

Title: Teaching Enhancement Grant: Flipping the organic chemistry prelab meeting

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Budget: \$2,000

Course: Organic Chemistry Laboratory I (CHEM2123), sections 11-15 and 21, expected enrollment of 96 for spring 2021.

Proposal

Executive Summary

The project proposed herein is aimed to increase student engagement in the organic chemistry teaching labs, specifically in the area of student preparation prior to the lab meeting. The endeavor involves “flipping” the typical prelab meeting from in-person and lecture-based to asynchronous delivery online. The students may benefit from student paced format that allows the students to prepare at their own pace allowing them to compile the requisite knowledge of materials, methods, skills, and experiment instructions. The prelab preparation will be redesigned to be more engaging than simple videos, and the activities will be available for use and refinement by future instructors of the course. The idea of a prelab redesign was in a way a serendipitous finding. Due to the need to go remote (or blended) during the current pandemic, we have had to shift some of the prelab activities online, which means that some of these materials are already partially developed and have undergone initial field testing. The scheduled in-person prelab meeting time will include team learning activities

Rationale

The organic chemistry lab requires students to be familiar with or recall theory, recognize names (materials and apparatus), instructions (verbal and written), skills or techniques (both old and new), and new information learned (observed) during the actual experiment. Much of this must be mastered in order to be successful in lab. Therefore, it has been argued that the inclusion of prelab activities are a particularly important aspect of chemistry lab experiences that require a high cognitive load.¹ Additionally, the organic chemistry lab has several moving parts (prelab write up, prelab meeting, prelab quiz, spectral problem sets, lab meeting, postlab write up and postlab questions). Scaffolding maybe one way to improve the organic chemistry lab experience, which might include a very simple presentation of the overall task leaving out the fine details until later in the process.

For each lab experiment students complete a prelab exercise (prelab write up) in their lab notebook and attend a weekly prelab lecture. The *prelab write up* consists of a) experiment title, b) one or two sentence summary of the experiment, c) reaction using complete structural formulas, d) table with all reagents and their respective safety data, and e) outline of experimental procedure with sufficient detail to actually perform the experiment. It is suggested that they set up their lab notebook for that week’s lab and read and study the experimental description from the lab manual before attending the prelab meeting. In the prelab meeting the students are also given a quiz that covers safety, spectroscopy, the previous laboratory experiment, and the current experiment. The quiz is used as both an attendance and assessment tool. The typical results (low scores) of these quizzes indicate that the students do not understand much of the theory behind the techniques and experiments, which means that they are relying on the cookbook nature of the experiment to get by. The remainder of the prelab time is used to discuss the safety aspects of the experiment and background or mechanistic detail for the reactions that are being performed that week. It is also an opportunity for the students to bring up questions about items that are difficult or unclear regarding the experiment’s procedure. However, students rarely ask questions during the prelab meeting, which is a concern. It is also clear when visiting the lab and talking with students that some of them are unsure about what they are doing. When the students lack confidence they likely have increased levels of anxiety, which may lead to errors or accidents in the lab.

The organic chemistry teaching laboratory is a complex environment, and students need to be well-prepared before entering that environment. Having an activity prior to attending the prelab meeting may be beneficial to the overall experience and learning of our students. We were previously giving a prelab lecture to the students and requiring them to do a pre-lab write up in their laboratory notebook; however, these two activities seem to suffer from a lack of engagement on the part of the student. The prelab meeting is delivered as the traditional “lecture” and the prelab write up does not require much intellectual input on the part of the student. Somehow, the students need to find value in the pre-lab activities, because without value engagement is likely not to occur. To address some of these issues we propose to move the prelab lecture to remote delivery and use the prelab meeting time for active learning assessment techniques. The hope is that the prelab activities would improve the student’s preparation and allow the lab to be run more efficiently, as the students would have a better handle on how to go about the experiment reducing some of the aforementioned issues.

Materials and Methods

The project involves the creation of pre-lab “lecture” videos for each of the experiment (~10 experiments per semester). This will involve the assembly PowerPoint slides, photos of actual lab materials and equipment, and short tutorials of the techniques that are used in the lab. To make the videos more interactive they will be incorporated into weekly Edpuzzle activities. These video lessons will allow the students to work at their own pace and a student-centered environment. The Edpuzzle platform also allows for voiceover, and checkpoints such as notes, free response, and multiple-choice questions to be placed within the video. The video activities can be automatically graded, and a threshold can be set at a certain level to assign mastery or credit. The prelab activities will be made available on blackboard in the students will have to complete them before attending the prelab meeting. This allows students to complete the pre-lab activity when they choose, and they will have continuous access throughout the semester in case they need to be revisited.

The prelab meeting time will be used to work on a group activity related to the experiment. The students will complete the activities with students that are in their lab section. This will help to build a better relationship within each lab cohort.

The success of this project will be evaluated by the results of a Qualtrics survey that will be administered to students to gauge their perception of the prelab activities and whether they were beneficial to their experience in lab. This will include open ended questions about their understanding of the experiment and their level of preparation. We will look for keywords or anecdotal evidence in survey responses that indicate the students’ perception of the prelab activities.

Budget and Justification

PI stipend: \$1,200 faculty stipend for Dustin Gross. Responsibilities: Coordinate the collection of PowerPoint slides, photos and videos of actual lab materials and equipment used in the lab, assemble the Edpuzzle activities, create/implement team activities, create/distribute perception survey to students, and write the project report.

Student stipends: \$800 undergraduate/graduate assistant support. Responsibilities: assist with the photos and videos and test/evaluate the Edpuzzle activities.

Total requested budget: \$2,000

References

- (1) Agustian, H. Y.; Seery, M. K. Reasserting the role of pre-laboratory activities in chemistry education: a proposed framework for their design. *Chem. Educ. Res. Pract.* **2017**, *18*, 518–532.