

# The End of the University as We Know It?

Wolfgang Bauer  
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# Learning to Cook

- Method 1: buy a cookbook and follow instructions



# Learning to Cook

- Method 1: buy a cookbook and follow instructions



- Method 1(a):  
(really still method 1, but with more modern delivery technology)

# Learning to Cook

- Method 2: take an internship with a famous cook
    - Immersive
    - One-on-one attention
    - Immediate feedback
    - Rigorous quality control
- BUT:**
- Very expensive
  - Can only be done for a few



**Cooking Schools**  
*Fire Up Your Culinary Skills*



**LE CORDON BLEU.**

**Le Cordon Bleu**

Food has a way of speaking to you, and inspiring you to be creative. And your creations bring smiles of delight to the faces of all who try them. So turn your creative talents into a career. Le Cordon Bleu's specialized training can get you started on your journey to learn the way to a culinary career.

**Our programs in culinary arts, pâtisserie and baking, and hospitality and restaurant management offer you opportunities to:**

- Train hands on alongside professional chef instructors in industry-equipped kitchens where you'll use commercial -grade tools of the trade and fine ingredients.
- Develop well-rounded experience, as you practice your skills serving patrons in on-campus, student-run restaurants.
- Move on to perfecting your skills and developing your creative style in your externship working alongside culinary professionals.



# Learning to Cook

- Method 3:
  - Select presentations from best chefs in the world
  - Detailed instructions from many sources
  - Send in your finished dishes for taste-tests
  - Receive feedback (email, text, ... from assistants of chefs)
  - Repeat
  - Final exam (for credit): perform in front of judges



# Learning to Cook

- Method 3 (cont.): provide a learning community
  - Exchange of ideas between learners
  - Create more than what teachers designed initially

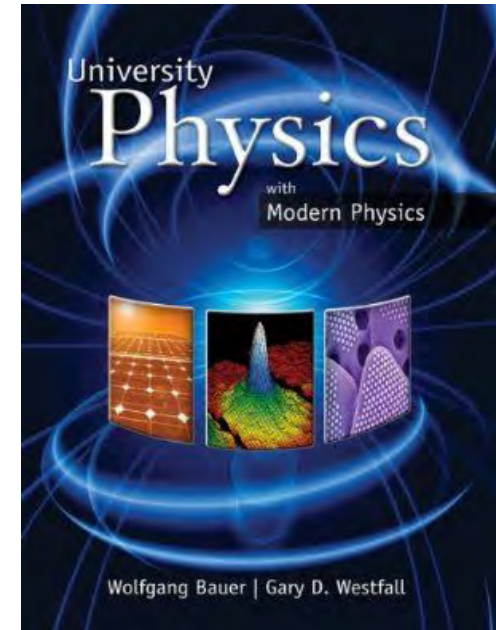
The screenshot shows a web browser window displaying the 'ICTmagic - Food & Cookery' Wikispaces page. The browser's address bar shows the URL 'http://ictmagic.wikispaces.com/Food+%26+Cookery'. The page has a dark header with the 'ICTmagic' logo. A sidebar on the left contains links to 'Wiki Home', 'Pages and Files', 'Members', 'Recent Changes', and 'Manage Wiki', along with a 'Search Wiki' box. Below the sidebar, there is a 'Winner Best educational wiki 2011 Edublog Awards' badge and a 'Featured on the Wikispaces blog' badge. The main content area is titled 'Food & Cookery' and lists several food-related websites with descriptions:

- <http://www.foodily.com/>: his is such a lovely recipe site. Search for recipes across the Net. Displayed consistently, clearly and simply.
- <http://cookite2bn.org/>: A lovely child-friendly cookery site with recipes, resources and activities.
- <http://www.foodafactoflife.org.uk/Index.aspx>: A great food tech site designed for children from the British Nutrition Foundation with recipe sheets and videos.
- <http://punchfork.com/>: A lovely, clear site to find yummy recipes for your cookery

The page also includes social media links (Facebook, Twitter, YouTube, RSS) and a 'Follow me' button on the right side.

# Learning to Do Physics

- Method 1: Buy a book *and read it*
  - Still **highly** recommended!
- Method 2: Enroll in a university
  - Attend physics lectures
  - In addition to method 1(!)
- Method 3: Take an online class
  - Digest materials at your own pace and on your own schedule
  - Select from different explanations by different experts and via different learning styles
  - Use a variety to formative and summative evaluation tools



# Virtual University Physics @MSU

- 1992: Presidential Faculty Fellow Award (k\$500)
- 1993: NSF-ILI grant (k\$45+45) to improve lab/lecture sequence in LBS (Bauer, Benenson, Westfall)
- 1995: MultiMedia Physics CD
- 1997: *lectureOnline* (Kortemeyer)
- 1997: Virtual University courses PHY231c, PHY232c
- 1998: cliXX Physik CD (Germany)
- 1998: HHMI grant (M\$1.8, McGroarty)
- 1999: Advanced Placement Physics
- 2000: MSU-deal with Apex Learning
- 2000: NSF-ITR grant (M\$2.1) for LON-CAPA (Kortemeyer, Bauer, Kashy<sup>2</sup>, Speier)
- 2008: Complete redo of all VU course offerings with Camtasia
- 2012: Current annual enrollment ~1,200/year
- 2013: Start Astronomy VU



# Delivery Vehicle

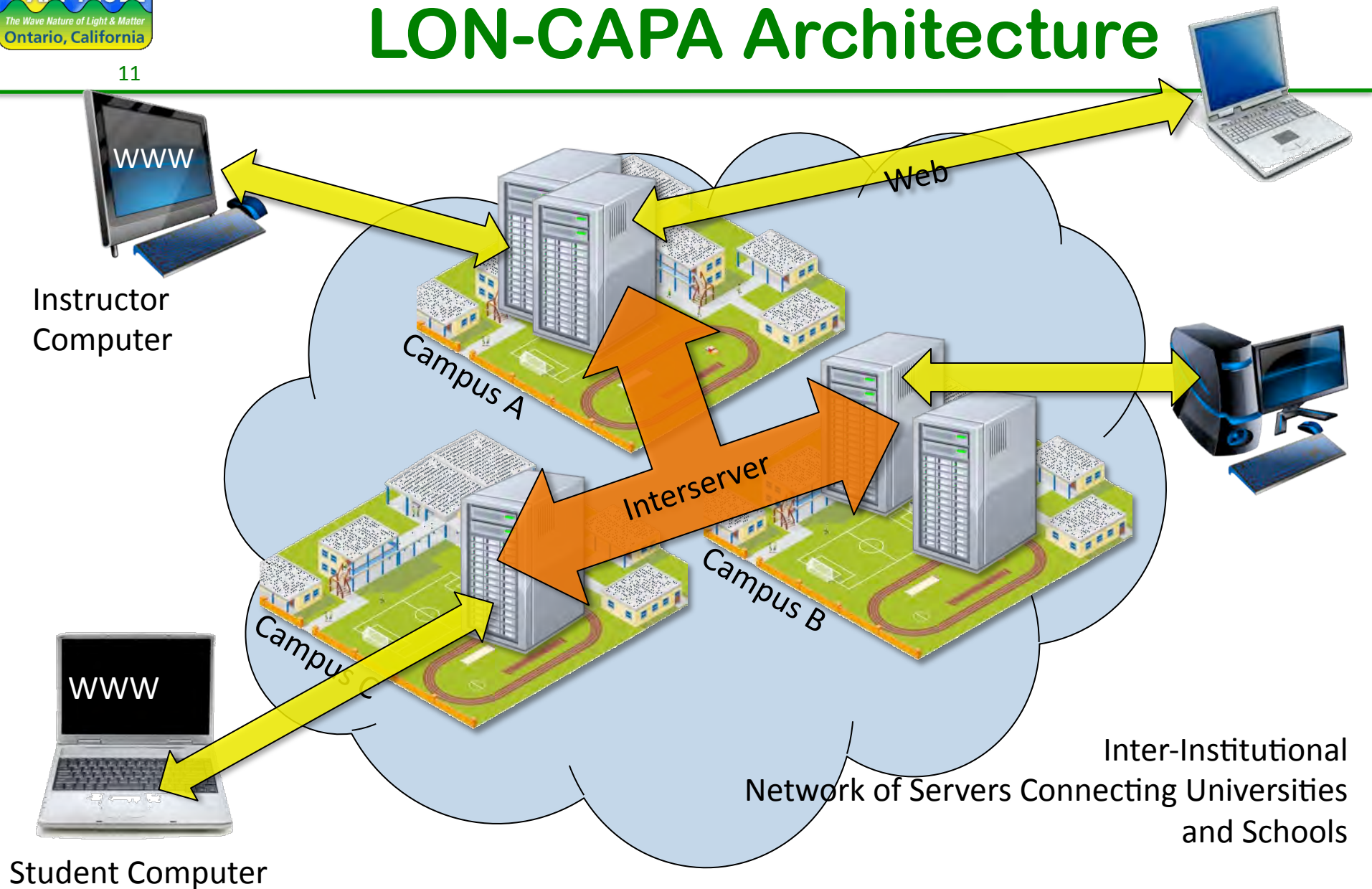


# LON-CAPA

- Learning Online Network
- Computer-Assisted Personalized Approach
- Course management system
- Homework engine
  - Individualized
    - Every student sees the same basic problem
    - Every student has different numbers
    - Allows groups of students to work together without the ability to just copy solutions
  - Reusable shared resources
    - Much more efficient use of instructor's time

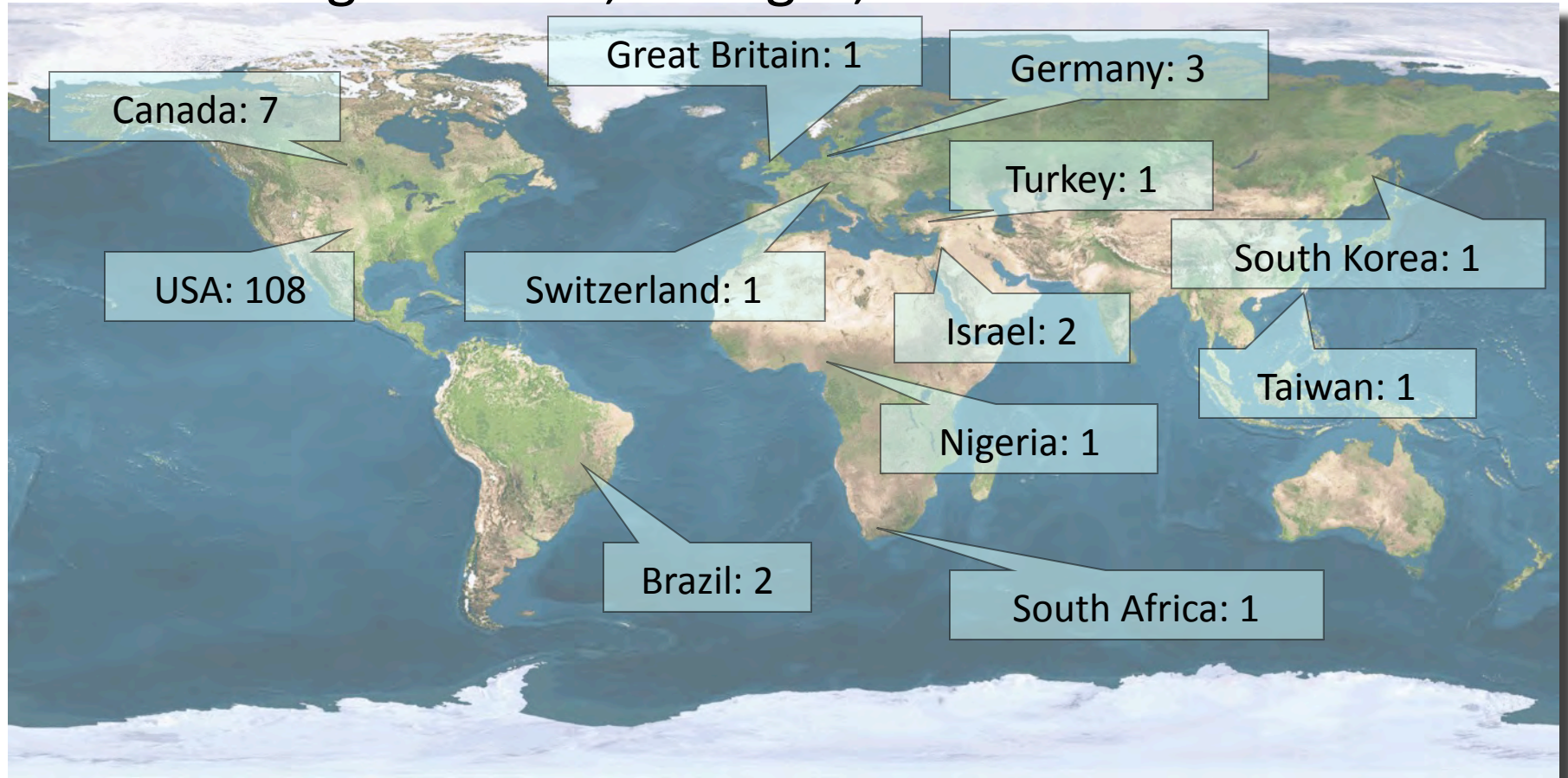


# LON-CAPA Architecture



# The LON-CAPA Community

## High Schools, Colleges, and Universities



... plus grant projects and publishing companies.

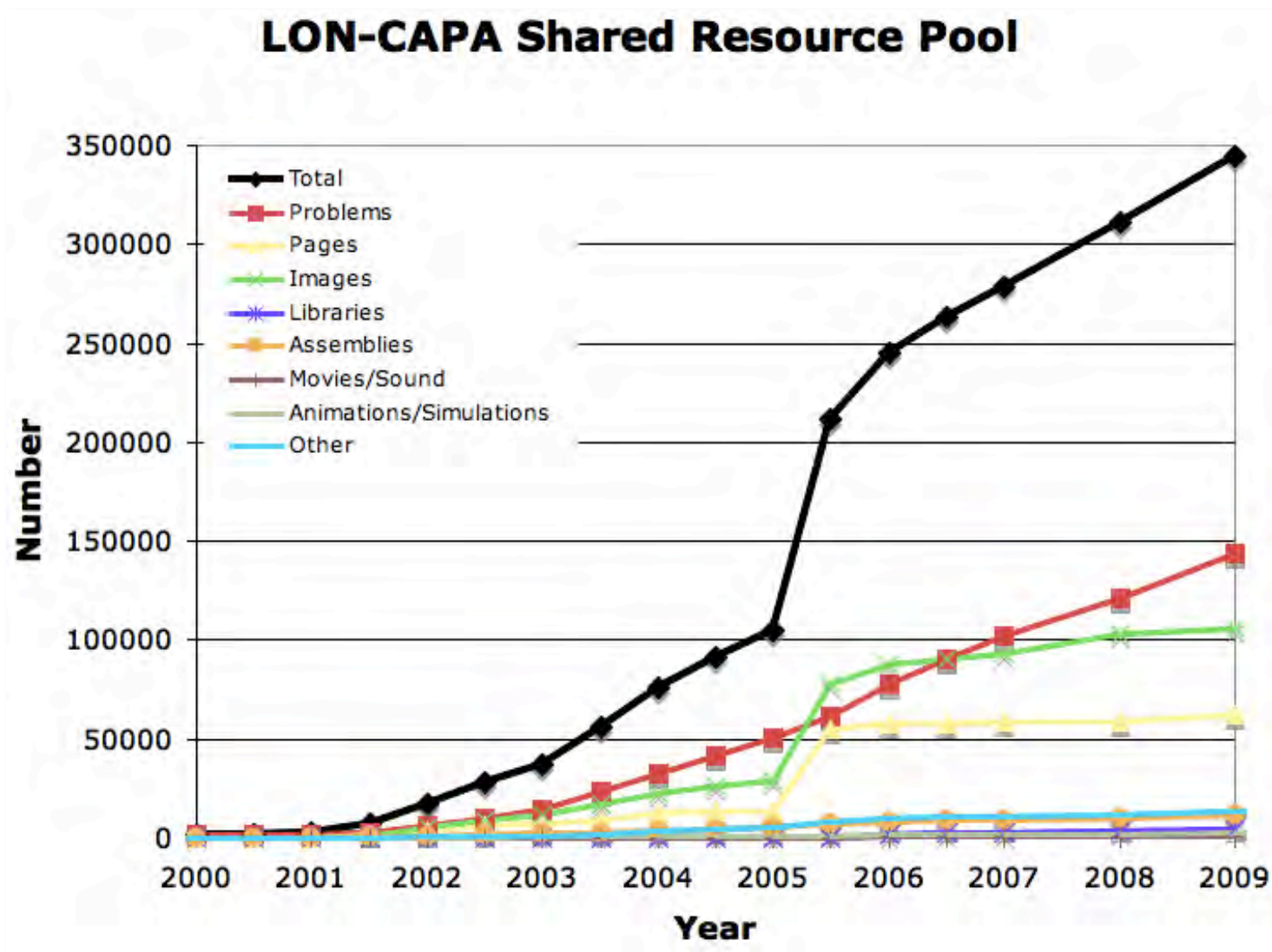


# Sharing of Resources!

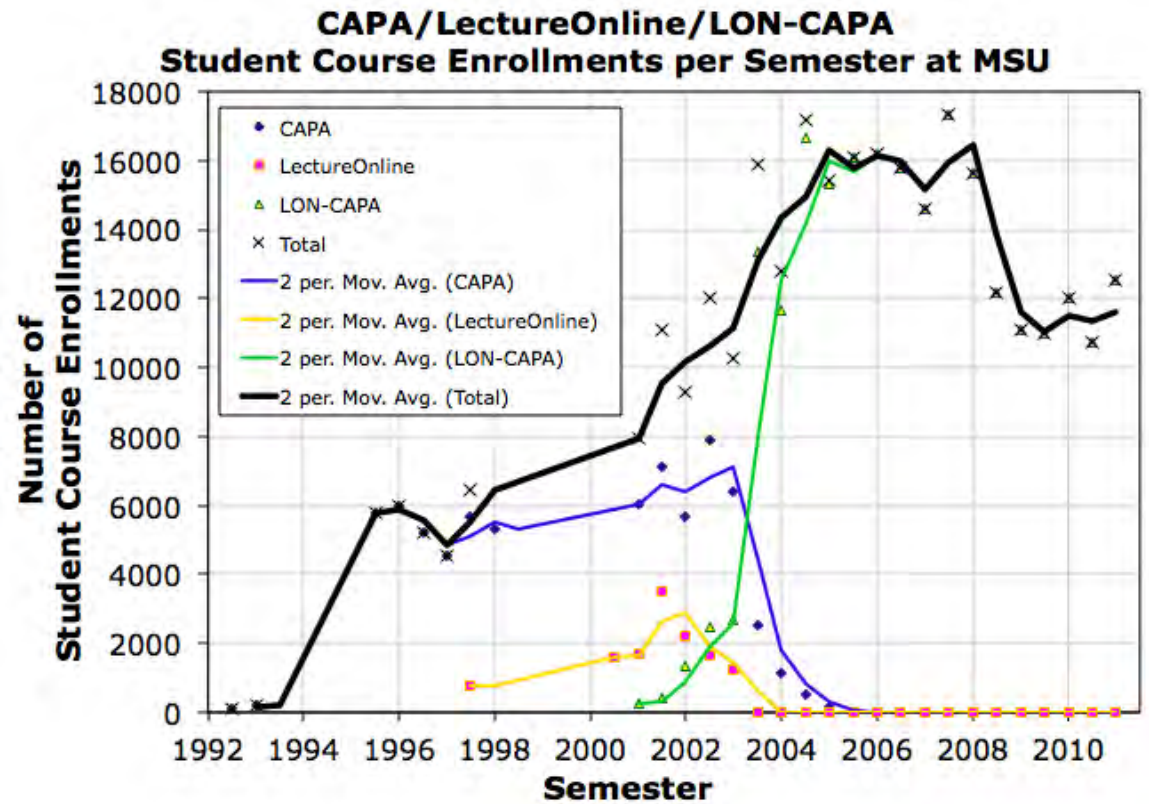
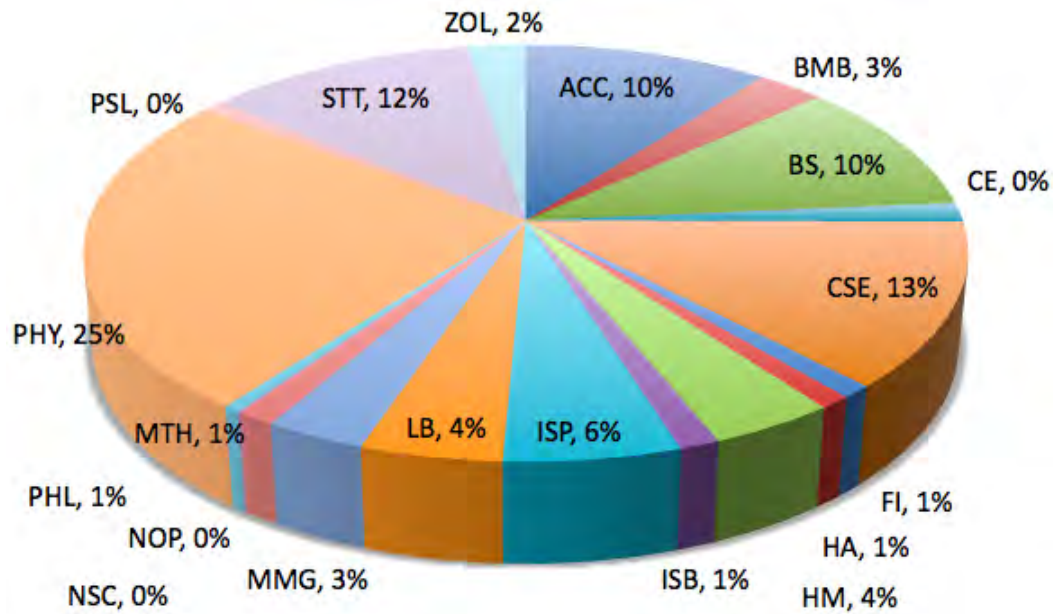
- Creating online resources is a lot of work
- Doing so for use in just one course is a waste of time and effort
- Many resources can be used among a number of courses and across institutions



# LON-CAPA Community



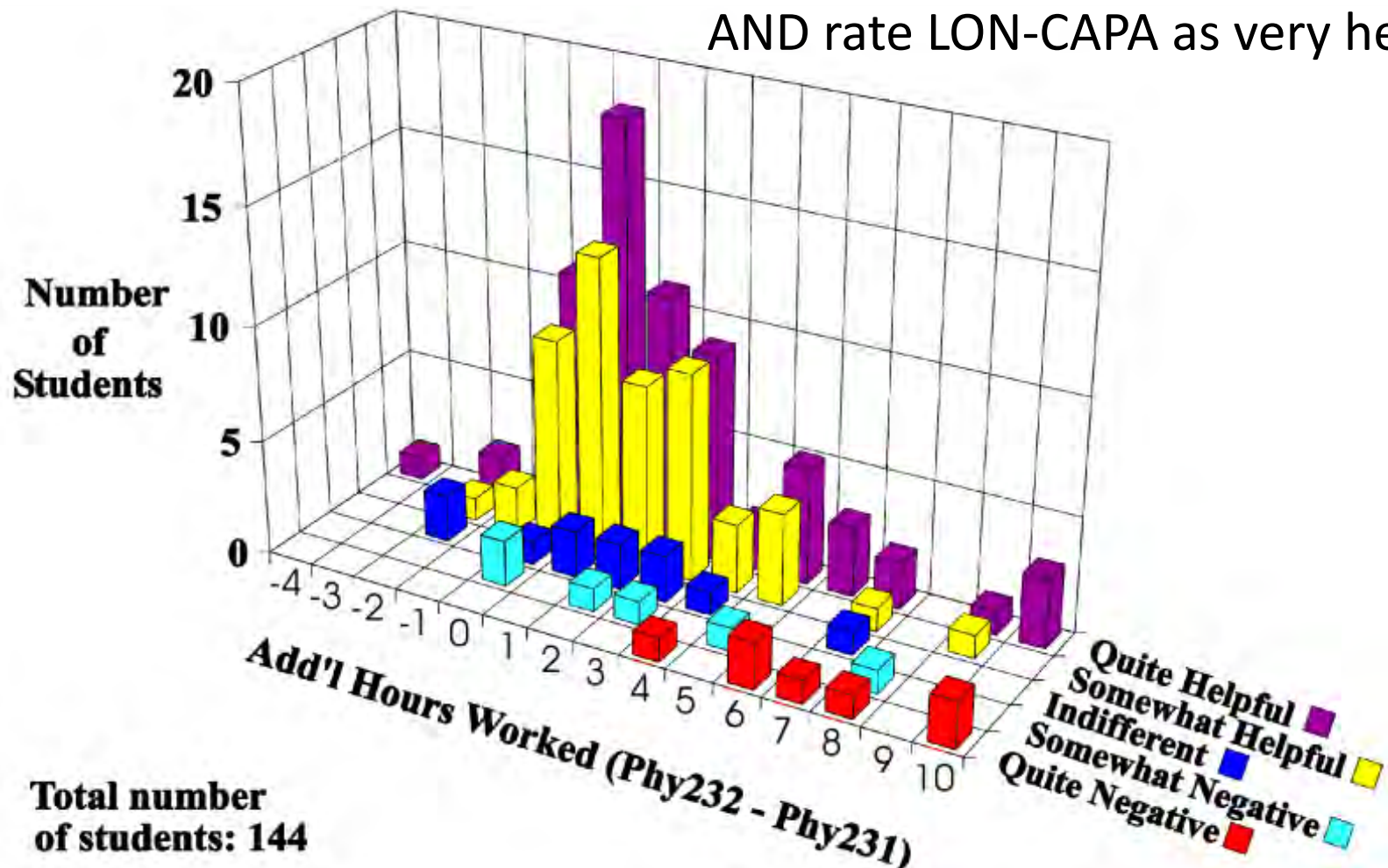
# Use @ MSU





# Selected Results: PER on LON-CAPA

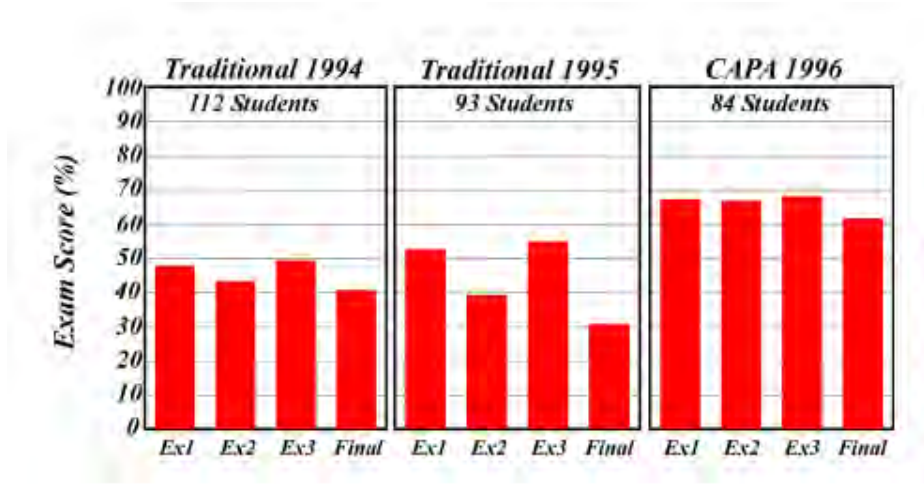
Students spend more time on task  
AND rate LON-CAPA as very helpful!





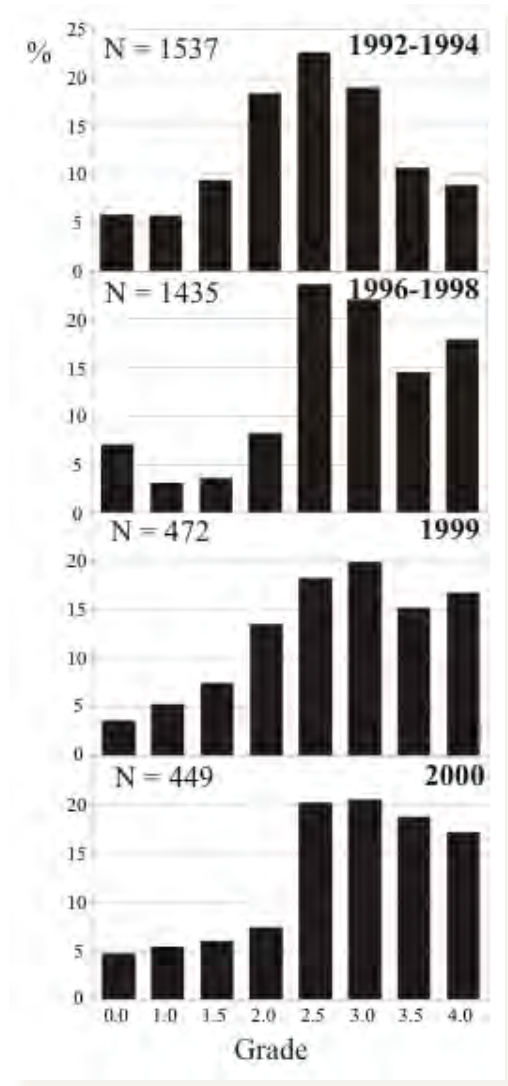
# Selected Results: PER on LON-CAPA

- Improved Exam Performance



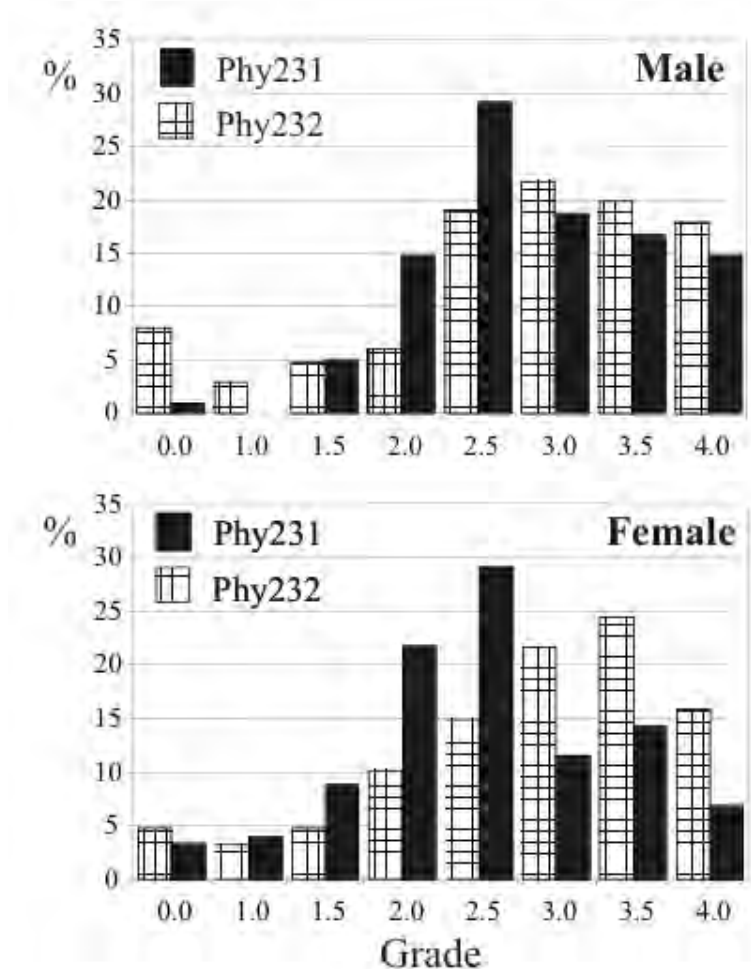
# Selected Results: PER on LON-CAPA

- Improved Course Performance



## Selected Results: PER on LON-CAPA

- Females show higher differential improvements than males



# Virtual University Course

LON-CAPA What's New?

http://educog.com/adm/whatsnew?refpage=start

cliXX BauerWestfall Atoms Economy TEXTBOOK Energy Nuclear Physics SendaiQuake MSUapprovals Wikipedia

Wolfgang Bauer (Course Coordinator) **PHY 184B Summer 2011** **New Messages** Roles Help Logout

**Main Menu** | **Return to Last Location** | **Course Contents** | **Course Editor** | **Groups** | Switch course role to...

PHY 184B Summer 2011 » **What's New?** What's New?

**Go to first resource**

Page set to be displayed and you have selected a role in this course.  
Currently: *What's New Page (user preference)*. **Change** for just this course or for all your courses/communities.

Hide all Show all

**Problems requiring handgrading** Hide

*No problems require handgrading*

**Problems with errors** Hide

*No problems with errors*

**(Problems with av. attempts  $\geq 2$  or deg. difficulty  $\geq 0.5$ ) and total number of students with submissions  $\geq 2$**  Hide

Change thresholds?

| Resource                | Part      | Num. students | Av. Attempts | Deg. Diff | Last Reset | Reset Count?             |
|-------------------------|-----------|---------------|--------------|-----------|------------|--------------------------|
|                         | part - 11 | 187           | 2.59         | 0.62      |            | <input type="checkbox"/> |
| AC circuit with R and C | part - 13 | 183           | 1.95         | 0.50      |            | <input type="checkbox"/> |
|                         | part - 17 | 184           | 2.18         | 0.54      |            | <input type="checkbox"/> |
| AC generator and a      | part -    |               |              |           |            |                          |

**Unread course discussion posts** Hide

Change options?

| Location                                       | Type     | Time of last post                           | Number of new posts |
|--|----------|---|---------------------|
| AC circuit with R and C                        | Resource | on Thursday, Aug 4 2011 at 10:13 pm (EDT)   | 22                  |
| AC generator and a resistor                    | Resource | on Thursday, Aug 4 2011 at 05:12 pm (EDT)   | 14                  |
| Acceleration of a wire inside a magnetic field | Resource | on Wednesday, Jul 13 2011 at 10:20 pm (EDT) | 10                  |
| Alpha particle                                 | Resource | on Thursday, Jun 9 2011 at 02:45 pm (EDT)   | 7                   |
| Assign a seat                                  | Resource | on Thursday, Jun 23 2011 at 05:30 pm (EDT)  | 1                   |
| Assign a seat                                  | Resource | on Wednesday, Jun 22 2011 at 05:17 pm (EDT) | 1                   |
| Axle rolling on rails                          | Resource | on Thursday, Jul 21 2011 at 09:55           | 2                   |



# Virtual University Course

LON-CAPA Course Contents

http://educog.com/adm/navmaps?&filter=,2&condition=0&hereType=&here=uploaded%2fmsu%2f81 Google

cliXX BauerWestfall Atoms Economy TEXTBOOK Energy Nuclear Physics SendaiQuake MSUapprovals Wikipedia

Wolfgang Bauer (Course Coordinator) PHY 184B Summer 2011 New Messages Roles Help Logout

Main Menu | Return to Last Location | Course Contents | Course Editor | Groups | Switch course role to...

PHY 184B Summer 2011 » Course Contents

Tools: Sort by: Default

- ☐ Syllabus
- ☒ Online Lectures
  - Lecture 21
  - Lecture 22
  - Lecture 23
  - Lecture 24
  - Lecture 25
  - Lecture 26
  - Lecture 27
  - Lecture 28
  - Lecture 29
  - Lecture 30
  - Lecture 31
  - Lecture 32
  - Lecture 33
  - Lecture 34
  - Lecture 35
- HW #0 (05/22)
- Test (60 minutes between Fr 3 PM and Su 8 PM) (hidden)
- HW #1 (05/26)
- HW #2 (06/02)
- HW #3 (06/09)
- HW #4 (06/23)

# Virtual University Course

LON-CAPA Course Contents

http://educog.com/adm/navmaps?&filter=10,2&condition=0&hereType=&here=uploaded%2fmsu%2f... Google

cliXX BauerWestfall Atoms Economy TEXTBOOK Energy Nuclear Physics SendaiQuake MSUapprovals Wikipedia

Wolfgang Bauer (Course Coordinator) **PHY 184B Summer 2011** **New Messages** Roles Help Logout

**Main Menu** | **Return to Last Location** | **Course Contents** | **Course Editor** | **Groups** | Switch course role to...

PHY 184B Summer 2011 » **Course Contents**

Tools: Sort by: Default

- ☐ Syllabus
- ☒ Online Lectures
  - Lecture 21
  - Lecture 22
  - Lecture 23
  - Lecture 24
  - Lecture 25
  - Lecture 26
  - Lecture 27
  - Lecture 28
    - Slides 28
    - Biot-Savart Law
    - Magnetic Field from a Long Straight Wire (demo)
    - Example: Definition of the Ampere
    - Example: Three Parallel Wires
    - Solved Problem: Electromagnetic Rail Accelerator
    - Example: Magnetic Field due to a Wire Loop
    - Example: Magnetic Fields from Current Distributions
    - Ampere's Law
    - Example: Magnetic Field Inside a Long Straight Wire
    - Magnetic Fields of Solenoids and Toroids
    - Atoms and Magnets
    - Magnetic Properties of Matter (demo)

# Virtual University Course

LON-CAPA Created by Camtasia Studio 6

http://educog.com/res/msu/physicslibrary/phy184c/Chapter%2028%20Magnetic%20Fields%20of%20... Google

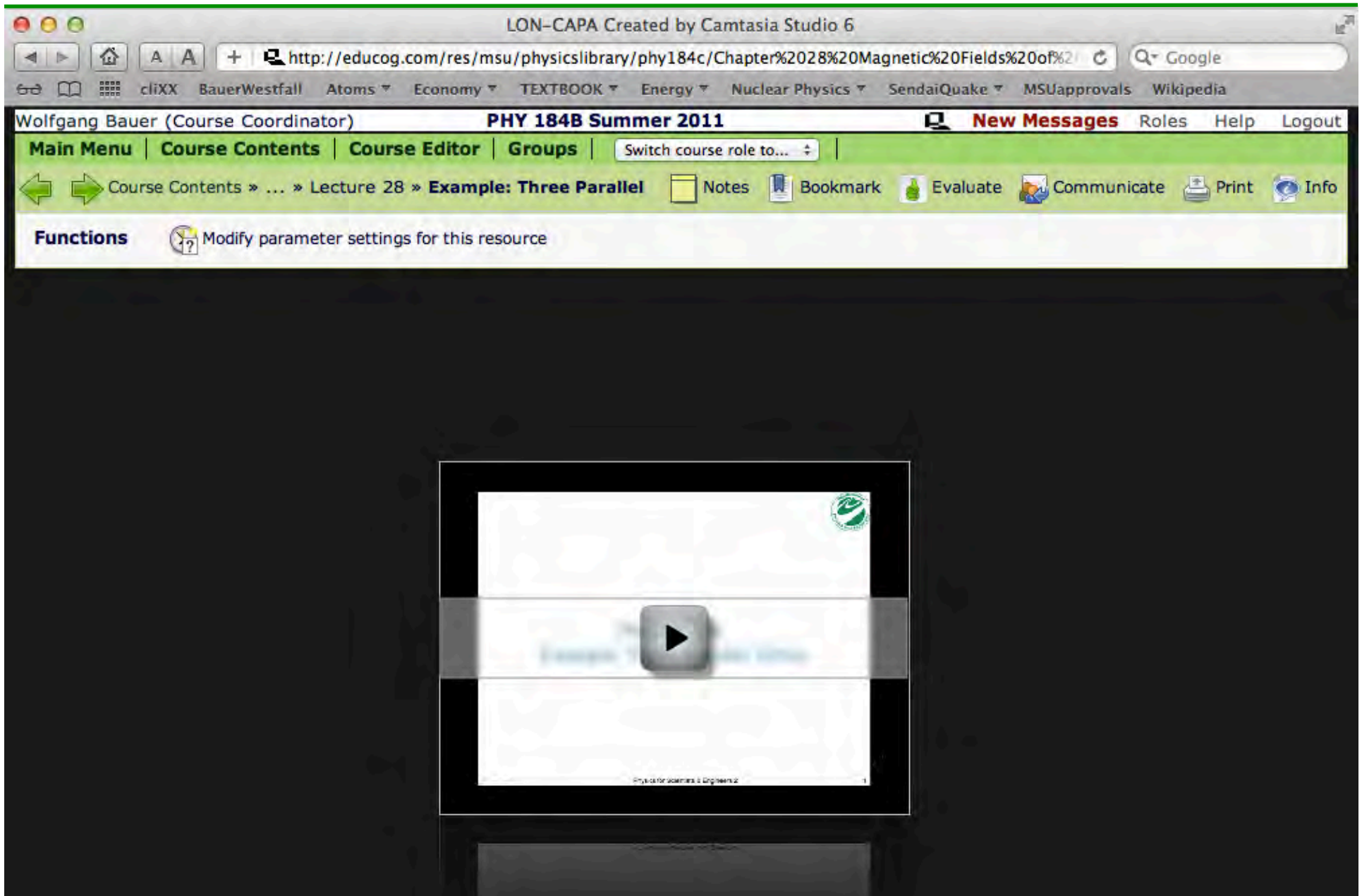
cliXX BauerWestfall Atoms Economy TEXTBOOK Energy Nuclear Physics SendaiQuake MSUapprovals Wikipedia

Wolfgang Bauer (Course Coordinator) PHY 184B Summer 2011 New Messages Roles Help Logout

Main Menu | Course Contents | Course Editor | Groups | Switch course role to...

Course Contents » ... » Lecture 28 » **Example: Three Parallel** Notes Bookmark Evaluate Communicate Print Info

Functions Modify parameter settings for this resource





# Virtual University Course

- 5-7 Minute video segments produced w. Camtasia
  - Screen capture
  - Tablet pc with stylus
  - Voiced over
- One-on-one tutoring session
  - Talking head not needed
  - Show what's on the screen

The screenshot shows a LON-CAPA interface for a physics course. The main content area displays a video segment titled "Example" which discusses the magnetic field and force on three parallel wires. The video content includes a diagram of three parallel wires (a, b, c) with current flowing out of the page. Wire (a) is at the top, (b) is in the middle, and (c) is at the bottom. The distance between (a) and (b) is  $d$ , and between (b) and (c) is  $d$ . Handwritten notes in red and green ink show the calculation of the net magnetic field at wire (a) due to wires (b) and (c). The net field is found to be  $B_{bc} = \frac{\mu_0 i}{2\pi d} - \frac{\mu_0 i}{4\pi d} = \frac{\mu_0 i}{4\pi d}$  pointing down. The force on wire (a) is then calculated as  $\vec{F}_{abc} = i_a \vec{L} \times \vec{B}_{bc}$ , pointing to the right.

Example

The figure shows three long, straight, parallel, equally spaced wires with identical currents either into or out of the page. What is the force on wire (a) due to the other two?

$B = \frac{\mu_0 i}{2\pi \cdot r}$   $r_b = d$   $r_c = 2d$

Step 1: Find the net magnetic field from wires (b) and (c):  $B_{bc}$

$B_b$  at (a) is down  $B_b = \frac{\mu_0 i_b}{2\pi d}$   $B_c = \frac{\mu_0 i_c}{2\pi(2d)}$

$B_c$  at (a) is up

The net field is  $B_{bc} = \frac{\mu_0 i}{2\pi d} - \frac{\mu_0 i}{4\pi d} = \frac{\mu_0 i}{4\pi d}$  down

Step 2: find the force on wire (a) with  $\vec{F}_{abc} = i_a \vec{L} \times \vec{B}_{bc}$

Physics for Scientists & Engineers 2



- Homework & Exam Questions
  - Individualized
  - Randomized
  - Computer-graded
- Grade book keeps track
  - Students have full info

LON-CAPA Potential field

http://educog.com/res/msu/physicslib/msuphysicslib/54\_ElecPotential1/msuprob04.problem?sym...

Wolfgang Bauer (Course Coordinator) PHY 184B Summer 2011 New Messages Roles Help Logout

Main Menu | Course Contents | Course Editor | Groups | Switch course role to...

Course Contents » ... » HW #3 (06/09) » Potential field

Functions Modify user grades for this assessment resource Modify parameter settings for this resource

The lines show the equipotential contours in the plane of three point charges,  $Q_1$ ,  $Q_2$ , and  $Q_3$ . The values of the potentials are in kV as indicated for the +5, 0, and -5 kV contours. The positions of the charges are indicated by the dots.

The letters are on the equipotential contours.

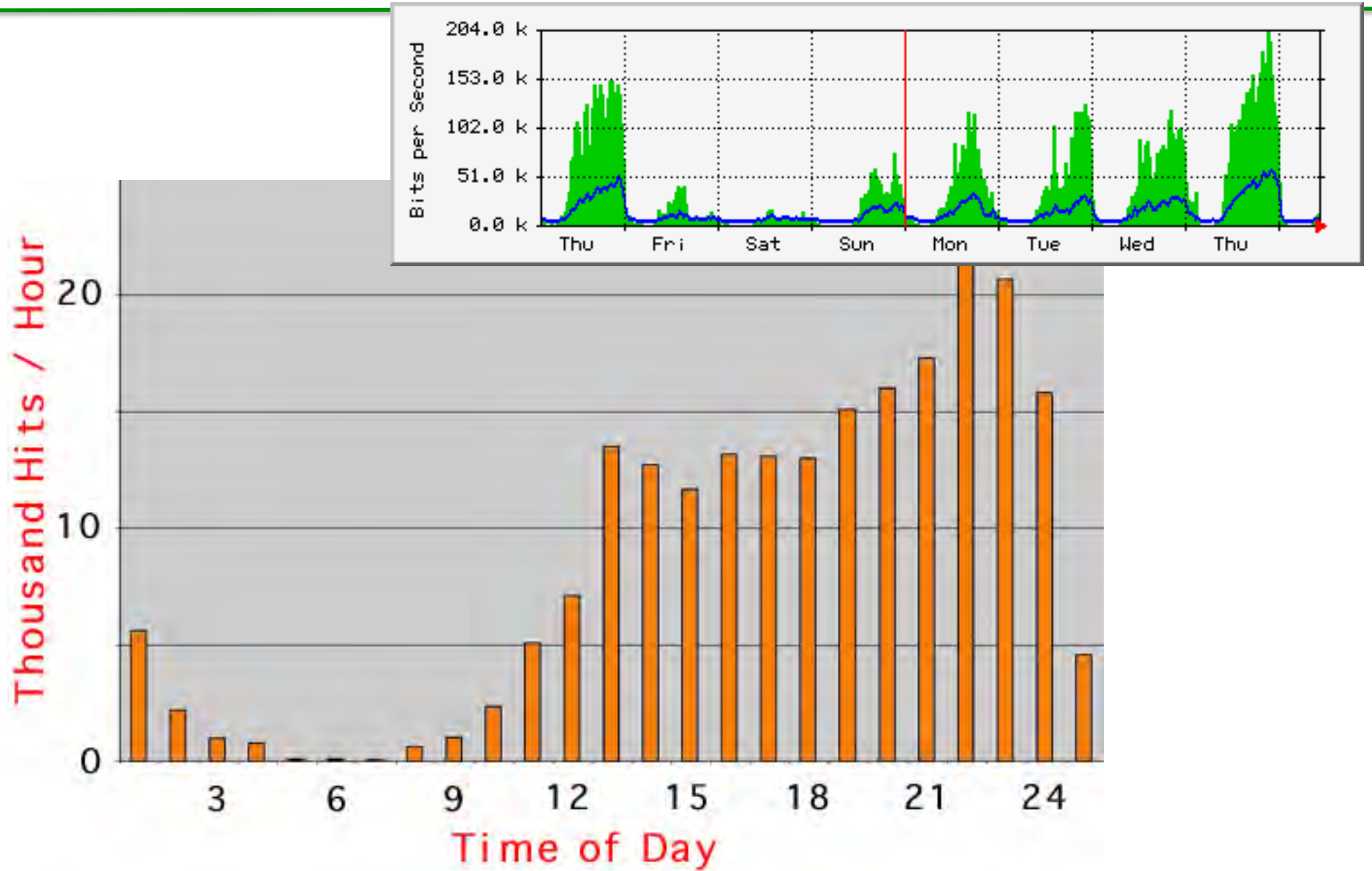
Charge  $Q_3$  has the largest magnitude of all.  
 The electric field at i is stronger than at j.  
 The force on a proton at g points to the bottom of the page.  
 Charge  $Q_2$  is the largest negative charge.  
 The electric field at k is zero.  
 $Q_1$  is a negative charge.

Submit Answer Tries 0/20

Calculate the work required to move a charge of  $-0.35 \times 10^{-12} \text{ C}$  from i to b.

Submit Answer Tries 0/20

# When Do Students Work?



# Exam Support

## STUDENT A

A capacitor is completely charged with 650 nC by a voltage source that had 350 V.

1 pt What is its capacitance? (in F)

- 7.A ☐  $1.49 \times 10^{-9}$  B ☐  $1.86 \times 10^{-9}$  C ☐  $2.32 \times 10^{-9}$   
D ☐  $2.90 \times 10^{-9}$  E ☐  $3.63 \times 10^{-9}$  F ☐  $4.53 \times 10^{-9}$   
G ☐  $5.67 \times 10^{-9}$  H ☐  $7.08 \times 10^{-9}$

1 pt Now the plates of the charged capacitor are pushed together with the voltage source already disconnected.

8. A ☐ The charge on the plates increases.  
B ☐ The energy stored in the capacitor remains the same.  
C ☐ The capacitance increases.  
D ☐ The voltage drop between the plates increases.  
E ☐ The energy stored in the capacitor increases.

1 pt

if the

9.A

D

C

## STUDENT B

A capacitor is completely charged with 670 nC by a voltage source that had 350 V.

1 pt What is its capacitance? (in F)

- 7.A ☐  $1.91 \times 10^{-9}$  B ☐  $2.39 \times 10^{-9}$  C ☐  $2.99 \times 10^{-9}$   
D ☐  $3.74 \times 10^{-9}$  E ☐  $4.67 \times 10^{-9}$  F ☐  $5.84 \times 10^{-9}$   
G ☐  $7.30 \times 10^{-9}$  H ☐  $9.13 \times 10^{-9}$

1 pt Now the plates of the charged capacitor are pulled apart with the voltage source already disconnected.

8. A ☐ The voltage drop between the plates increases.  
B ☐ The energy stored in the capacitor remains the same.  
C ☐ The charge on the plates increases.  
D ☐ The capacitance increases.  
E ☐ None of the above.

**Students receive automatically generated individualized multiple choice exams with their names (and photos).**

**LON-CAPA machine-grades the bubble sheets.**

# Exam Support: Re-Takes

A capacitor is completely charged with 650 nC by a voltage source that had 350 V.

1 pt What is its capacitance? (in F)

7. A ☐  $1.49 \times 10^{-9}$  B ☐  $1.86 \times 10^{-9}$  C ☐  $2.32 \times 10^{-9}$   
D ☐  $2.90 \times 10^{-9}$  E ☐  $3.63 \times 10^{-9}$  F ☐  $4.53 \times 10^{-9}$   
G ☐  $5.67 \times 10^{-9}$  H ☐  $7.08 \times 10^{-9}$

1 pt Now the plates of the charged capacitor are pulled apart with the voltage source already disconnected.

8. A ☐ The charge on the plates increases.  
B ☐ The energy stored in the capacitor remains the same.  
C ☐ The capacitance increases.  
D ☐ The voltage drop between the plates increases.  
E ☐ The energy stored in the capacitor increases.

1 pt The initial air gap was 8 mm. What is the stored energy if the air gap is now 6 mm? (in J)

9. A ☐ 0.00 B ☐  $8.53 \times 10^{-5}$  C ☐  $1.14 \times 10^{-4}$   
D ☐  $1.30 \times 10^{-4}$  E ☐  $1.52 \times 10^{-4}$  F ☐  $3.41 \times 10^{-4}$   
G ☐  $3.44 \times 10^{-4}$  H ☐  $4.87 \times 10^{-4}$

A capacitor is completely charged with 670 nC by a voltage source that had 375 V.

## Problem 6

Due on Tuesday, Feb 22 at 10:00 am

A capacitor is completely charged with 640 nC by a voltage source that has 375 V.

What is its capacitance?

Submit Answer Tries 0/3

Now the plates of the charged capacitor are pulled apart with the voltage source still connected.

- ☐ The capacitance increases.  
☐ The voltage drop between the plates increases.  
☐ The energy stored in the capacitor increases.  
☐ The energy stored in the capacitor remains the same.  
☐ None of the above.

Submit Answer Tries 0/2

The initial air gap was 5 mm. What is the stored energy if the air gap is now 10 mm?

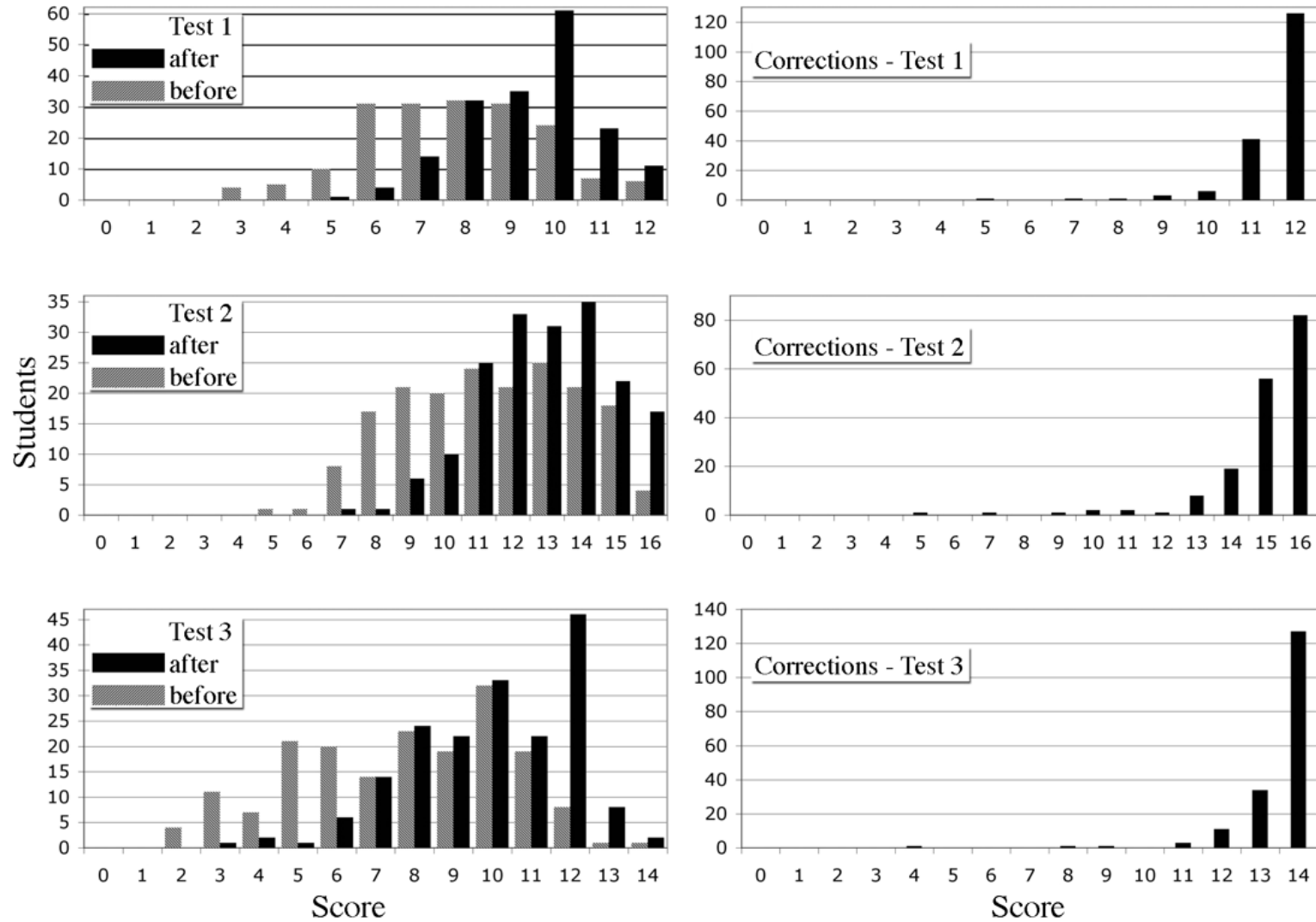
Submit Answer Tries 0/3

if the air gap is now 11 mm? (in J)

9. A ☐ 0.00 B ☐  $6.40 \times 10^{-5}$  C ☐  $1.17 \times 10^{-4}$   
D ☐  $2.15 \times 10^{-4}$  E ☐  $2.91 \times 10^{-4}$  F ☐  $3.63 \times 10^{-4}$   
G ☐  $4.39 \times 10^{-4}$  H ☐  $5.42 \times 10^{-4}$



# Exam Support: Re-Takes



*Kortemeyer, Bauer, Benenson, Kashy, The Physics Teacher 44, 235 (2006)*

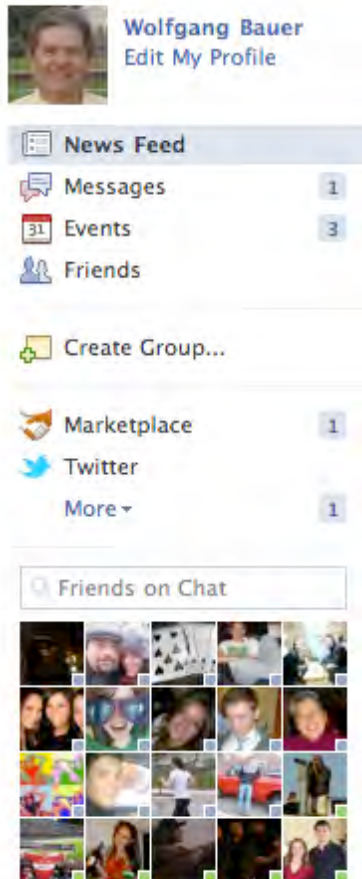
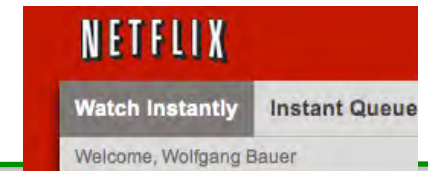
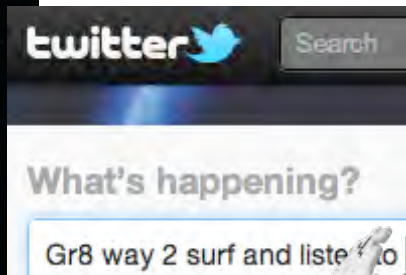
# Learning Outcomes

- Comparison study: Taught lecture based PHY231 and compared to VU PHY231c
- Same homework assignments, same exams, same grading system
- Virtual university students scored slightly higher on all three exams and on FCI baseline test, and obtained slightly higher final grades (2.93 vs. 2.87) on average
- One explanation: putting materials on www forces the students to engage in more active learning
- Another: VU students are self-selected group
- Needed: Controlled study

# The End of the University as We Know It?

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- Brick-and-mortar advantage is slowly vanishing
- Virtual courses offer greater flexibility and broader range
- Formative and summative evaluations are straightforward
  - Cheating can be contained
- Last advantage of the brick-and-mortar university: social interactions
  - Facebook, anyone ...



1998: Page, Brin

## How our students interact with the world



1994: Andreessen



1989: WWW, Berners-Lee



2007: iPhone (Apple)