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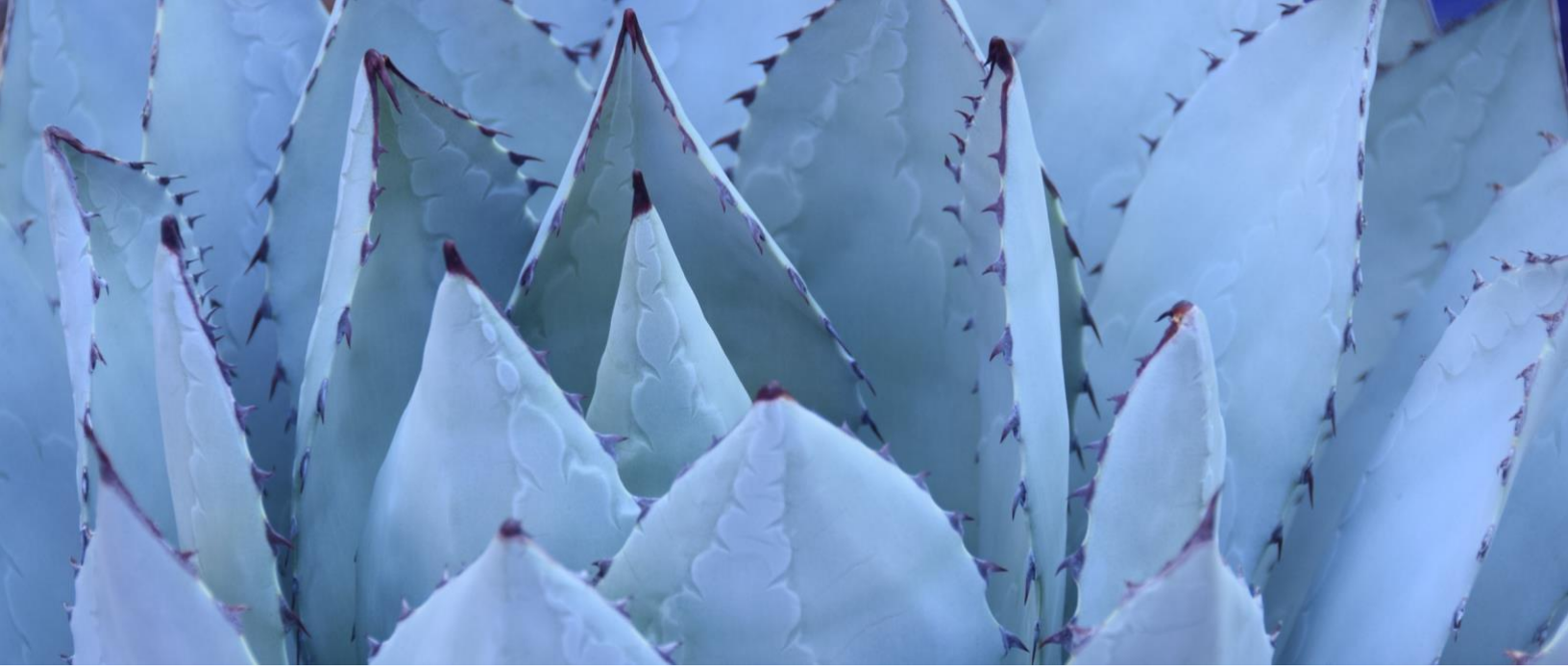

Stressing Students Out for the Real World: Case Study Simulations in the Agricultural Sciences

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The collegiate classroom is in many ways a poor proxy for the real world, and that disparity is especially pronounced in the agricultural sciences. While the academic study of complex biological systems in the context of a dynamic climate, global supply chains, and shifting rural economies may make for compelling multiple choice exam questions, students who cannot meaningfully apply their knowledge to unpredictable and convoluted situations will not be successful in their careers. Many courses are structured around learning content (e.g., an authoritative lecturer sharing information that will be assessed on an exam), but the cultivation of critical scholarly processes (e.g., critical thinking, information literacy, experimental design, technical writing, effective group work) are an afterthought and expected to flourish on their own without meaningful support in the pursuit of factual knowledge. The ubiquity of the internet has exacerbated the often-damaging impact of this philosophy, since information is more readily available than ever, but students often lack the ability (i.e., processes) to engage with available data effectively. To support digital literacy, critical thinking, and rapid consolidation of information, I developed and implemented a series of group-based, time-

sensitive case study assignments for my students simulating real-world scenarios they might see in the field of plant pathology.

Course Background

Across global agricultural production, microbial plant pathogens are the second leading cause of yield loss behind weeds, costing untold billions of dollars to producers annually. Developing integrative pest management practices that enhance the efficacy of chemical applications and cultural practices (e.g., tillage, row spacing, planting dates) are only possible, in part, with a better understanding of how microbes make plants sick and how to effectively break cycles of infection and spread. Principles of Plant Pathology (PPA 400G) is an upper-level lecture and laboratory course that focuses on the study and management of plant diseases through the characterization of host/pathogen infection cycles (see fig. 1). Understanding pathogens and their disease cycles is critical for effective management. Similarly to how a doctor knows not to prescribe an antibiotic treatment for a viral infection, and how the mistiming of medicinal interventions may fail to cure certain diseases, a grower must make precise, well informed management decisions to ensure the quality of their crop. This course helps prepare future growers, agricultural extension agents, and crop consultants to make those important decisions rapidly, with often incomplete or contradictory information provided to increase complexity.

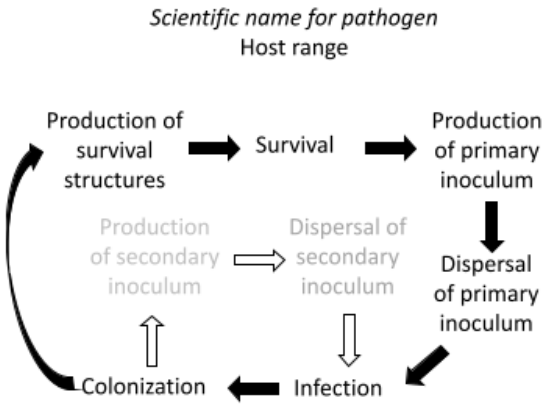

Figure 1. A representative plant disease cycle. Monocyclic diseases (black arrows and font) typically cause an annual infection cycle. Polycyclic diseases (dashed arrows and gray font) can undergo numerous cycles during the growing season, potentially causing damaging epidemics in a short amount of time.

Assignment Structure

Students were asked to complete these activities five times during the semester. The exercises occurred at the end of two to three week-long modules based on pathogen type to ensure students were familiar with the assessed topics. These case study exercises require all participants to have internet access and roughly 50 minutes of class time to complete. The case studies were structured to replicate a scenario where professional plant pathologists are contacted by a grower to investigate a potential disease problem on their crop and provide immediate management recommendations, followed by a live peer-review period where group members defend management plans. At the initiation of the exercise, students were randomly assigned into groups of four and asked to open a shared Microsoft PowerPoint document that they all could contribute to synchronously. Students then had 20 minutes to read a two-paragraph case study accompanied by diagnostic pictures (see fig. 2) and develop a three-minute presentation (with citations/resources) that addressed specified prompts about the background of the pathosystem, an understanding of the problem, and disease management recommendations (see fig. 3).

After the twenty-minute presentation development period, groups then presented their recommendations to the class and defended their strategies during a five-minute discussion where their peers were required to ask at least one question.

A grower named Jill called you frantically about a problem with her corn plants. She has 500 acres of tasseling corn, and when she was driving down her section road this morning she discovered that most of the leaves on the exterior rows have hundreds of small orange specs and a few large yellow to gray cigar-shaped lesions (see picture), and she is worried that her yields will suffer.

Figure 2. A representative case study prompt. At least one picture always accompanied the narrative story, which was purposely vague and lacking critical information. However, the picture combined with facts in the narrative provide enough evidence for the exercise. Photo curtesy of the author.

Create figure 3 with prompt outline:

1) Background and History of the Pathosystem
    a. Include pictures of a healthy host, diseased host, and the pathogen (if available).
    b. Include relevant history of the cropping system and/or disease.
    c. Provide specific values of economic loss (if available).
2) Understanding the Problem
    a. What are three questions you should ask a grower to learn more about their situation?
    b. What are two more pieces of information that you need to make a more informed recommendation?
3) Disease Management Recommendations
    a. What are three different specific management strategies that can be employed at specific locations in a disease cycle. Integrate your recommendations into this representative disease cycle (Figure 1) with arrows.

Fig. 3. Example instructions for assignment

Structure Rationale

While built around a rigid timeframe to increase pressure, this exercise was purposely open-ended and internally unstructured to allow the students flexibility to develop and pursue their own goals to the best of their ability. The limited timeframe was essential to encourage all groups to be deliberate and concise with their process. Since groups were randomly assigned, students quickly assumed roles that fit their strengths (e.g., leader/delegator, researcher, graphic designer, presenter) without formal guidance. The time constraint was also key in simulating a hypothetical, professional scenario of not having the benefit of time to engage in lengthy research protocols. A computer with access to the internet was critical for this experience, since students were expected to quickly identify the information they needed while concomitantly identifying credible sources. Lastly, a defense of their oral presentation was chosen as the final modality because students are often more critical than instructors are, and the public nature of the presentation ensured that students were accountable for their work in front of their peers.

Assessment Strategy

Groups were assessed with a holistic rubric on their adherence to the presentation prompts and the completeness of their presentation. To ensure that everyone participated equally in the team, each student was asked to rate the participation of each member of their group, which provided student-allocated, individual ratings calculated into the final score of the assignment.

Student Feedback

Most students initially expressed frustration and stress about the limited timeframe and lack of formalized group structure. However, after becoming familiar with the expectations and framework of the case studies followed by frequent practice, their feedback at the end of the semester was incredibly positive. When asked about why they struggled with presentations earlier in the semester, students generally responded that they were not prepared for an experience like this because most of their previous classes were structured as passive lectures followed by individual exams. As observed during the first case study assignment, most students were overwhelmed with the amount of work expected of them within a limited timeframe, mainly because they could not prepare by passively listening or studying content. Rather, they were forced to exercise the process of scholarship, which was uncomfortable. Additionally, most students were not initially confident with the confrontational nature of the case study defenses but became more effective advocates for their opinions throughout the course of the semester as they learned how to support their arguments with data. Lastly, some students were overwhelmed with the (purposefully) confusing and/or contradictory case study scenarios, which required them to critically analyze a complex situation while making educated guesses about several different unknowns. These concerns faded once the students understood that it was okay to not have all the answers and address their outstanding questions in the presentation. A key factor in the success of these exercises was their repetition throughout the semester. Left as a single occurrence, students would likely have been left with only those feelings of frustration. Building five of these case studies into the curricular rhythm allowed students to practice and grow more proficient with the processes.

Areas for Improvement

The two major areas for improvement for this case study exercise are framing the experience more thoroughly and scaffolding the group structures more explicitly. In future semesters, the case studies will be framed with more thorough introductions that give special attention to the rationale behind the structure. Framing in the future will also include a student-led discussion of strengths, weaknesses, and concerns. To improve student group self-organization, a list of roles (with detailed descriptions) will be shared to help inspire student choice. Additionally, each student's role will be recorded to ensure that they select a variety of positions throughout the semester.

Conclusion

The dynamic, time-sensitive, and publicly accountable nature of these case study exercises provided a new experience for many of the students, which resulted in a steep learning curve as they refined

(or developed) processes of critical thinking, information literacy, and group dynamics. The students initially expressed confusion and reluctance, but then steadily developed confidence and poise as they established ownership of their scholarship. While genre-specific and piloted with a small class of upper-level students, aspects of this framework are readily adaptable to different academic disciplines, course types, and delivery modalities. By leveraging real-world scenarios that prioritized fast thinking and principled decision-making over preparation and studiousness, this exercise helped students develop critical processes that will help them in their future careers.

Media

Blaber, Isabelle. Photograph of plant, Morocco. 2017. Photographer's personal collection. All rights reserved.

Hirsch, R. L. Photograph of case study example. 2020. Photographer's personal collection. All rights reserved.

___. Photograph of plant disease cycle. 2020. Photographer's personal collection. All rights reserved.

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