Faculty Learning Community

College of Natural Sciences & Mathematics

Final Report: 2016-17 Cohort

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Overview of the 2016-17 CNSM FLC

The overall goals of the 2016-17 CNSM FLC were to a) encourage faculty to be active in "scientific teaching" (that is, to identify problems in their courses, implement potential solutions, and to assess the effects of the interventions in as meaningful a way as possible) and b) to continue the work of previous FLCs in building a supportive community of faculty who are interested in improving their teaching skills.

The course material we covered in 2016-17 was basically the same as we had covered in 2015-16 (with Dr. Nate Onderdonk as leader, and Dr. Bruno Pernet as co-leader). However, in that iteration of the FLC almost all of the discussion was online; there were very few in-person meetings of the group. Online discussions were sometimes difficult to get started and were sometimes not particularly lively; in contrast, in our few in-person meetings, discussion flowed quite easily. After that 2015-16 iteration of the FLC, discussions with Drs. Jen-Mei Chang and Kelly Young led to the idea of offering the FLC in more of a hybrid structure, with more in-person meetings, as well as online discussions.

Thus for 2016-17, we modified the structure of the FLC so that there were a total of four in-person discussions, and six online discussions. Our first meeting was in-person, and at that meeting we scheduled all remaining in-person meetings for the fall semester. Scheduling was not very difficult. My sense was that this number of in-person meetings was not particularly onerous for participants. As prior experience had suggested, online discussions were sometimes slow to start, but in-person discussions were quite easy to start and were generally much more energetic and productive. I recommend such a hybrid structure in future iterations of the FLC.

2016-17 FLC Syllabus

CNSM Faculty Learning Community 2016-17

Leaders: Bruno Pernet (bruno.pernet@csulb.edu, 5-5378)
Thomas Gredig (thomas.gredig@csulb.edu, 5-4922)

The FLC is a small reading and discussion group of CNSM faculty focused on learning about and implementing effective and engaging teaching techniques. The “leaders” of this group don’t claim any special expertise in this area; we serve primarily to organize the group and to encourage participants to keep the discussion going.

The FLC includes two semesters of activities. The first includes six discussion topics, each covered over one or two weeks in a hybrid format (we’ll meet as a group a few times during the semester, and the remaining discussion will take place online). Topics are shown below in the schedule. We will provide links to brief readings about each topic at the beginning of the semester; all readings will be available at all times during the semester. Because watching others teach is a great way to get ideas about how to modify your own teaching, after the initial discussions there will be several weeks of scheduled peer classroom observations.

The second semester involves only one main activity: proposing a change in one of your courses, implementing it, and evaluating its effect on student learning. At the end of the fall semester we’ll meet to talk informally about what you plan to do; we’ll meet again very early in the spring semester to discuss your proposed change, and what kind of data you plan to collect to test whether or not the change improves learning. During the rest of the spring you’ll implement that change. Within a few weeks of the end of the spring semester you will turn in a short report describing the change and its measured results. Reports from past FLC participants are posted at https://web.csulb.edu/colleges/cnsm/learning/reports.html, if you’d like to get a sense of what people have done previously.

A tentative schedule for the course is below. We would like the whole FLC to meet in person on four occasions during the semester; we have tentatively chosen Fridays of the relevant weeks (in red) for those meetings, but we will query you early in August to see if those days work, and if so, to find a time we can meet on those days. All other activities can happen on your own schedule, in the date range provided.

Date	**Topic**
26 Aug	**In person meeting** (intros, discuss engaging students)
27 Aug-9 Sep	Online – engaging students: apply it
16 Sep	**In person meeting** (discuss assessment)
17-30 Sep	Online – backward design for assessment
1-14 Oct	Online – stereotype threat & impostor syndrome
21 Oct	**In person meeting** (discuss fostering a growth mindset)
22-28 Oct	**Peer classroom observation** (informal visit, without prior preparation)
29 Oct-4 Nov	**Pre-observation meeting** (in pairs, schedule visits for next week or two)
5-18 Nov	**Formal peer classroom observations**
9 Dec	**In person meeting** (ideas for spring modifications; suggestions for FLC)

List of Participants

Participants who completed both semesters of the FLC

Dr. Amanda Fisher, Biological Sciences

Dr. Erika Holland, Biological Sciences

Dr. Joshua Sack, Mathematics and Statistics

Dr. Young-Seok Shon, Chemistry and Biochemistry

Dr. Fangyuan Tian, Chemistry and Biochemistry

Dr. Christine Whitcraft, Biological Sciences

Participant who completed Fall semester activities, but not Spring semester

Dr. Claudia Ojeda-Aristizabal, Physics and Astronomy (Spring semester activities postponed until 2017-18)

Participants who dropped out of the FLC

Dr. William Straits, Science Education

Dr. James von Brecht, Mathematics and Statistics

FLC Leader: Dr. Bruno Pernet, Biological Sciences

FLC Co-leader: Dr. Thomas Gredig, Physics and Astronomy

Brief Summaries of Faculty Reports

Dr. Fisher (Plant Systematics, BIOL 427) sought to motivate her students to excel at the course's main challenge – learning 60 plant families by sight – by convincing them that all of them could do it (fostering growth mindset) and by frequently reminding them of how much they had already learned. She also sought to counter impostor syndrome by making explicit that she sought to design fair, unbiased exams. These interventions did not seem to improve exam scores over those of the previous year.

Dr. Holland (Introduction to Cell and Molecular Biology, BIOL 212) implemented use of iClickers in her large lecture course in order to improve attendance and assess comprehension of specific concepts. Judged qualitatively, at least, iClicker use improved attendance at lectures. In addition, she carried out detailed analysis of responses to iClicker questions and performance on related exam questions. Though there was no relationship between the difficulty of iClicker questions and performance on exams, the analysis gave her detailed insight into which concepts were particularly challenging for students, and thus ideas on how to modify future iterations of the course.

Dr. Sack (Introduction to Linear Algebra, MATH 247) sought to have his students identify particularly important concepts in the course by asking each student to submit a potential exam question a week before each exam. This intervention did not seem to improve final exam scores over those of the previous year. An attitudinal survey revealed that most students felt that the assignment was at least somewhat helpful, and most students recommended it be retained in future iterations of the course.

Dr. Shon (Organic Chemistry I, CHEM 220A) changed his course by a) introducing learning outcomes at the beginning of each lecture and b) in some lectures, using "one minute papers" to get feedback from students on what learning outcomes were most challenging for students. He also experimented with putting the material in a broader practical and historical context by presenting Youtube videos highlighting examples relevant to that day's material in some lectures. Student performance on topics whose related lectures included one minute papers was not higher than on those whose related lectures did not include one minute papers. Dr. Shon plans to continue occasional use of this intervention in future interations of the course, however, as it gives him useful information on which topics students find difficult.

Dr. Tian (Instrumental Analysis Methods, CHEM 451) made two changes to her course (providing learning objectives for selected chapters, and working through engaging case studies in the classroom) with the aim of encouraging active learning. These changes did not seem to affect student performance on ACS exams, as judged by comparing performance on questions from chapters where learning objectives to those from chapters where learning objectives were not presented). However, presentation of case studies appeared to have a positive effect on the students' abilities to solve real-world problems.

Dr. Whitcraft (Plant Ecology, BIOL 450) aimed to increase student use of office hours and their sense of belonging in the course by requiring each of them to meet with her individually during the first two weeks of the course. In these meetings (~10 min on average), Dr. Whitcraft interviewed them about their career goals and reasons for taking the course. Students in the Spring 2017 iteration of the course did attend office hours much more frequently than did students in the two previous iterations of the course, suggesting that this required early interview had its intended effect. Qualitative surveys of students indicated that they felt positive about the early interview, as well. Grade distributions did not change in the Spring 2017 iteration of the course relative to prior iterations of the course, however.

Amanda Fisher
Biological Sciences
BIOL427 Plant Systematics
24 students

CNSM Faculty Learning Community Final Report

Motivation for Change

I challenge BIOL427 Plant Systematics students to a difficult task- they must learn 60 plant families by sight. Students can become discouraged if they are not initially interested in botany or if they don't do well on an exam and fall behind in the course. Many students think they have little prior experience with plants and tell me at the end of the semester that they learned that they do in fact like plants and that they have begun to notice the plants around them. Some of my students may feel that they are "imposters" in a plant-focused course, because of their perceived lack of prior experience and their career goals in animal research or human health.

Goal

I wanted to encourage students to recognize their interest in plants and cultivate their curiosity about plant diversity. My hope was that this would lead them to be genuinely interested in learning the course material and study more as a natural extension of their curiosity. I used growth mindset techniques learned in FLC to motivate students to study plant families. I also wanted to counter imposter syndrome during examinations by making a statement before each exam to discourage students from feeling that they couldn't succeed in the course.

Implementation

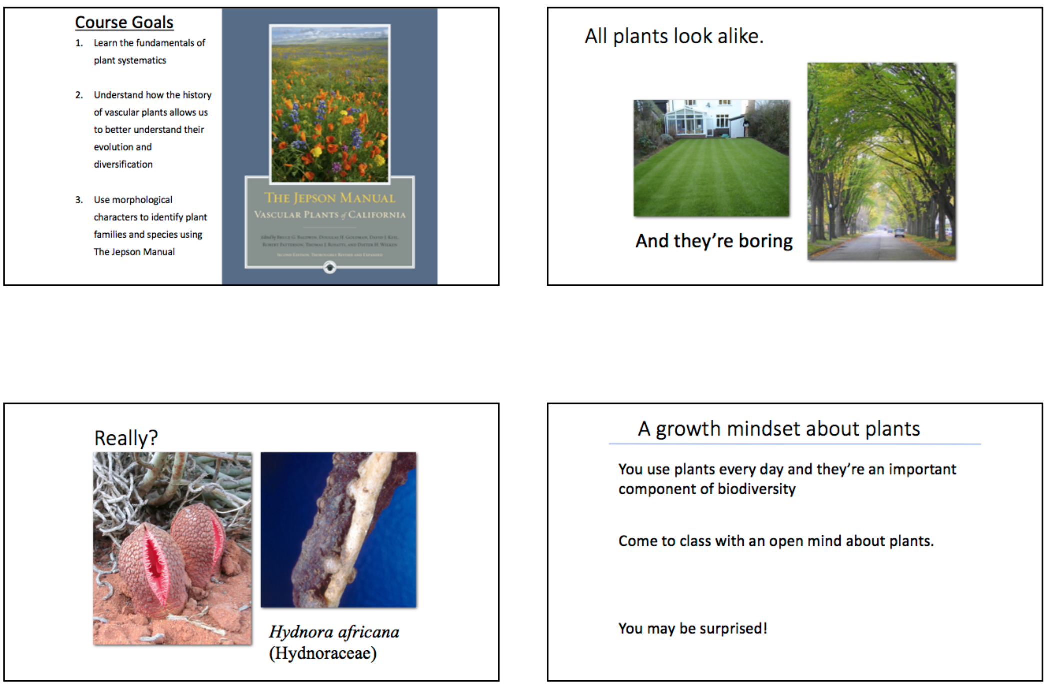
- **Lecture about developing a growth mindset** and clear expectations for the class.
- **Weekly reminders of learning progress** to encourage students of their ability to learn the material and succeed in the class.
- **Fair exam statements** before each lecture and lab examination to counter imposter syndrome.

Assessment strategies

- Comparison of Exam 1 scores from Spring 2017 with Spring 2016 with the expectation of higher exam scores in Spring 2017.
- Mid-semester student self-assessment of interest in plants.

Implementation

A portion of the lecture on the first day used techniques learned in FLC to establish a growth mindset atmosphere in the classroom (Fig 1). The students seemed engaged with these examples and that I was addressing their perceived lack of experience in botany, but I did not receive or expect much response. One response that I did not anticipate was from a student who was particularly excited about taking a botany class who loudly countered "No they're not!" when I posted the "All plants look alike and they're boring" slide. My attempt at encouragement may have inadvertently marginalized students starting the class with a genuine interest in the subject.



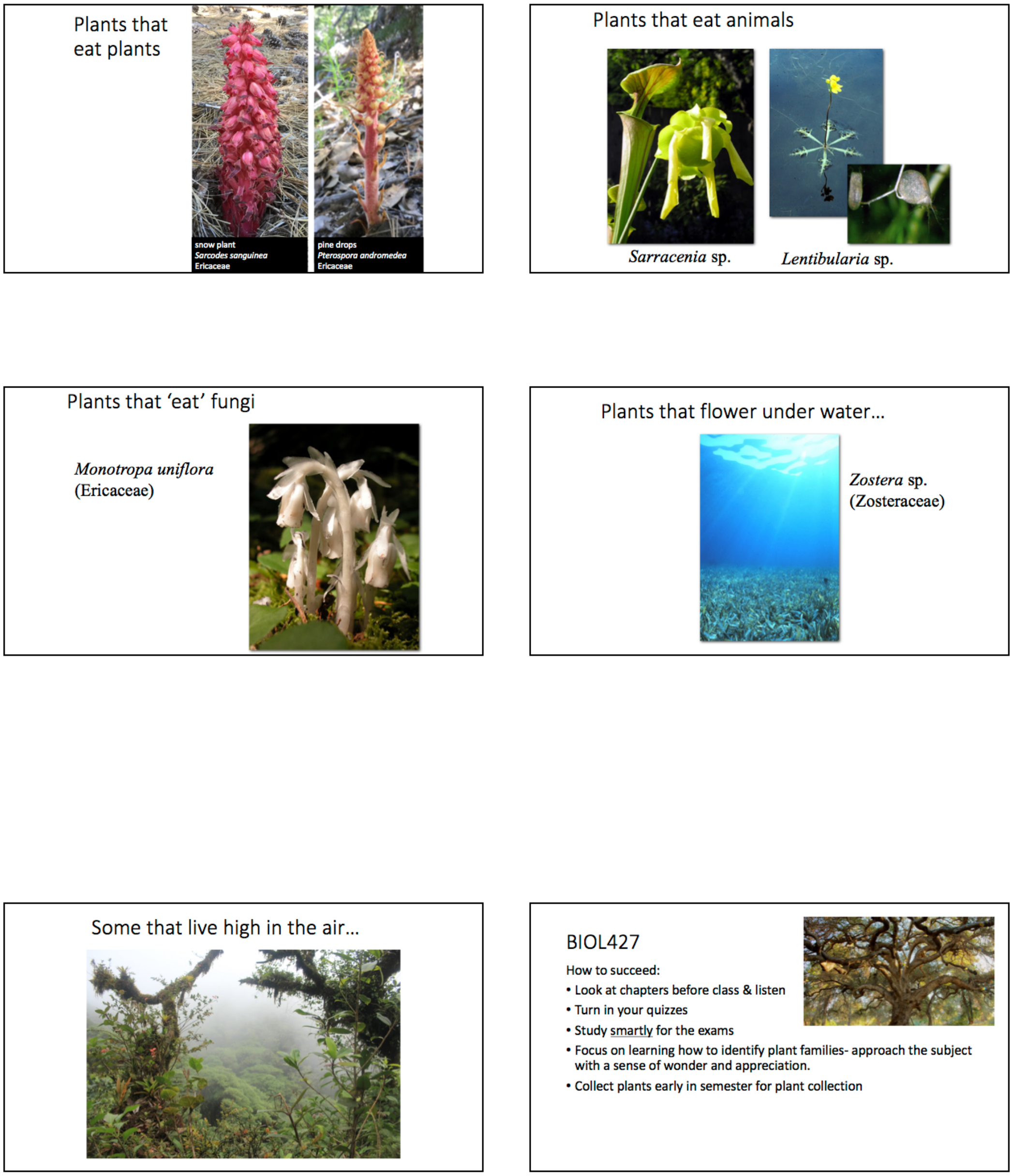


Figure 1. Introduction of a growth mindset in BIOL427 lecture slides.

Weekly reminders of learning progress

Each week I showed a slide of a plant phylogeny (Fig. 2) that illustrated the progress we had already made (gray) and the material that we were going to study that day (arrow and blue boxes). While showing these types of slides I used growth mindset phrases such as "We've already covered so much of the Eudicots and today we're studying four Lamiid orders. By the end of next week you'll have finished the Eudicots, the most diverse group of plants!" We used these slides to review names and relationships between the higher taxa and to highlight what the students had already achieved. These slides demonstrated that we could break the plant tree of life into manageable sections and reasonably learn all of the plant families.

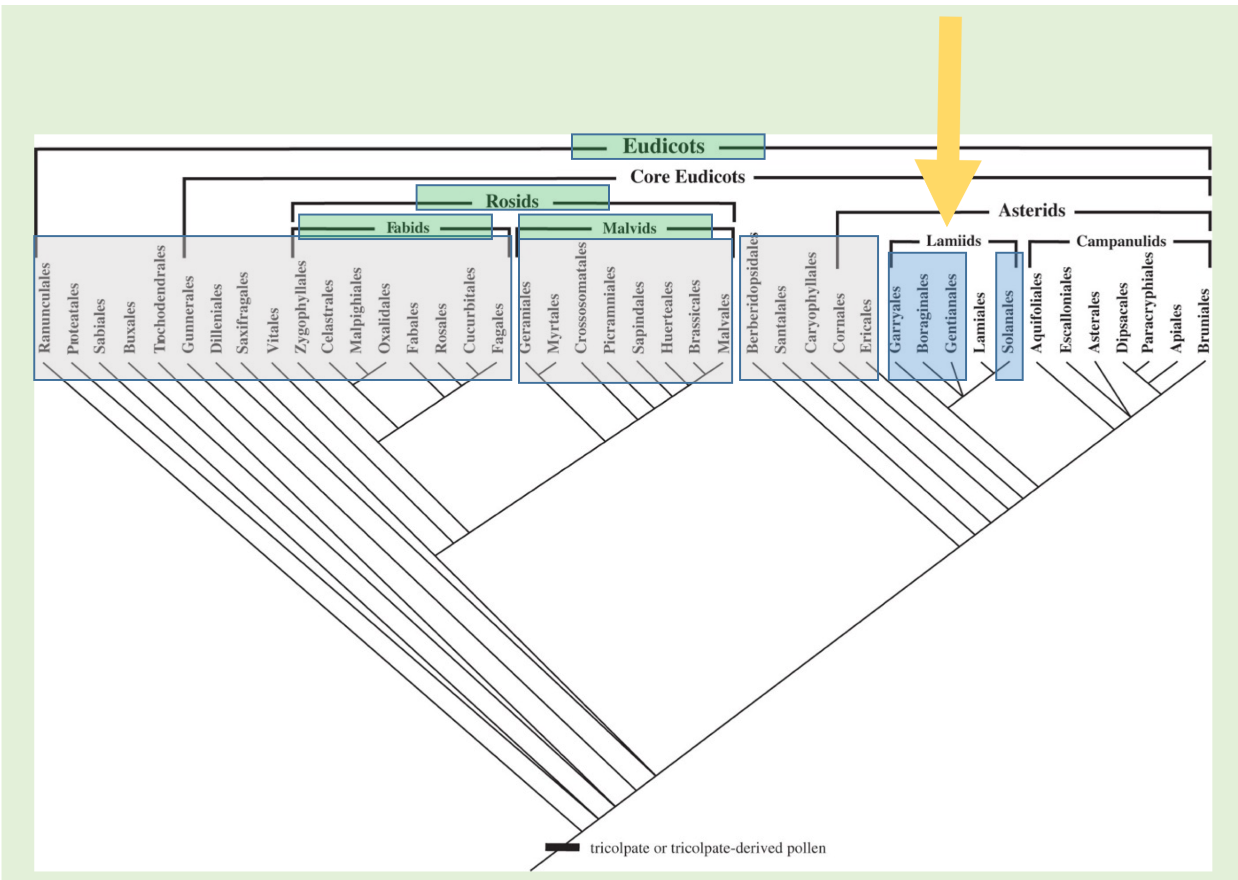


Figure 2. Learning progress illustrated during lecture.

Fair exam statement

I read variations on this statement at the beginning of the four exam days:

> *I wrote today's exam with the intention that it is fair and that you can earn all of the points if you have studied consistently over this portion of the course. My goal is to write exams that are not biased towards any particular gender, race, or prior experience with plants. You've been working hard and I know that you can do well if you take your time and think about each answer.*

Response

Our FLC readings demonstrated improvements in exam scores when students learned in an atmosphere of growth mindset and when the instructor made fair exam statements. I compared exam scores from 2016, the only previous year I have taught the course, with exam scores from 2017, during which time I implemented the growth mindset and fair exam statements in the course.

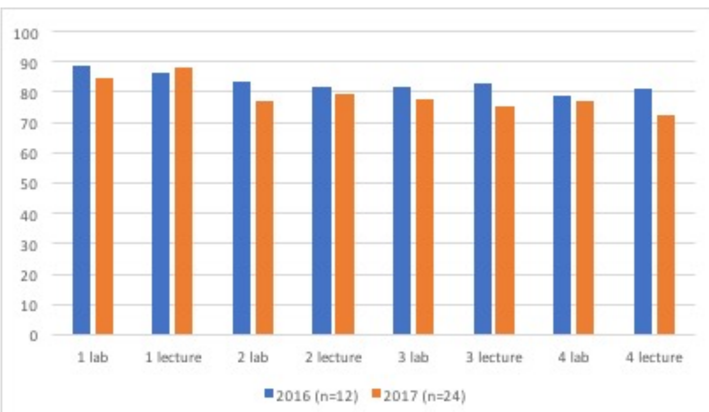
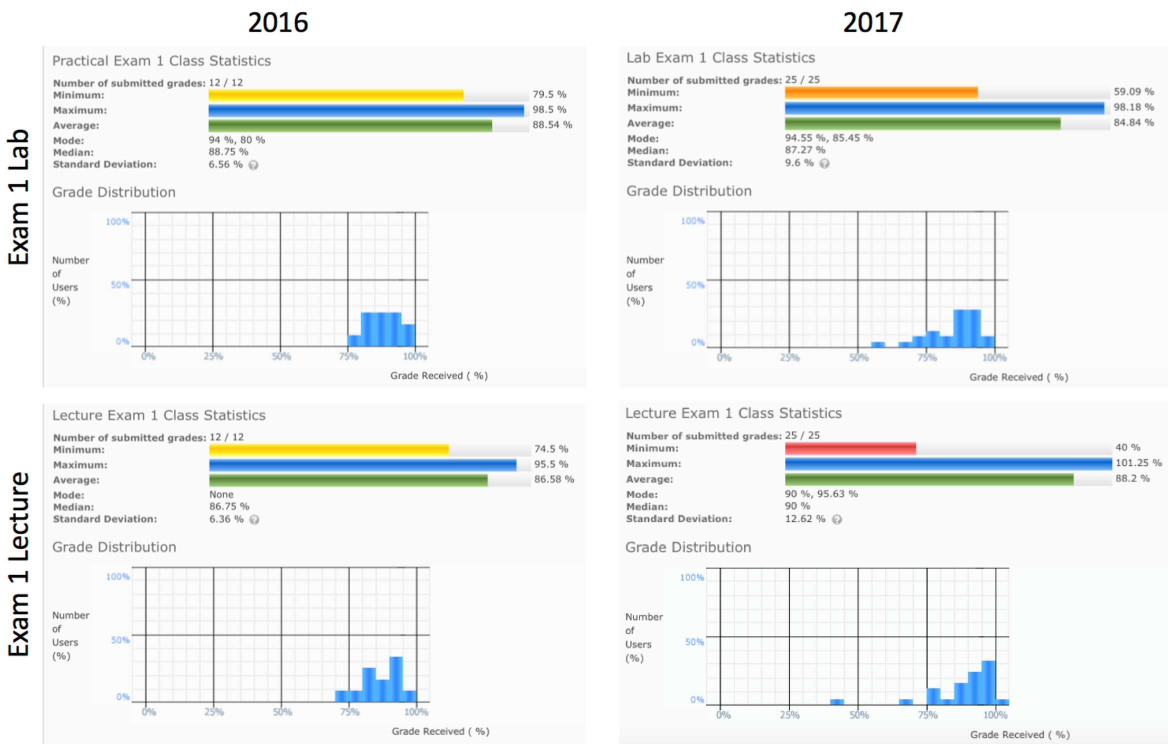


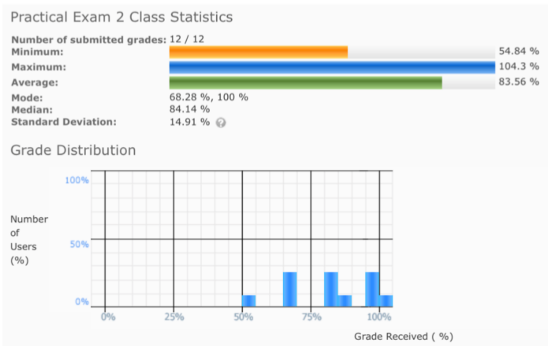
Figure 3. BIOL427 exam averages in 2016 and 2017. Scores were slightly higher in 2016.

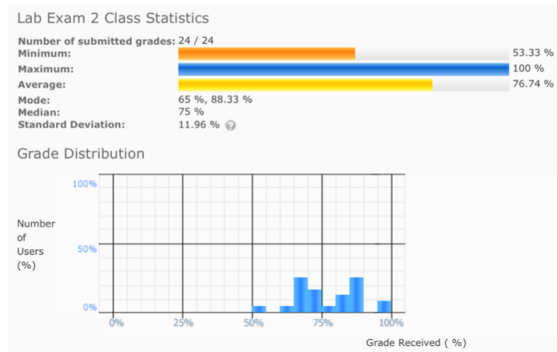
The average scores for each exam in the course were slightly, but consistently, higher in 2016 (Fig. 3), before the Faculty Learning Community changes. I do not think comparing these scores is a good measure of the response to the course changes for the following reasons (1) only two years were measured, (2) the class size doubled in 2017, and (3) the students in 2016 were exceptionally interested in botany. In 2016 four of the 12 students worked in my research lab and their career goals required learning the course content. There may have been other confounding factors, such as slight changes to the families covered in exams 2 and 3 or other factors.


2016
2017
Exam 1 Lab
Exam 1 Lecture
Practical Exam 1 Class Statistics
Number of submitted grades: 12 / 12
Minimum: 79.5 %
Maximum: 98.5 %
Average: 88.54 %
Mode: 94 %, 80 %
Median: 88.75 %
Standard Deviation: 6.56 %
Grade Distribution
Number of Users (%)
Grade Received (%)
Lab Exam 1 Class Statistics
Number of submitted grades: 25 / 25
Minimum: 59.09 %
Maximum: 98.18 %
Average: 84.84 %
Mode: 94.55 %, 85.45 %
Median: 87.27 %
Standard Deviation: 9.6 %
Grade Distribution
Number of Users (%)
Grade Received (%)
Lecture Exam 1 Class Statistics
Number of submitted grades: 12 / 12
Minimum: 74.5 %
Maximum: 95.5 %
Average: 86.58 %
Mode: None
Median: 86.75 %
Standard Deviation: 6.36 %
Grade Distribution
Number of Users (%)
Grade Received (%)
Lecture Exam 1 Class Statistics
Number of submitted grades: 25 / 25
Minimum: 40 %
Maximum: 101.25 %
Average: 88.2 %
Mode: 90 %, 95.63 %
Median: 90 %
Standard Deviation: 12.62 %
Grade Distribution
Number of Users (%)
Grade Received (%)

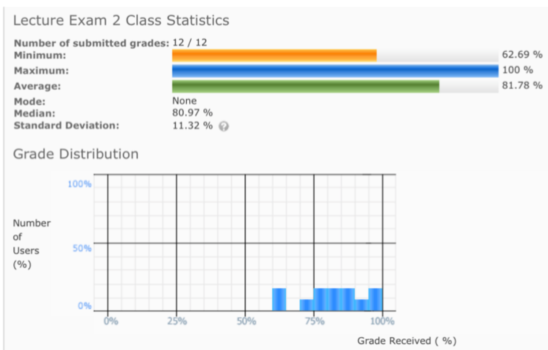
2016 | 2017

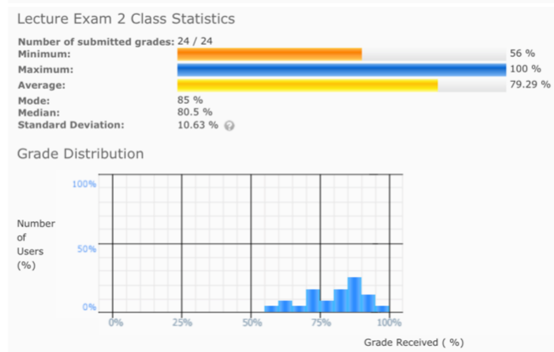
Exam 2 Lab





Exam 2 Lecture

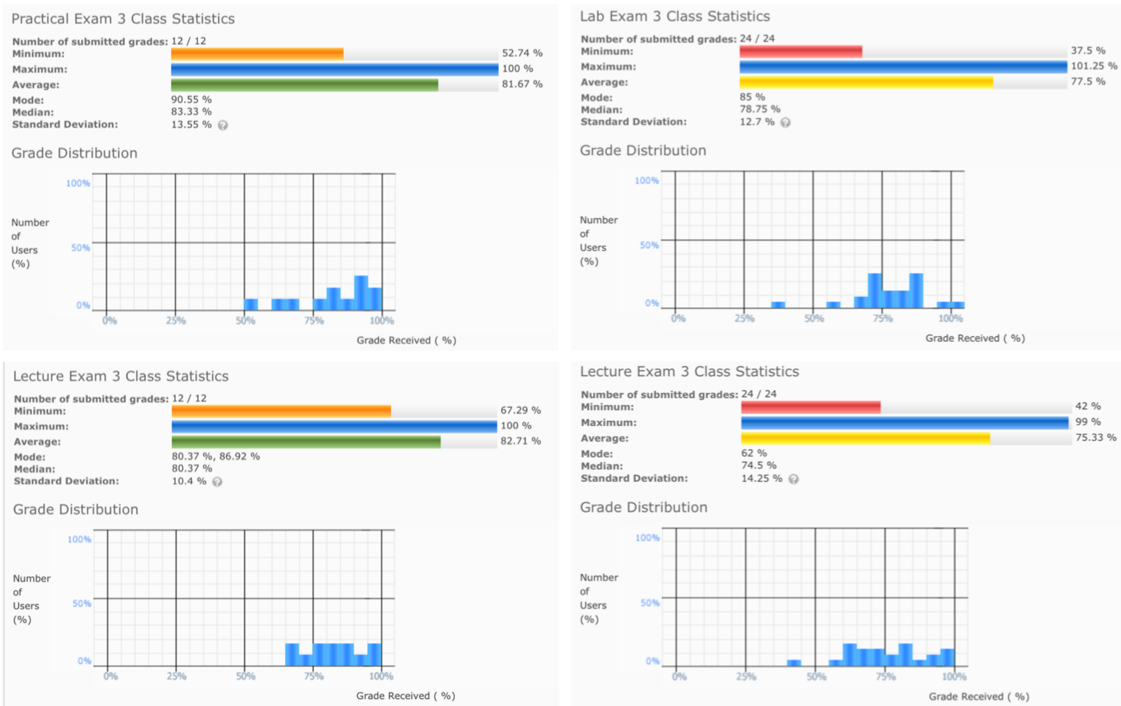




2016 2017

Exam 3 Lab

Exam 3 Lecture



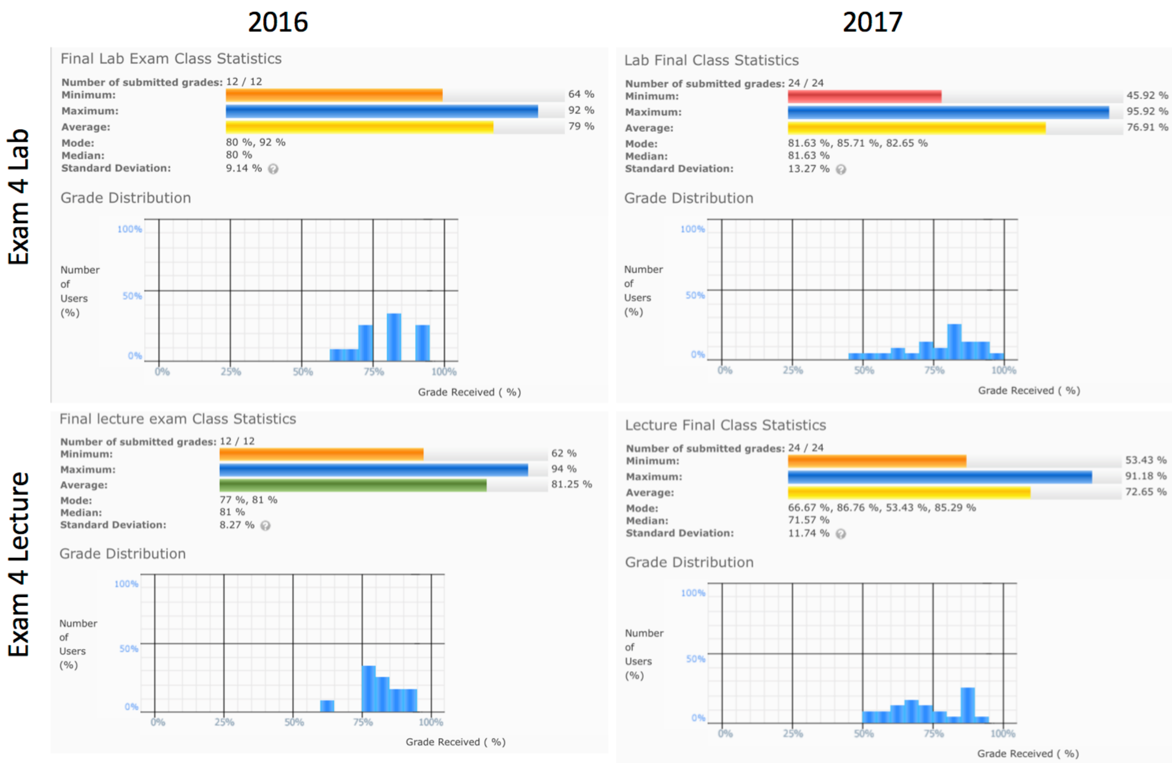


Figure 4. Comparison of 2016 and 2017 scores for each BIOL427 exam.

Mid-semester review of student interest in plants

In 2017 I asked BIOL427 students to fill out an anonymous review of the class at the end of the second exam. I was particularly interested in student responses to question 2 to assess if they had gained an interest in plants by the middle of the semester.

BIOL427 Sp2017 Midterm Review of Dr. Fisher

1. Was the second exam what you expected? Was it too difficult or too easy?

2. Are you enjoying the course? Are you learning about plant systematics? Are you more interested in plants now?

3. How can I improve the lectures and/or the labs to increase your learning?

4. What materials do you usually use to study for this course? Estimate a percentage for each.

Simpson textbook hardcopy
Simpson textbook online/ebook
Lecture notes
Lab handouts
Personal photos from lab
Classmate's photos from lab (totally fine if you do this)
Random websites (to look up terms, plant images, etc.)

I appreciate your hard work in this course and I hope to give you an appreciation for plants before you end your undergraduate career and take on the world with your Biology degree!

I had 23 students respond to the midterm review and their answers to question 2 were positive (Fig. 5). All students who responded self-reported that they were more interested in plants by the middle of the semester than when they began the course. This suggests that most students quickly develop a genuine interest in the course material.

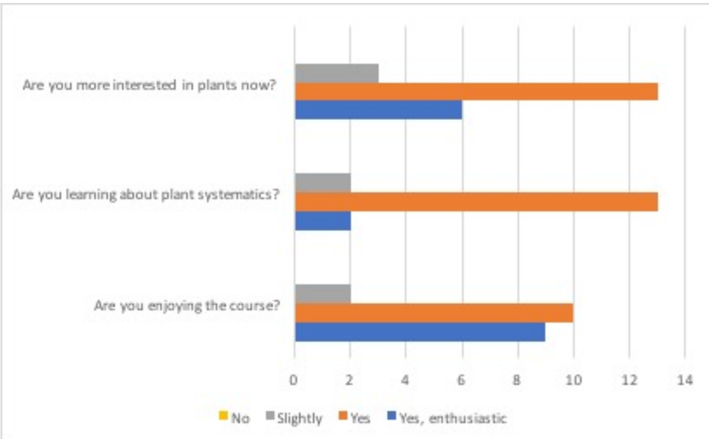


Figure 5. Student responses in 2017 mid-semester course evaluation.

Summary

My goal was to cultivate an **atmosphere of growth mindset** in the BIOL 427 Plant Systematics classroom and increase exam scores with a fair exam statement to **discourage imposter syndrome**. I used an early discussion on growth mindset towards botany and frequent reminders of learning progress to encourage students to approach the course material with a "sense of wonder." Students reported that they were all more interested in plants by the middle of the semester than at the beginning of the course. I also developed a fair exam statement that I read before administering the exams, but I did not see an increase in exam scores in comparison to 2016 scores.

Introduction:

Erika Holland
Biological Sciences
Modified Biology 212, S2017
Enrollment: 155 students

In previous course offerings for Biology 212 (Biol 212), and other courses taught, I have gauged student understanding of course material by asking informal questions during lecture. I hoped that this would increase discussion and build connections between previous and current material being covered. From these queries, I often received answers and discussion from only a handful of students and I was unable to assess overall class comprehension or students engagement in the material. Additionally, in this large lecture style classroom it was often difficult to track class attendance or that of individual students, where attendance likely affects their comprehension of course material. To help address these concerns, in the S2017 Biol 212 course I implemented iClicker questions to each of my lectures together with the ongoing open discussion questions during lecture.

Spring 2017 was the first semester that I taught the beginning section of Biol 212, such that the impact of iClicker inclusion on student performance with that from my previous Biol 212 offerings could not be completed. Therefore I utilized iClicker scoring together with ParScore Scantron assessment to help determine whether varying iClicker question difficulty in different lectures would affect student performance on the corresponding exam material. It was **hypothesized** that increased difficulty would foster greater learning and in class discussion and that students would perform higher on exam material that required more thought during in class exercises. This would help me understand the effectiveness of developed iClicker questions in promoting student performance during exams.

Approach and Results

Class performance on iClicker questions with varying complexity.

The portion of Biol 212 that I taught in S2017 included 13 lectures covering 10 Chapters from the Campbell Biology textbook and spanned basic chemistry to introductory concepts in cellular communication. To allow students time to set up their iClicker account, ultimately I was able to ask two iClicker questions during each of 11 lecture periods, covering 9 Chapters, and the two questions for a given day had the same level of complexity, which was rated as easy or difficult. Easy questions assessed basic concept comprehension where difficult questions required application or synthesis of lecture material. During class, students were allotted the same amount of time and open discussion for both types of questions. Chapter material, thus lecture material, varies in difficulty and therefore the type of iClicker question given for a lecture was assigned at random. On average 140 students, out of 155 enrolled in the class, participated in the iClicker questioning. Student iClicker scores were averaged by lecture and performance compared by different question type using a two-tailed Student’s T-test. Student performance on difficult iClicker questions was slightly lower than that compared to their performance on designated easy questions (Figure 1); however, the difference observed was not significant (p = 0.22). This suggests there was not a difference in performance on different types of iClicker questions and that regardless of question type in class students were able to work with their peers to discuss questions, refer to topic material and had ample amounts of time to come to a conclusion.

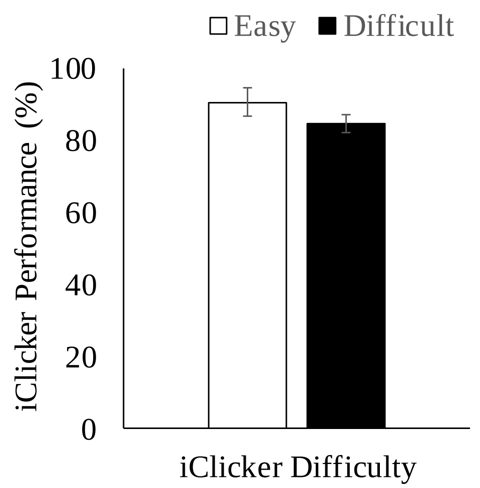


Figure 1. Student performance on iClicker questions with varying complexity. Numbers represent Means ± SEM. n= 5-6 questions per category.

iClicker complexity and student performance on corresponding exam material.

The discussion of a given chapter often spanned multiple lectures and in class assessments on one chapter's material may have received both easy (rating=0) and difficult (rating=1) iClicker questions. In order to compare the efficacy of iClicker question type with student performance on corresponding exam material, iClicker difficulty was averaged by chapter such that some chapters had a "moderate" rating (0.5). Performance on exams for a given chapter were then compared to that chapters rating for iClicker difficulty using a one-way ANOVA. It appeared that iClicker question difficulty for a given chapter did not affect exam performance on the corresponding material (p= 0.813; Figure 2). It should be noted that only two chapters ended up with a moderate rating and the exam performance on these chapters varied drastically and the material was suggested to be quite different. For example one chapter covered the basic chemistry of the element Carbon and how it elemental features contribute to biology. A lot of this information has been covered extensively in other course such as introductory chemistry and the average exam score for this chapter was 90%. The other chapter dealt with the details of cellular respiration and may have been primarily new material for most students. The average exam score for this chapter was 62%.

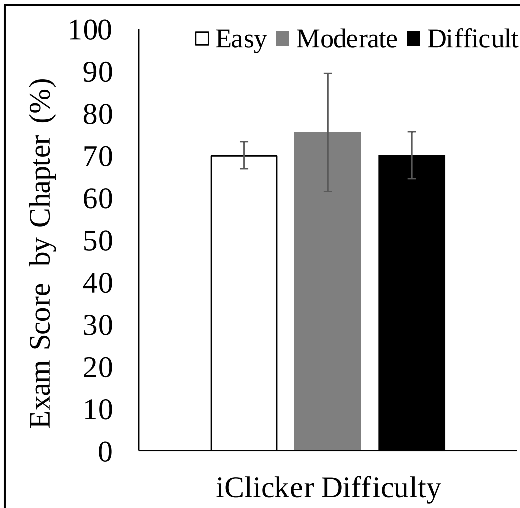


Figure 2. Student performance on exam material based on iClicker question complexity used to assess in class comprehension of corresponding material. Numbers represent Means ± SEM. n=2-5 chapters covered per iClicker category.

Therefore I investigated whether in class performance on iClicker questions, regardless of difficulty type, was predictive of performance on exam questions for the corresponding chapter material. Scores for iClickers questions, averaged by chapter, did not correlate with scores on exam questions based on the same chapter material (Figure 3; r=0.05) suggesting that iClicker performance was not a good indicator of exam performance. I then looked at both iClicker performance and exam performance for a given chapter relative to perceived novelty of class material. Where non-novel material would be material likely covered in previous or co-occurring classes (e.g. Chemistry) and novel material would be new for the majority of the students in the course. Interestingly both iClicker performance and exam performance was significant lower for chapters that were perceived to be novel material for the students (Student's t-test; Figure 4A p=0.02 iClicker; Figure 4B p=0.04 Exam). However, in this assessment I assigned chapter novelty based on my opinion of course material relative to that of other classes, what is covered in K-12 science classes and discussions I have had with students during office hours. Future courses including surveys of the student's perception and experience with course material would better assess whether previous familiarity supports performance in the class.

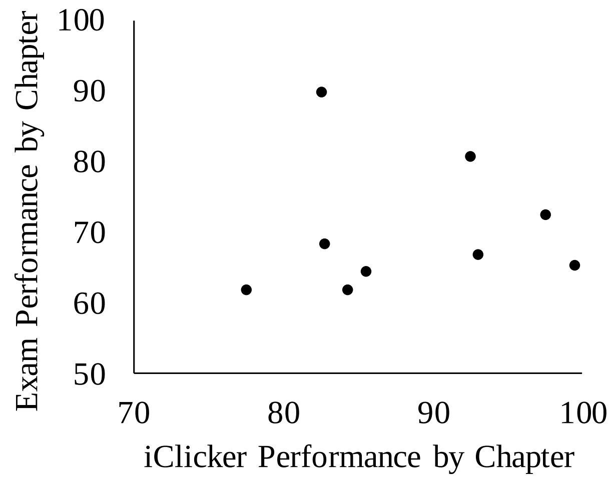


Figure 3. Correlation between student performance on exam material compared to performance on Clicker questions based on the corresponding chapter material. Each data point represents the average percentage of all students performance on iClicker questions or Exam questions for a given chapter.

Discussion and Future Development: While varying iClicker question difficulty did not alter student performance on exam material the in class student response system was a valuable addition to the Biol 212 class. Mainly, I saw a noticeable difference in overall course attendance in both the number of students attending at all and the number of students who stayed to the end of the lecture period. This information is only qualitative because my previous course offerings did not track attendance but I will continue to utilize the response system in the future. Additionally, in previous course offerings student reviews on the second half of the course suggested that more activities or the inclusion of such response systems would be welcomed breaks to straight lecture, as the class is an hour and fifteen minutes long.

The combination of the iClicker questions together with exam assessment using the ParScore system in the CSULB Academic Service Building helped me assess student performance on different chapters. A large amount of the first portion of the class is review and builds to material that contains many details on cellular pathways and cellular systems. In office hours students in Biol 212, and other related courses, often discuss how overwhelming these later chapters can be and struggle with appropriate study practices. This was reflected in the first exam for Biol 212 where the average was a 73% versus the second exam where the average was a 62%. This drastic difference between exam 1 and exam 2 was also observed for other instructors teaching the course previously (data not shown). Due to this information, together with the data shown in Figure 4, suggests that in class activities or take home worksheets, which increase student familiarity with the details in these chapters maybe useful. I hope to implement such activities as well as surveys regarding student perception of different chapter material in future Biol 212 offerings.

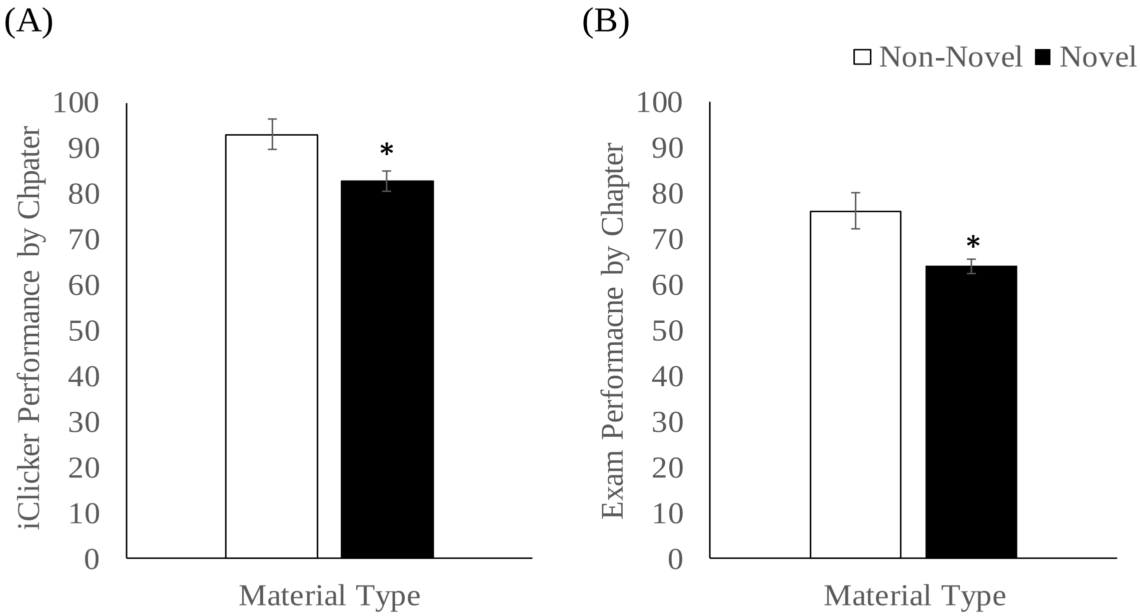


Figure 4. Student performance on iClicker (A) and exam (B) questions on material perceived as non-novel or novel. Numbers represent performance (%) averaged across different chapters deemed non-novel or novel and are Mean ± SEM. * $p \leq 0.05$

FLC Report for Spring 2017

Joshua Sack

During the spring semester of 2017, I implemented changes to the way I taught MATH 247, Introduction to Linear Algebra, since the last time I taught the course which was the spring semester of 2016. This is an advanced lower-division course that is a transition for students from more basic calculations to more abstract problems and concepts. It is an important step for mathematics majors, but also has significant applications to other fields, and hence includes students with a variety of majors. Both classes I taught had a similar composition of majors:

	2016	2017
Mathematics	15	12
Engineering	5	7
Computer Science	5	2
Physics or Chemistry	3	3
Other	2	3

Also, both classes had similar compositions of seniority:

	2016	2017
Freshman	4	2
Sophomores	7	8
Juniors	14	12
Seniors	5	5

The primary change I made to the class was to have them turn in, a week before each exam, a problem that they thought would be a good problem to put on the exam. The grading was intended to be lenient (mostly effort), and was not meant to be a significant component of the overall grade. Each such assignment counted as one among many homeworks toward the homework grade component. The purpose of the assignment was to the have students not only review past homework for their exam, but to think through what problems are particularly important and representative of their understanding. I measure the success of this change of the course in two ways (a) I compared the final exam scores of the course I taught in 2017 with the one I taught in 2016, and (b) I gave a survey to the students during the last couple of weeks of the course asking if they felt that this assignment helped them prepare for the exams.

The percent scores s for exams and assignment translate to letter grades as follows:

A	$90\% \leq s$
B	$80\% \leq s < 90\%$
C	$70\% \leq s < 80\%$
D	$60\% \leq s < 70\%$
F	$s < 60\%$

A general comparison of the final exam scores s, indicating the number of students getting in each letter grade range (with a high F range added for perspective) as well as the mean and median of the scores, is indicated as follows

	2016	2017
$90 \leq s$	4	6
$80 \leq s < 90$	6	5
$70 \leq s < 80$	7	4
$60 \leq s < 70$	5	7
$50 \leq s < 60$	3	2
$s < 50$	5	3
mean	66.7	69.5
median	74	73

The difference in the median does not appear to be significant. The means are also similar, and the slight improvement in mean from 2016 to 2017 appears to be in large part from a reduction in the low F's (below 50%) and an increase in A's.

The survey I gave at the end of the semester included two questions whose answers could be quantified:

1. Before each exam, you have been asked to turn in a problem that you think would be suitable for the exam. On a scale of 1 to 5 (1 being not helpful and 5 being very helpful) how helpful do you feel this assignment is?

2. Would you suggest this exercise be assigned in future MATH 247 classes?

For the first question, the students responded as follows:

	number of students	percent of students
1	0	0
2	4	18.18
3	7	31.82
4	8	36.36
5	3	13.64

Thus the 22 out 27 students who responded to this were fairly appreciative of the assignment. For the second question, a strong majority of 72.73% (16 out of 22 students) suggested the exercise be assigned in future classes.

I feel that the change to the course was mildly successful. The mean of the scores ticked up a little, and the number of very low scores was reduced. The change appears to be well-received by the students, as more than two thirds suggest the change be implemented in future classes as well. I intend to continue teaching this course with the change implemented, as the change should help students use a higher level thought process in coming up with potential exam problems, by organizing what they have learned and examining how the concepts are related. I will stress this purpose more next time I teach the course.

STEM Faculty Learning Community 2016-17
College of Natural Sciences and Mathematics
Final Report - Shon

Introduction
Name: Young-Seok Shon
Department: Chemistry and Biochemistry
Class: Organic Chemistry I (CHEM 220A)
Number of students in the class: 59 students

Hypothesis: *CHEM 220A Organic Chemistry I* is the first half of a two-semester sequence in organic chemistry for mostly Chemistry and Biology majors. The primary change made to this course was introducing and emphasizing the learning outcomes of the lecture topic at the beginning of each class. One minute paper was used to get instant feedback on their understanding regards to the learning outcomes – students were asked to choose one learning outcome they have the most problem with. The following class began with a practice question dealing with the concept directly related to that particular learning outcome. To gage the effectiveness of one minute paper and the subsequent problem solving, some of the lecture topics were ended without exercising one minute paper and corresponding problem solving. This new addition serves as the primary guideline for what students anticipate during the lecture and how students can approach the contents to be ready for exams. The midterm exam results were compared for a quick (but limited) assessment of different approaches. To motivate students and to increase their attentions, the related history of important science and discovery in organic chemistry were introduced using Youtube movie clips during the first half of the spring semester. The connection between the example and the lecture contents was emphasized. After noticing some decreases in attendance after the half point of semester, unannounced 2-3 minute quizzes (4 times – directly related to the topic just covered in the lecture & allowing group discussion) were implemented for extra credits to encourage students to attend class (given in the middle of lectures unannounced). These were in addition to the already scheduled 10 minute quizzes (6 times/semester) given at the beginning of the class.

Results: For Midterm 1 covering the first 4 topics in Organic Chemistry I, one minute paper was administered for Topic 1 and Topic 2. For the remaining two topics, Topic 3 and Topic 4, neither one minute paper nor practice problems were attempted. The analysis of Midterm 1 performance showed that the percentages for correct answers for Topics 1, 2, 3, and 4 are 71, 67, 81, and 70 %, respectively. Topic 4 – Alkanes and Cycloalkanes are generally considered as the most difficult topic covered in Midterm 1. The class average scores for Topics 1 and 2 are slightly lower than those for Topics 3 and 4. For Midterm 2, one minute paper and practice problems were used for Topics 5 and 7, but not for Topics 6 and 8. The performance analysis of Midterm 2 (Topics 5, 6, 7, and 8) showed the relatively low percentages for correct answers for each topics (67, 62, 60, and 41 %, respectively). Especially poor results were seen for Topic 8, which is considered the most difficult topic in all Organic Chemistry I lecture topics. The impacts of other modifications including the delivery of related history and movie clips were not evaluated. However, students were showing interests in some YouTube clips shown during the lecture indicating the positive influence of such activities. In addition, the attendance of students became higher after the announcement and administration of extra credit “pop” quizzes. Despite implementing several changes as mentioned above, student performance on specific topics did not show the direct and positive effect of one minute paper and the subsequent problem solving. The class average scores on exams remained unchanged or improved only slightly from Fall 2009 values, which are the data from the most recent semester I taught Organic Chemistry I – used to be CHEM 322A, the class for Biology majors.

Discussion: Despite the fact that the performance analysis of midterm exams did not reflect the positive influence of one minute paper, it clearly served the initial purpose of providing instant feedback to course concepts. I was able to know which learning outcomes students have the most trouble dealing with. The subsequent problem solving after one minute paper and the discussion of problems after the formal announced quizzes in addition to the student responses for ~5 questions per class I pose during the formal lecture encouraged the engagement of students. Due to lecture constraints on time, I had to stop presenting YouTube movie clips as the semester progressed (2^{nd} half) – fell behind ~2 weeks-worth of lecture at the half point. Although the delivery of related history and YouTube movie clips were used less than I originally planned during the Spring 2017 semester, I felt they served the purpose of getting students more engaged and interested in class. The direct impact of extra credit “pop” quiz was observed because more students were in attendance after the announcement of it. Students became more engaged during these “pop” quizzes because the group discussion is allowed for solving the questions.

I will continue to present the learning outcomes of each topic at the beginning of each class next semester for CHEM 220B Organic Chemistry II. The occasional uses of one minute paper and the subsequent problem solving will be offered to get instant feedback and more student engagement for the class. I also plan to continue to offer the extra credit unannounced quizzes to encourage students to attend the lecture next semester. A better time management will be necessary to increase the use of interesting organic chemistry facts and history using YouTube movie clips throughout the semester.

CNSM Faculty Learning Community Final Report

Fangyuan Tian

Department of Chemistry & Biochemistry

CHEM 451 (Instrumental Analysis Methods)

Spring 2017

Hypothesis

The goal of CHEM 451 aims to introduce various analytical instruments and correlate the fundamental chemical theories that students learn in other courses to modern equipment, thus better prepare students to use them in future. The changes I made this semester are to provide learning objectives for selective chapters and introduce three case studies through the whole semester. ***The modifications were based on the hypothesis that listing learning objectives and applying case studies in class will encourage active learning thus improve students' performance***. Providing learning objectives will help students to grasp the big picture at the beginning of a new chapter and keep students engaged during lectures when the listed content is explained. The learning objectives can also be used as useful study guides for exams. Introducing case studies to classroom promotes discussions and train students to solve real-world problems with the knowledge they learn in class. ***To assess the effectiveness of the changes, three approaches were applied: 1. American Chemical Society Exam; 2. Group presentation with given topics; 3. Case study questions in mid-term exams.***

Results & Discussions

American Chemical Society Exam: The average of the ACS final exam is 23.3 out of 50 questions correct with a class size of 43 students in Spring 17. The grade is within the standard deviation of the national average (24.1 +/- 6.6). However, it is 7% lower than the class average in Fall 16. The percent of wrong responses to each question were compared between Spring 17 and Fall 16, Fig 1. The questions were summarized and correlated to different chapters, Table 1.

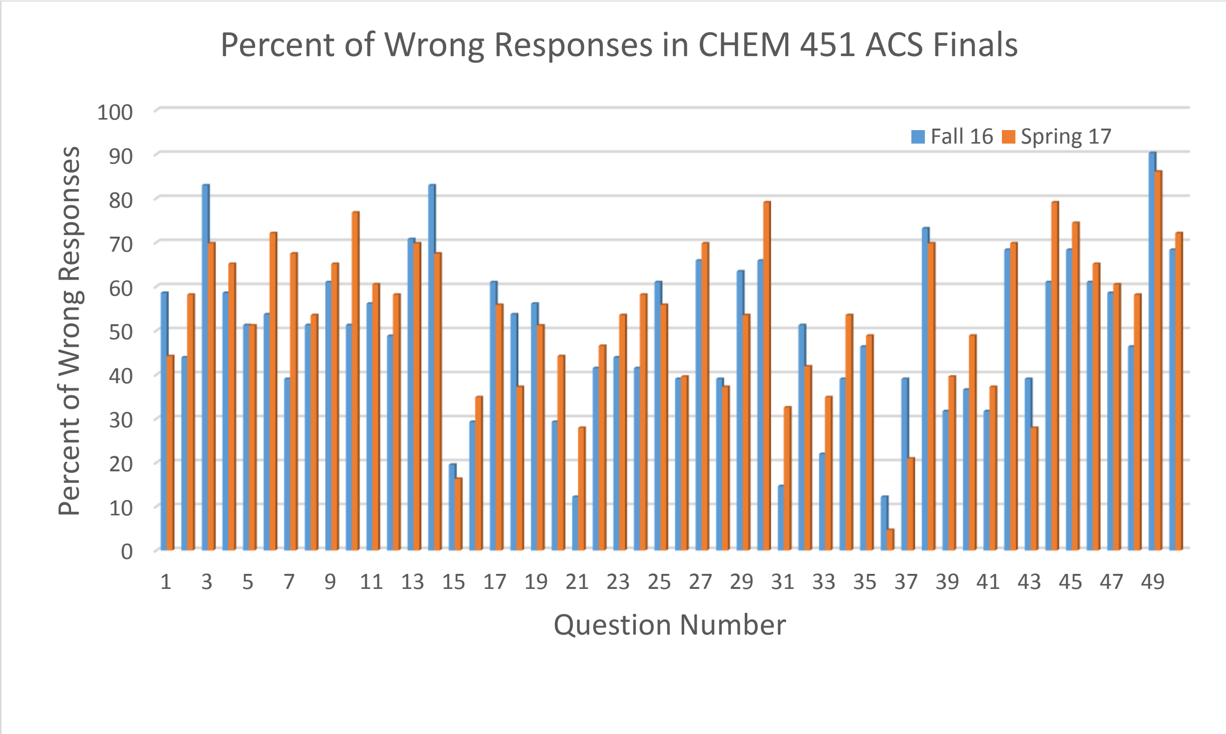


Figure 1. Grade analysis of percent of wrong responses to each questions in CHEM 451 ACS exams in Fall 16 and Spring 17 semesters.

Table 1. Questions Numbers Relate to Course Content

Question Numbers	Chapters	Learning objectives were provided (Y/N)
1-6	Optics & Electronics	N
7-13	Mass Spectrometry	Y
14-30	Optical spectroscopies	Y
31	Surface Techniques	N
32-36	Electrochemistry	N
37-50	Analytical Separation	Y

The data shows students performed better in questions 1, 3, 14, 18, 29, 32, 36, 37, and 43 in Spring 17, and most of the questions were listed as part of the learning objectives in particular chapters. For questions 6, 7, 10, 23, 24, 30, 31, 33, 34, 40, 44, and 48, a higher wrong responses rate was observed in Spring 17 compared with Fall 16. Most of the questions were from the chapters of which learning objectives were listed. One of the possible reasons is that students focused only on the content set out in the learning objectives as key points of each chapter while ignored other important parts.

Group Presentation: Students were divided into six groups and requested to give a 10-minute group presentation in the last class of the semester. All the presentation topics, listed in Table 2, are related to our daily life. All the groups proposed reasonable analytical instrumental techniques they learned in class to solve these questions. The presentations were graded by students and myself based on the performance rubrics. The content of the presentation was confirmed correct after peer reviewing the slides with the class. With the aids of online resources and course materials, students show excellent performance on solving real life problems.

Table 2. Group Presentation Topics

Group Number	Topic
1	How much vitamin C is in different kinds of fruits or vegetables?
2	How much cocaine is on US paper currency?
3	How much mercury is in seafood, such as shrimp or tuna?
4	How much sugar is in a bottle of Coke/Pepsi?
5	How much capsaicin is in peppers and/or hot sauce?
6	How much caffeine is in energy drinks and cacao beans?

Case Study Questions: Three case studies were discussed with prompted questions in class, one example was listed in Figure 2. All the case study resources were referenced from the Oxford Education Publisher. Similar case questions (sugar powder analysis) were given in the first mid-term exam with 87% of students got the correct answers. It indicates students can answer questions more related to our daily life after they encounter a similar situation was discussed in class.

Criminal Scene Investigation

A man is found lying dead on his living room floor with white powder on his upper lip. The man's roommate has a prior arrest for cocaine possession. However, there is also a box of powdered doughnuts on the kitchen counter. It is your job to determine

(1) whether the powder on the man's lip is cocaine;

(2) if it is cocaine, whether the cocaine is in the HCl form or freebase form (the penalties for possession of the two forms are different); and

(3) if it is cocaine, whether the man died of an overdose (I.e., what is the concentration of cocaine in his blood?)

Figure 2. An example of case study discussed in class.

Conclusions

Overall, listing learning objectives did not help to improve the ACS final grade while introducing case studies into class dramatically promoted students' critical thinking on solving real world problems. Based on the results of the three assessments, I will continue bringing case studies to class discussions. Further improvements include 1. Provide learning objectives with highlighting these points are not the only content on the exams. 2. Relate case studies with the corresponding learning objectives. 3. Summarize each chapter with practice questions to make students get familiar with the question format.

Christine Whitcraft

FLC 2016 – 2017 Final Report

Plant Ecology BIOL 450/550

Background Information on Plant Ecology

Plant Ecology (BIOL 450/550) is an introduction to the science of plant ecology, designed to provide students with a detailed understanding of the relationship of plants to their biotic and abiotic environments and the principles that govern plant distribution patterns. In addition to helping students understand key ecological concepts and methods, I try to demonstrate how plant ecology can be used to answer applied questions as well as to improve quantitative analysis abilities and critical thinking skills.

In order to teach ecological concepts while emphasizing analytical skills, I assign laboratory write-ups throughout the semester. These are designed to walk students through the process of research in incremental steps (literature review, hypothesis development, experimental design, data collection and methods, statistical analysis). For the classroom portion of the class, I give two exams (mid-term and final) with a take-home final for graduate students and an in-class final for undergraduate students. I only evaluated the undergraduate portion of this class for the FLC work.

Background on FLC modifications

My own opinion, colleagues' opinions, and the literature all aligned to suggest that many students do not take advantage of faculty help outside of class. When students do attend office hours or request appointments, it is usually immediately before homework assignments are due or immediately before exams are scheduled. Yet, exam and overall class performance often shows that many students could benefit from additional help. A study by Robinson et al. 2014 from an engineering class conducted a survey and found that students did not attend office hours because (1) they felt that understood the material well enough, (2) they did not have time before the homework was due, and (3) they spent little time studying outside of class. Articles in magazines like Harvard's Crimson often postulate that students should be required to make at least one visit to their professors' office hours per class each semester so that they can foster a more open relationship with professors.

Goals and Hypotheses

The goal of my class alteration was to increase students' senses of belonging and confidence as scientists as well as their willingness to come to office hours throughout the semester. I required each student in the class (15 undergraduates) to meet with me during office hours during the first two weeks of the class. In this short time period (on average 10 minutes), I asked students about graduation time, career wishes, and why they had signed up for Plant Ecology. This had worked in Conservation Biology (BIOL 459) where I was pleased that my interviews with students allowed me to get to know students in depth early in the semester, so I decided to implement this in Plant Ecology. I hypothesized that I would see increased office hours attendance as compared to earlier times that I had taught the class as well as higher overall mean GPA in the class as compared to earlier times I had taught the class.

Evaluation Strategy and Methods

Because Plant Ecology is a class that teach sporadically (Spring 2010, Spring 2012, Spring 2017), I initially had not planned to compare among classes. But assessing my modifications qualitatively throughout the class proved challenging so I evaluated (1) the number of times that students came to office hours for each semester to see if my initial interview altered the frequent of office hour attendance among years and (2) the grade distribution to see if grades changed among classes. In addition, I conducted an informal attitudinal survey to ask students for their impressions as to whether the initial interviews improved the class experience or influenced their willingness to attend office hours.

Results

Qualitatively, I enjoyed the experience of interviewing all of the students in my class. I immediately knew all of their names and had a better understanding of why they were in my class. Most students were graduating in Spring 2017 or Fall 2017, and most were interested in the field of ecology although several discussed just needing an upper division elective as their motivation for taking the class. Whether these interviews were a factor or not, I really felt close to this group of students and enjoyed the numerous field trips we took throughout the semester sa well as our classroom interactions. As a group this was a quitter, less participatory group of students than other classes (both Plant Ecology and other upper division classes).

Each semester that I have taught this class, I have recorded how many students attend office hours (Figure 1). While this number is not perfect, it offers a relatively accurate count of total students and total new students that have come to my office hours. These counts are compared in Figure 1 and indicate higher office hour attendance in Spring 2017 as compared to Spring 2010 and Spring 2012. In Spring 2017 (as part of this FLC assignment), I also recorded the point in the semester at which the students came to office hours (Figure 2). Visits were assigned to the categories (before lab assignment, before mid-term, before final, and unrelated to assignment) by both timing of the visit as well as material discussed with the student. The category “unrelated to assignment” included discussions with students about overall grade, about independent research opportunities, and about career plans. While I do not want to over interpret these numbers because many factors are involved (different classes, my development as an instructor), the increased attendance at office hours could potentially reflect increased comfort level of students as a result of our initial interview. Student feedback would support this.

Individual feedback from students indicated that the informal conversations at the start of the semester helped make them feel that they could approach me with all sorts of questions or problems. While these survey responses were all positive, there is inherent bias in the asking of these because students may have felt that they had to be positive about the process. If I repeated this, I would conduct a more anonymous survey. Specific student comments are below.

“I liked the opportunity to speak with you at the beginning of the semester. I felt it was much easier to approach you after that. I'm usually very hesitant to talk to most professors but doing this helped and you are easy to talk to anyway!”

“I think having us introduce ourselves is an effective strategy, it really allowed for communication throughout the semester since the initial introduction was made at the beginning of the semester. Overall I think this strategy makes you more approachable to ask question,go to office hours and even ask for advice.”

“I personally think engaging with students at the start of class is really effective. It breaks that initial barrier each student has on the first day of class, sends a welcoming message and I think students would feel more comfortable going into office hours after the interview.”

“I think it’s a really good idea on doing this because as a student you are able to get to know the professor more one on one. Plus it will be less intimidating to ask you questions after doing the interview.”

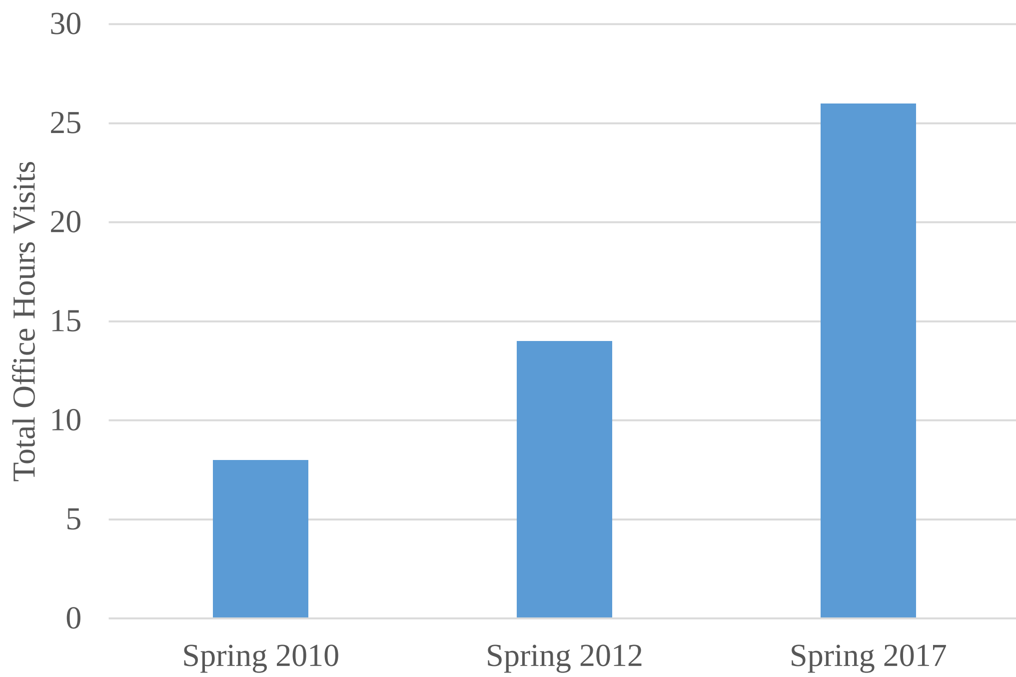


Figure 1. Total office hours visits among semesters. Note: these included repeated visits by the same student.

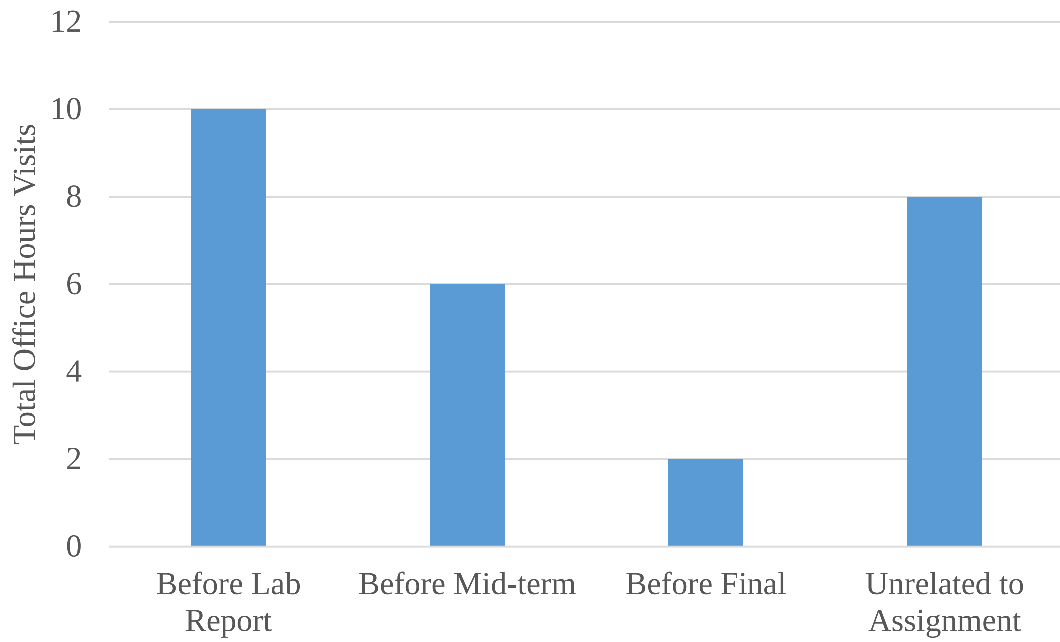


Figure 2. Total office hours visits by time point in the semester. Note: these included repeated visits by the same student.

Because I have given similar tests and assignments in each semester this class was taught, I felt comparing the grade distributions among years was relevant information. The grade distribution did not differ among the three years that I have taught this class (Tables 1-3), indicating that any increased attendance at office hours was not reflected in overall student performance.

Table 1. Grade distribution for Spring 2010 (total 20 undergraduates)

Grade	Count	Percent	Grade Pt	Points
A	4	20.0	4	16
B	8	40.0	3	24
C	8	40.0	2	16
D	0	0.0	1	0
F	0	0.0	0	0
Total	20		**Mean GPA**	**2.80**

Table 2. Grade distribution for Spring 2012 (total 22 undergraduates)

Grade	Count	Percent	Grade Pt	Points
A	2	9.09	4	8
B	10	45.45	3	30
C	8	36.36	2	16
D	2	9.09	1	2
F	0	0.00	0	0
Total	22		**Mean GPA**	**2.55**

Table 3. Grade distribution for Spring 2017 (total 15 undergraduates)

Grade	Count	Percent	Grade Pt	Points
A	1	7.14	4	4
B	10	71.43	3	30
C	3	21.43	2	6
D	0	0.00	1	0
F	0	0.00	0	0
total	14		**Mean GPA**	**2.86**

Discussion

I struggled with the final assignment of modifying my class for two reasons: (1) because I was teaching a different class between the Fall (wen we had FLC meetings) and the Spring (FLC modification) and (2) because there was significant time (5 years) between when I last taught this class and now. To improve this evaluation in future years, I would pair the interviews and student surveys with a more quantitative survey of student impressions about the initial interviews. Just soliciting student comments was difficult to assess. When I teach this class again (Spring 2019), I will continue to interviews because I enjoyed the dynamic it established for the class. I would also expand the interviews to be more frequent required interactions in my office throughout the semester. I could frame this as career sessions but also use it as a chance to ascertain how students are doing in the class and encourage reluctant students to address course material questions while they are in the office anyway.

In addition, in reading education blogs (e.g. Chemical Engineering Education), I could try to vary the times of my office hours throughout the semester. Student needs for additional instruction vary throughout the semester so in addition to regularly scheduled office hours, I could have flexible office hours that were changed periodically in proximity to homework due dates and exam dates.

Overall, I found the FLC experience valuable mainly for the discussions we had during meetings. These discussions provided me with a framework for some of my teaching philosophies, and Our sharing of teaching strategies with fellow educators and classroom visitations sparked additional teaching ideas for me. In addition, the growth mindset discussions helped provide a framework and terminology for concepts I was already interested in using in the classroom.

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