Online Education: The Coming Tsunami?

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From 1150 to 1450, the number of universities doubled every 100 years.

At that rate, there would be 2,000 now. There are 20,000!

What happened?

This observation came from Stanford’s Provost John Etchemendy.
Historical Context

Average cost of a volume library in 1400: ~200 years’ wages

Average cost of a volume library in 2012: ~7.5 years’ wages

Total volumes produced:
- 115 million manuscripts
- 532 million books

10th century: 1 million
11th century: 2 million
12th century: 3 million
13th century: 5 million
14th century: 13 million
15th century: 47 million
16th century: 317 million
17th century: 532 million
18th century: 904 million

Linear scale
Two Big Problems in Cost/Performance of Education

1. High quality education is becoming too costly
   - Emerging and growing problem in higher education
   - Instructors drive costs: replaced the cost of books as driver
     - If we simply increase student/teacher ratios: quality drops
     - Role of technology: Drive down cost of high quality (bend cost curve)

2. Poor Performance in many educational institutions
   - Massive shortage of qualified instructors worldwide
     - For example: 8-12 grades in US in science and math
     - Higher education in developing world: simply unavailable and likely too costly
Cost of Higher Education Has Risen Much Faster than Inflation

Source: Archibald & Feldman, “Why Does College Cost So Much?”
Global Higher Education Availability

Source: Global Education Digest 2006. UNESCO. Data are for 2004.
Can Technology Really Change Education?

• Online technologies may change education disruptively
  • Did not happen with earlier attempts

• Why now?
  • Widespread, high bandwidth connectivity
  • New model, based on “active classroom,” goes beyond talking head
    • Lecturers are “chunked” with interactive participatory activity
  • Improvements in automated assessment/feedback
  • Social media/crowd sourcing for group learning & peer grading
  • Semi-synchronous and asynchronous delivery
  • Online is “natural” for this generation
  • Certification of mastery as an alternative for some courses
  • Desperate need to improve cost-performance of education
Universities perform two education functions:
- Helping students learn: in class and outside
- Credentialing: certifying students achieve mastery of a subject (grades & degrees)
  - Good certification enhances learning!
  - P.S. Universities also serve to credential faculty for students, a critical role as well

Some educational efforts focus on learning:
- Khan Academy, iTunes U, OCW, etc.
- Important public service, which universities should contribute to

Much of the value and the challenge lies in credentialing
Wide Variety of Institutional Motivations

• Improve education
  • On campus and off

• Generate revenue/bend the cost curve in higher ed

• Enlarge or enhance mission
  • Overcome location or institution size constraints

• Increase reach at an acceptable price point
  • International?
Wide Range of Applications of Online Technologies I

- Improve traditional large lectures (online vs. live)
- Use faculty time and class time better
  - Flipped classroom idea
- Teach traditional courses remotely
  - Widely done today in semi-synchronous form
  - Move to more asynchronous models
    - Students proceed at their pace when ready
- Increase students per faculty & maintain quality
  - Reuse lecture material: redeploy faculty
- Course material to the world
  - The new form of textbooks
Wide Range of Applications of Online Technologies II

- Provide certification to large student bodies
  - How? Validity?
- Full online degree programs:
  - Scale? Quality?
- MOOCS (Massive Open Online Courses)
  - Venue for exploring these issues.
  - Lots of noise, less light!
  - Pluses and minuses
- Big questions around equivalence to on campus experiences and around “real learning”
Experience with Hybrid Learning versus In-person

- Hybrid learning combines online and in-person
- Flipped classroom: lectures online; in-person meetings
- Hybrid with online material from a 3rd party
- Experiences to date:
  - Flipped classroom
    - No instructor-reported differences in learning
    - Faculty in medium-large CS lectures (75-200) report better faculty-student engagement
  - Ithaka study of online CMU stat course at 7 places:
    - 1 hour face-to-face + online lectures
    - No difference in learning outcomes:
      - Online students report spending 25% less time
Gigantic interest in free courses from top institutions
  Numbers dropping as more courses from online, but still impressive

Physical presence may be “required” for some forms of learning
  Physical laboratories, hands-on projects, small seminars
    edX is planning to invest in online lab technologies

Some earlier experiments demonstrate possible approaches for intensive instructor feedback:
  Writing intensive courses with feedback both from tutors and peers

Promising early experiences with student-student intensive learning environments:
  Team projects and peer feedback both appear promising
Some Success in a Team-Oriented Massive Online Course

- Technology Entrepreneurship run on Venture Lab platform:
  - 82k signed up; 37k chose to do a project
  - Over 150 countries (US, Russia, India,...) and 20% women
  - > 10 companies formed

[Image: Venture Lab interface]

Technology Entrepreneurship Demo Decks

- BLIP a deal
- The Daily Dealers
- Dwarfs of Gothor
- Mobiitti
- IDH+C BOLIVIA

Site Credit: "BLIP a deal is the world's most comprehensive site for daily deals. We find over 1 million deals annually and allow you to store and manage all your offers in one place."
### OAP Final Report

**Report 1 - Testing the Value Proposition**

15 iLS - Intelligent Living Systems
15 iLS OAP Status Report

**Outline**

The purpose of our startup is to provide software, devices, and controllers to automate household management providing comfort, convenience and security through an integrated household network.

**Value Positioning Statement**

For people who want to make their lives more comfortable and need help with the technology needed to make their life easier.

The 15 iLS system is a combination of services and products that enables us to design and install modular home automation technology that focuses on providing solutions to the customer. The modular home automation systems are easy to use and designed to meet the needs of the customer - whatever that customer might need.

**Take Action to test if this is a viable business opportunity.**

### Submitted Peer Reviews

Thank you for submitting your evaluation on this report. You can view your evaluation and compare it against other peer evaluations in this page.

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|---|---|---|---|---|---|---|---|---|---|---|
|   |  |  |  |  |  |  |  |  |  |  |
| **You** | 10 | 10 | 10 | 10 |  |
| **Review 1** | 10 | 10 | 10 | 10 |  |
| **Review 2** | 9 | 9 | 9 | 8 |  |
| **Review 3** | 9 | 9 | 9 | 8 |  |
| **Review 4** | 10 | 8 | 8 | 10 |  |
| **Review 5** | 8 | 8 | 8 | 7 |  |
| **Review 6** | 9 | 10 | 10 | 9 |  |
| **Review 7** | 9 | 8 | 8 | 8 |  |
Biggest and most difficult challenge is dynamic range of student ability
- Size of classes and open enrollment drive this
- Some students have trouble keeping up (on weekly basis)
- Large dropout rates (>90% don’t finish)

Ability of instructor (or automated online system) to adapt material for students with widely varied ability is currently very limited
- Simple repetition is not enough (what we have so far)
- The greater the variation the harder the problem
  - Large enrollments of unscreened students exacerbates this
- Very large investments in content creation could provide more adaptability (unproven but seems obvious)
Size & dynamic range have even bigger impacts on assessment and credentialing:

1. Assessment must be graded at scale
   - Limits both kind of assignment and level of feedback
   - Peer grading OK for some assignments, not all

2. Need to have assessment “fit the class”
   - Dynamic range in student ability makes this difficult!
   - Good assessment challenges the best students while allowing the least capable to show some mastery
     - MIT 6.002 example: only 1/3 finish first assignment; < 5% complete course
While tech courses have attracted most initial interest, courses in the humanities and social sciences are getting traction.

Instructor feedback (e.g., from inline questions) have been useful for improving lectures.

Lots of window shopping: many students indicate interest but never even complete the first assignment.

Many working professionals looking to upgrade skills and also many international students.

Top students are motivated by virtual recognition as experts by their peers and the instructor (e.g. through badging).

Some students cheat even when course is free and for no credit!
Areas for Investment/Research

- Learning effectiveness: far too few controlled studies
  - Need education/learning experts

- Adaptive learning and automatic diagnosis:
  - Moving beyond repetition as the adaptation
  - Automating the help of a good tutor:
    - Hard and expensive but worth it at scale

- Assessment: large-scale assessment of more complex assignments/exams
  - Machine learning, Human-machine, etc.
  - How far can we go: writing, engineering problems?

- More experience and assessment of use of social media and crowd sourcing

- Virtualize labs?

- Identification and verification of the source of submitted work:
  - Necessary and may be a harder problem than for in-person classes
Some Implications

Online learning with lots of content of varying quality

• Online courses will become the new textbooks
• Content-alone likely to be inexpensive
• Replacement of lecture function of instructors by master online lecturers?
  • Perhaps with customization?

• Harder to predict what happens in credentialing:
  – Certification of post-degree professional education exists; clear value in some fields
  – Likely to be high variability in quality of certification:
    – Perhaps standard online lectures with customized certification as a model?
    – Big question: what happens in the undergraduate space?

– Big Unknowns:
  – Will certification of a “program” be a competitive alternative to full degree credentialing (disaggregation of degrees):
    • Evidence on both sides
      • No: Lower value attributed to incomplete degrees
      • Yes: Existing certification programs for specific skills
      • Be cautious: Lesson from the music industry: songs replaced albums despite resistance!
Surfing the Tsunami

- My thought: better to face the future than hide from it
  - Technology has disrupted many other endeavors
  - Sometimes positively & sometimes negatively
  - Explore how to use online teaching technologies to improve learning and better manage costs

- Surfing a big wave is unpredictable

The Great Wave Off Kanagawa, Hokusai, 1830-1833
## Stanford’s History in “Online” (AKA Distance) Education

<table>
<thead>
<tr>
<th>Project</th>
<th>Date</th>
<th>Delivery</th>
<th>Style</th>
<th>Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITN: online masters courses</td>
<td>1960s</td>
<td>CC TV</td>
<td>Sync</td>
<td>1,000s</td>
</tr>
<tr>
<td>Tutored videotape</td>
<td>1970s</td>
<td>Videotape</td>
<td>Semisync</td>
<td>100s</td>
</tr>
<tr>
<td>EPGY: advanced HS/AP</td>
<td>1980s-</td>
<td>Online</td>
<td>Async</td>
<td>1,000s</td>
</tr>
<tr>
<td>SCPD: exec ed, certificate</td>
<td>1990s</td>
<td>Internet</td>
<td>Semisync</td>
<td>10,000</td>
</tr>
<tr>
<td>AllLearn (Stanford, Yale, Princeton)</td>
<td>2000s</td>
<td>Internet</td>
<td>Async: no eval.</td>
<td>100s</td>
</tr>
<tr>
<td>Stanford Online HS</td>
<td>2000s</td>
<td>Internet</td>
<td>Semisync</td>
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<td>2007</td>
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<td>Stanford Massive Online</td>
<td>2011</td>
<td>Internet</td>
<td>Semisync/Async</td>
<td>100,000s</td>
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