You Can’t Do That!

Teaching Science Online with Real Laboratory Equipment

July 30th, 2014

http://wiche.edu/nanslo
Introduction

• M.S. in Inorganic Chemistry – The Ohio State University
• Ph.D. in Analytical Chemistry – University of Denver
• 20-years in US Air Force
  – 10 years teaching at the USAF Academy
  – 2 years as Co-Director of the Center for Research on Learning and Teaching
• Teaching chemistry for CCCOnline since 2006
• Director of CCCS NANSLO laboratory in Denver since 2012
Adult Learners in Online Science

• Online Science Courses are increasingly popular in the U.S.*
  – Average of 3% growth per year from 2002 through 2011
• Online Enrollments increased from 1.6 million to 6.7 million
  – Science students represented 32% of all online enrollments in 2011 (up from 10% in 2002)

*Source - I. Elaine Allen, PhD and Jeff Seaman, PhD, "Changing Course: Ten Years of Tracking Online Education in the United States", Babson Survey Research Group and Quahog Research Group, LLC., January, 2013

• 60% of online students are over 30 years old
Adult Learners in Online Science

• Why Online?
  – Flexibility
  – Access

• Why Science?
  – To advance their careers
  – Many in healthcare or related fields
  – Almost none of them are going to be scientists
Teaching Science

• What do we want them to learn about science?
  – That scientific principles are accurate – form basis of realistic view of the universe
  – How to conduct a scientific investigation – how the process of science works
Teaching Science

• How? (first year college)
  – We sit them down and tell them things
  – Have them read a textbook
  – We put them into groups (collaboration) in the laboratory and tell them to do things and tell them what to expect (confirmatory testing)
  – We *sometimes* ask them to perform and investigation without clear expectations of the outcome (inquiry-based)
Teaching Science

• Why?
  – Because this method of teaching was developed about 150 years ago during the industrial revolution and hasn’t changed much since then.
  – It’s what we’ve “always done”
Teaching Science Online

• How?
  – Post documents and videos to tell them things
  – Have them read a textbook
  – Use a lab kit to do the same kinds of confirmatory “experiments” that they would do in a traditional lab
  – OR - Make them come to a traditional lab
You Can’t Do That!

• It doesn’t work!
• They aren’t using “real” laboratory equipment
• They aren’t collaborating with other students
• They have no supervision in the “lab”

• Real issue: quality of the data
Remote Science is All Around Us

Hubble Telescope
1990 (23 years)

Little Hercules
2000 (13 years)

Curiosity Rover
2011 (10 years)

Except in the Classroom

Image credit: NASA and NOAA
This Confocal Microscope is Run by a Computer
What is the Difference Between 1m and 1000 km?
Remote Labs...

- Give students access to **real** state-of-the-art lab equipment
  - Let them collect accurate data
- Let students engage in authentic instrumental experimentation
- Allow students to collaborate with classmates
- Prepare students for a future of online science
How do Remote Labs Work?

- RWSL
  - Video Observation
  - Communications
  - Physical Manipulation/Instrument Control
  - Data Acquisition

- Observation
- Manipulation
- Data

Internet (Students)
Lab Equipment
How do Remote Labs Work?

RWSL

- Video Observation
- Physical Manipulation/Instrument Control
- Communications
- Data Acquisition

Observation

Manipulation

Data

Lab Equipment

Lab Technicians

Cameras/JAVA/HTML

Internet (Students)

Voice Conference

LabVIEW
What does this look like?
What does this look like?
What do students see?
What do students see?
What do students see?
NANSLO Advantages

• High quality equipment
• Excellent quality data
• Inquiry-based procedures – Free and Open
• Flexible scheduling
• Access
• Engages students
  – Averaging nearly 50% return on surveys
  – Over 75% of survey comments are positive
  – Most non-positive comments are constructive
• In Colorado: Use of Remote Labs by CCCOnline was critical in creating Articulation Agreements
You Can’t Do That!

• It doesn’t work!
• They aren’t touching things
• They don’t get a sense of physical risk
• We don’t know if this is effective

Real Issues:
• Learning
• Student Access

Yes we can!
Future Plans

• Increasing number of NANSLO Labs
  • Existing:
    ➢ North Island College (Vancouver Island)
    ➢ Denver
    ➢ Great Falls College, Montana
  • Possible Developments:
    ➢ SUNY
    ➢ California State University

• Increasing number of available activities
# Biology, Chemistry and Physics Majors Courses

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<tr>
<th>First Year</th>
<th>Second Year</th>
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<tr>
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Other CCCS Course Options

Non-Majors Courses
- BIO 105
- BIO 106
- CHE 101
- CHE 102
- PHY 105

Additional Majors
- Astronomy
- Computer Science
- Environmental Science
- Geology
Since We Already Use Robots

Lego Mindstorm

Arduino
Astronomy

- Large numbers of students
- Equipment is often already remote-controlled
- Opportunities for science literacy and outreach
Environmental Sensors
Research Courses
Questions?

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