CSTEM PIPELINE & ONLINE EDUCATION

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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

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- 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
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Backdrop: Skills shortages

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

Backdrop

- Cost of higher education
  - Suggested solutions:
  - Vocational diplomas
  - Online diploma

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Backdrop: Cost of higher education

- Suggested solutions:
  - Vocational diploma mill

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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

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CSTEM Pipeline

- **C**omputer
  - **S**cience
  - **T**echnology
  - **E**ngineering
  - **M**athematics

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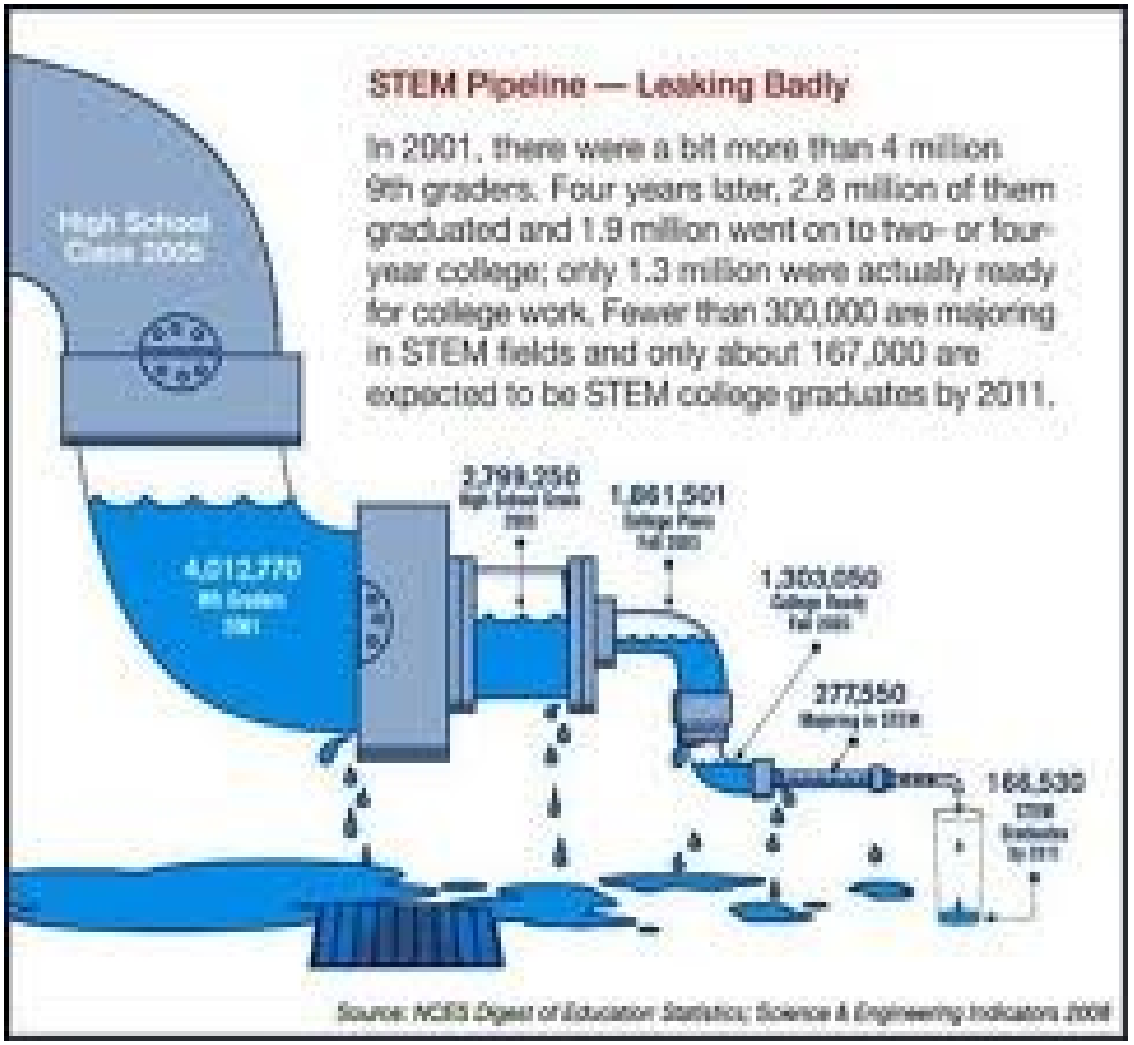

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- Requirements
- Online Education Issue
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Desired Graduation Requirements

- 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
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century skills and abilities

(*beyond* solid high school level Science, Mathematics, Humanities and Language skills)

- 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).

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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

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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