

Learning Outside the Laboratory



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In chemistry, many courses require a hands-on laboratory component. In CHEM 2401 (Introductory Organic Chemistry), students are required to complete pre-laboratory exercises in their lab notebook prior to each lab experiment. These exercises aim to familiarize the students with experimental procedures, instrumentation and theory of each experiment. Despite the learning goals intended to be achieved with pre-lab exercises, it is evident that some students only do the bare minimum to answer the questions to receive credit, and thus are not prepared for conducting these experiments. This problem became particularly evident to me in the polarimeter experiment, which includes pre-lab exercises as well as an in-lab quiz designed to test students' knowledge of operating the polarimeter instrument. This particular experiment is plagued by poor quiz grades and frustrated students requiring extra time to complete their measurements.

As a new teaching assistant in 2006, I had time to practice using the polarimeter prior to the lab experiment. At this point in my academic studies I had learned the theory of polarimetry but this was the first time I actually had seen and was able to use a polarimeter.

If teaching assistants are offered a session prior to the laboratory experiment to learn how to read the polarimeter and practice taking readings, students should also be afforded the same privilege, but how could this opportunity be given to hundreds of students where instrument time and individual student schedules are restrictive?

I decided to create a learning module that would help students prepare for the polarimeter experiment with a strong emphasis on reading the polarimeter and skills necessary for completing the in-lab quiz. My initial plan was to hold 2 or 3 tutorial sessions prior to the lab session; however, it quickly became apparent that with mid-term exams approaching and differing

schedules, participation may have suffered. Knowing that the class had an active Blackboard Learning System (BLS) page, I pursued the

possibility of offering the learning module online as this would allow students to participate at a time convenient for them.

Chittleborough *et al.* [1] and Limniou *et al.* [2] report that the use of online learning modules for pre-lab exercises improves student understanding of theory and experimental procedures. Students enjoy the flexibility to learn at their

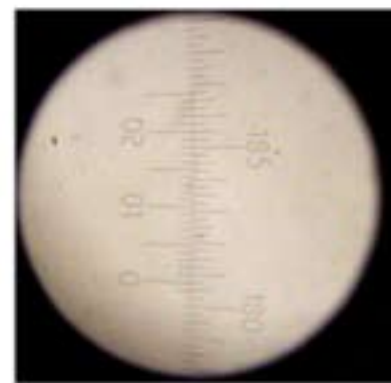
own pace (with multiple attempts) at a time that is convenient for them, prior to the experiment. Similarly, in the Department of Chemistry's successful "Concepts in Chemistry" program [3], students are very receptive to the online learning modules and vignettes which allow them to learn at their own pace, catch up on a concept they are struggling with, and review for tests and exams. With these ideas in mind, I created the online polarimeter module as an optional resource to students and the pilot run was delivered to all students enrolled in CHEM 2401 in Fall 2008.

The pilot run of the online polarimeter module included a vignette, self-assessment quiz (unlimited attempts), and a short



Schematic Scale [4]

Used with Permission



Polarimeter Scale

feedback survey. Since the students couldn't physically gain access to the instrumentation prior to their lab session, the vignette aimed to familiarize the students with the instrumentation and the required calculations using photos, video, step-by-step problem solving, and narration to deliver the material in an interactive way to supplement the experimental

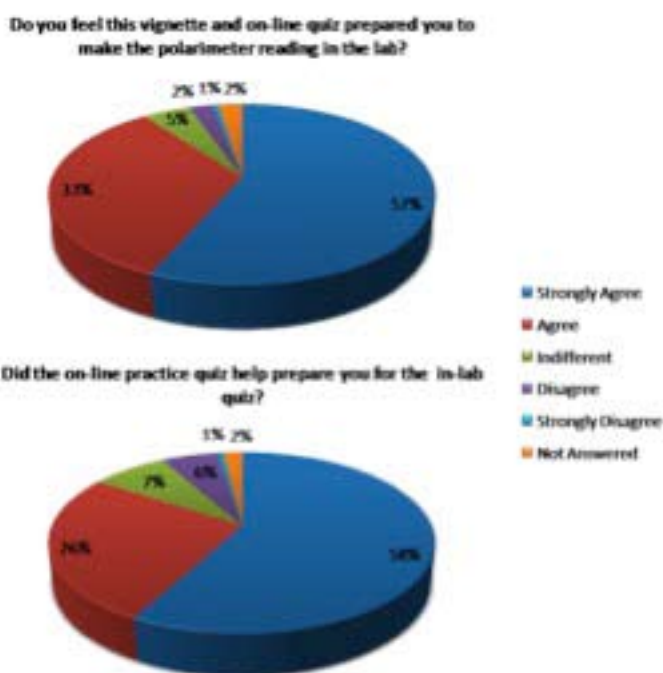
write-up in the course lab manual. For example, in the online module, students were able to practice reading both schematic scales (like those shown in the lab manual) and actual scales that they would see upon looking into the polarimeter eyepiece.

After watching the vignette, students could test their knowledge with a 10 question self-assessment quiz with unlimited attempts. Following the conclusion of the in-lab experiment students were

quiz questions would be beneficial. Based on student feedback, future modules were modified to include a quiz with a larger question bank, so that a new quiz was randomly generated for each new attempt as well as a problem set, complete with a solution key.

In total, the polarimeter module has been offered to three classes during 2008-2009. Over the course of three terms, the majority of students rated the vignette as excellent, and strongly agreed

said a CHEM 2401 student. When asked if they would like to have similar modules for other laboratory experiments, 81% of student respondents said “yes”. It is evident that there is great potential for further online learning tools for pre-laboratory exercises and students truly appreciate opportunities to learn about upcoming lab techniques prior to the experiment. By increasing student awareness of the importance of these online learning tools, students would be more likely to engage in these types of learning activities, as well as use their in-lab time more efficiently.



invited to fill out a short feedback survey online about the learning module.

After reading the survey results, I was thrilled to find that the module was so well received by students. They also made some excellent suggestions for improvement of the module. Students thought that more examples and more self assessment

that the module prepared them for the lab experiment and quiz. “I thought the vignette was a GREAT idea. It made things very clear as well as gave students a chance to “practice” lab procedures before going to lab. Sometimes it is very difficult to visualize what you will be doing in an experiment and tools like this are so useful,”

References Cited

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