Title

Come Join the Party!: Recent Progress of The Community Based LibreTexts (née ChemWiki) Project

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Abstract

The LibreTexts project is a multi-institutional collaborative venture to develop the next generation of open-access texts to improve postsecondary education at all levels of higher learning by developing an Open Access Resource environment. The project currently consists of 12 independently operating and interconnected libraries that are constantly being optimized by students, faculty, and outside experts to supplant conventional paper-based books. These free textbook alternatives are organized within a central environment that is both vertically (from advance to basic level) and horizontally (across different fields) integrated. The development approach is highly collaborative and grows via the efforts of a growing community, which has been particularly active in the recently years. We present this progress via 15 testimonials of Libretexts adopters and developers. The project is empowered by Mindtouch's cloud-delivered web platform.

Introduction

Rapidly rising undergraduate fees and textbook costs are serious factors impeding access to higher education for many students. In particular, high textbook costs are a serious barrier for under-served, at-risk students. The amount students are asked to pay for textbooks overburdens

governmental and familial financial resources. A 2005 US Government Accountability Office study estimated that the average annual cost of textbooks for a student in 2003-04 was $898 at four-year colleges with an average 3.8-year lifespan per textbook. Textbook costs continue to rise at a rate twice of inflation; according to the College Board, the average budget for textbooks and supplies during the 2012-2013 was $1,200. The high cost leads many students to sell their textbooks onto the secondary market to raise money for the next semester's book budget.

While open-access textbook resources are clearly beneficial in reducing educational costs, additional pedagogical benefits make their development and use additionally appealing to both faculty and students. Ideally, open-access textbook resources could be used to guide students toward a centralized and integrated "enhanced learning environment" capable of not only providing vetted textbook materials, but also capable of self-consistently tracking student-specific activity and performance to identify weaknesses in study habits. The proposed LibreTexts project is one such resource that upon sufficient development can provide exceptional flexibility in addressing current and future education needs. Moreover, the LibreTexts provides a powerful platform for digital evaluation of cross-disciplinary learning and can be leveraged as a powerful mechanism for the dissemination of content and evaluation of emerging education technologies and pedagogies.

Authorship and development are done by both students and faculty. The content of these libraries is both horizontally (across multiple fields) and vertically (across multiple levels of complexity) integrated within a massively interconnected network that provides, not just single textbooks, but an infinitely large library through which interconnected textbooks can be built. Grounded in social constructivism, the Libretexts project allow learners to cooperatively construct and organize knowledge. Because of their flexible and modular-based approach to instruction, the LibreTexts provides an important alternative to the "one-size-fits-all" approach to instruction where content is presented in a static prepackaged manner. LibreTexts is a next-generation learning system that promotes personalized, flexible, and interactive learning experiences.

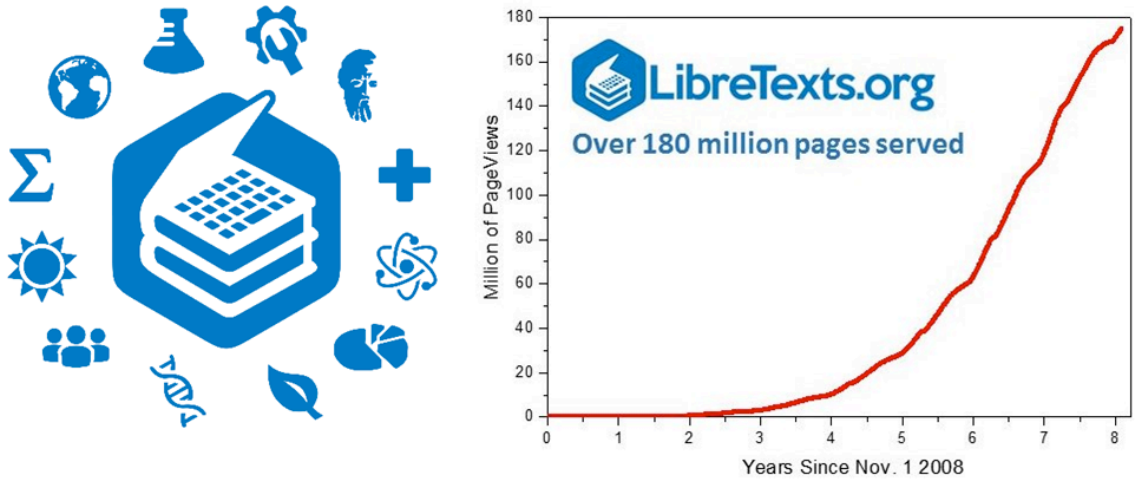

Figure 1: (Left) The Libretexts project encompasses 12 pseudo-independently operating "Libraries" dedicated toward enhancing post-secondary education in all fields of study. (Right) The LibreTexts project has confirmed over half a millennium of students reading and has served 180 million pages since 2008.

The LibreText project consists of 12 pseudo-independently operating and interconnected libraries that host over 42,000 (web) pages of content in specific fields with a current emphasis on science, technology, engineering, and mathematics (STEM) fields. Given that the greater Libretexts has evolved from the ChemWiki project, with an emphasis on chemistry textbooks, it is not surprising that the chemistry library is currently most developed library. The chemistry library hosts approximately 80% of the project's content and is responsible for 90% of current web traffic with an accumulated 200 million pageviews (approximately 4.5 million per month) and over a millennium of confirmed reading since 2008. Libraries containing content from other STEM disciplines have also been developing rapidly over the short time that the project has been expanded to the multidisciplinary LibreText platform.

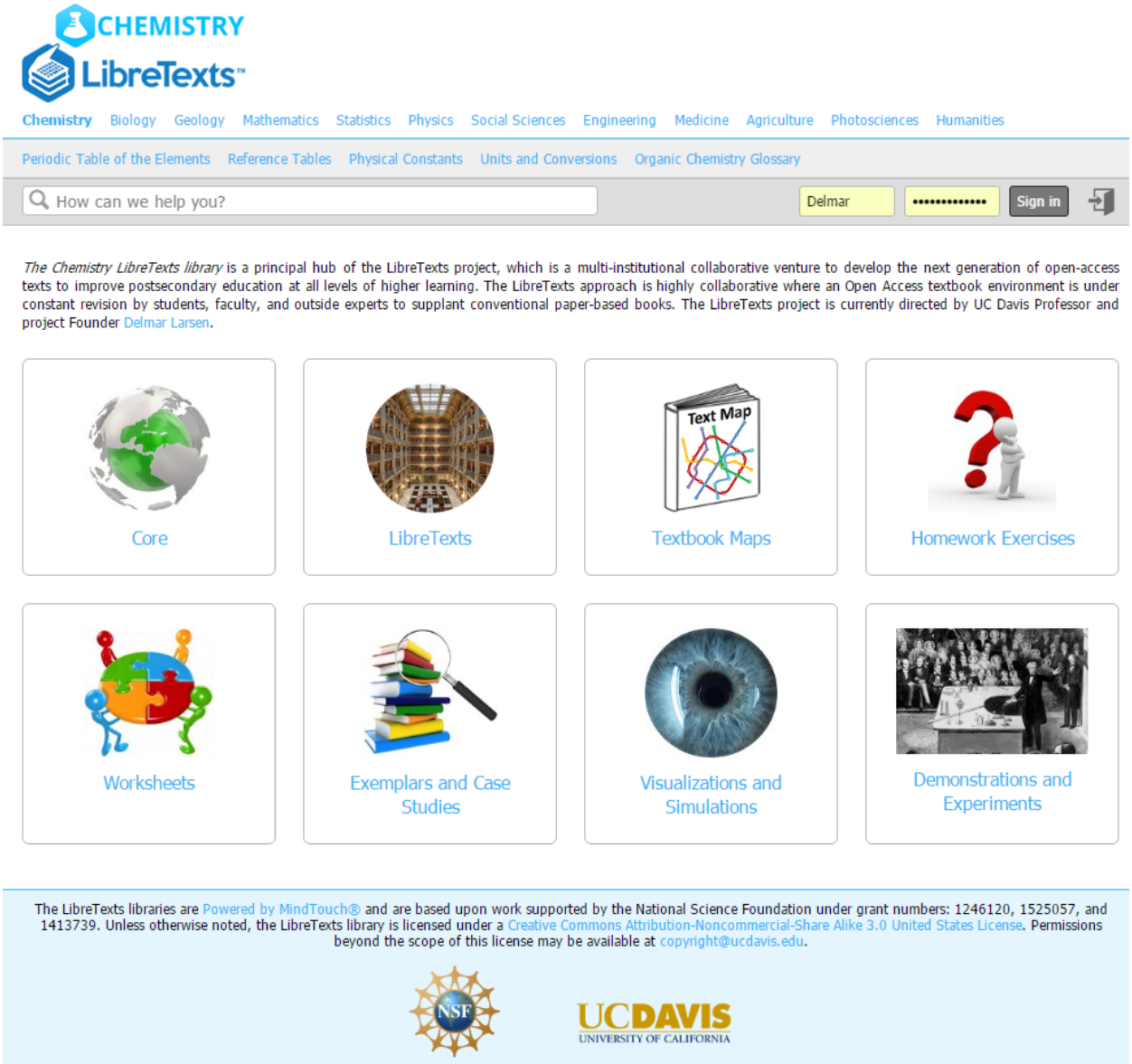

Figure 2: The Front page of the chemistry Libretexts Library

Each library is developed around the same general organization centered around three principal components: (1) the Core, (2) the Libretexts and (3) the Textbook maps. However, other key components include Exercises, Worksheets, Exemplars/Case Studies, Visualizations, and Demonstrations/Labs. There is also an extensive set of reference tables along with the Periodic Table of Elements accessed at the top bar of any page in the library.

- The LibreTexts core content is separated into the primary disciplinary sections and is meant as supplementary material to augment the LibreTexts (that are custom designed and developed "textbooks" for individual instructors, classes or schools) or Textbook Maps (content organized to "recreate" existing textbooks).
- LibreTexts are custom developed for individual instructors/classes and schools. Faculty do not need to recreate the wheel to generate a LibreText for their class and can peruse the existing LibreTexts; then these can be adapted to the instructor's specific desires.
- Textbook Maps are an attempt to recreate the content structure of existing textbooks to facilitate adoption.

We separate the Textmaps in terms six broad categories discussed below with associated testimonials.

GOB and Introductory Chemistry

We classify GOB (general-organic-biology) and introductory chemistry courses as free-standing courses that focus on a less rigorous presentation of content. We have two GOB texts in the system: the Ball et al. text and the CK-12 text. The non-GOB texts include another CK-12 text and another Ball's text along with Young's "Introductory Chemistry Online" text. Several textmaps that re-envision existing commercial textbooks are under development in this category with Tro's "Introductory Chemistry" text as the most developed (organized in part by Marisa Agnew at Sacramento City College). Below are three testimonials regarding the application of the LibreTexts into GOB or Introductory Chemistry courses.

University of Kentucky (Allison Soult): My classroom is an active learning (flipped) classroom so having access to resources such as the content of my LibreText are essential for my students both in and out of the classroom. Whether it is for assigned readings, using reference data, or looking up terms, the students can easily access the appropriate section of the book with one click from our learning management system. The flexibility of this strategy allows me to custom design my course materials in the way I wish to teach–. The ability to edit it in real time allows me the opportunity to update content and provide additional information (or remove unnecessary information) for students as needed throughout the semester.

Sacramento City College (Dianne Bennett): I began working in the summer of 2014 to develop a LibreText for my Chemistry 309 course at Sacramento City College (SCC). Chem 309 is a content heavy course for allied health students, which surveys general, organic, and biochemistry in a single semester to prepare students for anatomy, physiology, and microbiology. In addition, Chem 309 is part of an Allied Health Learning Community (AHLC) as a pathway from high school to allied health career programs.

The Chem 309 LibreText has supported innovations in teaching in my class. Student success for a very high-risk student demographic increased by 250% using a flipped format that was supported by a LibreText. LibreTexts also provide additional insights into student learning habits

that help us continue to develop and innovate how we teach. This type of information cannot be found through traditional texts. It is also important to know that 67% of the students at SCC live at or below the poverty level. Students are saving approximately $17,000 each semester in my Chem 309 courses. Since the fall of 2014, students have saved over $100,000 from the Chem 309 LibreText. While students greatly appreciate this financial savings, student surveys also show that students recognize the additional benefits of their LibreText.

Diablo Valley College (Ron Rusay): For my "Chemistry for Non-Science Majors" course (Chem-106), we use the Libretext as a platform for student engagement. The general vocabulary assignment is to define and build a comprehensive list of the Key Vocabulary Terms from lectures & Libretext or library resources, which are pertinent to and used in Chem 106. Other projects are posted and edited via personal accounts on a "private" in-course page as graded assignments. Student then used the vocabularies as exam questions after being reviewed and vetted for accuracy; they are then made public.

General Chemistry

Significant effort has been placed on developing and optimizing the general chemistry content on the LibreTexts. Since General Chemistry courses cover content across a wide range of chemistry sub-fields, no specific "General Chemistry" section exists in the Core although the content has been organized in corresponding sub-fields. The General Chemistry Textmaps include the integration of OpenStax textbooks (both Atom's first and "traditional" organized), Stephen Lower's "Chem1" virtual text, John Moore's "ChemPrime", Melanie Cooper and Mike Klymkowsky's "CLUE" text, and Averill and Eldridge's "Chemistry" text among many other contributions. Working Textmaps have been constructed for Brown and LeMay's "Chemistry" Text, Tro's "A Molecular Approach" text, Oxtoby's Text and Petrucci's "General Chemistry" text.

Students have used these resources in many general chemistry courses across the world and have avoided many millions of dollars to date in textbooks expenses. Below are four testimonials regarding the application of the LibreTexts in General Chemistry courses.

Mount Royal University (Brett McCollum): Many of our students at Mount Royal University struggle to afford postsecondary tuition, and even more avoid purchasing textbooks due to financial barriers. This widespread student behavior has a profound effect on instructional pedagogy. After learning of the LibreTexts project, I was able to curate and create content appropriate for my class. Within four months, my LibreTexts was used by 50,000 learners in over 30 countries. My students appreciated that the text was free, that it was accessible anywhere with an internet connection, that it was tailored to our course, and that the quality was comparable to a commercial textbook. The next semester, LibreTexts was adopted by four more faculty in my department, and even more the following semester. Since hearing testimonials from MRU students, other disciplines on campus are now investigating the process for transitioning to LibreTexts. We estimate that LibreTexts has saved our students over one quarter of a million dollars.

Valley City State University (Samuel Keasler): I've been using a Libretext for general chemistry for the last two years, involving about 25 students total, and have adopted a LibreText for use in my non-majors introductory chemistry class this past fall, involving another 20

students. The experience has been overwhelmingly positive and I'll be continuing to use and update them in the future.

The fact that students do not have to pay for a commercial textbook is an obvious benefit of a format like this. Less obvious, but just as important, is the pedagogical advantages of a customizable, webbased resource. If the cost savings were the only advantage, there are other open textbooks available. The reason I've gone to the effort of assembling a LibreText is that I'm excited about the opportunity to create the resource best suited to the classes and students that I'm teaching. I think that a major reason the LibreText project has been so successful and has grown so much is the work that Dr. Larsen is doing to assist faculty like me in getting our texts up and running.

One of my teaching goals for the next few years is to directly integrate some of the video content I've developed into the text alongside other more interactive supplements. This has the potential to make students more active while reading and improve comprehension, which is essential for the successful implementation of a flipped classroom.

There is no other platform that offers this level of flexibility, and it's that flexibility and the open licensing of all the content that makes the site such a valuable tool for innovative chemistry teaching. Faculty can build resources that meet the needs of their students and adapt these resources, as their teaching requires. With relatively little effort, faculty can add, remove, and rearrange topics, change how content is presented, and add new supplements. This adaptability is crucial for faculty who want to try new things.

Not only can faculty use Libretexts as a valuable tool to improve their own teaching, but the open content makes the site a hub for sharing ideas and looking at what other faculty are doing. In a matter of minutes, I can look at ten different ways of presenting a concept and if one of them is particularly appealing, I can integrate it directly into my own course.

Howard University (Joshua B. Halpern): With my collaborators at Prince George's Community College, Scott Sinex and Scott Johnson, we built a LibreText General Chemistry book for a one-semester course for engineers. It is the first of a new, coordinated engineering curriculum, integrating Introduction to Engineering, Chemistry, Physics and Calculus taken by engineering students. Particularly in the case of chemistry, the normal courses assume that students do not know many things that engineering students do such as the SI system, emphasize many things that are superfluous to most engineers such as biochemistry, repeat things that they will encounter in other courses such as General Physics and, because most engineers only take the first semester, leave out important topics such as chemical kinetics and equilibrium. Our Atoms First text starts by discussing atomic structure, the periodic table and molecules. After this, chapters describe states of matter and simple chemical reactions, followed by discussion of chemical kinetics, equilibrium, thermodynamics, electrochemistry, and nuclear chemistry using materials science examples and applications relevant to engineering. Tailoring of the text to engineering students enables teaching at a higher level including the calculus and encompassing almost the entire intellectual content of the normal two-semester General Chemistry course.

University of Arkansas, Little Rock (Robert Belford): UALR uses the 9th edition of Kotz in general chemistry and I started using LibreText by taking a clone of the textbook map and editing it to my idiosyncrasies. I am working on the material this summer and plan to use LibreText in the Fall of 2017 when I will be teaching first semester general chemistry (Chem 1).

My LibreText site is still under construction, but here are some highlights of what I have been doing or plan to do:

- Integrate YouTube videos including self-made problem solving videos showing various techniques and other videos that I found on the web.
- Mixing Q&A format in with normal textbook format. I think digital native students who have so much information readily available and find this format is easier to navigate for certain topics. LibreText allowed me to integrate the Fourth Paradigm of Science into my course textbook. This complements the more traditional format.
- Integrate Lab Material into my text. Create calibration and technique videos for lab equipment and link to videos through QR codes that can be placed into the lab manual or taped to the laboratory equipment. This will allow better integration of lecture with lab activity. The Libretexts also hosted ChemCollective Virtual Lab Activity. Note, students are assigned unknown numbers, and this is a prelab activity.
- We are in the process of integrate hypothes.is, a social annotation technology, into the system that will create a class group in hypothes.is and will require students to annotate readings before class and use these annotations to help "flip" class. Integration of hypothes.is has been successful into Drupal homepage to aggregate annotations (see next paper of this Newsletter). This new infrastructure will create homepage for each chapter that aggregates annotations on any page in LibreText, or open access resource on the web. It will also filter annotations in aggregator by tag that allows me to navigate LibreText and other material in class based on student annotations.

Organic Chemistry

Significant effort has been placed on developing the organic chemistry content. The Organic Chemistry Core has been recently restructured. The Textmaps included the recently completed Basic Principles of Organic Chemistry by Roberts and Caserio, Tim Soderberg's Organic Chemistry with a Biological Emphasis and William Reusch's Virtual Textbook of OChem among others. Recently effort has been placed on developing the Textmap for McMurry's Organic Chemistry for use on several campuses.

Development of the organic content on the LibreText has been slower than the Introductory and General chemistry content, but we are making steady progress. Below are four testimonials regarding the application of the LibreTexts in Organic Chemistry courses.

University of Minnesota, Morris (Tim Soderberg): Organic Chemistry With a Biological Emphasis has undergone a complete revision over the past several years, as I have rewritten many sections and added a substantial number of in-chapter exercises and end-of-chapter problems, and written introductory passages to each chapter in which I attempt to 'bring to life' the material of that chapter in the context of an interesting real-life story. Most recently, I have completed revisions on solutions to all in-chapter exercises and selected end-of-chapter problems. The next step is to finish loading the new content onto the LibreText platform.

University of Illinois at Springfield (Layne A. Morsch): In summer of 2015, I adopted the LibreTexts[1] as the textbook for my Organic Chemistry 1 course. Through use of the LibreText, my students have continued to grow in their understanding of organic chemistry as well as learning valuable skills in digital literacy. As I witnessed the students' exam scores unchanged

from previous courses where I used a traditional textbook, I decided to expand use of the LibreText to two additional courses. In addition to the technological training and data access from the LibreText, the economic value cannot be overlooked. Compared to buying new textbooks, my students have saved over $90,000 from our use of the LibreTexts. This is of particular value on our campus as the #1 reason students are not retained from one term to the next is financial. Shifting to high quality Open Educational Resources (OER), like the LibreText, is reducing the financial burden on our students. It is also highly valuable that the access to information does not end when the semester ends and many students report that they refer back to the freely available materials when they study for MCAT and GRE exams. Having the LibreText has also allowed me to monitor when my students are studying by examining pageview data. I could not get this sort of data when we used a traditional textbook.

Purdue University (Mark Lipton & Paul Wenthold): We noted that our students' first source of information for our classes was no longer the assigned textbook but rather it was a Google search, which led almost inexorably to Wikipedia. The second was that I had just radically redesigned my organic chemistry class and no existing textbook adequately reflected the organization of my class. The class I teach is a two-semester organic chemistry sequence for Chemistry majors here at Purdue University. Typically, this class has 70-90 of our Chemistry majors in it. I have now used the LibreText I created for my class for three years. In that time, student test scores have increased and student evaluations indicate strongly positive support for the LibreText and its value. Anecdotally, many students have told me that they turn to the LibreText rather than Wikipedia and its Google ranking reflects that (it's often the #1 hit in a Google search for a given topic in organic chemistry). In sheer numbers, my LibreText pages are getting 432 page views per day in the first semester and 787 page views per day in the second semester. That works out to about 5-6 and 10 page views per student per day, respectively. As a user, I found the LibreText easy to establish and the content already present on the site sufficient to create a "textbook" that mirrors the eclectic organization of my class. At this point, I have absolutely no desire to return to a printed text and am firmly committed to the use of the LibreText site.

Athabasca University (Dietmar Kennepohl): I teach organic chemistry for about 250 students per year who are now using a LibreTexts that is custom designed for them. The LibreTexts is much more than just a new technology for teaching and learning. Its approach of continuously building educational materials through collaborations and contributions from both teachers and students is an academic ideal. It moves the textbook away from merely a commercial product to be consumed to a vehicle of participation and engagement that also happens to have a strong social mandate of accessibility.

Analytical Chemistry

The Analytical Chemistry core is currently being expanded to with content from the Analytical Sciences Digital Library and the outstanding Chromedia website. We have multiple smaller projects that have been or are in the process of being integrated in the Core. The LibreText project has not been used as the exclusive textbook for any analytical chemistry course (to our knowledge), although David Harvey's "Analytical Chemistry 2.0" Textbook has been in the library for several years and has recently been upgraded. This summer a development team will be focusing on constructing the Textmap for Skoog's Principle of Instrumental Analysis" text,

which has recently been referred to as the most expensive chemistry textbook at over $400 on many campuses.

The LibreText system has been used for much of the past decade to host the lab manual for UCD's Instrumental Analysis (Chem 115) class and has recently been expanded to include the lab manual for the introductory Analytical chemistry course (Chem 105). Below is a testimonial regarding the application of the Libretexts in an Analytical Chemistry course.

University of California, Davis (Kristie Kosti): For my instrumental analysis course (Chem 115), I used the Libretext laboratory manual that was specifically written for UC Davis without any additional editing to the site. The nice part about the LibreTexts is that it is in html code and easy to fix for the next time the course is taught. As a benefit to the students and to this lab manual in the future, I gave extra credit asking the students to keep track of things they would change in the manual to make it clearer to the next generation of student users. The students enjoyed being able to interact with the lab manual in this way. The neatest part was seeing students generate images and photos to help update the manual. It really is not easy to do that with any other manual.

Physical and Theoretical Chemistry

The Physical Chemistry Core has been under developed since the beginning on the project, in part since a poorly crafted and expensive at the time physical chemistry for biologists textbook was the impetus for initiating the project. The available Physical Chemistry Textmaps range from DeVoe's "Thermodynamics" text, Simon al al.'s Advanced Theoretical Chemistry and Quantum Mechanic texts, Zielinksi's Quantum Text, and Valance's Symmetry notes. Under construction are two Textmaps that have garnered some interest recently: McQuarrie and Simon's Physical Chemistry Textmap and Atkin's Physical Chemistry textmap. Both of which are incomplete, although the McQuarrie textmap has been used for four Introductory Quantum (Chem 110A) courses and one second quarter Quantum course at UCD.

Below are two testimonials regarding the application of the Libretexts in Physical Chemistry courses.

University of California, Davis (Kristie Kosti): The value of the LibreTexts comes in the vast array of available resources from user-contributed content and the flexibility that this tool has. The Libretexts has so many components to it and so much flexibility in how it is used or implemented. In general, I would characterize three primary means of use that I have used it for now:

> (i) *Individual Course Website and Lecture Host* - A "Libretext" site can be set-up for an individual class where an instructor can generate their own text/textbook while integrating many of the figures, videos, and problems at other parts on the LibreTexts. Each course can then be directly edited and adapted to the student body that it serves. The adaptation is generally that LibreTexts is a textbook substitute and lecture note repository. The instructor intimately controls the direction of the students learning. It allows videos and messaging (which you can't get from a normal textbook even with the fancy DVD and online resources that cost the students extra).

(ii) Textbook Based Concept Maps - A giant wiki that has a unique spider-web-like design. Each current textbook has its own map based on each chapter, which includes figures and problems that follow very closely to the main text. Students can enhance their learning by accessing other textbook maps. An instructor can then pick and choose student learning materials

(iii) Resource repository - LibreTexts is an enormous repository of problems, figures, text, videos, and online resources. These single resources can be directly integrated into a Powerpoint lecture, problem set, or other. Students can be referred to more reading. Equations are saved as a mathtex. For someone who uses LaTex a lot, it means equation code can be copied and pasted (eliminating errors in PPT files or other lecture media). This is my own personal favorite way to use the LibreTexts.

In using the LibreTexts in all of these different iterations, I have found that it is a very flexible tool with an almost infinite multitude of usability. The amount of data, homeworks, lecture notes, videos, and other materials uploaded by other faculty at other institutions is substantial. I believe the Libretexts is a larger-than-life learning resource that has the potential to really alter the way that teaching and learning is performed.

Howard University (William R. Stockwell): Libretexts provides faculty with course resource texts that were written by the scientific community. Even more important: Libretexts allows faculty to contribute new material and to customize it for their own specific courses. This year at Howard University I have used Libretexts as the source of textbooks for four of my courses. I responsible for the undergraduate physical chemistry laboratory courses at Howard University; three sections in the Fall and two sections in the Spring. Libretexts served sixty students taking these laboratory courses. The Libretexts website allowed me to very efficiently provide a new excellent physical chemistry laboratory manual for my students. The students could refer their assigned laboratory experiments through the Libretexts website and it became instrumental to the success of my laboratory courses. Also, I used Libretexts to provide source material for my graduate courses in physical chemistry at Howard University last Fall and this Spring. My graduate students learned well from the textbook that I adapted from Libretexts. Libretexts was a very valuable contribution to the success of my teaching of this course; four graduate students took the first course and three are completing the second

Inorganic Chemistry

Development of the Inorganic content in the LibreTexts has been slow, but steady. The Inorganic Core is full of content and recently, we have integrated Bertini et al.'s Bioinorganic Chemistry textbook into the system and the Wikibook's Inorganic Chemistry built in Pennsylvania State University. A goal this summer is to complete the Textmap for Housecroft's "Inorganic Chemistry" textbook.

Saint Mary's College (Kathryn Haas): My students and I initially found LibreText's Chemistry library useful in— supplementing the traditional text in my Advanced Inorganic Chemistry course, beginning in 2013. More recently I had the opportunity to develop a new interdisciplinary Bioinorganic and Materials Chemistry (BMC) course, for which an ideal traditional text does not exist. The first iteration of the BMC course heavily relied on LibreText and other web-based materials in addition to a rather expensive traditional textbook. Students in

this first rendition of the course were disappointed with the cost and content of the traditional textbook and commented that they preferred the content (and no cost) from the web-based tools like LibreText and Wikipedia. After attending one of Dr. Larson's workshops and learning how to customize LibreText to my liking, I built and used a custom LibreText for the latest rendition of BMC in Fall 2016, and used this LibreText as the only required resource for BMC. Although the LibreText for this course is still in a fledgling state, students thanked me regularly for using this free resource which was customized to their needs. Further, the LibreText has transformed my teaching and has been essential to my ability to evolve an interdisciplinary course to the students' and my needs and interests without the constraining "walls" of a traditional text. I was able to easily pull from and customize material already in the interdisciplinary LibreText libraries and was able to write new content, with student help, when desired topics did not yet exist.

In addition to being the primary course text in my BMCcourse, LibreText is also now a platform for sharing student work. The creation of new open-access content for LibreTexts serves as an excellent opportunity for student projects. In the Fall of 2016, my students each picked a topic in bioinorganic chemistry on which they would write a new LibreText page including original figures and a new educational YouTube video about their topic. My course of eight students has developed four new pages in LibreText which are linked to their YouTube videos about the topic. This new content is based on the latest research literature on Fe-siderophores, Pt-chemotherapies, Cu-chaperones, and Mn-superoxide dismutase, much of which is not available in even the most recent versions of any traditional textbooks. Development of these projects took a significant amount of my time, and student work, however creating and editing these articles was unusually rewarding for both my students and I. Student feedback indicates that they value LibreText as a resource in their learning and appreciate both the experience of creating work for an authentic audience and the opportunity to contribute free open-access resources for other students.

The experience of building my own LibreText has been facilitated by the quick and thorough technical support provided by Dr. Larson and his team. I plan to use LibreText for future iterations of my BMC and Advanced Inorganic Chemistry courses and to continue to develop new open-access inorganic chemistry content for LibreText.

Concluding Thoughts

We encourage faculty with existing materials created for use in one or multiple classes to contribute vetted content to the LibreText libraries. We especially appreciate quality content such as homework questions, answers, solution manuals, supplements, and any other textbook materials that are intrinsically copyrighted by the faculty member that developed the material. All content would be transcribed from the original format directly into the libraries via primarily student effort and no additional effort is necessary. Author bylines and hyperlinking to contributed Modules are added.

Faculty desiring a more active involvement in the project can contribute in by: (1) mentoring student efforts in building content, (2) directly editing or creating new modules, (3) providing feedback or consulting on existing Modules, or (4) evaluating new pedagogical approaches and application of the Libretexts. Particularly active faulty contributors may also consider participating as co-PIs on future grants. Libretexts development effort can also be used to

address education components (e.g., “Broader Impacts”) in research grants and promotions. Contact Delmar Larsen or any of other Libretext developer for more information about taking the next step in education.

Acknowledgments

The would like to thank the many faculty, teaching assistants, and students that contributed to the Libretexts. Support for this pilot came from the National Science Foundation (DUE-IUSE 1246120, DUE TUES-1246120 and CHE-CLP 1413739). The LibreTexts are powered by Mindtouch Inc. K.H acknowledges a 2016 Cottrell Scholar Award from Research Corporation for Science Advancement.