Bigger is Better? Using MOOC Technology in a Software Engineering Course

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Who Am I?

- Computer science researcher
- Computer science instructor, textbook author
- Practicing software engineer
- Entrepreneur, technical advisor, investor
- MOOC instructor (Berkeley's first, Feb 2012)
- Academic Director for Online Education
- Musician & Music Director for Bay Area theater

What's a MOOC?

- 7-10 minute "lecturelets"
- Self-check questions
- Online quizzes and homework assignments that are *machine graded*
- Discussion forums monitored by TAs
- Synchronous deadlines
- Berkeley has decided to make MC tuition-free and non-credit

Online Education is Not One Thing

- Credit / certificate / degree / noncredit?
- Self-paced / cohort-based?
- Free / tuition?
- Online / live / blended?
- Large or small enrollment?
- Direct instructor interaction / self-serve?
- ***…YES***

Background: an example project from CS 169, Software Engineering

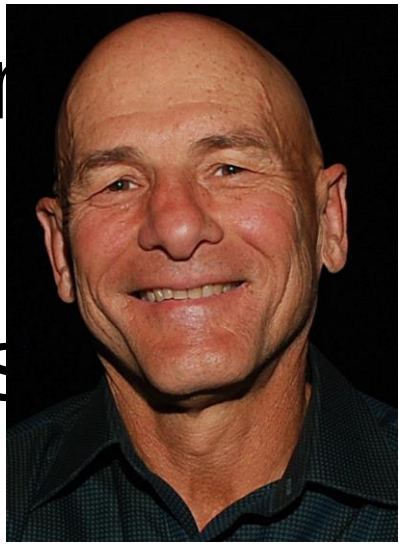
(Children's Hospital Oakland)

https://vimeo.com/59303323


Cal
EECS

Background: Software Engineering (CS 169)

- Modern software engineerin for Software as a Service
- Agile development matches students' schedules
- Uses & teaches Cloud Computing
- Emphasizes testing
- SaaS + cloud are vital the future of software



Prof. David Patterson

Reactions from customers & students

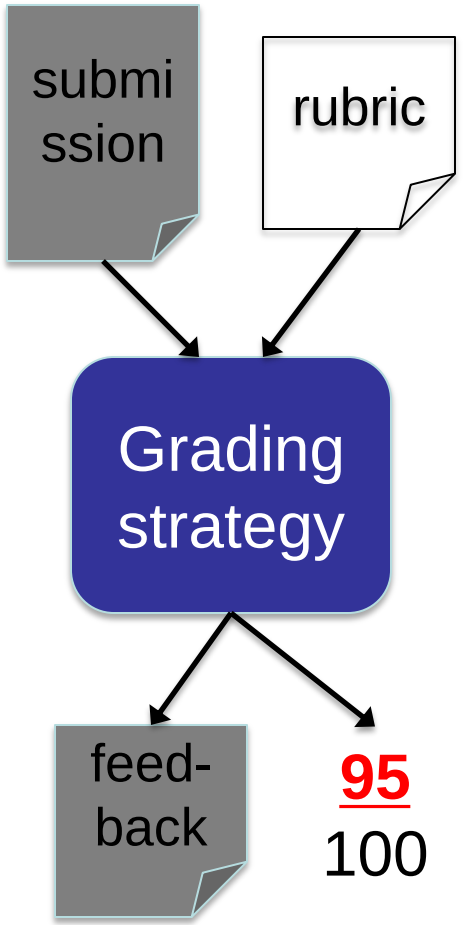
- Customer feedback
  - 92% customers “happy” or “thrilled”, 48% tried to hire students
  - 67% students intend to maintain app regardless
- Course popularity: 35 – 50 – 75 – 110 – 165
  - Highest HKN ratings for course and instructor, with largest offering
- 60% students said we should do everything possible to enroll more students to course

Adapting for a MOOC

- Sophisticated autograders for programming assignments (open source)
- Adapting lectures to 7-10 min segment + peer learning/self assessment question
  - 7-10 min segment + peer learning question
  - 8-10 hrs/week ugrad to convert & format videos
- No design project in MOOC!
- Same HWs, quizzes, deadlines
- Offered 3 times on Coursera, 3 times on EdX, plus new “part II” now on EdX

Autograding Strategies

Submission	Grading strategy
Upload code file(s)	• RSpec (correctness) • [soon] reek/flay (code style)
Upload test case files	• Mutation testing (Amman & Offutt): app with inserted bugs should fail tests
Submit URI of cloud-deployed app (Heroku)	• Remote (cloud-based) integration test using Mechanize
Interactive short-answer/multiple-choice	• Our tools emit both printed & online-format quizzes



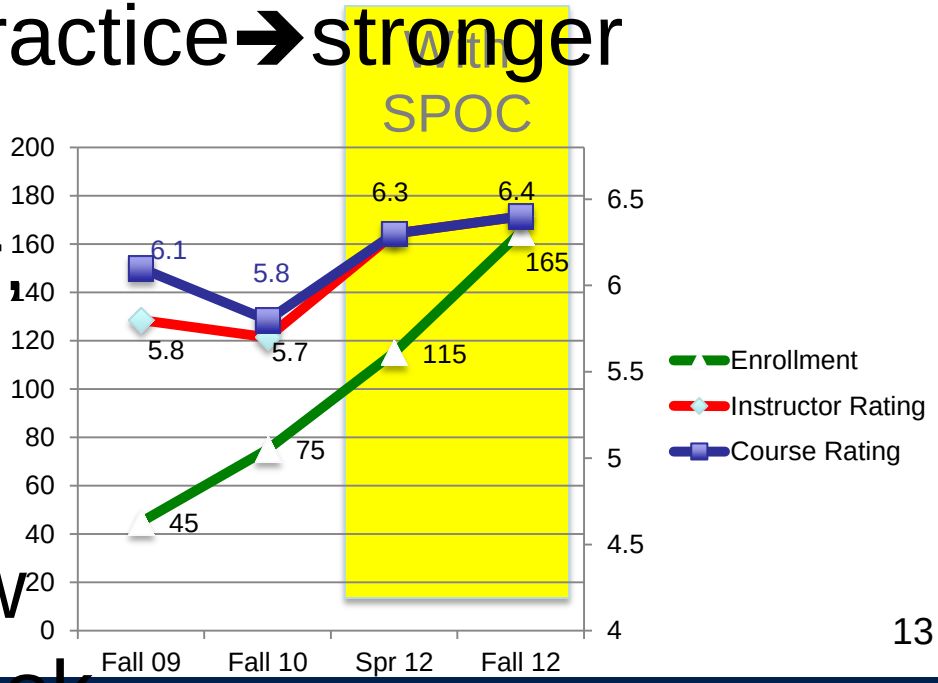
MOOC Myths:
What We Learned From
“CS 169.1x”

Myth :
Universities will use MOOCs to save money by firing faculty & TAs, sacrificing education quality.

Reality: MOOCs can instead save money by improving throughput and *increasing* education quality.

Classroom + MOOC = SPOC
(Small Private Online Course)

- Accommodate increased demand (now admit juniors, vs. turning away graduating seniors)
- Autograders improve instructor leverage, give students more practice➔stronger design projects
- Course ratings higher, despite larger size
- ~800 instructors passed MOOC; 8 now using our SPOC & book

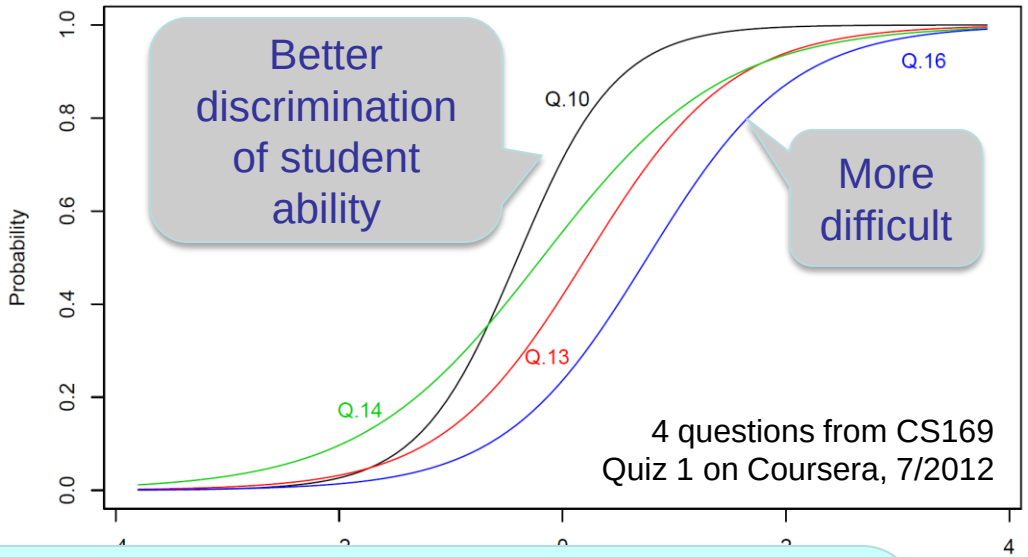


Myth:
MOOCs distract faculty from focusing on improving their on-campus teaching.

Reality: MOOCs can help to improve on-campus courses.

The world debugs your course

- **Item response theory** Predicts probability that a student of a given ability will answer a given question co
- Do
- Ca



Large # of students reduces standard error of question difficulty & discrimination model by 3x-10x.

* Frederic M. Lord, *Statistical Theories of Mental Test Scores* (1968) and *Applications of Item Response Theory to Practical Testing Problems* (1980)

Myth:
MOOCs cannot help courses that rely heavily on faculty-student interaction.

Reality: MOOCs allow faculty & TAs to *shift* resources to the higher-value activity of student interaction.

Enhance, not replace!

- "Autograding cannot replace instructor help"
  - Can it improve student confidence & raise productivity of instructor interactions?
  - C[illegible]
- "Or[illegible] cla[illegible]
  - What foundational skills can online strengthen?
- "Online interaction can't replace face to face"
  - How & why does perceived community in online courses correlate with improve learning

Trying to *substitute* one-for-one is the wrong goal. Ask instead where MOOCs can help the instructor.

* J.C. Richardson & K. Swan, *Examining Social Presence in Online Courses in Relation to Students' Perceived Learning and Satisfaction,* J. Asynch. Learning Networks 7, 2003

Why the M in MOOC matters

- Designing for scale improves classroom experience
  - Autograders allow multiple submissions of homework
  - Highly polished “low touch” infrastructure ensures smooth student experience when learning difficult material
- Better technology transfer to other instructors and other universities
- Large scale enables gathering large amounts of data

Takeaways

- SPOC improved on-campus instruction
- “M” in MOOC allows rest of world to “debug” your courses
- And makes it easier to transfer technology to other universities or instructors
- An immense amount of work, but heavily amortizable

"Everything in education should be about the value that can be added by having the real teacher there.

The mistake is the idea that this [MOOC] replaces the teacher. That's crazy."

—Eric S. Lander, Professor of Biology, MIT, and scientific adviser to President Barack Obama

Nick Anderson, EdX Turns 1: Now What?, *The Washington Post, May 2, 2013*