Adapting, Remixing, and Adopting an OER in General Chemistry I and II

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Visit the CHE 201 text by scanning the code above or visiting http://goo.gl/eUsMpu

Visit the CHE 202 text by scanning the code above or visiting https://goo.gl/gwf8kv

Abstract

Through the generous support of the OIT library and Open Oregon, General Chemistry I and II (CHE 201 and 202) at Oregon Institute of Technology has been able to switch to OER texts this academic year. It is estimated that this switch has saved each student up to $300 per year. The text was remixed from Openstax Chemistry as well as other texts and multimedia and is hosted online via LibreTexts. A printed version was also created to give students an option who prefer printed texts. Besides lowered student cost, benefits include specific tailoring of information for the course, supplements to suit different types of learners, and instant updates of information. Student reactions to the text have been mostly positive, with a majority of students reporting using the text more than a traditional textbook. Additionally, a statistical difference has been found in the number of students completing pre-class Reading Checks.

Introduction

At Oregon Tech, CHE 201 and CHE 202 (CHE 20X) are offered:

- In sequence (Fall and Winter) and in a "trailer sequence" (Winter and Spring)
  - Approximately 80-110 students annually
- For most of the engineering majors on our campus (except Civil Engineering)

CHE 20X had traditionally used the textbook *A Molecular Approach* by Tro

- Students had been able to purchase the 4th ($300 new) or the 3rd Edition (Used Only; not available through campus bookstore)
  - Bookstore availability is important particularly to our large veteran student population
- Students used this textbook for 1-2 terms of General Chemistry (depending on major)
- None of these students are chemistry **majors** – no reason to keep textbook, leading to selling back at fraction of initial cost

Objective

Adapt and remix existing materials for chemistry into one resource, eliminating extraneous sections not explicitly covered in these courses as they are currently taught at OIT.

- There was a question of how students would access this resource – a PDF on LMS with links and chapter lists? Something better?

LibreTexts: An Overview

From the website: *"The LibreTexts mission is to unite students, faculty and scholars in a cooperative effort to develop an easy-to-use online platform for the construction, customization, and dissemination of open educational resources (OER) to reduce the burdens of unreasonable textbook costs to our students and society."*

- 398 textbooks, textmaps, and LibreTexts
- 154 courses using LibreTexts
- Subjects include: Biology, Business, Chemistry, Engineering, Geosciences, Humanities, Mathematics, Medicine, Physics, Social Sciences, Statistics, and Workforce
- 223 million students served (Fig. 1)
- $31 million dollars saved

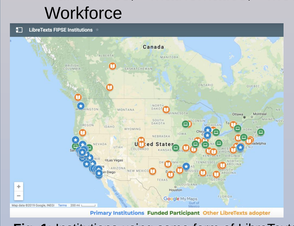

Fig. 1: Institutions using some form of LibreTexts in the United States

Resources on LibreTexts are:

- Open, free, and accessible to everyone with an internet connection
- Comprehensive, with new texts being developed and shared routinely
- Topical and always up to date
- Active, with a community of collaborators
- Interactive, with visualizations, simulations, and videos
- Accessible through assistive technologies across the platform

Benefits of LibreTexts to CHE 20X

LibreTexts began as the ChemWiki (UC Davis), meaning a large number of chemistry resources, including 17 textbooks and maps for General Chemistry, were already available.

- Chosen base resource: *Openstax Chemistry* (entirely mapped on LibreTexts)
- Chosen supplements: Crash Course & Sci Show Videos and others (embeddable), PhET simulations (HTML simulations already available in LibreText to insert on pages)
  - The availability of interactive resources for students was a large selling point

Additional benefits included:

- Instantly Editable (i.e. When IUPAC announced the new definitions for the kilogram, I was able to updated that section that day (Fig 2)).

Fig. 2: Screenshots before and after kg definition changed in Fall 2018

- Learning Objectives for each Unit and Section make it easy for students to track the information they are responsible for.
- End of chapter problems are available for students to get extra practice before weekly quizzes and I was able to 1) make sure more than the odd problems had answers and 2) post solution videos for students to see me working practice problems outside of class/office hours.
- Real time feedback and built-in editors: every page has links to request solution videos, give anonymous feedback, report typos for extra credit, and report wrong answers.

The Creation Process: Online and In Print

Fig. 3: Example page from course pack with online links

We started by making a list of all the sections of the Tro textbook we taught in both courses and the sections that could be substituted from *Openstax*, deleting irrelevant information (to our course). We then curated our collection of supplements, and as a last resort for a few pieces of information, we wrote it ourselves. We then chose the relevant end of section problems, determined the answers for even problems, and made solution videos for select problems. CHE 201 was mostly completed in Summer 2018 and ready for use in Fall 2018. CHE 202 was mostly completed in Fall 2018 and ready for use in Winter 2019.

Because some students still like to have a physical copy of the textbook, an online-only text could not be the only version. Because of this, in early adoption terms students were given the option to purchase the physical copy of *Openstax* and the appropriate reference sections and practice problems were made available to them where possible. In the subsequent trailer sequences, a course pack (PDF) was created from the online material, with shortcut links and QR codes generated for online only material to maintain a degree of high accessibility for students (Fig. 3). Working with Open Oregon, future course pack printings will be available through Lulu for less than $25 per text ($50 for both CHE 201 and 202 instead of $300).

Student Use of the Text

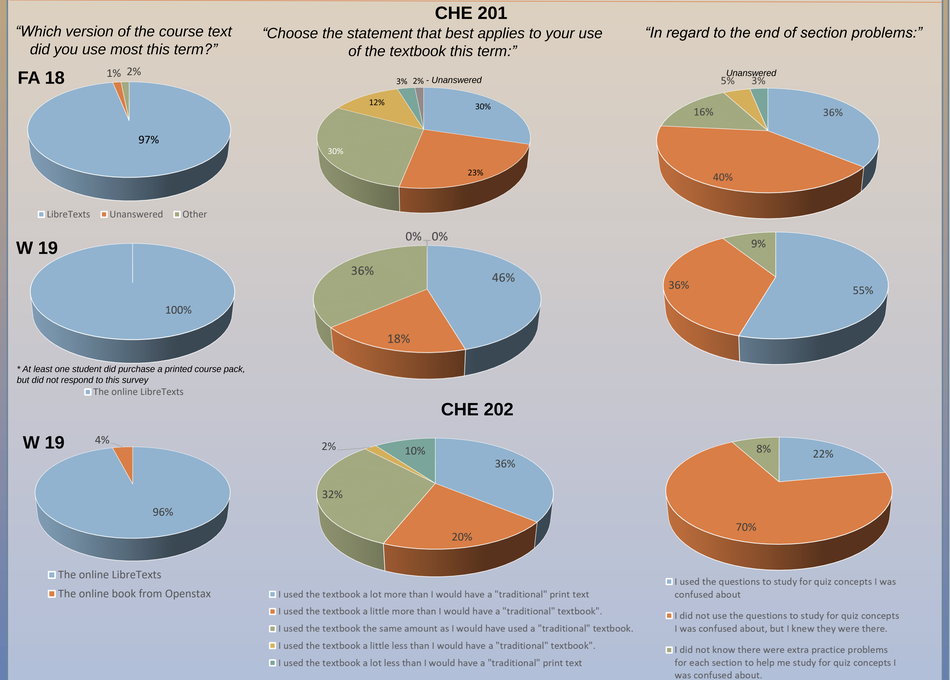

Fig. 4: Student Responses about LibreText version and overall use in CHE 201 and CHE 202. More in-depth questions were asked in W 19 and responses are given in Fig. 5 (below).

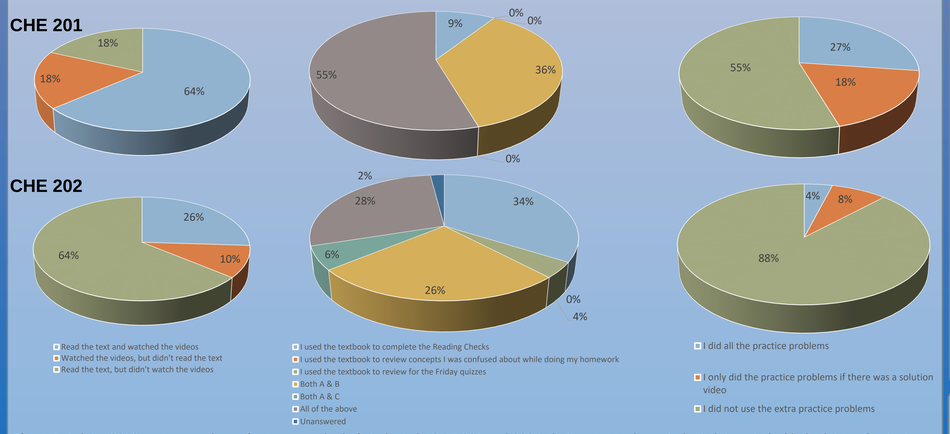

Fig. 5: In Winter 2019, more questions of use were asked of students in CHE 201 and 202 to better assess how students interacted with the interactive text.

Student Outcomes

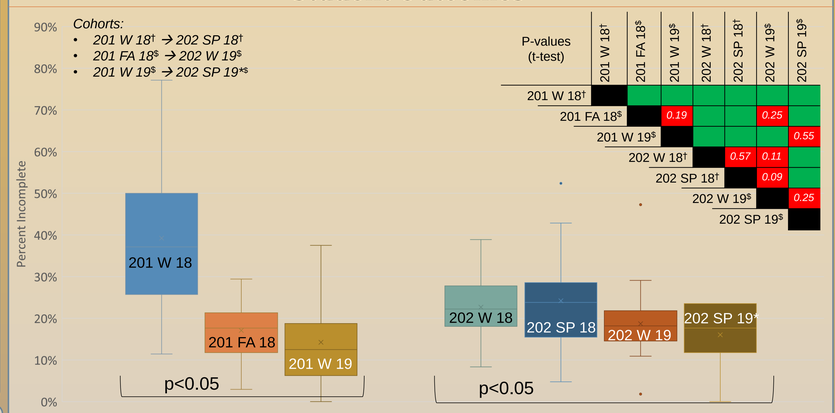

Fig. 6: Examination of pre-class "Reading Check" completion for sections using the traditional print text (†) v. LibreTexts ($). All sections of 201 and all sections of 202 were compared using ANOVA while individual sections was compared using t-test (table inlay). *SP 19 is still in progress; results may change when all Reading Check scores are available.

Statistical comparison of Reading Check completion showed encouraging results regarding student use of the text:

- Significant difference was found between 201 W '18 (traditional textbook) and all other sections.
  - Significant difference within the cohort (201 W 18 compared to 202 SP 18) suggests that students may be more inclined to do Reading Checks in the second term of the course compared to the first. This is further seen in the comparison of other cohorts (201 FA '18 v 202 W '19 and 201 W '19 v 202 SP '19).
  - Significant difference between 201 W '18 (traditional textbook) and both 201 FA '18 and 201 W '19 (LibreTexts) suggest that ease of accessibility made students more inclined to complete Reading Checks.
- The lack of significant difference between 201 FA '18 and 201 W '19 (both LibreTexts) suggest that the results seen when compared to the traditional textbook term (201 W '18) is not a coincidence.

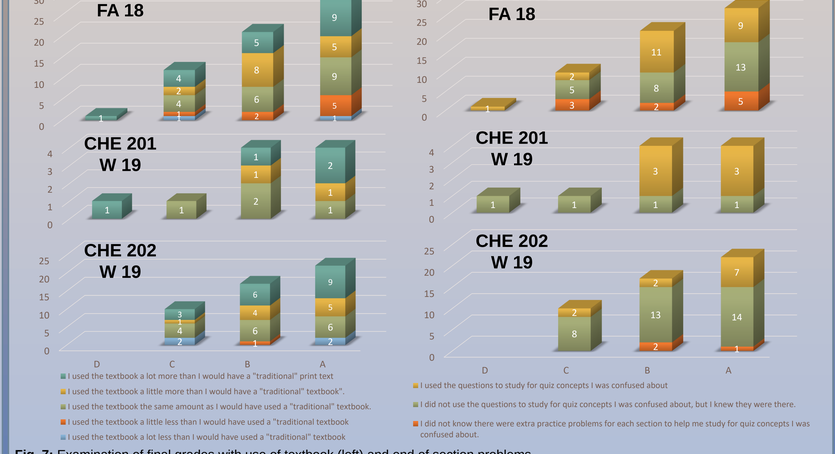

Fig. 7: Examination of final grades with use of textbook (left) and end of section problems.

Conclusions & Future Work

- An online (free) and in print (low-cost) resource has been created for General Chemistry I and II at Oregon Tech, which is fully tailored to the information presented in the courses and contains online supplements previously listed separately in LMS or sought independently by students.
  - Most of the students opted to use the online resource over the print resource and the majority of students in CHE 201 and 202 self-report using the textbook a lot or a little more than they would have used a traditional textbook.
  - Students self-reported not utilizing the practice problems at the end of sections, which seems to not have had an adverse effect on finals grades (Fig. 7).
    - **Future Work:** Short-links to the end of section problems have been added to the bottom of homework assignments this quarter to make the resource more readily available. Students will be surveyed at the end of this quarter for feedback on this inclusion as well as asking about use (repeat of W 19). Results within the cohort will be compared to see if use improved.
- The online resource appears to have made a statistical difference in pre-class Reading Check completion. We hypothesize that this is due to the increased ease and universality of access while taking an online quiz.

Future Work:

- We intend to continue collecting use data from cohorts for at least another year and assess any improvements that can be made. We will also continue soliciting other student feedback on the text.
- A section on "Ion-Dipole Intermolecular Forces" needs to be added to CHE 202 (SU 2019).

Acknowledgements

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