

# Tecnología educativa para motivar a los estudiantes

UNITEC, Universidad Tecnológica Centroamericana  
Cambridge, 24 febrero 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 verbore: ex quibus oriuntur inuidie & tentationes blasphemie suspiciones male-ossidationes hominū in parte corruptorū & q̄ veritate priuati 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 inhabitat inaccessibilē: quē null⁹ hominū vidit sed nec videre potest: cui honor & imperiū sempiternū erunt.

**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 operibus: facile tabuete & inuicere: thesaurizare sibi sūd amentū bonū in futurū: ut apphētēt veram vitā. In thimothee depositū custodi: deuitas 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 nō qñ dñi & doctrinā hīlāstentur.

Qui a dñm dētermināt  
seruiāt q̄a sūt  
ficij partīcipē  
Si q̄a aliter  
nis seruū  
que sūd in pie  
nichil scēns  
ones & pug  
tur inuidie d  
spicionez ma  
mate corru  
sūt: existimāt

aut quēst⁹ magnus: pietas cum sufficiens. Nichil enī intulim⁹ in hunc mūdū: hanc dubiū q̄a nec auferte nō possum⁹. Inhabētes autē alimēta et q̄bus regant: hīs dētū sum⁹. Nā q̄ uolunt dūmītra fieri: in q̄d dūt i cōtantiōnē a rīla-

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

Quitibz hūi⁹ seculi p̄cipe nō sublimē saepe nemē loq̄at⁹ in iugū diuitiarū

na oīa abūde  
ates fieri i bo  
mūnitate:  
tū bonū in  
vitā. Et thi  
deuitas p̄ph  
posuones  
idā p̄mittē  
ia tecū amē  
ad th̄mōtē  
am scām dā  
regōtationē

**A**postolus in epistola ad romanos loquitur de his qui in uoluntate sua se habent abscondi non possunt. **VI.** Uicūq; sūt sub iugo serui dñi os suos dñm honore dignos arbitrant: ne nō qñ dñi & doctrinā hīlāstentur. **Qui a dñm dētermināt seruiāt q̄a sūt ficij partīcipē Si q̄a aliter nis seruū que sūd in pie nichil scēns ones & pug tur inuidie d spicionez ma mate corru sūt: existimāt**

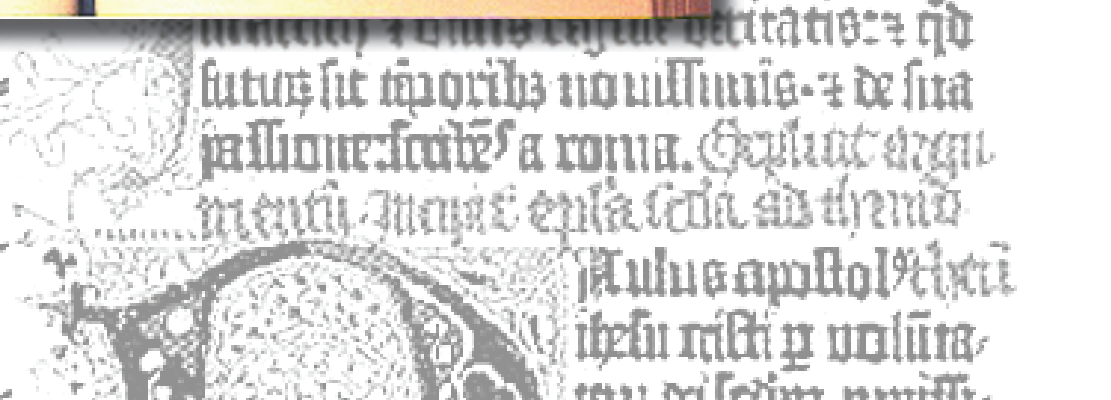
**Q**uoniam solus dominus habet immortalitatem et lucem inhabitat inaccessibilem quem nullus hominum uidit sed nec uidere potest nisi homo et imperium sempiternum amittit. Quibus huius seculi principibus non sublimem saepe neminem loquitur in iugum diuitiarum

na oīa abūde  
ates fieri i bo  
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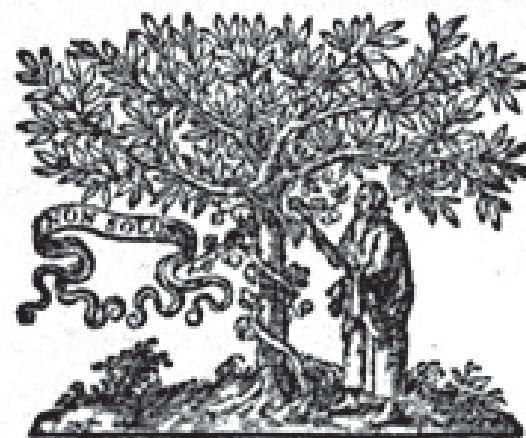
DISCORSI  
E  
DIMOSTRAZIONI  
MATEMATICHE,  
*intorno à due nuoue scienze*

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 filled with students seated at desks, facing a stage. A lecturer is visible on the stage, and a large screen displays text. The text overlaid on the image reads: "No solo la entrega de información sino la asimilación de información es clave".



# 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

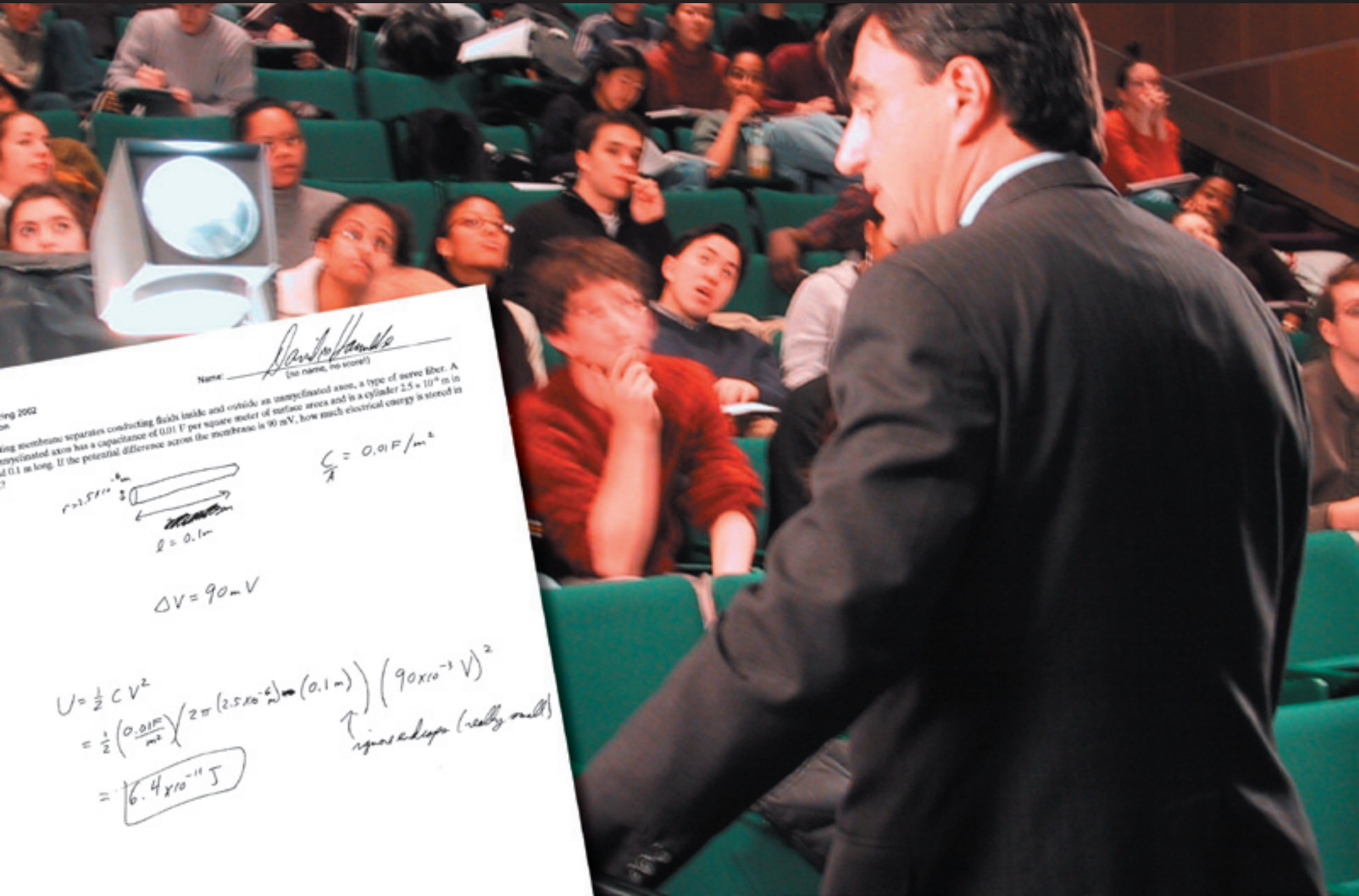


# Esquema

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

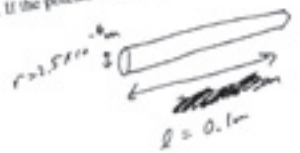


# Personalizando la enseñanza



Name: David 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  $0.01 \text{ F}$  per square meter of surface area and is a cylinder  $2.5 \times 10^{-6} \text{ m}$  in  
d  $0.1 \text{ m}$  long. If the potential difference across the membrane is  $90 \text{ mV}$ , how much electrical energy is stored in



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

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

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

↑ ignore edge (really small)

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



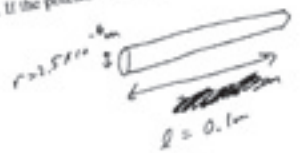
# Personalizando la enseñanza

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 membrane?



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

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

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

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# Personalizando la enseñanza

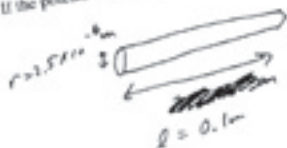
caras  
sin nombres

nombres  
sin caras

Name: Dante Vando  
(no name, no score)

ing 2002  
on

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

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

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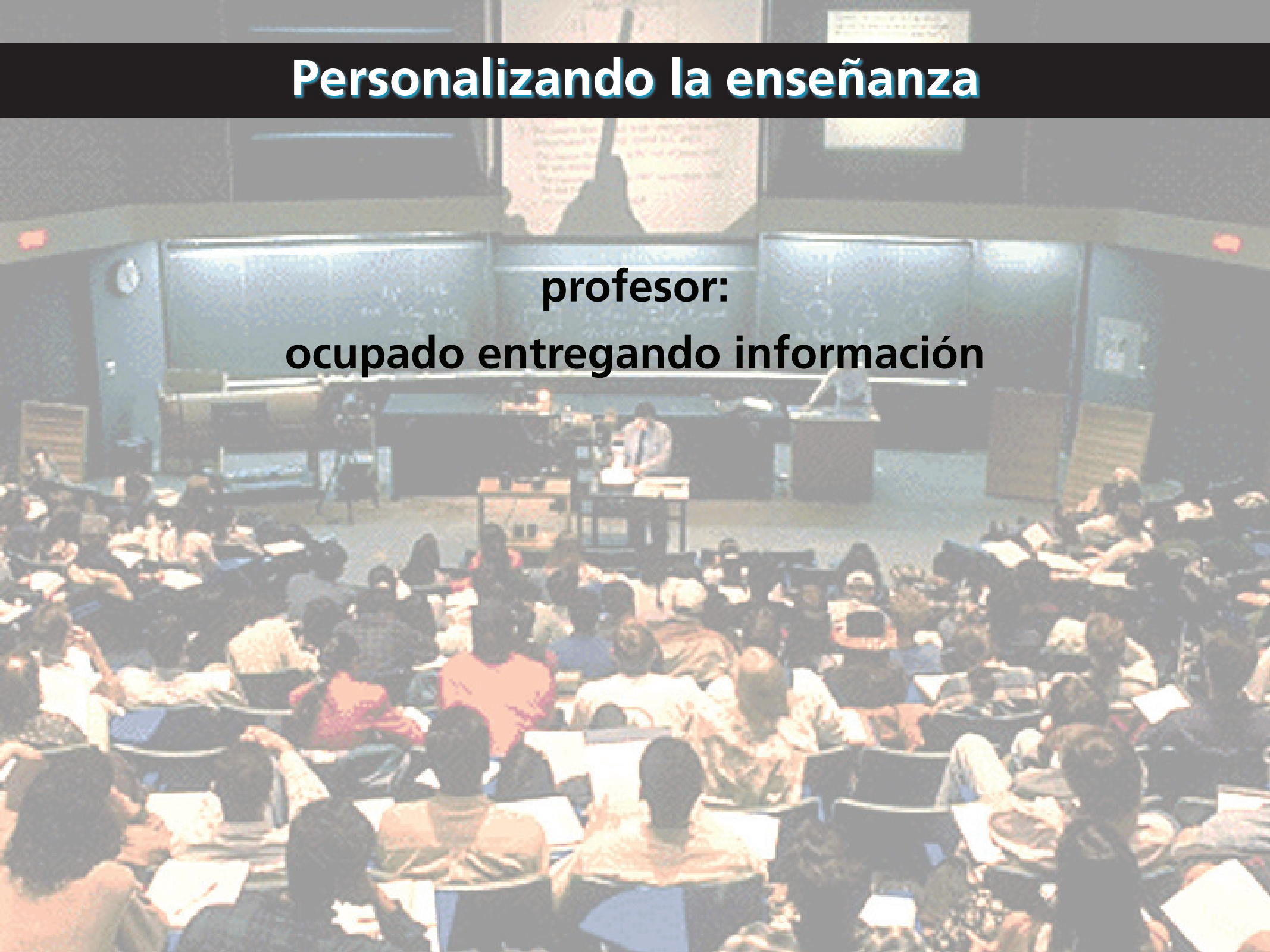
$$= \frac{1}{2} \left( \frac{0.01 \text{ F}}{\text{m}^2} \right) \left( 2\pi (2.5 \times 10^{-6} \text{ m}) (0.1 \text{ m}) \right) (90 \times 10^{-3} \text{ V})^2$$

↑ ignore edge (really small)

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

# 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.

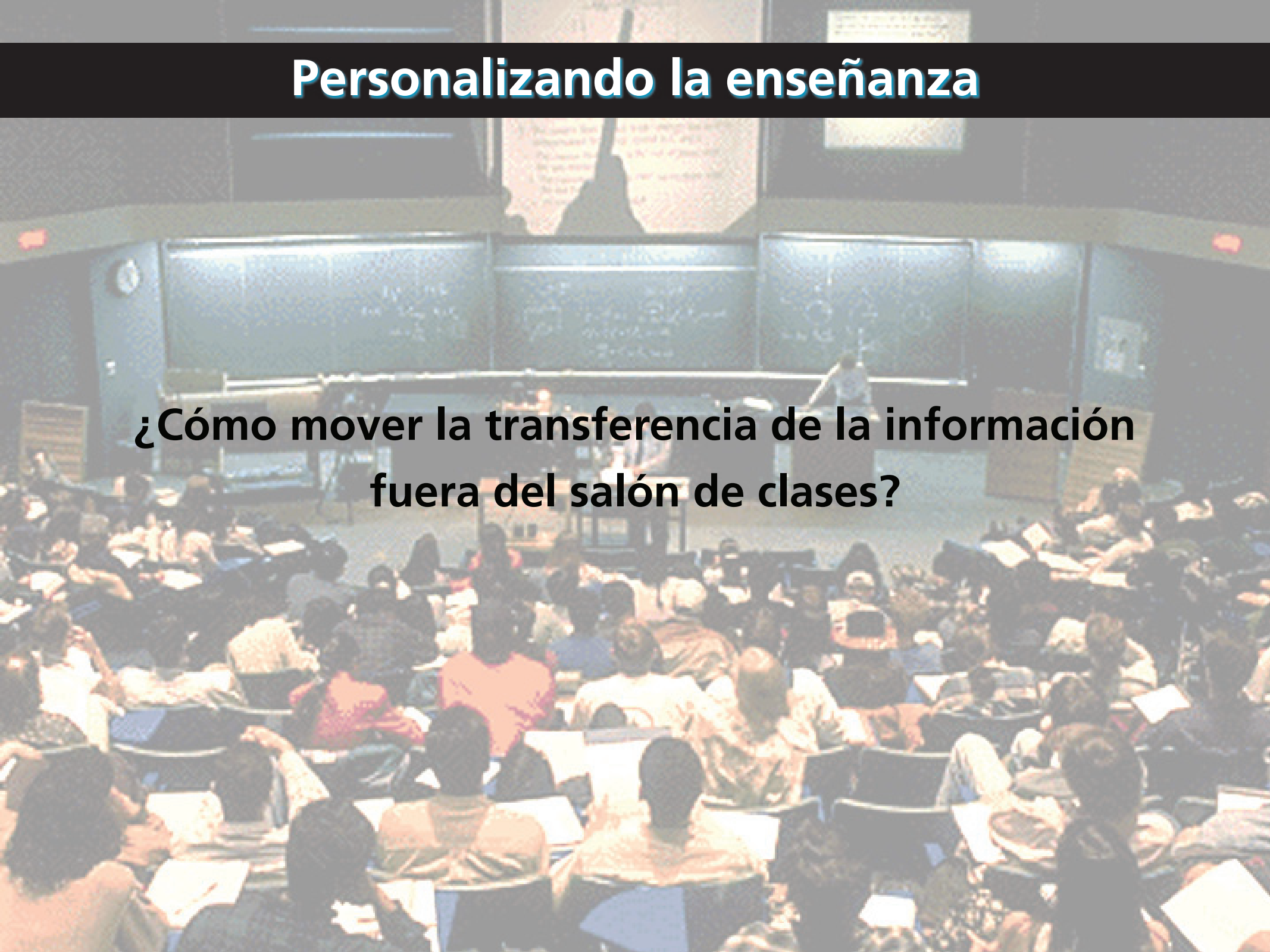
**profesor: no puede abordar  
las necesidades individuales de los estudiantes**

**estudiantes:  
no tienen tiempo de pensar**



# Personalizando la enseñanza

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

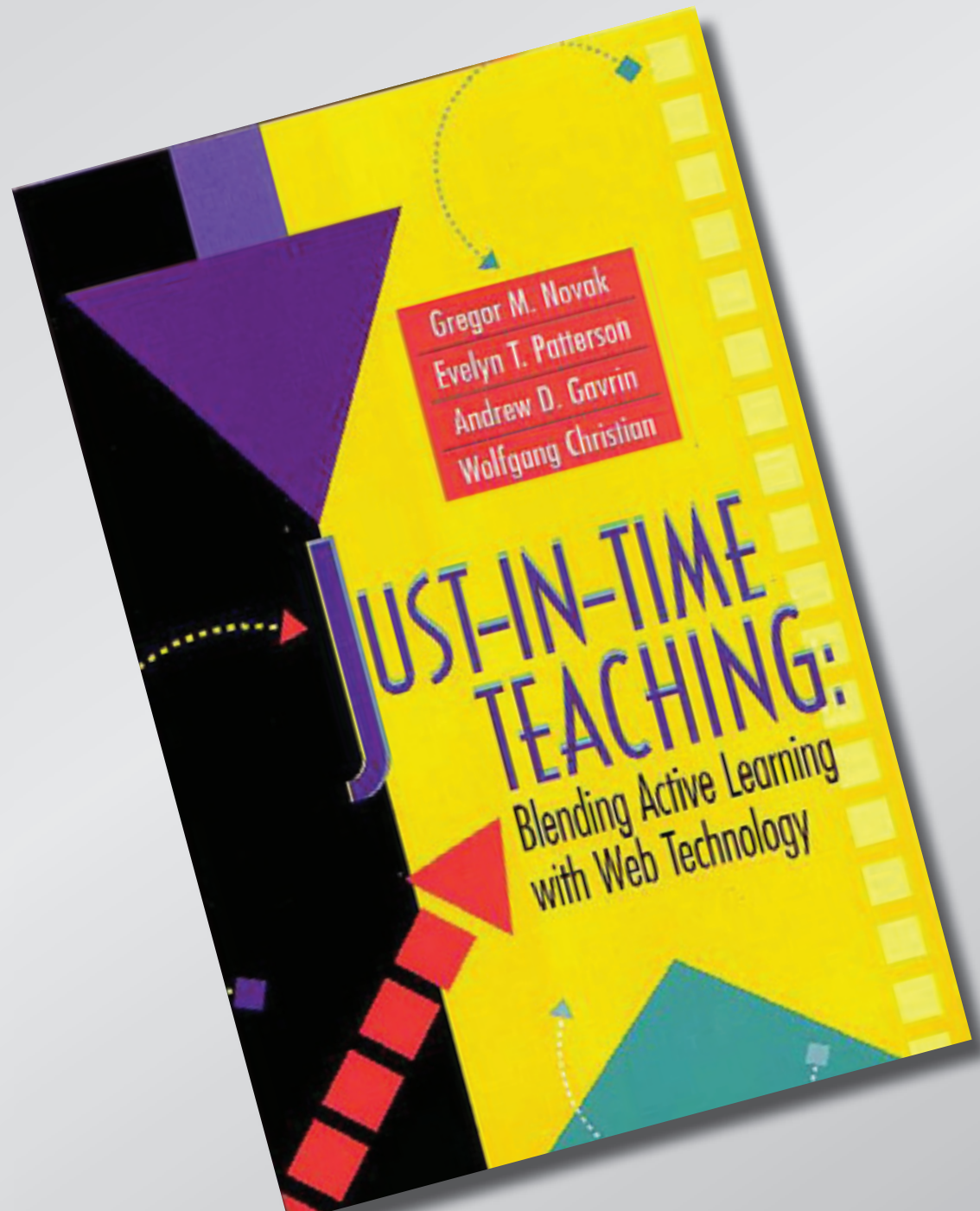


# Personalizando la enseñanza

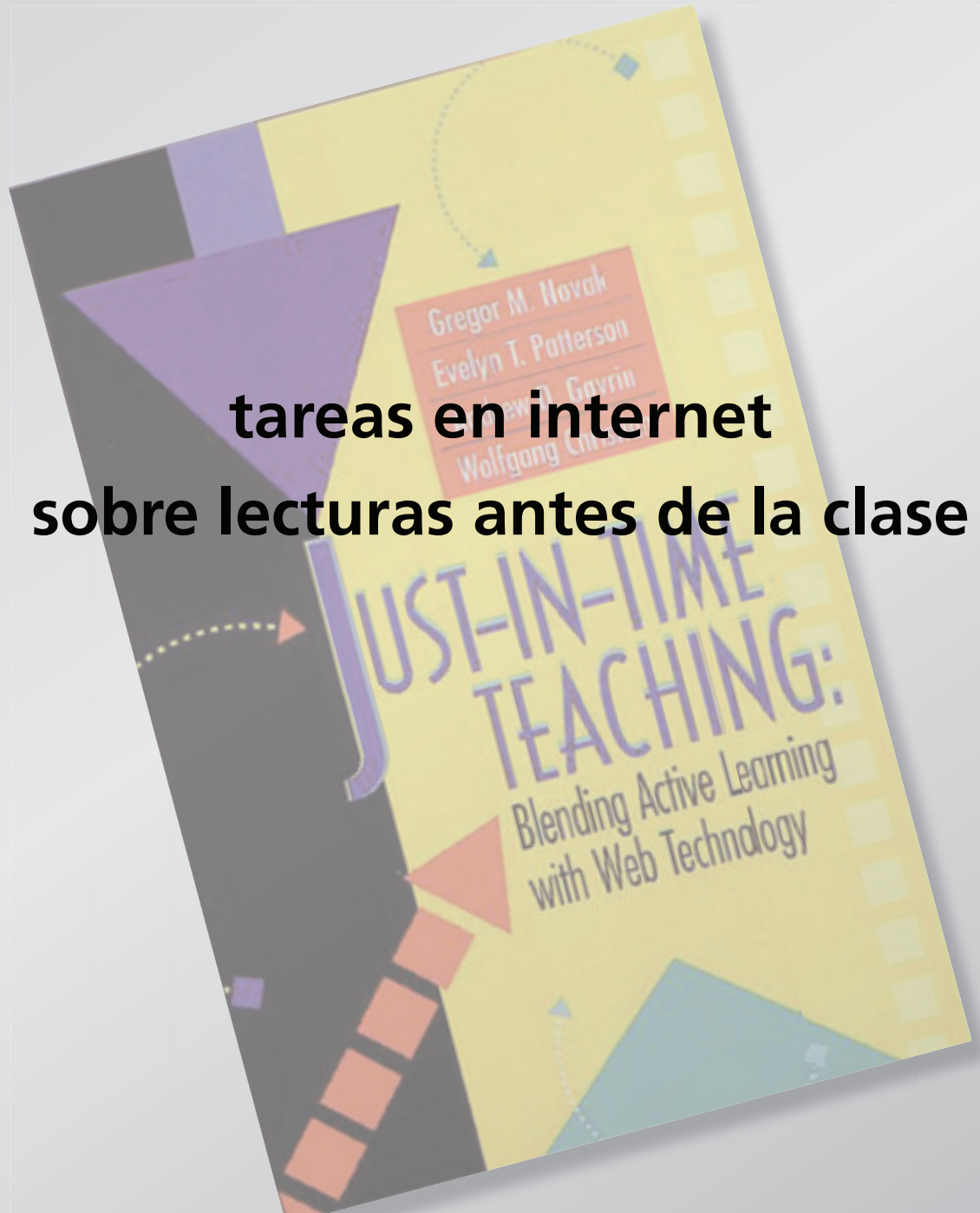
**¿Cómo mover la transferencia de la información fuera del salón de clases?**

**(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".

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
	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? <i>red</i>	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? <i>red</i>	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

The left sidebar contains sections for E-MAIL, COMING UP (5/2 Assignment 1), TOOLS (Run Similarity Check), QUICK LINKS (Standardized tests, Students), Sections (Select Section), and SITE ADMIN (Users, Conceptests, Topics, Bugs, Standardized test).



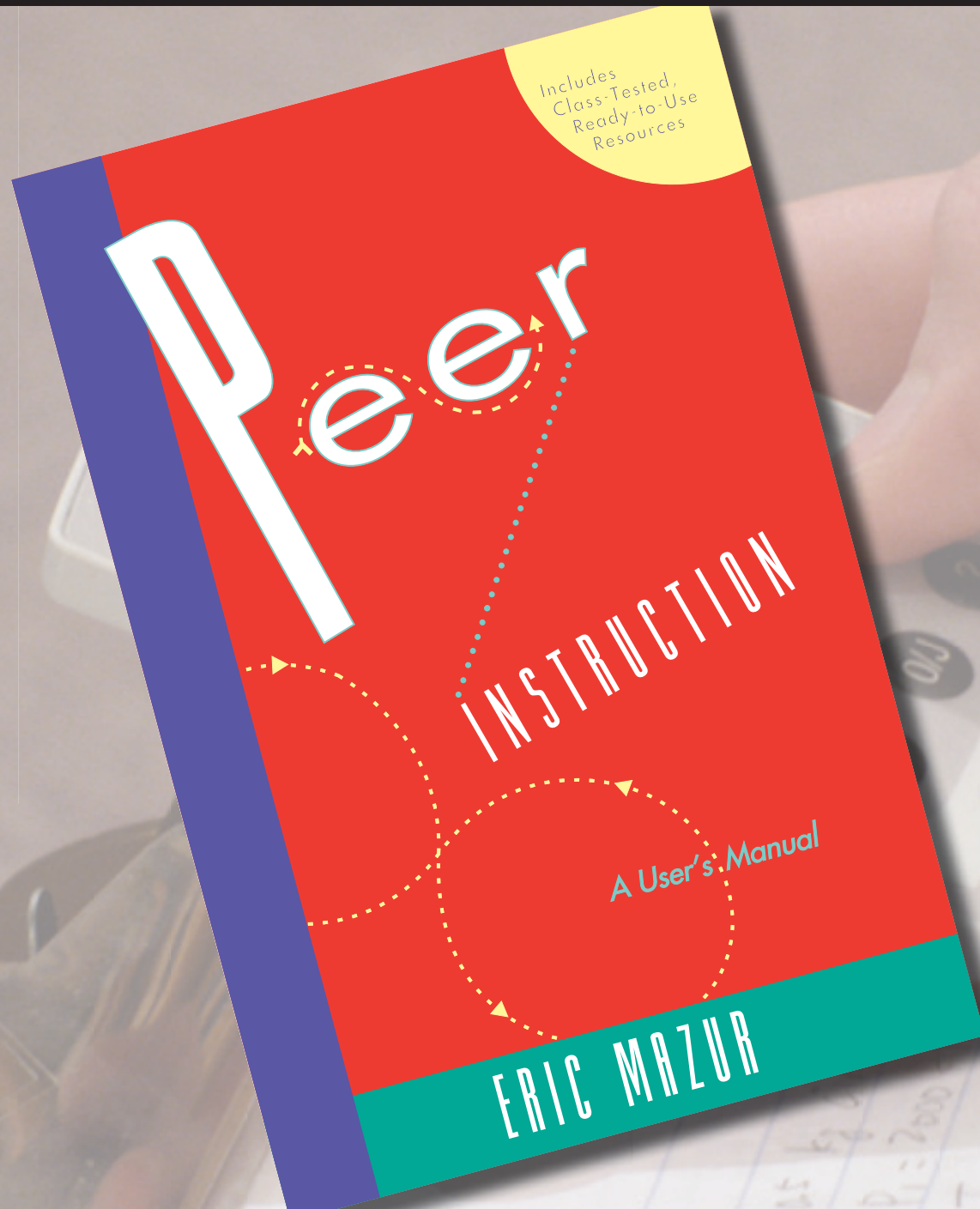




# Esquema

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

# Promoviendo el pensamiento



Handwritten notes on lined paper, including the equation  $T_a = 400k$  and other mathematical expressions.



# Promoviendo el pensamiento

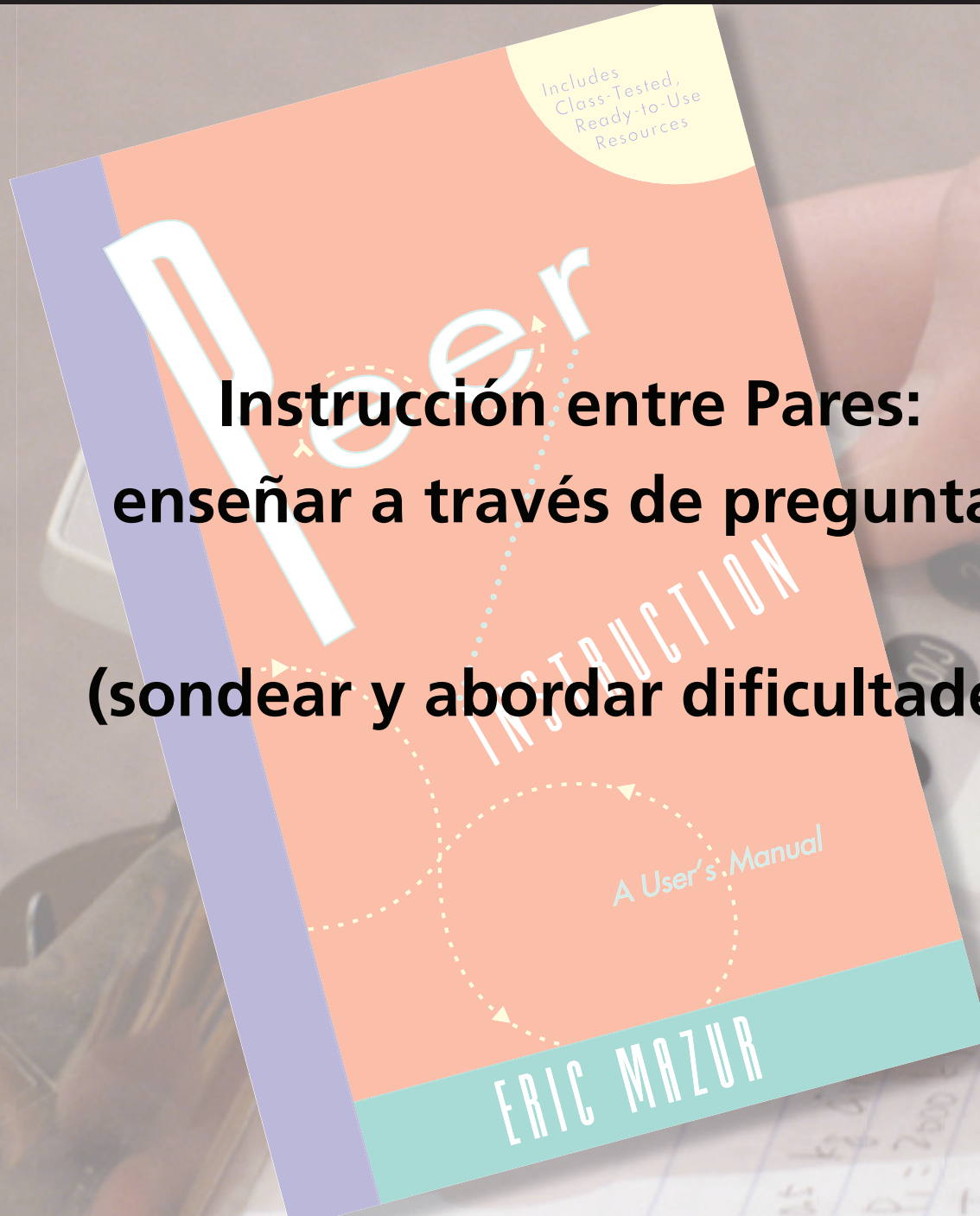
**Instrucción entre Pares:  
enseñar a través de preguntas**





# Promoviendo el pensamiento

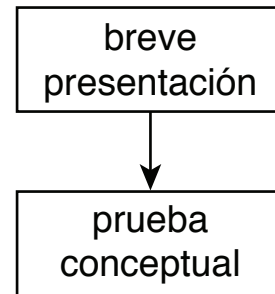
**Instrucción entre Pares:  
enseñar a través de preguntas  
(sondear y abordar dificultades)**



# Promoviendo el pensamiento

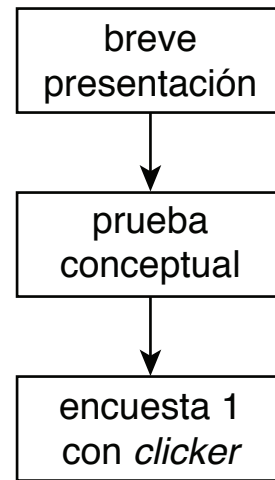
breve  
presentación

# Promoviendo el pensamiento

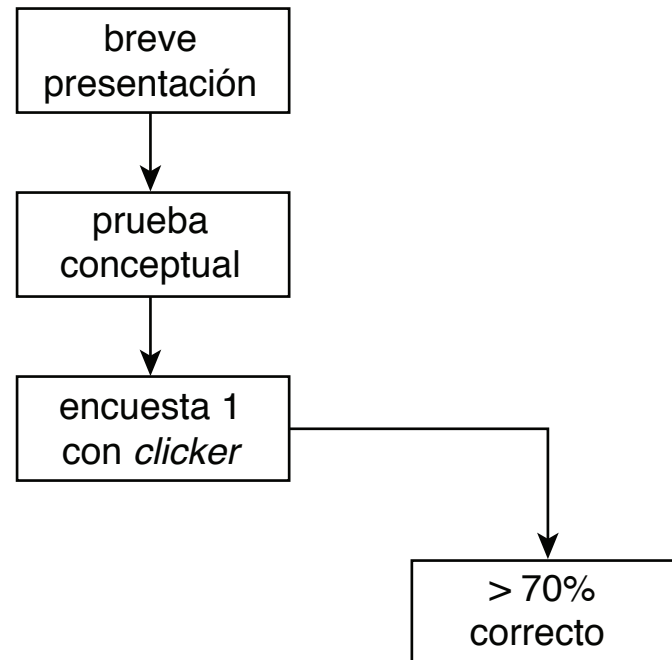




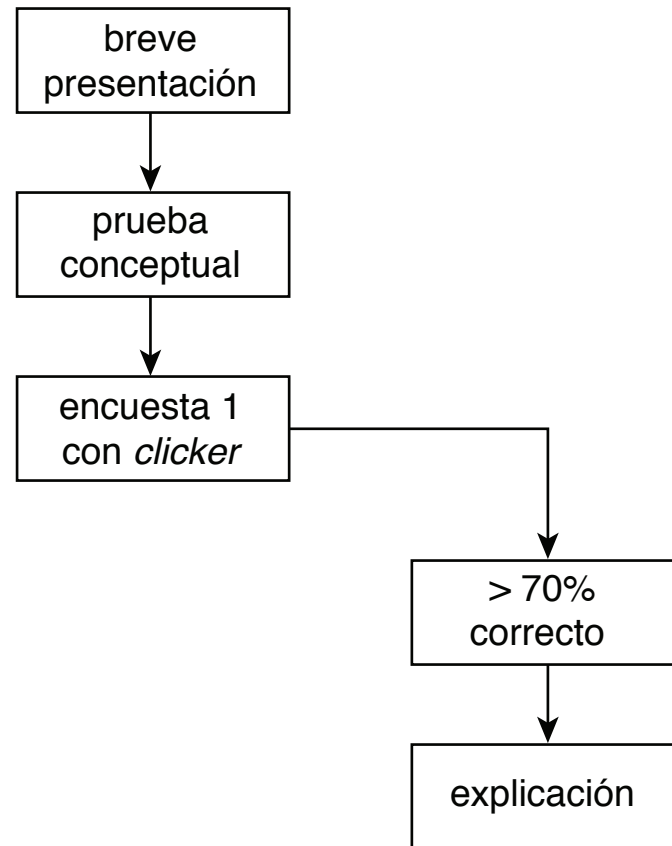
# Promoviendo el pensamiento



# Promoviendo el pensamiento

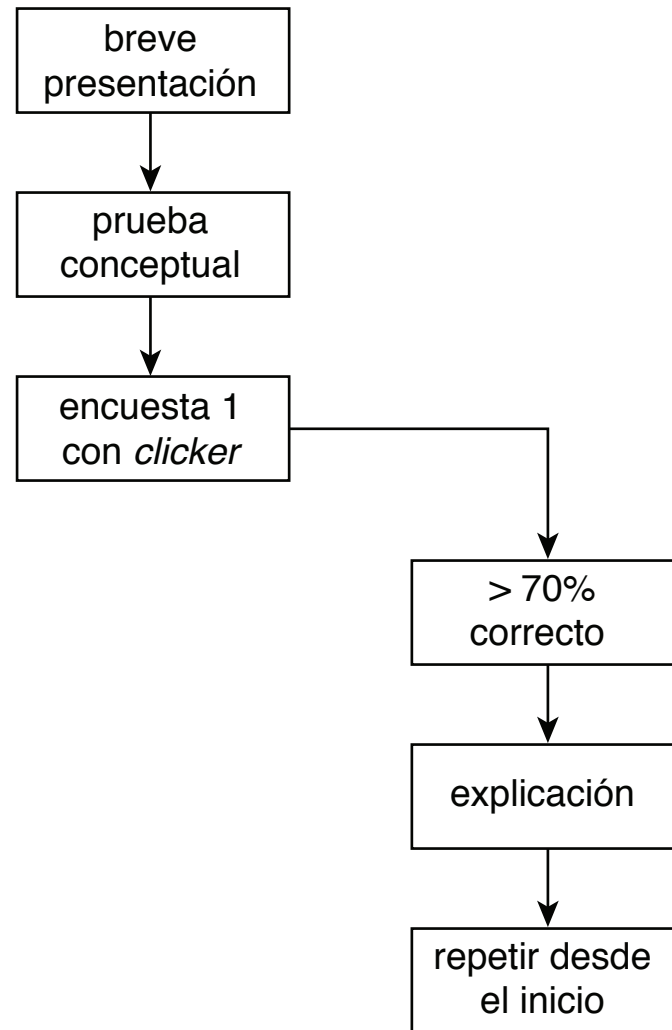


# Promoviendo el pensamiento

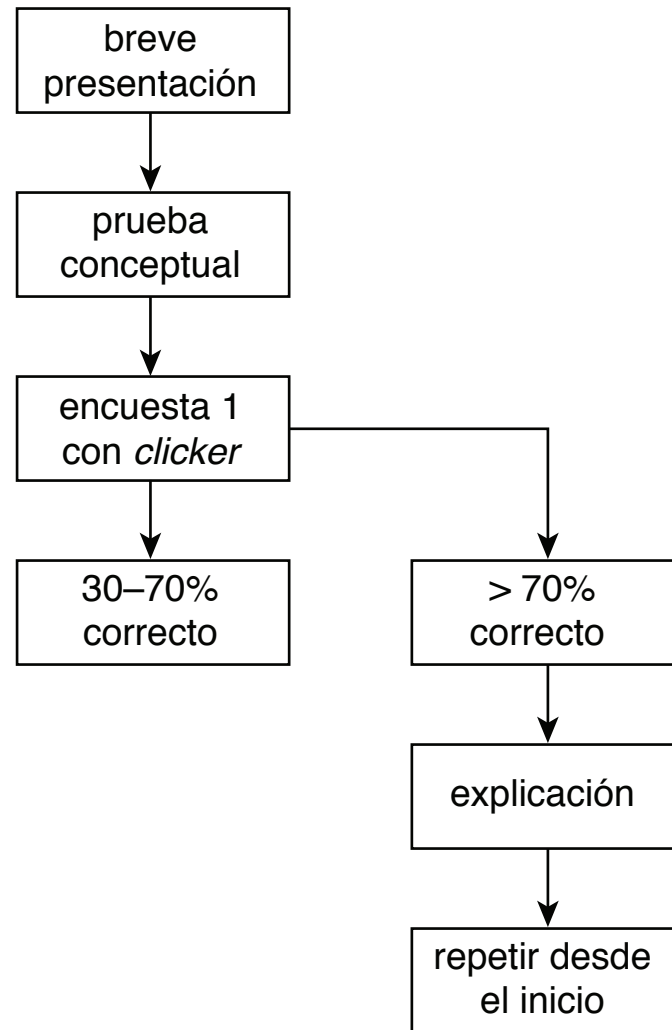




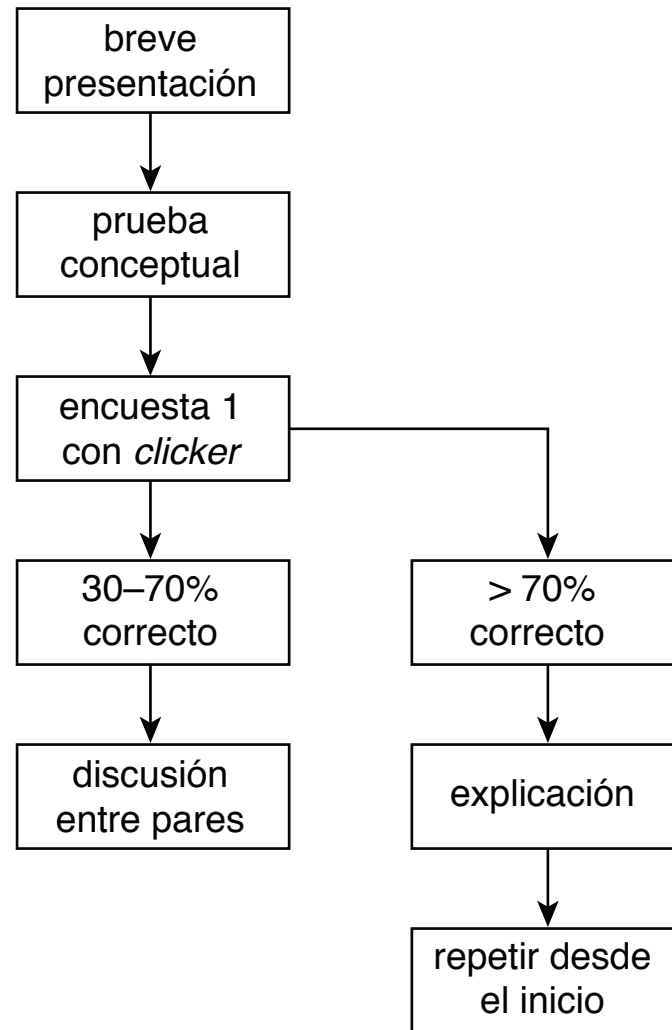
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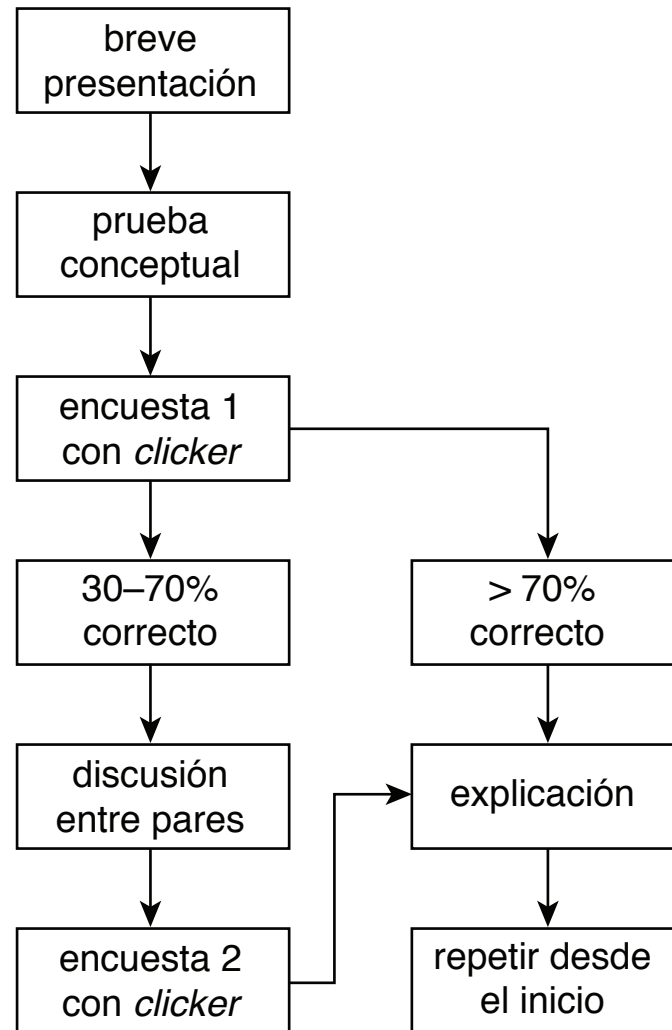


# Promoviendo el pensamiento

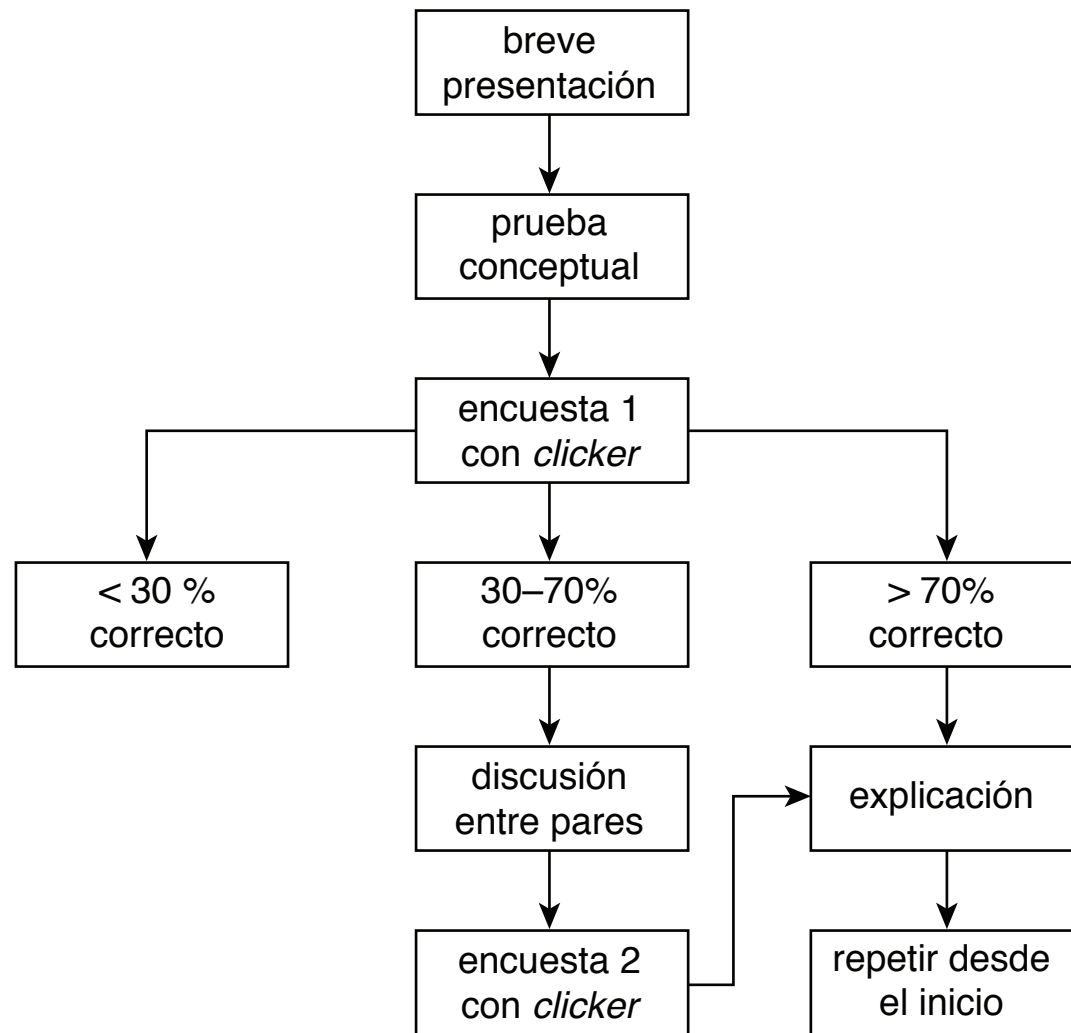




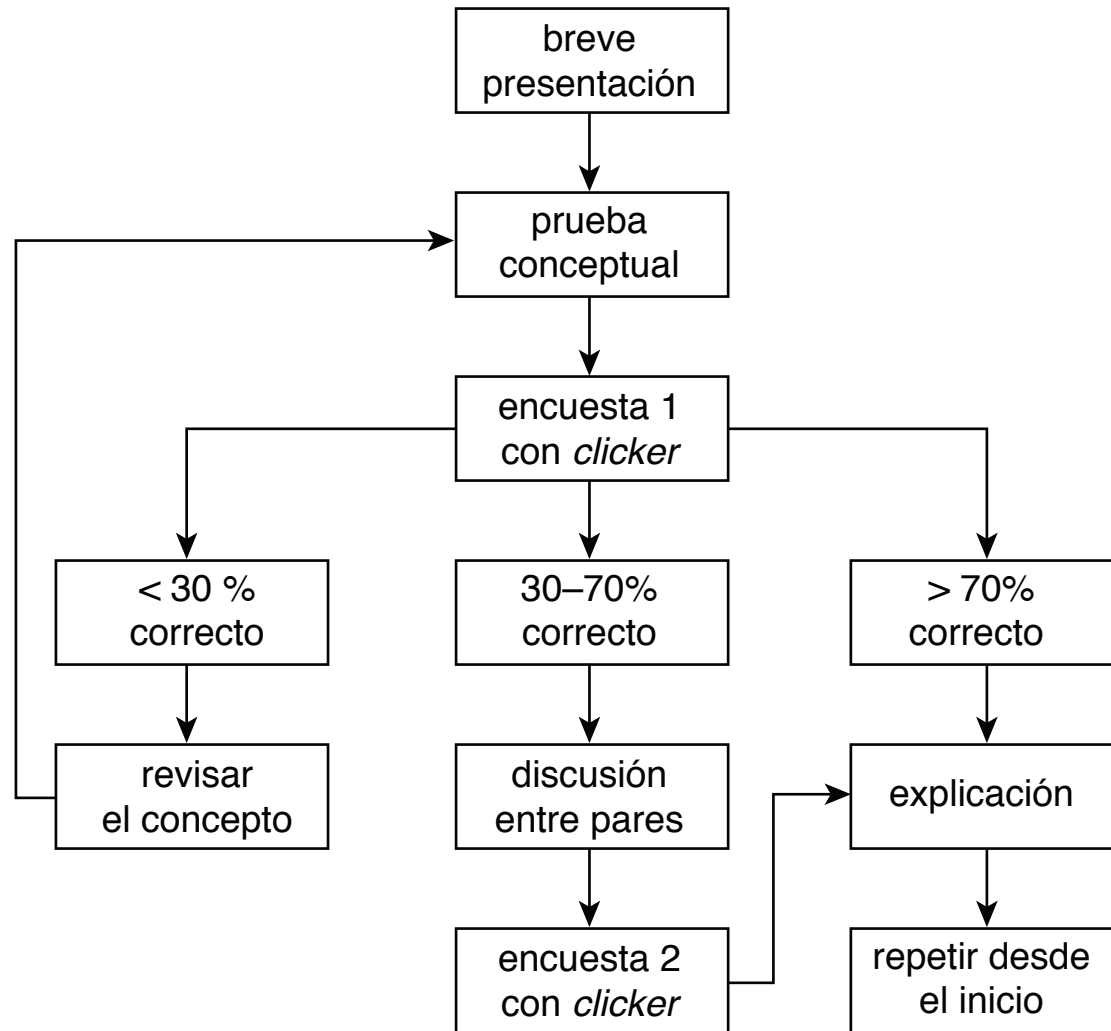
# Promoviendo el pensamiento



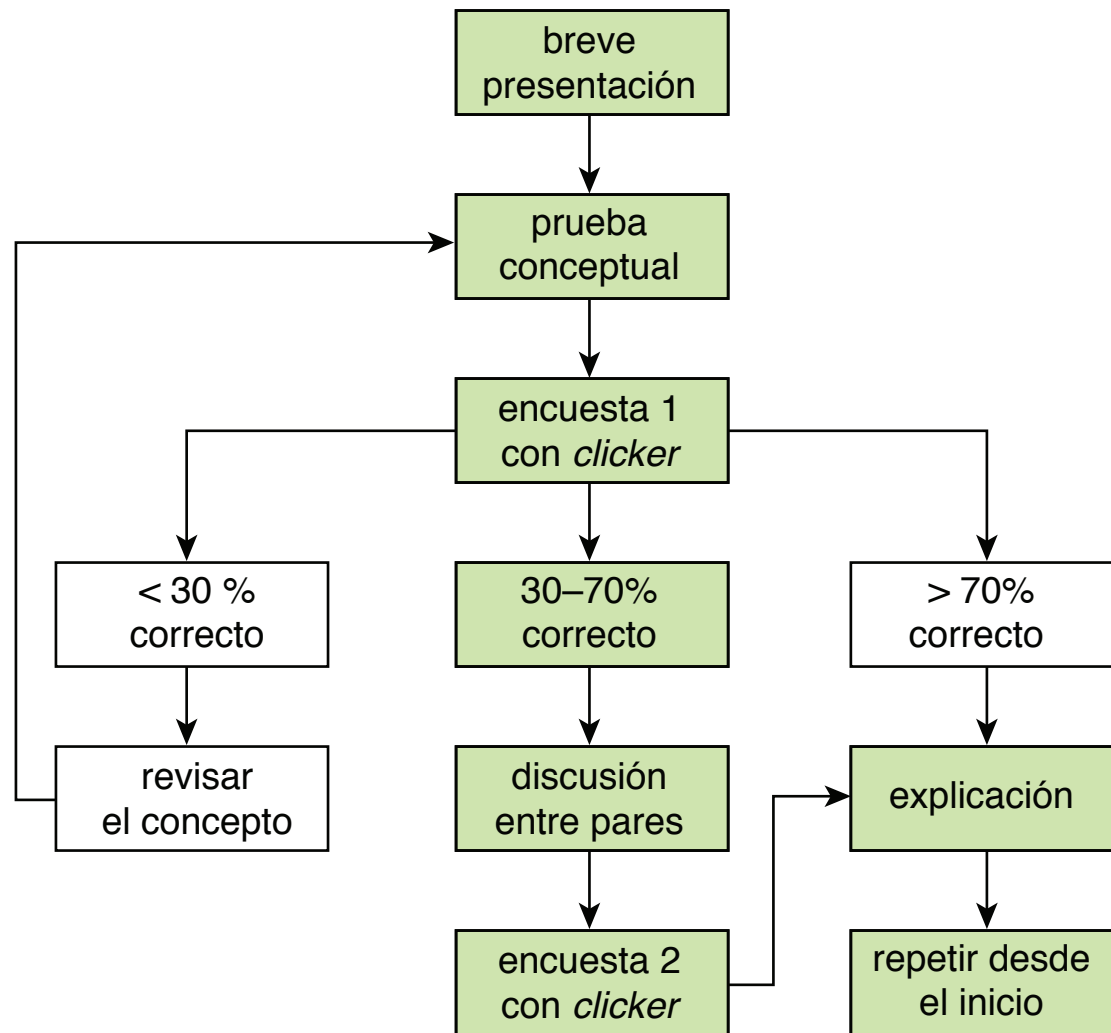
# Promoviendo el pensamiento



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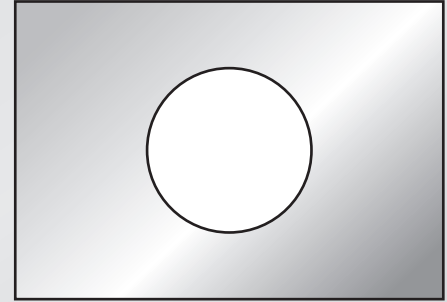
# Promoviendo el pensamiento





# Promoviendo el pensamiento

Considere una placa rectangular de metal con un agujero circular.

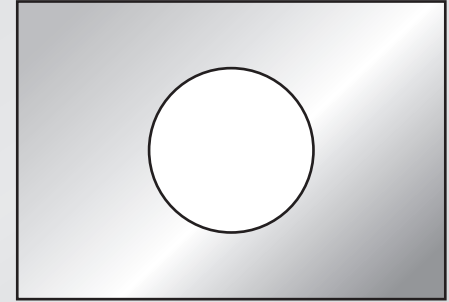


# Promoviendo el pensamiento

Considere una placa rectangular de metal con un agujero circular.

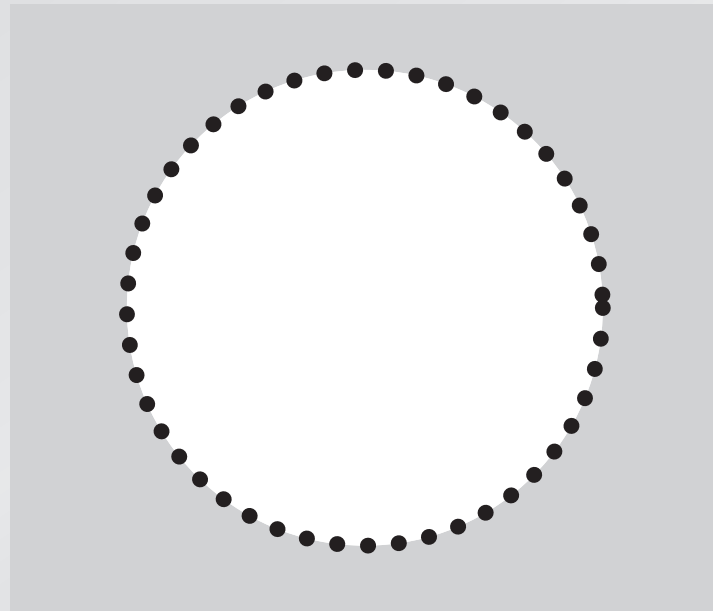
Cuando la placa se calienta de manera uniforme, el diámetro del agujero

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



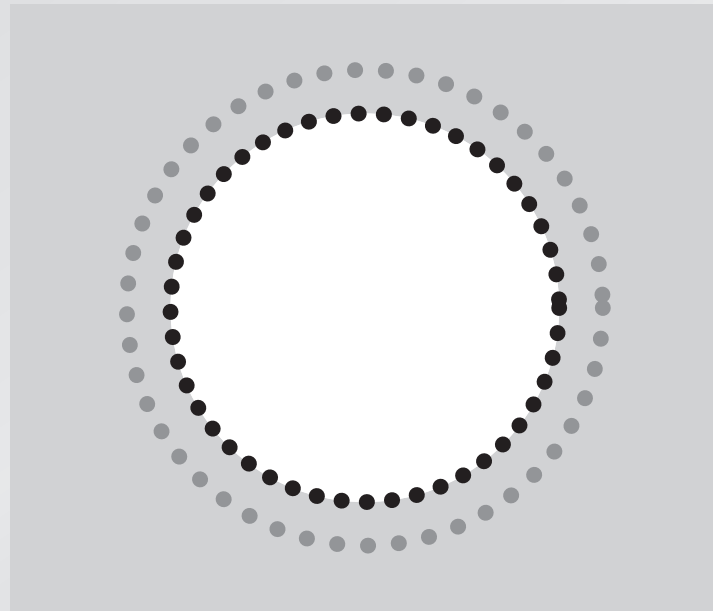
# Promoviendo el pensamiento

considere los átomos en el borde del agujero



# Promoviendo el pensamiento

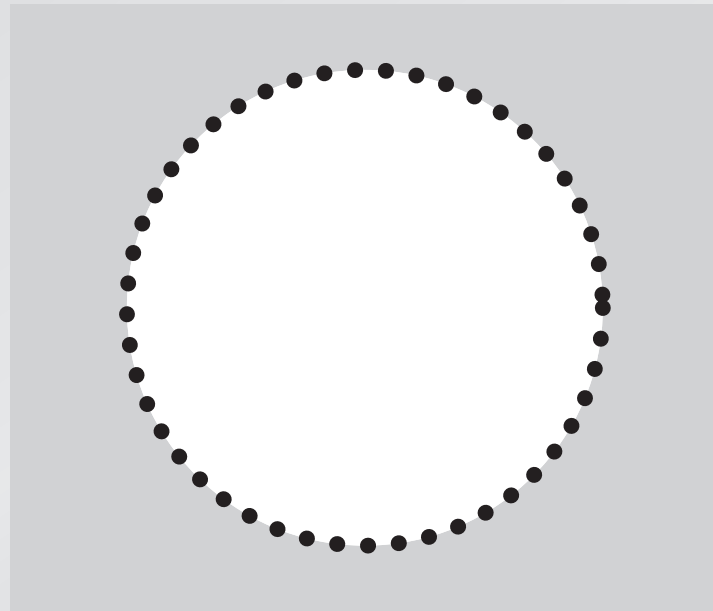
considere los átomos en el borde del agujero





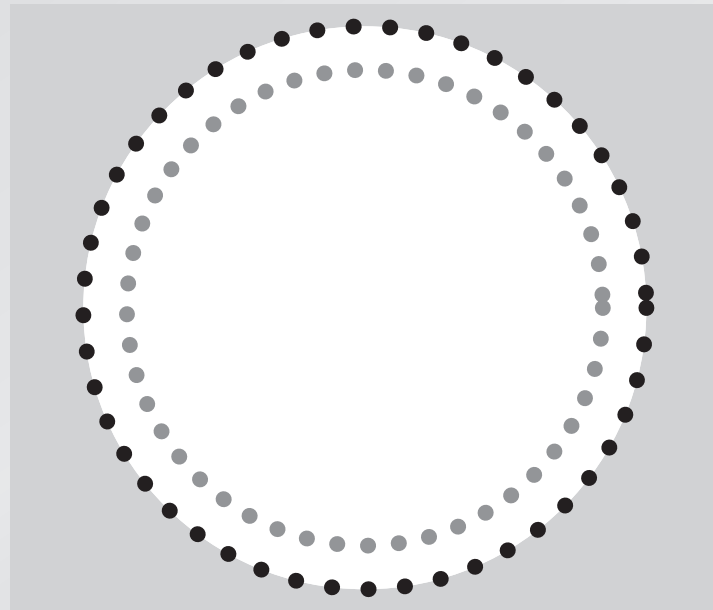
# Promoviendo el pensamiento

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!**

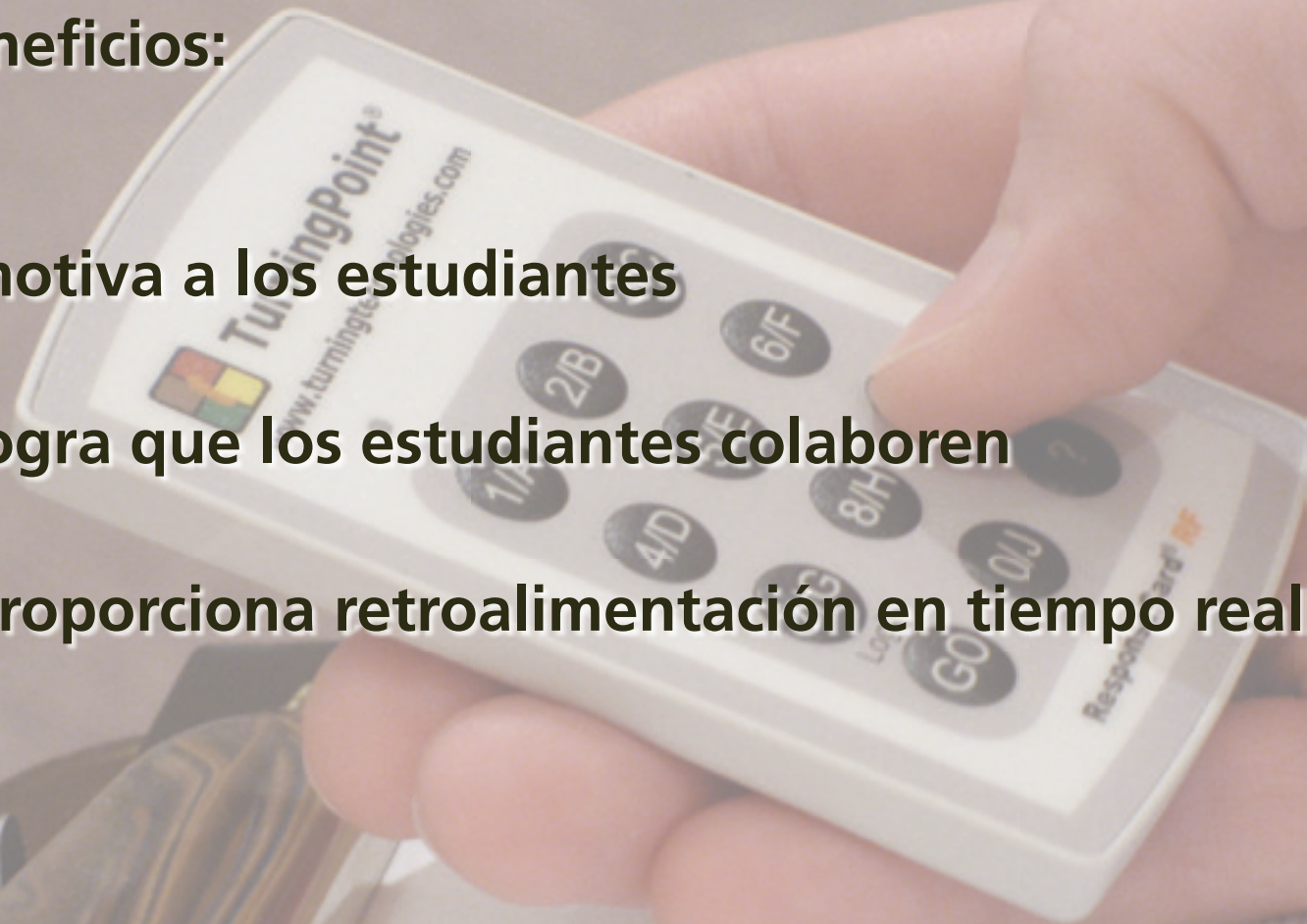




# Promoviendo el pensamiento

## 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

ILT: Manage

http://www.conceptest.org

ILT: Login local | ILT: Lecture | ILT: Reading

HOME READING LECTURES ASSIGNMENTS FORUMS NEWS HANDOUTS

Physics > Physics 10 > Lectures > 10 > Changing magnetic fields II 44 > 44

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, eddy currents are induced around the tube. Compared to a freely-falling magnet, the magnet through the tube

1. more slowly.  
2. exactly the same way.  
3. faster.

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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Physics > Introductory Electromagnetism > Magnetism > CT: 3750  
October 12, 2001 05:55:06 pm

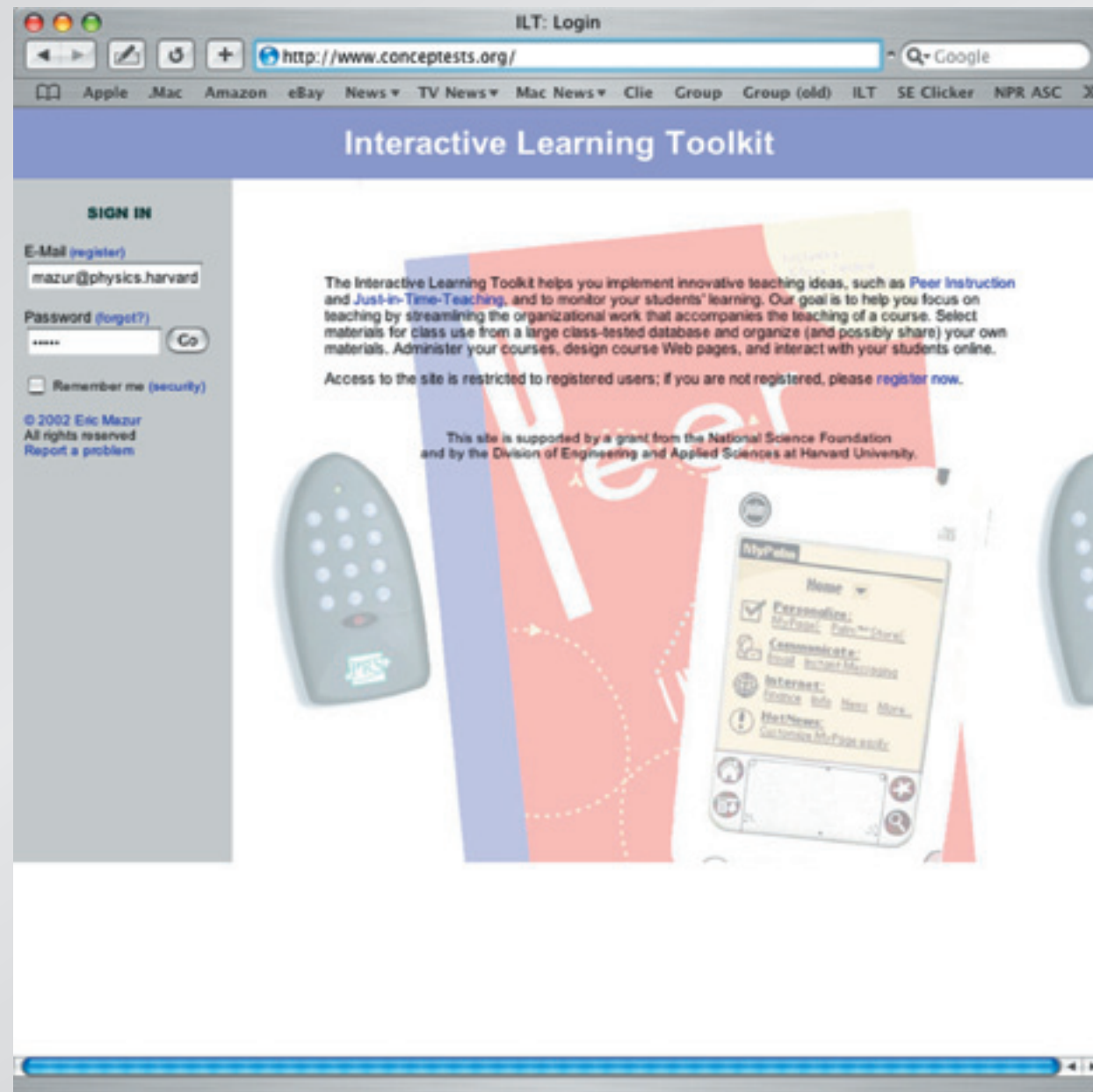
2. Consider the arrangement shown below. Conducting rod AB is lying on a U-shaped conductor, making good electrical contact. The arrangement is placed in a magnetic field (into page).



# 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:

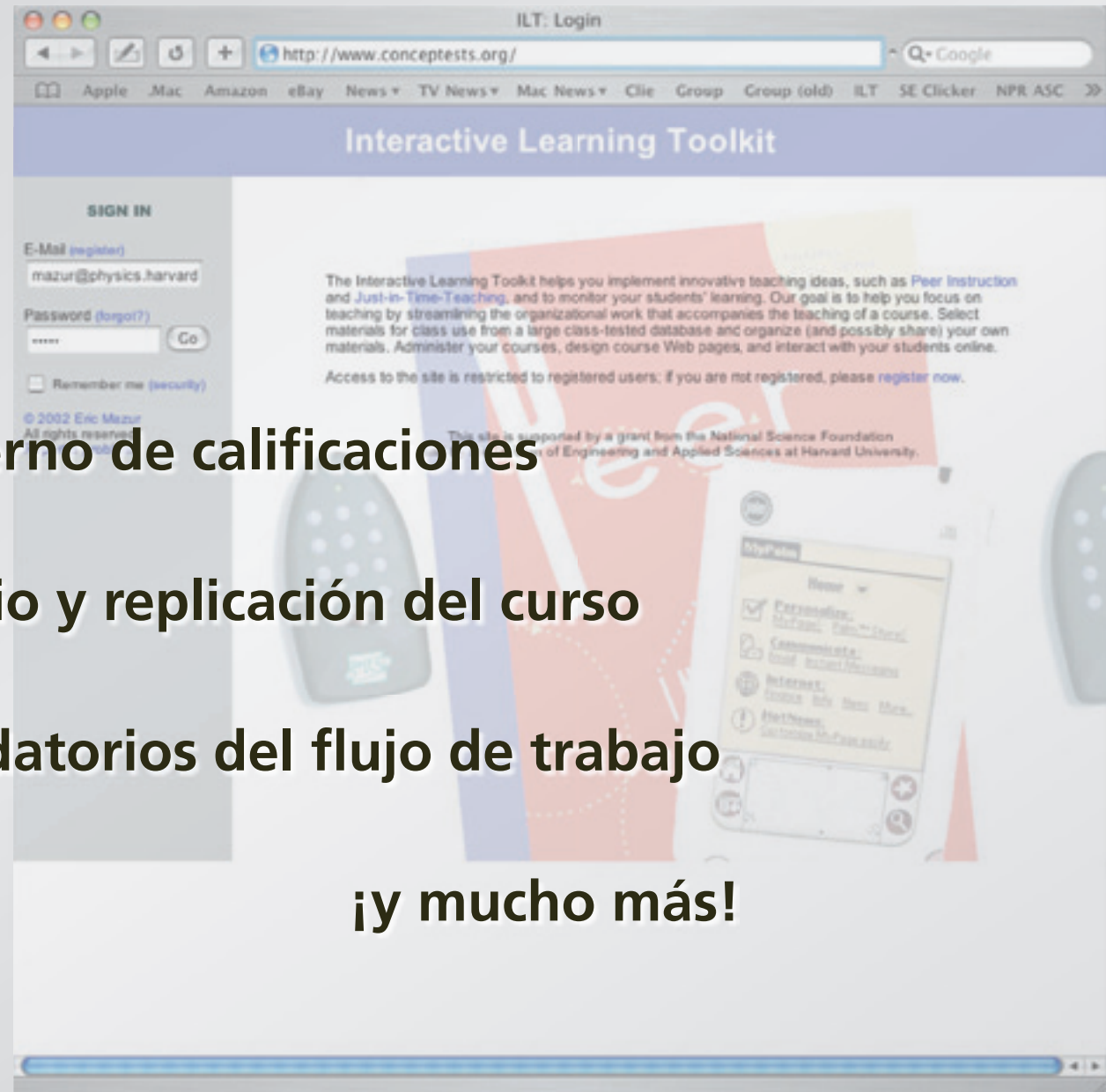
- Home
- Personalize: [MyPages](#), [Page Control](#)
- Communicate: [Email](#), [Instant Messages](#)
- Internet: [Course Site](#), [New](#), [More...](#)
- HotNews: [Customize MyPages](#)



# 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 links for 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. Two questions are shown:

**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.)

Bar charts show student response counts for each question. For Question 1, the counts are: 1 (126), 2 (32), 3 (9), 4 (4). For Question 2, the counts are: 1 (59), 2 (105), 3 (7), 4 (7).

# Integrando la enseñanza

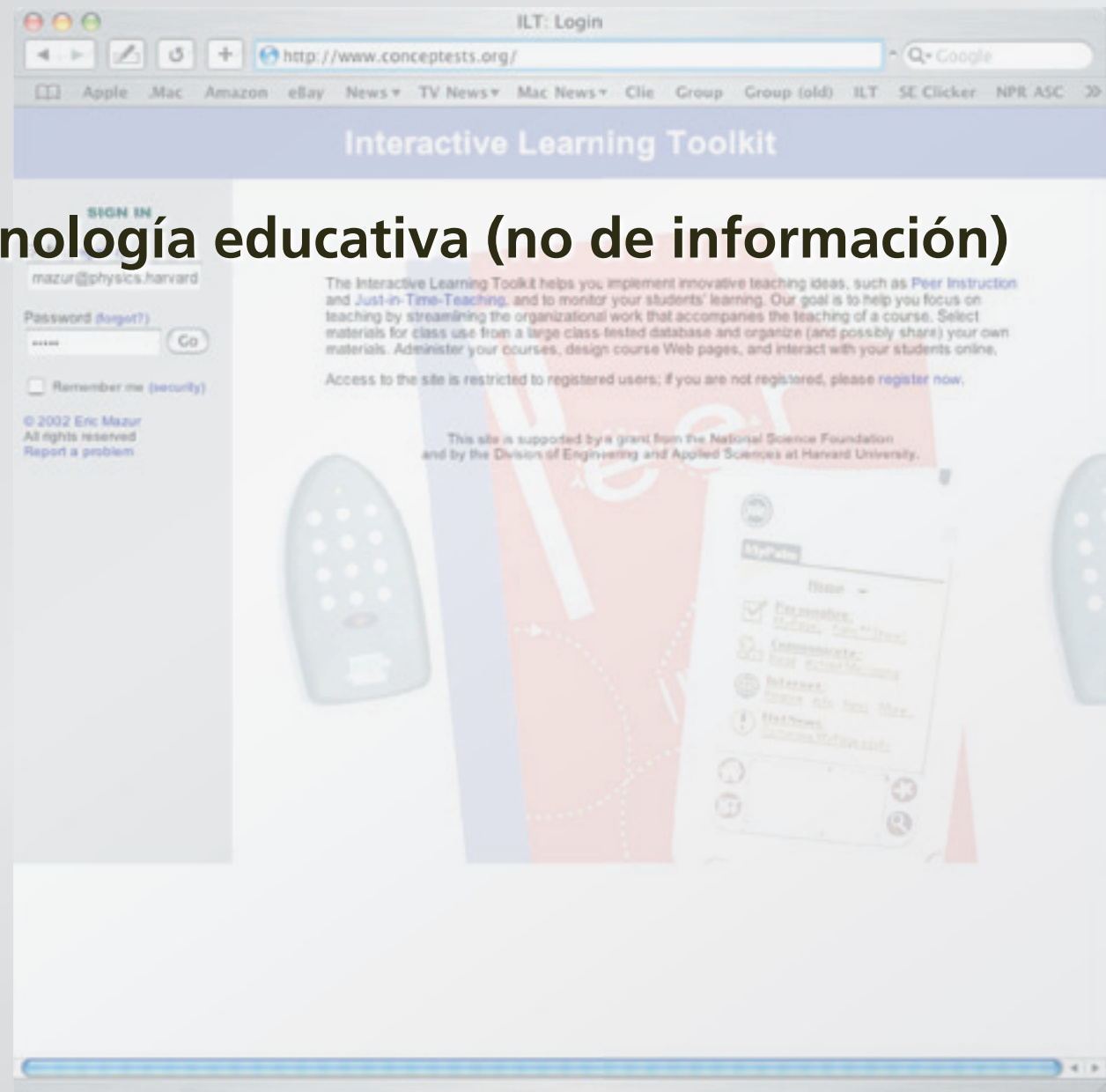
## Instrumentos de evaluación disponibles

- **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)

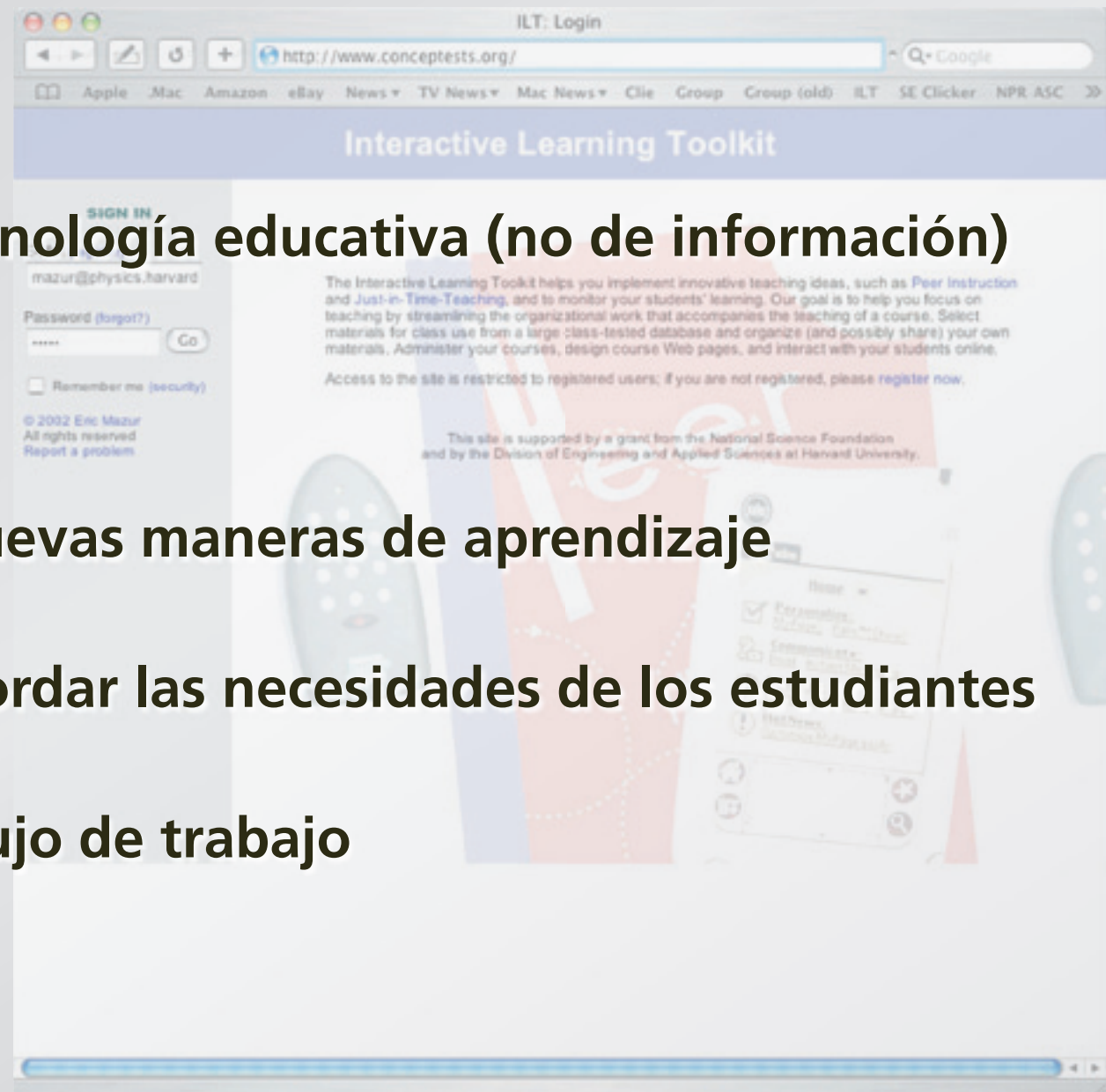


# Resumen

**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.”**

