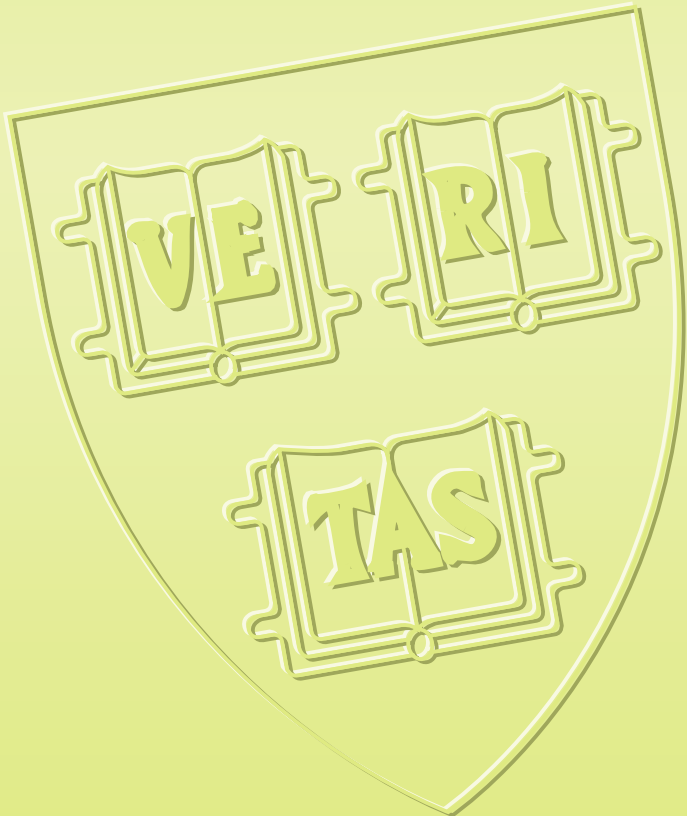


E ducation: information or engagement?



Eric Mazur
Physics

6 March 2000
Tech & Ed Planning Meeting



Technology is not a magic bullet

A brief history of Information Technology

- 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**

Quicūq; sunt sub iugo serui dñs suos omni honore dignos arbitrentur: ne nomine dñi & doctrina blasphemetur. Qui autem fideles habent dñs non detrahunt quia fides sunt: sed magis feruunt quia fideles sunt & dilecti: quia beneficii participes sunt hęc dote: & retribuire. Si quia aliter docet: & non acquiescit sanis seruationibus dñi nri ihesu cristi. et ei que secundum pietatem est doctrina: superbus nichil sciens sed languens circa questiones & pugnas verborum: ex quibus oriuntur inuidie detractiones blasphemie suspiciones male-afidationes hominum morte corruptorum & quæ veritate priuari sunt: existimantium questum esse pietatem. Est autem questus magnus: pietas cum sufficientia. Nichil enim intulimus in hunc mundum: hanc dubium quia nec auferre quæ possumus. Habentes autem alimenta et quibus tegamur: hijs stamus. Nam qui volunt diuites fieri inuidus est contritione & ille

diuinitus: qui solus habet immortalitatem & lucem inhabitat inaccessibilem: quem nullus hominum vidit sed nec videre potest: cui honor & imperium sempiternum amen.

Quibus huius seculi præcipue non sublimem sapientiam: neque sperare in incerto diuitiarum sed in deo vno qui præstat nobis omnia abunde ad fruendum: bene agere: diuites fieri in bonis operibus: facile tribuere. diuinitate rethesaurizare sibi futurum amicum bonum in futurum: ut apprehendant vitam. Ad thi-nachite depositum custodi: deuitas phanas vocum nouitates et oppositiones falli nostre scientie: quæ quidam præmittunt circa fidem occiderunt. Gratia tecum amen.

Explicit epistola prima ab ephraimo

Incipit argumentum in epistolam secundam

Tertius ephraim scribit de reprobatione martirij & omnis regule veritatis: & quod futurus sit temporibus nouissimis. & de sua passione scilicet a roma. *Explicit argumentum. Incipit epistola secunda ad thymotheum*

Mulus apostolus dicitur

ihesu cristi per voluntatem

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

Quicūq; sunt sub iugo serui dñi os suos omni honore dignos arbitrentur: ne non timeatur. Qui non deturmat seculi seruiant q̄a facti participent. Si q̄a aliter nris seruicium que sed in p̄ nichil scientes ones ⁊ pugnetur inuidie: spiciones n̄ morte corruunt: existimant

aut quest⁹ magis: pietas cum sufficientia. Nichil enī intulim⁹ in hunc mundū: hanc dubiū q̄a nec aufere n̄a possum⁹. Inhabētes autē alimēta et qb̄u te ganit: hijs daturū sum⁹. Nā q̄ uolunt dimitte fieri inuidiū: in coram nō ⁊ iſta

futurū sic temporibus nouissimis. ⁊ de sua passione: scabē a roma. Explet argumētū. Mens eplā scda ad thymō. Iulius apollo: iheru ihesu n̄sti p̄ uolūta

dñi unū: q̄ solus habet immortalitatem ⁊ lucē inhabitat inaccessibile: quē null⁹ hominū uidit sed nec uidere potest: cui h̄ on or ⁊ imperiū sempiternū amittit. Similit̄ hui⁹ seculi p̄cipe nō subleuat

seculi diuitiarū is oīa abūde ites fieri i bo: diuinitate: itū bonū in n̄ vitā. Lū th̄i: deuitas p̄ha: p̄posiciones idā p̄mittē: tria tecū amē. ad th̄i noctū: iam secūm dā: rēhoratōne: ritatis: ⁊ qd

aut quest⁹ magis: pietas cum sufficientia. Nichil enī intulim⁹ in hunc mundū: hanc dubiū q̄a nec aufere n̄a possum⁹. Inhabētes autē alimēta et qb̄u te ganit: hijs daturū sum⁹. Nā q̄ uolunt dimitte fieri inuidiū: in coram nō ⁊ iſta futurū sic temporibus nouissimis. ⁊ de sua passione: scabē a roma. Explet argumētū. Mens eplā scda ad thymō. Iulius apollo: iheru ihesu n̄sti p̄ uolūta

futurū sic temporibus nouissimis. ⁊ de sua passione: scabē a roma. Explet argumētū. Mens eplā scda ad thymō. Iulius apollo: iheru ihesu n̄sti p̄ uolūta



apud iheru... *apud iheru... in hunc mundum... in hunc mundum... in hunc mundum...*

Dicitur... *Dicitur... in hunc mundum... in hunc mundum... in hunc mundum...*

Dicitur... *Dicitur... in hunc mundum... in hunc mundum... in hunc mundum...*

Dicitur... *Dicitur... in hunc mundum... in hunc mundum... in hunc mundum...*

Dicitur... *Dicitur... in hunc mundum... in hunc mundum... in hunc mundum...*

Dicitur... *Dicitur... in hunc mundum... in hunc mundum... in hunc mundum...*



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...



The real problem

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

The 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 contains the URL "http://physics1a.harvard.edu/assignments.html". The page content includes a navigation menu on the left with options like "HOME", "SEARCH", "POST", and "HOME". The main content area displays three student responses to a question about centripetal and tangential forces. Each response includes a student's name, a small profile picture, the time of the response, the total number of responses, and the text of the response. The question text is visible at the top of the response list.

Physics 1a Reading Assignments
Physics Feedback

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

Best of the Web Today's Links Web Gallery Product News Microsoft Office for Macintosh Products for P1a

Physics 1a Reading Assignments
Physics Feedback

Brian Chan
11/03/98 11:03:07 PM
Total responses so far: 8

I was a little bit confused as to the relation between centripetal force and tangential 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 directly correlated to the static frictional force?

[NOTHING](#) | [EMAIL](#) | [ALL ANSWERS](#)

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

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

[NOTHING](#) | [EMAIL](#) | [ALL ANSWERS](#)

Cynthia Guzman
11/03/98 11:51:03 AM
Total responses so far: 3

Local machine zone

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" with the URL "http://physics1a.harvard.edu/assignment.html". The page content includes the title "Physics 1a Reading Assignments" and "Process Feedback". It displays three student responses, each with a profile picture, name, timestamp, and total response count. The first response is from Brian Chan, dated 11/03/98 11:03:07 PM, with 8 total responses. The second is from Alvin Cabrera, dated 11/03/98 12:06:19 AM, with 0 total responses. The third is from Cinthia Guzman, dated 11/03/98 11:51:03 AM, with 3 total responses. Each response includes a question about centripetal and static frictional forces and a link to "NOTES | EMAIL | ALL ANSWERS".

Physics 1a Reading Assignments
Process Feedback

Brian Chan
11/03/98 11:03:07 PM
Total responses so far: 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 directly correlated to the static frictional force?

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

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

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

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

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

Local machine zone

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.”

Physics 1a Reading Assignments

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

Best of the Web Today's Links Web Gallery Product News Microsoft Office for Macintosh Products for P1a

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 directly correlated to the static frictional force?

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

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

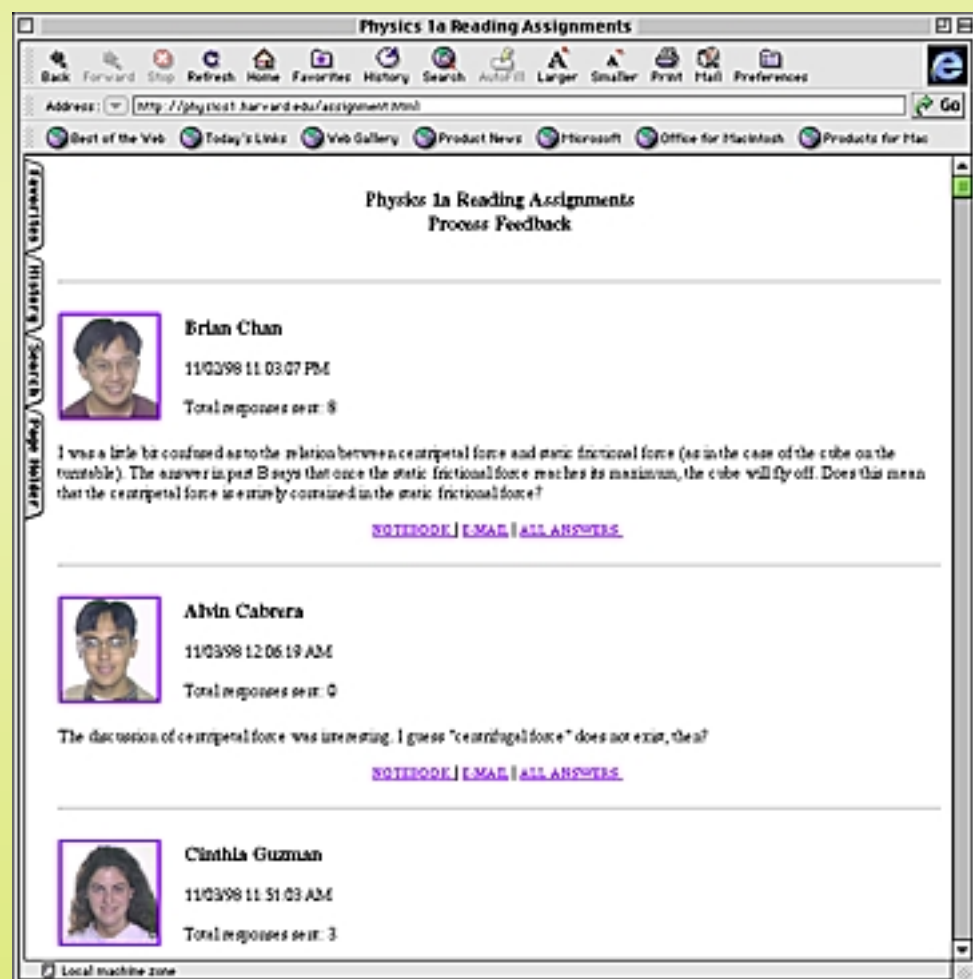
The direction of centripetal force was interesting. I guess "centrifugal force" does not exist, then?

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

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

Local machine zone

Just-in-time teaching



Physics 1a Reading Assignments
Process Feedback

Brian Chan
11/03/98 11:03:07 PM
Total responses so far: 8

I was a little bit confused as to the relation between a 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 so far: 0

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

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

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

Local machine zone

Just-in-time teaching

Benefits:

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

The screenshot shows a web browser window titled "Physics 1a Reading Assignments". The address bar shows the URL "http://physics1a.harvard.edu/assignments.html". The page content is titled "Physics 1a Reading Assignments Process Feedback". It displays a list of student responses to a question. The question text is partially visible: "I am a bit confused as to the relationship between centripetal force and tangential force (as in the case of the cube on the turntable). If the turntable is rotating at a constant angular velocity, the cube will fly off. Does this mean...".

Student Name	Response Time	Total Responses
[Photo]	11/03/98 11:03:07 PM	9
Alvin Cabrera	11/03/98 12:06:19 AM	0
Cynthia Guzman	11/03/98 11:51:03 AM	3

Navigation links: [NOTICE](#) | [EMAIL](#) | [ALL ANSWERS](#)

Personal response system

- keep students involved
- probe and address difficulties





Personal response system



Personal response system

1. aim tip at
nearest receiver

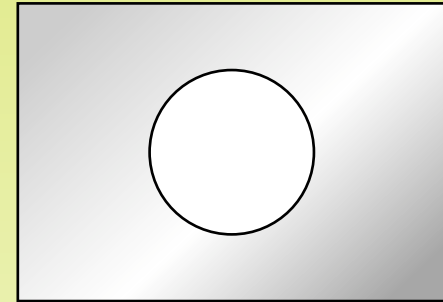


2. press button
corresponding
to answer

3. watch for ID on screen

Personal response system

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

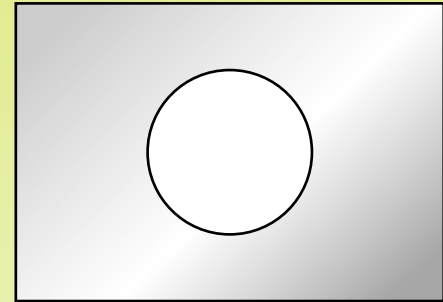


Personal response system

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

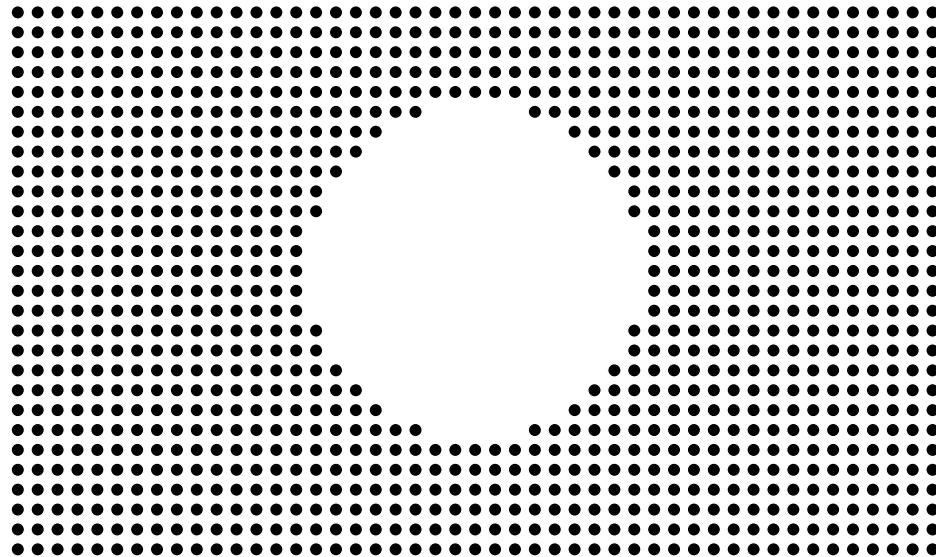
When the plate is heated so it uniformly expands, the diameter of the hole

1. increases
2. stays the same
3. decreases



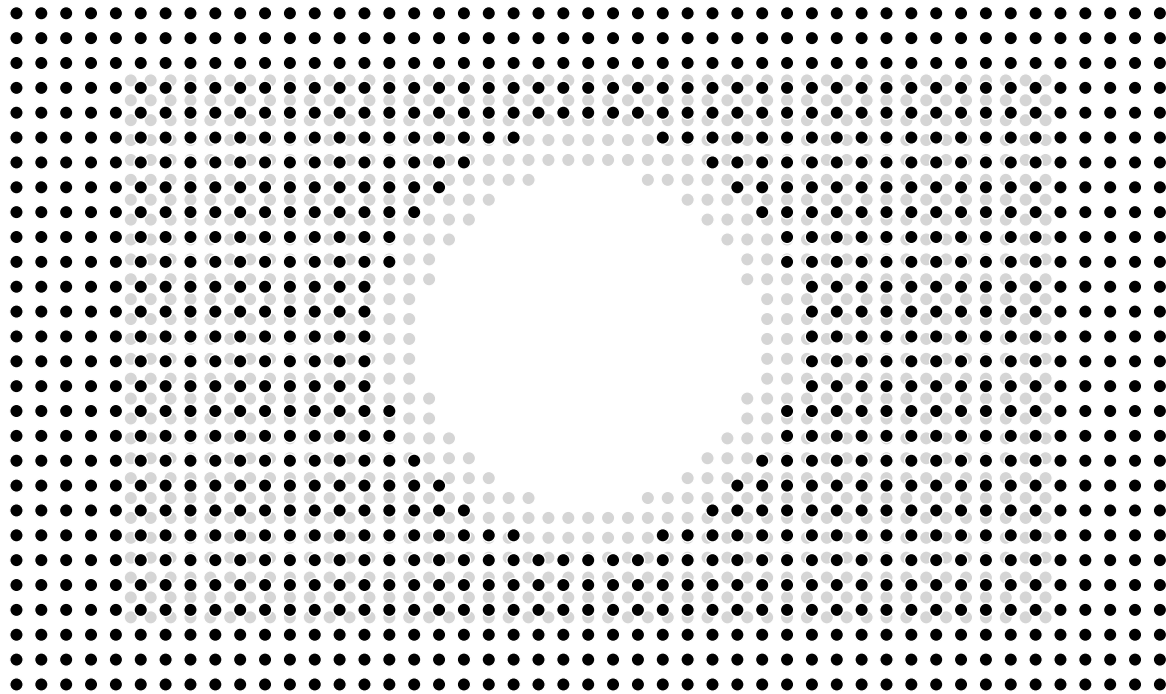
Personal response system

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>