Workshop Proceedings: Going Beyond Zoom — Tips and Tricks for Teaching Horticulture Online

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Summary. **During the 2021 American Society for Horticultural Science annual conference, the Teaching Methods Professional Interest Group hosted the workshop "Going beyond Zoom: Tips and tricks for teaching horticulture online." This workshop provided a forum for the dissemination of tools, materials, and approaches used to facilitate active learning in horticulture courses. Here we summarize the topics presented in the workshop as a resource for current and future horticulture instructors.**

In Mar. 2020, the COVID-19 pandemic forced educators to transition their courses to online delivery. In a matter of weeks, many horticulture courses became reliant on video conferencing software, such as Zoom (Zoom Video Communications, San Jose, CA, USA) and Microsoft Teams (Microsoft Corp., Redmond, WA, USA). Although these products are effective in supporting lecture-based courses, they are not ideal tools to facilitate active learning, especially the hands-on activities, laboratories, and field trips that strengthen horticulture education (Bauerle and Park, 2012; Craver and Williams, 2014; Nunez, 2020; Pritts, 2017). Fortunately, active learning in online courses was not new to many horticulture instructors. The Teaching Methods Professional Interest Group organized a workshop during the 2021 American Society for Horticultural Science annual conference where instructors shared anecdotal and technical information about their strategies for teaching engaging online horticulture courses. The following is a summary of their presentations during the workshop, including recommendations for online software, course organization, and digital content creation.

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This workshop was presented during the American Society for Horticultural Science Annual Conference, held 5–9 Aug. 2021, Denver, CO., and hosted by the Teaching Methods Professional Interest Group.

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Genially: An online integrative software program

Genially (Genially Web S.L., Córdoba, Spain) is a teaching tool that provides users the ability to create dynamic, interactive learning materials that are especially conducive to online learning. The platform offers a free version, and subscription plans provide greater access and program utilization. Educators can create presentations, infographics, interactive images, and games to engage students. Chad Miller, from Kansas State University (Manhattan, KS, USA), has used this software in a plant propagation course (Miller, 2021). The activity was offered as an extra credit opportunity, where 16 out of 29 students in class participated. Students were given written directions, a video tutorial on how to access Genially, and an outline of the assignment expectations, along with tips and techniques to use the program to create an interactive study aid. Students were provided with a common photo set of geophyte structures taken by the instructor. Students were asked to create interactive images, with the goal of identifying different morphological features of the geophyte structures covered in the class and in the laboratory. Students accomplished this by pinning or tagging additional content in the provided photos. Students could add as much (e.g., videos, extra links, photos, text, shapes, designs, etc.) or as little (based on the minimum assignment expectations) as they wanted in doing the activity. Thus, this serves as a student study aid and can be highly personalized (Fig. 1). These tools can assist students in learning course content through an interactive method, as opposed to memorizing content based on photos and lecture materials. One potential challenge is that technological skills vary among students. Thus, having clear directions and easy access is important. Integrating Genially images into presentation software (PowerPoint, Microsoft Corp.) presentations could enhance the classroom experience, encouraging student creativity and learning and providing opportunities for technology skill development. Student feedback showed that 44% of them "definitely think" the activity helped them with further learning the geophyte structures, and 56% indicated they "probably think" the activity assisted them in their geophyte structure learning. Fourteen out of the 16 believed the activity should be done in the future.

Laboratory Collabs: Learning from peers in online courses

Many learning management systems have a discussion forum tool that allows for direct student-to-student interactions. Laura Irish, from the University of Minnesota (Saint Paul, MN, USA), uses an interactive discussion forum tool, which she calls "Laboratory Collabs," in the online offering of the introductory plant propagation laboratory course. In her course, students propagate plants at home following a propagation experiment plan designed by the instructor. Laboratory Collabs foster a welcoming environment for students to share their experiences, resources, and

Fig. 1. Two different student submissions of interactive tools (A and B) created with Genially (Genially Web S.L., Córdoba, Spain). The red circles are examples of interactive elements that appear when the computer cursor hovers over the text or the arrow pin is clicked. Interactive tools were used as study aids in an online plant propagation course.

insight with their peers using either video or written posts. In addition to replacing some of the otherwise missing collaborative aspects of in-person laboratories (Covelli, 2017), Laboratory Collabs empower students to reflect on their hands-on experiments. Every Laboratory Collabs forum is available for students to reference at any time, creating opportunities for students to learn from peers who have encountered similar issues. During the workshop, Laura guided participants through the process of creating Laboratory Collabs. The first step in writing effective Laboratory Collabs is to create a plant propagation experiment timeline for the semester. Once the timeline has been established, three to five questions are written for each week; these questions focus on helping students reflect on what may be happening with their experiments. Typical questions focus on the environment around the plants, such as temperature of the growing area and growing light placement/duration, as well as challenges the students have been facing while growing their plants and remedies they have used or resources they have found helpful (Fig. 2). The assessment of the Laboratory Collabs is comprised of two halves: the initial discussion post and the two responses posts. At the end of the semester, students have reported that the Laboratory Collabs are one of the most useful assignments for learning about plant propagation in this online course.

Sticky syllabus and supply box: Making ideas stick

A completely online floral design course was launched in the pre-Zoom era (Anderson et al., 2017) and continues to be delivered through a Web-based learning management system (Canvas; Instructure, Inc., Salt Lake City, UT, USA) via lecture/laboratory demonstration videos that sequentially open as students complete each assignment. Neil Anderson, from the University of Minnesota (Saint Paul, MN, USA), shared his experience using a "sticky syllabus" and a supply box for hands-on activities in his online course. To help ideas "stick" in students' minds, instructors can use any combination of these components: simple, unexpected, concrete, credible, emotional, and story (Heath and Heath, 2007). In the floral design sticky syllabus, simple and credible learner objectives were used in combination with colors to connect learner outcomes. Because color is a visual element of design that evokes emotions and responses in students, advancing colors (red, orange, yellow) were used for the most important, foundational learner outcomes, and receding colors (blue, indigo, violet) were used for supplemental and supportive learner outcomes. Color-coding each learner outcome with lecture/laboratory topics and individual assignments helps students connect learner outcomes with each week's lectures and laboratory activities.

A supply box, containing all hardgoods required to make the assigned floral designs throughout the semester, is sold by the university bookstore. It is sourced from a local wholesale florist vendor that assembles each supply box

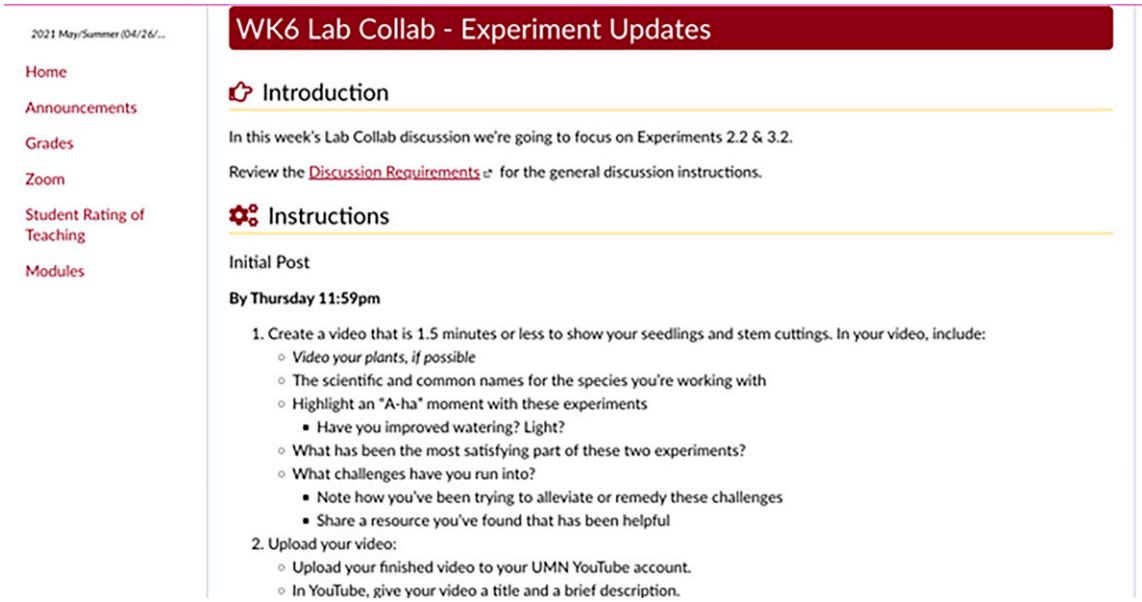

Fig. 2. Screen capture of a Laboratory Collabs discussion prompt on the learning management system. Laboratory Collabs were used to promote student reflection and interaction in the discussion forum of an online course.

with all required hardgoods for one student. The contents of the supply box are selected by the instructor and vary depending on holiday design requirements (e.g., Thanksgiving and Christmas holiday designs for fall semester vs. Valentine's Day, St. Patrick's Day, and Easter for spring semester). Each semester the instructor coordinates with the vendor and bookstore to ensure that the number of supply boxes meets the student enrollment. Students then purchase their supply boxes at the beginning of the semester to enable successful completion of floral design assignments using the correct hardgoods. A list of supplies

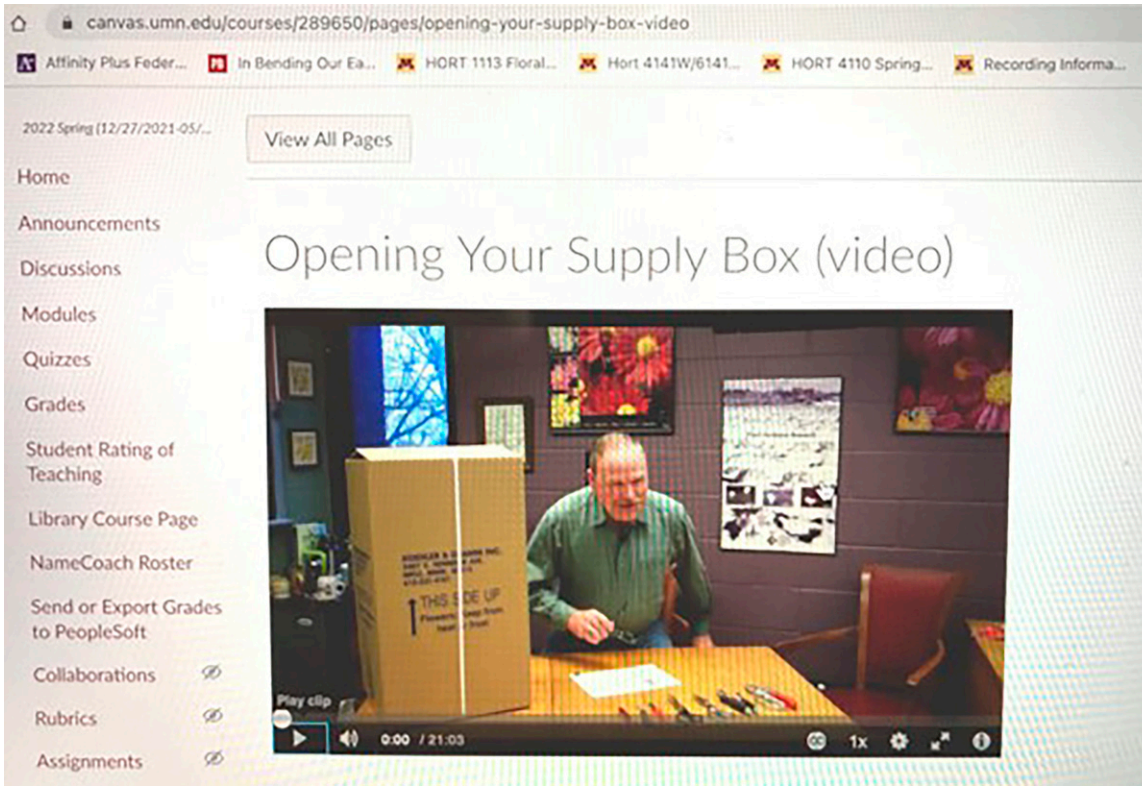

Fig. 3. Screen capture of the learning management system during a lecture video where the instructor is opening the supply box students purchase for the hands-on activities. Supply boxes were used to engage students in hands-on activities in an online floral design course.

Fig. 4. Plant growing kit containing a strawberry (*Fragaria* × *ananassa*) plant, plastic pot, soilless substrate, and controlled-released fertilizer mailed to students. Plant growing kits were used to engage students in hands-on activities in fully online courses.

is provided to all students, with wholesale prices, pictures, descriptions of each product, and the weeks/assignments where it will be used. A video is posted that shows the opening of the supply box (Fig. 3), identifying each item and how it will be used. Although supply chain issues were encountered during the pandemic, with many standard hardgoods becoming unavailable (e.g., annealed florist wire of various gauges, pinpoint holders, easels, florist spray paints), grading and personalized attention in the online course provided increased individualized learning (e.g., higher grades) over typical live lecture/laboratory delivery (Anderson et al., 2017).

Plant growing kits: Bringing horticulture home

Hands-on activities help engage students even when courses are taught fully online (Nunez and Silva, 2021). Mariana Neves da Silva, from the University of Florida (Gainesville, FL, USA), demonstrated a hands-on activity implemented in an undergraduate online horticulture course. She assembled and shipped growing kits

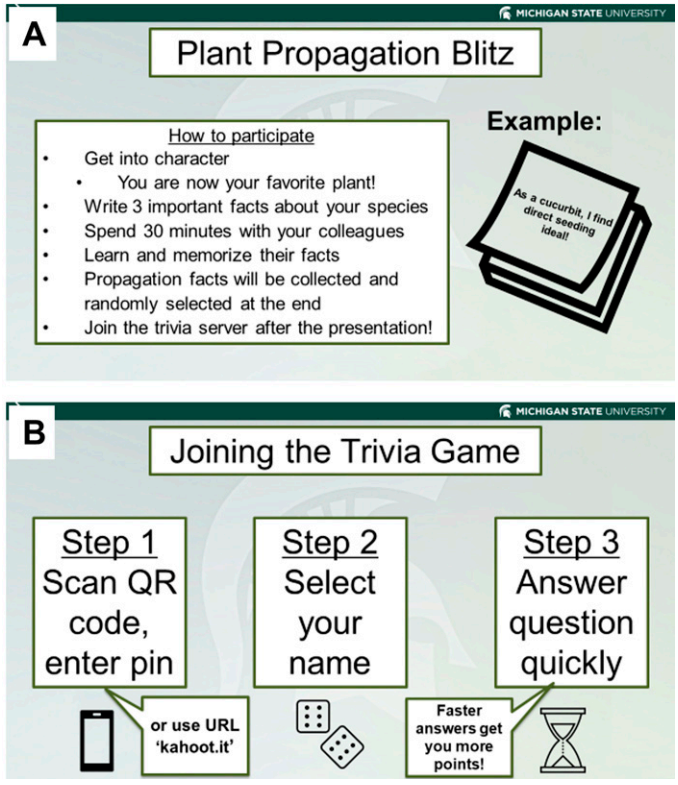

Fig. 5. Screen captures (A and B) of the instruction screens used to connect the audience with a game-based exercise using Kahoot! (Kahoot!, Oslo, Norway). Game-based exercises were used to encourage and facilitate memorization.

Fig. 6. Screen capture of a virtual reality tour of a southern highbush blueberry (*Vaccinium corymbosum* interspecific hybrids) farm. Virtual reality tours were used to teach students about irrigation practices, canopy training methods, and disease symptoms.

to students in her course. Each kit contained a small strawberry (*Fragaria* × *ananassa*) plant, a plastic pot, soilless substrate (coco coir and perlite), and controlled-released fertilizer (18N–2.62P–5.81K; Florikan, Sarasota, FL, USA) (Fig. 4). Plants were trimmed down to two leaves to facilitate shipping. Root balls were taped to the inside of the empty pot to prevent plant damage during transport. The amount of fertilizer provided was calculated to prevent overfertilization issues. All supplies were individually labeled. Students received instructions outlining how to grow their plants through online lectures and infographics. In turn, they provided weekly updates via a social networking service (Twitter; Twitter, Inc., San Francisco, CA, USA) or the course learning management system. This activity was successfully carried out for two semesters, and student responses were very positive. Student updates evidenced excitement, problem solving, and knowledge gain (Nunez and Silva, 2021).

Kahoot!: Using games to help with memorization

Game-based learning is a technique by which an instructor uses elements of reward, competition, and speed of recall to incentivize rote memorization (Subhash and Cudney, 2018). In online course settings, such as the ones used by educators during the COVID-19 pandemic, game-based learning can be an effective method to increase engagement. Christopher Imler, from Michigan State University Extension (East Lansing, MI, USA), shared his experiences using the Kahoot! learning platform (Kahoot!, Oslo, Norway) to design, deliver, and evaluate game-based learning activities in consumer horticulture courses. Kahoot! allows users to compete with their peers in a series of multiple-choice questions; the correct answer and speed of recall are tallied to rank participants. Christopher has used Kahoot! to incorporate course objective checkpoints in soil science lectures. For example, students answered timed questions regarding soil physical properties or plant propagation (Fig. 5). The activity served as an opportunity to engage the audience and provided real-time feedback for the instructor. Participants in the 2021 ASHS workshop experienced Kahoot! from the perspective of students and practiced creating content while becoming familiar with the software interface.

Virtual reality: Bringing students on digital field trips

Hardware and software developments have broadened access to virtual reality (VR) use in education (Elmqaddem, 2019). Nowadays, students can use their cellular phones, computer Web browsers, and videogame headsets to virtually explore several locations around the world. Gerardo Nunez, from the University of Florida (Gainesville, FL, USA), shared his experience creating and using VR field trips for his horticulture courses. Gerardo used a 15-megapixel fisheye camera (Gear 360; Samsung, Seoul, South Korea) to capture images of horticulture production facilities such as greenhouses, vineyards, and high tunnels (Fig. 6). Other cameras and even mobile applications can also be used. Although most facilities were welcoming of the VR content creation, it is advisable to discuss and agree on publication plans for VR images with facility owners or managers ahead of collection. Next, VR images were uploaded to a specialized image hosting service. Gerardo uses 360 Cities (360cities.net, Zeewolde, The Netherlands) in a paid subscription tier because this server allows him to password-protect, share, and embed VR content in learning management systems. Other websites, such as Google Earth (Alphabet Inc., Mountainview, CA, USA), offer similar hosting services but not password protection. To date, Gerardo has used VR field trips to introduce students to irrigation practices (drip vs. sprinkler), canopy training methods (open steep leader vs. V-shaped), and disease symptoms [citrus greening (caused by Candidatus Liberibacter asiaticus)]. He uses multiple-choice or open-

ended quizzes to assess learning about these topics. Usage metrics indicate VR videos are typically watched more times than lecture-capture videos, suggesting that VR media is compelling content for students. Students also regularly mention VR content in the student evaluation forms at the end of the semester.

The tools and approaches outlined above constitute a valuable repository for new and established educators seeking to enrich their online courses. Regardless of an eventual end to the pandemic, online horticulture education is here to stay. Therefore, these contributions have enduring value to the community of educators at ASHS.

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