Organic Education Resources
A cCWCS Community of Scholars

ChemWiki for Organic

BY LAYNE A. MORSCH, LMORSC1@UIS.EDU

UNIVERSITY OF ILLINOIS, SPRINGFIELD

Why?

I have heard many faculty lament their textbooks throughout my 15 years of teaching organic chemistry. We often find one that mostly fits what we would like to teach if we add in the extra parts that we wish were there and remove the pieces that we don't think are foundational to the subject. Then there is the added piece that textbook prices have risen so much that they are an impediment to many students. The publishers seem to realize this and have been offering digital access options that are more affordable, but these only give students access to the subject material for a limited amount of time. Once the subscription is over, the students can no longer access the information. The ChemWiki has saved an average of $238 per student enrolled in General Chemistry or Organic Courses based on reports from the faculty replacing their textbooks[1] and students have access to it in the future any time they need to seek for related information.

While at the 2014 Biennial Conference on Chemical Education at Grand Valley State University, I saw a presentation by Delmar Larsen on "Re-envisioning chemistry textbooks with the ChemWiki". Following this presentation, I considered the open-access ChemWiki Hyperlibrary as a potential alternative to the traditional textbook route. I was further encouraged to consider adopting open educational resources by a presentation by Cable Green from Creative Commons at a workshop held on my campus at the University of Illinois Springfield in October 2014.

How?

How did I prepare?

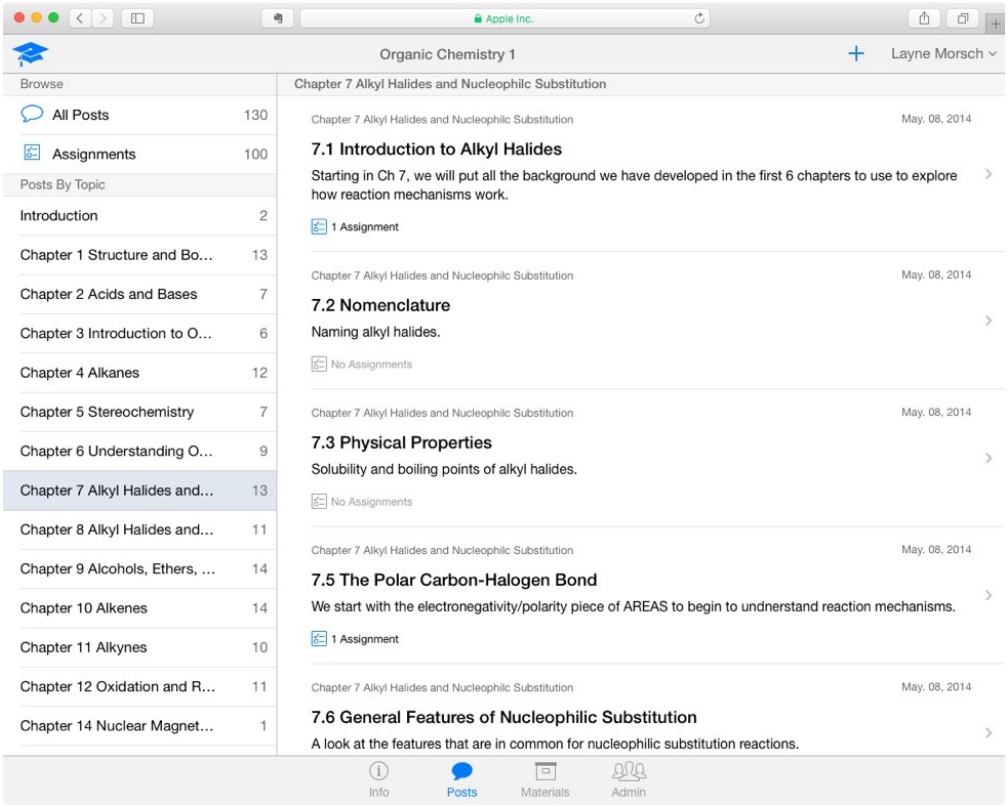
In February 2015 I contacted Dr. Larsen at the University of California Davis (the coordinator of the ChemWiki) to express my interest in adopting the ChemWiki for my organic chemistry courses. Dr. Larsen connected me with Dr. Steven Farmer from Sonoma State University who is one of the organic chemistry developers on the ChemWiki project. He requested a copy of (continued on p. 3)

Member Spotlight

Michael Wentzel
Augsburg College
Minneapolis, MN

After starting at Augsburg College and knowing the value of the cCWCS workshop from my time as a TA for the cCWCS Guided Inquiry in Organic Chemistry Laboratory workshop, I applied for and attended the Active Learning in Organic Chemistry workshop in Charlotte, NC learning a number of new ways to engage students in the learning process. Since then I have completely revamped my organic chemistry lectures and labs using both Clickers and flipped classroom videos since my attendance. I have found that using Clickers provides rapid feedback for me when used throughout lecture, especially helping to understand the level of understanding amongst students. It is easy for me to often know that the majority of my students understood a concept, but there is large difference between 55% and 95% comprehension! The Clickers allow for knowing this difference in real-time. I also find that it is useful to help my students develop their multiple-choice problem solving skills, which is a struggle for a number of my students. I also use my iPad to record evening review sessions working through homework problems, which allows for busy and commuter students to have access to this resource. It allows for a permanent resource for all students to view multiple times. I hope in the future to create video tutorials for specific concepts and topics to begin to completely flip my classroom in the future.

Technology plays an important role in my teaching as well. I have used online homework that is able to track student attempts and as a less formal method of just in time teaching. I hope to use more formal methods of just in time teaching with on-line pre-quizzes for lecture. I have already begun using them for my laboratory courses. The use of technology is also found in my classroom with new applications such as Chairs!, an application that helps student's practice cyclohexane chair flips in a game format. The aptitude of my students in this difficult practice has greatly improved as a result. Finally, I was fortunate to receive a cCWCS grant to purchase NMR software. This has allowed for students to work-up and analyze their own data instead of simply being handed a polished spectrum. It has greatly increased ownership and understanding of the NMR data my students generate.



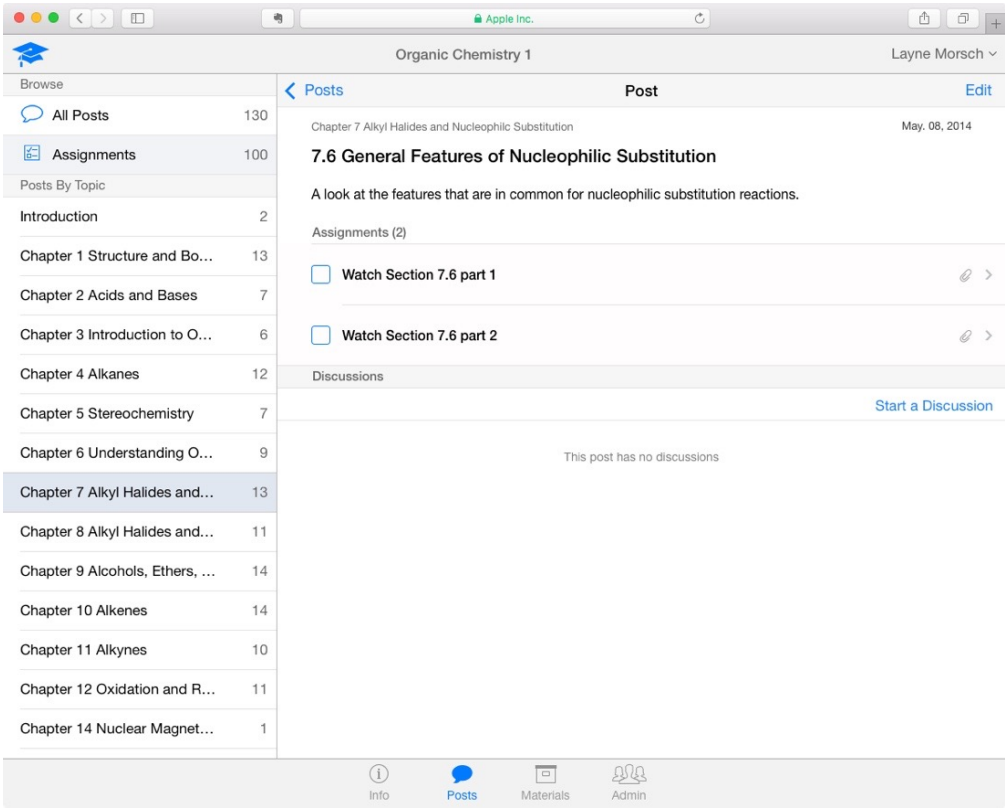


Figure 1. iTunesU organization. 1a (above) shows multiple sections within a chapter in iTunesU, 1b (below) shows links to videos within a section.

of my course schedule and which book I had been using (it was a book that they didn't already have a text map for). By the end of April, he had created complete text maps for my organic chemistry 1 and 2 (semester long) courses. I was also sent a set of instructions on how to edit pages if I want to either add or remove material to fine-tune it more to my needs. Dr. Farmer has also been quite willing to make edits for me when I wasn't sure exactly how to accomplish the changes I envisioned. Having the material ready this quickly allowed me to try out the ChemWiki for the first time during my summer course, which met throughout June and July 2015.

What is the class structure?

My organic summer class met 2 days a week for 2.5 hours, while fall semester classes meet two days a week for 1 hour 15 minutes per day. The

summer class had 17 students compared to the Fall semester course which has 58 students. iPads are required for all students in my organic courses and are used in several ways throughout the semester. The students use ChemDraw during class to learn how to carefully write out reactions and mechanisms.[2] They use iSpartan and Elements (electronic lab notebook)[3] in the lab. I have quizzes which they complete each day and submit using their iPads. The classes are taught flipped and all the lecture videos are delivered through iTunesU. This iTunesU course already had a complete outline of topics for each chapter (Figure 1, previous page) before adding the ChemWiki. To help students better incorporate reading the text when they desired to do so, I linked each section in iTunesU (Figure 2) to the corresponding section in the ChemWiki (Figure 3, on next page).

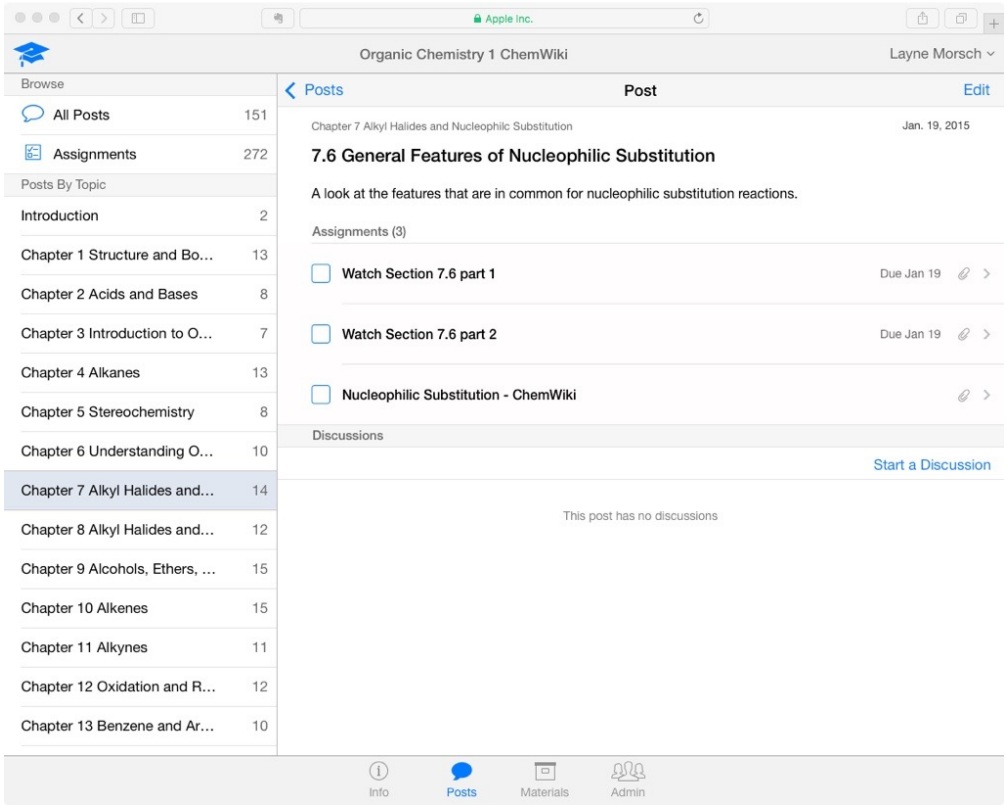
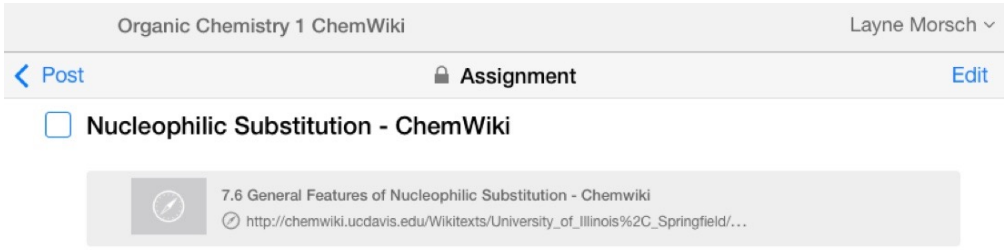


Figure 2. iTunesU with ChemWiki links built in. 2a (above) is the update of the Figure 1b image with the ChemWiki link added, 2b (below) shows the ChemWiki link.



How do students use the ChemWiki?

I surveyed my summer students as well as my Fall students (after the first exam) to get a better understanding of how they are using the ChemWiki. During the summer I gave an open ended response survey which 15 of the 17 students in class answered. Five of these students said that they consulted the ChemWiki on every chapter, 9 said they use it for some material ranging from checking it a couple times to reading through almost every chapter. There was one student that hadn't used the ChemWiki at all. I asked the students that had used the ChemWiki to describe how easy it was to find information. Their responses were compiled to create a word cloud to highlight

the most common ideas contained in their answers (Figure 4).

The majority of students found the ChemWiki easy to navigate and understand, especially with the direct links to each section from iTunesU. For example, "… it explains everything in detail about a particular topic with examples…". However, there were responses that the ChemWiki seemed overwhelming or that the student had a difficult time finding the information that they had questions about.

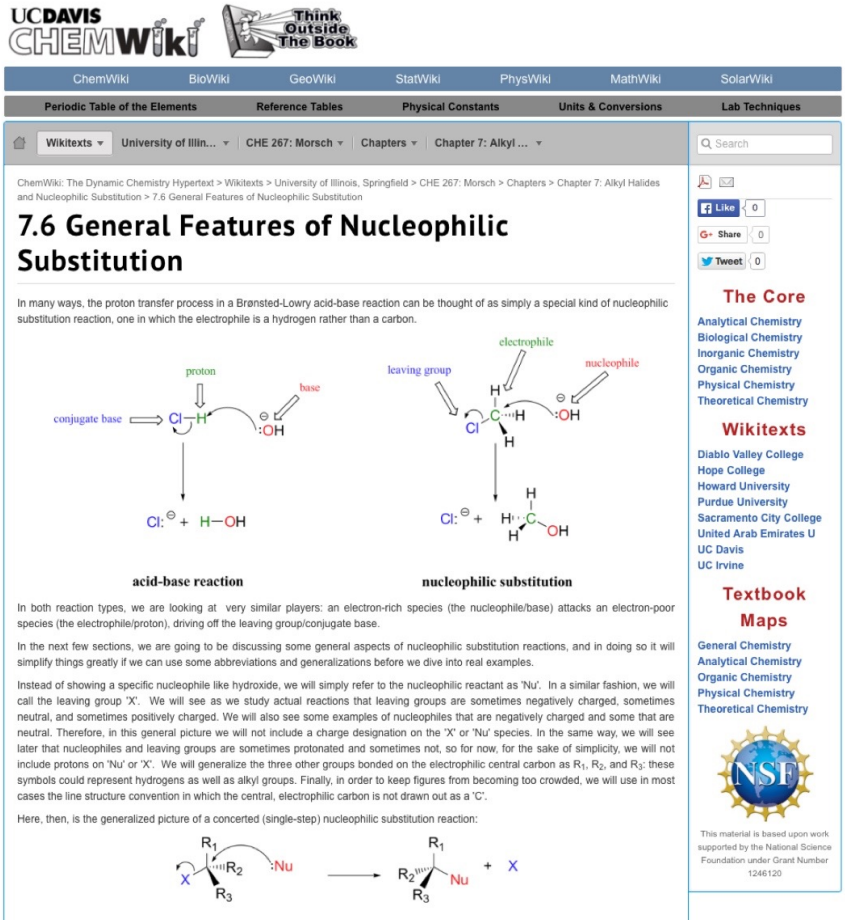


Figure 3. Example ChemWiki page.

During fall semester I surveyed the students following the first exam but this time I used a matrix to force them to choose the option that best represents how they use the ChemWiki (Figure 5, next page). The majority of students (34 out of 52 that responded) reported using it "For material where I don't fully understand the video explanations only".

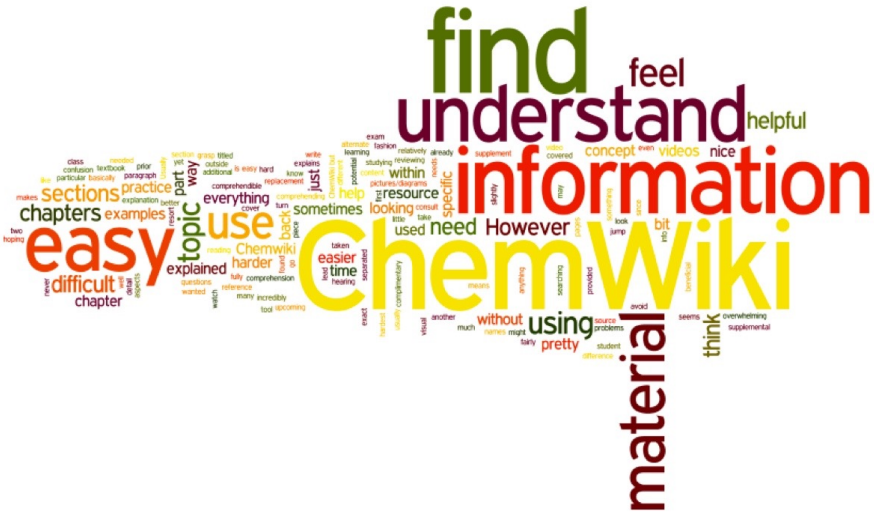


Figure 4. Word cloud of student responses to open ended question about how easy or difficult the ChemWiki is to use.

These reports of student usage were encouraging to me since one of my goals for using flipped teaching is to help students learn how to take responsibility for their own learning. I consider the ChemWiki, the video lectures and practice quizzes that I post as tools that are available for students to use as needed to understand the concepts of organic chemistry so they can apply them to solve problems. The majority of students

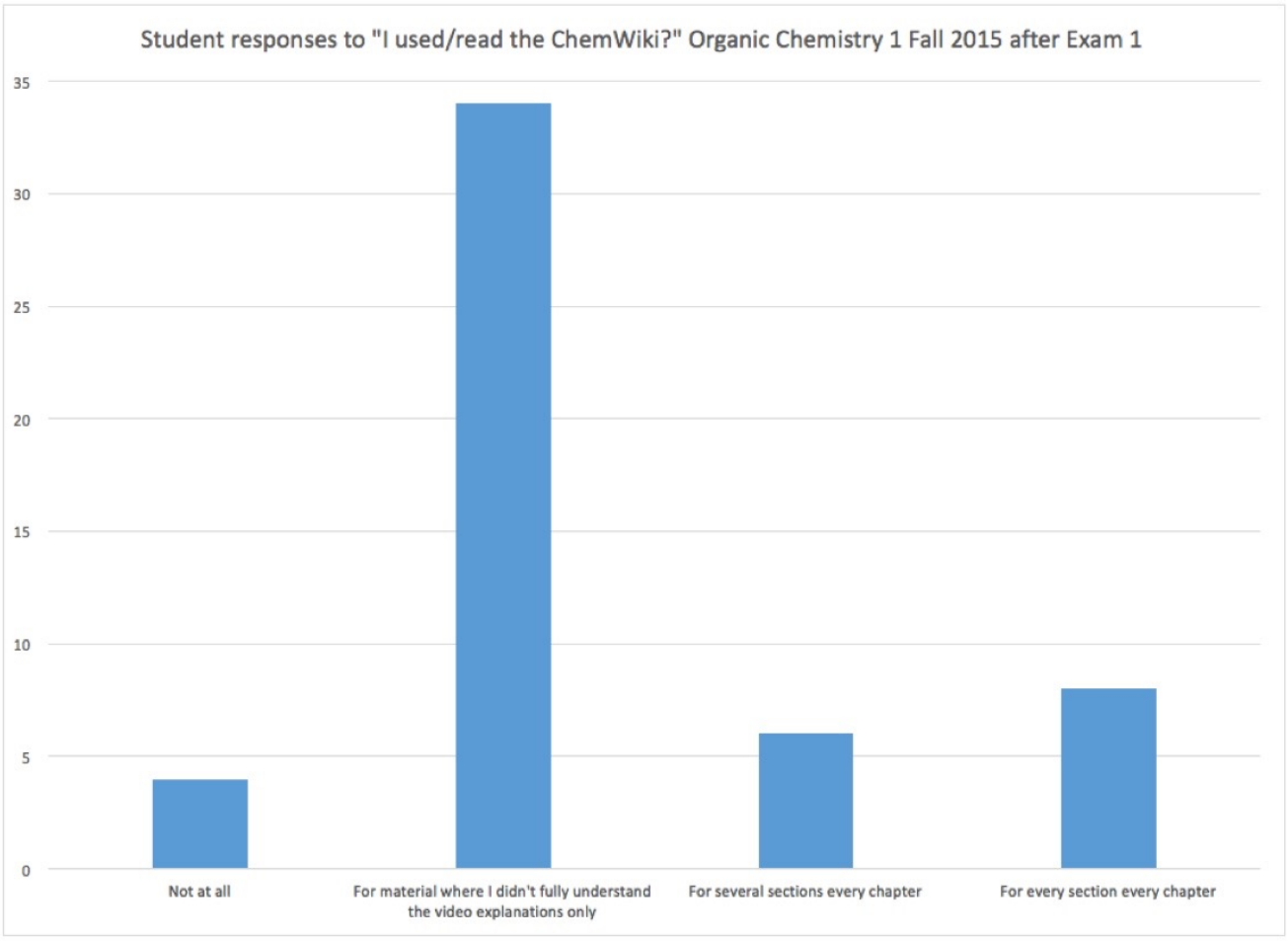


Figure 5. Figure 5. Student reported usage of the ChemWiki.

in my classes over the summer and fall have stated that this is how they are using the ChemWiki, when it can help them understand difficult concepts.

When do students use the ChemWiki?

With 17 students enrolled in the summer course, the average number of page views per day was 114 with a maximum of 511 for a single day and minimum of 40 page views. Having read Dr. Larsen's analysis of student usage data from UC Davis,[1,4] I expected to see large spikes in student usage before exams. However, only small spikes were observed for the summer course

TABLE 1. STUDENT SUCCESS USING THE CHEMWIKI AT UIS IN PLACE OF TRADITIONAL TEXTBOOK

YEAR	FORMAT	# STUDENTS	FINAL EXAM %
2012	Lecture	25	76.3
2013	Lecture	15	74.9
2014	Flip - Textbook	18	82.2
2015	Flip - ChemWiki	16	86.2

(Figure 6, next page). There was no increase in usage leading up to the summer final exam. The two largest spikes don't appear to have any relation to a class event and may have been caused by editing that Dr. Farmer or I were doing on the pages those days.

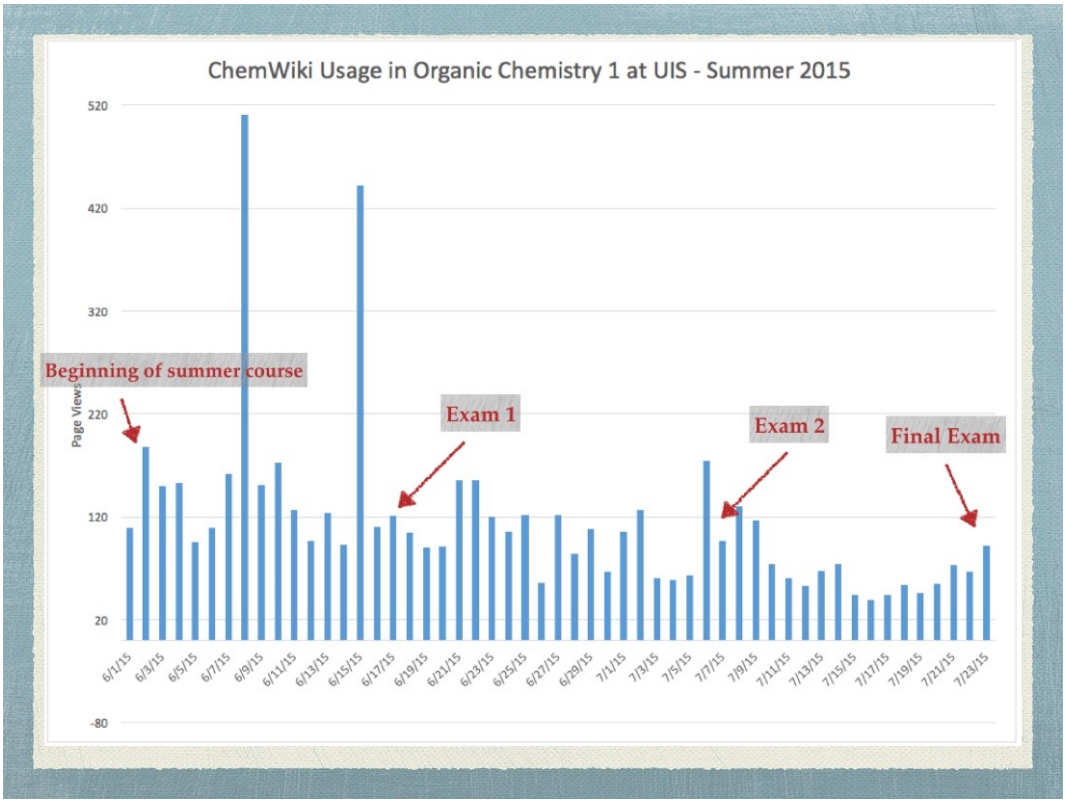


Figure 6. Page Views of ChemWiki for Summer 2015 organic chemistry 1 course at the University of Illinois Springfield.

This appears to suggest that the UIS students are using a more distributed studying model in place of massed learning (what we usually refer to as cramming). My best explanation for why the students are using a more distributed study method is based on how my flipped class works. Every class period begins with an open notes quiz (2 points) based on the assigned videos and reading for that day. We then spend the majority of class time working problems based on what was assigned. This encourages the students to keep up with material rather than waiting until right before an exam to begin studying.

However, this is only one possible interpretation of the data as the students could still be cramming just without using the ChemWiki extensively as part of their massed learning or there could be differences in the way students study as they progress through their degree programs which could lead to differences between my data and that from UC - Davis. With 17 students enrolled in the summer course, the average number of page views per day was 114 with a maximum of 511 for a single day and minimum of 40 page views.

Student Learning

Paramount to any analysis of alternative learning methods is whether the students are effectively meeting the learning objectives of the course. It has previously been shown at the University of California, Davis that students enrolled in a general chemistry course showed no statistical difference in achievement on pre-post test increases or course examinations based on whether they

used a traditional textbook or the ChemWiki.[5] While I did not have a controlled study, I can compare my summer course to previous equivalent summer organic 1 courses that I have taught. While this doesn't account for variability in the enrolled students from one summer to the next it can give a window into whether the students were able to succeed. The students have performed better both summers that I have incorporated flipped teaching in my course and they performed better in Summer 2015 with the ChemWiki than they did the previous summer using a textbook from a publisher.

Conclusion

So far the results are positive, indicating that the students using the ChemWiki are doing at least as well as those who used a traditional textbook in previous semesters. While these are small numbers, I am currently using the ChemWiki in my much larger Fall semester course. Switching to ChemWiki was just as easy as making any textbook change for my course. Like a traditional text, the ChemWiki incorporates figures and worked example problems. The only drawback I have found is that my students are requesting more practice problems so they can test their own understanding.

This semester alone, my students have saved over $20,000 from the cost of a traditional textbook and at least $9000 from the cost of purchasing access to a digital textbook for the academic year. Finally, I would like to add that though it was not my intention starting this process, it has become clear to me that this is also a social justice issue. I have had students in the past couple years tell me that they cannot take my class because they do not have enough money to buy the book. Others report not being able to access the book until near the time of the first exam while waiting for financial aid. It is a reality for many college students that they have to scrape together every dollar they can to afford to attend college. They simply cannot afford the additional cost of textbooks, especially in the sciences where our textbooks are often among the most expensive on campus. Are you ready to join me in making STEM education more accessible to these students?

References

1. Larsen, Delmar; Rusay, Ronald; Allen, Gregory; Guzman, Alberto; and Molinaro, Marco. The ChemWiki: A Free Online Substitute for Commercial Chemistry Textbook, Fall 2014 ACS CHED CCCE Newsletter. Accessed Oct 9, 2015. Online conference paper http://confchem.ccce.divched.org/2014FallCCCENLP10

2. Morsch, Layne A. and Lewis, Michael, "Engaging Organic Chemistry Students Using ChemDraw for iPad,"*Journal of Chemical Education*, **2015**, *92* (8), 1402-1405. DOI 10.1021/acs.jchemed.5b00054

3. Morsch, Layne A. Transforming the Chemistry Lab Notebook with Elements™, Fall 2014 ACS CHED CCCE Newsletter. Accessed Oct 12, 2015. Online conference paper http://confchem.ccce.divched.org/2014FallCCCENLP2

4. Allen, Gregory; Guzman-Alvarez, Alberto; Molinaro, Marco and Larsen, Delmar. "Assessing the Impact and Efficacy of the Open-Access ChemWiki Textbook Project." Educause Learning Initiative Brief (2015).

5. Allen, Gregory; Guzman-Alvarez, Alberto; Smith, Amy; Gamage, Alan; Molinaro, Marco and Larsen, Delmar S. "Evaluating the effectiveness of the open-access ChemWiki resource as a replacement for traditional general chemistry textbooks." *Chem. Educ. Res. Pract.*, **2015**, *16*, 939-948.

Upcoming Workshops and Symposium

cCWCS Workshop offerings for 2016 have been announced. The Active Learning in Organic Chemistry workshop will be in Cincinnati from June 20-24. We also have proposed workshops for the 2016 BCCE at University of Northern Colorado, on both technology and pedagogy. Lastly, we are planning a symposium at the BCCE so that past workshop participants can get together and share experiences. We hope to see you at BCCE!

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