CSTEM PIPELINE & ONLINE EDUCATION

Meera Sitharam
Feb. 5, 2013
Outline

• Backdrop
• CSTEM pipeline
• Desired Graduation Requirements
• Online Education Issues
• Our Approach
Backdrop

- Skills shortages
- College Completion rates
- Cost of higher education
- Peter Thiel and Pink Floyd
Backdrop: Skills shortages

• Blamed on
  – (Lack of) Education
  – (Lack of) Specialized Training
  – Corporate Squeeze
Backdrop: Skills shortages

• Blamed on
  – Education
  – (Lack of)
  – Specialized Training
  – Corporate Squeeze

After a decade of scrimping on education funding, the nation found itself crippled by skills shortages. People fell over a lot too.
Backdrop: Skills shortages

- Blamed on
  - (Lack of) Education
  - Specialized Training
  - Corporate Squeeze
Backdrop: Skills shortages

- Blamed on
  - (Lack of) Education
  - (Lack of) Specialized Training
  - Corporate Squeeze
    - not hiring; want skilled labor glut;
    - pay too little; H1B quota for immigrant labor
Backdrop

• **Cost of higher education**
  – Suggested solutions:
  – Vocational diplomas
  – Online diploma
Backdrop

- Skills shortages
- College Completion rates
- Cost of higher education
- Peter Thiel and Pink Floyd
Backdrop: Cost of higher education

• Suggested solutions:
  – Vocational diploma mill
Backdrop: Cost of higher education

- Suggested solutions:
  - Vocational diplomas
  - Online diploma mill
Backdrop

• Skills shortages
• College Completion rates
• Cost of higher education
• Peter Thiel and Pink Floyd

We don’t need no education... Hey teacher! leave them kids alone - Pink Floyd, The Wall

I'll pay you to drop out and become a start-up entrepreneur – Peter Thiel
Outline

• Backdrop
• CSTEM pipeline
• Desired Graduation Requirements
• Online Education Issues
• Our Approach
CSTEM Pipeline

- Computer
- Science
- Technology
- Engineering
- Mathematics
CSTEM Pipeline

- **Computer**
- **Science**
- **Technology**
- **Engineering**
- **Mathematics**

**STEM Pipeline — Leaking Badly**

In 2001, there were a bit more than 4 million 9th graders. Four years later, 2.8 million of them graduated and 1.9 million went on to two- or four-year college; only 1.3 million were actually ready for college work. Fewer than 300,000 are majoring in STEM fields and only about 167,000 are expected to be STEM college graduates by 2011.

Source: NCES Digest of Education Statistics; Science & Engineering Indicators 2008
Outline

• Backdrop
• CSTEM pipeline
• Desired Graduation
• Requirements
• Online Education Issues
• Our Approach
Desired Graduation Requirements

• Two Aspects
  ▫ Broad 21st century skills and abilities
  ▫ (beyond solid high school level Science, Mathematics, Humanities and Language skills)
  ▫ Specific Skills for CSTEM minors / majors
Desired Graduation Requirements

• Broad 21st century skills and abilities
• (beyond solid high school level Science, Mathematics, Humanities and Language skills)
• Specific skills for CSTEM minors / majors
Broad 21st century skills and abilities

• Consistent, Efficient Work Habits, Time Management, Goal setting, Organizational skills
• Professionalism: Dependability, Responsibility, Accountability
• Citizenship: Well-developed Ethical and Civic sense
• Creative and independent problem solving in diverse situations, comfortable with ambiguous, open-ended problems
• Critical, Analytic, Quantitative and Computational thinking and problem solving skills
• General resourcefulness, including: ability to use and deal with varying technology platforms
• Team communication and coordination skills: work as team leader on one project and as a team member on another
• Global outlook: exposure to other cultures, and diverse points of view.
Student Requirements

• Broad foundation (21st century CSTEM skills)
• CSTEM minors / majors
Specific Skills for CSTEM major / minor

• Study of focused CSTEM subject area: Approaching, Persisting, and Solving challenging, well-defined problems in that area
• Short-duration internship or capstone exposure to a CSTEM industry project (Industry and Government and Universities should work together to make this happen).
Outline

• Backdrop
• CSTEM pipeline
• Graduation Requirements
• Online Education Issues
• Our Approach
Online Education Positives

- Animated textbook
- Exercises as Games
- Increased access to interaction with worldwide peers and experts
- Open/Crowd sourced development and improvement of a searchable database of instructional material for standardized courses of study
- Large scale student response data (in easily analyzable format) for understanding how people learn
- Flipping the classroom
Online Education Types

• Four types
  ▪ Web-based textbooks with web assignments
  ▪ MOOC (Massive Online Open Courseware)
    - Coursera, Khan Math, Udacity
    - Noninteractive online content (audio + text/video)
    - Interactive robot-graded exercises
    - Peer to peer chat forum/discussion board with/without expert moderator
  ▪ MOOC with phone-in instructor help
    - Florida virtual school
  ▪ Socratic style interactive distance lectures on chatblazer, delivered by one instructor and two helpers, to a class of 30, and 4 hand-graded project assignments.
  ▪ Art of problem solving
Online Education Issues

• Cost

1. Web-based textbooks with web assignments (comparable to textbooks)
2. MOOC  *Coursera, Khan Math, Udacity*  (startup cost, $30K per course, one TA salary for 200 participants, one IT person salary for 1000 participants. For student: free unless discussion participant, need certification etc.)
3. MOOC with telephone access to instructor and some hand-grading. *Florida virtual school* ($500 per student for a semester)
Online Education Issues

- *Without* the standard level of support in large face-to-face courses (An expert prof to run the course and one TA for every 30 or so students)

1. What are the student/content characteristics needed to ensure quality?
2. How are the students to be authentically evaluated and certified at a distance without a proctor?
Online Education Issues

• Answer to Question 1
  – **Student**: well above average resourcefulness, discipline, self-confidence to self-assess learning effectiveness without hand-holding
  – **Course content**: entry level, not requiring depth of conceptual understanding, course just provides some practice and experience (course not major / minor in)

• Answer to Question 2
  – Difficult, unsolved research problem
Outline

• Backdrop
• CSTEM pipeline
• Student Requirements
• Online Education Issues
• Our Approach
Our Approach

• Recall: Desired Graduation Requirements
  – **Broad foundation** (21st century skills)
  – **CSTEM minors / majors**
Our approach

Improving access to **Broad foundation** in 21st century skills:
- K-12 teacher education for *computational thinking* (CT-K-12) and *computer science* (CS-9-12)
- Attracting students to **CSTEM major/minor**:
  - General education course *theory of computation in matter, life, mind, society*. 
Thank you