Incorporating MOOCs and other Online Resources into On-Campus Courses

Douglas H. Fisher
Director of the Vanderbilt Institute for Digital Learning
Vanderbilt University
Nashville, TN

Developed from various invited presentations, including

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)
Outline

• My experience with using MOOCs for supporting blended (online and face-to-face) learning

• My experience creating online content, designed for my on-campus students, but also used by students of MOOCs and others

• Customization using on-line material available to the community of instructors and students

• “A MOOC is NOT a textbook”, and other concerns about the online education movement

• “Undergraduate education in the national spotlight”, and other exciting consequences of the online movement

• Questions of design, practice, and research
Outline

- My experience with using MOOCs for supporting blended (online and face-to-face) learning
- My experience creating online content, designed for my on-campus students, but also used by students of MOOCs and others
- Customization using on-line material available to the community of instructors and students
- “A MOOC is NOT a textbook”, and other concerns about the online education movement
- “Undergraduate education in the national spotlight”, and other exciting consequences of the online movement
- Questions of design, practice, and research

Douglas H. Fisher
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
In Class Exercises

In Database class, 'flipping' enabled small-group problem solving and/or treatment of larger scale database designs that illustrated the concepts.

1. Watch the Hans Rosling video on visualizing data at http://www.youtube.com/watch?v=jbkSRLYSOjo (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
Brief history with (other professors’) MOOCs

Since Spring 2012: Have used online lectures by others for

- **Database** (Spring 2012, Spring 2013 *with caveat*)
- **Machine Learning** (Spring 2012, Fall 2012 was full *wrapper*)
- **Artificial Intelligence** (Fall 2012)

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

- **Database** (S12)  Instructor Average: 4.27 (0.74)  Course Average: 3.63 (0.64)
  pre-MOOC use: 4.00 (0.95)  from Spring 2011  3.41 (1.11)

- **Machine Learning** (S12)  Instructor Average: 4.33 (0.66)  Course Average: 4.22 (0.41)
  pre-MOOC use: 3.83 (0.89)  from Spring 2006  3.66 (1.11)

- **Machine Learning** (F12)  Instructor Average: 4.16 (0.68)  Course Average: 4.16 (0.68)

- **AI** (F12)  Instructor Average: 4.25 (0.66)  Course Average: 4.00 (0.70)
  pre-MOOC use: 4.25 (1.03)  from Fall 2011  4.05 (0.72)

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

* Videos optional in 2013 (because of concerns with Terms of Service)
** Stanford course on COURSERA required (lectures, programs, quizzes) for Vanderbilt course – obtained written approval, consistent with Terms of Service

Douglas H. Fisher
Outline

• My experience with using MOOCs for supporting blended (online and face-to-face) learning

• My experience creating online content, designed for my on-campus students, but also used by students of MOOCs and others

• Customization using on-line material available to the community of instructors and students

• “A MOOC is NOT a textbook”, and other concerns about the online education movement

• “Undergraduate education in the national spotlight”, and other exciting consequences of the online movement

• Questions of design, practice, and research

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

Example: scheduling activities

Variables: A, B, C, D, E that represent the starting times of

thanks! You also helped me with cs188 6 days ago

Thanks! Just helped me figuring this out! I'm taking this online classes edx.org/courses/BerkeleyX/CS188.1x/2012_Fall
And was struggling to understand the other professor...

106 thumbs up, 3 thumbs down; 62 subscribers

Douglas H. Fisher
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/
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
Outline

• My experience with using MOOCs for supporting blended (online and face-to-face) learning

• My experience creating online content, designed for my on-campus students, but also used by students of MOOCs and others

• Customization using on-line material available to the community of instructors and students

• “A MOOC is NOT a textbook”, and other concerns about the online education movement

• “Undergraduate education in the national spotlight”, and other exciting consequences of the online movement

• Questions of design, practice, and research

Douglas H. Fisher
The next Machine Learning course I teach will be drawn from multiple sources, including some of my own.

- **Functional Programming Principles in Scala** (Ecole Polytechnique)
- **Malicious Software underground story** (U of London)
- **Interactive Programming** (Rice)
- **Crytography** (Stanford)
- **Computer Vision** (UC Berkeley)
- **Applied Cryptography** (Udacity)
- **Computing for Data Analysis** (Johns Hopkins)
- **Coding the Matrix: Linear Algebra CS applications** (Brown)
- **Software Defined Networks** (U Maryland)
- **Heterogeneous Parallel Programming** (Stanford)
- **Interactive Programming** (Rice)
- **Crytography** (Stanford)
- **Machine Learning** (U Washington)
- **Machine Learning** (Stanford)
- **Gamification** (U Penn)
- **AI Planning** (Edinburgh)
- **Social Network Analysis (Michigan)**
- **Web Intelligence and Big Data** (IIT, Dehli)
- **Creative, Serious and Playful Science of Android Apps** (UIUC)
- **Computer Vision and Video** (Duke)
- **Image and Video** (Duke)
- **Computational Photography** (GaTech)
- **VLSI CAD: Logic to Layout** (UIUC)
- **Douglas H. Fisher**
- **community**
- **customization**
- **Networked Life** (U Penn)
- **Creative programing For digital media & Mobile Apps** (U of London)
Community resource repositories: One example

http://www.teachingtree.co/

Supporting customization and online textbooks, and steps towards online educational social networks

Douglas H. Fisher
Iterative Deepening Depth First Search

ORDER OF EXPANSION: A B D H I 0

Initialize Frontier = {I, E, C}
I removed from Frontier
I is not a Goal
I at max depth

Related Concepts
- Depth-Bounded Search
- IDDFS Search Tree
- Iterative Deepening Complexity
Online Computer Science curricula can be customized from courses that are free and online (this slide, some “Basic” courses)

<table>
<thead>
<tr>
<th>Introduction to Logic (Stanford)</th>
<th>Combinatorics (Princeton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learn to Program: Fundamentals (Toronto)</td>
<td>Introduction to Computer Science 1 (Harvard) and 2 (MIT)</td>
</tr>
</tbody>
</table>

“equivalent” alternatives

<table>
<thead>
<tr>
<th>Learn to Program: Crafting Quality Code (Toronto)</th>
<th>CS 212 Design of Computer Programs (Udacity)</th>
</tr>
</thead>
</table>

“equivalent” alternatives

The Hardware/Software Interface (U Washington)


“equivalent” alternatives

Douglas H. Fisher
An Online Computer Science Curriculum (Core)

- Algorithms Part 2 (Princeton)
- Algorithms: Design and Analysis, Part 2 (Stanford)
- Automata (Stanford)
- Programming Languages (U Washington)
- Compilers (Stanford)
- Pattern-Oriented Software Architectures (Vanderbilt)
- Design of Computer Programs (Udacity)
- Software as a Service (UC Berkeley)
- Introduction to Databases (Stanford)
- Computer Architecture (Princeton)
- Computer Networks (U Washington)
- CS188.1x Artificial Intelligence (UC Berkeley)
- CS373 Artificial Intelligence (Udacity)

Douglas H. Fisher
An Online Computer Science Curriculum (Technical Electives)

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)
Discrete Optimization (Melbourne)
Networked Life (U Penn)
Social Network Analysis (Michigan)
Software Defined Networks (U Maryland)
Malicious Software underground story (U of London)
Interactive Programming (Rice)
Gamification (U Penn)
AI Planning (Edinburgh)
NLP (Stanford)
Coding the Matrix: Linear Algebra CS applications (Brown)
Functional Programming Principles in Scala (Ecole Polytechnique)
Heterogeneous Parallel Programming (Stanford)
Crytography (Stanford)
Applied Cryptography (Udacity)
Computing for Data Analysis (Johns Hopkins)
VLSI CAD: Logic to Layout (UIUC)
Computer Vision (Stanford/Michigan)
Computer Vision (UC Berkeley)
Computational Photography (GaTech)
Image and Video (Duke)
Douglas H. Fisher
An Online Computer Science Curriculum (Technical Electives)
October 2012
An Online Computer Science Curriculum
Tech/Soc

Writing in the Sciences
(Stanford)

Sci, Tech, Soc in China
(Hong Kong)

Computational
Investing
(GaTech)

Internet History, Technology, and Security
(Michigan)

Securing Digital Democracy
(Michigan)

How to Build a Startup
(Udacity)

Information Security and Risk Management in Context
(U Washington)

Online Games: Literature, New Media, and Narrative
(Vanderbilt)

Specialized and Tutorial

MySQL Databases For Beginners
(Udemy)

Differential Equations
(Khan Academy)

Sciences, Humanities, Arts

few thus far, but enough To fill out a “major”

October 2012

Douglas H. Fisher
Outline

• My experience with using MOOCs for supporting blended (online and face-to-face) learning

• My experience creating online content, designed for my on-campus students, but also used by students of MOOCs and others

• Customization using on-line material available to the community of instructors and students

• “A MOOC is NOT a textbook”, and other concerns about the online education movement

• “Undergraduate education in the national spotlight”, and other exciting consequences of the online movement

• Questions of design, practice, and research

Douglas H. Fisher
What had concerned me

- What would I do in class if not lecture? (happily, I ended up enjoying “flipping” the class, using active learning methods)
- What would students, faculty, and Vanderbilt think of my “outsourcing” lectures?

My responses to my concerns

- Create my own content, so that I just don’t take, but I “give back”
- Cast a MOOC as a “multimedia textbook” for purposes of acceptance

What concerns me (and/or others)

- MOOCs of today are NOT “multimedia textbooks” – they support “just-enough” learning
- Lack of incentives (e.g., reputation, financial) to create open-source content
- Intellectual property – copyright, licensing, patents (a concern of many)
- Academic integrity (but I think that disruption so far has been positive)

Douglas H. Fisher
A MOOC is NOT a Textbook

- (I now know that) MOOCs of today are NOT “multimedia textbooks”, though they have been cast that way to promote acceptance

- A MOOC supports “just-enough” learning (some would justifiably say “just-in-time” learning)

- In contrast, a good textbook
  
  ... is inclusive of knowledge and exceeds the knowledge that any one course/instructor would cover;

  ... synthesizes knowledge from multiple sources, aspiring to create a big picture with common terminology and complementary components; and

  ... supports course customization by each of the many faculty who will adopt the textbook.

- A MOOC is intended as a course, not a textbook, though it can be part of the community resources from which multimedia textbooks arise

- Open-source, multimedia textbooks will be emerge as community members skilled at synthesis “step up to the plate” to synthesize across the online resources

Douglas H. Fisher
Outline

• My experience with using MOOCs for supporting blended (online and face-to-face) learning

• My experience creating online content, designed for my on-campus students, but also used by students of MOOCs and others

• Customization using on-line material available to the community of instructors and students

• “A MOOC is NOT a textbook”, and other concerns about the online education movement

• “Undergraduate education in the national spotlight”, and other exciting consequences of the online movement

• Questions of design, practice, and research

Douglas H. Fisher
What gets me excited about unfolding online activity

• Higher education, particularly **undergraduate education, is in the national spotlight**, among faculty, students, parents, and alums

• I feel in **community** with other educators (for first time in 25 years teaching); students see community embraced by their instructors – **a scholarly community**

• **Content creation**, by me **and by students**,

• **Open source** for content and infrastructure (e.g., edX, Open Learning Initiative)

• Professors and alums in learning community, **modeling lifelong learning**

• **Students can sample new areas cheaply** (even with 10s of $1000s in tuition!!!)

• **Local and global learning communities, and interaction between them**

• **Across-institution MOOCs** (yet more community) **e.g., Sustainability**

• **Learning about learning** (e.g., Workshop on Multidisciplinary Research for Online Education – see link on final slide)

• Even greater **customization** across courses and curricula (the response to “just enough” material – a true “multimedia textbook” results from community)

Douglas H. Fisher
Example of Distributed Shared (Across-institution) Course

Build on our previous course development activities (e.g., the highly interdisciplinary and popular “State of the Planet” course at Cornell) by developing a distributed shared course across many institutions.

Exploit existing infrastructure to develop and host courses

Virtual technology to manage lectures, and formal and informal discussion groups

Instill a commitment to place through local and regional “super sections,” with course activities customized to regional challenges.

One general theme: what will my region be like in 40 years?
Possible participants in the Middle Tennessee super section of the State of the Planet MOOC (e.g., organized around watershed)

Local themes:
- flooding,
- green spaces,
- historic districts

Regional themes:
- water quality,
- invasive species,
- climate change

Possible non-academic partners:
- Non-Profits,
- Governments,
- Corporate advisors on local and regional issues

Local content use and creation, within context of global course
Outline

• My experience with using MOOCs for supporting blended (online and face-to-face) learning

• My experience creating online content, designed for my on-campus students, but also used by students of MOOCs and others

• Customization using on-line material available to the community of instructors and students

• “A MOOC is NOT a textbook”, and other concerns about the online education movement

• “Undergraduate education in the national spotlight”, and other exciting consequences of the online movement

• Questions of design, practice, and research

Douglas H. Fisher
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

Douglas H. Fisher
Online education for lifelong learning (requiring longitudinal studies)

- Can institutions leverage “MOOCs” to engage alums in lifelong learning, perhaps with special affordances for alums, giving students more bang for their buck over a lifetime?

- Do MOOC students remain better engaged in MOOC courses by the institutions from which they graduated (i.e., is there an “alum effect”)?

- Will faculty and alum learners increase engagement by on-campus students in courses, raising their appreciation of lifelong learning, informal learning, etc.

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)

Douglas H. Fisher
Questions of Practice and Research

Content comparisons (for in-person, online, blended)

• Will lectures that are prepared for the world tend to be better than lectures prepared and reviewed for onsite? (for example)
  Big picture lectures? Big big picture (inspirational) lectures?
  Nuts and bolts lectures? others...
  NOT mutually exclusive ... will they tend to become so???

• Will content creation by students for online and authentic audiences* raise their game
  o in technical and explanatory writing (e.g., for Wikimedia)?
  o communicating implications of technology?
  o in annotation and providing help (e.g., NB**, global discussion)?
  o video creation and lesson planning?
  o communication generally?

Big questions for assessment

Will computing technologies and educational expertise combined to promote personalized learning at scale, allow (ABET) assessments, 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

How will such pedagogically-informed, high-tech systems succeed in different areas, for evaluating

- of technical skills and concepts?
- of systems-level reasoning?
- of writing quality?
- of motivation to engage lifelong learning?
- of collaboration skills and inclination?

Douglas H. Fisher
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/UCWOFdpEfNuQP3O_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/