Science Societies

Empathy, animation, and forest film crews

Resources for teaching tough courses online

By DJ McCauley

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kinnikinnick - Arctostaphylos uva-ursi. Identification and characteristics.

- *Natural Sciences Education* recently published a special section titled "Enhancing Natural Sciences Education in Postsecondary Settings."
- Two papers in the special section discuss the efficacy and student use of online learning techniques, from videos in the field to dynamic quizzes and online animations.
- Two authors, April Ulery and Patrick Culbert, discuss their findings and offer tips for online instruction as learning leans virtual this fall.



With the help of an on-campus professional film crew, Patrick Culbert, University of British Columbia, created a series of 53 videos showing indicator plant species in the coastal rainforests of British Columbia. Photo by Michael Sider.

Distance learning is not a new concept. It dates as far back as 1728 when Caleb Phillips advertised a correspondence course in shorthand in the Boston Gazette (**https://bit.ly/2DJmG55**). In 2018, the National Center for Education reported that 16.6% of post-secondary students were enrolled exclusively in distance education courses with 35.3% of all students taking some sort of online course in conjunction with in-person classes (**https://bit.ly/2ZFy5vv**).

Online learning has broadened the scope of what students can learn without setting foot in a classroom. With disruptions to in-person learning from the COVID-19 pandemic, teachers who have never created online courses quickly find themselves pivoting to web-based platforms.



This still frame from the series shows Patrick Culbert seated in front of the kinnikinnick plant. Inset: Culbert's hand, showing scale, points out the small red berries on the kinnikinnick plant. Images courtesy of Patrick Culbert.

"University of British Columbia announced that we were transitioning to online classes at 5 pm on a Friday," says Patrick Culbert, an Assistant Professor of Teaching in the Department of Forest and Conservation Sciences at the university. "We rolled out online courses on Monday."

Instructors, now delivering lectures and materials in new ways, are looking for reliable resources for hard-to-teach courses. For example, Culbert's forestry field course is all virtual this fall. Likewise, professors of lab-based courses find themselves in a bind.

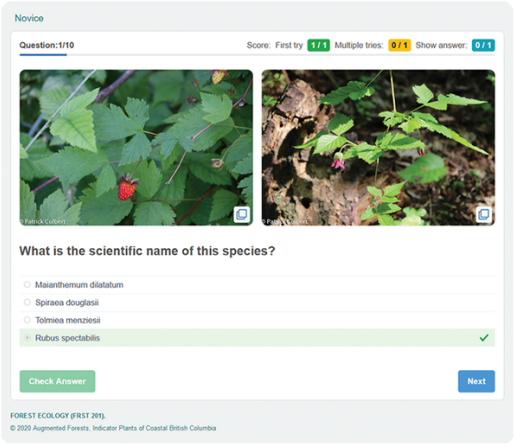
As instructors pivot to online learning, the recent special section in *Natural Sciences Education* (NSE), "Enhancing Natural Sciences Education in Postsecondary Settings," could not have better timing. In this article, two authors of papers in the special section describe the online tools their teams created and how those tools can help students learn from afar.

Field Course, Sans Field

Culbert sits cross-legged in the forest in front of a short, densely growing shrub, spotted with small red berries and leathery, oval-shaped leaves (see image above). The kinnikinnick (or common bearberry) is shown from several angles with Culbert in the shots for scale. What you can't see in this dazzling video is the film crew on the other side of the camera.

With the help of UBC Studios, an on-campus professional film crew, Culbert created a series of 53 videos showing indicator plant species in the coastal rainforests of British Columbia. As part of the 200-level forest ecology course at UBC, students are required to learn names and ecological characteristics of 69 indicator plant species.

Along with videos, Culbert created a website with pages for each of the plant species, including photos and their ecological characteristics. The site also features a dynamic quizzing system. This custom-made tool allows students to pick the plants they want to study from a checklist. With dynamically generating questions and a large stock of images, the dedicated forestry aficionado-in-training can take a quiz several times with little chance of seeing repeat questions.



A plant identification question from the online quizzing platform.

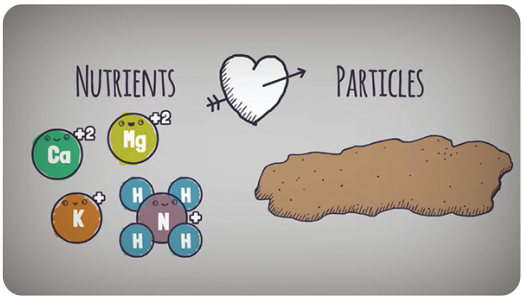
In his article published in NSE, Culbert documented student use and feedback on these instructional materials using a survey (**https://doi.org/10.1002/nse2.20015**). His students responded favorably to all of the resources provided. Unanimously, the students agreed or strongly agreed that the video resources were very helpful in learning to identify the plants.

But was it worth the time and effort?

Culbert thinks so. “Teaching field courses is difficult at the best of times,” he says.

Even under ideal conditions, students in the field might not find an indicator plant. If they do see a plant species, they might only have a minute or two to observe it.

Unlike a field guide or flashcards, Culbert's videos give students the next best thing to a guided walk in the woods. Using motion parallax through moving shots helps viewers visualize the plants in three dimensions unlike looking at a still image.



A still image from New Mexico State University's "Cation Exchange" video, demonstrating the attraction between positively charged soil nutrients and negatively charged soil particles. Image from ***ScienceOfAgriculture.org****.*

"These resources were originally meant to be supplements to the field course," Culbert explains. "Now they're the primary materials."

Thirty percent of students in the Department of Forest and Conservation Sciences are international. Countless others may live in urban areas. With UBC's Faculty of Forestry conducting courses completely online, Culbert's videos provide an invaluable resource for the field course.

Producing the videos was expensive—Culbert clocks 53 videos for Can$35,000—but they're now free for any interested party to watch.

We've reached 50,000 views in total on YouTube," Culbert says. "Based on the links, we can see other universities are assigning them. Though I don't know who those people are, I'm so glad the videos can help.

Animating Agriculture

In a climate quite different from the cool, wet rainforests of British Columbia, a team at New Mexico State University (NMSU) has been creating learning materials—games, videos, animations, quizzes—for more than 30 years. The Department of Innovative Media Research and Extension put its charming animated videos to the test, highlighting the efficacy of these learning tools in an NSE article (

https://doi.org/10.1002/nse2.20011).

April Ulery, SSSA President-Elect and Professor in NMSU's Department of Plant and Environmental Sciences, served on the team that created short, clever videos to explain topics of intermediate difficulty in agriculture and soil science.

The team used pre- and post-test surveys to evaluate the effectiveness of the information shared in a video about soil cation exchange capacity. Before watching the five-minute bit, only 49% of students correctly answered that divalent cations would be held tightest in typical temperate region soils. After watching the video, 83% answered correctly.

Anecdotally, Ulery mentioned that she sometimes asked her students for feedback on the videos after showing them to her classes in person.

“Sometimes they tell me the videos look a little juvenile,” Ulery says. “But what they don't realize is that cation exchange capacity is something that has confused generations of students, but they've just learned it in three minutes.”

The team's other animated videos, available at ScienceOfAgriculture.org, include an explanation of adsorption and absorption, an exploration of the logarithmic scale, and soil porosity, just to name a few.

Tips for Teaching Online

Both Culbert and Ulery created their online course materials as supplements to classroom courses, but the COVID-19 pandemic has pushed virtual learning (and the well-made resources it requires) into the spotlight.“It’s a strange thing to say, but COVID has been a boon to our website,” Ulery says. “It’s the perfect storm: it forced us to go online and see what we can really do with education and outreach.”

With traditional classroom courses now offered online, it may just be a unique opportunity for postsecondary educators to try new methods of assessment, field learning, and creative assignments.

Ulery recommends low-stakes forms of assessment that minimize the temptation for students to plagiarize or Google-test answers.

“With the whole of the internet right there, it may be best to find ways to assess students that don't encourage cheating,” Ulery says.

She often asks students to send in photos of their handwritten assignments, noting that even the simple act of writing information longhand can help students retain information.



A soil scientist takes samples to test soil cation exchange capacity. Image from ***ScienceOfAgriculture.org****.*

Meanwhile, Culbert works to find new, creative ways for his department to effectively teach from afar.

Now he's testing 360-degree video cameras for use in field courses. In a sample video that Culbert put together for his department, he stands in the forest with the camera attached to a hand-held monopod (think selfie-stick) and talks through the species he sees around him. You can click and drag, looking around as Culbert does. It's as close to a walk in the woods with your forestry professor as you can reasonably get without investing in an expensive virtual reality system.“We just really want students to feel like they’re in the forest,” Culbert says. “My students might be in a city, or halfway across the world from Vancouver, but if they can start becoming observers of the plants around them, even in a video, they have the tools to start identifying them.”



April Ulery (right) showing New Mexico State University (NMSU) undergrads how to access digital learning tools in the classroom. Photo courtesy of NMSU's Department of Innovative Media Research and Extension.

Finally, the biggest change for those used to teaching in the classroom may be the lack of "emotional return" they get from online teaching.

"It's hard when you can't hear [your students] laugh at your jokes, however bad," Ulery says. "Or you can't see their face when they have a question or when a concept clicks. You *can* reach out to them, though. Talk to them individually. Find ways to be available and let them know you are there for them, just like you would in person."

Similarly, Culbert encourages empathy.

"We're all doing our best right now," he says. "We just need to recognize these aren't the circumstances anyone signed up for, but we've got to do our best to teach and support our students."

For professors with years of experience in the classroom to college freshmen enrolled in introductory courses they weren't expecting to take online, the climate for learning looks a little bit different this fall. But chances are good that some aspects of online learning are here to stay, and the research and insights provided in the *Natural Sciences Education* special section give instructors another valuable resource to create engaging means of learning for their students in the sciences.

Dig deeper

Check out this special section, “Enhancing Natural Sciences Education in Postsecondary Settings,” in *Natural Sciences Education* at **https://acsess.onlinelibrary.wiley.com/toc/21688281/2020/49/1**.

Everald McLennon, Biswanath Dari, Gaurav Jha, Debjani Sihi, Vanaja Kankarla, Regenerative agriculture and integrative permaculture for sustainable and technology driven global food production and security, Agronomy Journal, 10.1002/agj2.20814, **113**, 6, (4541-4559), (2021)

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