



Multiple Technologies to Address Multiple Instructional Needs



Overview

- What are the problems ?
- What is the best way to respond ?
- How did we get into this situation ?
- An “outside the (black) box” solution

What is the problem ?



Students don't learn as much as we'd like.

What is the problem ?

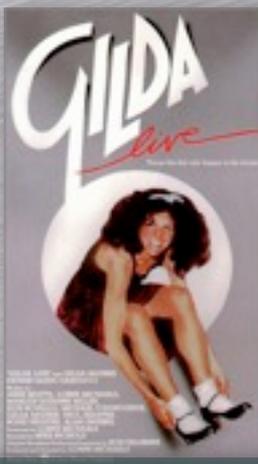
Sorry, video not available

Search YouTube for "Five Minute University"

"The 5-Minute University"

Don Novello as Father Guido Sarducci

from Gilda Live (1980)



Students don't learn as much as we'd like.

What is the problem ?

**Education is one of the few things
a person is willing to pay for
and not get.**



William Lowe Bryan

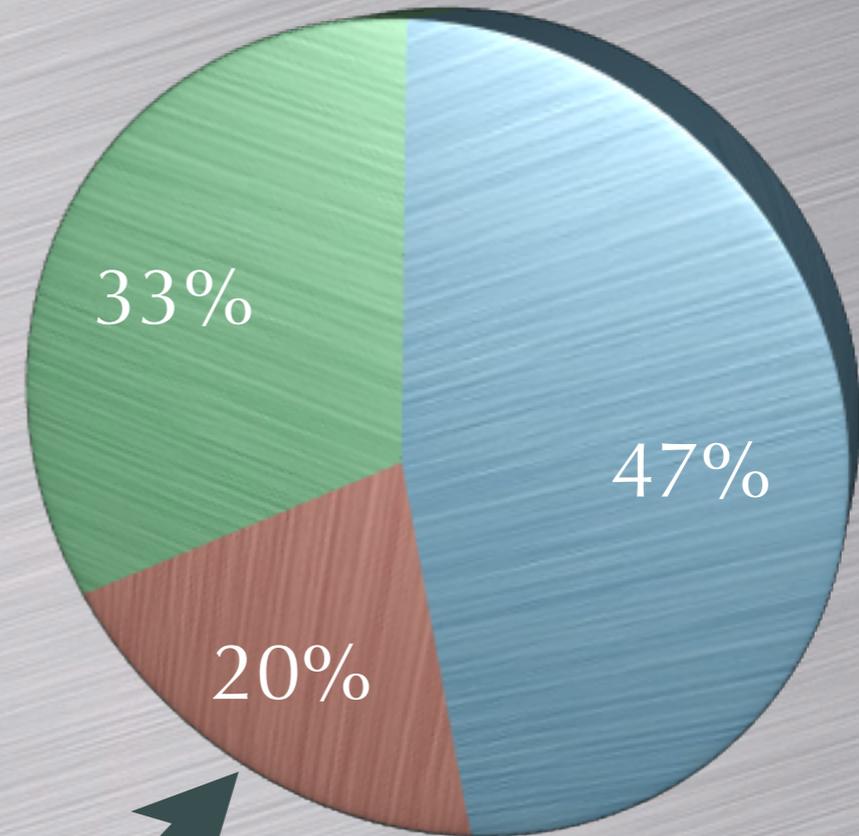
Students don't enjoy it as much as we'd like.

What is the problem ?

New demographics

1972: 47% of all high school graduates immediately enrolled in college.

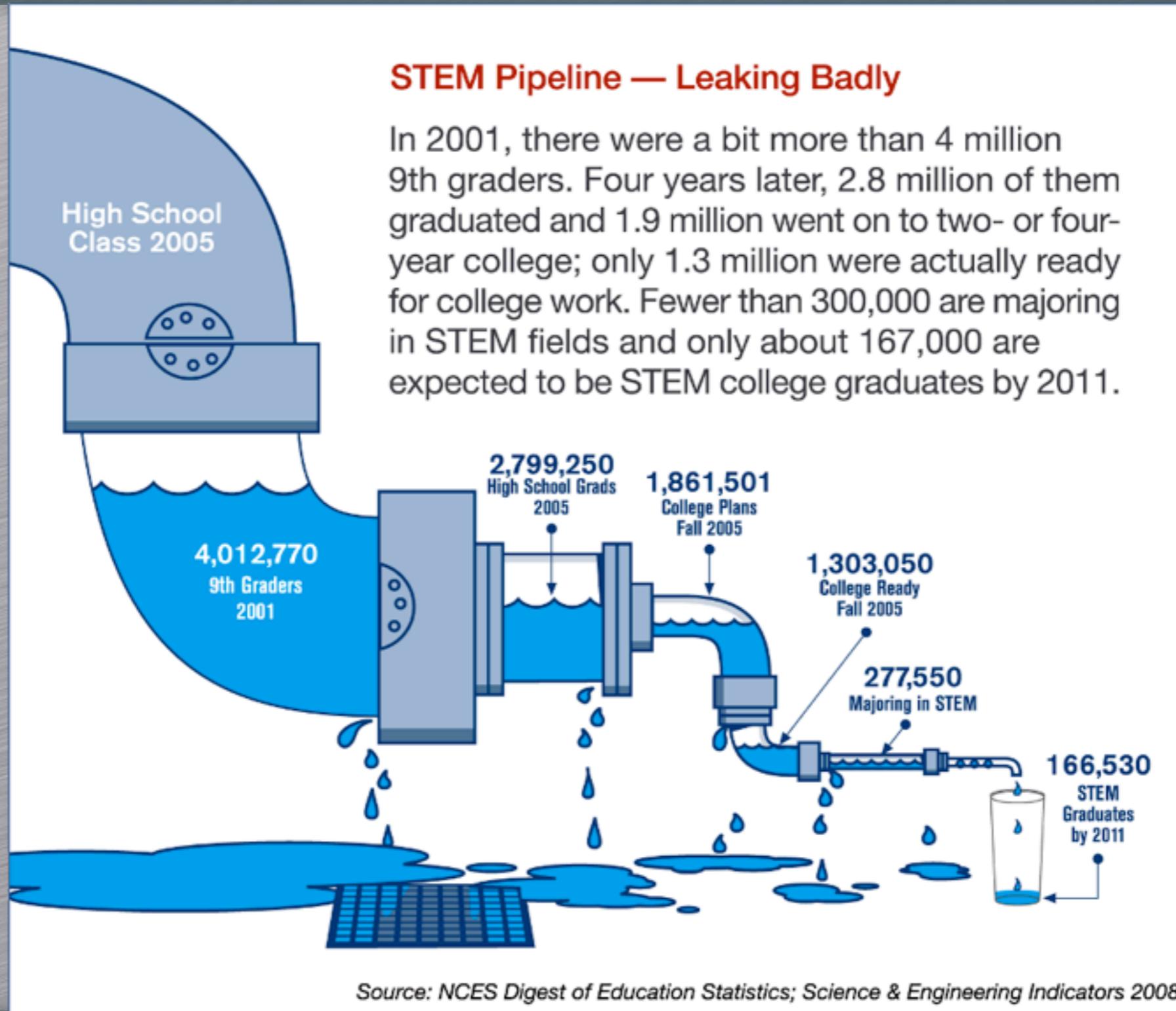
2007: **67%** (2 M of 3 M)
...and it is still rising.



What do we do with these folks?

Students are more diverse than we'd like.

What is the problem ?



...and they don't make it through the system.

What is the problem ?



Kids these days...

75% (4 and under) use computers

27% (6 and under) use computers daily

**26% (ages 8-18) use more than
2 media sources simultaneously**

Kaiser Family Foundation, 2003 & 2005 and NCES 2003

Students are digital natives. We aren't.

What is the problem ?

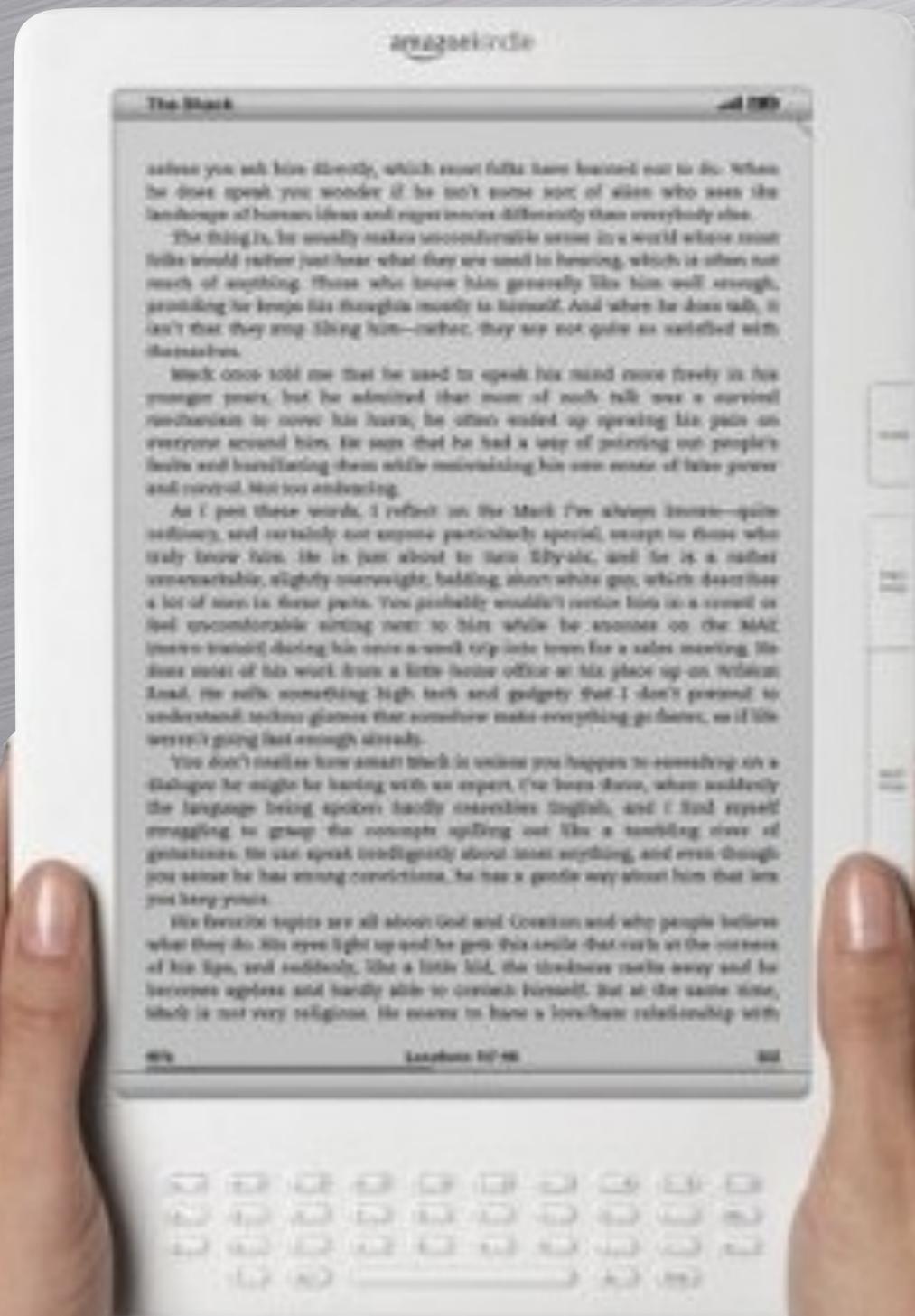
Today's College Grads

Television	>20,000 hrs
Video Games	>10,000 hrs
Reading	< 5,000 hrs

Mark Prensky, (2001). *Digital natives, digital immigrants*

Students are digital natives. We aren't.

What is the problem ?



**In June, Amazon's
e-books outsold
paper by nearly a
factor of two**

Students are digital natives. We aren't.

What is the problem ?

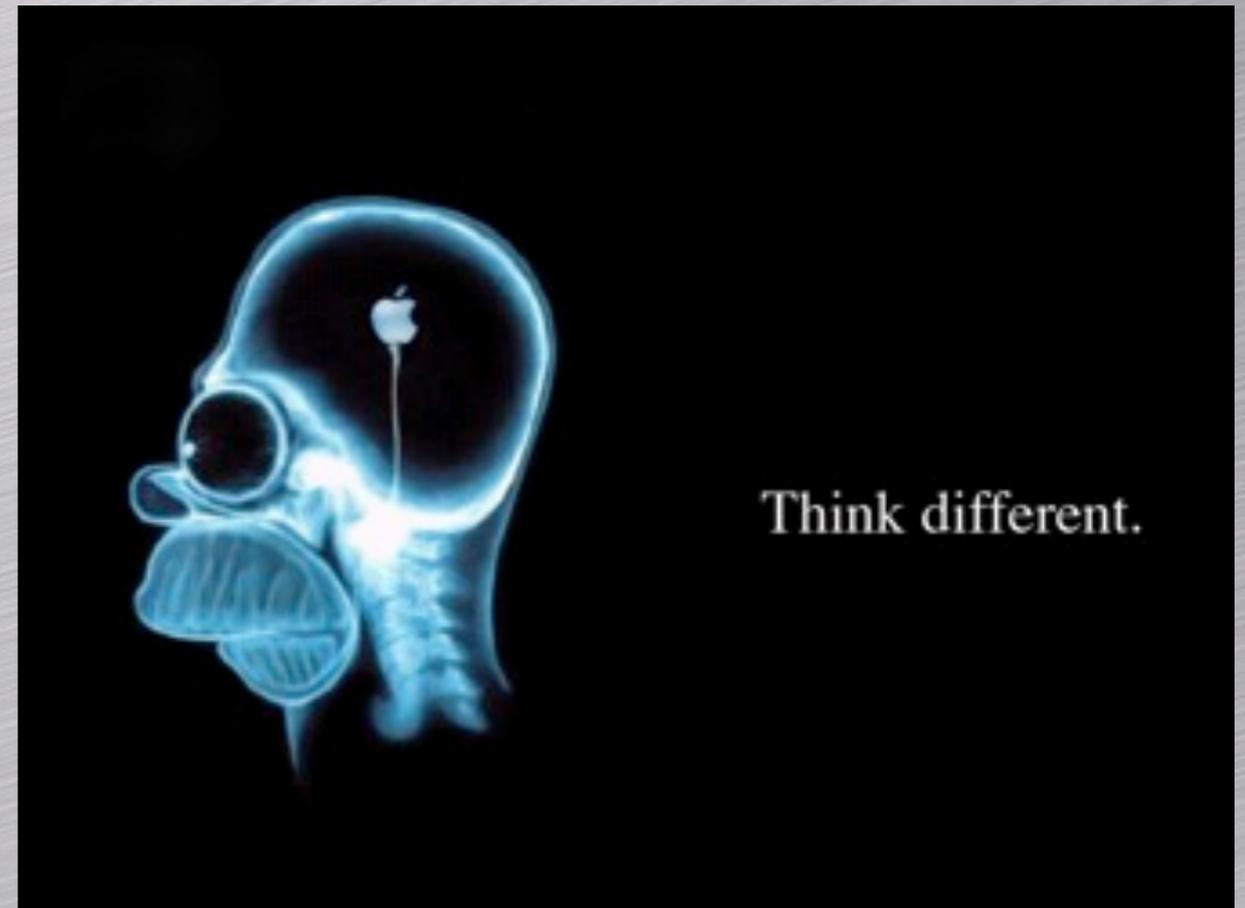


They've been using Google since they first learned to read

Students are digital natives. We aren't.

What is the problem ?

They think
differently about
technology

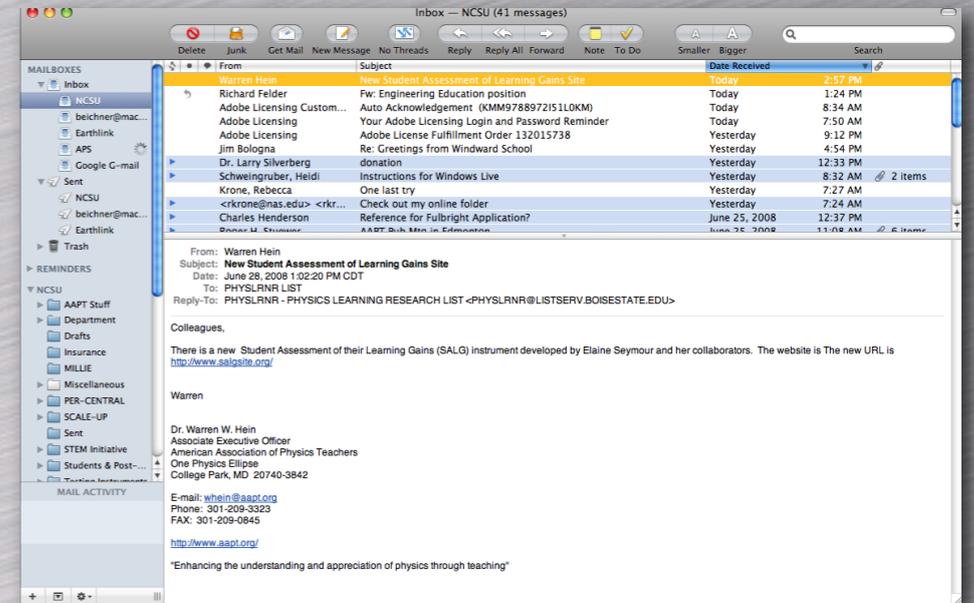


Think different.

Students are digital natives. We aren't.

What is the problem ?

Do you do most of your electronic communication through e-mail...



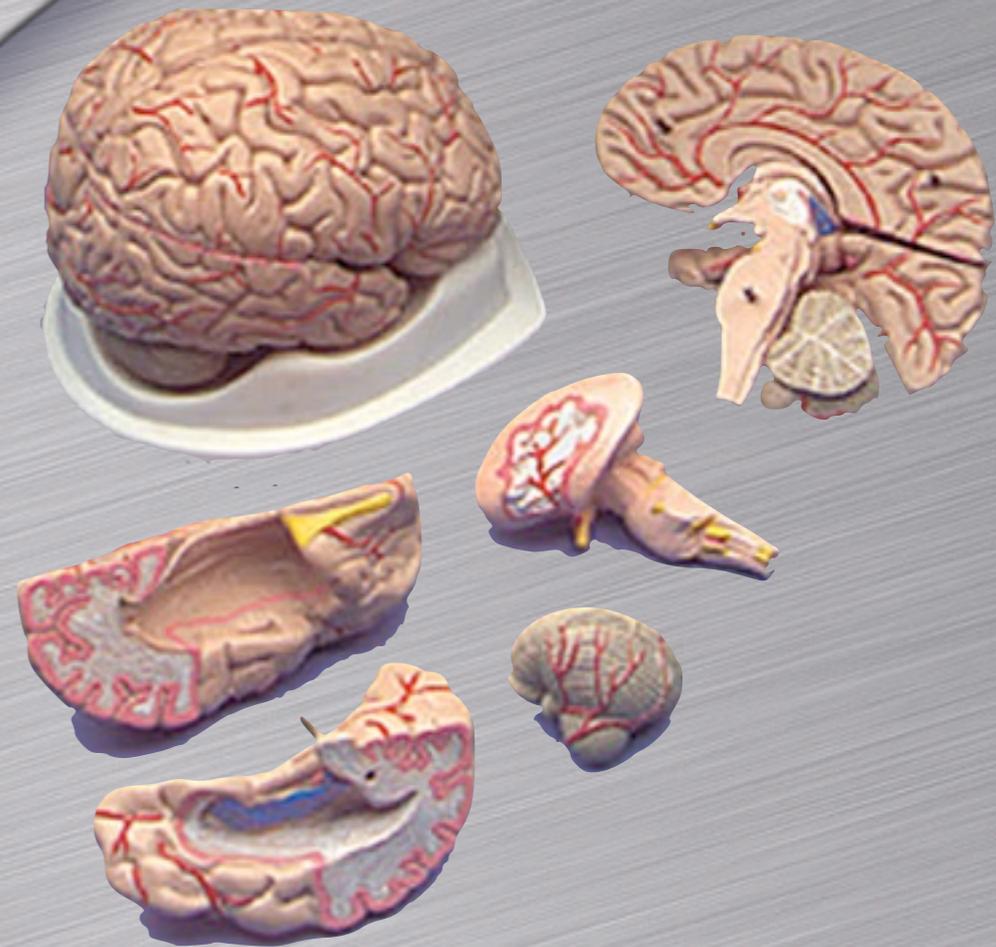
...or via texting, IM and FaceBook ?

Students are digital natives. We aren't.

What is the problem ?

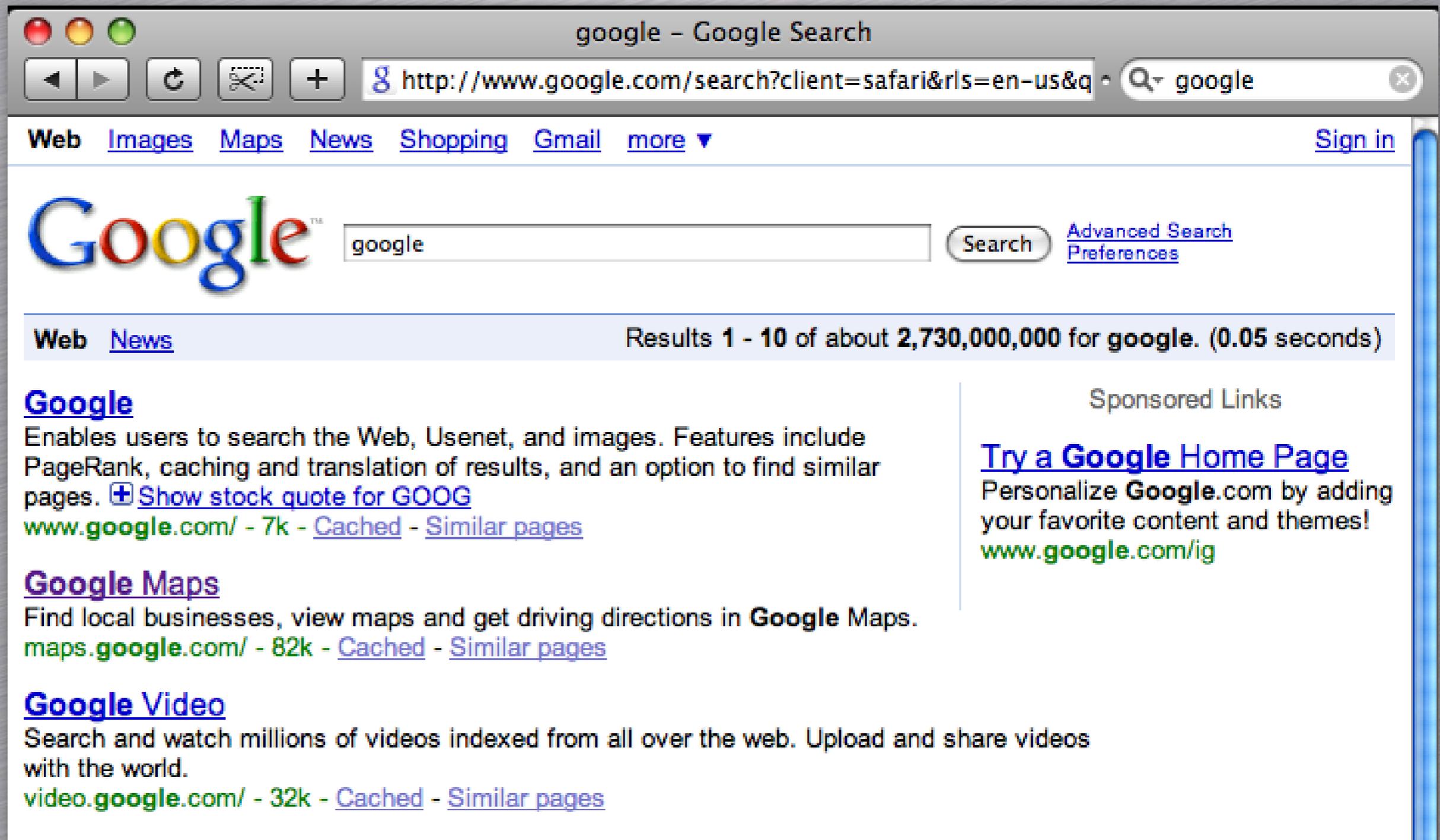
**The brain is
plastic !**

**Hebb's Rule: Neurons that
fire together, wire together.**



Students are digital natives. We aren't.

What is the problem ?



The image shows a screenshot of a web browser window displaying a Google search result. The browser's address bar shows the URL <http://www.google.com/search?client=safari&rls=en-us&q=google>. The search bar contains the word "google". The search results show "Results 1 - 10 of about 2,730,000,000 for google. (0.05 seconds)". The first result is for "Google", with a description: "Enables users to search the Web, Usenet, and images. Features include PageRank, caching and translation of results, and an option to find similar pages." It includes a link to "Show stock quote for GOOG" and a URL www.google.com/ with "7k" results, "Cached", and "Similar pages" options. Other results include "Google Maps" and "Google Video". A "Sponsored Links" section on the right features a link to "Try a Google Home Page" with the text "Personalize Google.com by adding your favorite content and themes!" and a URL www.google.com/ig.

google - Google Search

[Web](#) [Images](#) [Maps](#) [News](#) [Shopping](#) [Gmail](#) [more](#) [Sign in](#)

Google [Advanced Search](#)
[Preferences](#)

[Web](#) [News](#) Results 1 - 10 of about 2,730,000,000 for google. (0.05 seconds)

[Google](#)
Enables users to search the Web, Usenet, and images. Features include PageRank, caching and translation of results, and an option to find similar pages. [+](#) [Show stock quote for GOOG](#)
www.google.com/ - 7k - [Cached](#) - [Similar pages](#)

[Google Maps](#)
Find local businesses, view maps and get driving directions in **Google Maps**.
maps.google.com/ - 82k - [Cached](#) - [Similar pages](#)

[Google Video](#)
Search and watch millions of videos indexed from all over the web. Upload and share videos with the world.
video.google.com/ - 32k - [Cached](#) - [Similar pages](#)

Sponsored Links

[Try a Google Home Page](#)
Personalize **Google.com** by adding your favorite content and themes!
www.google.com/ig

Information scarcity to abundance

What is the problem ?



... abundance

What is the problem ?

A student voice: "...we have the world at our fingertips — and the world has been at our fingertips for our entire lives.

I think this access to information seriously undermines this generation's view of authority, especially traditional scholastic authority."

*Tim Clydesdale , "Wake Up and Smell the New Epistemology,"
January 23, 2009 Chronicle of Higher Education*

Information access changes everything

What is the problem ?

400,000 Students
Accredited
\$1B Venture Capital

The screenshot shows the University of Phoenix website interface. At the top, there is a navigation bar with links for 'Colleges & Divisions', 'Online & Campus Programs', 'Tuition & Financial Options', 'Admissions', 'Campus Locations', 'Community', and 'About Us'. A main banner features a woman and the text 'I Am A PHOENIX' with a sub-headline: 'University of Phoenix students are hard working wives, mothers, fathers, grandparents, executives, soldiers, nurses and teachers all striving to better themselves. Click below to see a few of their inspiring stories.' Below the banner, there are three main sections: 'Degree Programs' (From associate's to doctoral, our degree programs are designed to provide working students with knowledge they can use...), 'Campus Locations' (Nearly 200 locations across the United States, as well as internationally...), and 'Financial Information' (University of Phoenix is committed to accessible education, even during the national financial crisis...). To the right, there is a 'GET STARTED TODAY!' section with a 'Learn more' button, and a 'Request Additional Information' button. Below that is a 'NEWS' section with a 'RSS FEED' and several news items, including 'Valley Charities Receive \$22K Thanks to Apollo Group Employee Donations' and 'University of Phoenix St. Louis Campuses Give Back This Holiday Season'. At the bottom, there is a footer with copyright information: '©2006-2008 University of Phoenix, Inc. All rights reserved. Users of this site agree to the Terms & Conditions and Privacy Policy.'

Students have options.

What is the problem ?



More than **20%** of all current students are taking an online course right now.

Students have options...



What is the problem ?



Students have options. And this isn't the best one.

How can we respond ?

**When was the last time you
watched a lecture on TV ?**



Given a choice...

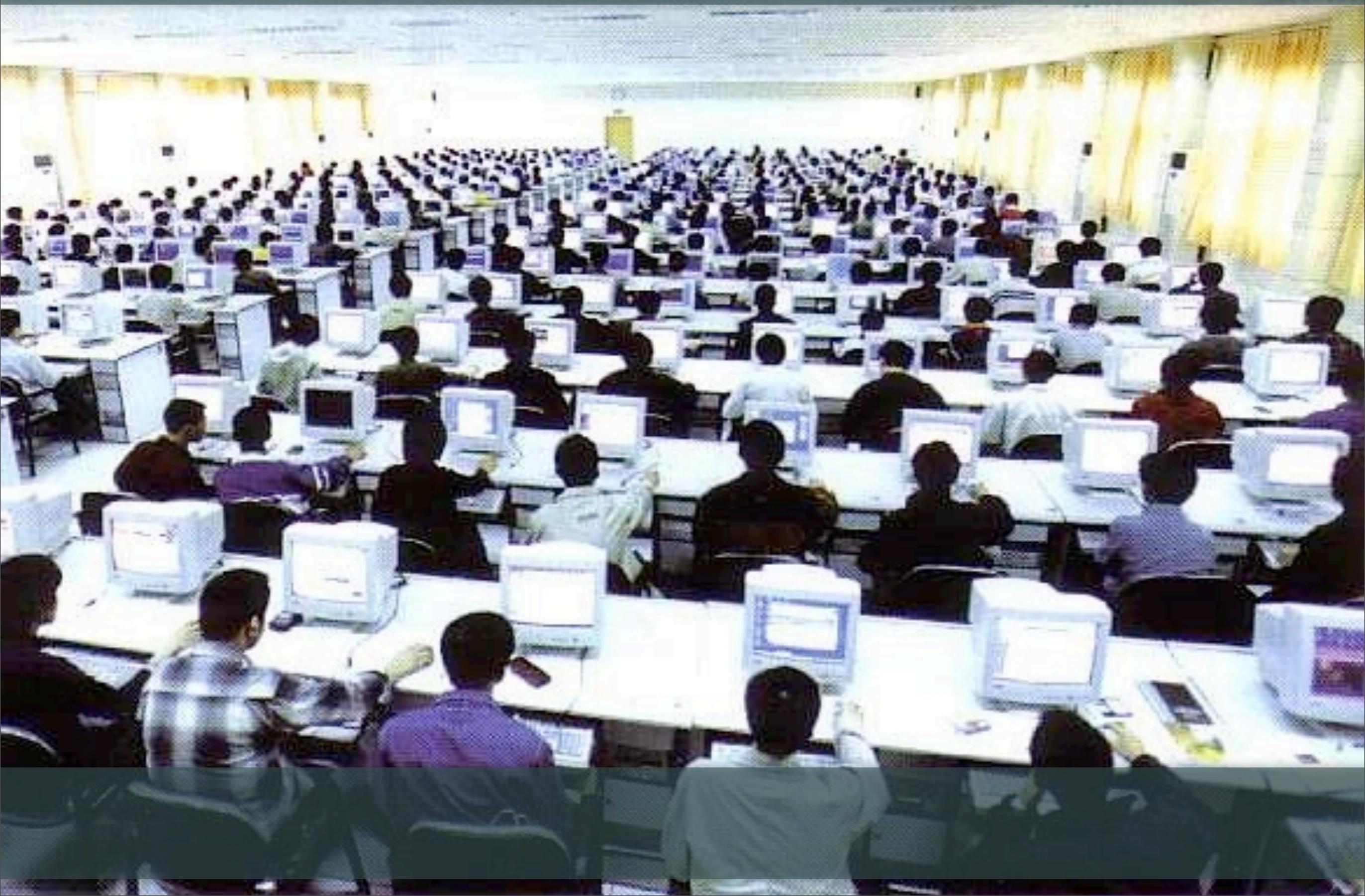
Overview

- What are the problems ?
- What is the best way to respond ?
- How did we get into this situation ?
- An “outside the (black) box solution

What should we NOT do ?



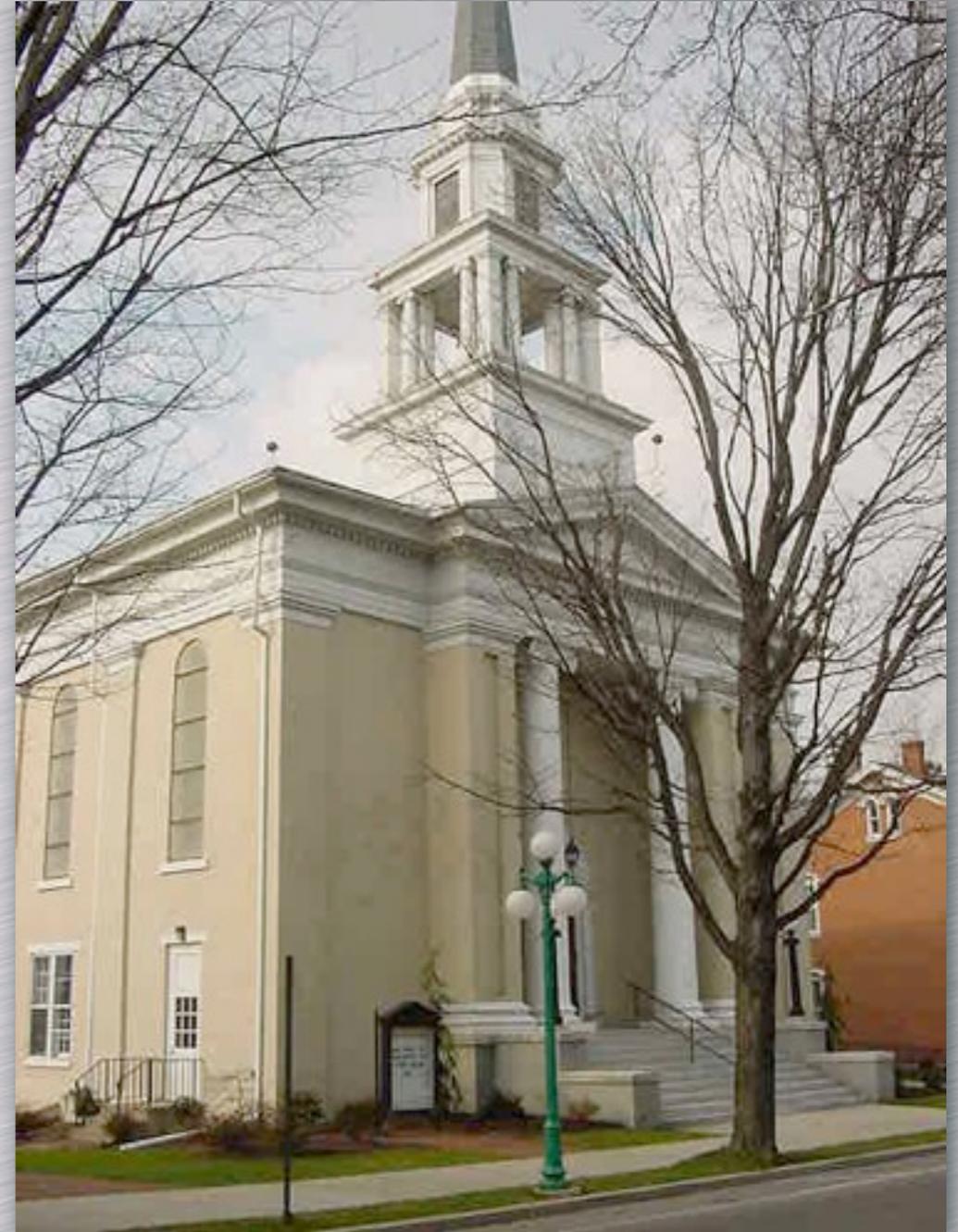
What should we NOT do ?



How can we respond ?



≠



Recognize that information ≠ knowledge

How can we respond ?

**CRITICAL
THINKING...**

But how often do we explicitly teach critical thinking (and not assume students would pick it up automatically by **osmosis** ?)



Actually teach critical thinking

How can we respond ?

The *Journal of Higher Education* has called Alexander Astin's book *Four Critical Years* the most frequently cited work in the higher education literature.

In *What Matters in College?* Astin presents a completely new and expanded study of how students change and develop in college — and reveals how colleges can enhance that development. Based on a study of more than 20,000 students, 25,000 faculty members, and 200 institutions, the book shows how college programs (faculty, student peer groups, and other variables) affect students' college experiences, and how these factors can shape students' personalities and behavior; values and beliefs; and academic, cognitive, and career development.

This paperback edition includes a new introduction that revisits the findings of the original work in light of the author's most recent investigations on college students.

The Author

Alexander W. Astin is professor of higher education and director of the Higher Education Research Institute at the University of California, Los Angeles. He is also founding director of the Cooperative Institutional Research Program and author of more than one hundred articles and seventeen books, including *Assessment for Excellence* (1991) and *Achieving Educational Excellence* (Jossey-Bass, 1992). In 1992, he received the American Association for Counseling and Development's Extended Research Award.

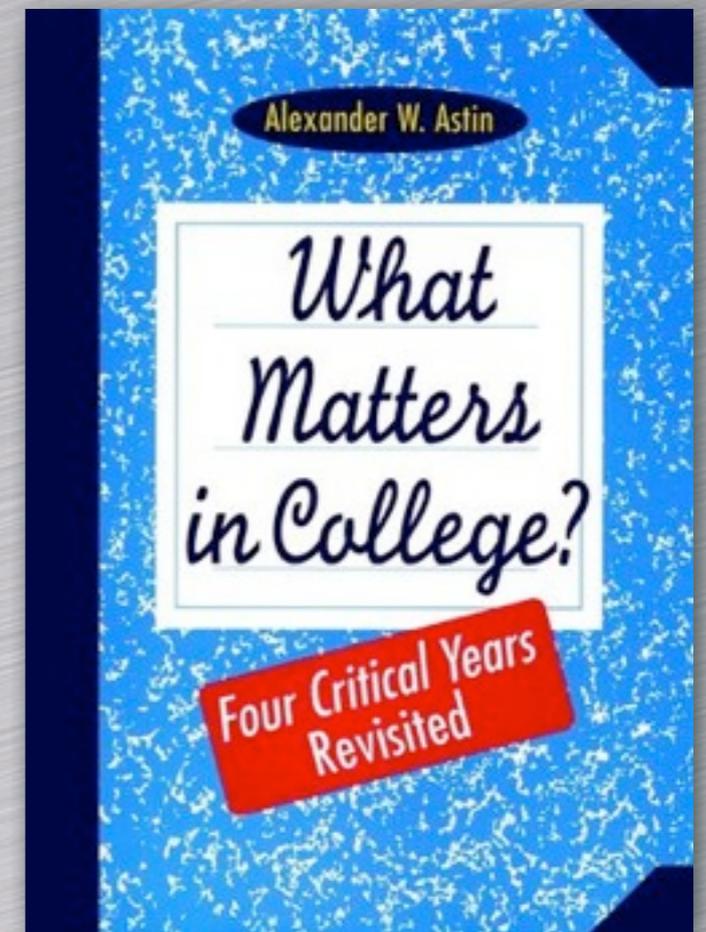
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EDUCATION

ISBN 0-7879-0838-X



90000



Quality of RELATIONSHIPS
(faculty to student
and
student to student)

is
What Matters

Play our trump card

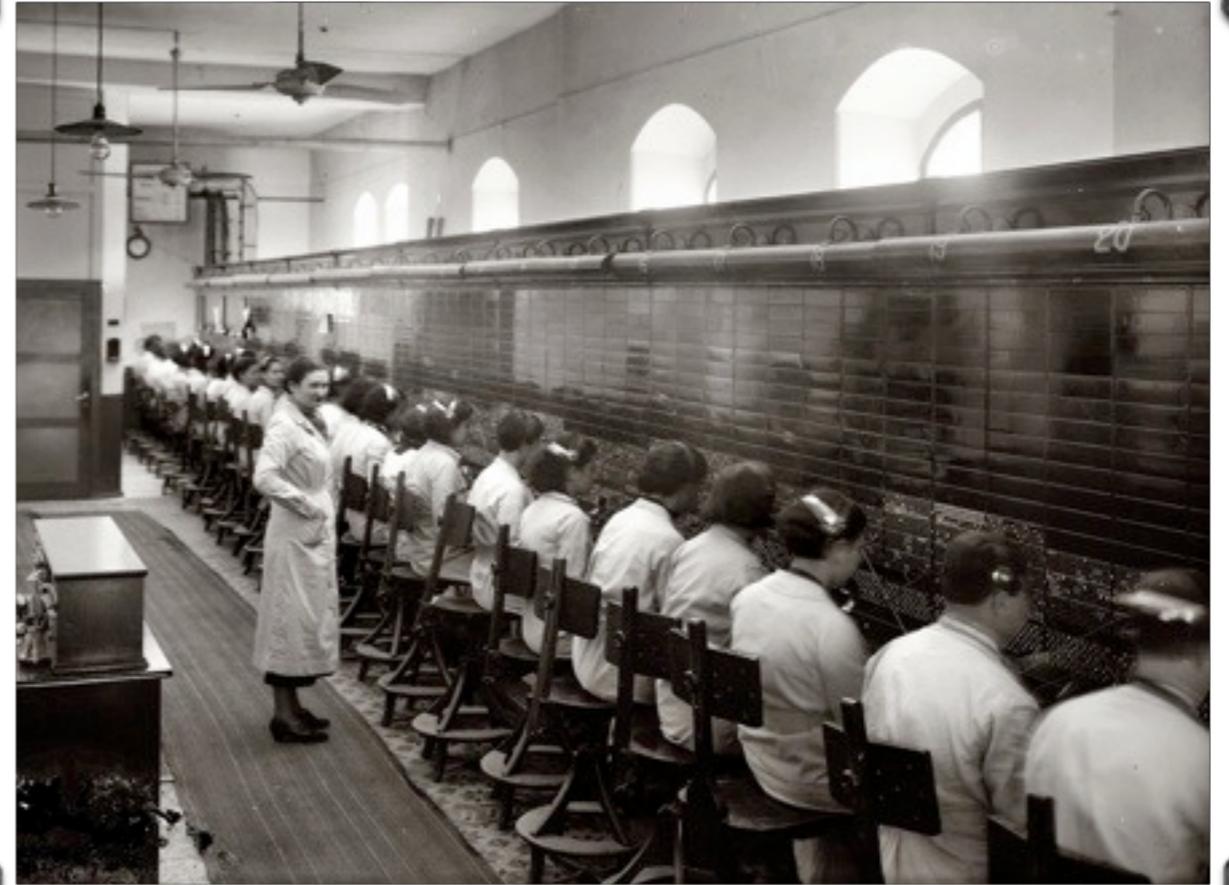
How can we respond ?

What do students prefer ?



Play our trump card

How can we respond ?



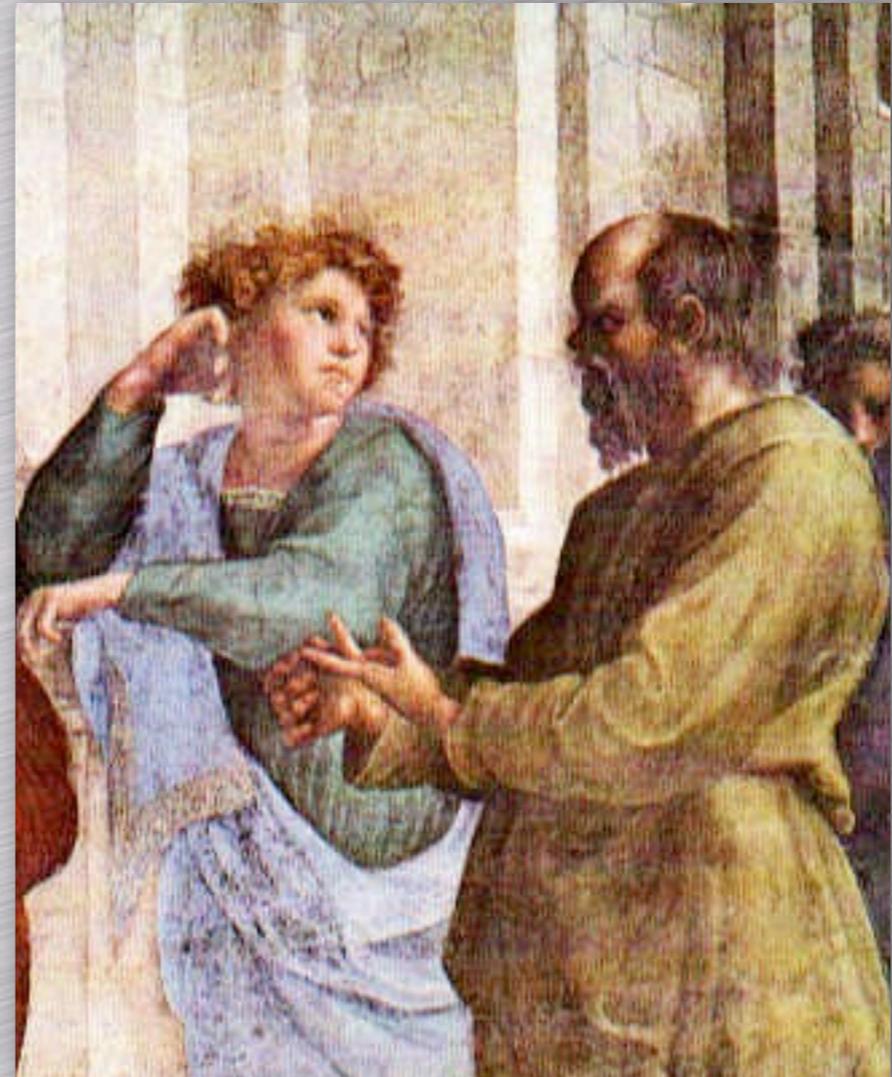
Network Routers

Computers

Don't waste peoples' talents

How can we respond ?

If you can be replaced by an iPod, you will be !



Don't waste peoples' talents

Overview

- What are the problems ?
- What is the best way to respond ?
- **How did we get into this situation ?**
- An “outside the (black) box solution

What happened ?

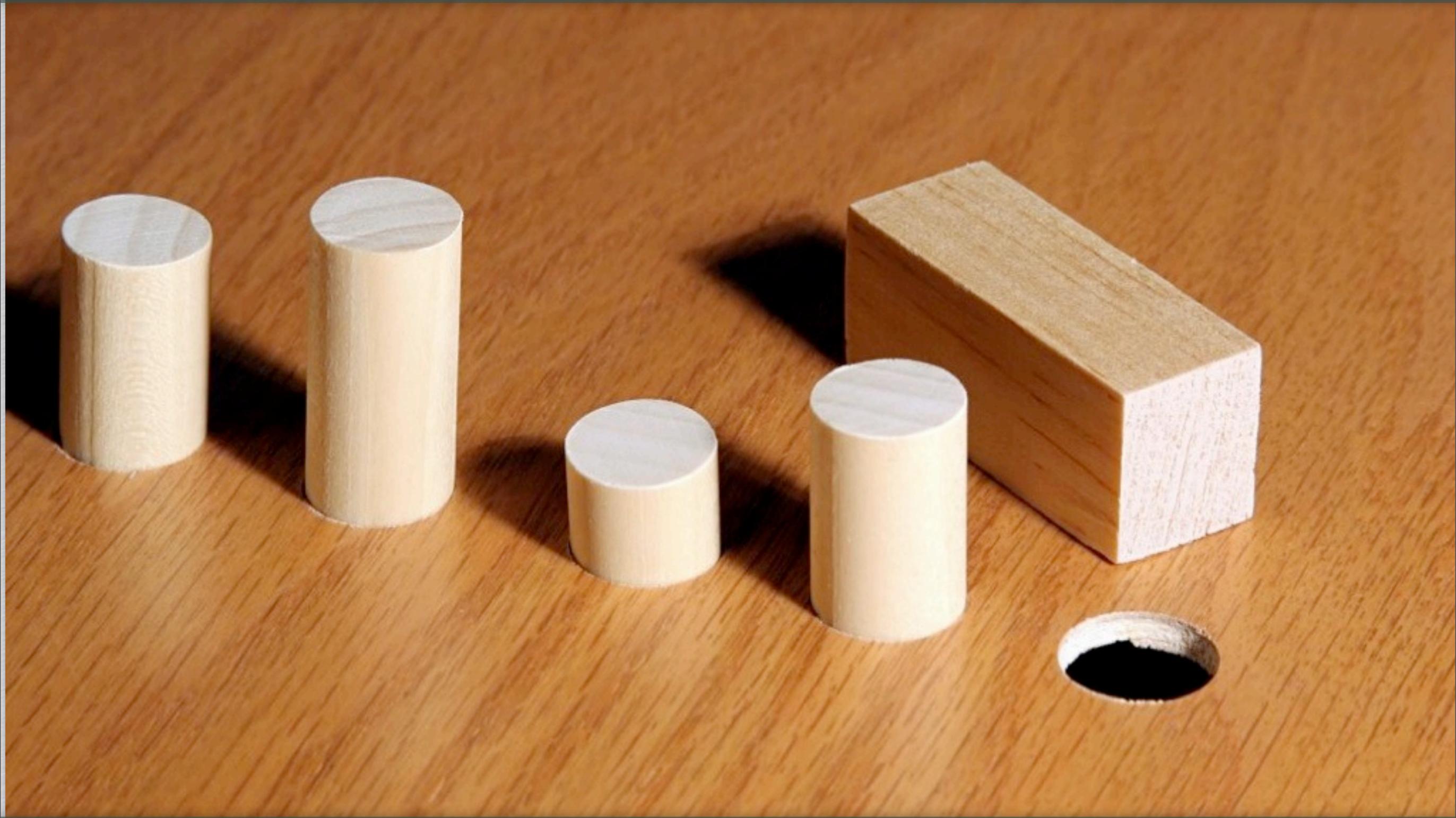


θέατρον

auditorium

Greeks invented viewing/listening places

What happened ?

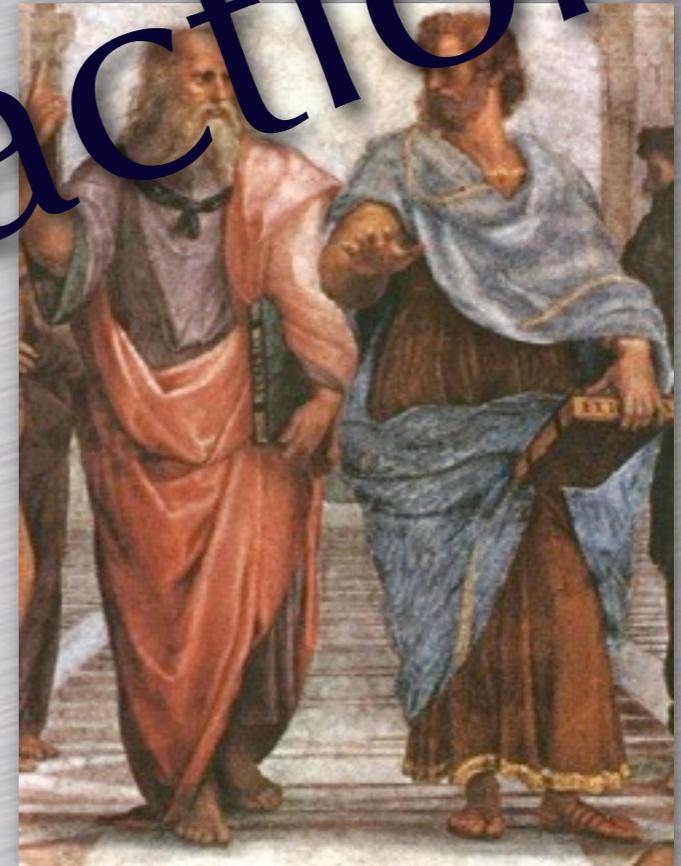


Auditoriums weren't designed for education

What happened ?

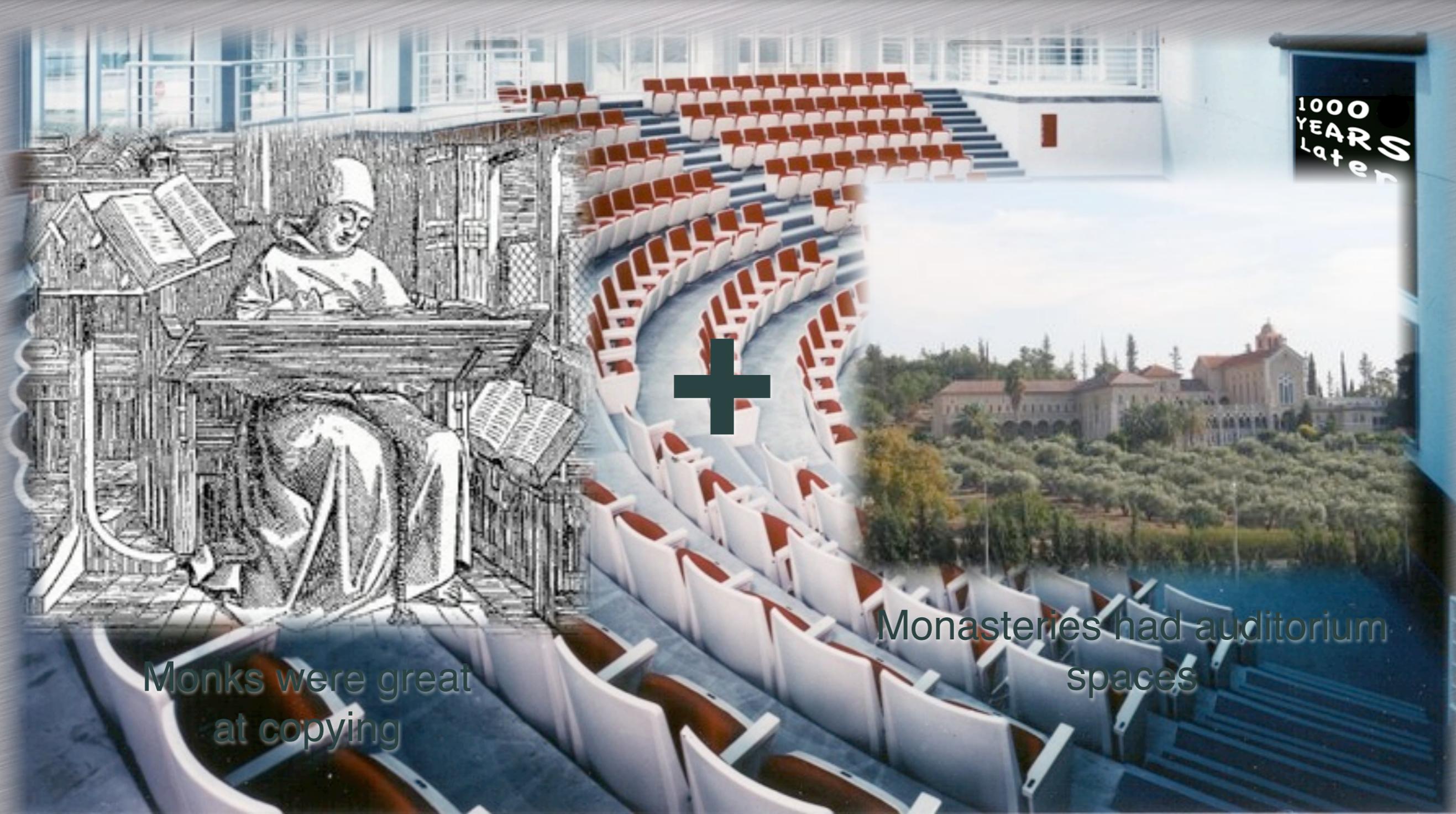


"What Matters" is
Social Interaction



Greeks did education differently

How did we get here ?



Monks were great
at copying

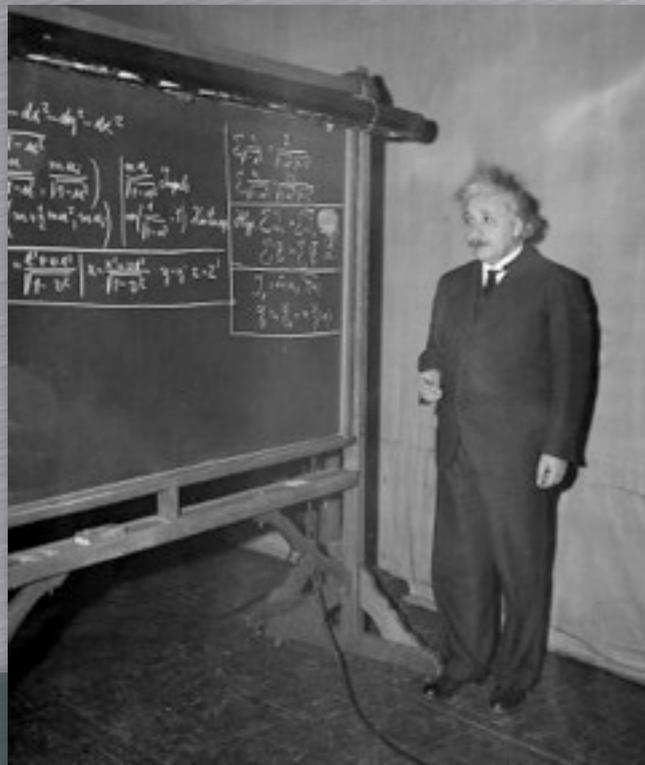
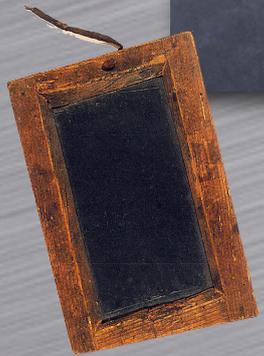
Monasteries had auditorium
spaces

Auditorium turned into Lecture Hall

How did we get here ?

Aa Bb Cc Dd Ee Ff Gg

🍏 + 🍏 = ?



Blackboard

How did we get here ?



Various Projectors

How did we get here ?



Broadcast and recorded television

How did we get here ?

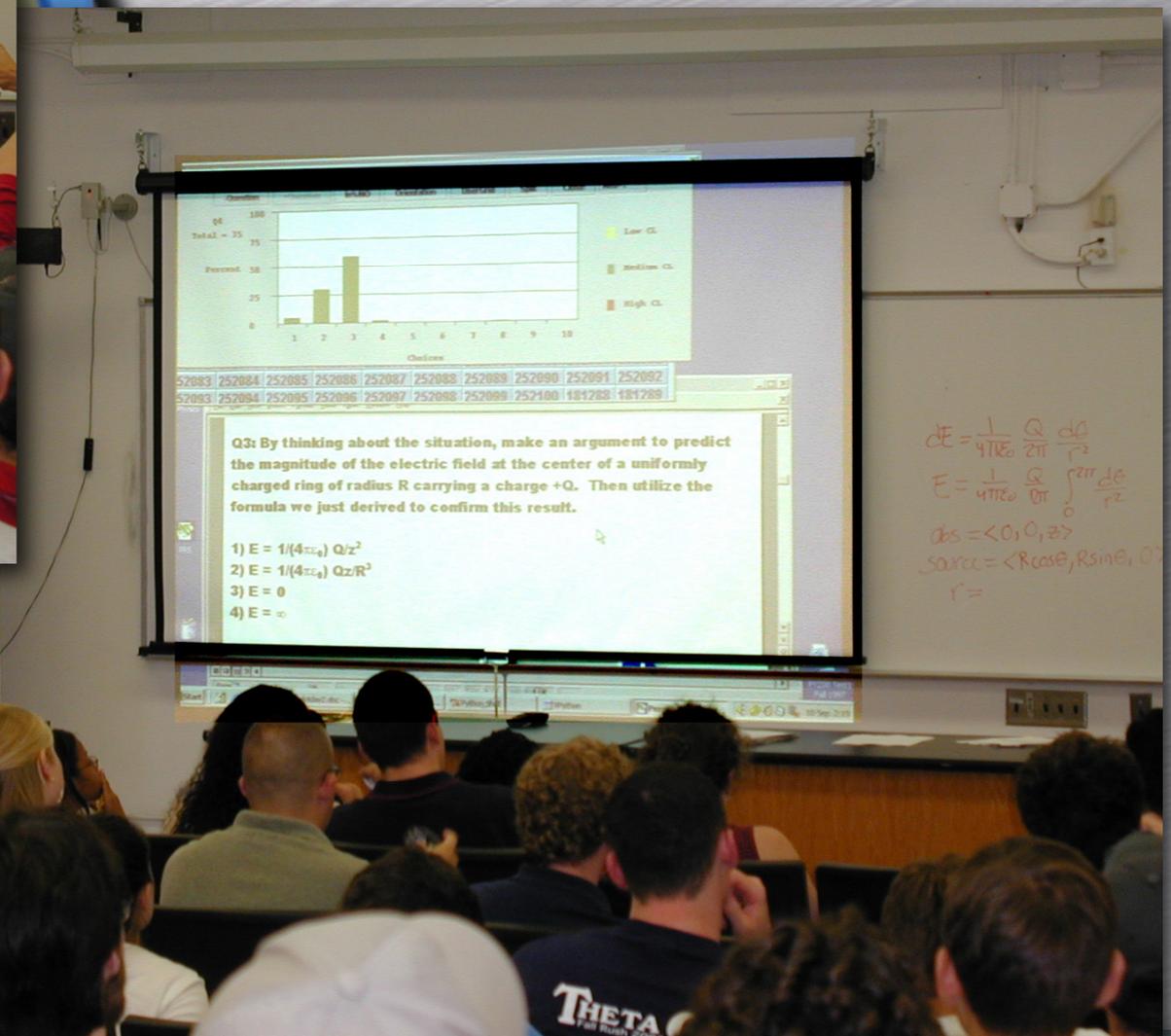


Microcomputers

How did we get here ?



$$dE = \frac{1}{4\pi\epsilon_0} \frac{Q}{2\pi} \frac{dq}{r^2}$$
$$E = \frac{1}{4\pi\epsilon_0} \frac{Q}{2\pi} \int_0^{2\pi} \frac{dq}{r^2}$$
$$ds = \langle 0, 0, z \rangle$$
$$s \times r = \langle R\cos\theta, R\sin\theta, 0 \rangle$$
$$r =$$



Student Response Systems "Clickers"

How did we get here ?



MIT OpenCourseWare, Intro to Bioengineering, BE.010J
Prof. Douglas Lauffenburger, Head of Biological Engineering

Personal Electronics

How did we get here ?

Teachers have been concerned about student use of technology in the classroom for a long time.

...if one sees written treatises...these are not...the things of most worth...

Plato, Seventh Letter, 353 BCE

**Adapting to new
technology is
difficult**



Sorry, video not available

Search YouTube for “Monastery Helpdesk”

Overview

- What are the problems ?
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Technology

Technology (tek'näləjē) noun - the application of scientific knowledge for practical purposes...a designed solution to a particular problem



SCALE-UP

Student-Centered Active Learning Environment for Undergraduate Programs



Classroom environment was intentionally re-designed to facilitate interactions between students and with the instructor

SCALE-UP

7 feet

a

WebAssign.ncsu

Week 10, P1, MWF-208

Course: PY 208, section 002, 2003

Instructor: Beichner, Robert J

Week 10, P1, MWF-208

Due: Monday, March 31, 2003 07:05 AM EST

About this assignment

Chap. 33: 1,8,10 TEN (10) submissions are allowed. Answers to even-numbered questions are posted in the case outside the classroom.

1. (a) What is the speed of light in fused quartz? m/s

(b) What is the speed of light in sodium chloride? m/s

2. Suppose that you want to photograph a person who is 1.8 m tall. For what distance should the camera lens be m from the person?

3. A person whose eyes are $H = 1.64$ m above the floor, Fig. 33-44. What is the height of the floor that can be seen reflected in the mirror? cm

Figure 33-44.

Save Work without Grading

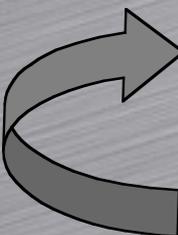
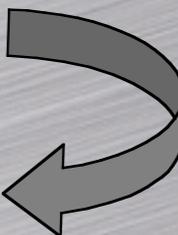
Submit for Grading

- Round Tables
 - 3 Teams of 3 per Table
 - Homework lottery
 - Pass and the instructor walks around the room, listening and asking questions
-
- alls
- s
- us
- ork,
- 8A

SCALE-UP

5 hours/week* (MW 2 hrs, F 1 hr)

10 minute lecture (Organization & Motivation)

 **Activities** (Tangibles, Ponderables, Visibles) 

Followup discussion

5 minute lecture summary

* for NC State Physics

“Typical” Classtime

SCALE-UP

How thick is one page from your textbook ?



Figure out how to read Universal Product Codes



How many extra electrons are on a piece of tape ?



Why does the definition of flux include a dot product ?



Tangibles

Simple (or complex) observations

SCALE-UP

How far does a bowling ball skid ?



What fraction of a candy bar is used in the store ?



How many electrons fit on a foil-covered ball ?



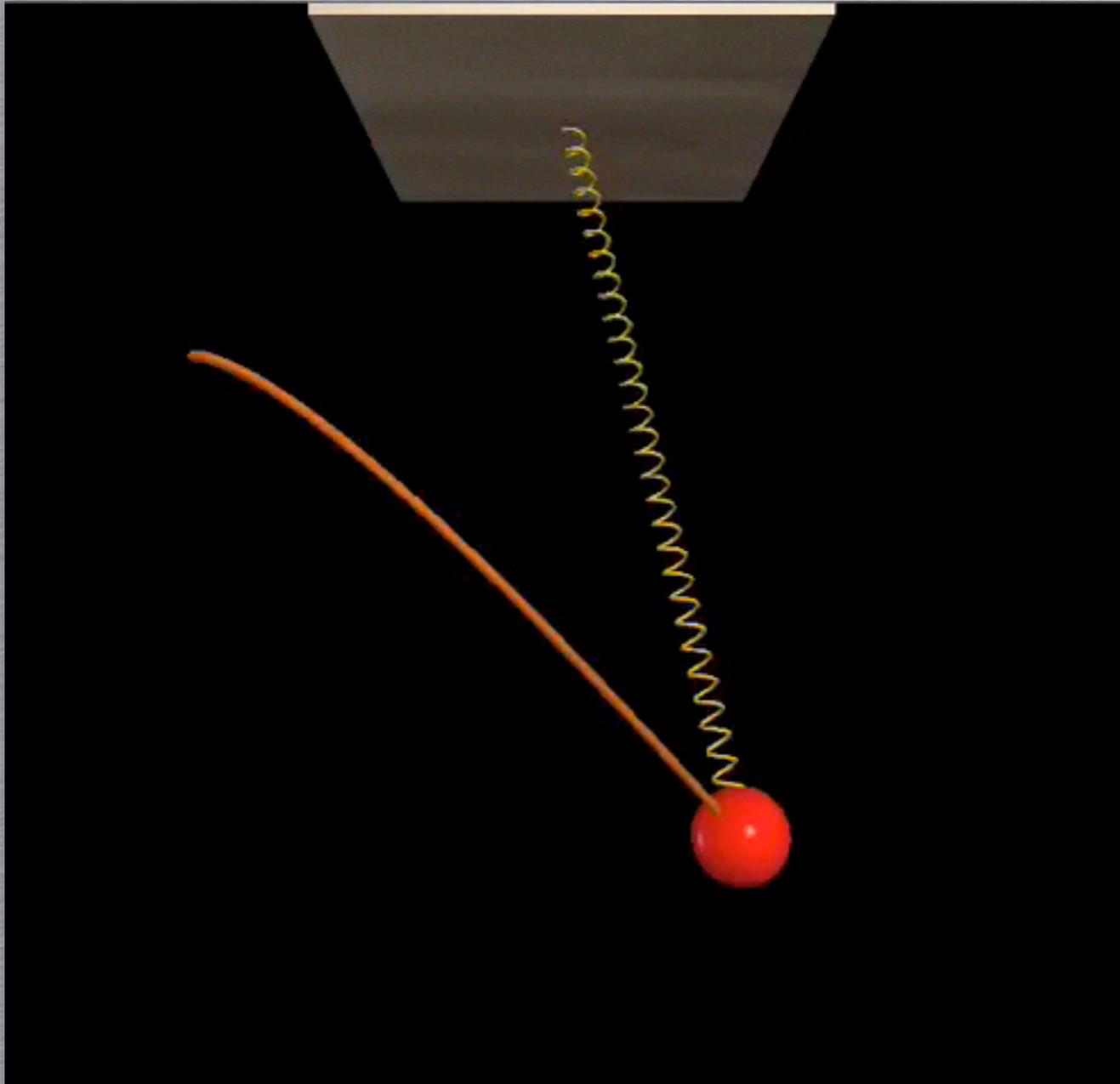
How many steps is it from NYC to LA ?



Ponderables

Ill-defined problems

SCALE-UP



```
*vertical_spring_3D.py - /Users/beichner/Desktop/M & I/For Bob/Pgms/vertical_s...
from visual import *

a=display(y=0, width=800, height=900)
##a.stereo='crosseyed'

ball=sphere(pos=(0,0,0), radius=0.03, color=color.red,
            display=a,material=materials.plastic)
ball.mass=0.020
ball.p=vector(0,0,0)
ball.trail = curve(color=color.green, radius=0.003)
ball.trail.color=(.8,.3,0)

L0=0.20
spring = helix(pos=(0,L0,0), axis=(0,-L0,0), radius=0.008,
              thickness=.003, color=(1,.7,0), coils=30)
spring.k = 0.9

h=.01
ceiling=box(pos=(0,L0+h,0), size=(1.5*L0,h,1.5*L0),
            material=materials.wood)

dt=0.01
t=0.
Fgrav = vector (0,-ball.mass*9.8,0)
a.center=(0,-L0/2.,0)

ball.pos=vector(-0.2,0,0.2)
spring.axis=ball.pos-spring.pos
ball.p = vector(.01,0,.01)

a.autoscale=0
while 1:
    if a.mouse.clicked > 0:
        break
    rate(40)
    sdir = ball.pos - spring.pos
    smag = sdir.mag - L0
    s = smag*norm(sdir)
    Fspring = -spring.k*s
    Fnet = Fspring + Fgrav
    ball.p = ball.p + Fnet*dt
    ball.pos = ball.pos + (ball.p/ball.mass)*dt
    spring.axis = ball.pos - spring.pos
    ball.trail.append(pos=ball.pos)

    t=t+dt
```

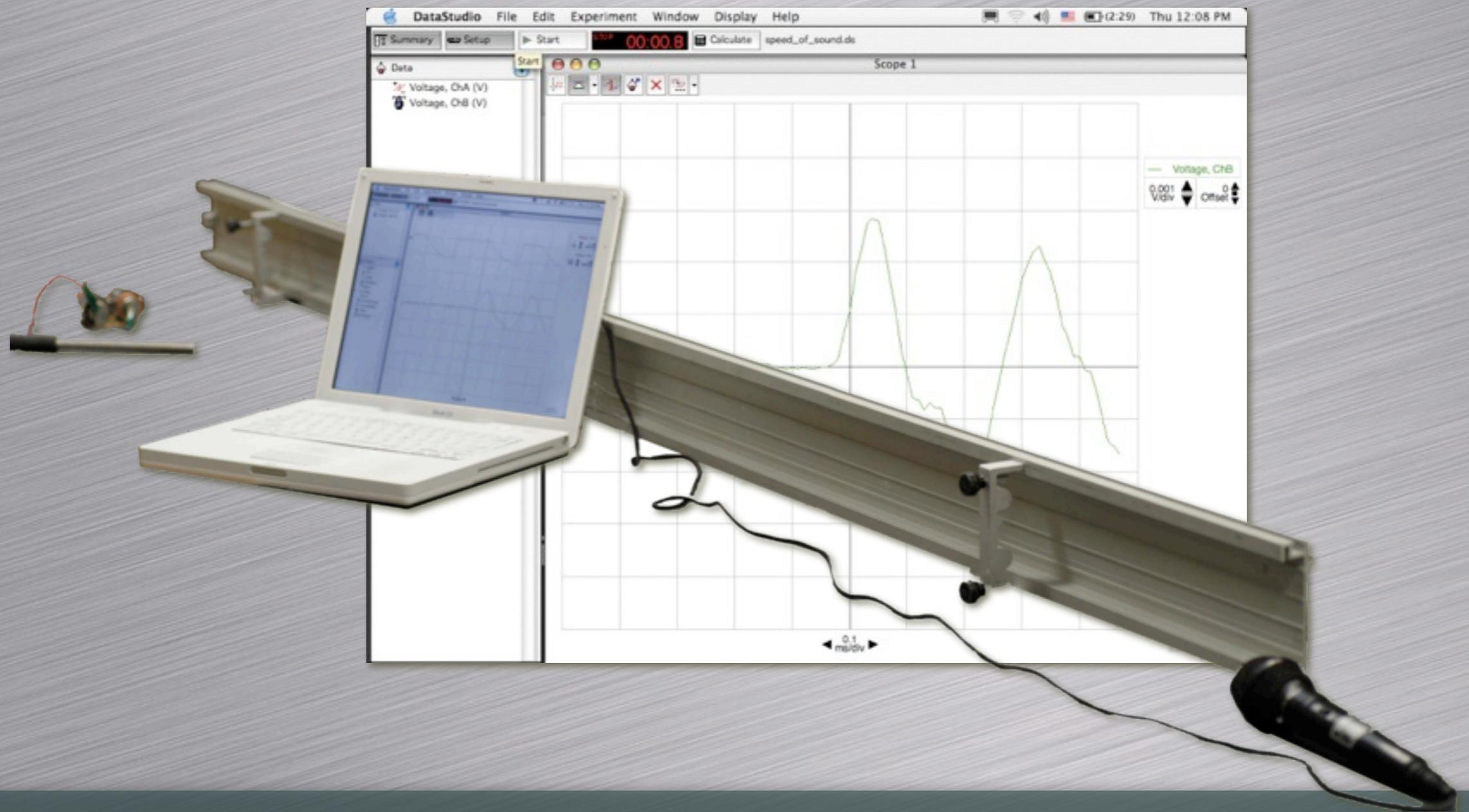
Ln: 24 Col: 0

Visibles

Student-generated models of reality

SCALE-UP

Stretch wires, measure speed of sound, predict thermal properties



Semester-Long Linkages

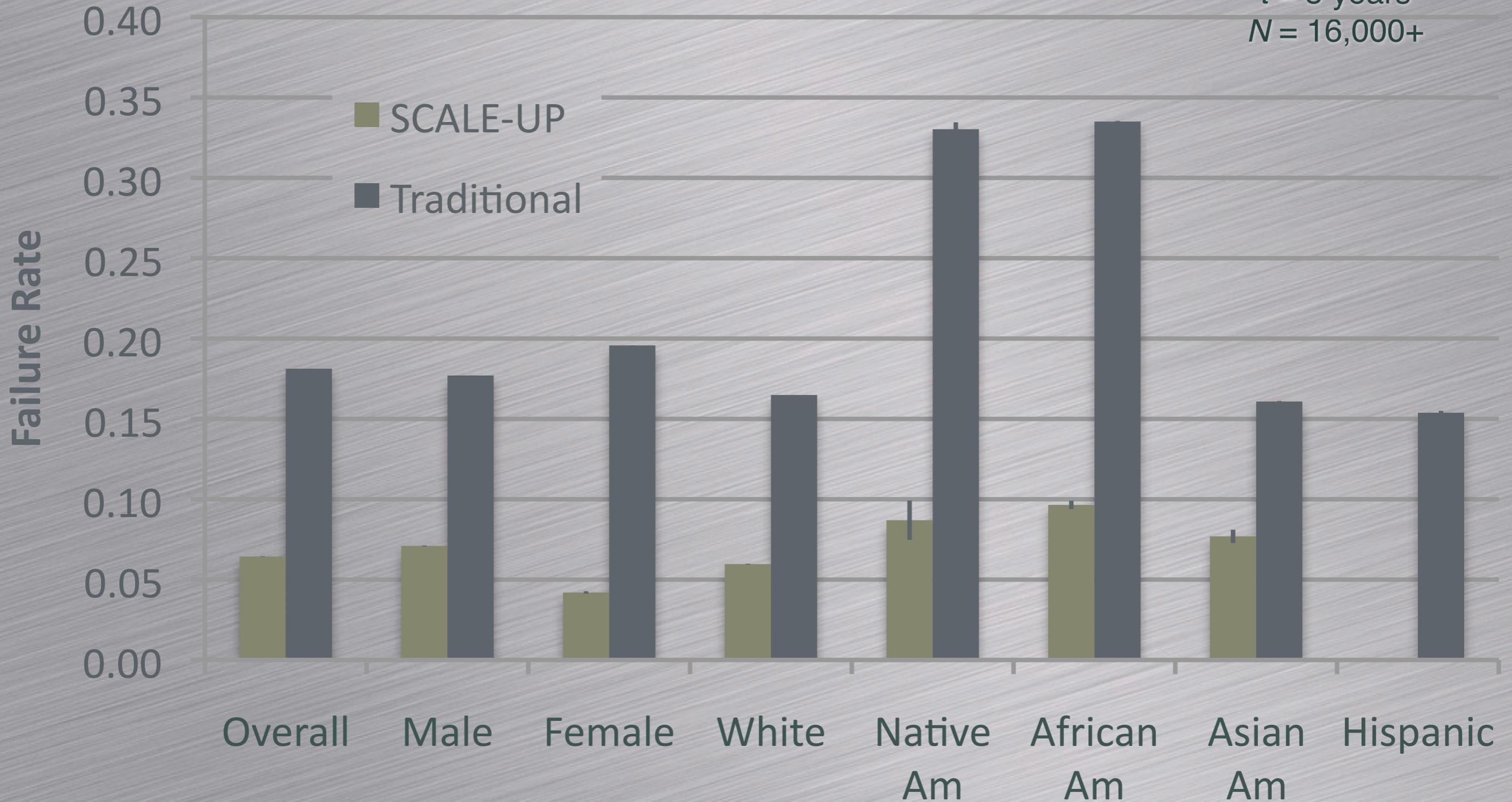
Did It Work ?

- Problem solving skills developed
- Conceptual learning increased
- Retention much higher
- Top students benefit most
- Performance in later classes enhanced
- Student attitudes better

Did It Work ?

Retention Rates

NCSU
t = 5 years
N = 16,000+



Where Are We Now ?



Wisconsin-Platteville



Minnesota



Virginia Med School

Florida Gulf Coast



UT Dallas



Where Are We Now ?





For more info...

beichner@ncsu.edu

SCALE-UP website
(<http://scaleup.ncsu.edu>)
is now a wiki.

SCALE-UP

Student-Centered Active Learning Environment for Undergraduate Programs

**How would you like to teach
(or learn) in a classroom
like this one at MIT?**

The purpose of this website is to share designs for state-of-the-art learning studios, teaching methods, and instructional materials that are based on more than a decade of discipline-based education research. Visit our [Frequently-Asked-Questions](#) page to start, or take a look at a [4-minute movie](#) where Minnesota students and faculty talk about their classroom.

As a visitor to the site, you can [view](#) classroom designs and find contact information for dozens of colleges and universities that are offering highly interactive, collaborative, guided-inquiry-based learning to their students.

If you are considering adopting this approach for your own instruction, [ask](#) to become a member of the site for access to many more details and instructional materials being developed and tested by faculty around the world.



Visitors may click [here](#) to go to pages describing the work of many of the institutions adopting SCALE-UP.

Registered site members, click [here](#) to log in. (There is additional detailed information available only to those who have registered.)

Contact [Robert J. Beichner](#) for more information or to become a member. He will need to verify that you are a legitimate faculty member, so be sure to include a web link or other means of verification in your e-mail.



Some SCALE-UP sites in the US. [View Larger Map](#)



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