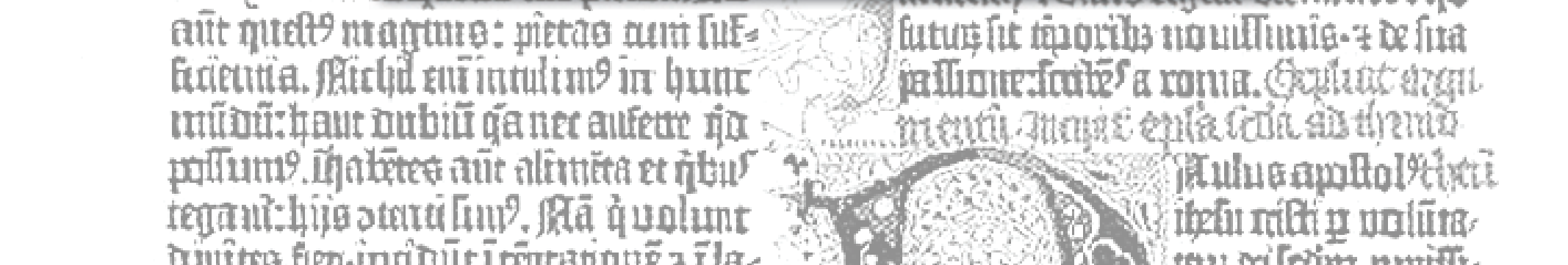
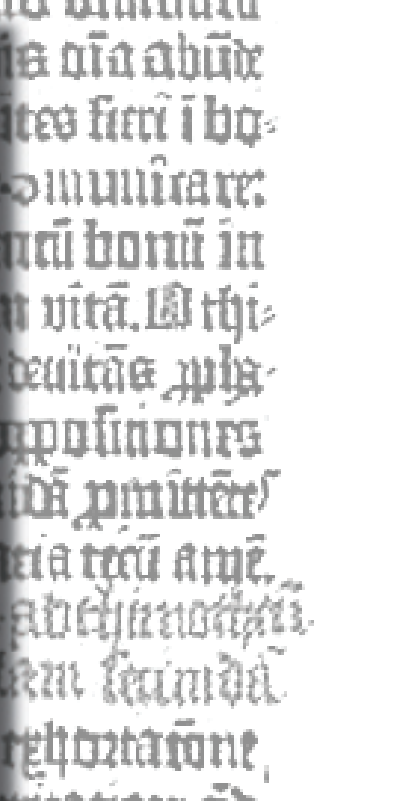
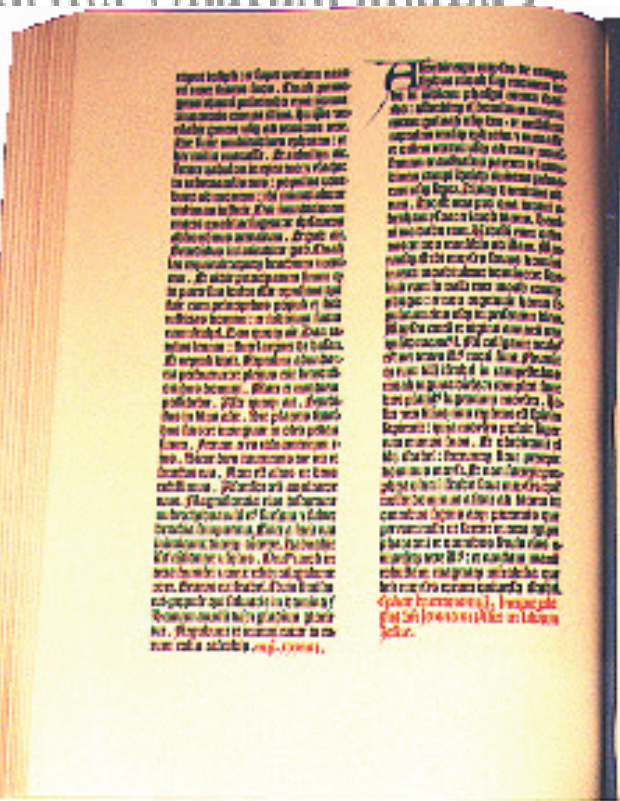
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diūa unū: q̄ solus habet immortalitatem & lucē inhabitat inaccessibilē: quē null⁹ homī uīdit sed nec uidere potest: nisi hōmō & imperiū sempiternū amittit.

Quitibz hūi⁹ seculi p̄cipe nō sublimē saepe nem̄ loq̄ar: in iugū diuitiarū

na oīa abūde p̄tes fieri i bo- dūmūtare: m̄tū bonū in m̄ vitā. Et thi- deuitas p̄ha- p̄posiōnes idā p̄mūtēt: aia tecū amē. ad th̄mōtā. am̄ sc̄m dā reḡortatōne

utūq; & dūm̄ regit ueritatis: & q̄d futurus sit tēporibz nouissimis. & de sua passione: sc̄dē a roma. Gessit argu- mentū. Inuā ē ep̄la sc̄dā ad th̄mō. Nihilus ap̄stol⁹ th̄m̄ ihesu r̄stī p̄ uolūta- tou dē sedm̄ n̄missi-



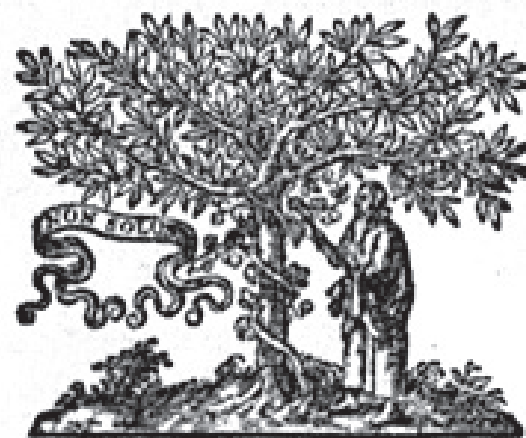


DISCORSI  
E  
DIMOSTRAZIONI  
MATEMATICHE,  
*intorno à due nuoue scienze*

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 gravità d'alcuni Solidi.*



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



# Introducción

¡pero las clases apenas han evolucionado!



# Introducción

**No solo la entrega de información  
sino la asimilación de información es clave**

A large lecture hall with a professor at the front and students seated at desks. The professor is standing at a podium, gesturing towards a large screen displaying a diagram. The students are seated at desks, many with papers and laptops open. The room is dimly lit, with the main light source being the projector screen and the professor's desk.



# Introducción

Piense sobre las metas educativas  
antes de introducir la tecnología



# Introducción

**¿En qué consiste el uso efectivo de la tecnología?**

- **promueve las metas educativas**
- **facilita nuevas formas de aprendizaje**
- **la inversión esta en consonancia con los rendimientos**
- **reutilizable y flexible**



# Esquema

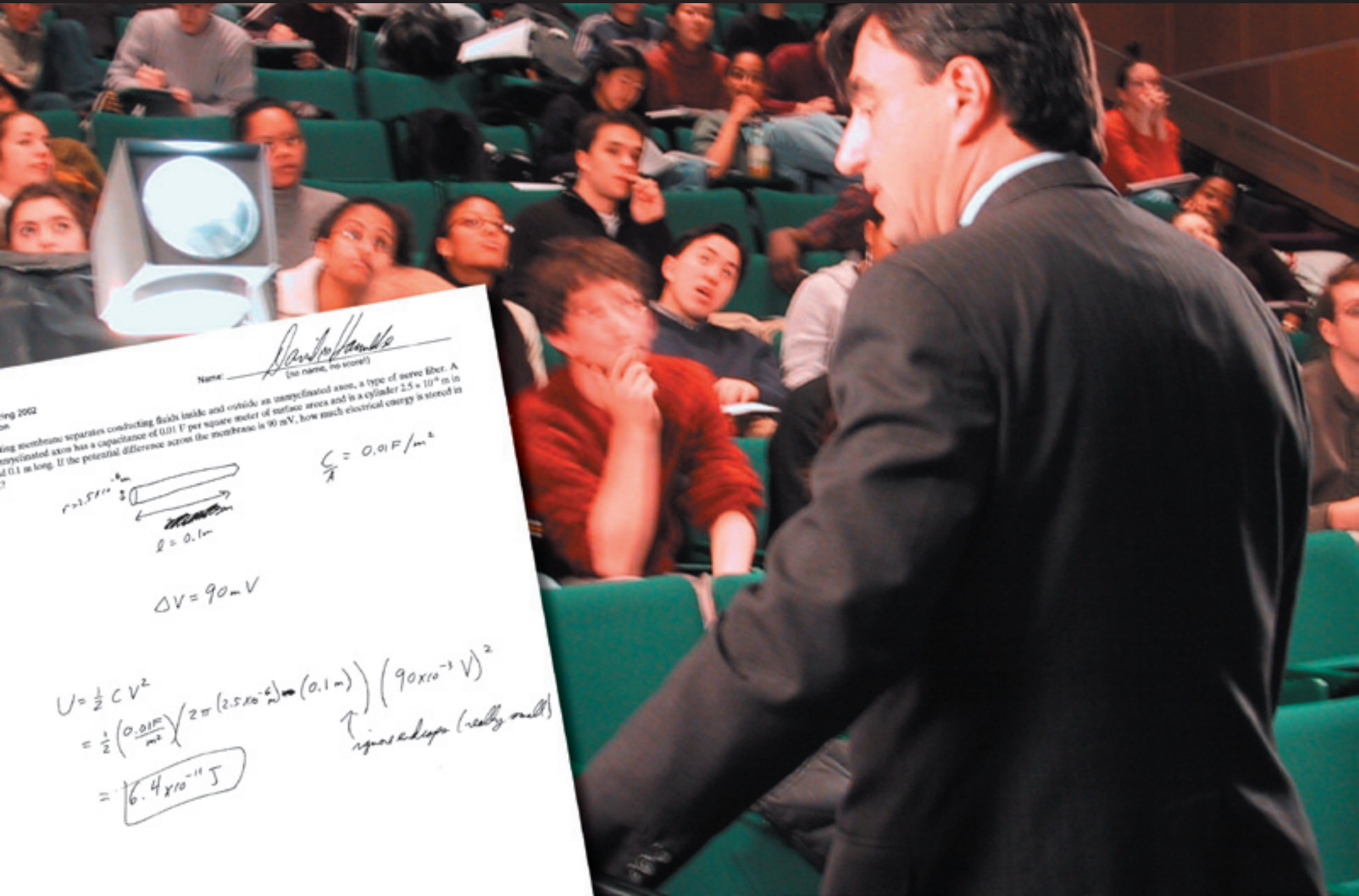


# Esquema

- Personalizando la enseñanza
- Promoviendo el pensamiento
- Integrando la enseñanza

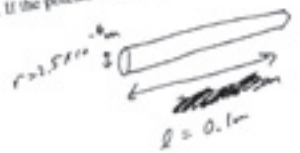


# Personalizando la enseñanza



Name: Dante Vando  
(no name, no work)

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



$$C = 0.01 F/m^2$$

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

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

↑ ignore edge (really small)

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



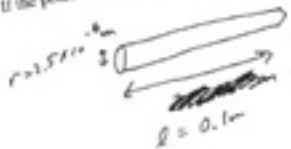
# Personalizando la enseñanza

caras  
sin nombres

Name: Dante Vando  
(no name, no word)

ing 2002  
on

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



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

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

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

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# Personalizando la enseñanza

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$r = 2.5 \times 10^{-6} \text{ m}$   
 $l = 0.1 \text{ m}$

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

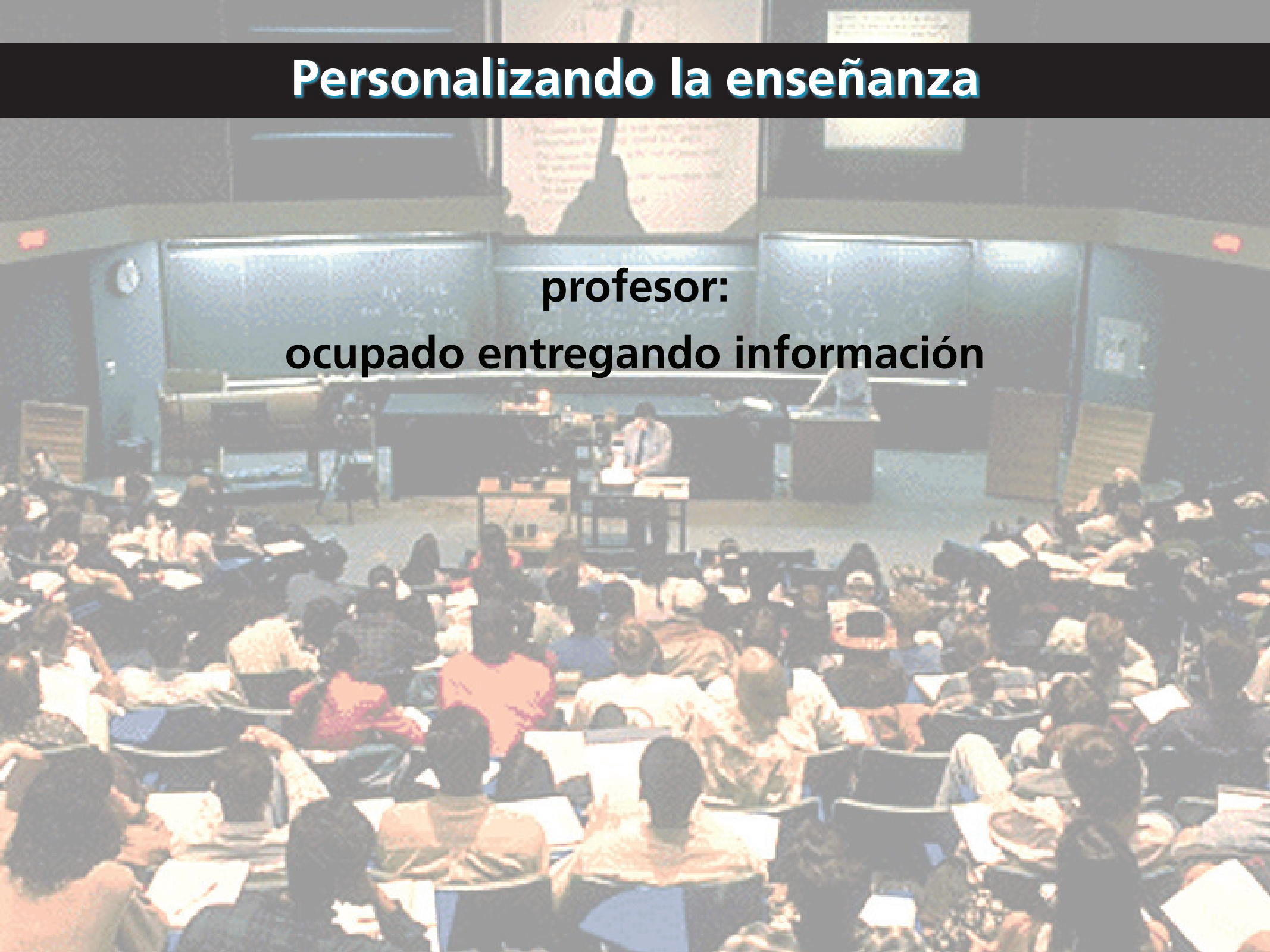
$\Delta V = 90 \text{ mV}$

$U = \frac{1}{2} C V^2$   
 $= \frac{1}{2} \left( \frac{0.01 \text{ F}}{\text{m}^2} \right) \left( 2\pi (2.5 \times 10^{-6} \text{ m}) (0.1 \text{ m}) \right) (90 \times 10^{-3} \text{ V})^2$   
 $= \boxed{6.4 \times 10^{-11} \text{ J}}$

↑ ignore edge (really small)

# Personalizando la enseñanza

**profesor:  
ocupado entregando información**



# Personalizando la enseñanza

A large lecture hall with a professor at the front and students taking notes. The professor is standing at a podium, and the students are seated in rows, many with their hands raised or taking notes. The room has a curved wall and a large screen at the front.

**profesor:**  
**ocupado entregando información**

**estudiantes:**  
**ocupados tomando notas**



# Personalizando la enseñanza

A large lecture hall with a professor at a podium and many students seated at desks. The room is filled with students, and the professor is standing at the front, addressing the class. The text is overlaid on the image.

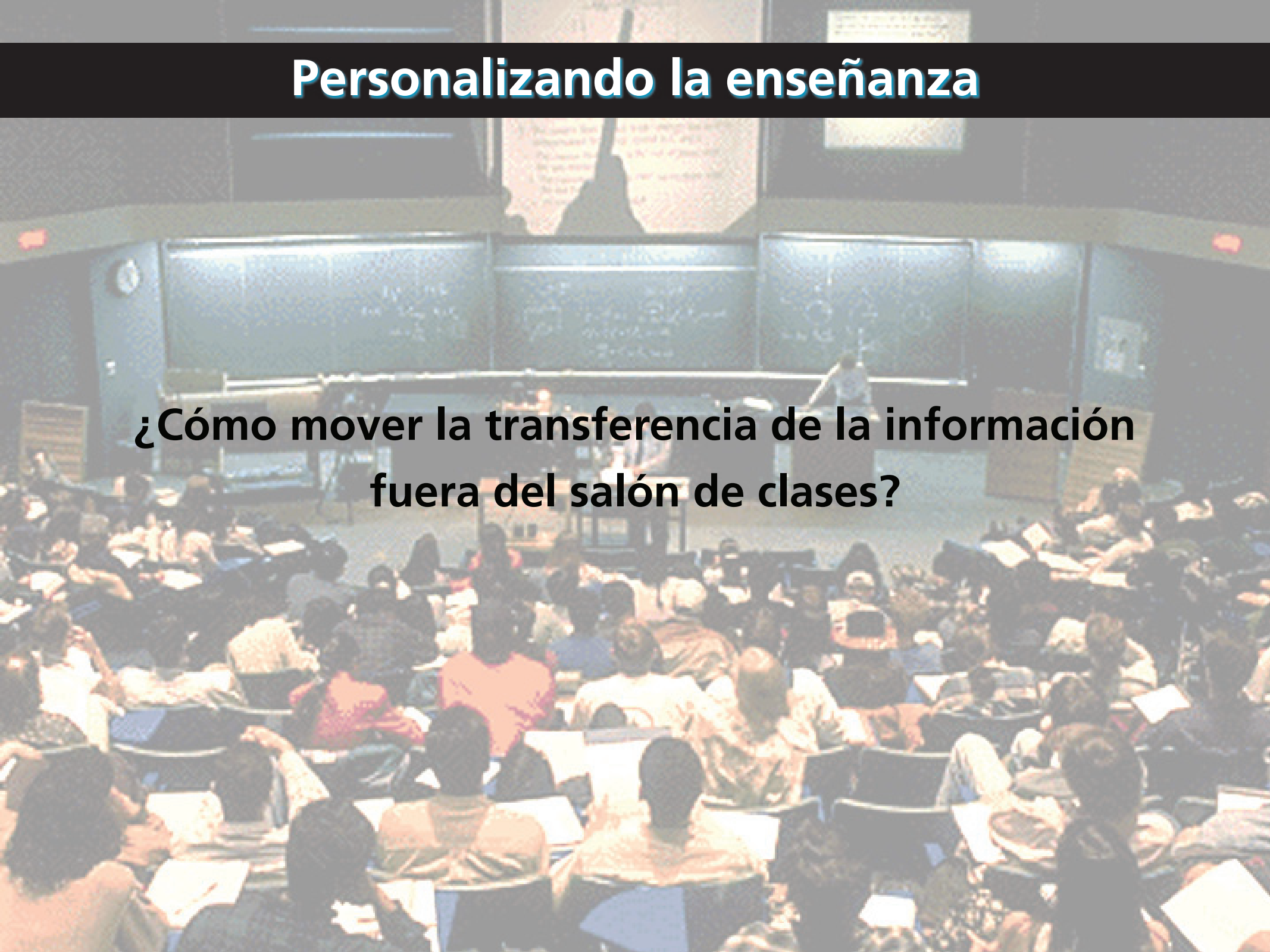
**profesor: no puede abordar  
las necesidades individuales de los estudiantes**

**estudiantes:  
no tienen tiempo de pensar**



# Personalizando la enseñanza

**¿Cómo mover la transferencia de la información fuera del salón de clases?**

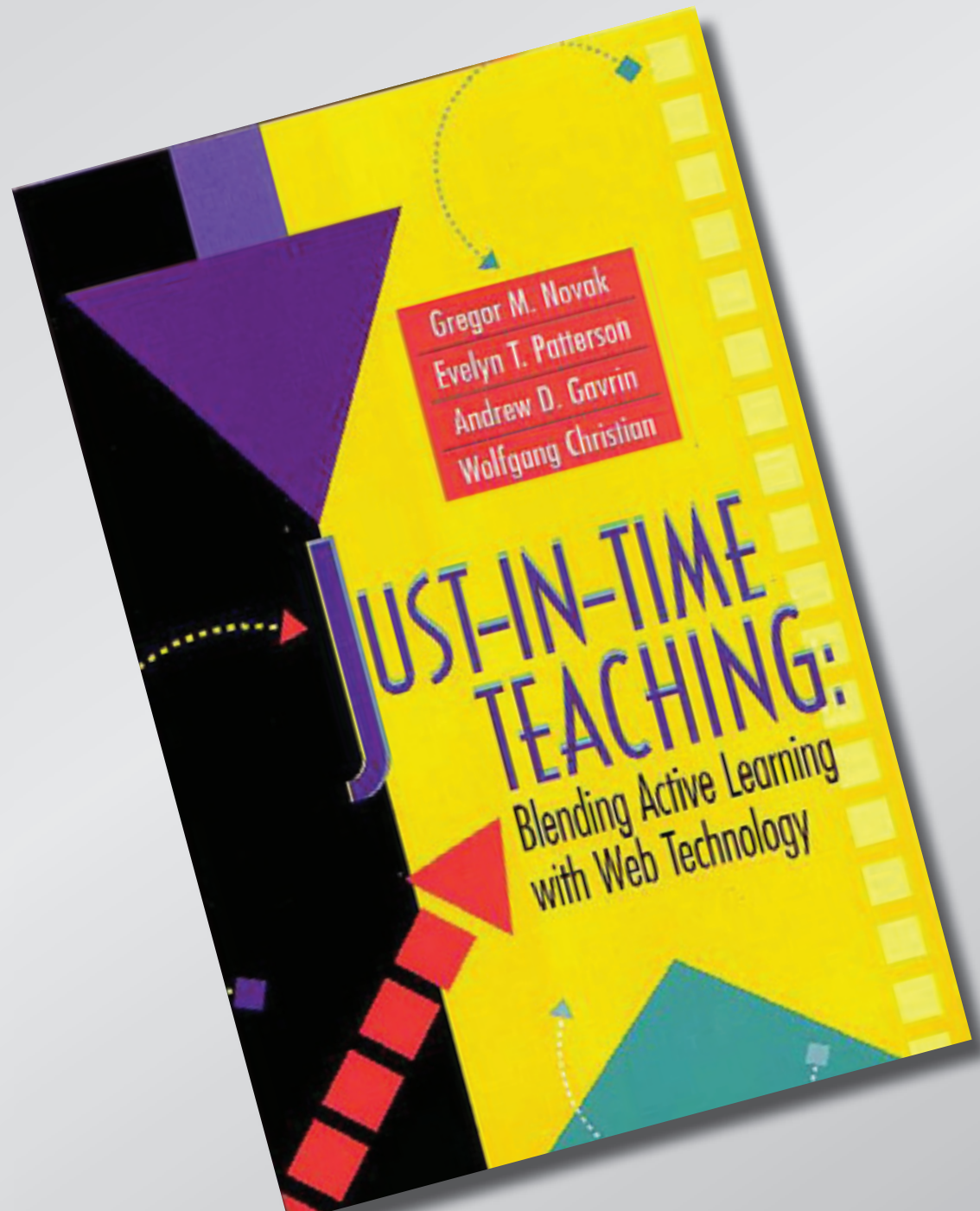


# Personalizando la enseñanza

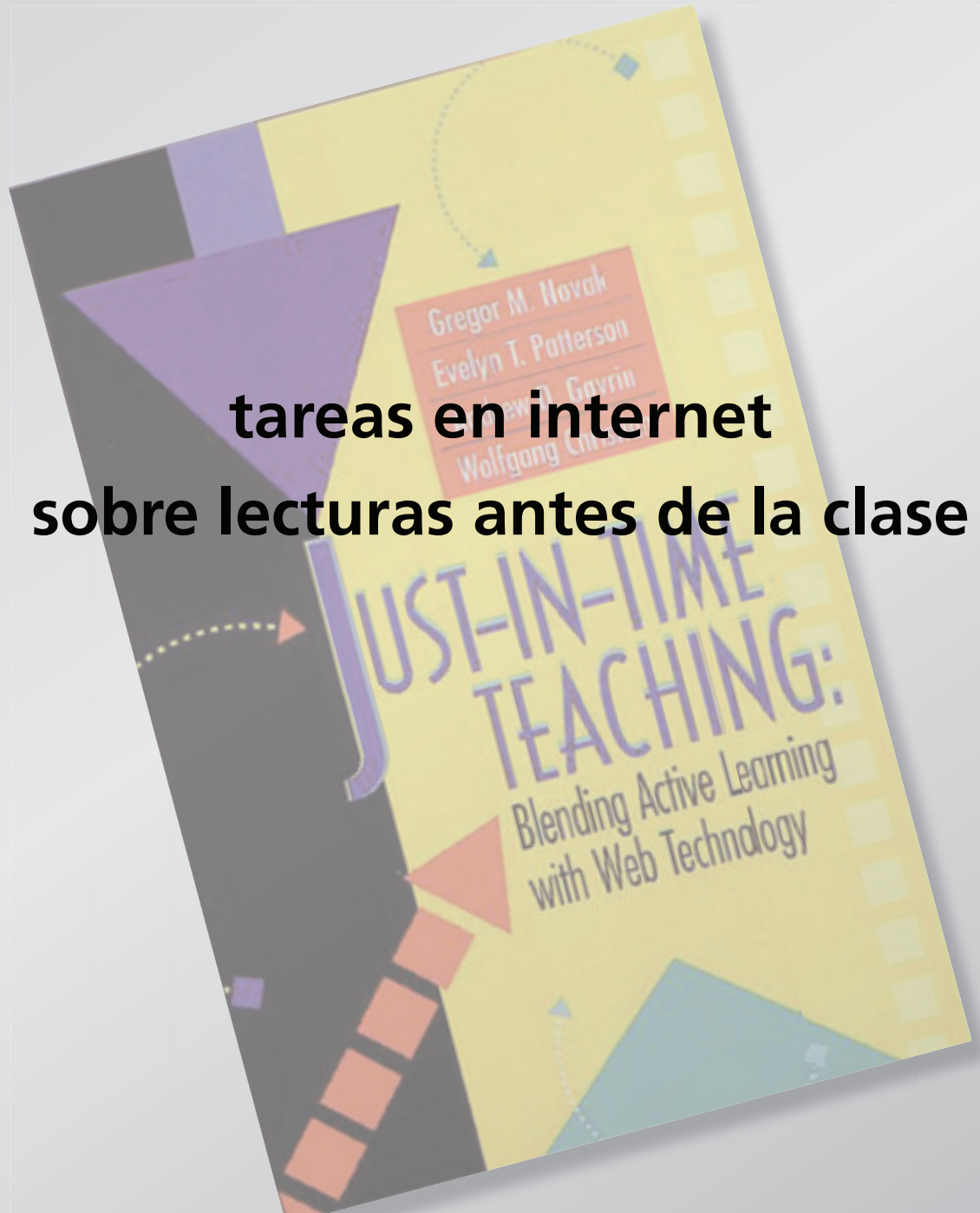
**¿Cómo mover la transferencia de la información fuera del salón de clases?**

**(de manera que podamos enfocarnos en asimilar la información)**

# Personalizando la enseñanza



# Personalizando la enseñanza



**tareas en internet  
sobre lecturas antes de la clase**



# Personalizando la enseñanza

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 current page is "Student Responses" for the assignment "Changing magnetic fields II".

**E-MAIL**  
Manage email connection  
Email (3)

**COMING UP**  
5/2 Assignment 1

**TOOLS**  
Run Similarity Check

**QUICK LINKS**  
Standardized tests  
Students

**Sections**  
Select Section

© 2002 Eric Mazur  
All rights reserved  
Report a problem

**SITE ADMIN**  
Users  
Conceptests  
Topics  
Bugs  
Standardized test

Courses > Physics 1b > Reading > Changing magnetic fields II > < Student Responses

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
	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
	Misi Arjia 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 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	4/7/2003 2:13:13 pm	0 / 1

# Personalizando la enseñanza

## Beneficios

- conecta nombres con caras
- prepara a los estudiantes para la clase
- enseñanza asincrónica
- tiempo de clase más enfocado

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 and displays a "Student Responses" section for an assignment titled "Changing magnetic fields II". The page includes a navigation menu with options like HOME, READING, LECTURES, ASSIGNMENTS, FORUMS, NEWS, and HANDOUTS. A sidebar on the left contains sections for E-MAIL, TOOLS, QUICK LINKS, and SITE ADMIN. The main content area shows a list of student responses with columns for Student, Answer, Time, and Response. The responses are from students like John Yunog, John Wang, and Kori Susser, discussing topics like inductance and Faraday's Law.

Student	Answer	Time	Response
[Profile Picture]	[Redacted]	12/31/1969 6:59:59 pm	0 / 1
[Profile Picture]	John 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
[Profile Picture]	John Wang 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	7/31/2009 12:00:00 am	0 / 1
[Profile Picture]	Moi Arpa I did not find any part confusing. I found the concept of inductance important, and it's interesting to see how it's related to other parallel between	4/6/2103 4:59:00 pm	0 / 1
[Profile Picture]	Kori Susser 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	4/7/2005 2:13:13 pm	0 / 1

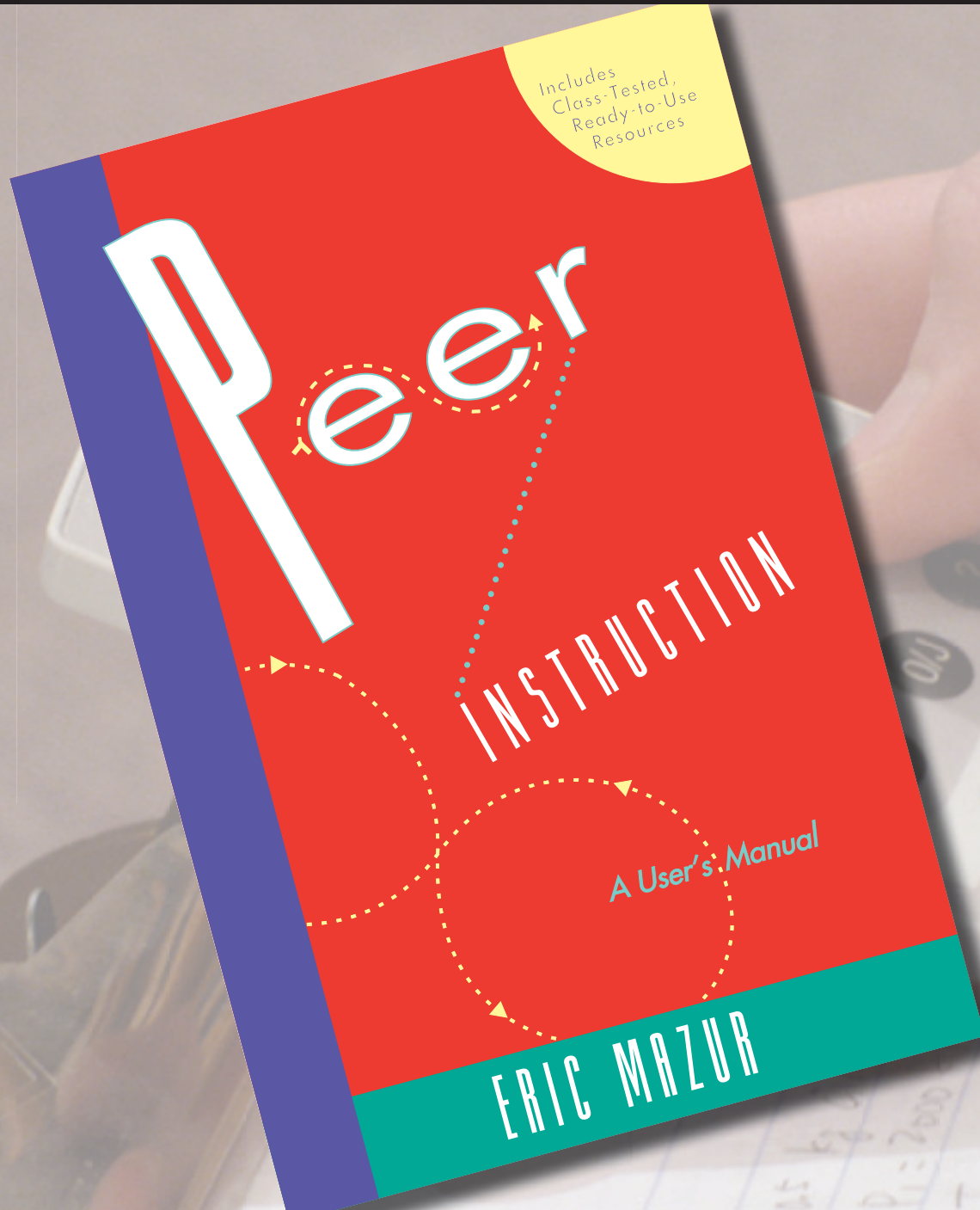




# Esquema

- Personalizando la enseñanza
- **Promoviendo el pensamiento**
- Integrando la enseñanza

# Promoviendo el pensamiento



Handwritten notes on a piece of paper, including:  
 $P = 2000$   
 $T = 1000 \text{ K}$   
 $T_0 = 400 \text{ K}$



# Promoviendo el pensamiento

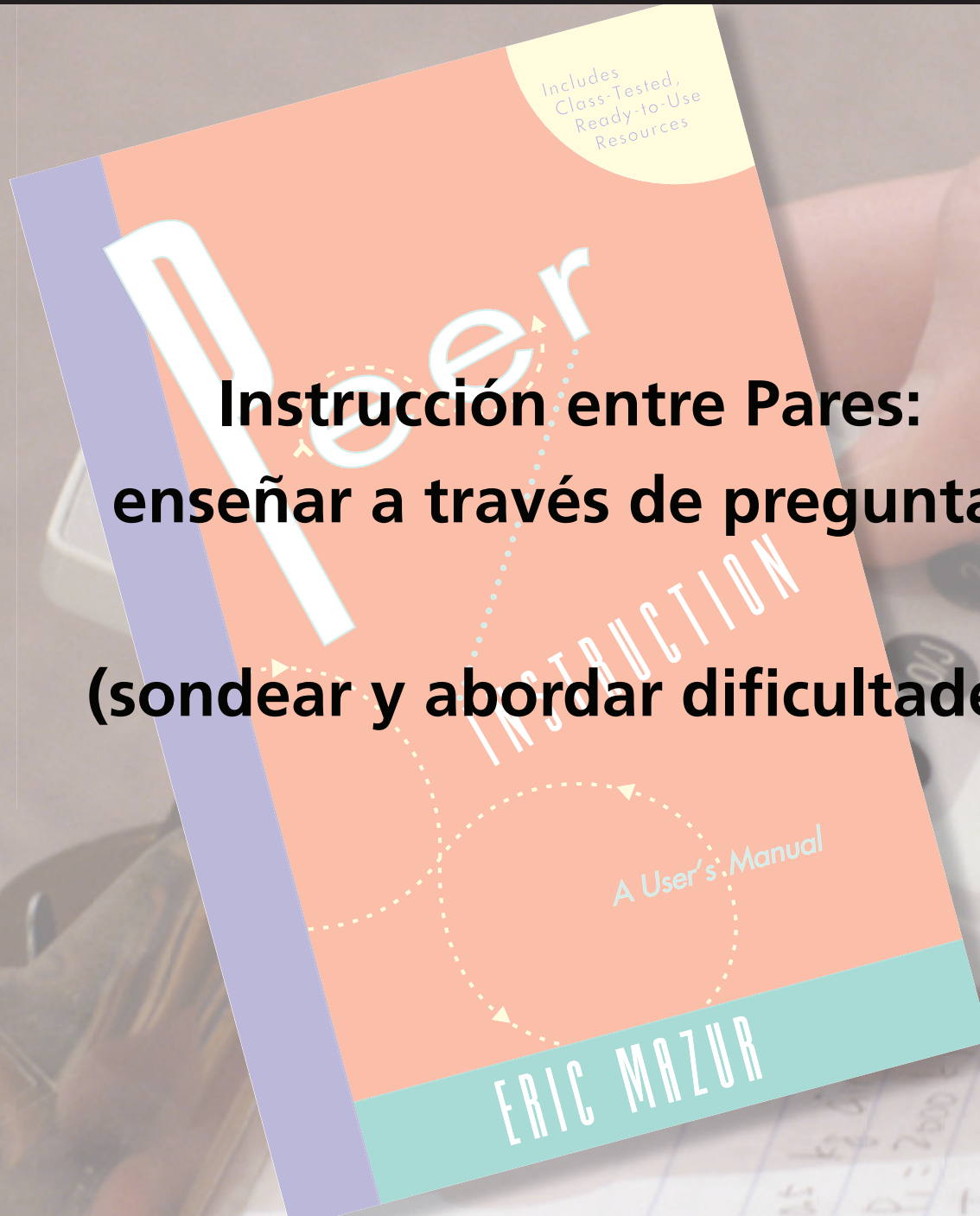
**Instrucción entre Pares:  
enseñar a través de preguntas**





# Promoviendo el pensamiento

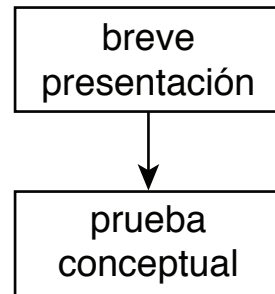
**Instrucción entre Pares:  
enseñar a través de preguntas  
(sondear y abordar dificultades)**



# Promoviendo el pensamiento

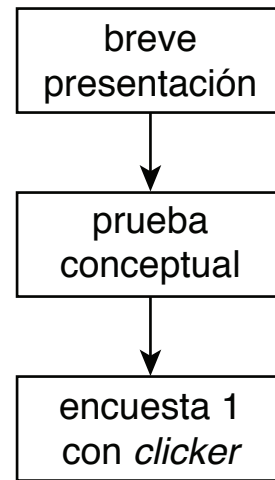
breve  
presentación

# Promoviendo el pensamiento

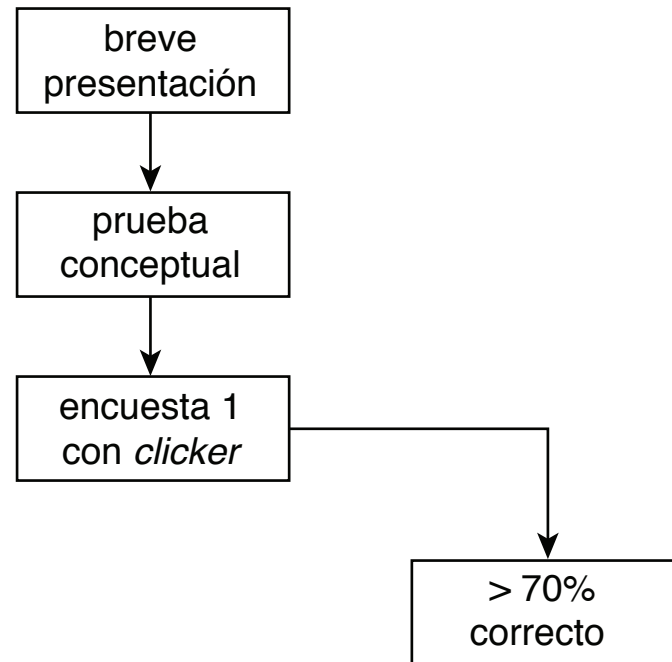




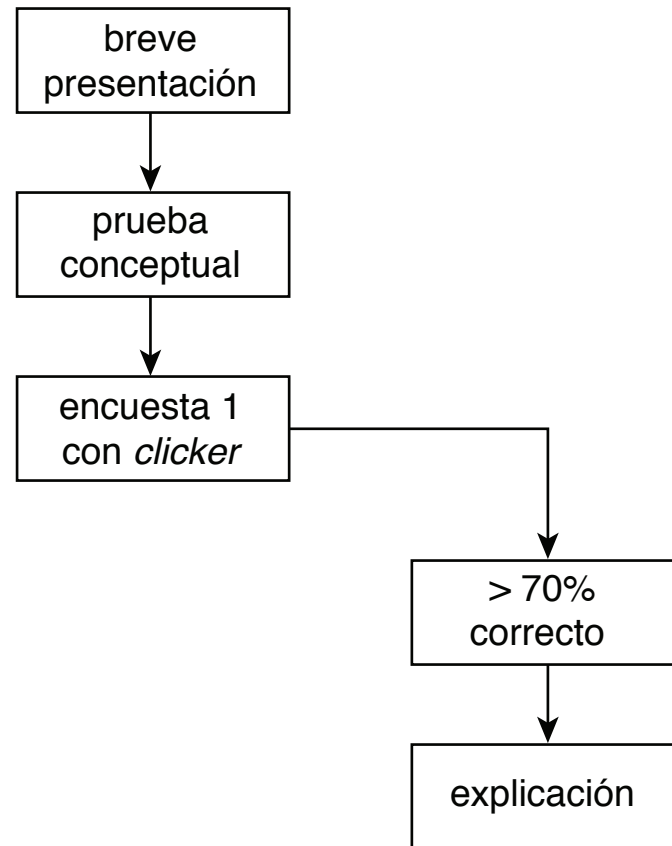
# Promoviendo el pensamiento



# Promoviendo el pensamiento

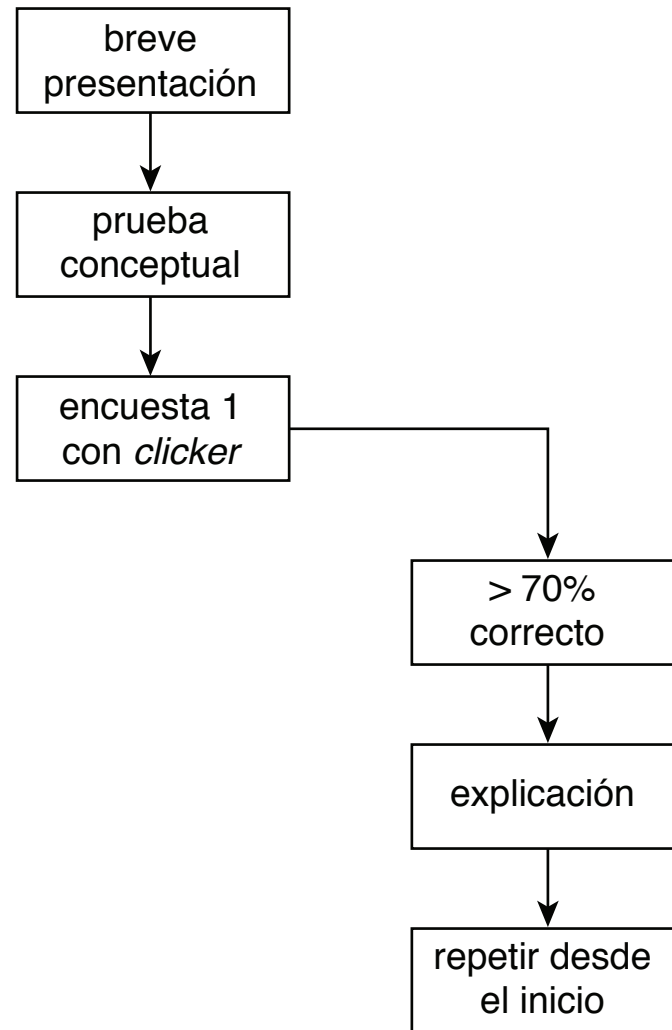


# Promoviendo el pensamiento

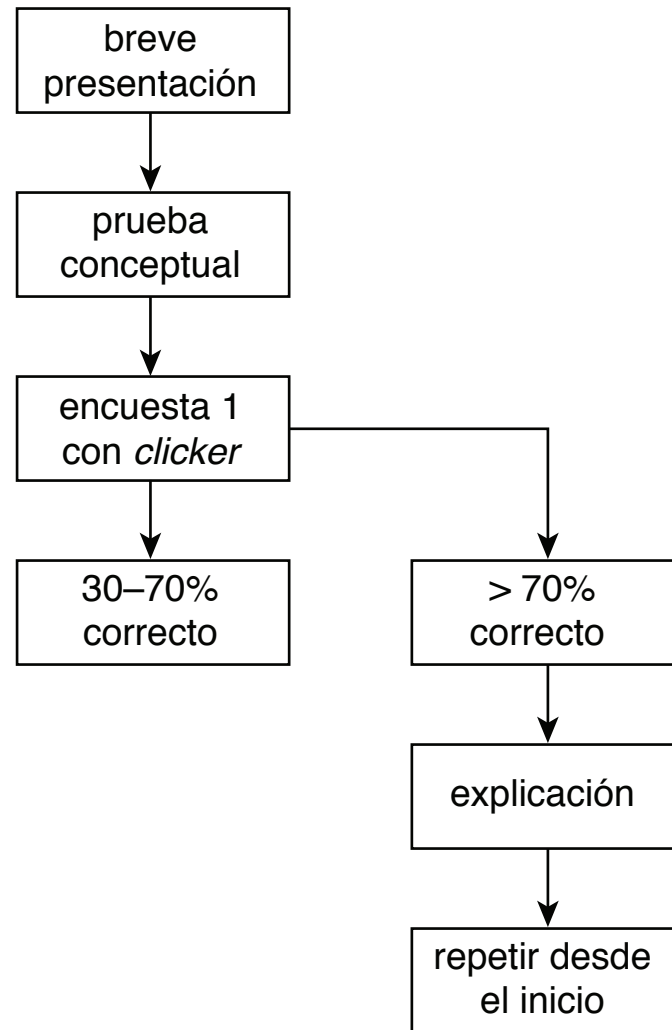




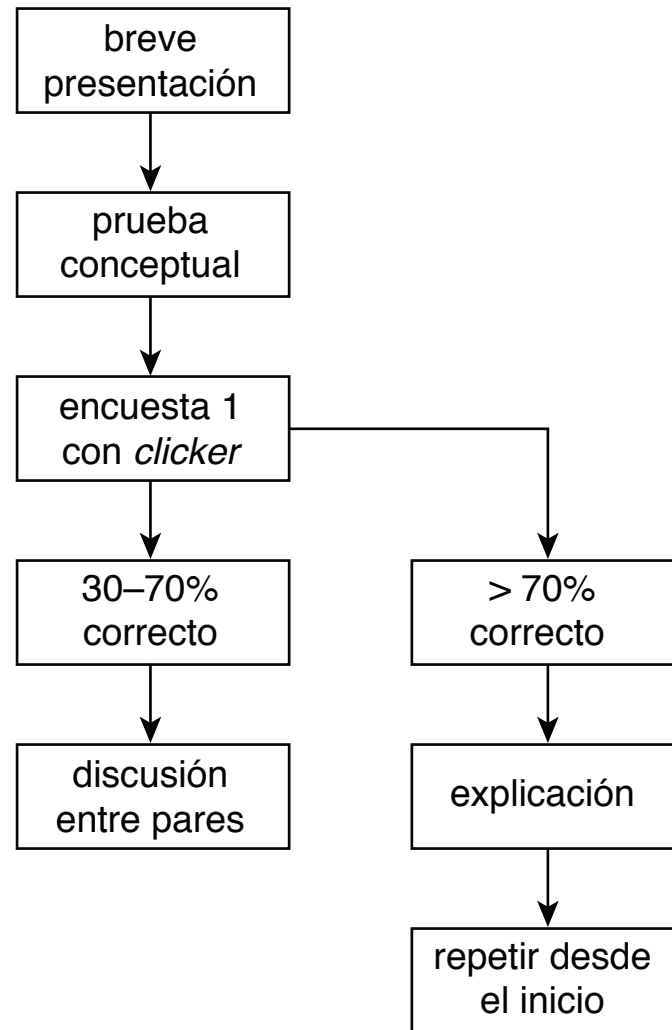
# Promoviendo el pensamiento



# Promoviendo el pensamiento

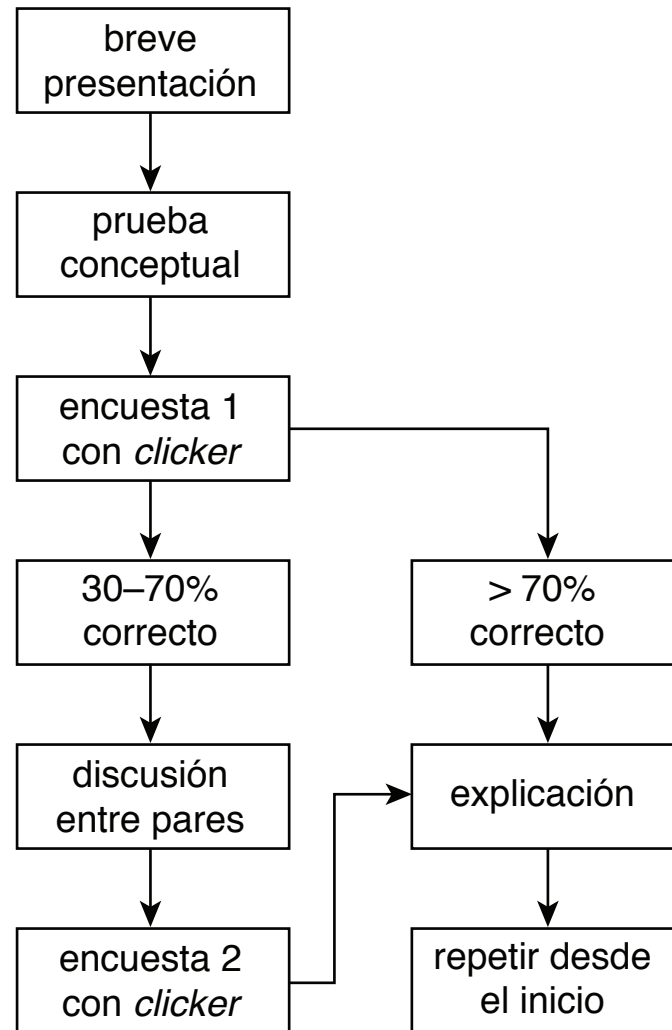


# Promoviendo el pensamiento

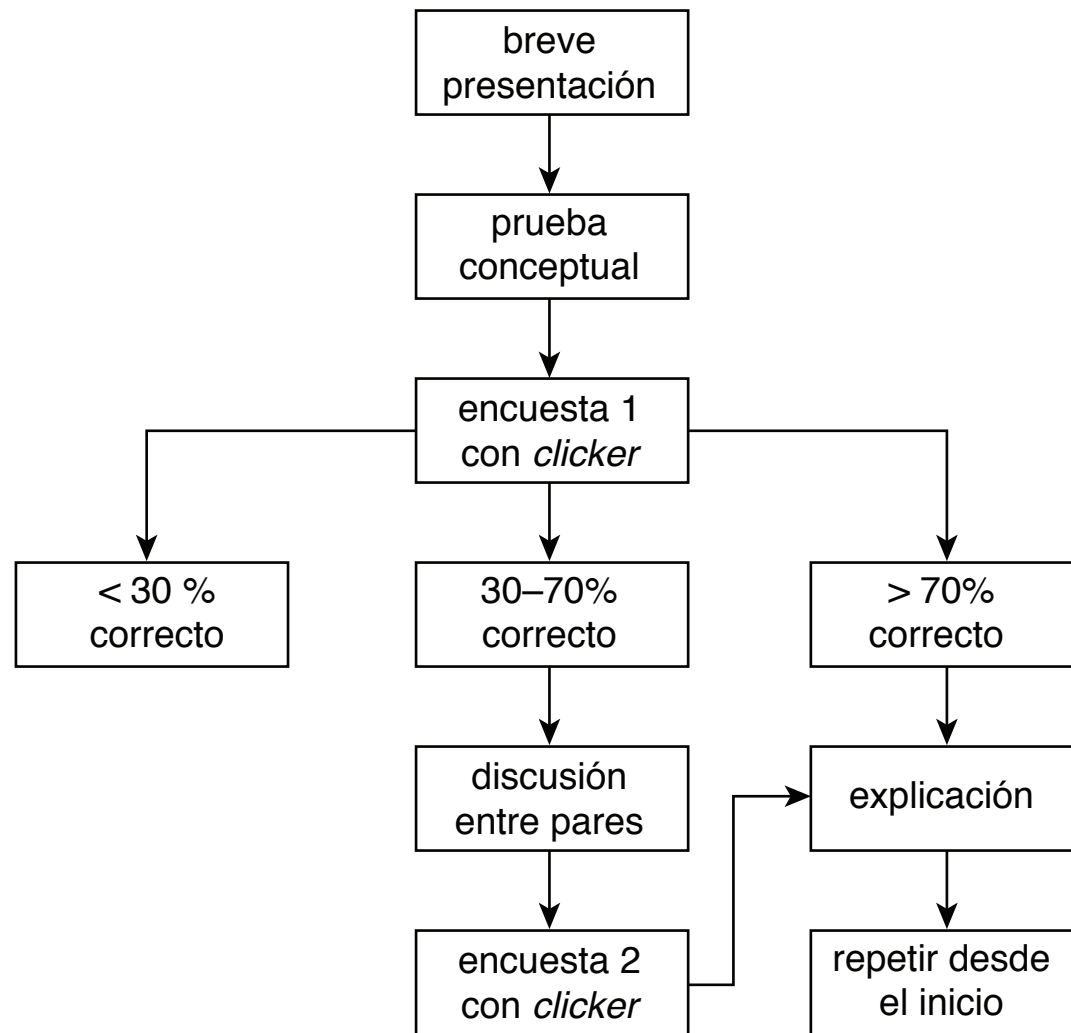




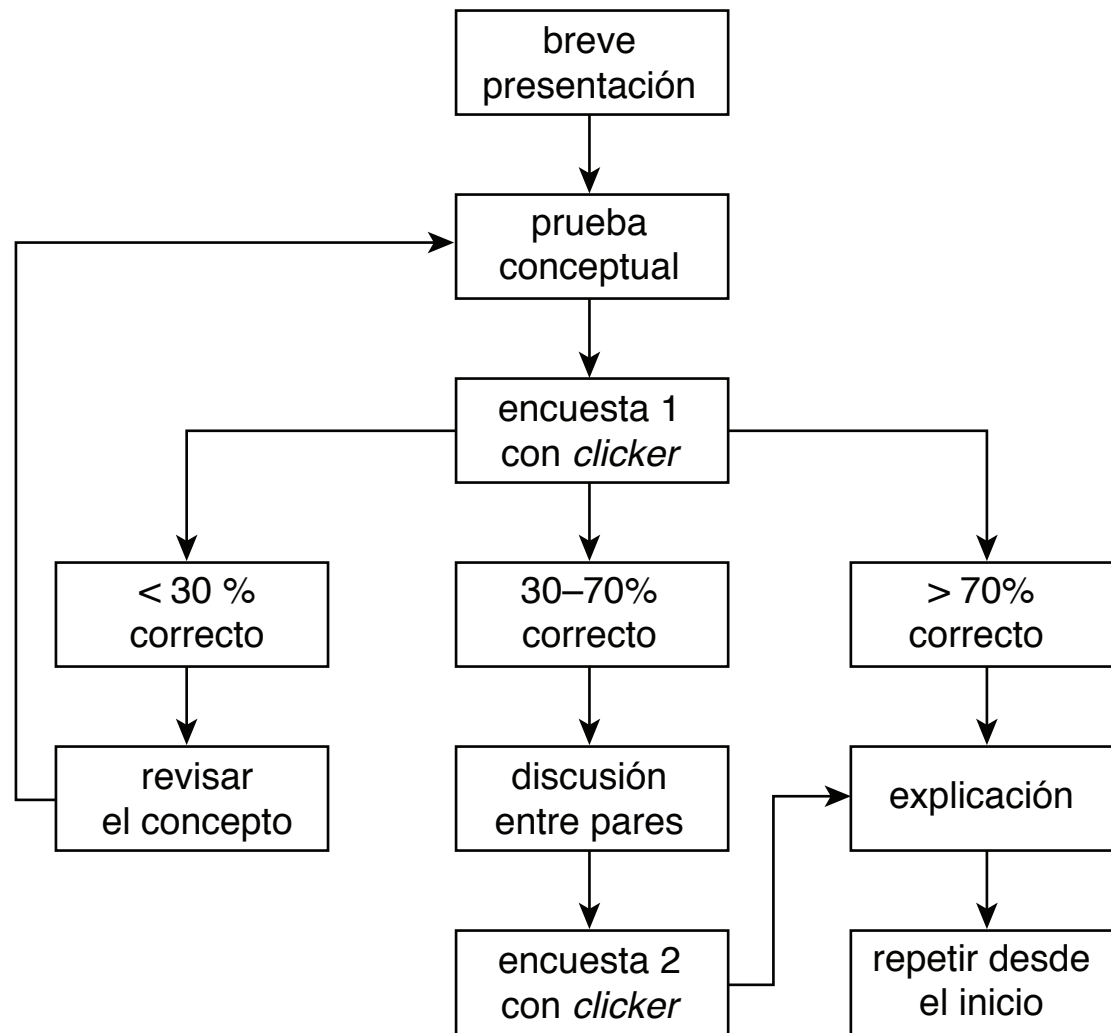
# Promoviendo el pensamiento



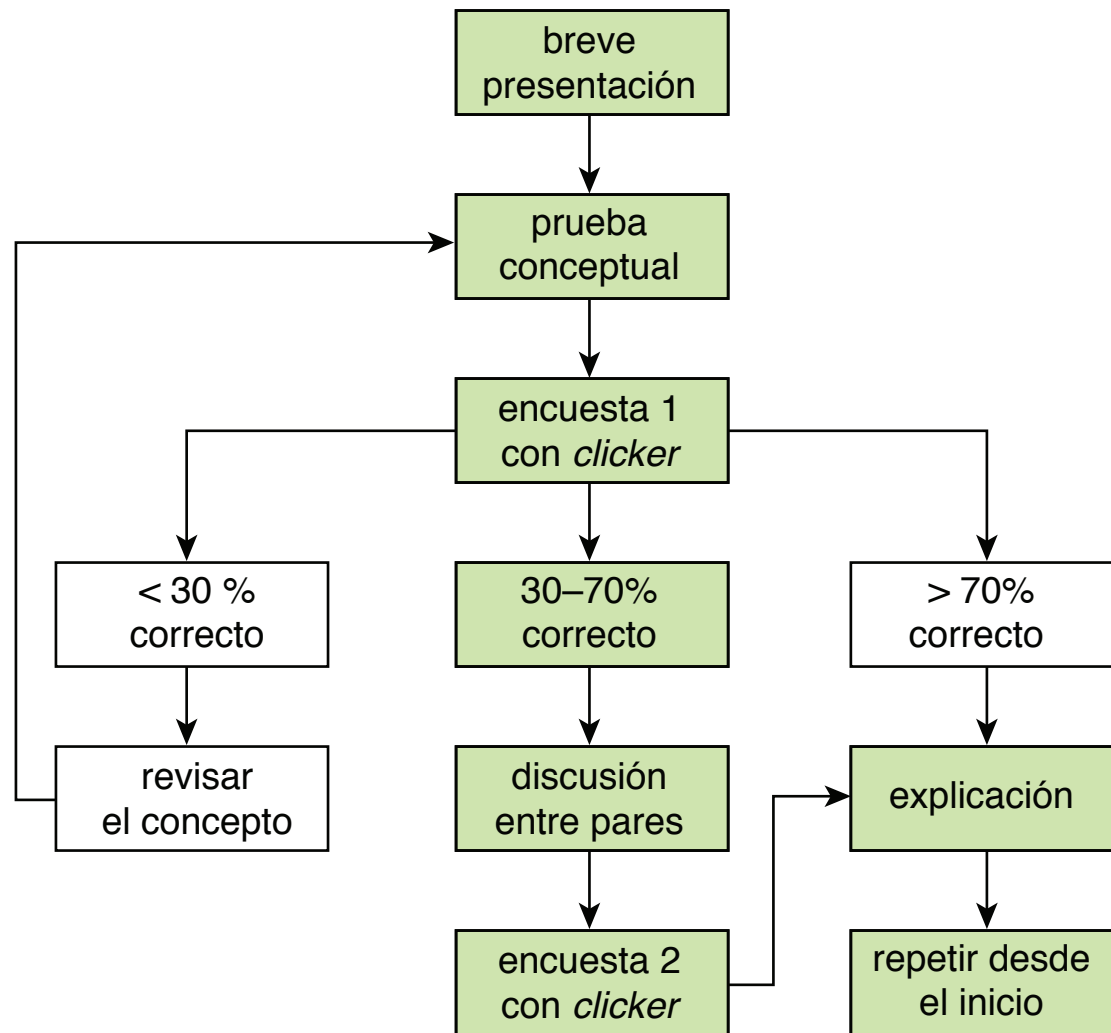
# Promoviendo el pensamiento



# Promoviendo el pensamiento



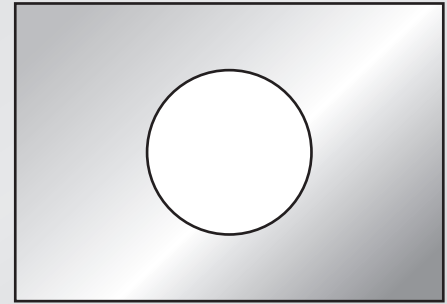
# Promoviendo el pensamiento





# Promoviendo el pensamiento

Considere una placa rectangular de metal con un agujero circular.

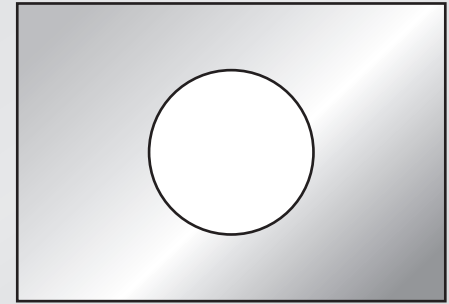


# Promoviendo el pensamiento

Considere una placa rectangular de metal con un agujero circular.

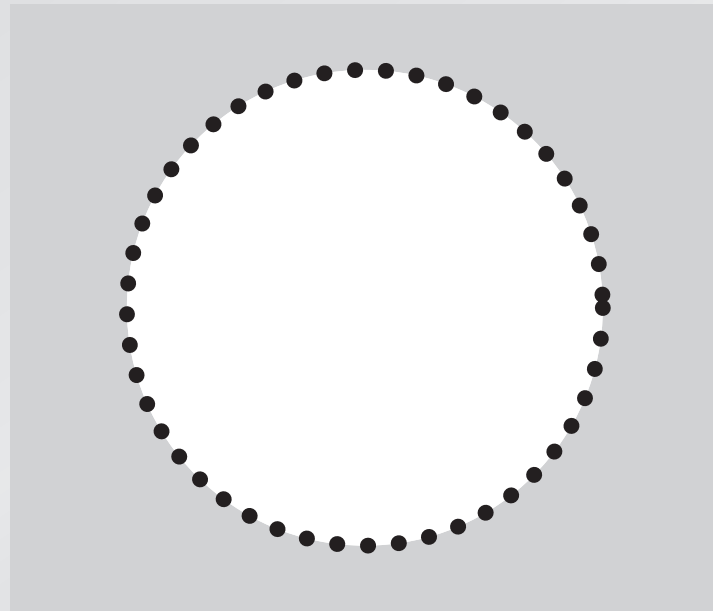
Cuando la placa se calienta de manera uniforme, el diámetro del agujero

1. aumenta.
2. se mantiene igual.
3. reduce.



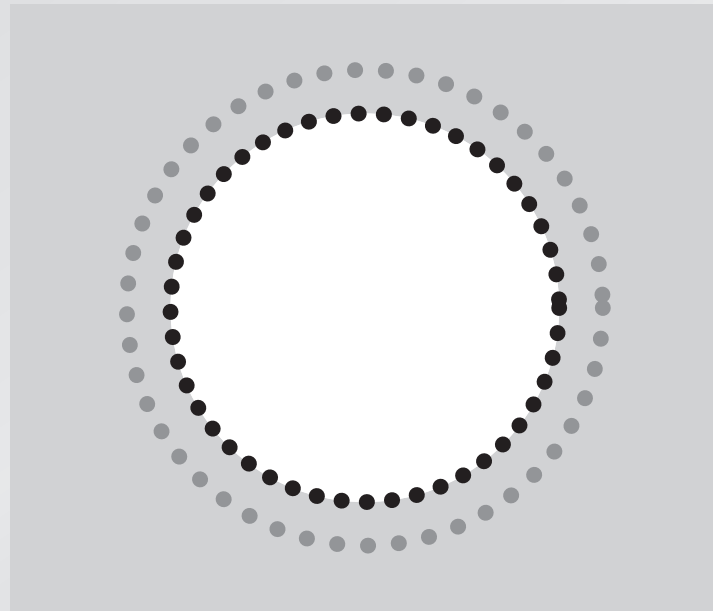
# Promoviendo el pensamiento

considere los átomos en el borde del agujero



# Promoviendo el pensamiento

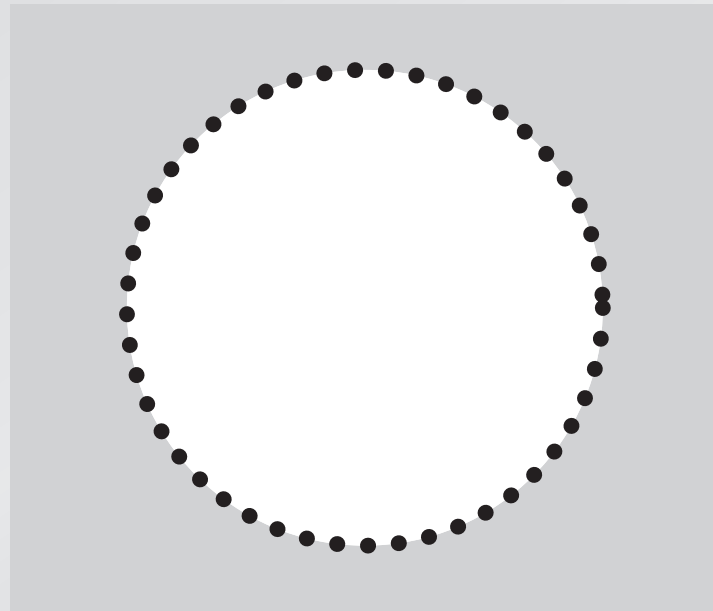
considere los átomos en el borde del agujero





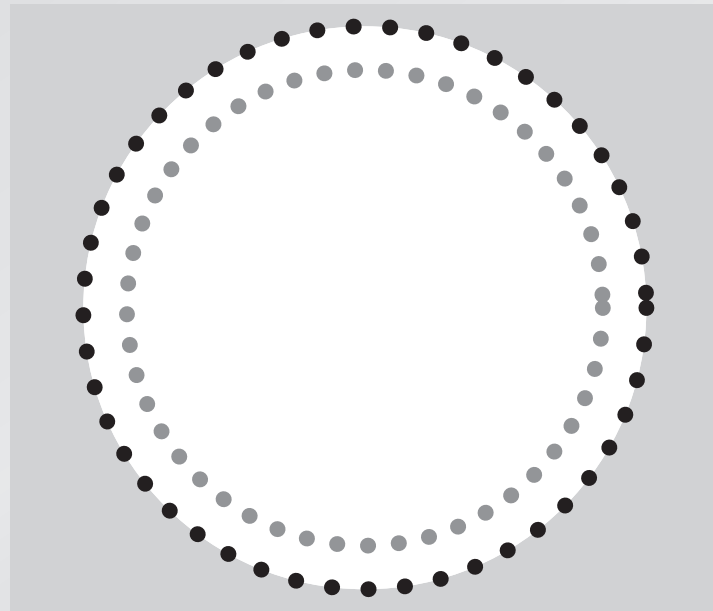
# Promoviendo el pensamiento

considere los átomos en el borde del agujero



# Promoviendo el pensamiento

considere los átomos en el borde del agujero



# Promoviendo el pensamiento

**¡todos ustedes se motivaron!**

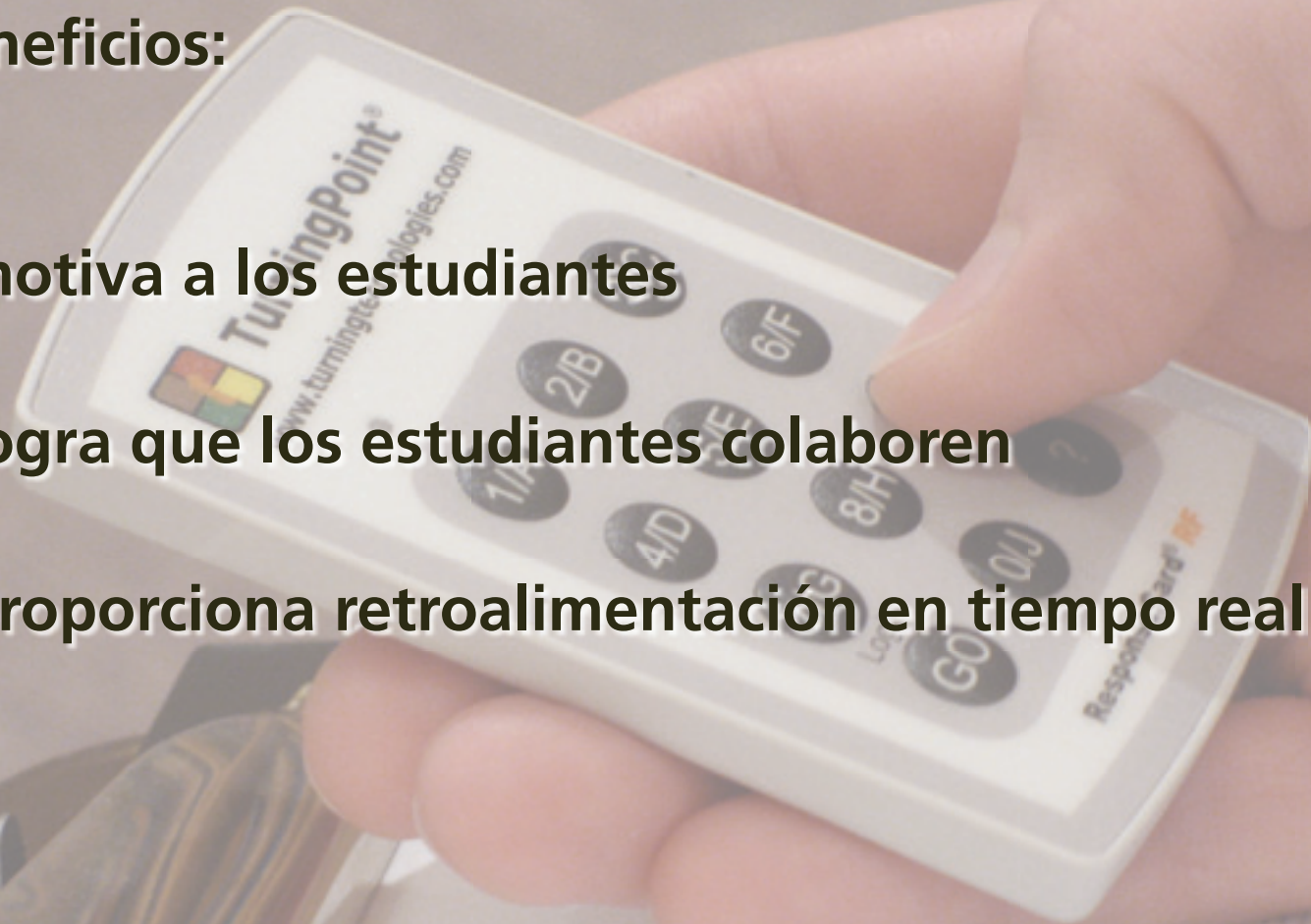




# Promoviendo el pensamiento

## Beneficios:

- motiva a los estudiantes
- logra que los estudiantes colaboren
- proporciona retroalimentación en tiempo real



# Promoviendo el pensamiento

## Algunos obstáculos:

- encontrar materiales
- recolectar y manejar la retroalimentación
- poner las preguntas a disposición de los estudiantes

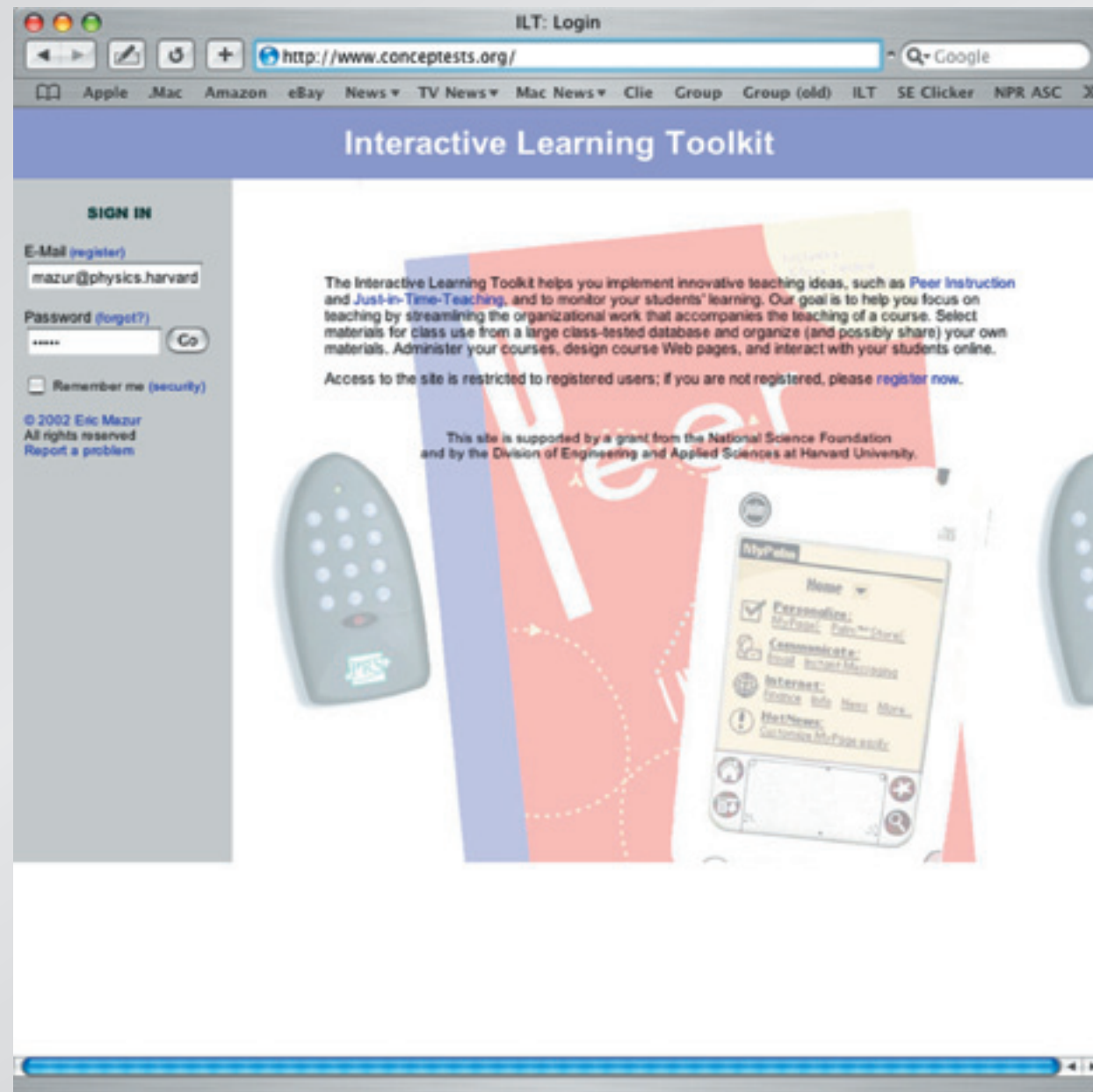
The screenshot shows a web browser window titled "ILT: Manage" with the URL "http://www.conceptest.org". The browser's address bar and search bar are visible. The page content includes a navigation menu with links for HOME, READING, LECTURES, ASSIGNMENTS, FORUMS, NEWS, and HANDOUTS. The main content area displays a physics problem titled "Physics > Introductory Electromagnetism > Magnetism > CT: 3691" dated October 25, 2001. The problem asks for the speed of a magnet falling through a long aluminum tube. The solution provided includes a diagram of the magnet and tube, and a detailed explanation of the induced currents and magnetic fields. The diagram shows a magnet falling through a tube, with a magnetic field  $B$  indicated. The solution lists three options: 1. more slowly, 2. exactly the same way, 3. faster. The answer is 1, explaining that the induced current produces an opposing magnetic field that repels the magnet, slowing its fall. A second problem is partially visible at the bottom of the page, involving a conducting rod AB on a U-shaped conductor in a magnetic field.



# Esquema

- Personalizando la enseñanza
- Promoviendo el pensamiento
- Integrando la enseñanza

# Integrando la enseñanza



The screenshot shows a web browser window titled "ILT: Login" with the URL "http://www.conceptests.org/". The browser's address bar includes a search engine icon and the text "Google". Below the address bar is a navigation menu with links for "Apple", ".Mac", "Amazon", "eBay", "News", "TV News", "Mac News", "Clie", "Group", "Group (old)", "ILT", "SE Clicker", "NPR", and "ASC".

## Interactive Learning Toolkit

**SIGN IN**

E-Mail ([register](#))

Password ([forget?](#))

Remember me ([security](#))

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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 central graphic features a large, stylized "Peer" text in white and red. To the right, a mobile phone displays a menu titled "MyPages" with the following items:

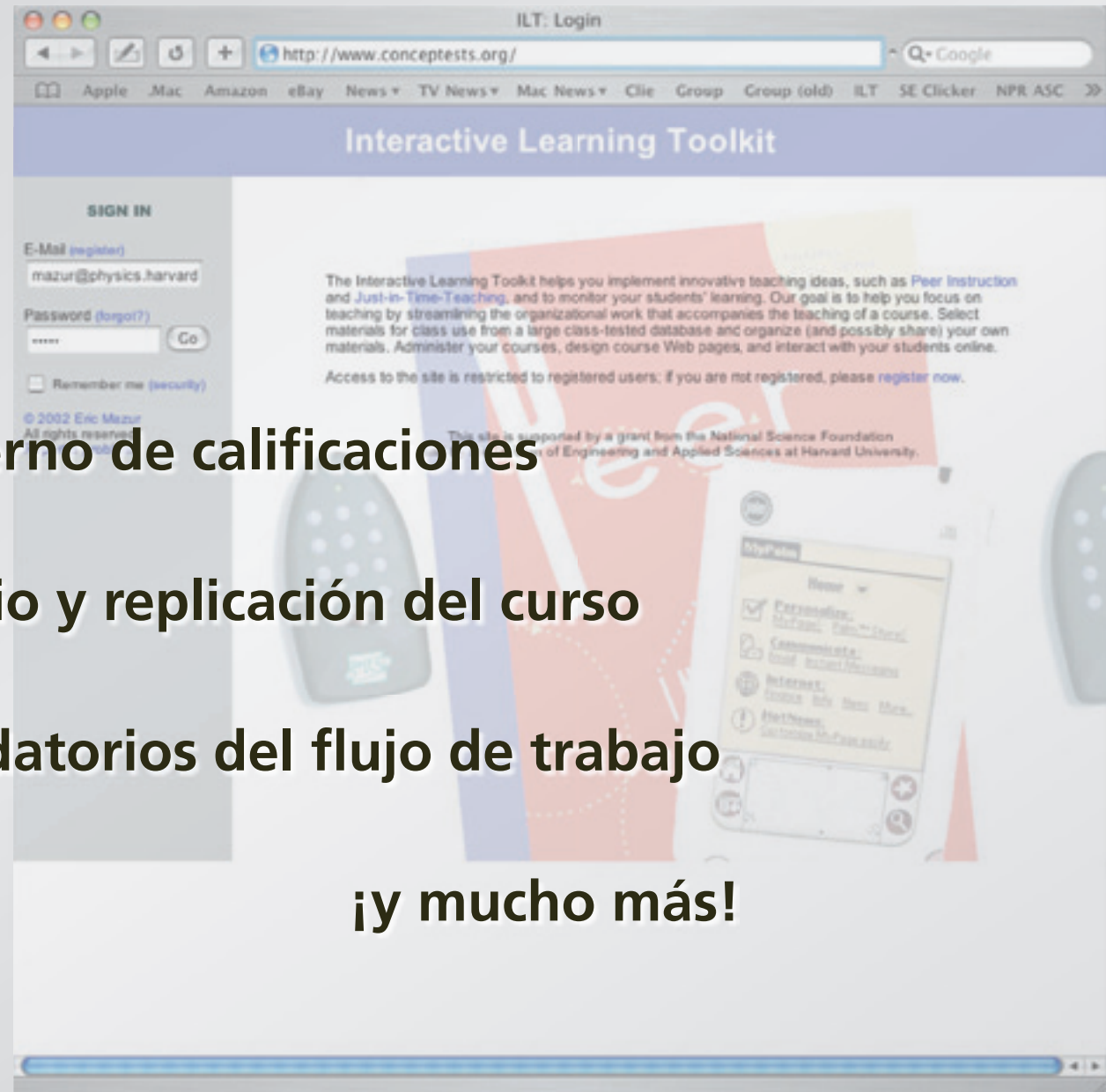
- Home
- Personalize: [MyPages](#), [Page Control](#)
- Communicate: [Email](#), [Instant Messages](#)
- Internet: [Course Site](#), [News](#), [Misc.](#)
- HotNews: [Customize MyPages](#)



# Integrando la enseñanza

- foros
- email
- cuaderno de calificaciones
- horario y replicación del curso
- recordatorios del flujo de trabajo

¡y mucho más!



# Integrando la enseñanza

## módulo de evaluación en línea

- fácil de administrar
- fácil de implementar
- resultados fáciles

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 dated "February 2006". It features a navigation menu with "HOME", "READING", "LECTURES", "ASSIGNMENTS", "FORUMS", "NEWS", and "HANDOUTS". The main content area displays "Details of the student responses by question" for "Physics Background Questions" and "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?

**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 a 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.)

# Integrando la enseñanza

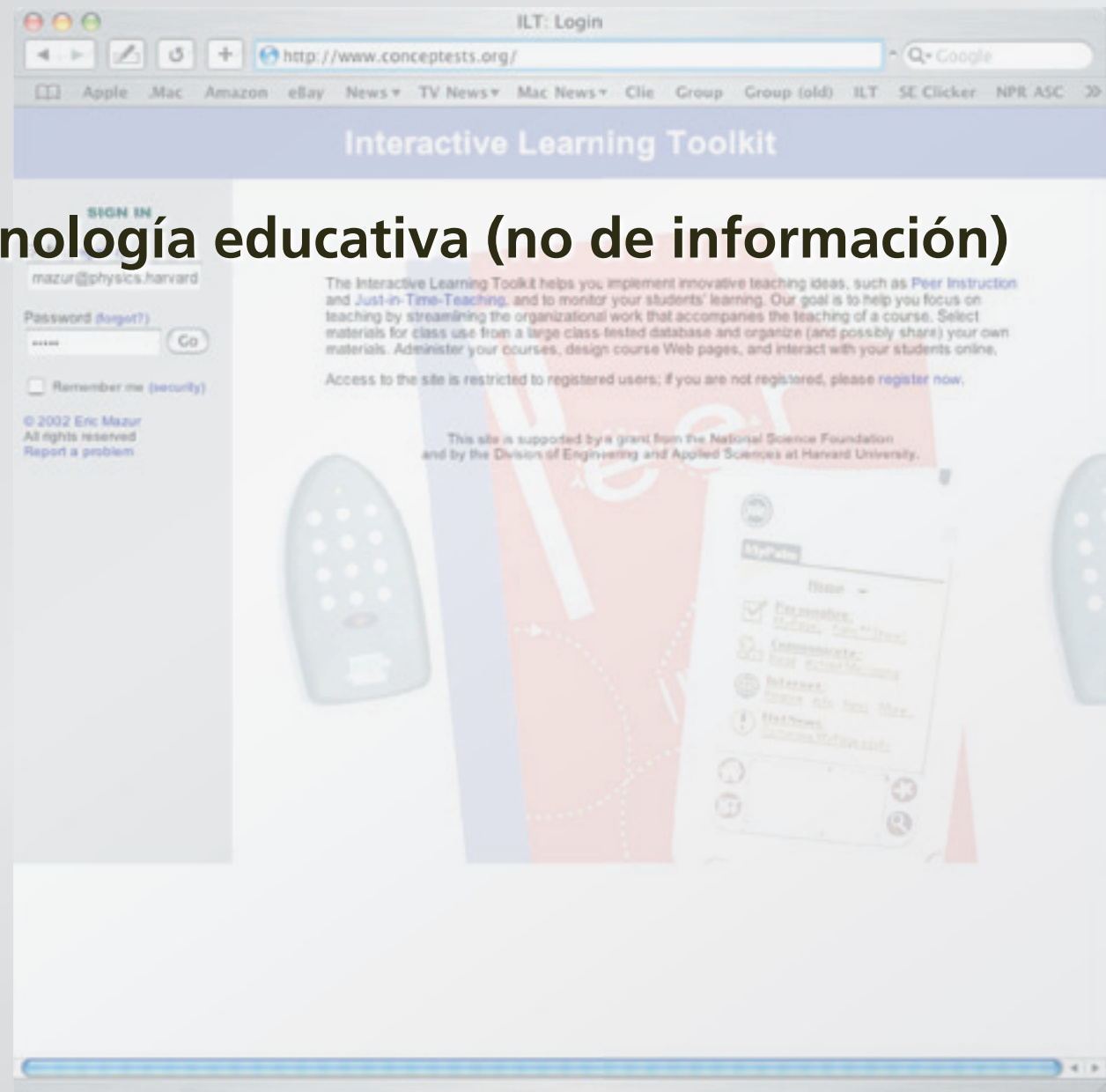
## Instrumentos de evaluación disponibles

- **Inventario del Concepto de Fuerzas (FCI)**
- **Encuesta Conceptual sobre Electricidad y Magnetismo (CSEM)**
- **Prueba de Lawson para el razonamiento científico**
- **Prueba Diagnóstico de Astronomía (ADT)**
- **Prueba Maryland sobre Expectativas Físicas (MPEX)**

**¡más de 25,000 estudiantes evaluados!**

# Resumen

necesitamos tecnología educativa (no de información)

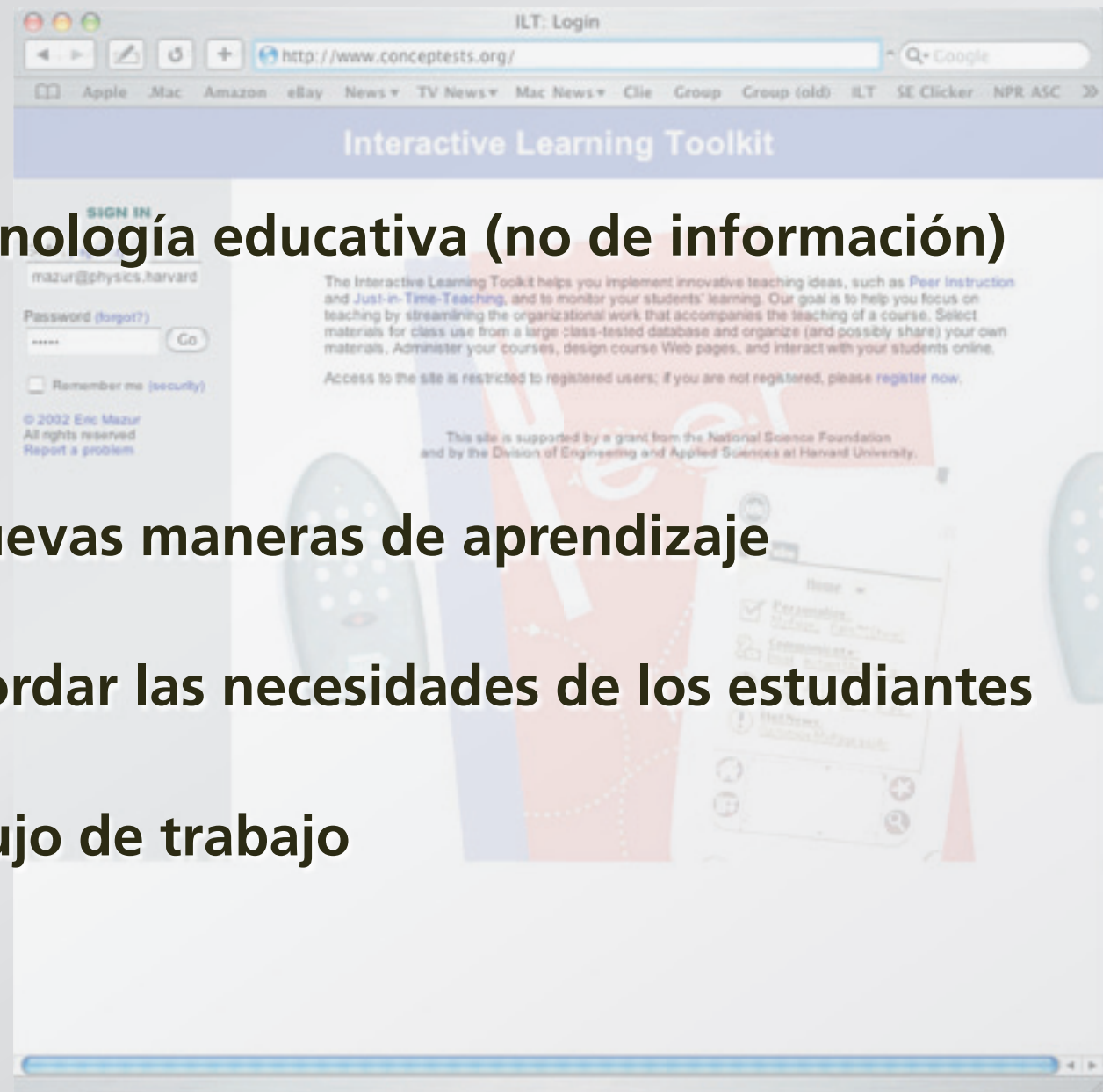


# Resumen

**necesitamos tecnología educativa (no de información)**

**con el fin de:**

- **promover nuevas maneras de aprendizaje**
- **ayudar a abordar las necesidades de los estudiantes**
- **facilitar el flujo de trabajo**

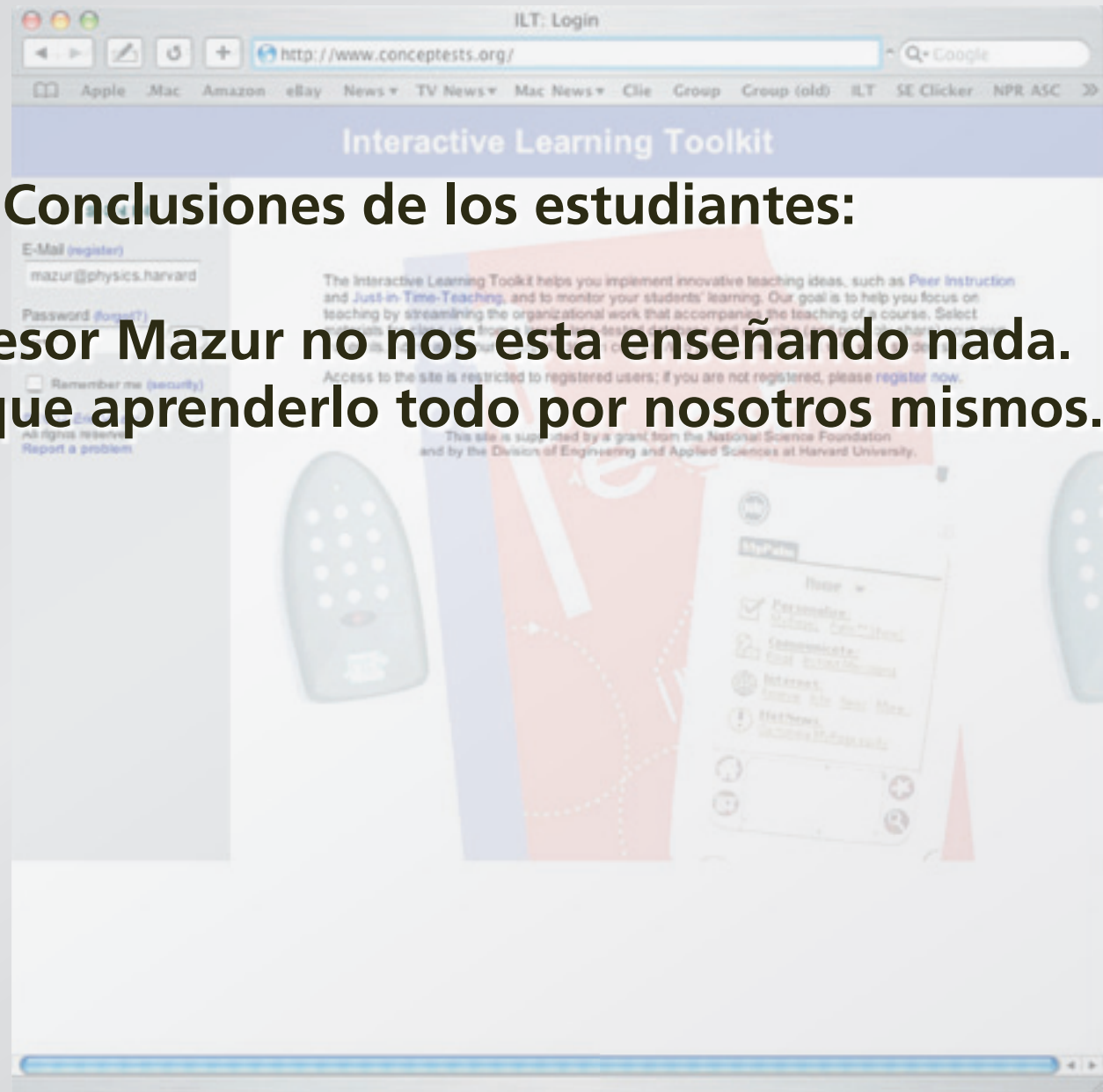




# Resumen

## Conclusiones de los estudiantes:

**“El profesor Mazur no nos esta enseñando nada. Tenemos que aprenderlo todo por nosotros mismos.”**



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**Davis Foundation**

**National Science Foundation**

**Harvard SEAS Information Technology Group**

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