

Provost's Initiative on Teaching Advancement (PITA) Proposal
Progress Report
January 31, 2007

Title: Redesigning the Learning Objectives for Use of Web-based Learning Modules in Plants, Pathogens, and People (PLPA 200)

Investigators: Darin M. Eastburn, Crop Sciences, eastburn@uiuc.edu, 244-9632
Cleora J. D'Arcy, Crop Sciences
Bertram Bruce, Library and Information Sciences

Abstract:

Students in Plants, Pathogens, and People (PLPA 200) complete assignments through the use of a web site designed to present content and allow the students to engage in virtual scientific experiments. A previous study found that students were spending minimal time on the site, primarily because they viewed the assignments as a repeat of what they learned in lecture. We decided to restructure the web site assignments to focus on learning the scientific method, a topic not covered in the lecture. New material on the scientific method was added to the site in the summer of 2006. In the Fall 2006 semester, students in PLPA 200 were given a pre-test to determine their level of competence in describing and applying the scientific method, assigned a series of virtual lab experiments and asked to reflect on those experiments in writing, and then given a post-test to ascertain if their competence had improved. Comparing pre-test and post-test scores, total scores were significantly higher on the post-test, when compared with scores on the pre-test. When evaluating the parallel questions on the pre- and post-tests in pair-wise fashion, student scores were higher on the post-test for eight of the thirteen questions, and there were no significant difference between scores on the pre- and post-tests for the other five questions. This study will be repeated in the Spring 2007 semester.

Project overview:

Plants, Pathogens, and People, PLPA 200, is an undergraduate course that fulfills general education requirements for advanced composition and natural science. During the course of a semester, students learn about the biology and impact of approximately fifteen important plant disease epidemics. To provide for the needs of diverse learning styles and to incorporate the concept of active learning into PLPA 200, the instructors, Drs. D'Arcy and Eastburn, developed the Plants, Pathogens and People (PPP) website (<http://www.ppp.uiuc.edu>). The site offers in-depth information and on-line activities related to some of the important plant diseases that are covered in class lectures.

From 2004 to 2006 we conducted a study to determine whether completion of class assignments that require the use of the website, as a supplement to lectures, results in greater student understanding of the subject matter than when the information is delivered through lectures alone. We found that while use of the web site increases learning about specific diseases in some instances, the improvements were not as consistent or as dramatic as we would have hoped.

In the current study we are evaluating aspects of learning that are addressed on the web site, but not in lecture. One such aspect is the use of the scientific method to answer questions of interest.

The current study was initiated in Fall 2006 and is continuing in Spring 2007. At the beginning of each semester the students are given a pre-test to assess their level of competence in applying the scientific method. Students are asked to explain the concepts involved in the scientific process, including observation, hypothesis, variables, use of control treatments, conclusion, and replication/repetition. They also are asked to identify these elements in a specific experiment. Over the course of the semester, students complete a series of virtual lab experiments on the PPP site. For each experiment they submit a lab notebook, including a statement of purpose, an hypothesis, an analysis of results, and a conclusion. They also complete an online web assignment that asks them to explain the experiment, including identifying the variable being studied, the controls used, whether the experiment was replicated or repeated, and whether or not their hypothesis was supported. Students receive feedback on their submitted notebooks and assignments before the next ones are due, thus having the chance to learn to use the scientific method more effectively over the course of the semester. At the end of the semester each student is given a post-test to reassess their competence in applying the scientific method. The questions on the pre- and post-tests are parallel, but the experiments described are different, thus facilitating pair-wise comparisons of student responses.

Preliminary results:

The material on the scientific method on the PPP site was expanded and is now presented in such a way as to highlight its importance and to lead the students more carefully through the steps of the process. Information on the development of research questions and generation of testable hypotheses was enhanced.

For Fall 2006, a total of 63 students completed both pre- and post-tests, as well as the three web site assignments. Total and individual question scores on the pre- and post-tests were compared using pair-wise comparison T tests, calculated using the Proc GLM procedure of SAS. Comparing the total scores of pre- and post-tests, students, on average, showed significantly higher scores on the post-test. Looking at the scores of individual questions (parallel questions on pre- and post-tests), students scored significantly higher ($\alpha = 0.5$), on eight of the thirteen questions. There were no significant differences between pre- and post-test scores for five of the thirteen questions. The improvement on the post-test was typically seen on the questions asking for general descriptions, such as "What is a scientific observation?", while scores on the questions that asked for specific information, such as "Write a specific hypothesis for this experiment" generally did not improve on the post-test. So for the Fall of 2006, following the completion of web based assignments involving virtual experiments, and the completion of three lab notebooks and online assignments on these experiments, students in PLPA 200 showed a significant improvement in their ability to describe the general concepts associated with the scientific method. However, they did not demonstrate an increased level of competence in being able to apply that knowledge to specific situations.

This study is being repeated during the Spring 2007 semester in PLPA 200. When we have data from two semesters, we will also examine the effect of other variables, including the gender and science background of the students, on their learning and use of the scientific method.