Aerial Ballet

Suzanne Banas, Ph.D.; NBCT

South Miami Middle Community School

sbanas@dadeschools.net

Table of Contents

Learning Goals:

Aerial Ballet: A Swarm of Dancing Drones is designed to provide an engaging way for students to demonstrate mastery of the various coding programs through creating “steps” motions of a “dance.

Everyone loves a show. Imagine a Swarm of drones. Coding drones (robots), together with real time movements as well as storytelling, and a music score, to create a dance of the drones -- an aerial ballet. It’s like a display in the sky where you have much finer control of the display. You can have anything from text messages to shapes and transformations. The drones weigh less than a softball and are made from flexible plastic to make them safer.

Using a collection of small drones called ‘SWARMS’ that can autonomously coordinate with each other, students can code the flight of the drone to move automatically instead of manually. Small drones can be flown very safely around the school or classroom, controlled by a number of apps or student programed code. The students can use coding blocks or Arduino code to program a drone to fly in a variety of directions, this creating a “dance” This takes into account outcomes from the curriculum such as position and direction, properties of 2D and 3D shapes, parallel and perpendicular lines and crucially, problem solving, logical thinking and computational thinking – key skills that our young people require as they move into the future workplace. Adding in light-emitting diodes (LEDs) for display purposes these dance Swarms of drones can now be ‘firelight” shows instead of fireworks.

Florida Standards:

SC.912.CS-CP.1.4: Collect real-time data from sources such as simulations, scientific and robotic sensors, and device emulators, using this data to formulate strategies or algorithms to solve advanced problems.

SC.912.CS-CS.6.7: Describe major applications of artificial intelligence and robotics, including, but not limited to, the medical, space, and automotive fields.

SC.912.CS-CS.4.1: Describe a software development process that is used to solve problems at different software development stages (e.g., design, coding, testing, and verification).

SC.35.CS-CS.6.3: Explain that computers model intelligent behavior (as found in robotics, speech and language recognition, and computer animation).

SC.912.CS-CS.6.4: Explain the notion of intelligent behavior through computer modeling and robotics.

SP.PK12.US.1.4a Develop mathematical skills and/or computational fluency for everyday living, such as money skills, estimation skills, time and measurement skills, and comprehension of graphs, tables, schedules, and charts.

SC.68.CS-CS.2.2 Solve real-life issues in science and engineering (i.e., generalize a solution to open-ended problems) using computational thinking skills.

CTE-GEN.68.GENRL.17.14 Apply math, reading, science, and critical thinking skills as they relate to industry.

VA.912.C.1.2 Use critical-thinking skills for various contexts to develop, refine, and reflect on an artistic theme.

VA.912.S.2.3 Demonstrate visual-thinking skills to process the challenges and execution of a creative endeavor.

VA.68.F.1.1 Use non-traditional thinking and various techniques to create two-, three-, and/or four-dimensional artworks

Course Outline/Overview

This project is done in many ways. Through the Physical Science course, I have Engineering Fridays (once a week) where the students learn to code. Their first project is to create a Robot Dance party. Second part is to create a drone flight dance, then to work as a Swarm. I also used this with an after-school class in aeronautics, which met twice a week. They began with the principles of flight and design working up to programming the flight of the drone incorporating the principles of flight. Working in pairs the students can pick and choose as they feel the need to complete their own Robot Dance. Since coding is new for many students and very few have coded, some have cognitive/ learning disabilities, Limited Language Proficiencies and anxiety/issues/fear of coding Using Scratch (block based coding) could be used to provide a differentiated way for them to comfortably be engaged in the learning and project. Scratch is a right brain – left brain integrating coding with robots/ drones that builds both creativity and coding skill. Once students feel comfortable with this intuitive programming they can advance from the basic color coding to intermediate block-based programming.

Overall Value: Looking at our basic outcomes from the curriculum such as position and direction, properties of 2D and 3D shapes, parallel and perpendicular lines and crucially, problem solving, logical thinking and computational thinking as well as providing the key skills that our young people require as they move into the future workplace.

Figure 1 CoDrone

Lesson Plans and step-by-step guide in implementing

Options:

Introduce the concepts of coding through Code.org or any other block based coding program. This can be done as an assignment or as home learning. This

Give an introduction to Arduino coding. Arduino.cc needs to be downloaded but has some tutorials

troduce the students to Scratch initially,

I used SparkFun's Redbot robot (terrestrial). Sparkfun has wonderful tutorials and investigations to learn basic coding and commands needed to move the robot.

Use the tutorials in the CoDrone (ariel) to have the students learn the basics of Arduino coding and the movements for programing a drone flight.

The Tello drone uses Scratch 2.0 which is block based coding. Introduce the students to Scratch initially, then with the drone. *Appendix has the instruction use with the drone

Suggestions:

- Since flying a drone has issues with understanding 3 Dimensions (up – down – sideways) PRACTICE
- Drones can be fragile.
- Even though drones can be flown manually, coding can assist in eliminating crashes.
- Students should learn to control a terrestrial robot first.
- Both these drones can be flown indoors

I use this project as part of my Engineering Frdays with my Honors Physical Science classes. Where they learn the basics of coding. Then they code in Arduino the Redbot robots to create a dance. Then they learn to code the drones.

As a teacher you need to decide the direction of the coding project. My students did a robot dance party with the assessment as a video. They coded the Redbot movements 'steps' into a dance with music. You could have the students code a 'run' through a course. They measure and time a programmed "route". They are graded on how well they program the route.

The drones can be flown manually, but if students do not have practice with remote control cars, flying drones is not easy and tends to lead to crashes. Crashes can result in damage to the propellers that will need to e replaced. The Tello drone uses an app on the phone to fly manually and wifi to be the coded program from Scratch 2.0. The CoDrone has an Arduino flight controller for manual or an app on the phone, as well as being programed. The Tello is easier to fly, has a camera but less functionality. The CoDrone can do all sorts of maneuvers, has IR sensors and swarms easily.

Figure 2 Tello Drone

Resource List:

https://scratch.mit.edu/ Scratch program

INFORMATION to use Scratch with the Tello Drone Tello Scratch README
1. Visit https://scratch.mit.edu/download and follow the instructions
to install the Scratch 2.0 Offline Editor.
2. Download and install node.js from https://nodejs.org/en/.
3. Download Tello.js and Tello.s2e from
https://dl-cdn.ryzerobotics.com/downloads/tello/20180222/Scratch.zip, open
the terminal, go to the file directory where you saved the previous files,
and type "node Tello.js"
4. Open Scratch 2.0, hold the “Shift” key, click the “File” menu, click
"Import Experimental HTTP Extension," and select "Tello.s2e" file in the file directory.
5. The Tello interface will be shown in Scratch under "More Blocks.”

https://www.robolink.com/learn-codrone-pro/ CoDrone learning tutorials

https://www.arduino.cc/ Arduino CC, website and tutorials, and support

https://learn.sparkfun.com/tutorials/experiment-guide-for-redbot-with-shadow-chassis?_ga=2.184376549.2116710050.1530629304-312683598.1527009286&_gac=1.237637300.1528297718.EAIaIQobChMIqsbn0Ki_2wIVxCWBCh2uDgZnEAAYASAAEgL3efD_BwE Redbot experiment guide/tutorials

Supplies and supplemental materials

Tello Drone can be bought almost anywhere.

https://store.dji.com/product/tello DJI has the best rating and gives teacher discounts

https://www.ryzerobotics.com/tello Ryze is the developer of the Tello drone

CoDrone

https://www.robolink.com/codrone/ Robolink, developer

Sparkfun Redbot Inventors Kit Robot

https://www.sparkfun.com/products/12649

TELLO drone

Whether you're at a park, in the office, or hanging out at home, you can always take off and experience the world from exciting new perspectives. Tello has two antennas that make video transmission extra stable and a high-capacity battery that offers impressively long flight times.

13Min	100M	720P	2Antennas
Flight Time	Flight Distance	HD Transmission	Smart Switching

Thanks to all the tech that Tello's packing, like a flight controller powered by DJI, you can perform awesome tricks and with just a tap on screen. Flying has never been so fun and easy!

Throw & Go

Start flying by simply tossing Tello into the air.

8D Flips

Slide on screen to perform cool aerial stunts

Bounce Mode

Tello flies up and down from your hand automatically

Equipped with a high-quality image processor, Tello shoots incredible photos and videos. Even if you don't know how to fly, you can record pro-level videos with EZ Shots and share them on social media from your smartphone.

EZ Shots

Record coordinated short videos with Circle, 360, and Up & Away.

Electronic Image Stabilization

Capture consistently clear images.

Intel Processor

Professional processing yields high-quality footage.

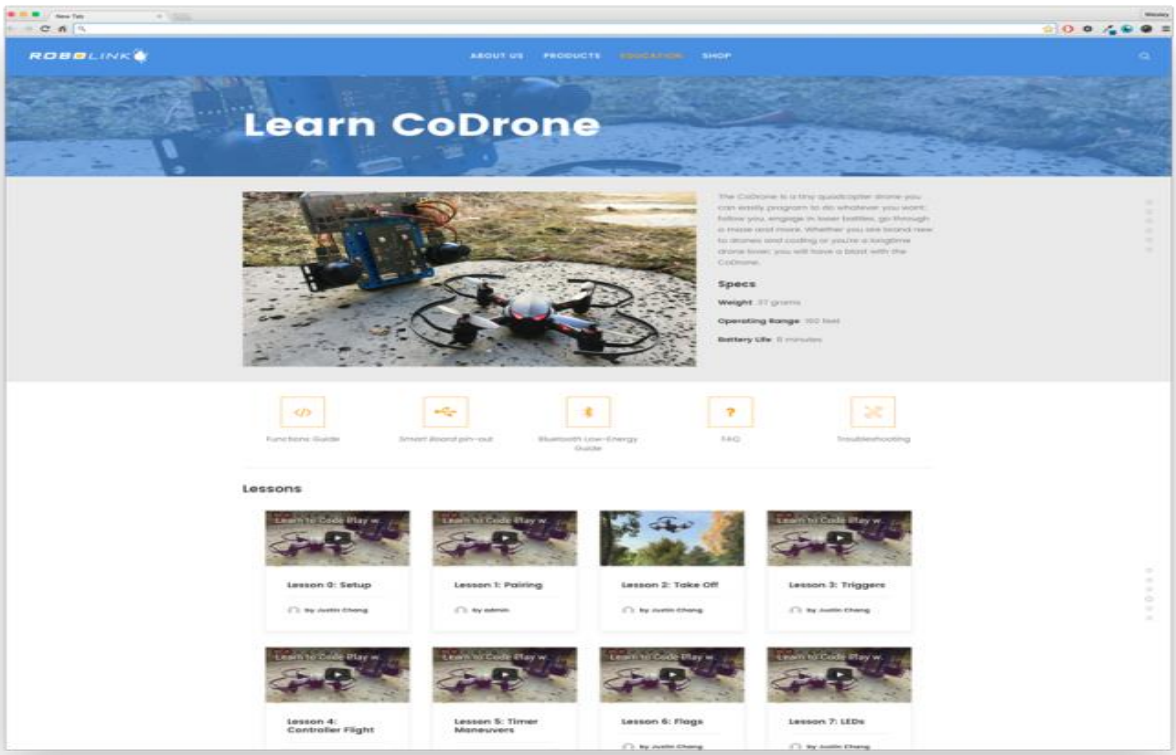
5 MP Photos

Preserve great memories with high-resolution pictures.

CoDrone

The drone that teaches you how to code
It is programmable

	Flight Time		**IR sensors**
	8 mins		**Bluetooth 4.0**
	Battery Charge time		**Weight**
	40 mins		Just 37 g
	Flight Range		**Barometer Sensor**
	160 ft		Assists with altitude control
	Hovering		**Dimensions**
	Optical flow sensor for hovering		133mm x 133mm
			Gyroscope
			3-axis gyroscope and 3-axis accelerometer for altitude control


ROBOLINK
ABOUT US
PRODUCTS
EDUCATION
SHOP
Learn CoDrone
Specs
Weight
Operating Range
Battery Life
Lessons
Lesson 0: Setup
Lesson 1: Pairing
Lesson 2: Take Off
Lesson 3: Triggers
Lesson 4: Controller Flight
Lesson 5: Timer Maneuvers
Lesson 6: Flags
Lesson 7: LEDs