The End of the University as We Know It?

Wolfgang Bauer
Michigan State University
Learning to Cook

• Method 1: buy a cookbook and follow instructions
Learning to Cook

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• 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
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
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, Kashy², 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

Instructor Computer

Student Computer

WWW

Campus A

Campus B

Interserver

Web

Inter-Institutional Network of Servers Connecting Universities and Schools
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

LON-CAPA Shared Resource Pool

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Use @ MSU
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

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.

Problems requiring handgrading
No problems require handgrading

Problems with errors
No problems with errors

Table: Unread course discussion posts

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Virtual University Course
Virtual University Course
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
• Homework & Exam Questions
  – Individualized
  – Randomized
  – Computer-graded
• Grade book keeps track
  – Students have full info
When Do Students Work?

![Graph showing data on student work habits.](image)

- Time of Day
- Thousand Hits / Hour
- Bits per Second

Wolfgang Bauer

February 6, 2012
Students receive automatically generated individualized multiple choice exams with their names (and photos).

LON-CAPA machine-grades the bubble sheets.
A capacitor is completely charged with 650 nC by a voltage source that had 350 V.

1 pt What is its capacitance? (in F)

- 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 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.
   F: The energy stored in the capacitor remains the same.
   G: None of the above.

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

- 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: $4.87 \times 10^{-4}$
Exam Support: Re-Takes

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?

• 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 ...
How our students interact with the world

1989: WWW, Berners-Lee
1994: Andreessen
1998: Page, Brin
2007: iPhone (Apple)