Innovative

Incorporating Drone Technology into an Undergraduate Agriculture Technology Course

Dr. Edward Franklin
University of Arizona
1110 E. South Campus Dr. #2015 Saguaro Hall
Tucson, AZ 85721
(520)621-1523
eafrank@ag.arizona.edu

Mr. Richard McPherson
Rio Rico High School Agriculture Department
rmcpherson@scv35.org

Ms. Michelle Truman
The WakWay Foundation
michelle@wakway.org

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Introduction/need for innovation or idea

Production agriculture faces the challenge of producing more food and fiber from less available acreage. Increasing costs of inputs (seed, fertilizer, chemicals), and decreasing availability of water require producers to adopt site-specific management practices, also known as precision agriculture (Davis, Casady, & Massey, 1998). A prevalent area of drone use is within the agriculture industry (Rattigan, 2021). Global Market Insights (Global Market Insights, 2021) predicts the agricultural drone market will surpass $1 billion by 2024. The American Association for Agricultural Education (AAAE) National Research Agenda identifies seven research priority areas (Roberts,Harder, & Brashears, 2016). The AAAE Research Agenda Priority #2 addresses New Technologies, Practice and Product Adoption Decisions. Innovation and the adoption of new technologies will be required to feed an expanding world population (Conway, 2012). Can the adoption of drone technology for agricultural education pre-service students and students majoring in non-teaching agriculture benefit from this curriculum infusion? This presentation describes the content and activities of a five-week instructional unit into the *AGTM 351 Operations in Agriculture* course at The University of Arizona in spring 2022.

How it works/methodology/program phases/steps

We purchased a Phantom 4 Pro V.2 drone (DJI.com), capable of recording pictures, video,and ability to map farmland with a commercial mapping application. This system provided initialtraining. The course instructor completed the FAA Part 107 Certification for commercial operation of drones. To provide hands-on opportunities for students to fly drones, three Syma X5C model drones (suitable for indoor flying) were purchased. An obstacle course of PVC pipe and fittings was created and assembled in the laboratory. The five-week curriculum content included small unmanned aerial systems (sUAS), safety & flight regulations (FAA DroneZone.gov), recreation and commercial operations, using a commercial mapping application(DroneDeploy.com), airspace, weather, remote pilot responsibilities, and application of waivers. Laboratory activities included flying demonstrations of three GPS-guided drones, programming and flying a mapping mission.

Results to date/implications

All 22 students enrolled in the course completed the online “The Recreation Unmanned Safety Test (TRUST)” exam and submitted a copy of their certificate. This is a (FAA) newly required document for recreation drone pilots, as of June 2021. All students engaged in practice flying our indoor drones (non-GPS) to develop and hone their skills in launching, maneuvering through a PVC pipe obstacle course, and safely land. Three courses were set up with three individual drone systems operating simultaneously. These economical drones are resilient and take the impact of crashing into the laboratory ceiling, into stools, and into PVC pipe with no damage. However, the short battery charging limited flight time to a range of 10-15 minutes. Students demonstrated ability to successfully launch the Phantom model drone and fly manual mission on two separate occasions. We focused on manual operation practicing launch, pitch, roll, yaw, and landing. The second mission included taking and

recording a “drone selfie”. Students worked in small groups researching the various Classes of Airspace and presenting theirwork to the class during a lecture. Another group assignment was to student’s research drone topics for a power point presentation to be made to local high school agriculture students. Topics presented were flight safety and registration with FAA; drone use in agriculture; drones & livestock; drones and military use.

Future plans/advice to others

Developing a semester-length drone technology course. Topics include use of thermal sensors to inspect solar PV arrays, drone use to monitor grazing livestock in rural areas, tracking wildlife, regulations and use of larger spray-equipped drone systems in production agriculture. Laboratory activities will include multiple field trips to our university research farm to engage in mapping field exercises to collect data and later analyze. Inviting a local agriculture instructor who currently uses drone technology in secondary agriculture classrooms (R. McPherson, personal communication, February 2022) to speak to pre-service teacher education students of benefits of instruction, career preparation for students, and development of a 2+2 drone technology program We invited personnel from the WakWay Foundation (WakWay, 2022) to bring their drone inventory and demonstrate multiple flying systems during a laboratory session. Students were invited to operate remote controllers to fly larger drone systems. Seek funding to expand our program to increase our drone system inventory so multiple students can fly drones at the same time, to acquire specialized sensors, enterprise-level field mapping applications, personal safety devices for drone pilots and observers, and reference materials to assist students preparing for commercial drone (FAA) Part 107 Certification exam.

Costs/resources needed

The cost of drones will vary depending on their intended use. Popular makes and models like the DJI family of drones including Mavic Air, Phantom, and Inspire are designed for recording photographs, videos, and are used with mapping applications. Agriculture drones used for spray applications (such as the DJI Agras T10) are larger in size, include multiple rotors to support the added payload of a larger battery, spray nozzles, distribution lines, and a holding tank. These drones require additional operator permits for field applications. We recommend purchasing a minimum of five re-chargeable batteries if mapping large fields will be a goal of your instruction.

Associated expenses related to operating drones include the following items. Note: these are approximating and vary by type and model.

• Drone system: $1,200.00 • Rechargeable batteries: $189.00 • Storage cases: $200.00 • FAA Registration: $5.00/drone • Indoor Drones: $55.00	• Replacement propellors: $15.00 • Micro SD Cards: $26.00 • Mapping Application Subscription: $1,200/yr • FAA Part 107 Certification: $100.00 • RealFlight 9.5 Simulator: $175.00

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