

**Provost's Initiative on Teaching Advancement (PITA)**  
**Final Report**  
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**Project Title:** Evaluating the effectiveness of web-based learning modules in Plant, Pathogens, and People (PLPA 200)

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**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. The material on the site is a supplement to, not a replacement for, material presented in lecture. End of semester surveys indicate that students enjoy using the site and find it valuable, but we lack direct evidence to show that using the site enhances student learning. This study was undertaken to determine if students better understand course material as a result of using the web site. In the Fall of 2004 and Spring of 2005, students were asked to complete any two of three disease modules on the PPP web site. We then gave a series of short answer and essay questions on the final exam that compare students' understanding of the PPP web covered diseases, as well as similar diseases that are covered in lecture but not on the PPP web site. Because of a distribution problem, with students self selecting the modules they would do, we changed the assignment for Fall of 2005 and Spring of 2006 by placing the students into specific web assignment groups. Initial results from the first semester of the study were encouraging, indicating that for some of the diseases students had better understanding (i.e., higher scores) of those diseases that they had learned about with the aid of the PPP web site. When given the choice, students generally preferred to answer questions on the diseases they had covered on the PPP web site and avoided those that they had not. Further analysis and inclusion of additional semesters shows that while use of the web site appears to increase learning about specific diseases in some instances, the improvements are not as consistent or as dramatic as we would have hoped. Based on the data analyses and the results of student focus group sessions, we now believe that we can use the PPP web site to help students understand and use the scientific method, rather than to reinforce material covered in lecture.

**Project Overview**

Plants, Pathogens and People, PLPA 200, is an undergraduate course that fulfills general education requirements for advanced composition and natural sciences. 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) web site (<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. Although we have several semesters of student feedback indicating that they find the PPP site useful and interesting, we do not have any direct evidence that use of the site improves student learning. In this study we are working to determine whether completion of class assignments that require the use of the web site results in greater student understanding of the subject matter, as compared to

information that is delivered only through a lecture format. The PPP site was designed to enhance, not to replace, the other forms of instruction used in the course.

We have developed a set of questions relating to important facts, concepts, and principles for a series of diseases. Late blight of potatoes, crown gall, and Dutch elm disease are the three diseases covered on the PPP site. Downy mildew of grapes, fire blight of apples, and chestnut blight are the three diseases not covered on the PPP site. These diseases were chosen because they are similar to and taught in the same units as the three PPP diseases. Late blight and downy mildew are both fungal diseases covered in week one; crown gall and fire blight are both bacterial diseases covered in week four; and Dutch elm disease and chestnut blight are both diseases of trees covered in week eleven. The final exam includes a set of short answer questions, asking for specific details on each of the six diseases, as well as a set of short essay questions that ask students to compare two diseases, selected by the students from the pairs listed above. Since we have a record of which diseases each student studied for the web assignments, we can compare their performance on the questions for the diseases they learned about with and without use of the PPP site.

### Results

We collected data during Fall 2004, Spring 2005, Fall 2005, and Spring 2006 semesters of PLPA 200. Results from a total of 80 students were obtained in F2004, 70 in S2005, 71 in F2005, and 68 in S2006. In Fall of 2004 and Spring of 2005 students were required to complete web assignments for two of the three diseases: late blight, crown gall, and Dutch elm disease (Table 1). Because of an uneven distribution of disease assignments selected and because of student comments in focus group sessions, in the Fall of 2005 and Spring of 2006 students were assigned to work on only one of the three diseases on the PPP site, and the assignments required more in-depth study of that disease.

**Table 1.** Distribution of web site assignment selection by students

Disease Studied	Number of Students (%)			
	Fall 2004	Spring 2005	Fall 2005	Spring 2006
Late Blight	85	89	31	34
Crown Gall	55	73	35	35
Dutch Elm Disease	37	20	34	31

### Short Answer Exam Questions:

For the short answer questions, student totals for each of the six diseases were compared with the web assignments they chose to do using analysis of variance and mean comparison analysis (Table 2). There were a few significant associations that seemed to indicate a positive effect of completing a specific disease assignment and the students' performance on the appropriate short answer portion of the final, such as late blight in F2004 and S2005, and crown gall in F2004. However, there were a number of positive associations that were difficult to interpret, such as a positive association between fire blight answers and the Dutch elm assignment in F2004, and most of the short answer levels were not significantly associated with the student doing the appropriate web assignment. The large number of positive associations with the late blight web activity may be the result of the order in which the web assignments were due. The late blight web assignment was the first of the three to be due. The most motivated students tended to

complete this assignment to “get it out of the way” early in the semester, while those students who tend to procrastinate on assignments would not have chosen to do the late blight assignment. Therefore the higher short answer scores associated with those students who did the late blight web assignment may be due to the relative ability and/or motivation of the students rather than a direct effect of doing the web assignment. There were no significant (0.05 level) associations of short answer score and web assignment in Fall 2005 or Spring 2006. In these two semesters students were placed into one of three groups.

**Table 2.** Significant associations of short answer scores and web assignment groups.

Short Answer Disease Group	Significant <sup>1</sup> Associations With Web Assignment Groups			
	Fall 2004	Spring 2005	Fall 2005	Spring 2006
Late blight answers	LB <sup>2</sup>	LB	--	--
Downy mildew answers	LB	LB	--	--
Crown gall answers	CG, LB	LB	--	--
Fire blight answers	LB, DED	LB	--	--
Dutch elm answers	--	--	--	--
Chestnut blight answers	LB	LB	--	--

<sup>1</sup> Significant in an analysis of variance ( $P > F$  0.05) with short answer score entered as the dependent variable and web assignment group affiliation (yes/no) entered as the independent class variable.

<sup>2</sup> LB=late blight web assignment; CG=crown gall web assignment; DED=Dutch elm disease web assignment.

### Essay Exam Questions:

For the essay questions, scores for the web-covered diseases were compared to the scores for the corresponding non-web diseases using both analysis of variance and paired comparison T tests, which were segregated by whether the student had completed the corresponding web assignment or not. In all four semesters over half of the students chose to complete the essay questions for the late blight – downy mildew pair of diseases. In F2004 and S2005 most of these students had also completed the late blight web assignment, but in F2005 only 17 of the 45 students who chose the late blight – downy mildew pair had done the late blight web assignment, and in S2006 only 14 of the 36 students who chose the late blight – downy mildew pair had done the late blight web assignment. Analysis of variance and paired T Tests, comparing the differences between late blight and downy mildew scores on the essay questions generally showed no differences between scores based on the web assignments the students completed. In the S2005 semester the students who had done the late blight web assignment did score significantly better on the downy mildew questions than those who did not do that web assignment, but there were no differences in late blight scores.

In the four semesters, 27, 25, 21, and 30 students, respectively, chose to answer the essay questions for Dutch elm disease - chestnut blight disease pair. Of these only 10, 5, 11, and 11 students, respectively, had done the Dutch elm web assignment. Students generally scored higher on the Dutch elm questions than on the chestnut blight questions, but there were no significant differences in Dutch elm scores between students who had done the Dutch elm web assignment and those who had not.

Only a few students (5 in F04, 1 in S05, 5 in F05, and 0 in S06) chose to answer the essay questions on crown gall and fire blight. All but two of these students had completed the crown gall web assignment. However, there was no significant difference between the scores for the crown gall and fire blight answers, and no significant differences between scores of students who did or did not complete the crown gall web assignment.

Based on these results it appears that only a slight improvement on some final exam scores resulted from students completing the web assignments, and most of the time there was no significant improvement of exam scores. This is disappointing, but on reflection may be the result of the way that we use the PPP web site, and the success of the other means by which students learn in PLPA 200.

### **Focus Groups:**

To help us understand how the students were completing the web assignment and how they perceived their usefulness in helping them learn, we conducted a series of focus groups, primarily with students from the Fall 2004, Spring 2005, and Fall 2005 semesters. In these focus groups some of the students commented that the web activities were “fun” and a good way to review material that was presented in lecture. Some students appreciated the interactive aspects of the site, saying that it was a better way to go over the material as compared to reading a text book. Several students commented on the pictures.

“The pictures were inspirational, but I guess I tried to just focus on the various diseases and try to just understand the cycle and then forget about everything else.”

A few said that the amount of material on the site was somewhat overwhelming, but was still very helpful when studying for weekly quizzes. Several students commented that they found the virtual lab activities kind of tedious because they already knew what was going to happen (because of lecture), and they were just clicking through the activity to get it done, instead of spending a lot of time on it. Others liked the activities, indicating that actually doing something with the disease helped them stay interested and retain the information better than if they had read it in a text book. When asked what aspect of the site they liked best, one student answered

“I think the activities part. Actually, like, kind of interacting. You could actually see what was going on in the experiment, and to find out the results and stuff. It was a lot more interactive and clarified it more than just, like, reading a paragraph or something.”

Some found the resources section to be helpful, indicating that it helped them clarify information presented in class. Others did not take the time to look at it in much detail because they did not have to in order to complete the assignment.

“When I looked at the resources, there was like nine readings, and I was usually doing this stuff like two nights before it was due, so I’d just go straight to the activities”. “Yeah, I looked at the resources and stuff, but basically I’d just like run thru it to find the answer to the quizzes...”

On average, students indicated that they spent about an hour on each of the web assignments. One student commented “I didn’t really get more interested because of the website. I kind of skimmed it as much as possible just to get thru it.” Others indicated that it helped them review for quizzes and presented material in a well organized fashion that helped them better understand

what was said in class. “It just helped me understand what was said in class. Information was very clear.”

### **Conclusions**

If the students are only spending a limited amount of time on the site, and perceive that it just reinforces the material that they get in lecture, then maybe it should not be surprising that we did not find more significant improvements in exam question scores as a result of the web site activities, although several students indicated that the site helped them study for the weekly quizzes.

After looking at the results we have begun a process of reevaluating our use of the PPP website in PLPA 200. One comment from a faculty member not involved with teaching the course was that we do “too good of a job” of presenting information in the lecture part of the class, so the students do not get much more from the web site. What we may be overlooking is how the web site activities are helping the students learn the scientific process of experimentation, something that we do not cover much in the lecture part of the class. We have now initiated a study to evaluate the effect of using the activities section of the site on the students’ abilities to formulate a hypothesis, design a controlled experiment, interpret results, and develop an appropriate conclusion. This will involve the administration of pre and post tests to measure students’ understanding of the scientific process.

Results from this study were presented at the 2005 annual meeting of the International Society for the Scholarship of Teaching and Learning (ISSoTL) in Vancouver, Canada, and at the 2006 annual meeting of the American Phytopathological Society in Quebec City, Canada. We are planning to prepare a manuscript on this project and its findings for publication in a peer reviewed journal.