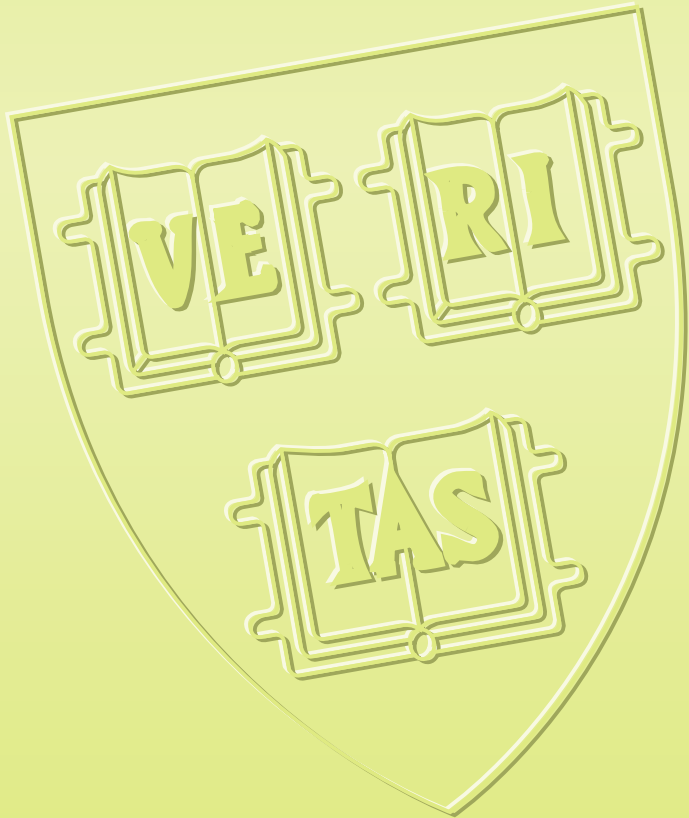


# **E**ngaging students in the classroom .....



**E**ric Mazur  
Physics

12 October 1999  
Tech & Ed Planning Meeting

**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: ⁊ reuerentare. Si q̃a aliter doce: ⁊ nō acquiescit sanis seruicibz dñi nr̃i ihesu cristi. et ei que sūd in pietatē ⁊ doctrinā: superbius nichil sciens sed languēs circa questiones ⁊ 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 tegant: 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**imilit̃ hui⁹ seculi p̃cipe nō sublimare 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 sūd 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 thimotheo*

*Incipit argumentū in eplam secundā*

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

**M**ulus apostol⁹ h̃c i

ihesu cristi p̃ uolūta-







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

**Q**uicūq; sunt sub iugo serui dñi qd suos omni honore dignos arbitrantur: ne non

metur. Qui nō determinat feruiat qā si fieri participat. Si qā aliter nō feruiat que sed in pū nichil facientes: et pugnat inuidie: spiciones nō metate corrū sūt: existimant

aut quest⁹ magnus: pietas cum sufficiens. Michl enī intulim⁹ in hunc mūdū: hanc dubiū qā nec auferre nō possum⁹. Ihabētes aut alimēta et qbus tegant: hīs daturū sim⁹. Nā q uolunt diuitem fieri inuidie contrariū ē et illo

dñi uiuū: q̄ solus habet immortalitatem et lucē inhabitat inaccessibilē: quē null⁹ hominū uidit sed nec uidere potest: cui hōi or et imperiū sempiternū amittit. Similitas hui⁹ seculi p̄cipe nō sublimet

diuitiarū is oīa abūdetes fieri i bonū uiuere: nū bonū in uita. Ad thi deuitas pph appositiones idā pmitte⁹: etia tecū amē. ab ethi noctū. am secundā rehortatione: et qd

futur⁹ sit temporib⁹ nō uisum ē. et de sua passione: scabē a roma. Explet argumētū. Inuicē ep̄la scda ad thymō. Iulius ap̄stol⁹ iheri ihesu nati p uolūta: et nō solum nō uisū.



arguit iheri in ep̄la secunda...  
...et de sua passione: scabē a roma.  
...et de sua passione: scabē a roma.

**E**xplet argumētū. Inuicē ep̄la scda ad thymō. Iulius ap̄stol⁹ iheri ihesu nati p uolūta: et nō solum nō uisū.

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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 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?

---

- 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. Each response is followed by a link to "SCIENCE | EMAIL | ALL ANSWERS".

**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](#) | [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

## 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. His question is about the relationship between centripetal and static frictional forces on a rotating cube. The second entry is from Alvin Cabrera, dated 11/03/98 12:06:19 AM, with 0 responses. His comment is about the discussion of centripetal force. The third entry is from Cinthia Guzman, dated 11/03/98 11:51:03 AM, with 3 responses. 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  
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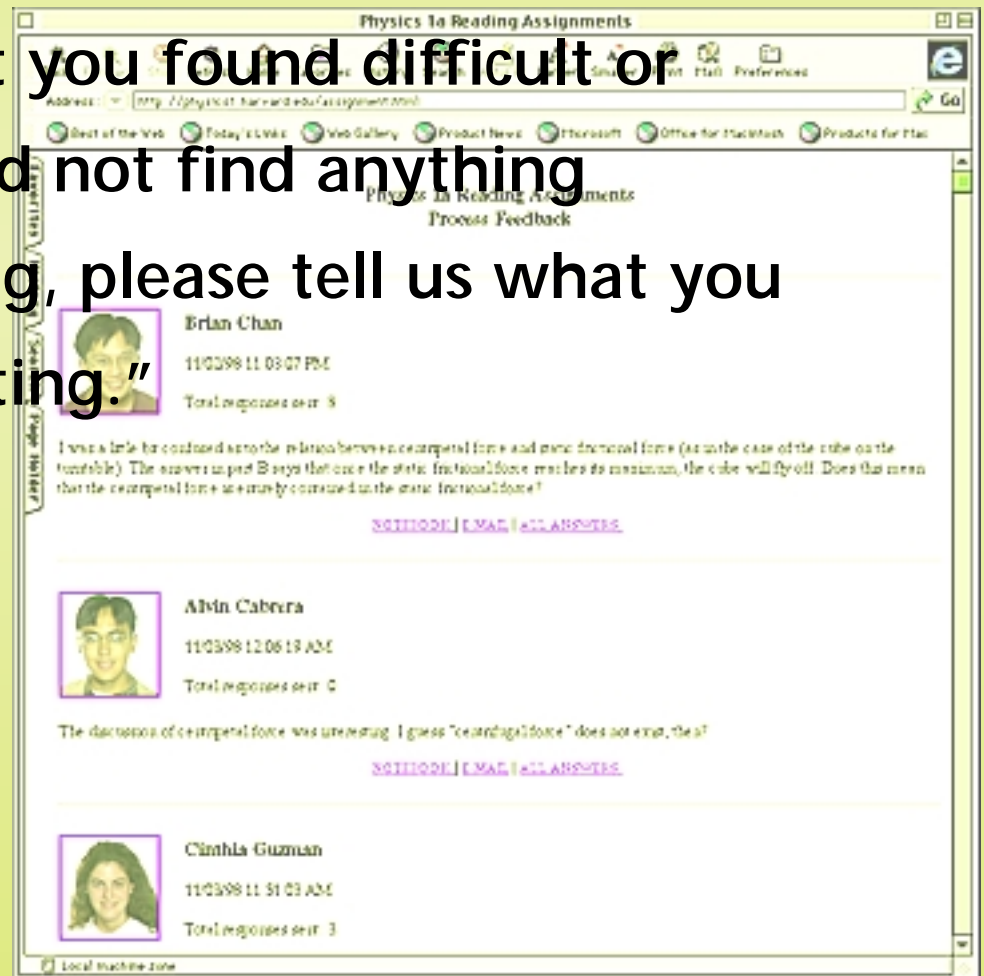
[SCIENCE](#) | [EMAIL](#) | [ALL ANSWERS](#)

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 seen: 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 seen: 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 seen: 3

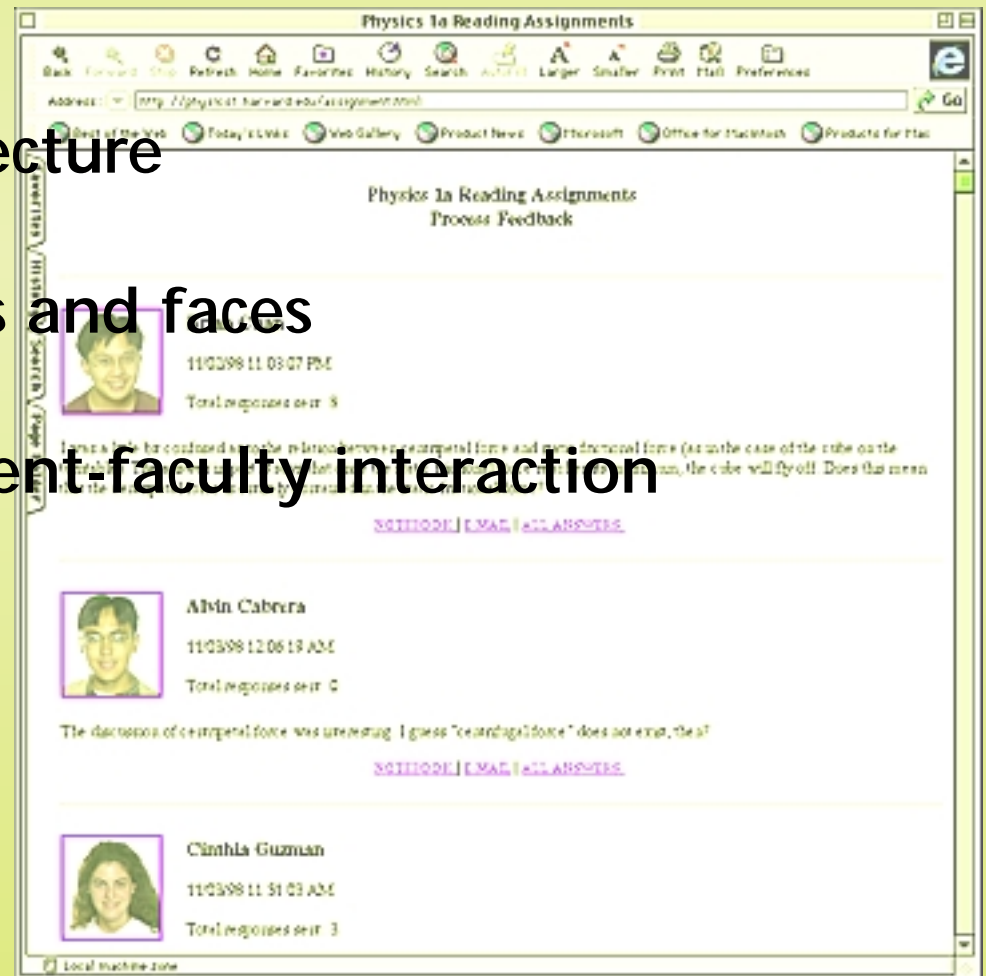
Local machine zone



# 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

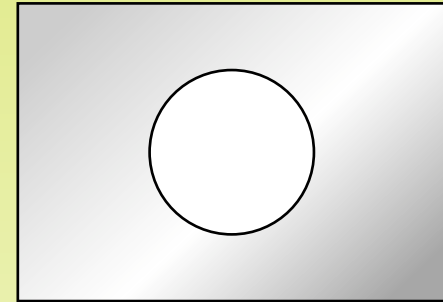


2. press button  
corresponding  
to answer

3. watch for ID on screen

# Personal response system

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

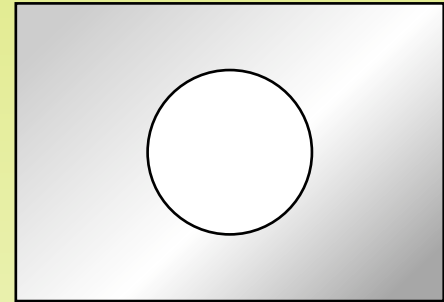


# Personal response system

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

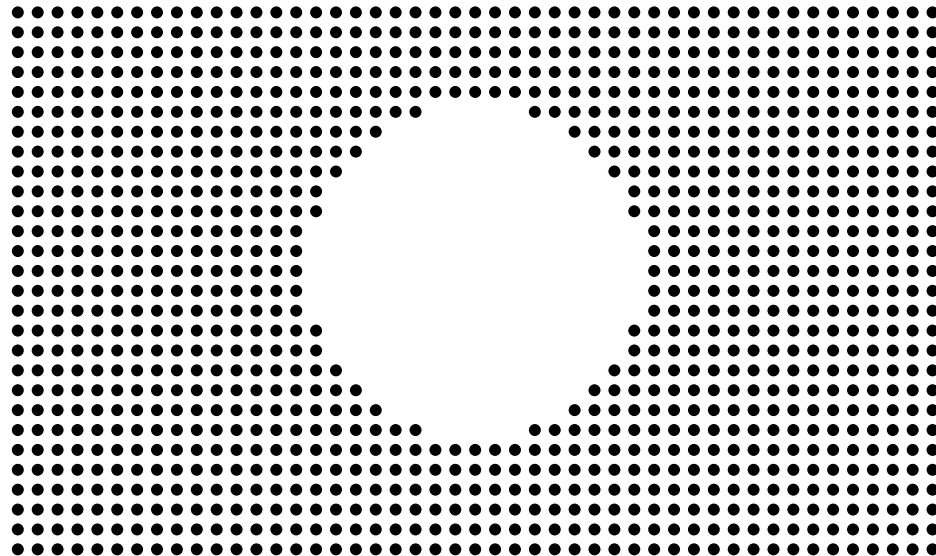






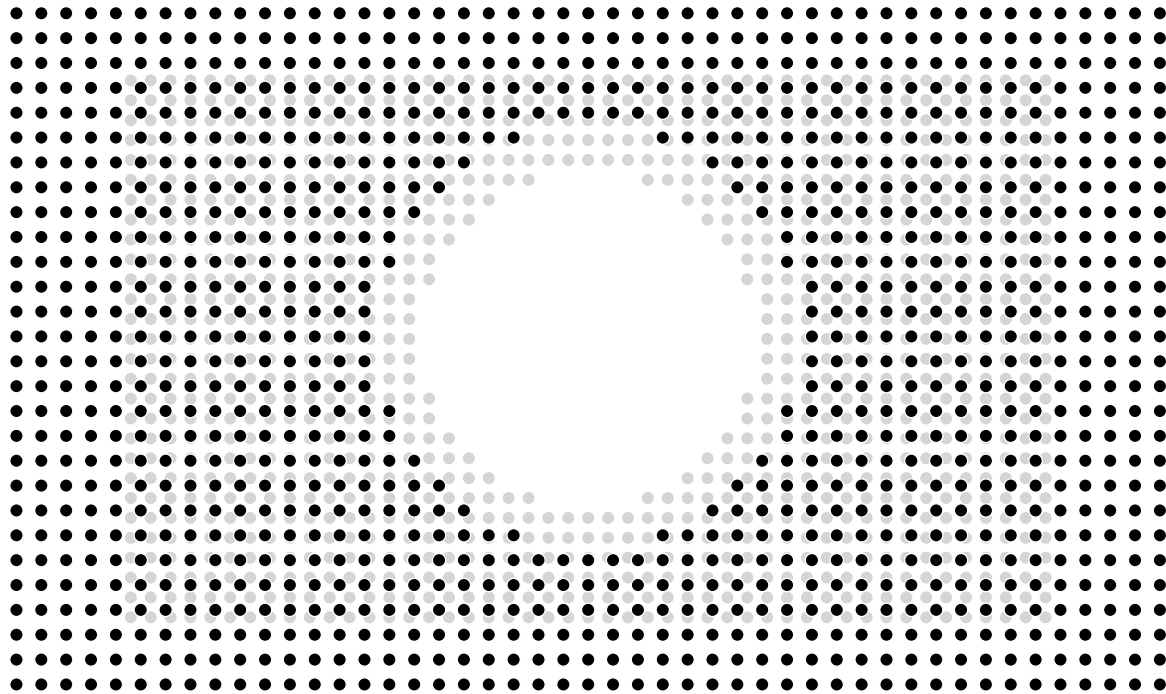
# Personal response system

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  
Prentice Hall  
Varitronix**

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

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