Online Education: The Coming Tsunami?

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Historical Context

- From 1150 to 1450, universities doubled every 100 years
- At that rate, would be 2,000 now. There are 20,000!
- Printing press (1450) led to an explosion in universities
  - Rate of growth of books (or manuscripts before 1450):
    - 5x growth from 12th to 15th century;
    - 200x growth from 15th to 18th
  - Cost of 100 volume library
    - 14th century: 25 years of wages
    - 21st century: 20 days of wages
- Instructors replaced books as driving cost in education
The Cost of Higher Education

Source: Archibald & Feldman, Why Does College Cost So Much?
Two Big Problems in Cost/Performance of Education

1. Poor Performance
   - Massive shortage of qualified instructors worldwide
     - 8-12 in US in science and math
     - Higher education throughout developing world
   - Goal: provide access: “good” education at “low” cost

2. High performance is too costly for many

   1. Emerging and growing problem in US higher education
      - Instructors drive costs
        - If we simply increase student/teacher ratios: quality drops.
      - Role of technology: Drive down cost of high quality (bend cost curve)
Can Technology Really Change Education?

- Online technologies may change education disruptively
  - Untrue in the past!

- Why now?
  - Widespread, high bandwidth connectivity
  - New model 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
  - Desperate need to improve cost-performance of education
## 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>1000s</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>1000s</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>
<td>100s</td>
</tr>
<tr>
<td>Stanford on-campus online</td>
<td>2005</td>
<td>Internet</td>
<td>Semisync</td>
<td>1000s</td>
</tr>
<tr>
<td>Stanford on iTunes</td>
<td>2007</td>
<td>Internet</td>
<td>Async no eval.</td>
<td>1,000,000s</td>
</tr>
<tr>
<td>Stanford Massive Online</td>
<td>2011</td>
<td>Internet</td>
<td>Semisync/Async</td>
<td>100,000s</td>
</tr>
</tbody>
</table>

1,000s completing
Wide Range of Applications of Online Technologies

- Improve traditional large lectures (online vs. live)
- Use faculty time better (flipped classroom)
- Teach traditional courses remotely (done; more?)
- Increase students/faculty maintaining quality
  - Reuse lecture material
  - Eliminate preparation time: redeploy faculty
- Provide certification to large student bodies
  - How? Validity?
  - Quality given the need for automated grading?
- Course material to the world
  - The new form of textbooks
- Full online degree programs: scale, certification?
Learning versus Credentialing

• 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!

• Some educational efforts focus on learning:
  • Kahn Academy, iTunes U, OCW, etc.
  • Important public service, which universities should contribute to.
WIDE VARIETY OF MOTIVATIONS

- Improve education
  - On campus and off
- Generate revenue
  - Will it be significant?
- Enlarge or enhance mission
  - Overcome location or institution size constraints
- Increase availability at an acceptable price point
  - International?
- Profit
Class size & distribution of ability affect learning:

- Some experiences cannot easily replicate at scale:
  - Physical labs, small, interactive courses, intensive feedback courses (e.g., writing intensive courses)
  - Edx is investing in online labs
  - Models exist for online writing instruction with tutor participation
- Ability of instructor (or automated online system) to adapt material for students with widely varied ability is 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
  - Likely to have large drop out or non-completion rates
    - We would normally view these as unacceptable and examine our admissions procedures and the teaching
  - *Very large* investments in content creation could provide more adaptability (unproven but seems obvious).
Quality of credentialing in many fields will be inversely related to class size

1. Assessment must be graded at scale
   - Limits both kind of assignment and level of feedback
   - Peer grading only OK for small-stake assignments

2. Need to have assessment “fit the class”
   - Variability in student capability affects credentialing
     - For example: course is too easy for a Stanford student
     - Assignments and exams do not push the best students and strain the least able
     - MIT 6.002 example: only 1/3 finish first assignment; < 10% complete course
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

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

• Using social media to “be in a class” virtually
  • Group learning situations

• Virtualize labs, projects

• Identification and verification of the source of submitted work
Online learning with lots of content of varying quality

- Online courses will become the new textbooks.
- Content-alone likely to be inexpensive
- Replace of lecture function of instructors by master online lecturers

- Harder to predict what happens in credentialing:
  - Certification for post degree professional education has happened and has clear value in some fields
  - Likely to be high variability in quality of certification
  - Big question: what happens in the UG space?

- Big Unknowns:
  - Will certification of a “program” be a serious competitor for full degree credentialing (disassembly of degrees):
    - Evidence on both sides
      - No: Lower value to incomplete degrees
      - Yes: Existing certification programs for specific skills
      - Be cautious: Lesson from the music industry: songs replaced albums despite resistance!
My thought: better to face the future than hide from it
- Be the disrupter; not the disrupted
- Reduce cost or be eliminated

Stanford’s primary goals:
- Improve education for Stanford students
- Bend the cost curve for others
  - Be a high quality content provider
  - Experiment with online for high quality education & certification available to more students, more cost effectively

Surfing a big wave is unpredictable.