Teaching Engineering Online

A Review of Challenges and Solutions to Teaching Technical Content in Online Courses

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Overview

• Common myths/concerns of online education  
  – Technical content at distance  
  – Laboratories a part of online courses

• Concerns specific to teaching technical content online  
  – Organizing/presenting technical content  
  – Options for teaching laboratories

• Tips for getting started

Introduction

• What challenges have you faced, or are worried about facing?
  
• Common myths/concerns  
  – Enrollment  
  – Quality of learning outcomes  
  – The need for instructors will decline  
  – Security/authenticity

Enrollment

4,600,000  
Colleges require that at least one class online  
By 2014 the number will increase to 18.65 million  
1/2 of 4500 brick-and-mortar colleges are now offering degrees online  
96% of traditional universities now offer some online instruction

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ACCREDITATION OF TECHNICAL DEGREE PROGRAMS ONLINE

ACI Spring 2014 Convention  
March 23 - 25, Reno, NV

Current Practices in On-line Learning

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Quality of Learning Outcomes

- No significant difference
  - Database of literature that compares distance ed outcomes to traditional face-to-face outcomes (>350 papers)
  - Evidence supports that distance learning outcomes are as good or better than face-to-face

Source: http://www.nosignificantdifference.org/

Need for instructors

- Some research (e.g., Sloan-C & Babson Research Group) suggests that online learning increases the need for instructors (e.g., some institutions limit class sizes to 20 or less).
- Another line of research on the Community of Inquiry framework (e.g., Garrison, Anderson, & Archer, 2000) shows that learner-instructor interactions and peer-learner interactions are important components of creating meaningful learning experiences online.

Security/Authenticity

- Services available:
  - Clemson University & ICAI Assessment Guide
  - Random password and security questions
  - Proctor centers
- Other techniques
  - Video conferencing
  - Establishing honor codes

Technical Content Online

- Specific challenges:
  - Complex mathematical and visual models
  - Communicating and engaging students with technical concepts in text-based environment
  - Hands-on laboratories

Choosing the right tech:

- Video/screen capture software (e.g., Jing/Camtasia)
- Tablet PCs
- Smart pen (Livescribe) that links hand-writing to audio

Designing the course for online environment:

- How will students interact with instructor(s)?
- How will students interact with each other?
- What will students be required to learn (e.g., clear and measurable objectives)?
- How will learning materials prepare students for success?

Options for Labs

- Remote labs
  - At-home kit
- Virtual labs
  - Real-time, virtual control of physical lab equipment
- Simulation labs
  - Simulating an experiment through computer software
- Intensive residency periods
  - One or two short periods of time spent in a face-to-face lab
Remote Labs

- **Advantages:**
  - High authenticity

- **Limitations:**
  - Not easily scalable
  - Limited to experiments that use common materials and instruments

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Virtual Lab

- **Advantages**
  - Authentic (generates real data, user makes decisions)
  - Scalable

- **Limitations:**
  - Requires on-site staff for set-up
  - May require more sophisticated equipment than if same lab were performed face-to-face
  - Some of the “hands-on” feel is lost

- **Recommendations:**
  - May be more appropriate for well-established programs

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Simulation Lab

- **Advantages:**
  - Good for illustrating concepts and relationships between variables
  - Real-time feedback without setting up much
  - Scalable

- **Limitations:**
  - Simulated data may not be truly representative of real data
  - Expensive to generate or purchase software

- **Recommendations:**
  - May be best used as pre-lab exercise

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Intensive Residency Labs

- **Advantages:**
  - Use existing laboratory equipment and procedures without additional investment
  - Authentic hands-on lab in supervised environment

- **Limitations:**
  - Requires time commitment and travel that some students may find challenging

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Tips for Getting Started

- **Cost depends on delivery model**

  **Low Cost Model**
  - Modules consist of readings and problem sets from textbook

  **High Cost Model**
  - Modules consist of readings, interactive discussions, supplemental “lecture notes,” demonstrations, examples of complex models, immediate feedback self-evaluation quizzes

  - About $3k for low cost model, up to $50k for high cost model.
  - In general, the goal would be to fall somewhere in between

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**Anecdotal best practices from the MCE program**

- Use short screen casts explain difficult concepts
- **$50 - $1000 for software depending on instruction and needs; free software is available, but with limitations**
- A typical 50-minute lecture will reduce to 2-3 (20-30 minutes total)
- Asynchronous and can be replayed as much as needed.
- Organize content into modules
  - Generally organized into “weeks” for convenience
  - Group learning materials, activities, and assignments into chunks that will help students follow the curriculum and gradually build understanding
Tips for Getting Started

• Anecdotal best practices from the MCE program
  – Incorporate peer interaction
    • Group discussion
      – open-ended questions that encourage students to explore difficult concepts in a way other than plug-and-chug equations
    • Peer review
      – professional skill expected in the work force
  • Group work
    – reinforce teamwork skills for distributed teams

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Thank you!

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