Teaching Tips/Notes NACTA Journal

A Custom-built Digital Tool for Live Remote Teaching from the Field

In March 2020, teaching faculty at Oregon State University were instructed to switch from in-person to remote teaching within three weeks due to the COVID-19 pandemic. This was a daunting task, particularly for field trip-based courses in agricultural sciences. Two field trip-based courses had to be transitioned: "CROP 280: Introduction to the Complexity of Oregon Cropping Systems" and "CROP/HORT 480: Case Studies in Cropping Systems Management." CROP 280 (with 8 field trips) serves as an introductory agronomy course in which students observe crops under different management strategies to enhance understanding of agronomic practices. CROP/HORT 480 (with 6 field trips) serves as the senior capstone course. During the capstone course, agronomy and horticulture students observe real-world production issues in the field, which they then analyze and determine possible solutions. Students work in teams and communicate to the grower probable causes and management strategies to resolve the observed issues. Both courses require student-grower interactions and in-field observations during the field trips or interruption.

Initial Digital Tool Design

The University designated Zoom (Zoom Video Communications, San Jose, CA) as the platform to deliver remotely taught courses. Prior to the start of the term, we experimented with the GoPro Hero 8 (GoPro, Inc., San Mateo, CA) camera to utilize its higher quality video capability for livestreaming field trips. However, this proved unreliable due to multiple, potential failure points related to hardware and software. During the 2020 spring term, we used a system that consisted of two cell phones, external microphones, and a multi-channel handheld audio mixer. One phone was used to only transmit audio, the other only video. We did this intentionally to minimize the bandwidth required on any one device to reduce audio and video stream lag.

This dual cellphone setup worked but had limitations. While some issues were due to an unfamiliarity with the Zoom platform (e.g., 'pinning' the device streaming video), others were specific to this setup, including the multitude of steps for assembling the system and unreliable connectivity. Because of connectivity problems, we also made back-up recordings using a GoPro Hero 8 camera for later viewing on Canvas (Instructure, Salt Lake City, UT), the courses' learning management system (LMS). The dual cell phone setup also required at least one extra person in the field to maintain the audio setup, troubleshoot, and to monitor the live Zoom chat. Because of these limitations, we chose to create a new system for the following year's remote field trips.

Final Tool Design

The redesigned system, depicted in Figure 1, was used during the 2021 spring term. It consisted of a metal music stand tray connected to a sturdy tripod using a quarter-inch screw adapter. A high-quality conference speakerphone (Yamaha Cooperation of America, Buena Park, CA) and a cellular hot spot device were attached to the tray using Velcro (Velcro IP Holdings, LLC, Manchester, NH). The instructor's tablet computer was mounted facing outward on a tablet holder that was connected to the tray using an articulating arm. A Huddly Go (Huddly Inc. Oslo, Norway) wide-angle conference camera was attached to the top of the tablet holder. This arrangement allowed the instructor to monitor the live video feed as well as monitor the Zoom chat. A separate power pack for livestreaming longer field trips and a small umbrella for rainy conditions was also added to the tray (Figure 2). The total cost of the system in February 2021 was approximately $450, excluding the tablet computer.

There were numerous advantages of the 2021 system over the initial system. The new system can be assembled off-site and transported fully assembled to the field. It also can be left fully assembled throughout the entire teaching term. The tablet computer and the cellular hotspot were charged between field trips, and the camera and speakerphone were charged from the tablet during use. The high-quality speakerphone was key to the success of the system. The far-field noise reduction system eliminated background noises that occurred frequently on farms and field sites. The built-in microphone auto-adjusted its volume to presenters speaking at various distances.

One instructor was able to use this system without any additional staff in the field. However, it was helpful to involve a remote technology assistant to assist with a system check at the beginning of class, admit students into the Zoom room, and monitor the Zoom chat. The Zoom field trips were recorded, and recordings were posted on the LMS pages. A backup video using another camera was not necessary because of the high-quality video and audio output of the redesigned system. In the case study course, close-up photos of the affected crops and pests (if present) were captured before or after the contact time with the students and were then posted on the LMS.

Toward the end of the courses, students completed surveys to assess the effectiveness of this system. They responded favorably and appreciated the ease of interactions with the growers and the high quality of the audio and video transmission. "I would keep almost everything the same. The sound and picture quality was almost always great, and the interactions between the presenter and students were super easy and helpful" was a typical response to a survey question about further improvements. Strong wind during two of the field trips, however, negatively affected sound quality despite the integrated noise-canceling technology. To address this issue, we wrapped the sides of the speakerphone with one-inch-thick foam, which greatly reduced the wind-generated noise.

In conclusion, this custom-built transmission and recording tool proved to be effective to teach live from the field to remote-learning students. It required a moderate amount of investment

and some customization but was easy to use and an adequate substitute for in-person field trips.

Figure 1

Components of the custom-built transmission and recording tool

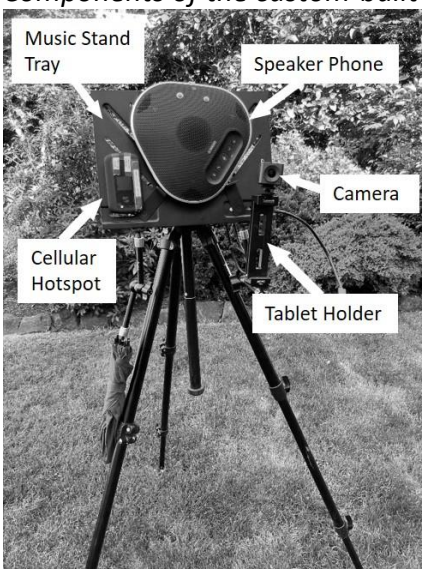

Figure 2

Field set-up of the custom-built transmission and recording tool

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