Drones - Session 1 Staff EXPO
20th July 2017 (9am – 10:30 am) Amy Aldous

Drones are the new in thing! Sales are booming in Australia but be need to be aware that these miniature aircrafts can only be used under strict conditions here in Australia.

In today’s session we will learn about:

➢ What Drones are
➢ Different types of Drones
➢ The benefits of using Drones and laws involved in using them, and;
➢ How we can use Drones in Education to engage our students and enhance our curriculum.

What are drones?

A drone, in a technological context, is an unmanned aircraft. Drones are more formally known as unmanned aerial vehicles (UAVs) or unmanned aircraft systems (UASes). Essentially, a drone is a flying robot. The aircrafts may be remotely controlled or can fly autonomously through software-controlled flight plans in their embedded systems working in conjunction with onboard sensors and GPS.

Over the last few years, educators have begun to harness the power of drones to engage students and to bring lessons to life in the modern classroom. There’s no doubt that we are at the very beginning of the drone era, and the potential to use these gadgets in education has not yet been fully realised.

When it comes to using drones, teachers are truly spoiled for choice. Not only can they have students build their own from scratch, but they can also encourage students to utilise skills in robotics, mathematics, electronics, chemistry, coding and programming when doing so.

As drones increasingly become cheaper and more accessible, schools are able to purchase them with ease. The Civil Aviation Safety Authority outlines several regulations that all individuals must adhere to when flying these aircrafts. Educators should visit casa.gov.au for more information.

Different types of Drones

Although multi-rotors get most of the attention in the drone world, they are not the only option. Fixed-wing aircraft are used for aerial mapping, single-rotor helicopters are also a great solution for some niche applications too. Here’s a run-down of the four main types of aerial drone platforms, and the strengths and weaknesses of each.
**UAS: The nuts and bolts**

### Types of UAS

- **Fixed-wing**: UAS with airplane-like wings
- **Multi-rotor**: UAS with more than two rotors
- **Quad-copters**: UAS with four rotors

### Featured technologies

- **Most UAS have:**
  - Auto take-off/landing
  - Digital flight recorder
  - GPS (Global Positioning System)
  - Timer
  - Map interface
  - Battery information

- **Some UAS have:**
  - Return to home
  - Automatic planning
  - Ground control software

### What makes them fly?

- **Terrain control (RC):** Must be used by operators to control the UAS
- **Digital control:** Used to control the UAS through a console

### Cameras/sensors:

- **Normal/High-end:** Used for photography and videography
- **Forward-looking/LIDAR:** Used for mapping and navigation

### Pros and Cons Table

<table>
<thead>
<tr>
<th></th>
<th>Pros</th>
<th>Cons</th>
<th>Typical Uses</th>
<th>Price (AU$)</th>
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<tbody>
<tr>
<td><strong>Multi-Rotor</strong></td>
<td>Accessibility, Ease of use, VTOL &amp; hover flight, Can operate in a confined area</td>
<td>Short flight times, Small payload capacity</td>
<td>Aerial Photography and Video Aerial inspection</td>
<td>$5k-$65k for pro drones</td>
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<tr>
<td><strong>Fixed-Wing</strong></td>
<td>Long endurance, Large area coverage, Fast flight speed</td>
<td>Launch and recovery needs a lot of space, no VTOL/hover, Harder to fly, more training needed, Expensive</td>
<td>Aerial Mapping, Pipeline and Power Line Inspection</td>
<td>$25k-$110k for pro drones</td>
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<tr>
<td><strong>Single-Rotor</strong></td>
<td>VTOL and hover flight, Long endurance (with gas power), Heavier payload capability</td>
<td>More dangerous, Harder to fly, more training needed, Expensive</td>
<td>Aerial Lidar laser scanning</td>
<td>$25k-$110k for pro drones</td>
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<tr>
<td><strong>Fixed-Wing Hybrid</strong></td>
<td>VTOL and long-endurance flight</td>
<td>Not perfect at either hovering or forward flight, Still in development</td>
<td>Drone Delivery</td>
<td>TBD, In development</td>
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The benefits of using Drones and laws involved

First and foremost, flying a drone at school is great fun! Students get an immediate sense of satisfaction flying the drone and then, when they see their footage they feel extremely proud too. Secondly, flying a drone is great for developing hand/eye coordination. You’re not just controlling a robot in 2 dimensions - you’re controlling it in three dimensions which is a lot more difficult.

Under 2kg drone rules for all users

- Don’t fly a drone within 30m of people, places or property
- Don’t fly above 400ft (120m) within city areas
- Don’t fly over crowds or near emergency situations
- Drones must remain in the clear sight of the operator
- Flights must be within daylight hours
  (more details in CASA AC101-10)

Drones must be flown within the visual line-of-sight (so not at night), students must be able to see the drone with the naked eye (this means without binoculars), drones must not fly closer than 30 metres to vehicles, boats, buildings or people, and they must not be flown over populous areas such as beaches, heavily populated parks or sports ovals. It also goes without saying that drones should fly away from other aircraft, so at least 5.5 km from airfields, aerodromes and helicopter landing sites. For more information, schools can have regard to Part 101 Civil Aviation Safety Regulations or the CASA rules. As soon as a drone leaves the eyesight of an operator, the flight is deemed unsafe.

With an average of 15 people per year being prosecuted by the Civil Aviation Safety Authority (CASA) for dangerous flying, so new flyers to learn the rules. CASA can issue fines ranging from $900 up to $9,000.

Privacy law and its regulation of drone flight with the use of video or photography devices is, however, unchartered terrain. While CASA can regulate the safety of our air spaces, it cannot regulate privacy concerns. Moreover, the Commonwealth Privacy Act currently does not extend to individuals flying drones such as recreational fliers. Schools should consider how the taking of photos or video via drones may impinge on another person’s privacy before allowing students to take images of people during drone flying activities.

Schools can technically allow students to fly drones over private land, but this is a dangerous path. Schools may be liable for the tort of nuisance as they are unreasonably interfering with a person’s use and enjoyment of their land by keeping them under surveillance or ‘snooping’ on their activities. The surveillance of a drone may also be a form of harassment, especially where the intent is to ‘peep or pry’ on the person.

There are no rules as to what height a drone needs to be flown at to avoid trespassing on private land, but it is a general rule that flight should not affect the owner’s use and enjoyment of their property. This means drones should not gate crash any family BBQs and respect the privacy of neighbours at all times. Drone fliers shalt love thy neighbour as thyself. Namely, avoid flying drones over private property.
Use of drones in General

When starting with Drones get a lot of experience using it yourself in all sorts of different conditions. Get experience using it in calm conditions, in windy conditions, so you are totally familiar with how it works so you are an expert on it. You really just need to understand how they work yourself in order to have an appreciation of the safety aspects and how it flies and what you can and should not allow the students to do with it.

It’s clear that drones certainly have a ‘wow factor’ but how do you actually use them in a school setting?

For general use students:

- Make movies and take pictures at school events, such as the athletics carnival or dancing concert.
- Set up an indoor obstacle course with the goal of having students complete drone races.

Uses by Subject Area:

Science:

- Biology: Look at the micro world and the macro world and the patterns repeated in each. Complete transects of areas etc.
- Marine: record ocean patterns and film snorkelers and divers.
- Chemistry: Students must learn about battery chemistry and capacity in order to truly understand drone design and function.
- Science experiments/investigations: Measuring tools could be attached to the drone to measure air pressure, wind speed, temperature, etc.

Maths:

- Estimating and measuring heights, speed, distance travelled, time taken to fly.
- A basic knowledge of trigonometry can be essential in learning how to design and operate drones.
• At an even higher level, drones can be used to teach concepts like Bernoulli’s principle as students learn how to predict things such as stall speed.

• Create a gigantic graph. Build a large four-quadrant graph with chalk, use the drone to practice landing on different ordered pairs.

**HASS:**

• Have students participate in kinesthetic cartography: Draw a map of the world in chalk and have the students “migrate” or conquer areas to show the spread of different empires. Photograph or record their movements to chronicle historical changes.

• Geography - local geography studies can be enhanced with drone footage (some drones now have GPS built in)

**Physical Education:**

• Send the drone up during PE class to record students demonstrating a particular sporting action. Have students watch the footage and discuss where they should have been and what they can do better.

• Team sports, do overhead video of students position of the filed during play/match

• Film sports days and sporting matches from different angles to analyse later to see if any improvements are needed.

**English:**

• Literacy - explanation texts can be written on how to control the drone

**Art:**

• Drones are versatile because you can attach so many different kinds of objects and tools to them. This includes paintbrushes and paint. Lay a sheet out on the grass, **attach** paintbrushes, have students lower their drones into paint buckets, and then hover, splash, and **air drop** paint
IT/Computing:

- Some drones can be programmed on the ipads too (ours cannot) thus creating a new and exciting way to deliver the computing curriculum.

Drama:

- Record drama rehearsals and see what staging may need improvement. The footage maybe really useful for the Students to see from many different angles.

Developing skills for the future

We don't know what jobs will be around when our students leave school. Many of the job titles in existence now did not exist when our parents were children. However, we do know that more and more jobs are being created every year for drone pilots, not just in the military but for companies such as Amazon for deliveries.

So instead of leaving that drone in the staffroom and wondering what you can do with it, why not get it out of its box and give it to a bunch of students and ask them how you can use it to enhance your curriculum? I'm sure that they will come up with some interesting ideas too!
How to Fly a Drone

It can be hard to master the flying skills required to fly a drone smoothly and without crashing it!

To get started it is best to practice with the smaller STUNT drone before moving up to the Walkera QR X350 Pro Quadcopter.

The 5 Skills to Master:

1. Take-off and landing
2. Hovering in one place
3. Forward, backward, right, left
   4. 360 Yaw
   5. Full Circle

Drone Flying Tips - 5 Skills Beginner Pilots Should Master
https://youtu.be/KRzKkJskhEw

Drone Flying Tips - 7 Tips for Beginner Pilots
https://youtu.be/3qd4bbssmKc

1. Take-off and landing

   It is important to take-off on a level surface and lift up with enough throttle (up relatively fast). This is so you don’t bounce up and down and experience ground effect.

2. Hovering in one place

   Hovering is one of the most important skills to master for smooth flight. Try to hover the Drone in one place for more than 15 seconds. It may be boring but an essential skill to help fly the drone well.

3. Forward, backward, right, left

   Master the art of using the controls by moving the drone forward and backwards, then left and right.

   It is important to make sure you have the drone facing away from you, the back of it facing you and the nose of the drone facing forward. This means that when you
move it left on the controls it will go left and if you move it right it will go right.

Sometimes when flying it for a while it can be easy to get confused as to which way it is facing. Try to keep the drone in your line of sight to avoid getting confused and change the direction of the drone to line up with your movements again.

To master this skill, try to make a cross shape while flying by moving the drone forward and back from a center point and then left to right also over the center point.

4. 360 Yaw

A 360 Yaw basically spins the drone around, so that you can learn how to control the Drone when you move the drone away and turn it around to come back. Therefore, potentially turning it around so it might be facing towards you not away from you. This inverts the directional movements e.g. Move left on the control and it goes right etc.

The STUNT Drone has a headless mode so it will not 360 yaw the same way the Walkera QR X350 Pro Quadcopter.

5. Full Circle

With the nose facing forward move the drone in a circle (hit a home run!). You will be using both the throttle and direction lever to make the full circle.

Drone Flying Tips - 7 Mistakes to Avoid
https://youtu.be/eEKJq9tU85A
Resources:

Ready Set Drone, How to Videos; http://www.readysetdrone.com/category/how-to/


