Biology Labs Online
CSU Virtual Labs Project
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CSULA

Professional Learning Community
Virtual Labs
February 19, 2015

If you prefer telephony for the audio portion of the meeting,
1-571-392-7703 and enter PIN 573 610 209 723
Your CSU Course Redesign with Technology Team
Session Outline

● Welcome and Introductions
● An Introduction of and rationale for Virtual Labs
● Examples of Virtual Labs
● The CSULA course redesign project
  ○ Overview
  ○ Pedagogy
  ○ Models
  ○ Demonstration
  ○ Assessment
○ Concluding Remarks
○ Announcements
Session Polling

Polling Question –
Indicate your general awareness of virtual labs.
A. Very aware – I used them extensively
B. Aware – I use them occasionally
C. Somewhat aware – I have not used them
D. Not aware – Want to find out about them
What are virtual labs?

- Online, interactive, and hands-on
- Come in a variety of forms
  - Simulations (e.g. BLOL)
  - Interactive video of real experiments (e.g. SSL)
  - Remote access to remote data
  - Remote control of an experiment
- Many examples are available from a variety of sources (publishers, universities, vendors, foundations, individual educators). Check out http://teachingcommons.cdl.edu/virtuallabs/
Why use virtual labs?

- Improve pedagogy
  - Add opportunities for inquiry-based learning
  - Address difficult lab topics (e.g. evolution)
  - Allow students to make and learn from mistakes!
  - Engage students
- Improve convenience (e.g. 24 / 7 access)
- Address bottlenecks
  - Increase section offerings
    - Less demand for limited lab facilities
    - Lower personnel and equipment costs
  - Lower course repeat rates
Examples of a Virtual Labs

EvolutionLab

Drosophila

BiologyLabsOnline.com

ScienceCourseware.org/vcise/drosophila
The CSULA Course Redesign Project

Overview

- Redesigning a GE biology laboratory course
- Replace traditional labs with engaging inquiry-based exercises
- Assess different modes of delivery
- Two new models of lab instruction vs. traditional:
  - All Labs Online
  - Hybrid Flipped Lab
Assessment

- Hired an assessment evaluator (Dr. Ji Son)
- Pre- and post-course student surveys
- Student Attitudes: BioCLASS Colorado Learning Attitudes about Science Survey (Semsar, Knight, Birol, & Smith 2011)
- Knowledge: Natural Selection Concept Inventory (Anderson, Fisher, & Norman, 2002)
- Research Methodology: Biological Concepts Instrument (Klymkowsky, Underwood, & Garvin-Doxas 2010)
- Performance as reflected by course grades
Model 1 – All Labs Online

- All labs were offered online F13 & W14.
- Drop-in help center staffed 30 hrs/wk.
- Nine virtual labs used.
- Guided experiments designed around course concepts.
- Multiple choice questions to assess their learning.
- For 3 labs, students addressed a scientific problem by
  - formulating a hypothesis;
  - designing and carrying out experiments;
  - analyzing the results;
  - writing a brief scientific report.
Model 2 – Hybrid Flipped Lab

- Flipped lab model: guided assignments at home and higher-level group activities aided by instructors in lab.

- Students met every other week during Sp14 in the physical lab facility where
  - instructor introduced lab topic and software;
  - students discussed in groups the individual virtual lab assignments;
  - students worked in groups to formulate hypotheses, design and run experiments, analyze results, and write a brief scientific report.

- Off weeks, students worked on individual virtual lab assignments similar to Model 1.
Class was divided into two tracks, A and B, which met asynchronously throughout the quarter.

<table>
<thead>
<tr>
<th>Week</th>
<th>Track A</th>
<th>Track B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Intro to virtual lab</td>
<td>No lab</td>
</tr>
<tr>
<td>2</td>
<td>Online exercises</td>
<td>Intro to virtual lab</td>
</tr>
<tr>
<td>3</td>
<td>Group report in lab</td>
<td>Online exercises</td>
</tr>
<tr>
<td>4</td>
<td>Online exercises</td>
<td>Group report in lab</td>
</tr>
<tr>
<td>5</td>
<td>Group report in lab</td>
<td>Online exercises</td>
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<td>6</td>
<td>Online exercises</td>
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<td>8</td>
<td>Online exercises</td>
<td>Group report in lab</td>
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<tr>
<td>9</td>
<td>Group report in lab</td>
<td>Online exercises</td>
</tr>
<tr>
<td>10</td>
<td>No lab</td>
<td>Group report in lab</td>
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</tbody>
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Assessment — Grades

- Course grades were higher in sections that included the hybrid flipped lab.
- There were fewer repeatable grades in sections that included the hybrid flipped lab.
There were statistically significant favorable changes in student attitudes towards the study of biology in courses with sections that included the hybrid flipped labs.

### Mean Percent Change in Positive Attitudes Towards Biology

<table>
<thead>
<tr>
<th>Attitudinal Category</th>
<th>Wet labs</th>
<th>Virtual labs</th>
<th>Hybrid labs</th>
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</thead>
<tbody>
<tr>
<td>Problem-solving difficulty</td>
<td></td>
<td></td>
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<tr>
<td>Problem solving effort</td>
<td>0.08% ± 2.38%</td>
<td>1.32% ± 2.97%</td>
<td>6.97% ± 2.39%</td>
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<tr>
<td>Problem solving strategies</td>
<td></td>
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<tr>
<td>Conceptual connections</td>
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<tr>
<td>Real world connections</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Reasoning</td>
<td>-6.68% ± 2.80%</td>
<td>-4.41% ± 3.59%</td>
<td>2.44% ± 2.29%</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>0.97% ± 2.15%</td>
<td>1.33% ± 2.62%</td>
<td>6.30% ± 1.95%</td>
</tr>
</tbody>
</table>
Assessment — Knowledge

- There were no significant changes in knowledge of evolution when comparing before/after surveys or the different course models.
- There were no significant changes in knowledge of research methodology when comparing before/after or the different course models.
Addressing the Bottleneck

Online labs reduced costs, allowed more students to be served, and had a positive impact on time to graduation.
Conclusion

Virtual labs used with a hybrid flipped lab model have the potential to increase student learning and positive attitudes towards science while simultaneously reducing bottlenecks to graduation.

For more information, visit the ePortfolio at http://tinyurl.com/vlab-eport

(Course materials are available for downloading at this url.)
Announcements

• Links to the recording and slides will be posted on the Virtual Labs website, http://teachingcommons.cdl.edu/virtuallabs/index.html

• Next Vlab PLC Meeting, *Calculus-Based Mechanics with Laboratory*, Fully Online by Dr. Galen P. Pickett, March 19 from 12-1p @ http://tinyurl.com/ATS-ROOM1

• Proven Course Redesign - Adopting Faculty RFP, due February 23rd

• Promising Practices RFP, due March 6th

• CSU Quality Online Learning & Teaching, Awards and Recognition Prog, Call for Submissions through May 15