

Premier’s Teachers Mutual Bank New and Emerging Technologies Scholarship

New Horizons for Unmanned Technology

Kerry Wallace-Massone

Heathcote High School

Sponsored by



# Introduction

Unmanned Aerial Vehicles (UAVs), commonly known as drones, are the fastest growing, in-demand industry and are already being implemented across a vast array of commercial areas globally. Australia has a current and projected shortfall of workers prepared in Science, Technology, Engineering, Arts and Mathematics (STEAM/STEM) fields with girls being even less represented. As educators we must prepare 21st century learners for jobs that don’t even exist yet. A curriculum rich in technology use is the best way to prepare them and we can use students’ fascination with UAV technology to implement it. UAVs represent an intersection of innovative technology with enormous career potential.

The underlying design, computing, mathematics, and physics necessary for UAVs provides the potential for a wide-reaching P-TECH-style of collaboration between educators and industry. This provides students with a better understanding of the relevance of their learning whilst aligning with Australian Digital Technologies Curriculum and the Australian Government’s National Innovation and Science Agenda.

Seventy-five percent of the fastest growing industries require STEM skills, however currently women make up less than twenty-five percent of the STEM workforce. The Turnbull government is investing over $30 million dollars in internships and post-school career advice to increase support for women and girls to choose to study STEM[[1]](#endnote-1).

# Focus of Study

The focus of my study was to examine and compare:

* best practice safely using UAV technologies integrated with STEM with girls to take them from secondary school to higher education
* collaborations between secondary education, higher education and UAV industries
* coding of UAV devices - Industry Innovation Competiveness Agenda[[2]](#endnote-2) and Coding across the Curriculum[[3]](#endnote-3)
* using 3D printing and UAV devices together
* best practice: emerging digital technologies implementation, independently/collaboratively - Australian Curriculum: Technologies
* using UAV technologies to bridge educational gap for girls
* future higher education/UAV technologies
* teacher professional development

# Significant Learning

### IEEE Aero Conference, Big Sky, Montana USA

The international IEEE Aerospace Conference[[4]](#endnote-4) is organised to promote interdisciplinary understanding of aerospace systems and their underlying science and technology and to provide networking opportunities between the attendees.

I was fortunate to meet the women who have reached the pinnacle of STEM careers in the USA. Many of these women work for NASA as scientists or contract to NASA. I discussed what led them to have these interesting and rewarding careers and discover their motivation and obstacles along the way.

NASA Manager, Dave Lavery, is very involved in future missions to Mars. He uses robotics competitions in primary, secondary and tertiary education to promote engagement in STEM subjects. He also aims to and find and foster future NASA scientists who most likely will be involved in future Mars missions that Dave has overseen, including the use of UAVs to complement the Rover. This concept of targeting winners of robotic competitions overseen by NASA allows them to pinpoint potential future scientists who are then mentored through their education. This program is very cost effective and time efficient. The first cohort, 23 years ago, are still enjoying very rewarding careers and are now mentors for those who follow.

### IEEE Aero Conference – Junior Conference

At the junior conference[[5]](#endnote-5) I was able to meet some of the future American scientists/engineers at the Junior Conference of the IEEE Conference. The junior conference forum is for students in kindergarten through high school to present technical papers on their ideas, reasoning, fieldwork, research, experiments, inventions, or topical surveys.

The presentations demonstrated the students’ originality and inquisitiveness. Topics were varied and included cyber security, dreaming, reality and Mars exploration to mention a few.

### St Catherine’s Island Georgia, USA

St. Catherine’s Island[[6]](#endnote-6) is one of eight large barrier islands on the coast of the American state of Georgia. It is owned by the Saint Catherine’s Island Foundation and is not open to the public. The research centre is set up to promote sea turtle conservation research and education.

I was visiting this island with undergraduate students from Smith College, Boston and Professor Jon Caris, Director of Spatial Analysis Lab. The girls were flying a variety of DJI Phantoms on missions to map the habitat of sea turtles and tortoise burrows on the island. They also mapped a 16th Century mission site that was used to convert the local Guale Indian tribe. This site was lost to the history books until its rediscovery through remote-sensing in 1981.

The girls were very confident and competent users of both the UAVs and the mapping software and very enthusiastic about using them for conservation purposes. Smith College has a video of the [trip to St Catherines Island](http://www.science.smith.edu/sal/2017/05/08/documentary-video-research-trip-to-st-catherines-island/).

It was a rewarding opportunity. I was able to see UAV technology being used with girls to promote their interest in STEM fields of work whilst following their love of conservation and marine wildlife.

### Drone Film Festival 2017 New York City USA

On the first day at the 2017 New York City Drone Film Festival[[7]](#endnote-7) a panel highlighted the latest legal information surrounding drones, with some excellent examples that were relevant to what was happening now in the US news. A panel with industry leaders discussed using drones to push creative boundaries. This included Ty Evans, a skateboard movie director and Phillip Bloom who has created a lot of the cutting-edge video. Lastly I met the people who put together “The Human Flying Drone”. This is an amazing feat of engineering and is the result of a collaboration with Samsung promoting 360-degree technology which is about to revolutionise drone cinematography.

Screenings and the announcement of the winners were on the following day. An Australian team won the Landscape category with stunning cinematography including beautiful wildlife and settings such as The Kimberly, Arnhem Land, Cairns and Cape York. There was also a young Sydney finalist who had the entertained the audience with her entry in the Featuring Drones category for her film “Dron’t You Love Me?” A very emotional win was in the News and Documentary category with Drone Operators of #NoDAPL. We were privileged with an Indigenous song of gratitude. This film was about the Indigenous Peoples protesting about the Dakota Access pipeline construction on traditional lands and Sacred Sites. The footage was confronting and certainly highlighted the ability of drones to help tell a story and record data that may be used to ascertain factual evidence.

### Foxcroft School, Middleburgh Virginia USA

I visited Foxcroft School, in Middleburg Virginia[[8]](#endnote-8) to gain insights into the benefits of interdisciplinary and experiential learning. Foxcroft caters to female students ranging from local students to many international students.

I collaborated with Dr Marie Evans, the school’s STEM Head who runs their very successful STEM program. She shared some very interesting data in relation to girls’ education. When girls attend an all-girls school they are six times more likely to major in science, maths and technology, three times more likely to consider an engineering degree and ten percent more confident in their maths and technical studies.

The school has an extensive STEM program. Engineering and technology are integrated into the science and maths curriculum to help students develop problem-solving abilities, strengthen critical and analytical thinking, expand competence and comfort with technology and grow confidence and willingness to take academic risks.

The STEM Initiative focuses on extracurricular activities and partnerships with educational, business and non-profit groups. It offers the girls high-interest opportunities for hands-on learning outside the classroom. Six of the seven STEM teachers are women, who use hands on projects, often connected to the school or the community’s needs.

Other strategies to inspire students include bringing in motivational speakers, like Sheena Allen, who had been invited to the school while I was there. A very successful App maker, she was not originally drawn to technology but followed her instincts to create apps that were missing in the market. She has been so successful she is now part of a documentary called “She Started That”, which is about young entrepreneurial women.

### Thomas Jefferson High School for Science and Technology

I visited Thomas Jefferson High School for Science and Technology (TJ)[[9]](#endnote-9). I met with Lisa Wu who teaches marine biology and is the lab director for the oceanography and geophysical systems lab.

TJ is the result of a partnership of businesses and schools created to improve education in science, mathematics, and technology. Representatives from business and industry and staff of the Fairfax County Public Schools work together in curriculum and facilities development for the school.

Lisa Wu introduced me to her marine class who were working on their final projects. We ran through some interesting projects which included some serious collaboration between entities such as the US Navy and NASA. This allowed students to have access to tools and resources. The class also had access to two mentors who were both scientists to aid them in their research.

I discussed with Evan Glazer the school principal the way the mentor, community and industry programs greatly benefit all stakeholders at TJ.

I visited an artificial intelligence class where students were very engaged in their project work but were also very excited about the weekend Hackathon. HackTJ is a student-run hackathon at TJHSST, where students have 24 hours to learn to code and/or work with friends to make an idea come to life. HackTJ is open to all current high school students. In the context of a hackathon, “hacking” is to build a real application over the length of the event.

### Teacher/s Takes Flight

I worked with KwF to build and fly my own UAV/Drone. KwF created the Teachers Take Flight program[[10]](#endnote-10) to prepare educators with the necessary technical skills to build, program and operate unmanned aerial systems for an educational curriculum with a mission focus. The mission focus should be relevant to each school context, but some excellent examples include environmental, community needs and humanitarian efforts.

Teachers Take Flight inspires and prepares educators to empower students in solving real world challenges in a diverse and collaborative environment through the integration of STEM education that applies to UAVs.

This workshop will enable me to engage students in a new way whilst introducing exciting technologies and approaches to learning and give me the ability to share this knowledge with my colleagues. KwF provide the kits and the knowhow for the teacher training, and then teachers can take the knowledge back to their own classrooms.

I built a hexacoptor, however, most students would build a quadcopter. You have the option to customise your UAV for instance you could add a go-pro or other device to your UAV. I think this is such a good program, because it is not enough to just fly a UAV, as students need to understand why it flies. The UAV uses open source software, which has a great interface that students love engaging with. For example, you could upload maps of your school, via Google maps for the interface and then program the UAV to fly around set waypoints that you set to accomplish your mission.

### SuperHERo Girls Drone Workshop with Glasgow Middle School, Washington, USA

I visited Glasgow Middle School[[11]](#endnote-11) to act as a mentor at the DaVinci Challenge: SuperHERo DroneGirls workshop after building my own UAV.

Glasgow Middle School is an International Baccalaureate (IB) World School, authorised to deliver the IB Middle Years Program. Glasgow serves a richly diverse community. Students and their families come from over sixty countries, speaking more than two dozen languages. The students also have a diverse range of learning needs, from students who have just arrived in the country to those students taking part in the advanced academic program.

Funding for this after school multi week project was given by the Business Women’s Giving Circle Fund. The workshop is a hands-on, innovative STEM drone workshop that empowers middle to high school girls with leadership and entrepreneurial skills including critical thinking and collaboration via the design, fabrication and operation of a drone with a mission focus to develop solutions for real world challenges.

The workshop started with my exhibiting my completed UAV and doing a flying demonstration for the students. We then returned to their science lab where the girls worked in teams.They were then given some history of flight and analysed how different animals use flight and a discussion ensued about how the UAVs could possibly be customised for their mission’s purpose.

During the first lesson the girls managed to put together the top and bottom plates and screw on the arms of their quadcopter. They then attached the ESPs (Electronic Speed Controllers) and tied these down with cable ties. The girls were then ready for the next lesson where they would then attach the motors and eventually the propellers and other parts. They will then go onto a testing phase and eventually flying the drones.

I was really impressed how well the girls collaborated. There was also parental involvement where one of the parents joined the class to watch how the teams were working and provided encouragement when needed. I enjoyed the concept of parents coming to watch what is going on in the classroom as it built a wonderful community feel.

### ROCKET HISTORY! Recycled Rocket Launched SpaceX Falcon 9 SES-10 Kennedy Space Centre

My study tour has allowed me to visit many Air and Space museums, but I was also very lucky to witness a Rocket Launch at Cape Canaveral,[[12]](#endnote-12) from the Kennedy Space Centre.

This was the first reuse of a recovered first stage of the Falcon 9 rocket. SpaceX then landed the Falcon 9 first stage on the autonomous spaceport drone ship (ASDS), *Of Course I Still Love You*, in the Atlantic Ocean.

The rockets payload was carrying the SES-10 communications satellite for SES. This communications satellite will provide television broadcast and telecommunication services for Central and South America.

[A video is available](http://www.space.com/36292-touchdown-spacexs-1st-reused-rocket-lands-on-drone-ship-video.html) to watch the launch and then the landing on the drone ship. Further information about the drone ship can be found on [Wikipedia](https://en.wikipedia.org/wiki/Autonomous_spaceport_drone_ship).

### Sinclair College Dayton – UAS Training and Certification Centre

I visited Sinclair Dayton[[13]](#endnote-13), Ohio to visit Jeff Miller, Assistant Vice President, Workforce Development at Sinclair Community College to study their UAS training and certification centre.

Sinclair college consistently ranks amongst the top community colleges in the USA and is also the largest community college. Sinclair College has invested over six million dollars into expanding the UAS program at the College whilst the State of Ohio invested a further four million. Sinclair was the first community college to be allowed to fly UAVs and has over 200 aircraft to fly which gives them the same flight capability as some of the big universities in the USA. You can do a one-year study of UAVs as part of an applied science degree or you can undertake a Short-Term Technical Certificates for use in:

* First Responder Leadership
* Precision Agriculture
* Geospatial Information
* Aerial Sensing or Data Analyst.

Sinclair is on the Board of Directors for the League of Innovation for Community Colleges. The league of Innovation has a mission to cultivate innovation in the community college environment. They achieve this by working with corporate partners, government agencies, academia and private foundations. The UAS training centre at Sinclair College works very closely with the US military, in particular collaborating with Wright Patterson Air Force Base to encourage research in areas of interest to them.

The mission of Sinclair Colleges UAS Centre is to create a National Centre for UAS Training and Certification, establish a national leadership position in Workforce Development and Training to support the growing UAS market. Sinclair’s mission aligns with the state/region’s UAS strategy being driven by the Dayton Development Coalition, the State of Ohio, and Wright Patterson Air Force Base.

The Sinclair college also runs the Upward Bound Program for High School students. It is a free academic support program for college and career readiness offering weekday after school and weekend training to bridge the gap between schools and college. The program allows students to gain credits for further studies.

An exciting project that Sinclair Community College is collaborating on is the Live, Virtual, Constructive Demonstrations. LVC is when a hypothetical scenario takes place, for example, in the aftermath of a tornado touchdown at the National Centre for Medical Readiness. UAVs are then used in the scenario with activities focusing on search and rescue and disaster relief operations, which are then analysed in relation to what worked well and what could be improved. This is just one more example of the excellent work being done in collaboration at Sinclair Community College.

# Conclusion

Schools have much to benefit from collaborations between industry, mentors and government bodies that can drive the way forward for STEM education. This will prepare students for 21st century careers that address the shortfall in the STEM workforce to lead to greater prosperity for Australia.

Girls learn best with UAV technology when it is for a meaningful purpose, and in collaborative single sex learning environments.

Competitions run in collaboration with industry, schools and government bodies are an excellent way to channel students into STEM higher education.

The future of UAV qualifications is to have them embedded into other higher education courses where they are required.

UAVs should be taught and used in conjunction with other tools, such as coding or 3D printing to prepare 21st century learners to be problem solvers for problems and jobs that may not exist yet.

1. The Liberal Party of Australia 2016, Media Release: Supporting more women and girls into STEM careers, <<https://www.liberal.org.au/latest-news/2016/06/26/supporting-more-women-and-girls-stem-careers>> [↑](#endnote-ref-1)
2. Australian Government, Industry Innovation and Competitiveness Agenda: An action plan for a stronger Australia, <<https://www.pmc.gov.au/sites/default/files/publications/industry_innovation_competitiveness_agenda.pdf>> [↑](#endnote-ref-2)
3. NSW Education Standards Authority, Digital Technologies and ICT Resources, <<http://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/learning-areas/technologies/coding-across-the-curriculum>> [↑](#endnote-ref-3)
4. mummadrone’s Blog, *NSW Premier's Teacher Scholarship Study Tour: IEEE Aero Conference*. 2017. Retrieved August 19, 2017, <<https://uavstudytour2017.wordpress.com/2017/03/11/big-sky-montana-ieee-aero-conference/>> [↑](#endnote-ref-4)
5. mummadrone’s Blog. *NSW Premier's Teacher Scholarship Study Tour: IEEE Aero Junior Conference*. 2017. Retrieved August 19, 2017, <<https://uavstudytour2017.wordpress.com/2017/03/08/ieee-aero-conference-junior-conference/>> [↑](#endnote-ref-5)
6. mummadrone’s Blog. *NSW Premier's Teacher Scholarship Study Tour: St Catherines Island*. 2017. Retrieved August 19, 2017, <<https://uavstudytour2017.wordpress.com/2017/03/14/blog-post-title-2/>> [↑](#endnote-ref-6)
7. mummadrone’s Blog. *NSW Premier's Teacher Scholarship Study Tour: New York City Drone Film Festival* 2017. Retrieved August 19, 2017, <<https://uavstudytour2017.wordpress.com/2017/03/19/new-york-city-drone-film-festival-2017/>> [↑](#endnote-ref-7)
8. mummadrone’s Blog. *NSW Premier's Teacher Scholarship Study Tour: Foxcroft School* 2017. Retrieved August 19, 2017, <<https://uavstudytour2017.wordpress.com/2017/03/23/foxcroft-school/>> [↑](#endnote-ref-8)
9. mummadrone’s Blog. *NSW Premier's Teacher Scholarship Study Tour: Foxcroft School* 2017. Retrieved August 19, 2017, <<https://uavstudytour2017.wordpress.com/2017/03/27/thomas-jefferson-high-school-for-science-technology/>> [↑](#endnote-ref-9)
10. mummadrone’s Blog. *NSW Premier's Teacher Scholarship Study Tour: Teacher/s Take Flight* 2017. Retrieved August 19, 2017, <<https://uavstudytour2017.wordpress.com/2017/03/27/teachers-takes-flight/>> [↑](#endnote-ref-10)
11. mummadrone’s Blog. *NSW Premier's Teacher Scholarship Study Tour: Super Hero Glasgow Middle School* 2017. Retrieved August 19, 2017, <<https://uavstudytour2017.wordpress.com/2017/03/27/superhero-girls-drone-workshop-with-glasgow-middle-school/>> [↑](#endnote-ref-11)
12. mummadrone’s Blog. *NSW Premier's Teacher Scholarship Study Tour: Rocket History* 2017. Retrieved August 19, 2017, <<https://uavstudytour2017.wordpress.com/2017/04/01/rocket-history-recycled-rocket-launched-kennedy-space-centre-spacex-falcon-9-ses-10-and-then-lands-on-drone-ship/>> [↑](#endnote-ref-12)
13. mummadrone’s Blog. *NSW Premier's Teacher Scholarship Study Tour: Sinclair College, Dayton* 2017. Retrieved August 19, 2017, <<https://uavstudytour2017.wordpress.com/2017/04/02/sinclair-college-dayton-uas-training-and-certification-centre/>> [↑](#endnote-ref-13)