Using MOOCs to enhance on-campus education
Experience, lessons, and research opportunities

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Presentation to
No way back? Exploring the impact, data and potential of MOOCs

Sponsored by
Association for Learning Technology
Wednesday, November 6, 2013

Also: ITHAKA S+R Sustainable Scholarship Symposium (http://vimeo.com/53361649) (10/16/12)
COURSERA Webinar (http://www.youtube.com/watch?v=v4MKx-SEKr4) (1/17/13)
ABET 2013 Panel titled The Future is Now (4/12/13)
AAUP 2013 Panel on Open Access Textbooks and MOOCs (6/21/13)
COURSERA in TN (http://news.vanderbilt.edu/2013/06/coursera-videos/) (6/24/13)
SEC Deans Meeting (8/1/13), Medical Grand Rounds (9/10/13), VUIT All Hands Meeting (10/2/13)
Andrew W. Mellon Foundation (10/28/13), Association of Research Libraries Leaders Fellowship Institute (11/12/13)
PI Forum on Virtual Environments and Game-Based Learning in the Classroom (11/18/13)
Transforming American Education

Learning
Powered by Technology

National Education Technology Plan 2010
Executive Summary

U.S. Department of Education
Office of Educational Technology

Learning: Engage and Empower
Teaching: Prepare and Connect
Assessment: Measure What Matters
Infrastructure: Access and Enable
Productivity: Redesign and Transform

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A Grand Challenge: Personalized Education

Learning: Engage and Empower

“The model of learning described in this plan calls for engaging and empowering learning experiences for all learners. The model asks that we focus what and how we teach to match what people need to know, how they learn, where and when they will learn, and who needs to learn. It brings state-of-the art technology into learning to enable, motivate, and inspire all students, regardless of background, languages, or disabilities, to achieve. It leverages the power of technology to provide personalized learning and to enable continuous and lifelong learning.”

National Education Technology Plan 2010, Executive Summary
U.S. Department of Education, Office of Educational Technology, p. 10

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Integration by Parts

\[ \int u \, dv = uv - \int v \, du \]

Ex: \[ \int x e^{-x} \, dx \quad \overline{\frac{u}{dv}} \]
More Stanford CS, Entrepreneurship Courses Go Online

November 22nd, 2011 by Erwin Gianchandani

This fall, Stanford launched a highly-publicized experiment in online learning, offering three of its most popular introductory computer science classes — Machine Learning, Introduction to Databases, and Introduction to Artificial Intelligence — through the Web for free. The classes, taught by Stanford faculty, are being held online in conjunction with the regular on-campus courses. And by all accounts, they’ve been a huge hit: over 130,000 people signed up for the AI class, and while the numbers have dropped off considerably now that school is actually in session, some 35,000 students turned in the first three weeks of homework assignments (in addition to the 175 Stanford students taking the class on campus).

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WEEK 2

Flipping the class: “Passive” info reception out of class; active learning in class

To Do (additionally) before Jan 14/15 Quiz: read (a) Sections 2.3 and 2.4, from textbook; watch videos at https://class.coursera.org/db/lecture/index “Querying relational databases” (6 min), and “Relational Algebra” (18 min + 20 min)

QUIZ 1 (Jan 14/15): Quiz 1 (You have 15 min from time of download to complete this quiz;

PLENARY Class meeting (Jan 15): Discussion on Introduction, Relational Model from readings and video to date; watch http://www.youtube.com/watch?v=jbkSRLYSojo and answer post (to Oak Discussions) the questions given here Hans Rosling Database Exercises (week of Jan 13); illustrate study group dynamics; announce project teams and meeting times
Querying Relational Databases

Steps in creating and using a (relational) database

1. Design schema; create using DDL
2. "Bulk load" initial data

https://class.coursera.org/db/lecture/3
In Class Exercises

1. Watch the Hans Rosling video on visualizing data at http://www.youtube.com/watch?v=jbkSRLYSJo (a 4 minute video)

2. Dr. Rosling concludes that the analysis involved plotting “120,000 numbers.” Explain where the 120,000 count came from.

3. List the attributes that you believe must be stored in a database that supports this analysis (and perhaps similar analyses)

4. Give candidate (tentative) relational schema (at least two) for a database that would support this and similar analyses

5. Give three queries in relational algebra over the schema that you give in part 4, which you think would be useful for the video’s analysis or a similar analysis
Since Spring 2012: Have used online lectures by others for

- **Database** (Spring 2012, Spring 2013)
- **Machine Learning** (Spring 2012, Fall 2012)
- **Artificial Intelligence** (Fall 2012)

With following instructor and course ratings on 5 point scale; 3 is “average”

<table>
<thead>
<tr>
<th>Course</th>
<th>Instructor Average</th>
<th>Course Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database (S13)</td>
<td>4.41 (0.69)</td>
<td>4.24 (0.72)</td>
</tr>
<tr>
<td>Database (S12)</td>
<td>4.27 (0.74)</td>
<td>3.63 (0.64)</td>
</tr>
<tr>
<td>Machine Learning (F12)</td>
<td>4.16 (0.68)</td>
<td>4.16 (0.68)</td>
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<tr>
<td>Machine Learning (S12)</td>
<td>4.33 (0.66)</td>
<td>4.22 (0.41)</td>
</tr>
<tr>
<td>AI (F12)</td>
<td>4.25 (0.66)</td>
<td>4.00 (0.70)</td>
</tr>
</tbody>
</table>

Summary Observation: Instructor rating and course rating *means went up* or held steady; *standard deviations went down*; but *beware confounds!*

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Video call out(s) from an AI MOOC in Fall 2012 of MY video

http://www.youtube.com/channel/UCWOFdpEFNuQP3O_JUiwhT8A

Number of Views, top-8 videos

6,353 biggest ‘hit’
4,657
4,533
1,662
1,557
1,471
1,071
1,007 my first ‘hit’

37,262 views total since Fall 2012
119 thumbs up, 3 thumbs down; 73 subscribers

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Why this pattern? (hypothesis – because of MOOCs)
A course that feels like a collaborative effort

Welcome, DougFisher!
Here are all of the courses you currently have access to in Studio:

Artificial Intelligence - Vanderbilt University
BerkeleyX / CS188x-2 / Artificial_Intelligence
Students and faculty can crowd-source textbook creation (here, an example of a lab text by “the community”)

Artificial Intelligence for Computational Sustainability: A Lab Companion

Please see how you can contribute: Guide for Contributors

0. Preface for educators and learners
1. Introduction to Computational Sustainability

AI Chapters
2. State Space Search
3. Constraint-Based Reasoning and Optimization
4. Knowledge Representation
5. Reasoning Under Uncertainty
6. Machine Learning for Prediction
7. Deterministic Planning and Problem Solving
8. Planning Under Uncertainty
9. Machine Learning for Planning and Problem Solving
10. Multi-Agent

Sustainability Chapters
11. Agriculture
12. Behavior and Consumerism
13. Biodiversity and Conservation
14. Climate and Ocean modeling and observation
15. Design, Life-Cycle, and Materials
16. Energy, including Smart Grids
17. Fresh Water Ecosystems and Resources
18. Transportation and Urban Design

http://en.wikibooks.org/wiki/Artificial_Intelligence_for_Computational_Sustainability:_A_Lab_Companion
My video lectures have used slides, licensed for derivations, from course textbook site

Next step (I hope): use nb to enable online annotation. Reinvigorate textbooks by making them environments/contexts for discourse

nb is an annotation taking tool developed by the Haystack Group at CSAIL. Students and Faculty can use nb to annotate arbitrary PDF files online, in a collaborative fashion. nb.mit.edu/about/
The next Machine Learning course I teach will be drawn from multiple sources, including some of my own.

Creative, Serious and Playful Science of Android Apps (UIUC)
Creative programming For digital media & Mobile Apps (U of London)
Web Intelligence and Big Data (IIT, Dehli)
Machine Learning (Stanford)
Machine Learning (U Washington)
Q (Melbourne)
Networked Life (U Penn)
Social Network Analysis (Michigan)

Software Defined Networks (U Maryland)
Malicious Software underground story (U of London)
Interactive Programming (Rice)

Functional Programming Principles in Scala (Ecole Polytechnique)
Heterogeneous Parallel Programming (Stanford)

Cryptography (Stanford)
Applied Cryptography (Udacity)

Gamification (U Penn)
AI Planning (Edinburgh)
Computing for Data Analysis (Johns Hopkins)

Computational Photography (GaTech)
Computer Vision (Stanford/Michigan)
Computer Vision (UC Berkeley)

VLSI CAD: Logic to Layout (UIUC)
Coding the Matrix: Linear Algebra CS applications (Brown)

Creative, Serious and Playful Science of Android Apps (UIUC)
Creative programming For digital media & Mobile Apps (U of London)
Web Intelligence and Big Data (IIT, Dehli)
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AI Planning (Edinburgh)
Computing for Data Analysis (Johns Hopkins)

Computational Photography (GaTech)
Computer Vision (Stanford/Michigan)
Computer Vision (UC Berkeley)

VLSI CAD: Logic to Layout (UIUC)
Coding the Matrix: Linear Algebra CS applications (Brown)
Some questions suggested from this experience

Educational Data Mining

- look beyond individual MOOCs, and mine data in a MOOC’s “solar system” and beyond
- look for correlations between MOOC activity and other online content (e.g., Youtube, Wikipedia)
- intentional content creation (e.g., on Youtube) to fill MOOC gaps
- Other tracking of community growth

Benefits (or not) of MOOCs for on-campus education

- flipping the classroom; course design issues in wrapping a MOOC
- faculty engagement
- Local learning communities within global learning communities “the world is flat” – Thomas Friedman
Customization and Crowdsourcing

Micro-construct customization

- Lessons and courses

Macro-construct customization

- Curricula
Online Computer Science curricula can be customized from courses that are free and online (this slide, some “Basic” courses)

**Introduction to Logic**  
(Stanford)

**Combinatorics**  
(Princeton)

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**Learn to Program:**  
Fundamentals  
(Toronto)

**Introduction to Computer Science 1**  
(Harvard)

**CS 101**  
(Stanford)

**Computer Science 101**  
(Stanford)

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**Learn to Program:**  
Crafting Quality Code  
(Toronto)

**CS 212**  
(Udacity)

**Design of Computer Programs**  
(Udacity)

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**The Hardware/Software Interface**  
(U Washington)

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**CS 215**  
Algorithms:  
Crunching Social Networks  
(Udacity)

**Algorithms Part 1**  
(Princeton)

**“equivalent” alternatives**

**Algorithms: Design and Analysis, Part 1**  
(Stanford)

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A plethora of resources enable customized curricula

- **Introduction to Logic** (Stanford)
- **Combinatorics** (Princeton)
- **Learn to Program: Fundamentals** (Toronto, Coursera)
- **Introduction to Computer Science 1** (Harvard)
- **Introduction to Computer Science 2** (MIT)
- **CS 101** (Stanford)
- **Computer Science 101** (Princeton)
- **Learn to Program: Crafting Quality Code** (Toronto)
- **CS 212** (Udacity)
- **Design of Computer Programs** (Udacity)
- **The Hardware/Software Interface** (U Washington, Coursera)
- **CS 215** (Udacity)
- **Algorithms Part 1** (Princeton)
- **Algorithms: Design and Analysis, Part 1** (Stanford, Coursera)

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October 2012
Opportunities

• Nascent steps towards crowd-sourced curricula

Vanderbilt University and University of Maryland join forces to offer MOOC sequence on mobile app development

by Melanie Moran | Posted on Monday, Sep. 9, 2013 — 7:00 AM

教授于计算机科学的Doug Schmidt在Coursera上录制视频。（Susan Urmy/Vanderbilt）
But local learning communities too

https://www.coursera.org/course/posa

Pattern-Oriented Software Architectures for Concurrent and Networked Software

Adapted from Doug Schmidt
https://www.coursera.org/course/onlinegames

Online Games: Literature, New Media, and Narrative

Jay Clayton

Focused on Tolkien and The Lord of the Rings Online, this course explores what happens to stories and films when they are turned into online games.

Workload: 4-6 hours/week
Taught In: English
Subtitles Available In: English

Sessions:
Sep 9th 2013 (6 weeks long)  Sign Up
Future sessions

Hi Doug:

I can confirm that we have gone live. All of the settings are correct, and it appears that a thousand students have already entered the course (wow!)

I can't even begin to tell you how excited I am for this class. Completely geeking out over here.

Douglas H. Fisher
College: Online Courses, Online Gaming and the One Ring

“IT IS MINE, I TELL YOU. MY OWN. MY PRECIOUS. YES, MY PRECIOUS.”
— J.R.R. TOLKIEN, THE FELLOWSHIP OF THE RING

Part of Delbanco’s work is an attempt to quantify where college goes from here – what does the future hold for higher education? One piece of that emerging story is online courses. Will ideas of Massively Open Online Courses be coupled with classroom instruction or maybe eventually supplant the live lecture?

To further our discussions of college this fall, let’s explore online learning together. Starting Monday, Sept. 9th, through Coursera.org, Prof. Jay Clayton of Vanderbilt is offering “Online Games: Literature, New Media, and Narrative.” The course will discuss what happens to stories as they are turned into films and online games, focusing specifically on The Fellowship of the Ring by J.R.R. Tolkien (along with the Peter Jackson movie and the MMORPG by Turbine). More information can be found here.

Register for the class by this Saturday, Sept. 8th (it’s free) and email Hank Ingram Spouse of House Rick Keuler (rick.keuler@vanderbilt.edu) that you want to be involved. Hank’s House will host movie viewing sessions required by the course and will help those that register secure copies of the reading if necessary. While

http://commonplace.vanderbilt.edu/?i=6856

A recurring theme: local learning communities embedded in global learning community

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Opportunities

- Local learning communities embedded in global community
  ... faculty and alums modeling lifelong learning

10s of 1000s of students Worldwide,

20 faculty, staff, students, alums, and two OSHER students at Vanderbilt
Design Strategies for MOOCs

- Design MOOCs with local learning communities in mind, so that the designs of MOOCs and of local learning “architectures” co-evolve,
  - rather than simply relying on opportunistic, as-is use; to a great extent this is a lesson from the larger, pre-MOOC experience with online and blended learning

- Design MOOCs explicitly for course customization, with material intended to be reused, **remixed**, and revised (this seems a very novel suggestion).
  - Even those aspects of MOOCs that are consistent with remixing (e.g., short videos), are done for other reasons (e.g., student attention span), rather than with customization in mind *per se*

- Design MOOCs with research opportunities in mind, in areas such as educational data mining and human-computer interactions (though we are seeing more of this),
  - Rather than simply opportunistic, after-the-fact hypothesis generation
Strengths

• Disruption: undergraduate education in the national spotlight
• Disruption: made scales of openness and size explicit
• Changing Faculty Roles: active learning (flipping the class)
• Faculty must “up their game” (on the education side)
• Access to Higher Education (for those formally without)
• Branding and recruitment (for institutions and individuals)
• Proliferation of Online Content
  content creation and sharing by faculty and students
• Learning about learning
  educational data mining (which started before MOOCs)
Weaknesses

- High costs (time and money) to start up
- Non-uniform student population (prerequisite satisfaction)
- Many students isolated (apropos “drop-out” rates)
Processes and Costs

• Start-up costs, including studios (10s of $1000s)

• Course design (CfT) and pre-production reviewing for quality, copyright (library), cultural sensitivities

• Production
  Monetary Costs (faculty release, supplements)
  Iteration with course design

• Offering
  Instructor involvement, TAs,
  real-time revision of material

• Post Course assessment and revision and reoffering

“A general filmmaking rule I learned at Vandy, and have experienced in my own work, is that every minute of final video will require, at bare minimum, one hour of editing; i.e. a 10-minute video will take at least 10 hours to edit. I’d say that combining my and <the instructor’s> effort on these videos will yield at least 300 hours of work” One of our dedicated videographers
Opportunities

• Engaging alums, as lifelong learners, TAs, mentors, and instructors
  Non-uniform population not all bad, if planned for

• Recruiting help (TAs, tutors) through the online population
  (http://cloudandcampus.blogspot.com/2013/05/finding-best-teaching-assistant-in-world.html)

• Continuous improvement (using global population for feedback)

• Students can cheaply sample new subjects

• Across-institution created MOOCs (e.g., on Sustainability)

• Local learning communities (e.g., on campus courses)
  embedded in global community
  students directly benefitting from feedback
  student awareness of cultural differences
  student awareness of global competitiveness
  faculty and alums modeling lifelong learning

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Opportunities

• Will computing technologies and educational expertise combined to promote *personalized learning at scale*, allow assessments (e.g., ABET), both “pre-visit” and “visit”, to be done “automatically”, while still
  
  • thoroughly
  • consistently
  • efficiently

in say, 10-20 years?

Technology will beg data collection and (perhaps) a deep infusion of Assessment! (e.g., see Vanderbilt’s Knowledge Map: http://knowledgemap.mc.vanderbilt.edu/research/content/knowledgemap-km-web-application

• Generally, *increasing bang for the buck* can involve

  • *reducing the buck*, which is way above my pay-grade and currently very controversial

  • *increasing the bang* (e.g., MOOCs for lifelong and life-wide learning, involving campus students in global discourse), and often at my discretion (e.g., MOOCs to satisfy course prerequisites)

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Threats

• Changing faculty roles: educational “factories”
• Quality control (poor quality broadcast to the World)
• Conflicts of commitment (unbundled universities)
• Cheating
• The demise of textbooks (but see text annotation tools)
• Intellectual property
List of Courses that used MOOC material

https://my.vanderbilt.edu/cs260/  Undergraduate AI ... used lecture material from Web, including my own

https://my.vanderbilt.edu/cs360fall2012/  Graduate AI ... no MOOC material per se, but students required to produce a video lecture on undergraduate AI content of a Tutorial nature

https://my.vanderbilt.edu/cs390fall2012/  Graduate Machine Learning course, true wrapper, requiring satisfaction of COURSERA/Stanford MOOC course and additional reading and project

https://my.vanderbilt.edu/cs265/  Undergraduate Database, using COURSERA/Stanford Lectures (required in S12, now optional, waiting to see how user agreements settle out)

Other Links

YouTube channel of my online content:  
https://www.youtube.com/channel/UCWOFdpeNuQP3O_JUiwhT8A?feature=mhee

A narrative summary of my experience “Warming up to MOOCs”  http://chronicle.com/blogs/profhacker/warming-up-to-moocs/44022

Workshop on Multidisciplinary Research for Online Education:  http://www.cra.org/ccc/visioning/visioning-activities/online-education/286-multidisciplinary-research-for-online-education-workshop


Learning on Campus and in the Cloud blog:  http://cloudandcampus.blogspot.com/