MOOC:
How Big Can Learning Be?

Mung Chiang
Princeton University
Stanford professor resigns, launches Udacity: Free, online, university-level computer science courses

By Mercedes White, Deseret News
Published: Thursday, Feb. 2 2012 12:00 p.m. MST

Stanford Professors Launch Coursera With $16M From Kleiner Perkins and NEA

APRIL 18, 2012 AT 2:00 AM PT

Harvard and MIT Create EDX to Offer Massive Open Online Courses (MOOCs) Worldwide in Harvard, MIT; Online Courses | May 2nd, 2012 | 7 Comments

Amherst says No to edX

Posted on May 2, 2013 by InTheCac

San Jose State University Faculty Pushes Back Against EdX

May 3, 2013

Duke faculty pulls the plug on plan to join online consortium

Posted by Leslie Eastman » Friday, May 3, 2013 at 11:00am

Harvard Professors Raise Concerns over MOOCs’ Threat to Higher Education

WITTEN BY MICHELLE SHUMATE CREATED ON THURSDAY, MAY 3 2013 13:32
July 19, 2013

San Jose State U. Puts MOOC Project With Udacity on Hold

Friday, September 6, 2013

Princeton Professor Pulls Out of MOOC

Georgia Tech To Offer Online Master's Degree For Less Than $7,000

The Huffington Post | By Tyler Kingcade
Posted: 9/16/2013 1:17 pm EDT

Google and edX Create a MOOC Site for the Rest of Us

September 10, 2013, 3:28 pm
I. A Personal Journey of Learning
An Inter-disciplinary Course

20Q
about networked life
Two “Just-in-Time” Textbooks

- Networked Life
  - 20 Questions and Answers
  - Mung Chiang

- Networks Illustrated
  - Principles without Calculus
  - Christopher Brinton
  - Mung Chiang
Going MOOC

• One of six Princeton pilots in Sept. 2012
  – Non-exclusive arrangement with Coursera
• No credits at all
  – Tons of emails complaining about that…
• Khan Academy recording style
  – Tremendous TA help, especially Chris Brinton
• Kudos, VOH, GCH
• 180,000+ students enrolled so far
  – That many people who know eigenvector?
Flipping at Princeton

• Why pay tuition? Class time is for interaction
• One-way lecturing can stay on YouTube.

• “I don’t know what I’m talking about”
  – Better teacher on campus.
• “Same 3-hand”
  – Better student on campus?
• “Did you actually watch the video?”
  – Where is the “new spine” of synchronous learning?
Policy Hot Buttons

• What counts as teaching outside?
• What counts as publishing?
• Who owns IP?
• What counts as class time credit?
• How about teacher-signed certificate?

• Why are we even in MOOC?
  – University leaders, Alumni, Faculty, Staff, Students
  – Potential students
  – Governments, Legislatures
II. Many Dimensions of MOOC
There’s More Than 1 MOOC

• Content provider vs. Platform provider
• Content aggregation vs. Content creation
• Open source platform vs. Closed
• Nonprofit vs. For profit
• Degree, credits, certificate, “nothing”...
Many Types of MOOC

<table>
<thead>
<tr>
<th>Consumer/Producer</th>
<th>Institutions</th>
<th>Individual Teachers</th>
<th>Individual Non-teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutions</td>
<td>Needs accreditation</td>
<td>Georgia Tech/Udacity</td>
<td>Difficult to achieve</td>
</tr>
<tr>
<td>Individuals</td>
<td>Coursera</td>
<td>Udacity</td>
<td>“Fancy” publishing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Goals/Ages</th>
<th>K12</th>
<th>College</th>
<th>Graduate &amp; Professional</th>
<th>Lifelong Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accelerate degree</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Get/switch jobs</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>General education</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Fun</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
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</tbody>
</table>
1. Broad Access and Reduce Cost

[Map of the world]

[Graph showing cost in thousands of dollars from 1973 to 2013 for Private Nonprofit Four-Year institutions in blue and Public Four-Year institutions in red]
2. Roles of University/Faculty

• What’s the physical campus of a university for?
  – A. Drinking at parties
  – B. “Social club” initiation
  – C. Sanity check before branded stamp
  – D. Face to face learning experience

• So, how much can you charge for the service?

• What about students who didn’t dare to apply?
3. Economics

• Revenue (not working out yet)
  – Eyeballs (e.g., advertising)
  – Content (e.g., freemium package)
  – Certificate (e.g., proctored exams)
  – Data (e.g., employment matching)

• Cost
  – Production of content
  – Hosting of content/data
  – Labor by teaching staff: one-time and recurrent
  – Opportunity cost
4. Policy (The 3 A’s)

- **Authentication**
  - Are you who you say you are?

- **Assessment**
  - Self-grade
  - Peer-grade
  - Machine-grade
  - Expert-grade

- **Accreditation**
  - Who approves?
  - Who cares?
5. (Most Importantly) Pedagogy

- New science of learning
  - Distance
  - Asynchronous
  - Massiv
  - Heterogeneous
  - Low (average) engagement
III. Scale Up Learning
# This Isn’t the First Attempt

<table>
<thead>
<tr>
<th>Year</th>
<th>Name</th>
<th>Technology</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1892</td>
<td>Correspondence Learning</td>
<td>Postal mail</td>
<td>University of Chicago created first college-level distance learning program</td>
</tr>
<tr>
<td>1921</td>
<td>Educational Radio Licenses</td>
<td>Radio</td>
<td>FCC began granting educational radio licenses to colleges, allowing education delivery through live radio shows</td>
</tr>
<tr>
<td>1963</td>
<td>IFTS</td>
<td>TV</td>
<td>FCC created Instructional Television Fixed Service (ITFS), allowing broadcast of courses over TV</td>
</tr>
<tr>
<td>1970</td>
<td>Coastline Community College</td>
<td></td>
<td>First college without physical campus, courses mainly broadcasted on TV</td>
</tr>
<tr>
<td>1985</td>
<td>National Technological University</td>
<td>Satellite</td>
<td>Online degree courses via satellite transmission; students could call in and participate in discussions</td>
</tr>
<tr>
<td>1993</td>
<td>Jones International University</td>
<td></td>
<td>First accredited, fully online university</td>
</tr>
<tr>
<td>2002</td>
<td>MIT’s OpenCourseWare</td>
<td>Internet</td>
<td>Free, open, web-based publication of MIT course materials</td>
</tr>
<tr>
<td>2005</td>
<td>Blackboard</td>
<td></td>
<td>Blackboard and WebCT merge to become a leading LMS</td>
</tr>
<tr>
<td>2007</td>
<td>Kahn Academy iTunes U</td>
<td></td>
<td>Non-profit educational site offering video lectures to anyone</td>
</tr>
<tr>
<td>2008</td>
<td>MOOC</td>
<td></td>
<td>Canadian universities</td>
</tr>
<tr>
<td>2011</td>
<td>100K MOOC</td>
<td></td>
<td>Udacity, edX, Coursera, Semester Online...</td>
</tr>
</tbody>
</table>
One Core Challenge

• Is 2014 the year for teaching and learning to become a **scalable** human activity?
  – Is technology ready? (Pretty much)
  – Is pedagogy ready? (Not yet)
  – Are business models ready? (Not yet)
  – Are teachers and students ready? (Not yet)
Scale – Efficacy Tradeoff

Is this possible?

Data from http://www.katyjordan.com/MOOCproject.html
Scale Up: Social Learning

Only 30% of Coursera courses have 1000+ forum-active students
Individualization shows promise over One-Size-Fits-All (OSFA)
Data about Learning

• (massive amount of) Data is
  – Common bridge across research disciplines
  – Essential foundation to data analytics
  – Major (potential) revenue source

• Open access to data presents:
  – Legal issues
  – Business issues
  – Remains a key uncertainty today
What is “Open”? 

- Open content consumption so far 
- Open content creation? 
- Open content packaging? 
- Open policy-setting? 
- Open platform? 
- Open data?
“Science of Learning” Research

- Metrics of efficacy
- Design of experiment
- Personalize
- Recommend
- Incentivize
- Predict
- Model of learning
- Taxonomy/structure of knowledge
Social Learning Networks (SLN)
IV. Scaling Up
Observations About Forum

• Sharp decline rate
  – Impact on social learning

• Information overload
  – Possibility of automatic recommendation

• Not the same as forums like Stackoverflow
  – Focused around one course
  – Both social and tech. discussions
Data

• Summer 2013
• **73 courses on Coursera**
  – 8 vocational courses
  – 29 quantitative (non-vocational) courses
  – 36 other courses
• **115,922 students on forum**
• **171,197 threads**
• **830,000 posts**
Examples

Drug Discoveries Development

Functional Programming

Sustainability of Food Systems
Student Activity & Thread Length

Log–log Plot

- number of users vs. number of posts
- count vs. length of the threads

Log–log Plot

- Log–log Plot of number of posts vs. number of users
- Log–log Plot of length of the threads vs. count
Regression Analysis

- **Quantitative**: smaller initial volume, but slower decline

- **Initial popularity**: light impact on decline rate

- **Teacher participation**: increased volume but similar decline rate

- **Peer-reviewed homework**: much increased volume but slightly increased decline rate

- **More threads** at the same time reduces attention received by each thread
V. Scaling Down
Individualization → Scale

- **Tutor**: (1:1)
- **Lecture**: (1:250)
- **MOOC**: (1:50,000)
- **Individualization**: (200:50,000)
MIIC

- Mobile
  - Meet the challenge of seamless dynamic content modification
- Integrated
  - First system integrating book + lecture + assessment + social learning
- Individualized
  - One course transparently and intelligently turns into “parallel universes”

User Interaction

Behavioral Measurements → Data Analytics → Content/Pres. Adaptation
Student Trials 2013

PageRank: the First Matrix

- \( H \) matrix: \( h_{ij} = \begin{cases} 1/O_i & \text{if } i \rightarrow j \\ 0 & \text{otherwise} \end{cases} \)
- \( \pi \) vector: \( \pi_i = \text{Node } i\text{'s importance} \)

\[ \pi_1[2] = \sum_{j=1}^{n} \frac{\pi_j[1]}{O_j}, \]

i.e., the inner-product of \( \pi \) vector from the previous iteration and the first column of \( H \):

\[ \pi_1[2] = (\pi[1])^T \text{ (column 1 of } H). \]

Similarly,
Prediction

- 3196 students and 69 quizzes, relatively sparse
- Train “neighborhood method”
- 81% score-prediction accuracy so far
VI. This Experiment We Call MOOC
1. Long Timescale

• Will be a long time before we have sufficient data to validate the many hypotheses today.

• **Tiered models** to emerge:
  1. (free) TED talks
  2. $99.95 freshman courses with on-campus tutors
  3. online professional degree
Diverse Expectations

• Extremely diverse set of constituents, with vastly different expectations

• Flipping people is hard
Advancing Pedagogy

• Pedagogical advances need to catch up with business discussions
• Are these millions of people actually learning? What data informs us?
Much More To Learn About Learning
Thank You

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