Bringing agriculture into the ODeL environment: Challenges and opportunities

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Abstract

University-based agricultural courses are increasingly being taught via distance education. Various ODeL models function perfectly well in place of the traditional agricultural classroom learning experience and target a much more broad and diverse student body in the process. However, integration of the vital on-farm course component, typically available to students housed at a centralized location, into a distance curriculum presents unique challenges to ODeL course developers and instructors. Questions that must be addressed to ensure a complete educational experience include: How can students fully comprehend the diversity of current farming technologies? What is the best way to teach students the basic principles of soil testing or seed propagation? How can instructors encourage meaningful farmer x student interaction? Using three different agricultural courses currently taught at Washington State University as models, various approaches will be discussed that address these and other important questions. These approaches include: blended learning, in-depth farmer interviews, plant propagation techniques, hands-on soil analysis and interpretation, and experimental design of taste test evaluations. Additionally, potential solutions to the problems associated with student conduction of agroecological experiments without access to university provided laboratories, greenhouses and fields will be discussed. This lack of experimental design framework, using appropriate technologies, is currently a major barrier to expansion of ODeL in the agricultural sciences. Therefore, novel course designs and innovative assessment frameworks utilizing participatory methods of various experimental methodologies are still needed to best meet the needs of distance-based students in agricultural disciplines.

Background

Though an astounding variety of university agriculture courses teach hands-on laboratory, greenhouse and field techniques, very few of these procedures and practices are available to the on-line student of agriculture. Rather than having dedicated laboratory, greenhouse and/or field space for experiential learning, instructors and developers of ODeL courses must implement novel methods that will teach distance students the same principles of agriculture as would the in-class or field-based experiences. Here I will review the diversity of techniques currently employed in three on-line agriculture courses at Washington State University: 'Organic Farming and Gardening', 'Introduction to Agroecology' and 'Field Analysis of Sustainable Food Systems.' These courses span a range of university levels and focus on first-, third-, and fourth-year undergraduate students as well as graduate students from a broad range of backgrounds and agricultural sub-disciplines.

Course 1: Organic Farming and Gardening

The goal of Organic Gardening and Farming is to provide students with an introduction to the field of organic agriculture and the basic principles and production practices involved. Topics covered include an introduction to the growing literature on organic farming, the issue of sustainability, soil quality in terms of its physical, chemical, and biological characteristics, organic soil fertility, basic plant botany and plant propagation techniques, weed and pest management, food health and safety, general organic garden and farm planning and organic certification requirements. There are multiple hands-on activities in this class to supplement readings and discussion to help students meet the goal of the course. Three of these activities, including: 1) a blind taste test; 2) an evaluation of soil quality; and, 3) an on-farm interview, will be presented here.

Activity 1: Blind Taste Test

The purpose of this activity is to teach students how to conduct a blind taste test, often a new experience for undergraduate students not yet trained in food science. The assignment instructions asks the students to conduct a blind taste test at home on one organic and one conventional product of their choosing. The two food products have to be the same fruit, vegetable, or food product. Specific considerations of, and instructions to, the student include:

- "*When purchasing your product, try to choose items as visually similar as possible. For produce, take into consideration the size and ripeness. For example, if you choose bananas, the organic and conventional bananas need to be of similar size and ripeness. If you decide to test a processed product try to ensure that they are as similar as possible in terms of salt content, etc.*"
- *"Conduct the test with your friends or family. There should be at least 3 people participating. Don't participate in the conclusions yourself and don't let your test panel know which product is which, until after all results are gathered!"*
- *"Decide on at least four testing criteria of your choosing. Such criteria could be sweetness, firmness, flavor, overall acceptability, aesthetics, etc. Ask your panel to state their preference based on your chosen criteria and record the results."*

Students plan their research, carry it out, record and discuss the results in a threaded discussion with each other and with the instructor, and results are written up in the form of a short research paper. Often students went above and beyond the activity requirements. For example, in 2011, J.M. (only student initials will be used to preserve anonymity) designed separate taste tests for broccoli, apples and milk; D.R. tested carrots and tomatoes; and J.S. tested red leaf lettuce, apples and bananas. Results often varied dramatically among experiments. For example, one student discovered that "every respondent found the organically grown banana to be superior to its traditionally grown counterpart in sweetness, consistency, and overall quality. The common comment I received was that the organically grown bananas were far sweeter than the traditionally grown bananas, and the "banana essence" was stronger." (H.A., 2011) Another found that "the participants…agreed that the conventional apple smelled more ripe. As for taste, the conventional apple was sweeter, though both apples were also tart." (S.M., 2011) By conducting these studies themselves, students learn first-hand the limitations of taste-tests and will be more prepared to critically analyze other oft-publicized taste tests. For example, S.M. (2011) wrote that

> "there were several limitations to this study, including the small number of participants and small number of fruits sampled. Testing a number of varieties of apples, for example, may have brought up some characteristic to organic apples that were hard to see in a comparison of just one variety. Another limitation was that because the participants knew just by looking at the apples which was conventional, they could have skewed their responses to show preference for the organic apple. Additionally, the organic apples were shipped from New Zealand and it was unknown from where inside the US the conventional apples were shipped. Shipping and storage times could drastically alter the taste of the fruit. A study that took place during the growing season of the fruit being tasted might give a better and more interesting measure of quality between conventional and organic."

Activity 2: Evaluating Soil Quality

The purpose of this activity is to teach simple procedures for assessing soil quality. This is one of the first and most important activities that students will need to do when selecting a site for a garden or evaluating land for a farm. The assignment instructions for this activity asks students to find a site such as a garden or farm field where they can conduct four hands-on tests of soil structure and aggregation. First, students are asked to loosen soil with a hand trowel or spade and pick up a handful. They then need to answer and record questions, including: What does it look like? Is it crumbly when you break it apart? Is it soft or hard? Is the structure aggregated, blocky or fine and sandy? What does it smell like? A woodsy, earthy smell indicates the presence of lots of active actinomycetes. Can you see any earthworms or other macrofauna? The four specific soil evaluations the students conduct include (as written to the students on the course website):

- **Evaluating soil texture:** "*Take a small handful of soil and wet it a little with water. Work the water into the soil so it is evenly worked in and then press it between your thumb and first fingers to make a ribbon. How long of a ribbon can you make with your soil?*"
- **Digging a soil pit:** "*Now take a shovel and dig a small pit. It should be at least one foot deep but you can dig deeper if you like. How easy is the soil to dig through? Do you notice any signs of compaction as you dig deeper? How moist is the soil? Is it dry on the surface or not? How deep do you have to dig before you see moisture? How many*

earthworms do you find? What do the plant roots look like? How many different layers or soil horizons do you see? What colors are they?"

- **Visualize organic matter and aggregation:** *"Put about ½ a cup of soil in a glass jar full of water and gently shake it up. Look at it at intervals during the day and measure the time it takes for the water to become clear. The larger the aggregates held together with organic matter and microbial exudates, the faster they will fall to the bottom and the water become clear."*
- **Water infiltration:** *"There are a number of different things you could do to measure water infiltration. If you have your own garden or access to a place where it is safe to leave your soil pit open, you can fill it with water, allow it to drain and then immediately fill it again and measure the time it takes for the water to drain. Another thing you can do is find a plastic or metal ring to press at least 6 inches into the ground leaving at least a couple of inches protruding above the surface. You could even use a plastic bottle with the bottom sawn off to do this. Fill the ring with water and measure the amount of time it takes for the water to disappear. If you can't leave your soil pit uncovered, there is still an interesting soil infiltration experiment you could do. Take a glass jar and fill it with layers of different soil. You could start with a layer of sand and add a layer of subsoil from the bottom of your pit followed by a layer of the topsoil. Allow the soil to air dry and then slowly trickle water onto the surface. Watch how it infiltrates. Is there any ponding on the surface? Does the surface start to seal over? What happens at the boundary layers between the soils of different textures?"*

Many students enjoyed this activity as it related closely to their own gardens where they had often toiled to improve their soil structure and quality. As D.R. writes in 2011,

> "My efforts have been paying off: the top foot of soil has the ideal characteristics necessary to support vegetables, but the sandy clay a foot down isn't ideal so there is still a need for continued improvement. Though it would be possible to work the current topsoil down into the clay mixture another foot deeper, this would upset the ecosystem that has been building up in the soil over the past four years, especially since the clay was previously amended with sand so it isn't impeding drainage."

Other students did not find quite the results they were looking for, but still managed to accurately assess and gauge the condition of their soil. For example, S.M. (2011) notes that "the soil in this garden bed has…very poor structure and a severe lack of organic matter and soil-dwelling organisms. These qualities usually come hand in hand, so it is understandable that the soil would lack all three. Organic matter in the soil recruits and stimulates the growth of beneficial organisms like bacteria, fungi, and earthworms."

Activity 3: On Farm Interview

The purpose of this activity is to give students the opportunity to visit a farm, conduct a thorough interview with a farmer, and see firsthand some of the practices that have been topics throughout the duration of the course. The assignment instructions are to: 1) locate a farm, garden or greenhouse operation and set up a date when the farmer is available for a visit and interview; and, 2) prepare a minimum of six questions to ask during the tour. These could include how and when the grower became involved in organic agriculture, how they run their operation, how they control for weeds, manage pests, soil fertility, market their produce, etc.

This activity often proves to be the most challenging and rewarding activity of the course as students get to visit a real farm and interview the growers and managers involved. Additionally, students were often struck by the close ties and involvement many of the farmers had with the local community. This sense of place is evident in this passage written by C.C (2011):

> "Upon my arrival, I was greeted with a big smile and a, "Come on in and meet the family" welcome. I entered the office and received hugs from sisters Kristi and Konnie. The sense of family was overwhelming and made me feel right at home. After being assured that I could come back and ask any tailing questions Dan and I headed out to the fields. We drove through the countryside and observed agriculture at its best surrounding everything. Every field contained a different crop and they were all very green and luscious. As we drove by he named every crop, as well as its owner. The sense of community was great and I could tell why someone would want to root themselves down with a family farm in this town."

Course 2: Introduction to Agroecology

This course is designed as a junior-level, introductory agroecology course and integrates basic principles of ecology (including species interactions, population dynamics, disturbance, succession, natural selection, genetic and species diversity and stability, etc.) with current issues in agricultural systems (including soil quality, weed control, pest and disease management, genetic diversity, etc.). The course focuses on modern and traditional farming systems where the use of agroecological concepts and practices has improved the overall economic, social, and environmental sustainability of these farming systems.

There is one semester-long asynchronous activity that is designed to literally bring these ecological concepts to life in a form that is exciting to students, encourages discussion within groups and stimulates cross-pollination of ideas among each group in class. Asynchronous communication has been shown to facilitate in-depth communication among student in the ODeL environment and students appreciate the ability and freedom to move at their own pace (Tallent-Runnels et al., 2006).

Each student conducts their own lab activity at home. The lab activity explores competition and mutualism dynamics through evaluation of intercropping systems of spring barley and various other crop species (Table 1). Through data collection and photos taken throughout the semester, students evaluate these activities for proof of different ecological concepts, including mutualism, competition, allelopathy and interference. Students are divided into groups that will study the relationships between spring barley and an individual crop species. These groups are listed in the table below.

Table 1.

Group	Keystone Species	Intercrop Species	Source
1	Spring barley	Clover	Peaceful Valley* Item #: SCM700 (Low growing Clover Mix, nitrocoated)
2	Spring barley	Medic	Peaceful Valley* Item #: SCM400 (California Medic Mix, nitrocoated)
3	Spring barley	Alfalfa	Territorial Seed Company† Item #: WW4417/E (Nitro Alfalfa Cover Crop)
4	Spring barley	Buckwheat	Territorial Seed Company† Item #: WW4416/E (Buckwheat Cover Crop)
5	Spring barley	Oats	Territorial Seed Company† Item #: WW4414/E (Oats Cover Crop)
6	Spring barley	Bunching Onions	Territorial Seed Company† Item #: ON556/S (Red Beard Onion)
7	Spring barley	Radishes	Territorial Seed Company† Item #: RD741/S (Cherry Belle Radish)

*www.groworganic.com; †www.territorialseed.com; ¶Spring barley variety will be: Organic Purple Hulless Barley (1 oz) from Sustainable Seed Co. (www.sustainableseedco.com). A backup source for this will be: Tibetan Purple Hulless Barley from Uprising Seeds (www.uprisingorganics.com)

Students are asked to purchase seeds, soil mix and seedling flats. This activity was partially chosen based on the affordability and availability of the materials needed. The methods are divided into the following five steps, each of which is documented, discussed with other students in their groups, and submitted to the instructor for a grade: 1) planting, 2) germination and emergence, 3) early plant height, 4) tiller number and plant height at maturity, and 5) barley and intercrop yield. In the final weeks of the class, after each group has discussed the ecological implications of their specific intercropping activity, it is time for all the groups to interact with each other. This is where this type of experiential learning activity gathers strength and fully utilizes the unique advantages of the ODeL classroom. Students from the warm tropical climates of Florida and Southern California discuss interference interaction with students from the high-elevation mountain valleys of Colorado. Students from India discuss the vagaries of mutualism with students from Mexico. All students are invested in their own experiment, but bring in their local climate, farming systems, crops, and food system experiences to help explain their observations and analyses.

Experiential learning activity is a hallmark of undergraduate education in the agricultural sciences (Splan et al., 2011), and it can and must be included in the ODeL classroom. Closely aligned with constructivist learning theory, experiential learning adheres to the pedagogical principles that “learning should be authentic, active and student-centered, and that it must also be facilitated through social negotiation” (Splan et al., 2011). This is the intent of the activity developed for the Introduction to Agroecology course.

Course 3: Field Analysis of Sustainable Food Systems

Blended learning is a combination of online and classroom learning that includes superior components of online courses, including convenience and expanded student diversity and participation, without the complete loss of face-to-face contact (Rovai and Jordan, 2004). Evidence exists that suggests that blended courses often produce a stronger sense of community among students then either traditional or fully online courses (Rovai and Jordan, 2004). Blended courses frequently reduce feelings of isolation among students (Haythornthwaite et al., 2000; Morgan and Tam, 1999) and appeal to those who are dependent learners, less self-regulated and in need of frequent direction from a visible professor (Rovai and Jordan, 2004). Similarly, students with more introverted personalities often feel a stronger sense of contribution and personal fulfillment in blended courses than in the traditional classroom, where discussions can be dominated by more vocal students. ‘Field Analysis of Sustainable Food Systems’ is an illustration of a blended course that fosters an expanded sense of community among students through the use of an extended, multi-day field trip to unique farming systems throughout Washington State.

An intensive, experiential course Field Analysis of Sustainable Food Systems integrates online discussions with field visits to farms, food processing, distribution and marketing facilities to investigate and develop an understanding and analysis of issues and relationships for sustainable food and farming systems. The key component of the course for all participants is a required, *week-long, in-person immersion field experience* during spring break. The remainder of the course activities and requirements are completed online. The course begins with weekly online discussions on specific topics relating to concepts and practices in sustainable agriculture, with a focus on livestock systems, specialty crops and cereals grown in Washington State. This provides a broad background on the economic, environmental, production and social aspects of agricultural production and consumption in the US and specifically, in the target region visited during the field trip.

Conclusions

Novel ODeL techniques are needed to fully address the needs of agriculture students, where experiential learning is often the most effective teaching tool available. The three courses described in this paper give examples of a variety of different methods used to cultivate, complement and incorporate the hands-on learning experience into the OdeL environment.

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