

Affordable Learning Georgia Textbook Transformation Grants

Final Report

Date: May 10, 2016

Grant Number: 111

Institution Name(s): Middle Georgia State University

Team Members (Name, Title, Department, Institutions if different, and email address for each):

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Project Lead: Jonathan G. Cannon

Course Name(s) and Course Numbers: CHEM 1151 and 1152

Semester Project Began: Spring 2015

Semester(s) of Implementation: 2

Average Number of Students Per Course Section: 21

Number of Course Sections Affected by Implementation: 7

Total Number of Students Affected by Implementation: 150

1. Narrative

Chem 1151 Survey of Chemistry I

The comparison of the data before and after the transition in CHEM 1151 revealed that there was no overall impact on student learning. However, students spend significantly less money on course materials, making the transformation positive. Additionally, faculty found the new homework system more user-friendly. Both homework platforms used were received positively by students. The OWL platform (before) is approximately triple the cost. The quality of the product does not justify the additional cost.

The textbook prior to transformation was not well received by students. Many of the students did not realize the Openstax book was available, so most of the reviews after transformation were neutral. In the second semester of implementation, faculty repeatedly encouraged students to use the Openstax book. However, student's comments showed that students still did not utilize this resource, still commenting that there was no textbook available for the course. Depending on student and faculty opinion, we will either continue with this resource or move to Chemwiki for CHEM 1151 as well. The Openstax book is better suited for the principles sequence than for survey.

At this point, it is difficult to draw conclusions on the DFW rates. DFW rates Individual instructors have their own rates, and the instructors teaching the course have changed. Additionally, the entrance requirements for the institution and core requirements are different, causing a shift in demographics of students. If we look at the data we currently have, the failure and withdrawal rate has increased dramatically, from 8% (Spring 2015) to 38% (Fall 2015) to 24% (Spring 2016). We hope that the drop in DFW rate in the second semester of implementation is the beginning of a trend, as faculty and students become more accustomed to the new materials.

The delivery method and instructional techniques did not change significantly, however reference materials changed. Time was used to set up homework problem sets, and lecture materials which are reusable in the future. Additional instructor resources (test banks, etc.) were not available, increasing the time required to set up quizzes and exams.

Chem 1152 Survey of Chemistry II

While Openstax provided a textbook that adequately matched our departmental course outline for Chem 1151, no similar OER textbook existed for Chem 1152. We opted to construct an online textbook using pages selected from Chemwiki hosted by the University of California at Davis, and to supplement lectures with short, topical videos provided by Khan Academy. We were able to construct adequate materials, increase student use of these materials over the previous, purchased textbook, and save students between \$70 and >\$200 dollars each.

Before beginning to construct the syllabus, we met with faculty from the Department of Health Sciences since most of our students in this sequence are Health Science majors. The first hurdle

was to make modifications to the emphasis of the course to better match the needs of Health Science majors without departing from the agreed upon Chemistry department curriculum and standards. This required a de-emphasis of certain topics typically emphasized in textbooks for this course, and an increase in emphasis on biochemical topics. We found Chemwiki topic pages and Khan Academy videos that matched every topic for the course. The videos and wiki pages were mostly short enough and specific enough that many students found them useful references. The most typical complaint was that they were more in depth than what was expected for class, and that they didn't line up perfectly with what was tested. The second most common problem was that the resources didn't spend enough time on or give enough examples of the most basic concepts appropriate for the level of preparation of the majority of our students. This was particularly true of the biochemistry topics where the available pages dedicated most of their space to giving facts and vocabulary--much of it highly technical and not of lasting use to non-specialists--and little space tying the concepts back to organic chemistry and the chemical reasoning we attempted to teach in the first half of the semester.

The flexibility allowed by constructing a textbook from individual topic pages gave greater choice in the organization of topics in the course, and greater adaptability to the needs of the students. However, using a new relatively new resource that has undergone less editing and carried with it fewer instructor resources was challenging. While many topics had good examples on the Chemwiki pages, some topics had few or completely lacked examples of problem solving. Others only had problems more difficult than the level of a survey course. Chemwiki provides no lecture slides or test bank. The quality and quantity of figures are frequently lower than in textbooks. But while these seem like significant drawbacks from the perspective of a professor, it should be remembered that: 1. the majority of students never used the textbook they purchased, 2. we found it easy to adapt or borrow old, or create new, lecture slides for the material, and 3. it was possible to acquire and adapt exam materials simply by asking colleagues who had taught similar courses.

Three factors constrained our changes. Some faculty were willing to change to an OER textbook as long as it didn't significantly change what they teach. Consequently, changes had to be minimal. Second, the faculty implementing the changes (Dr. Cannon and Dr. Khatmullin) were inexperienced in teaching this course. Third, we had to use the already existing departmental assessment test which was geared toward the previous curriculum, and not to the emphasis suggested by the Health Sciences faculty.

We were able to modify the assessment test during the Spring 2016 semester in an attempt to better test fundamentals common to all instructors' choices in course emphasis. Students using the open resources scored much better than their counterparts; however, we fear that this was a function of the revised questions and not the abilities or learning of the students.

In summary, the cost savings to students provided by the changes, and the absence of negative impacts on learning outcomes, are sufficient reasons for us to contribute to further development and improvement of OER materials. Dr. Cannon has made contacts and plans to

be involved with development of interactive sample problems and ancillary instructor materials for the Chemwiki project. However, the lack of fully developed resources for the organic and biochemistry portions of the course, and the needs of some of our faculty to have a print textbook, preclude our continuing with Chemwiki as the primary text for these courses *at this time*. Nevertheless, as a consequence of our exploration of low cost textbook options, we have plans as a department to switch to an intermediate cost, primarily electronic text and tutorial system with an optional print book.

2. Quotes

Chem 1151

- The textbook is helpful when looking for a worked example in order to figure out a complex problem.
- I enjoy being able to reference the textbook anywhere I have an internet connection without toting a bulky book around, although I seem to comprehend the material better with a physical book.
- The textbook is easy to understand. I think it was an extra bonus that we didn't have to pay for it. As far as the helpfulness for studying, I really didn't use it for that. I used it more as a supplemental source when I couldn't figure something out from old exams, or my notes, homework, or the internet.

Chem 1152

- [Sapling Learning] was very easy to use. I used it to study some, but some questions proved to be quite difficult.
- The textbook was easy to navigate but I found it had a lot of information that we didn't use for some topics.
- I did not like the textbook. However the videos were nice.

3. Quantitative and Qualitative Measures

3a. Overall Measurements

Student Opinion of Materials

Was the overall student opinion about the materials used in the course positive, neutral, or negative?

Chem 1151

Total number of students affected in this project: 93

Homework Opinion

- Positive: 70 % of 72 number of respondents
- Neutral: 22 % of 72 number of respondents
- Negative: 8 % of 72 number of respondents

Textbook Opinion

- Positive: 6 % of 72 number of respondents
- Neutral: 75 % of 72 number of respondents
- Negative: 19 % of 72 number of respondents

Chem 1152

Total number of students affected in this project: 51

Homework Opinion

- Positive: 48 % of 31 number of respondents
- Neutral: 35 % of 31 number of respondents
- Negative: 16 % of 31 number of respondents

Textbook Opinion

- Positive: 39 % of 29 number of respondents
- Neutral: 32 % of 29 number of respondents
- Negative: 23 % of 29 number of respondents

Total

Total number of students affected in this project: 134

Homework Opinion

- Positive: 60 % of 103 number of respondents
- Neutral: 25 % of 103 number of respondents

- Negative: 15 % of 103 number of respondents

Textbook Opinion

- Positive: 15 % of 101 number of respondents
- Neutral: 56 % of 101 number of respondents
- Negative: 29 % of 101 number of respondents

Student Learning Outcomes and Grades

Chem 1151

Choose One:

- Positive: Higher performance outcomes measured over previous semester(s)
- Neutral: Same performance outcomes over previous semester(s)
- Negative: Lower performance outcomes over previous semester(s)

Chem 1152

Choose One:

- Positive: Higher performance outcomes measured over previous semester(s)
- Neutral: Same performance outcomes over previous semester(s)
- Negative: Lower performance outcomes over previous semester(s)

Student Drop/Fail/Withdraw (DFW) Rates

Drop/Fail/Withdraw Rate:

Chem 1151

32 % of students, out of a total 115 students affected, dropped/failed/withdrew from the course in the final semester of implementation.

Choose One:

- Positive: This is a lower percentage of students with D/F/W than previous semester(s)
- Neutral: This is the same percentage of students with D/F/W than previous semester(s)
- Negative: This is a higher percentage of students with D/F/W than previous semester(s)

Chem 1152

7 % of students, out of a total 57 students affected, dropped/failed/withdrew from the course in the final semester of implementation.

Choose One:

- x Positive: This is a lower percentage of students with D/F/W than previous semester(s)
- Neutral: This is the same percentage of students with D/F/W than previous semester(s)
- Negative: This is a higher percentage of students with D/F/W than previous semester(s)

3b. Narrative

Chem 1151 Survey of Chemistry I

In comparison to previous semesters, students seemed indifferent to the change in homework systems. The previous opinion was 64% of 22 students thought that the OWL homework system was positive. Student opinion is slightly improved with 69% of 72 students having a positive opinion of Sapling Learning. Sapling Learning is significantly cheaper for students, significantly easier for faculty to use, and students are marginally in favor of the change.

The textbook was less well received by students, but students were less polarized. In previous semesters, 29% of students liked the textbook while 67% disliked it. The open source textbook was neutrally received by students, where 75% were neutral towards the textbook and 20% dislike it. Many students commented that they did not know of the textbook.

We had a dramatic increase in the number of students that failed or dropped CHEM 1151. Upon a closer look, we were unsure if the increase was due to the change in course materials, or other changes. The data collected prior to transformation had a FW rate of 8%, but it was a different instructor. If we pull data for the same instructor, the FW rate is 9% compared to her 34% for the fall semester and 24% for the spring semester. However, the data collected before transformation for the same instructor was collected shortly after the school was consolidated. Consolidation caused many of the core requirements to change, so the demographics have changed. Prior to consolidation, the vast majority of students were pre-nursing majors. The current courses include more non-science majors. At this point, we are unable to determine if the considerable increase in FW rates are due to the textbook transformation, the change in the demographics of students, the instructor, or some combination thereof. It is also possible they are ordinary statistical fluctuations, since FW rates for introductory science courses at our school are often 30% or more.

Student success for learning objectives seems to be nearly the same. Prior to transformation, students averaged 73.6% correct on our assessment questions. After transformation, there was

a slight drop to 69.5% correct. With the limited amount of data, we attribute this change to variation in the class demographics. Learning was not hindered by the transformation.

For CHEM 1151, the transformation retained a positive opinion on the homework system, removed the negative opinion on the textbook, but may have contributed to an increase in FW rates (though more research would need to be done to make sure).

Chem 1152 Survey of Chemistry II

The measurable impact on the students was primarily in the form of improved opinions about the textbook. Our objective assessment remained the same. Fewer students withdrew or failed, but it is likely within the range of statistical fluctuations for only 57 students. The departmental assessment had almost exactly the same average and standard deviation of scores between the spring 2015 and fall 2016 courses before and after the textbook transformation. The modified assessment given in spring 2016 showed much greater success for the students using OER materials, 65% correct vs. 40% for students using our previous textbook. This is worth further examination, but is not a convincing indicator of improved student outcomes. It indicates that the test better matches the course expectations for students using the OER, but matches the expectations of students using the previous textbook no better than the unmodified assessment test.

We had proposed doing a pretest to measure improvements over the course of the semester. We were unable to do so because of limited willingness to participate of faculty who were not directly involved with the project. We looked into using past scores and grades from Chem 1151 to compare them with outcomes for the same students in 1152, but we had insufficient overlap between the students involved in both semesters of the study to draw any meaningful conclusions.

Both the students and professors noticed the imperfect fit of the Chemwiki textbook and Khan Academy videos to the course; however, 73% of the students used Chemwiki more than once a week compared to only 39% with the previous textbook. 48% of students used Chemwiki 3-5 times per week, while only 6% used the previous textbook that often. Student opinions of the textbook shifted from 6% positive and 61% negative with the previous book to 39% positive and only 23% negative with Chemwiki. The increased textbook usage is likely partially the result of differences in teaching methods between Dr. Nuckels and Dr. Cannon. Dr. Nuckels relies heavily on lecture slides to convey the material expected of her students. Dr. Cannon employed a flipped classroom approach, requiring students to have watched videos or read and taken notes before attending class. Dr. Nuckels's students ranked class notes and previous exams as the most important materials for success in the course with the textbook being lowest ranked, while Dr. Cannon's students ranked the textbook and course notes equally and only somewhat higher than other resources.

Our change in online homework system was a bigger success. Student opinions shifted from a 6% positive and 71% negative response with OWL to a 48% positive and 16% negative response

with Sapling Learning. While still an imperfect fit for our expectations of the course, we were better able to match problems with the desired outcomes than with the previous system, and there were almost no complaints about the ease of using the system. That is in contrast to frequent complaints about OWL. Also, 52% of the students felt that Sapling Learning was the first or second most important tool for success in the course compared with only 30% ranking the previous system that highly.

4. Sustainability Plan

For CHEM 1151, the textbook is provided on Openstax.org. Updating and maintenance of course materials will be done by the publishers. Additional materials are on D2L.

For CHEM 1152, the textbook is maintained by Chemwiki. We will provide professors with the option of using the specialized textbook map we prepared this semester or one of the Chemwiki textbook maps that aligns with a published General, Organic, and Biochemistry textbook. The specialized textbook map will continue to be adapted by individual professors, while the alternative textbook map will provide a stable reference.

Sapling Learning homework assignments from the study will be provided to professors who can then modify them in conjunction with support staff from Sapling Learning.

Khan Academy videos are maintained by Khan Academy. We used the most stable links available, but links will occasionally require updating when Khan Academy updates topical videos.

Despite all materials being selected or prepared in formats which can be easily distributed, reused, and adapted, the limited amounts of ancillary instructor materials available for CHEM 1152, and the lack of an optional printed text for the same course, make continuation of OER use for this course infeasible for our department at this time.

5. Future Plans

This project has supported our use of Sapling Learning as an online homework system. Students seem to overall be indifferent to the change in systems, and faculty use is significantly easier. However, as a department we have decided that a complete shift to OER is impractical at this time.

Now that we have more knowledge and experience with the available OERs, we have found better developed materials for Organic and Biochemistry courses, as well as the general chemistry course for science majors. We have begun incorporating many of these materials as lower cost options for students in those courses. We have also reexamined the available commercial materials for CHEM 1151/1152 and identified options costing significantly less than our previous textbook, if not as little as the open textbooks. In summary, while our project to shift CHEM 1151/1152 completely to open resources could be described as a failure, we have managed through this process to 1. Educate our colleagues about the improving OER options, 2.

Shift the courses to a less expensive (if not free) textbook and homework system option, and 3. Provide lower cost options for students in several other courses who would otherwise pay \$2-300 for textbooks or try to complete the courses without having any textbook.

Jonathan Cannon and Estelle Nuckels presented our results at the USG Teaching Learning Conference in April 2016. Dr. Cannon has joined the growing team of associate editors on the Chemwiki project, and we plan to help improve and expand on the materials available for GOB Chemistry courses to remove the barriers we experienced for us and for others who wish to provide affordable resources for their students in the future.

6. Description of Photograph

(left-right, back row) Dr. Khatmullin, instructor for Chem 1151 and co-developer of Chem 1152; Dr. Cannon, team lead and co-developer/instructor for Chem 1152; Dr. Nuckels, instructor for Chem 1151 and 1152 and developer for Chem 1151.

(left-right, front row) Delightful distractions.