Course Redesign with Technology
CHEM 100 L Virtual Lab
Survey of General Chemistry Lab

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CHEM 100L Survey of Chemistry Laboratory

- This is a one unit General Chemistry Lab for non-science majors that is offered online. Class Size: 24
- GE Credit: 1.0
- Instructional Delivery: Hybrid, 80% online and 20% in-class instruction.
  - Online component includes 10 Experiments from Latenitelabs.com
  - In-class includes 4 Lab-lectures per semester (3 hours/Lab lecture)
- This course is taken mainly by non-majors, example Business majors, Health Sciences, Radio & TV, Accounting majors etc.
Why Redesign the Course?

- The main goal is to provide a convenient method for students to achieve the same learning goals as regular in-residence lab students.
- Another goal was to reduce the physical laboratory space taken up by the CHEM 100L course.
- There was one VL (Virtual Lab) section offered in Summer of 2015 as a trial. Currently there are four VL sections.
- Pedagogical Approach: Learning activities are constructed so that students discover and build knowledge for themselves and develop an understanding of the scientific method, and learn Chemistry concepts, principles and relationships.
GE Learning Goal 1
Apply scientific methodology through active experimental methods and experiences in laboratory/activity.

• All the virtual Experiments are designed to
  • develop their critical thinking
  • develop their fundamental laboratory skills
  • learn how to obtain and record measurements accurately
  • learn how to analyze data and do calculation
  • interpret data
  • compare results with literature values
  • prove/disprove hypotheses
Latenitelabs Tour
Latenitelabs

- **Http:www.latenitelabs.com**
  - Price 60$/student (manual, quiz included)
  - 10 Experiments: Very similar to the Wet Lab experiments with 7 experiments being same.
  - Students have one week to complete lab

- Mail home Lab kits were tried
  - Elementary and More expensive

- Let’s go to latenitelabs.com
Lab Lectures

- Most effective way of communicating and interacting with students
- Lab lectures are provided on Titanium for each experiment with details of
  - Goals and hypotheses
  - Chemical Principles,
  - Theory
  - Experimental protocols,
  - Results and analyses,
  - Calculations and Graphing
  - Interpreting the results from data
  - Error assessments
  - Discussion of results

- In future,
  - Videos of Lab lectures may be provided
  - Videos of actual experimental set-up in Wet lab could be included
- Let’s take a look at the PPT slides for the Experiments on Titanium (and available on e-portfoli o)
Exams and Assessment
The Wet Lab exams and Virtual Lab exams from Summer 2015 are posted on e-portfolio.

Let’s take a look at one of the exams:
- During the summer, I administered one of the exams as a timed online exam. I found a few students having identical answers, so I have switched to paper exams.

Exams are similar to Short Answer portion of the Labs. Unless students do the lab themselves, it is almost impossible to do well on the exams.

There are 3 written exams worth 30% total of their grade, so they need to pass them to get a passing grade. Written Exams are mandatory.
Wet Lab vs Online Lab Grade Comparison

- Actual exams from Summer 2015 Wet Labs and Online exams are posted on e-portfolio

<table>
<thead>
<tr>
<th>Wet Lab Exam</th>
<th>Average Exam Score</th>
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</thead>
<tbody>
<tr>
<td>Exam 1 in-class exam</td>
<td>71%</td>
</tr>
<tr>
<td>Exam 2 in-class exam</td>
<td>64%</td>
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<table>
<thead>
<tr>
<th>Virtual Lab Exam</th>
<th>Average Exam Score</th>
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</thead>
<tbody>
<tr>
<td>Exam 1 in-class exam</td>
<td>69%</td>
</tr>
<tr>
<td>Exam 2 in-class exam</td>
<td>74%</td>
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<tr>
<td>Exam 3 online exam</td>
<td>83%</td>
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Student Comments

- Mostly Positive (all posted on e-portfolio)
- The students grade distribution was similar to the Wet Lab grades. Of the 23 students,

<table>
<thead>
<tr>
<th>Grade</th>
<th>Count</th>
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<tbody>
<tr>
<td>A's</td>
<td>3</td>
</tr>
<tr>
<td>B's</td>
<td>7</td>
</tr>
<tr>
<td>C's</td>
<td>11</td>
</tr>
<tr>
<td>D's</td>
<td>2</td>
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- Some SOQ comments (All SOQ’s posted on e-portfolio)
  - Online lab is a great way, safe and no waste
  - The labs were not extremely difficult, but would still take some independent learning to carry out correctly. Exams adhere to course contents and lecture - there was never anything surprising. The reading was very manageable.
  - Highly suggest continuing these online labs! They were really fun! I had so much anxiety going into this course for I am not great at chemistry, but when I found out it was an online chemistry lab course I was able to actually have fun while doing each lesson and was not stressed at all!
  - It is difficult and time consuming, but overall it is an interesting class
  - She was very encouraging and helpful throughout the class meetings.
  - The labs were very user friendly and easy to navigate through considering I am not very good at Chemistry!
GE learning Goal II
Evaluate the validity and limitations of theories and scientific claims in interpreting experimental results.

- The Lab results are analyzed by comparing with literature values provided.
- Students submit answers to questions online that
  - test the understanding of the data collected,
  - the reasons for the data collection and
  - the interpretation of the results
  - Reasons for errors and deviation within limits
The Latenitelabs requires students to submit Lab Reports in accepted scientific writing formats and scientific notations and correct significant figures.

- These are graded and feedback is given online

In addition, students have written exams during Lab lectures
Reflection

• Pros

  ◦ Students did receive a good theoretical understanding of how the scientific method is implemented in every experiment.
  ◦ Lab lectures essential for communication
  ◦ Most of them understood the reason for performing common experimental techniques and how they achieved the goals.
  ◦ Were they to implement these in a real lab later, there may be a training period required to teach them to use of the actual glassware and equipment, however, the experimental protocols, methodologies and analyses would be easier for them to undertake after taking this online lab.

• Cons

  ◦ The major set-back in this class was students forgetting the online deadlines. Improved with email reminders.
  ◦ The program does not have randomized error generation capability. So it is an ideal set-up in a sense.
  ◦ Students also don’t learn safety measures or handle actual lab equipment. Simulated Labs.
  ◦ Experiments lack tactile and sensory perceptions.
Thank You!
Questions?