Redesigning the General Chemistry Laboratory Experience

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About the Course
- First-Semester General Chemistry (CHEM 111) is the foundational course in chemistry for science and engineering students.
- Completion of CHEM 111 is in excessively high demand because it is an introductory pre-requisite for many different courses among numerous majors of study.
- The only mandated pre-requisite for enrollment is completion of the Entry Level Mathematics (ELM) requirement.

About the Students
- Juniors 19%
- Sophomores 29%
- Freshmen 32%
- Seniors 18%

Chemistry 15%
Physics & Animal Sciences 15%
Other 15%
Health Sciences 15%
Biology 17%
Engineering 27%

50% First Gen, 45% Pell Eligible, 35% Underrepresented Minorities

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Student Population vs Grade

The Need for Redesign
- A consistent DFW rate of around 30%
- Distinct and bleak achievement gap for underrepresented minorities

Redesign Goals
- Our overarching goal is to provide an enhanced first-semester General Chemistry laboratory experience that will result in:
  - Strengthening the learning outcomes of the course
  - Increasing the success rate of the course and decreasing the achievement gap

This enhanced lab experience for students will result from:
- Improved preparation for lab
- Deeper understanding and exploration of the experiments
- Recognizing the application of lecture content in the lab

The Redesigned General Chemistry Laboratory Experience

PREVIOUSLY
- Lab Experiment Manual
  - Originally published in 1977 by external authors
  - Costs >$100, must be new for empty report sheets
  - Required multiple announcements

- Pre-Lab Assignment
  - Assigned reading from lab experiment manual

- Pre-Lab Assignments
  - Students turned in their completed questions at the start of lab
  - Questions were graded and returned the following week

- In-Lab Lectures
  - Given by laboratory instructors every week

- Laboratory Experiments
  - Had not been updated in nearly 10 years

CURRENTLY
- Lab Experiment Manual
  - Developed in-house for our needs
  - Costs $30, with $5 going to chemistry club

- Pre-Lab Preparation
  - Completion of a virtual lab experiment, or
  - Watching an instructional video, or
  - Assigned reading

- Pre-Lab Assignments
  - Students complete online as a Blackboard Test
  - Instant feedback provided
  - Reduced grading for instructors

- In-Lab Lectures
  - Weeks #1-6 given by laboratory instructors
  - Weeks #7-15 given by student groups

- Laboratory Experiments
  - Replaced several experiments with ones developed in-house
  - Added experiment with analysis of Alka-Seltzer® to add relevance and real-world application

Preliminary Findings

Lab Manual Purchases

<table>
<thead>
<tr>
<th></th>
<th>Fall 2016</th>
<th>Spring 2018</th>
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<tbody>
<tr>
<td>Students who Purchased Manual</td>
<td>85%</td>
<td>100%</td>
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<tr>
<td>Average Manual Cost</td>
<td>$122</td>
<td>$30</td>
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Lab Scores

Total Lab Write-Up Scores

Pre-Lab Question Scores

Initial Feedback
- Students
  - Previous students requested videos and better visuals in manual; both were incorporated
  - Experienced technical issues with virtual labs
  - Students favor instructional videos over virtual labs

Instructors
  - “Online prelabs – How do I love them, let me count the ways.”
  - “Manual is written much better than previously.”
  - Unique implementations of student presentations

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