Using Computer Simulations to Prepare Students for Hands-on Labs

Philip J. Stephens
Villanova University
Department of Biology
Villanova, PA 19085
phil.stephens@villanova.edu

Abstract

The growth of online biology instruction has been facilitated by the development of interactive lab simulations (Gilman, 2006), which seem to appeal to today's visuospatially oriented students (Habraken, 2004). However one study indicates that, while virtual exercises are seen as effective by college-level students, they are not as effective as face-to-face labs across a series of criteria (Stuckey-Mickell and Stuckey-Danner, 2007). The present study utilizes interactive lab simulations as a prelab activity and examines whether they can be used effectively to prepare students for hands-on, face-to-face labs.

In spring 2009, the Animal Physiology course at Villanova University met in two lab sections, on successive afternoons each week. All students were given access to an online handout, which was posted one week before the lab meetings, and a Ph.I.L.S. (Flash) simulation (Stephens, 2008) was also given to one lab section. The students were asked to gather data from the simulation, produce a graph, and answer questions to show that they had grasped the objectives of the lab. All students in the class completed an online pre-lab quiz, were observed by an impartial teaching assistant during the hands-on lab, and produced a (post-lab) report. This procedure was repeated for a second lab, but this time the other section was given the simulation.

Students who completed the pre-lab simulation scored at the same or higher level as those who had access to only the handout, suggesting that completing the interactive simulation improved student preparation for the hands-on lab. Students who used the simulation knew how to collect and analyze data and make graphs in the hands-on lab; the other group struggled in these areas even though they had access to the same software in the online handout. Interestingly, in parts of the lab not covered by the simulation, all students performed at the same low level. For example, one simulation relied on students watching video clips to see how to set up a mouse in the chamber. Students in both sections watched an average of less than one of the five movie clips, and observations by an impartial graduate student revealed that all students had difficulty placing the mouse in the cage and setting up the chamber. Clearly, students learn best from a simulation when they are forced to complete each step.

This problem was obviated in a second lab because the simulation was changed to force students to go through each step in attaching electrodes to the skin to recording electromyograms. Further, since this was the first lab in the course to use (iWorx) Data

Acquisition Units, the simulation also introduced the students to recording and measuring with the (LabScribe) software. It was clear that students who performed the simulation were well prepared for the hands-on experience because they finished the first part of the lab exercise in an average of 7 minutes. Students who only had the handout asked more questions, referred to the handout more often, and took more than 35 minutes to complete the first part of the lab.

This preliminary study indicates that students who complete a pre-lab simulation are better prepared for the hands-on lab, and complete the exercises quicker and more efficiently than those who only had access to the lab hand-out. However, students learn best when they perform all procedures within the virtual lab, which means that the Ph.I.L.S. simulations must be modified to incorporate all of the steps performed in the hands-on lab.

Literature Cited

Gilman, S. L. 2006. Do Online Labs Work? An Assessment of an Online Lab on Cell Division. *American Biology Teacher*, 68(9), 131-134.

Habraken, C. 2004. Integrating into chemistry teaching today's student's visuospatial talents and skills, and the teaching of today's chemistry's graphical language. *Journal of Science Education and Technology*, *13*(1), 89-94.

Stephens, P.J. 2008. Physiology Interactive Lab Simulations (Ph.I.L.S.) 3.0. McGraw Hill Publishers.

Stuckey-Mickell, T.A. and Stuckey-Danner, B.D. 2007. Virtual Labs in the Online Biology Course: Student Perceptions of Effectiveness and Usability. Journal of Online Learning and Teaching, 3 (2).