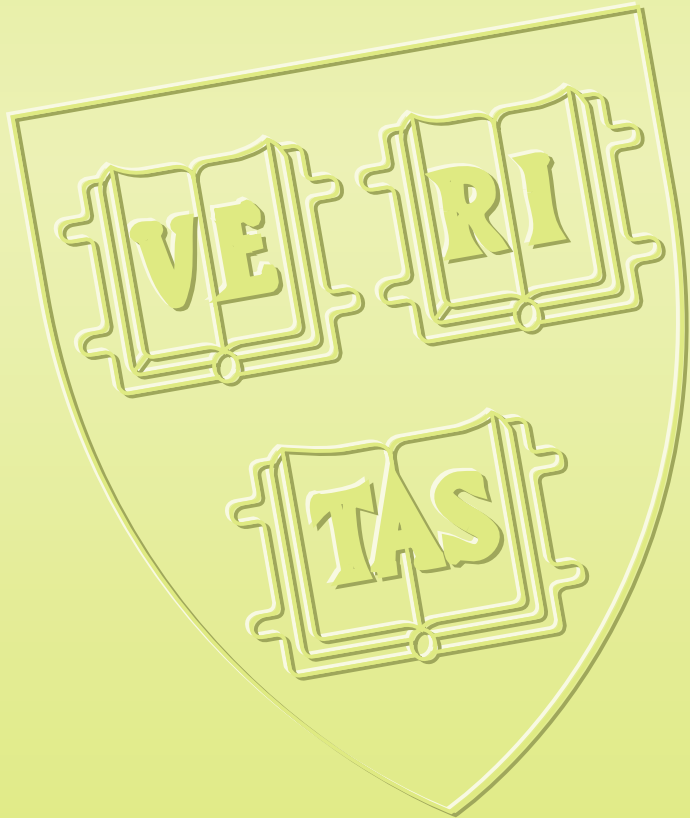


# **T**echnology: cure or headache?

.....



**E**ric Mazur  
Physics

21 October 1999  
Hong Kong University

**Technology is not a magic bullet**

# A brief history of Information Technology

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- ◌ blackboard
- ◌ overhead projector
- ◌ television
- ◌ computer



**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

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

**P**uicūq; sūt sub iugo serui dñs suos om̃i honore dignos arbitrant̃: ne nomē dñi ⁊ doctrina blasphemetur. Qui aut̃ fideles habent dñs nō otremāt quia fides sūt: sed magis seruiāt q̃a fideles sūt ⁊ dilecti: q̃a beneficij participes sunt h̃c dōce: ⁊ retributare. Si q̃a aliter doce: ⁊ nō acquiescit sanis seruicibz dñi nr̃i ih̃esu cristi. et ei que sūm pietatē ⁊ doctrinē: superbus nichil sciens sed languēs circa questionē ⁊ pugnas verborū: ex quibz oriūtur inuidie detractiones blasphemie suspiciones male-afidationes hominū morte corruptorū ⁊ q̃ veritate priuati sūt: exstimatiū questū esse pietatē. Iste aut̃ quest⁹ magnus: pietas cum sufficiens. Nichil enī intulim⁹ in hunc mūdū: hanc dubiū q̃a nec auferre nō possum⁹. Ihabētes aut̃ alimēta et qb̃ tegam⁹: hijs otati sum⁹. Nā q̃ volunt diuites fieri inuidi sūt i contrarietate ⁊ i la-

diā uiuū: q̃ solus habet immortalitatem ⁊ lucē inhabitat inaccessibilē: quē null⁹ hominū uidit sed nec uidere potest: cui h̃ onor ⁊ imperiū sempiternū amittit.

**S**imilibz hui⁹ seculi p̃cipe nō sublimē sapere: neq; sperare in iucato diuitiarū sed i deo uiuere q̃ p̃stat nobis oīa abūde ad fruēdū: bene agere: diuites fieri i bonis opribz: facile tribuere: diuinitate rethesaurizare sibi fūd amētū bonū in futurū: ut app̃hetūdē veram vitā. Ibi thimothee depositū custodi: deuitas phanas uocū nouitates et oppositiones falli noscē sciēcie: quā quidā p̃mittētes circa fidem occiderūt. Ibracia tecū amē.

*Explicit epistola prima ab thymotheo*

*Incipit argumentū in eplam secundā*

**T**himotheo scribit de rehortatione martirij ⁊ om̃is regule ueritatis: ⁊ qd futur⁹ sit t̃poribz nouissimis. ⁊ de sua passione: sc̃b̃ a roma. *Explicit argumentū. Incipit eplā secūda ad thymō*

**M**ulus apostol⁹ h̃c i

ih̃esu cristi p̃ uolūta-











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 una Appendice del centro di gravità d'alcuni Solidi.*



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



but lectures have barely evolved...





# **T**he real problem .....

**not delivery of information  
but assimilation of knowledge**



**T**he key point  
.....

**think about educational goals  
before introducing technology**



# What constitutes effective use of technology?

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

# What problems can technology help with?

---

Large lectures...

- 🕒 are impersonal
- 🕒 focus on information transfer
- 🕒 don't necessarily address students' needs

# Just-in-time teaching

- move some of the information transfer out of the classroom
- find out what needs to be “lectured” on

The screenshot shows a web browser window titled "Physics 1a Reading Assignments". The address bar displays "http://physics1a.harvard.edu/assignments.html". The page content includes a sidebar with links like "Assignments", "History", "Search", "People", and "Index". The main content area lists student responses to a reading assignment. Each entry includes a student's name, a small profile picture, the date and time of the response, the number of responses received, and the text of the response. The responses are from Brian Chan, Alvin Cabrera, and Cinthia Guzman.

**Physics 1a Reading Assignments**  
Recent Feedback

Address: <http://physics1a.harvard.edu/assignments.html> Go

Best of the Web Today's LWA's Web Gallery Product News Microsoft Office for Macintosh Products for Mac

**Physics 1a Reading Assignments**  
Recent Feedback

**Brian Chan**  
11/03/98 11:03:07 PM  
Total responses sent: 5

I was a little bit confused as to the relation between centripetal force and static frictional force (as in the case of the cube on the turntable). The answer in part B says that once the static frictional force reaches its maximum, the cube will fly off. Does this mean that the centripetal force is actually composed in the static frictional force?

[SCIENCE](#) | [LWA](#) | [ALL ANSWERS](#)

**Alvin Cabrera**  
11/03/98 12:06:19 AM  
Total responses sent: 0

The discussion of centripetal force was interesting. I guess "centrifugal force" does not exist, then?

[SCIENCE](#) | [LWA](#) | [ALL ANSWERS](#)

**Cinthia Guzman**  
11/03/98 11:51:03 AM  
Total responses sent: 3

Local machine: zoe



# Just-in-time teaching

## Pre-class reading assignment

- 2 questions on content
- 1 feedback question

The screenshot shows a web browser window titled "Physics 1a Reading Assignments". The address bar displays "http://physics1a.harvard.edu/assignments.html". The page content includes a "Process Feedback" section with three student entries, each featuring a profile picture, name, timestamp, and response count. The first entry is from Brian Chan, dated 11/03/98 11:03:07 PM, with 5 responses. The second is from Alvin Cabrera, dated 11/03/98 12:06:19 AM, with 0 responses. The third is from Cinthia Guzman, dated 11/03/98 11:51:03 AM, with 3 responses. Each entry includes a feedback question about centripetal and static frictional forces. At the bottom of the page, there are links for "SCIENCE", "EMAIL", and "ALL ANSWERS".

Physics 1a Reading Assignments  
Process Feedback

Brian Chan  
11/03/98 11:03:07 PM  
Total responses sent: 5

I was a little bit confused as to the relation between centripetal force and static frictional force (as in the case of the cube on the turntable). The answer in part B says that once the static frictional force reaches its maximum, the cube will fly off. Does this mean that the centripetal force is actually composed in the static frictional force?

[SCIENCE](#) | [EMAIL](#) | [ALL ANSWERS](#)

Alvin Cabrera  
11/03/98 12:06:19 AM  
Total responses sent: 0

The discussion of centripetal force was interesting. I guess "centrifugal force" does not exist, then?

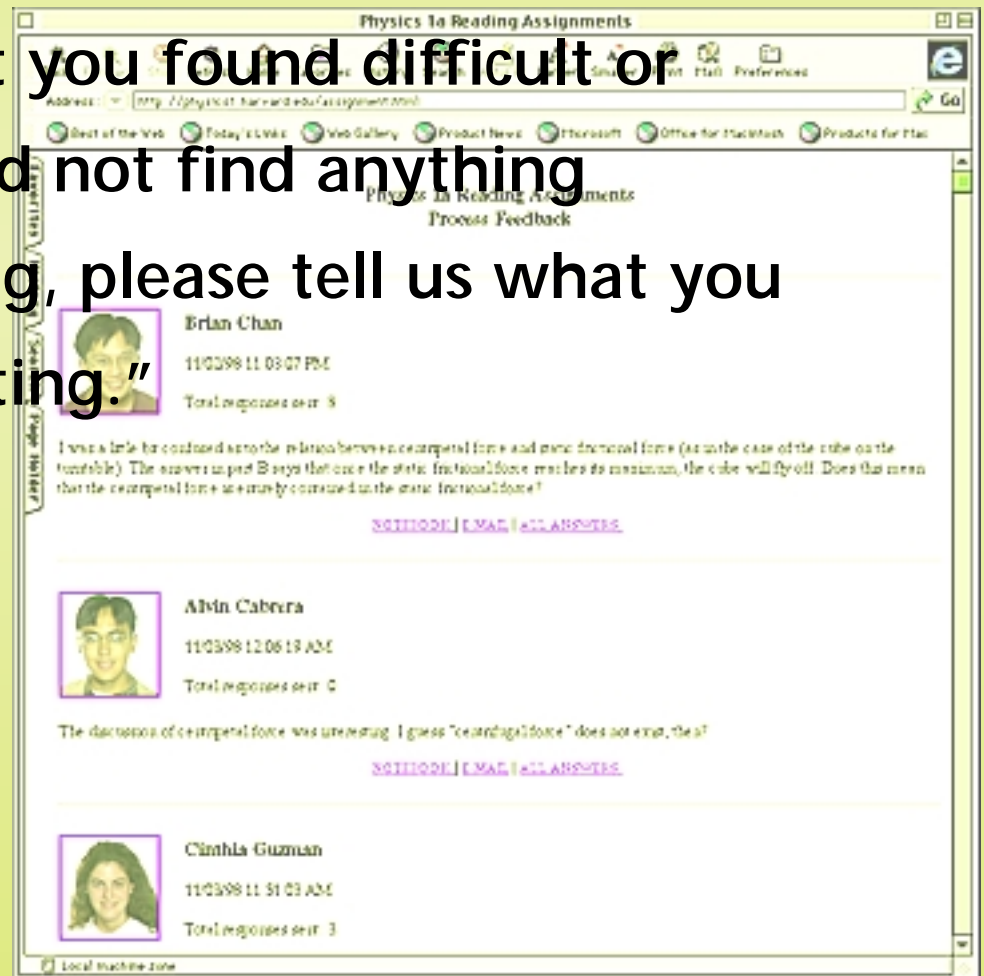
[SCIENCE](#) | [EMAIL](#) | [ALL ANSWERS](#)

Cinthia Guzman  
11/03/98 11:51:03 AM  
Total responses sent: 3

Local machine: zoe

# Just-in-time teaching

“Please tell us what you found difficult or confusing. If you did not find anything difficult or confusing, please tell us what you found most interesting.”



# Just-in-time teaching

Physics 1a Reading Assignments

Back Forward Stop Refresh Home Favorites History Search AutoFill Larger Smaller Print Mail Preferences


Address: <http://phy101st.harvard.edu/assignment.html> Go

Best of the Web Today's Links Web Gallery Product News Microsoft Office for Macintosh Products for Mac

---

Physics 1a Reading Assignments  
Process Feedback


---

 **Brian Chan**  
11/03/98 11:03:07 PM  
Total responses sent: 8

I was a little bit confused as to the relation between centripetal force and static frictional force (as in the case of the cube on the turntable). The answer in part B says that once the static frictional force reaches its maximum, the cube will fly off. Does this mean that the centripetal force is entirely contained in the static frictional force?

[NOTEBOOK](#) | [EMAIL](#) | [ALL ANSWERS](#)


---

 **Alvin Cabrera**  
11/03/98 12:06:19 AM  
Total responses sent: 0

The discussion of centripetal force was interesting. I guess "centrifugal force" does not exist, then?

[NOTEBOOK](#) | [EMAIL](#) | [ALL ANSWERS](#)

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 **Cynthia Guzman**  
11/03/98 11:51:03 AM  
Total responses sent: 3

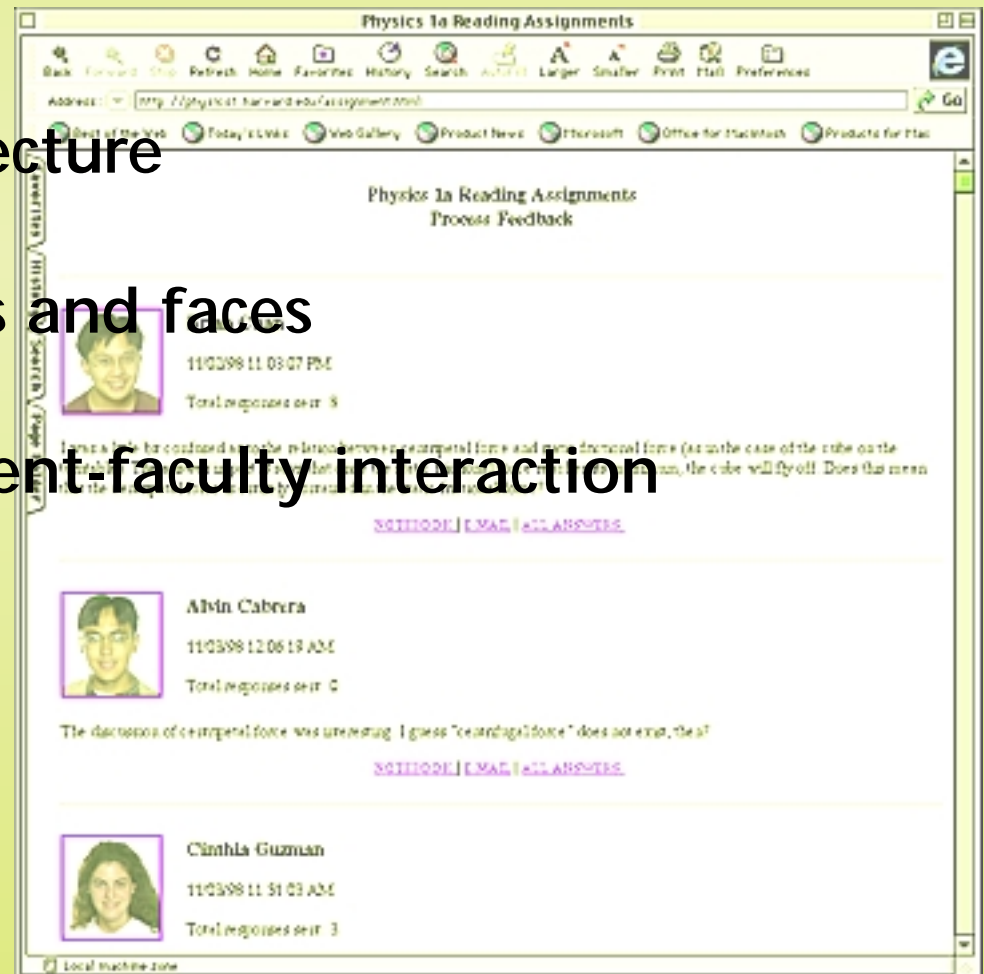
Local machine zone



# Just-in-time teaching

## Benefits:

- more focused lecture
- connects names and faces
- additional student-faculty interaction



# Personal response system

- keep students involved
- probe and address difficulties







# Personal response system



# Personal response system

1. aim tip at  
nearest receiver

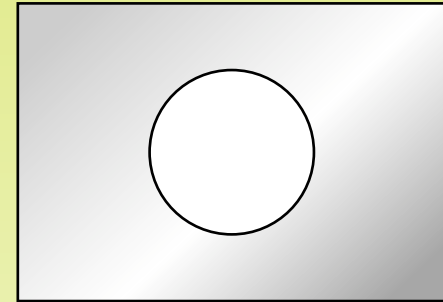


2. press button  
corresponding  
to answer

3. watch for your ID on screen

# Personal response system

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



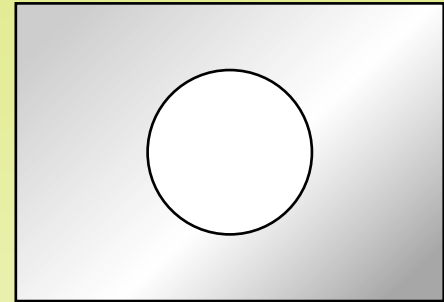


# Personal response system

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

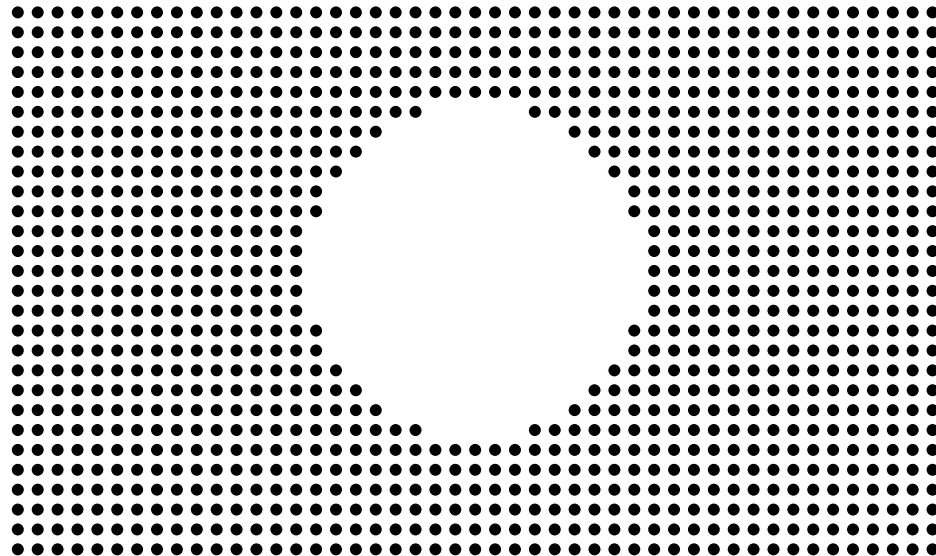
When the plate is heated so it uniformly expands, the diameter of the hole

1. increases
2. stays the same
3. decreases



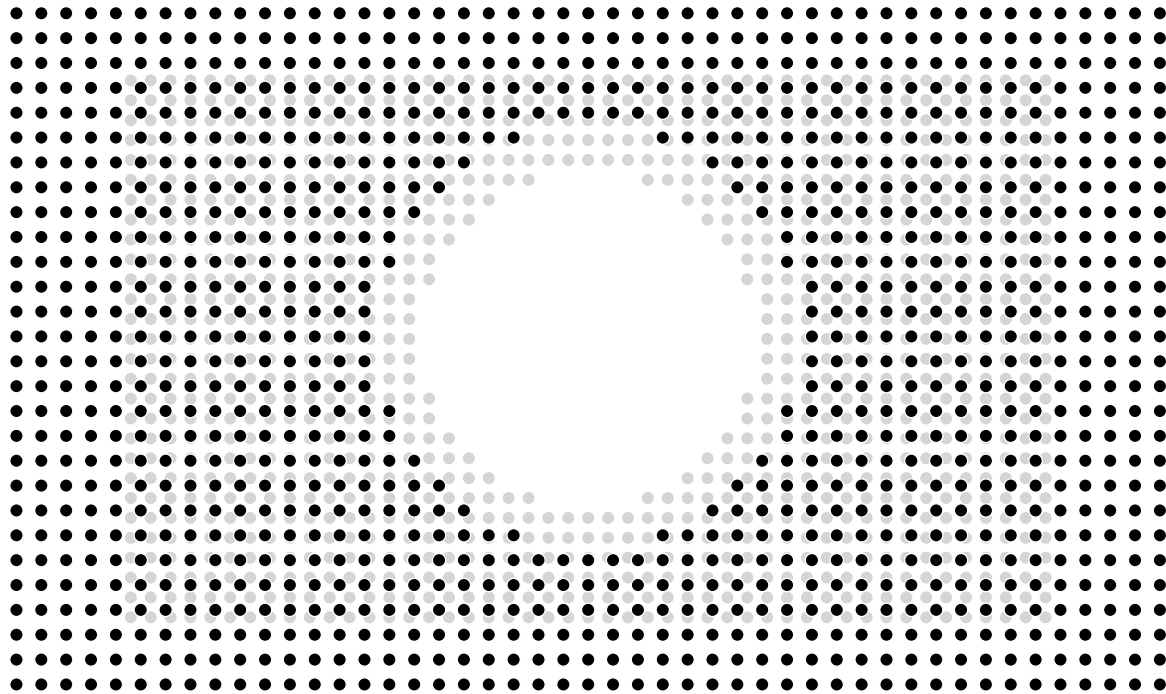
# Personal response system

Just so you won't lose sleep:



# Personal response system

Just so you won't lose sleep:





# Personal response system

## Benefits:

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







**A** parting thought  
.....

**we need *education* technology,  
not just information technology**

# Acknowledgements

Dr. Catherine Crouch  
Elizabeth Hess  
Leo Donnelly

For a copy of this presentation and  
additional information, see:

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