Introducing Drones Into an Agricultural Science Classroom

Master of Arts Project Defense
Michigan State University
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Tuesday, July 15, 2025
9:00 AM
Zoom Meeting: https://msu.zoom.us/j/91340944624

Abstract

As we see advancements throughout agriculture, one continual theme is technology. Though there are various types and uses for technology within agriculture, one that is continuously growing is Unmanned Aircraft Systems, more commonly known as "drones." With a vast amount of information available, the use of drones can seem daunting to anyone unfamiliar. The purpose of "Introducing Drones into an Agricultural Science Classroom" is to inform teachers how drones may be an enhancement to their program and offer new opportunities to their students. This guide will discuss how drones can be valuable in an agricultural education setting while examining legal requirements teachers may need to effectively use a drone. It will also consider types of drones and their uses to offer a guide and starting point for any instructor that would like to start implementing drones into their program.

Committee Members

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Chapter 1

In 2020, the Clare-Gladwin FFA chapter received a grant to purchase four drones for agricultural and educational purposes. As we all remember, 2020 was not an ideal year to implement a new curriculum into any program and the drones have never been effectively used in the program. I've worked within the program since 2019, but I was hired as the new instructor

in June 2025. A huge goal for me was to effectively use the drones, but I didn't know anything about them. I have used my Masters as an opportunity to learn as much as I can about drones while being mindful of the applications of drones within agriculture. Making drones useful for the program was important to me, but as I continued to dive deeper into the world of drones, I found myself interested for another reason.

I grew up on a dairy farm and had a deep passion for 4H and agriculture growing up, so there was never really a question if I would find myself in some field of agriculture. My favorite part of agriculture, specifically teaching it, is that there is a place for everyone even if they didn't grow up on a farm. This is the biggest reason I have found such an interest in drones because they can be a gateway to introduce students to agriculture, especially when they don't think they belong in the field. Drones are also an excellent example of experiential learning. The basis for experiential learning is that knowledge and understanding is built by learning opportunities that allow for experience and opportunities to build on that experience. This is why I decided to make my Masters project a reference guide for agricultural science teachers to help them understand how drones are becoming an integral part of agriculture, how they can be implemented into their own programs, and a basic understanding of drones.

Chapter 2

At its core, the process of experiential learning relies on a cycle that is made up of four components; experiencing, reflecting, thinking, and acting. It is suggested that this cycle is how learning happens naturally, but for deep learning to occur, all of the parts of the cycle must be deliberately engaged in (Kolb & Kolb, 2017). Drones offer a wonderful opportunity to use all of the parts of the experiential learning cycle. Students are often highly engaged in drone opportunities, especially when they are allowed to experience piloting. When controlling a

drone, there are continuous cycles of experiential learning. At a basic level, simply controlling and moving the drone can require an action and reflection of what that action has accomplished, thinking about how to correct or continue that reaction, and following through with a correction or continuation of an action. If students are allowed to dive deeper into drone usage, experiential learning can continue through film or technical use of the drone. If a student was required to fly and video record a course, they must first experience the initial recording, then reflect on the footage, decide if the product is what they thought it was during their flight, and then either act on a re-fly or keep the footage they have. By encouraging students to use these methods to obtain deep learning, they will learn skills that can be transferred to other aspects of their learning as well.

Based on SAT and other mandated testing scores, 74.9% of Michigan graduates are not college ready (MI School Data, 2025). These data are made up of test scores for mathematics and a reading and writing score, but clearly show how important increased student understanding and comprehension is. *The Effect of Drones in the Educational Process: A Systematic Review* states "Drones are suitable and can benefit learning activities that include logic and deductive reasoning, debate, geography, advanced math, electronics, and eye-hand coordination. Students can also benefit from drone capture-imaging in both speaking and writing classes." (Pergantis & Drigas, 2024, p. 2). Pergantis and Drigas go on to discuss how the use of drones in a high school classroom increased student involvement and understanding;

> The results found that workshops with drone-based platforms helped in understanding, elaborating, and explaining the content covered, and it can be concluded that there was a significant relationship between the use of technology packages provided in the

educational process and the students' ability to learn meaningfully in STEM fields. (Pergantis & Drigas, 2024, p. 6)

Drones offer students real world opportunities to apply learned content that deepens their understanding, especially when it comes to math and science.

Education is about so much more than preparing students for college, it is also about creating productive citizens and part of that is building soft and social skills. In *Learning Beyond the Classroom: Drones in STEM Education for the Next Generation,* Kimeria stated, "They [students] need to learn about *how* to think rather than the rigid paradigm of *what* to know." (Kimeria, 2023, para 2). Drones offer students opportunities to work together to solve problems and create new ideas and solutions. Creativity, adaption, and problem solving are some of the most important skills to many employers. In using drones, students are allowed to explore educational opportunities that don't feel like a traditional learning environment.

Chapter 3

Although drones seem like a common term within technology, I found that general knowledge and understanding of drones and their uses was extremely limited. I can even admit that when I started the Masters program at Michigan State University, I had very little knowledge or real understanding of drones. As I learned and researched more about drones, the opportunities that became clear continued to surprise me. My understanding and knowledge about drones comes from taking Michigan State University's *FAA Part 107 Drone Test Prep and Beyon*d class and Mid Michigan College's *Drone Piloting* class. These led me to obtaining my FAA (Federal Aviation Administration) Remote Pilot Certificate. All of this helped me to realize how useful and important drones are and how many opportunities they offer students.

Chapter 4

The goal of this project is to offer instructors guidance on the legal requirements to teach drone activities, types and purposes of drones, and the value of drones within an agricultural education setting. There has been some jargon used throughout this report, but the following terms will be seen repeatedly throughout chapter four.

FAA - Federal Aviation Administration

UAS - Unmanned Aircraft System

sUAS - Small Unmanned Aircraft System

14 CFR - Title 14 of the Code of Federal Regulations set forth by the FAA

LIDAR - Light Detection and Ranging

All laws and regulations related to all types of UAS are regulated by the FAA. Rules that govern sUAS fall under 14 CFR Part 107. Part 107 regulates commercial sUAS operations and to fall under Part 107 a sUAS must "Weigh less than 55 pounds (25 kg), including everything that is onboard or otherwise attached to the aircraft." and "Are operated without the possibility of direct human intervention from within or on the aircraft." (ASA Test Prep Board, 2023). However, there are some small aircrafts that do not fall under Part 107, but those are often not considered drones (i.e. kites, moored balloons, amateur rockets). All sUAS that weigh more than 0.55 pounds and less than 55 pounds must be registered with the FAA. If a sUAS is required to be registered, it can be done online. A Remote Pilot Certification is only required if the drone will be used for commercial purposes. If the drone is only going to be used for recreational purposes, a certification is not required.

Using a drone for teaching purposes is currently a gray area because it is not considered commercial use, but as instructors are normally paid for their time flying the UAS, they could

fall under commercial use. Obtaining a Remote Pilot Certification requires taking a timed and proctored FAA Knowledge Exam. The exam is made up of 60 multiple choice questions, with an allotted time of two hours. To pass the exam, a minimum score of 70% is required. There are five topics spread throughout the exam, each making up different percentages of the total of the exam. The topics are as follows, regulations, airspace and requirements, weather, loading and performance, and operations. There are specific institutions that will proctor the FAA knowledge exam and they can be found online. After finding a location to take the knowledge exam, the individual must register for the exam and pay for it. In March of 2025, the exam cost $175.00. Upon completion of the exam with a score of at least 70%, the individual can then register for a certification through the FAA. Certification must be renewed via an online course every 24 months.

Some individuals may find that taking classes that are specifically meant to help in preparation for taking the FAA knowledge exam, such as Michigan State University's *FAA Part 107 Drone Test Prep and Beyon*d, are helpful, but not required. Study guides can be purchased online, such as Amazon. This method is not for everyone because it requires dedication and methodical interpretation of laws. There are no regulations on how individuals prepare for the FAA knowledge exam, but from experience, I can say that I would have struggled had I not taken the class at Michigan State University. Even if a class is taken, I would suggest purchasing the *FAA Knowledge Exam Test Prep* booklet (purchased through Amazon) and using it to take some practice exams. There are free online exams that come with the practice booklet and this may help to get a feel for what the exam will look like. The practice booklet will also walk through the test preparation, finding a proctored place to take the exam, and applying for the certification.

There are four main categories of UAS, multi-rotor, fixed-wing, single-rotor, and fixed-wing hybrid. A physical description, pros, cons, and common uses can be found in *Chart A*.

Type	Description	Pros	Cons	Common Uses
Multi-rotor	More than one rotor, most commonly 4 (quadcopter)	Good flight control, a lot of movement in its own axis, can fly close to structures, easy to learn	Limited speed and endurance, limited fly time due to current battery technology	3D scans, photography, thermal reports, videography, visual inspections
Fixed-wing	One rigid wing (looks like a traditional airplane)	Cover long distances with long flight times, can fly at high altitudes and carry more weight than other drones	Expensive, require a lot more training to use	Drone surveying, aerial mapping, security
Single-rotor	Has only one rotor (looks like a traditional helicopter)	More efficient than multi-rotor units, offers better hovering, built to be strong	Expensive, harder to control, can be more dangerous, require more maintenance	Carrying heavy loads, Aerial LIDAR scan, drone surveying
Fixed-wing hybrid	Merging of fixed-wing and rotor-based	Great for hovering or forward flight, offers benefits from both fixed-wing and rotor-based	Very few available, very little technology for them currently	Delivery

Chart A (Rennie, 2016)

Multi-rotor UAS are often very popular in agriculture because they are easy to use, can be used for a variety of different activities, and can vary greatly in cost. Specifically in agriculture, UAS can be used for performance, pest control, and monitoring. Plant performance can be monitored through infrared and multispectral cameras that can detect plant health, disease, or areas of soil issues. By finding areas that are of concern, pest control can be more specific and allow for potential decreased amounts of pesticides while fertilizer application can

be more specific and areas that are in greater need can be better identified. Even at a basic level, drones can be used simply to offer producers an “eye in the sky”. With a simple camera on a UAS, livestock herds can be found and monitored, fields can be viewed to look for crop damage, and fence lines can be viewed for potential issues (4 Ways Drones Are Used in Agriculture, 2025).

Chapter two highlighted how drones can be helpful in classrooms by increasing experiential learning opportunities, strengthening student learning across all disciplines, and building student soft and social skills, but drones may be most useful in an agricultural education program. Drones offer a way to get students interested in the topics that many instructors struggle to gain student engagement and understanding, such as crop and soil health. By looking at a crop through a drone, students are still looking into the individual issues within crop science, but it now feels more like playing rather than studying. It offers students opportunities to view agriculture in a way that they may not have considered before. They don’t have to be the one driving the tractor or even doing the spraying, but their input and knowledge is still invaluable to that producer.

Chapter 5

In conclusion, throughout my experience in the Master of Arts program at Michigan State University, I have learned about leadership, technology in education, and community sustainability. These opportunities have allowed me to learn more about myself and who I want to be as a teacher. My knowledge and understanding about drones has increased substantially throughout my time in this program and I have gained new skills that I will use both in the classroom and out. In 1988, Future Farmers of America changed to the FFA Organization (Crnkovic, 2025). This was in recognition that agriculture is so much more than growing crops

and livestock and it offers so many more opportunities. Drones may be non-traditional, but their value is continuing to increase and they offer students who don't see their future in agriculture a way in and a way to be part of an amazing community.

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Appendices

Appendix 1: Introducing Drones Into an Agricultural Science Classroom video

Appendix 2: Introducing Drones Into an Agricultural Science Classroom informational graphic