COURSE SHARING: PILOT STEM LAB

AN APPLIED COURSE GUIDED BY INDUSTRY EXPERTISE

A COLLABORATION CASE STUDY SERIES

AUGUST 2015

COMMITMENT TO COLLABORATION

As a pioneer consortium in higher education, 4-VA is committed to fostering collaboration across the Commonwealth.

We are also committed to measuring, learning from, and sharing the outcomes of our work. We believe in the importance of assessment and evaluation. When possible, we seek to measure our impact using verified research methods.

Case studies are a research design that involves an intensive study of one or more cases with multiple sources of evidence. Each 4-VA member institution selected a signature 4-VA project, not an entire initiative, for their case study. An analysis on collaborating across universities will be the unifying theme across cases.

The goal of these reports is to share what we have learned through our work across universities and to inform our stakeholders within the Commonwealth about 4-VA initiatives. This work will provide information to (1) promote enhanced processes; (2) share knowledge and best practices; and (3) advance collaboration.

4-VA was launched with leadership support from the Secretary of Education, the Governor, four university presidents, and an industry partner, Cisco Systems Inc. –the first collaborative of its kind in Virginia. The Collaborative is designed to help universities work together to achieve Virginia's goals for higher education.

Kelsey Kirland
4-VA Assessment Coordinator

JMU & NOVA LABS COLLABORATION

EXECUTIVE SUMMARY

This case features an innovative STEM lab and course sharing experience that resulted in a strong industry partnership. Nova Labs and the James Madison University (JMU) Physics department were connected by the 4-VA Director through shared interest in robotics. The course instruction was provided by members of Nova Labs, a non-profit organization, who are industry experts in robotics. The course required remote technologies and classroom support from Dr. Kevin Giovanetti, a Physics faculty member. Through this course JMU students built an advanced remote controlled robot called a quadcopter. Students applied fundamental robotics skills to create the complex quadcopter. Field engineers at Nova Labs shared their expertise with students through remote technology during the applied course. This collaboration gave students access to robust robotics experiences that surpassed the fundamental offerings currently available within the robotics minor at JMU. The Physics faculty hope to create a technologically advanced learning environment and to help industry leaders identify talent at JMU.

The 4-VA Collaborative provides the Physics department with an opportunity to remotely connect with industry expertise.

GRANT OVERVIEW

ACHIEVING 4-VA GOALS

1. Define instructional models, including a clear definition of instructional costs;
2. Significantly expand access for all Virginians to programs, preparing them for rewarding careers;
3. Increase the research competitiveness of the partner universities; and
4. Increase opportunities and enhance the success of students in science, technology, engineering, and mathematics (STEM) courses and programs.

REACHING AIMS WITH EXCELLENCE

COURSE SHARING

Aims to:

Lead the Commonwealth in thinking about new models for teaching and learning

Increase online delivery and access to Virginia citizens

Focus on program areas with increased employment opportunities in Virginia

Reaching aims by:

- ✔ Piloted a STEM lab with multiple technologies used to create a dynamic and engaging space
- ✔ Expanded educational opportunities while maximizing remote and local expertise
- ✔ Students acquired industry desired skill sets in robotics

NOVA LABS

"Nova Labs is a membership-driven all-volunteer makerspace based in Reston, Virginia that was founded in 2011 with the purpose of empowering everyone to *Rediscover the Joy of Making Things*!

Our facility houses classrooms, workspace, incubator offices and a shop that includes both common tools and advanced fabrication equipment. Members teach classes, maintain equipment, and promote making in the community.

Nova Labs members support a wide range of open source development projects that benefit both the local community and the world!" -an excerpt from Nova Labs website.

ROBOTICS

A NEW MINOR AT JMU DRAWS ON MULTIPLE DISCIPLINES

A few years ago the Physics department took lead in developing a robotics minor in collaboration with the department of Engineering, Computer Science, and Mathematics. The interdisciplinary program involves students in the design, construction, and application of robots.

Students develop a basic understanding of robot control systems, sensors, motion, circuits, and the overall design of robots. With this, students are asked to make connections and understand the role of robotics technology on diverse real-life applications. A key outcome of the minor is that students will learn to work on an interdisciplinary team developing a technical product.

As the minor has developed and enrollments have increased, Physics faculty have been looking to bring advanced technological opportunities to the program.

PROJECT OVERVIEW

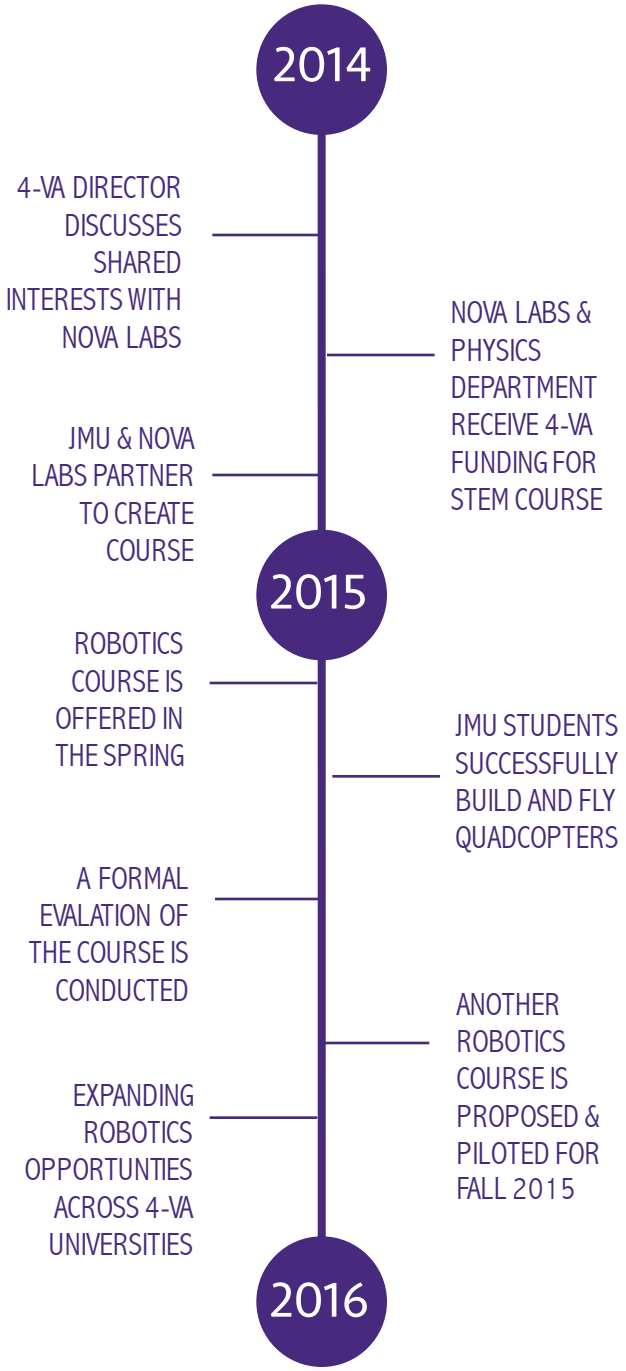
NOVA LABS EXPERTISE + JMU STUDENTS WITH A ROBOTICS MINOR = AN APPLIED ROBOTICS COURSE GUIDED BY INDUSTRY EXPERTISE

5 FACULTY COLLABORATORS & 4-VA STAFF

4-VA RESEARCH FUNDS **$17K**

INDUSTRY EXPERTS FROM NOVA LABS

JMU STUDENTS ENROLLED



COLLABORATION TIMELINE

MAKING CONNECTIONS

A series of factors contributed to the collaboration with Nova Labs.

First, the robotics faculty were looking for people to collaborate with in an effort to strengthen and grow the program. Nova labs had the skills and the industry experience to teach a robotics course at this level. Their skill sets were important because of the limited JMU faculty with advanced robotics skills.

Second, a critical mass of students had developed within the robotics minor. With this number of students in a relatively new program, additional outlets for application were identified as a need by the faculty.

Creating opportunities for students to develop relationships with professionals in the field was also a priority.

Lastly, the makerspace at Nova Labs provides highly desirable resources and access for students.

A makerspace is largely described as a community center with tools that allow members to design, prototype, and create manufactured works. Spaces such as these are fairly new but they have drawn national attention with projects making significant impact.

Dr. Grabiel Niculescu, Coordinator of the robotics minor, explained that the course with Nova Labs was a platform to extend advanced robotics opportunities to JMU students.

Robotics faculty also hoped that the partnership with Nova Labs would help industry leaders identify talent within JMU.

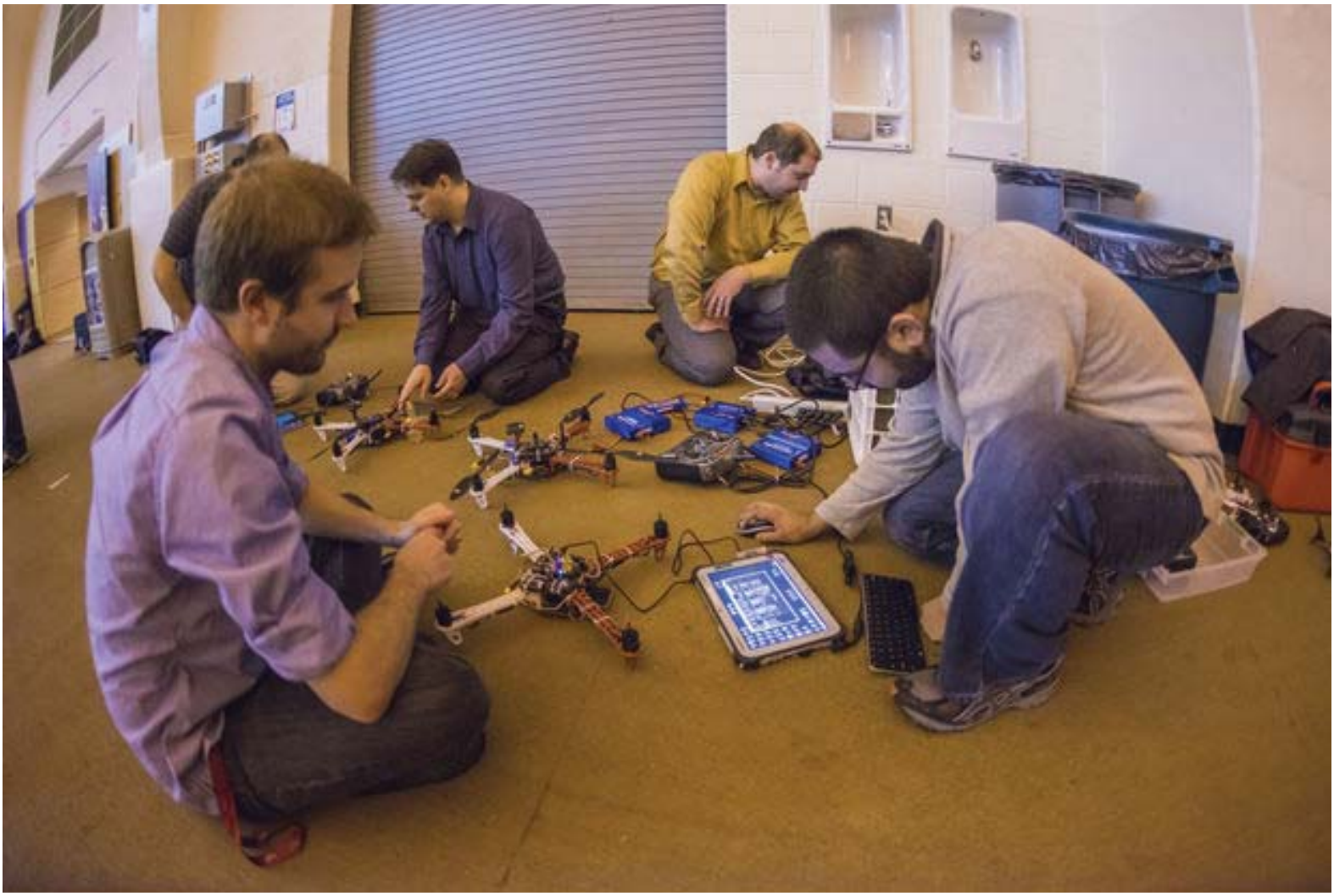


Photo Credit: *Dan Stein | The Breeze*

ON THE FIRST DAY OF CLASS, eight students were enrolled; within a week, enrollment had more than doubled to 18 students. Word traveled fast about this unique course that involved industry leaders and the opportunity to build an advanced, remote controlled robot. Students found themselves flying quadcopters during the first two-weeks of class.

A ROBOTICS PARTNERSHIP WITH NOVA LABS

Bo Pollett and Fred Briggs from Nova Labs, with a wide range of experiences teaching adults and facilitating workshops, developed a curriculum for the robotics course in collaboration with JMU Physics Professor Dr. Giovanetti. They created a bill of materials that would supply students with drone kits for the quadcopters. The professionals at Nova Labs worked closely with the JMU 4-VA Director and Physics faculty to refine the course to ensure that it would be a success.

Together they created a guided class with a set of lessons, tools, and materials to help students work in teams to produce a quadcopter.

Students in the class were given this prompt, "Create a helicopter for the blue rhino project that could catch Rhino poachers in Arica." The real world application of this course strongly aligns with the outcomes and goals of the robotics minors.

TEACHING ROBOTICS

DETAILS OF THE COURSE

NEW INSTRUCTIONAL MODEL

Leveraging a variety of technologies to support a STEM lab experience with remote experts

The sixteen week course during the spring of 2015 was a hands on experience for students to build a quadcopter.

COURSE EXPERIENCE

The undergraduate course served as a core course requirement for the robotics minor. Class time was structured into three parts:

1. **Theoretical and conceptual models** of physics and mechanical engineering were discussed via WebEx, a video conferencing software.
2. **Focused tutorials** for drone and quadcopter assembly were also delivered via WebEx.
3. **Lab time** used to build and test drone technology was delivered through Suitable® Technologies BeamPro robots.

CLASSROOM TECHNOLOGY

Maximizing multiple forms of technology

Nova Labs instruction was delivered through WebEx and Beam technology, a mobile video conferencing communication tool. The Beam provided one-on-one support for students during lab time. Nova Labs professionals noted many opportunities to extend the use of technology for future courses. The classroom and lab were retrofitted with the appropriate technology in order to connect students in Harrisonburg, Virginia to experts in Reston, Virginia.

ADVANCED LEARNING

Matching fundamentals to application

The course has many opportunities for application to previous material as well as the intersection of more complex material. This course provided students with their first opportunity to build something as advanced as a quadcopter.

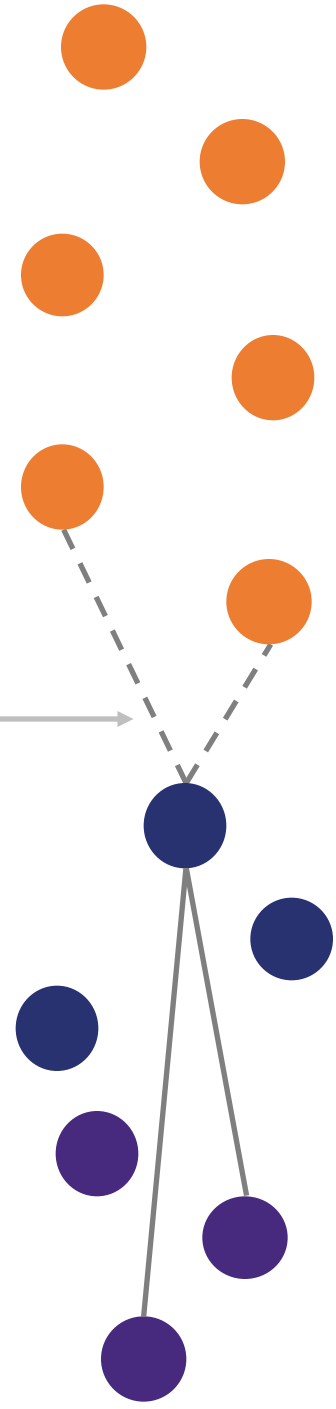
KEY PLAYERS

The robotics course was created with the help of many committed individuals who are dedicated to providing lab experiences for hands-on learning and to enhancing the success of STEM programs.

Fred Briggs	Nova Labs member, key instructor, subject matter expert
Bo Pollett	Nova Labs member, key instructor, subject matter expert
Christopher Vu	Nova Labs member, supporting instructor, doctoral student at George Mason University
Brian Jacoby	Nova Labs member, supporting instructor, subject matter expert
Tom Welsh	Nova Labs board member, connector, point of contact for JMU
Ted Markson	Nova Labs President of the board, connector, point of contact for JMU

CONNECTING SHARED INTEREST AND EXPERTISE THROUGH 4-VA

Nick Swayne	4-VA Director at JMU, connector, initial point of contact for NOVA Labs
Kai Brokamp	4-VA Assistant Director at JMU, program support
Chris Ashley	4-VA student worker, retrofitted classroom and provided technical support
Carole Nash	Faculty Associate Center for Faculty Innovation, conducted course evaluation
Kevin Giovanetti	Professor of Physics at JMU, robotics course instructor of record
Gabriel Niculescu	Associate Professor of Physics at JMU, minor coordinator, classroom support



A strong partnership developed between Nova Labs and the Physics department as a result of their shared interest in robotics. 4-VA funding connected a departmental need with a growing non-profit supported by industry experts.

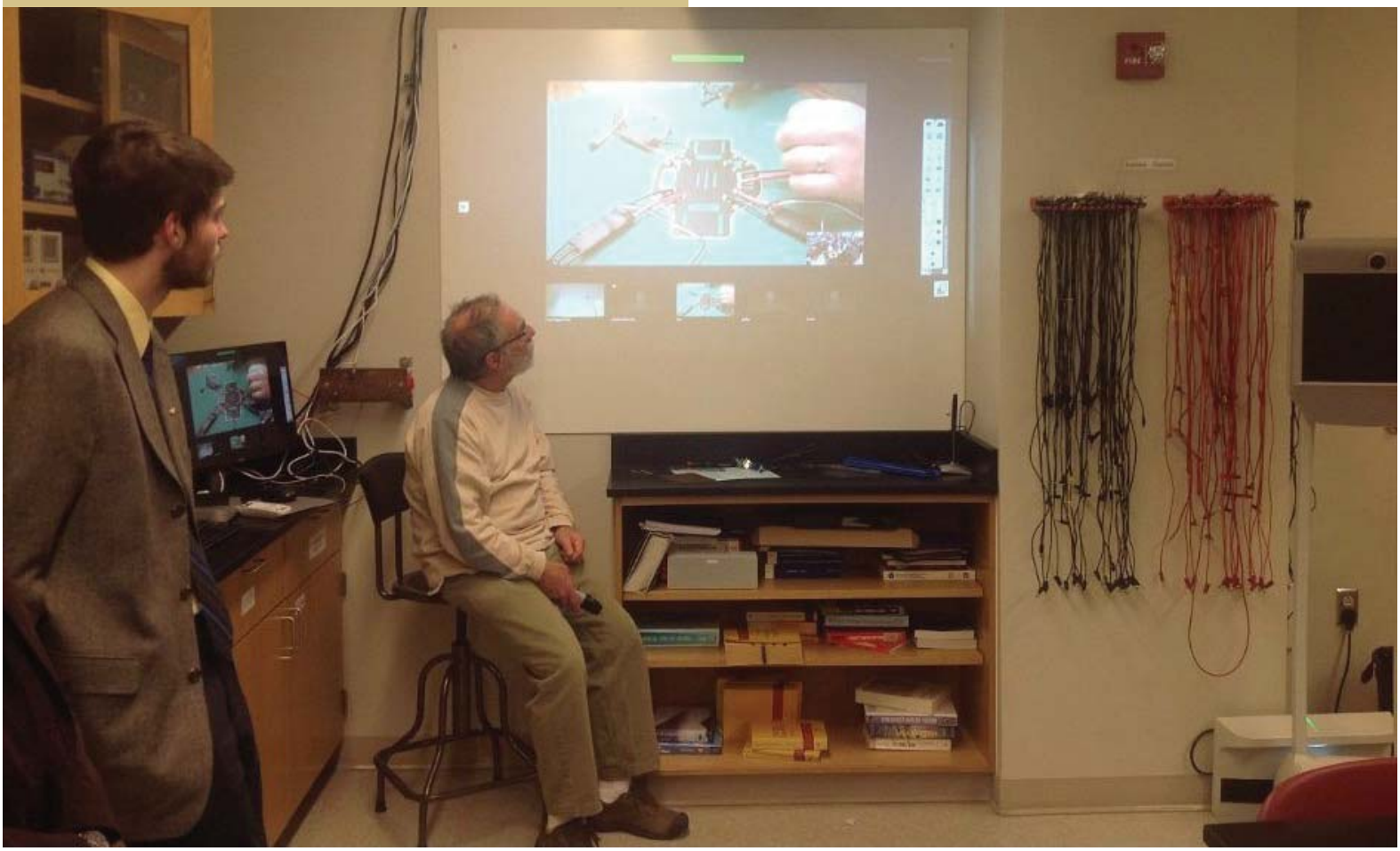
STEM LAB IMPACT

- New instructional model for connecting remote expertise to STEM labs
- Enhanced course sharing relationships between JMU and Nova Labs
- Advanced robotics skills and capacity
- Future involvement with partner universities using the STEM lab
- Development of new course topics based on remote expertise

A COLLABORATVE COURSE WITH COMMITMENT FROM MUTLIPLE STAKEHOLDERS

Although the course instruction was provided by Nova Labs, JMU invested a great deal of time and resources into the course.

Dr. Giovanetti and Dr. Niculescu spent time one-on-one with students to give them the technical support they needed. Nova Lab instructors came to visit JMU at key points throughout the semester to interact with the students and provide support while flying the quadcopters.



Dr. Giovanetti and Chris Ashley from JMU in the remote STEM lab watching a lesson from Nova Labs

Photo Credit: *Kim Reedy | JMU X Labs*

THE STUDENT EXPERIENCE

"THE FIRST FLIGHT DAY WAS BY FAR THE BEST DAY. NOT ONLY WERE WE ABLE TO FINALLY SEE THE DRONES IN ACTION, BUT THE FOLKS AT NOVA LABS CAME DOWN WITH THEIR OWN DRONES AND HELPED TROUBLESHOOT ANY PROBLEMS WE MAY HAVE HAD."

Brandon Fitzwater, Mathematics Major, JMU Senior

The course was comprised of mostly juniors and seniors in pursuit of the robotics minor at JMU. Students noted that the small groups, stress free learning environment, and focus on application were viewed as strengths of the course.

This is exemplified in a student comment, "The hands on approach was a nice change of pace from your standard classroom setting. It was a treat to have the people at Nova Labs take the time and share their expertise on unmanned systems with us. Despite them not being available in person, they videoed in each lecture and controlled a robot around the room in case you had any particular issues with your drone."

Students also commented on the helpful knowledge and skills shared with them by Dr. Giovanetti and the Nova Labs instructors, such as soldering. Soldering is a process by which two metal items are joined together by melting and adding a filler metal. Mastery of this process is essential to a successful drone flight. With a variety of advanced lab techniques, many safety procedures were put into place as students were using high powered equipment to build the drones.

Nova Labs instructors delivered detailed instructions using remote technology to communicate minuet techniques that are essential to successful soldering. This approach challenged the instructors but students appreciated learning the soldering technique.

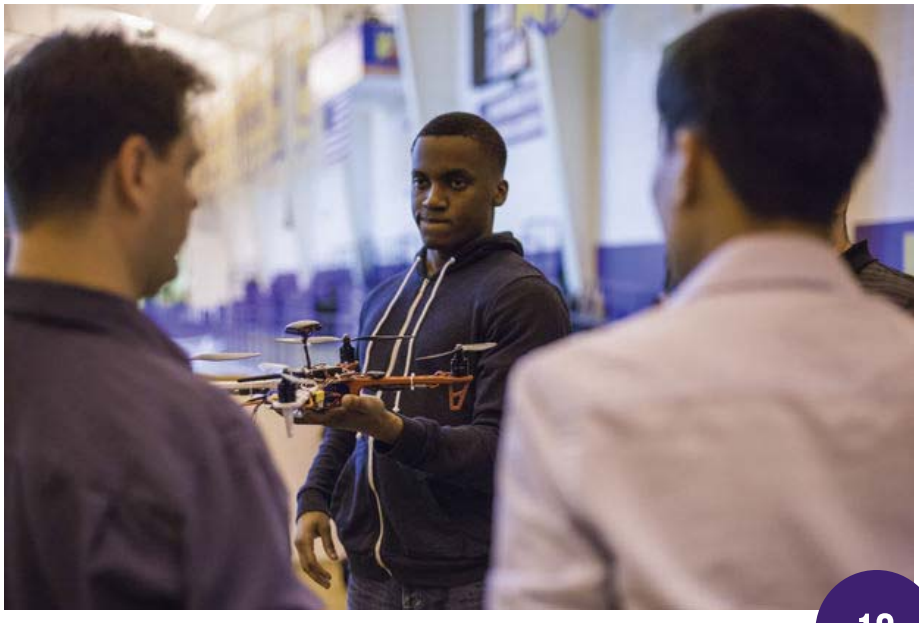


Photo Credit: *Dan Stein | The Breeze*

KEY FACTORS OF THE SUCCESSFUL COLLABORATION

- CONNECTING PEOPLE WITH SHARED INTEREST
- MATCHING ROBOTICS FUNDAMENTALS TO AN OPPORTUNITY FOR APPLICATION
- ENTHUSIASM TO COMPLETE COLLABORATION AND WORK THROUGH POTENTIAL BARREIRS
- CONNECTING EXPERTISE THROUGH 4-VA

The success of this course was attributed to a multitude of factors. The 4-VA funds were essential to securing the necessary resources for the course, contributing to a robust robotics experience. These funds gave students access to state-of-the-art equipment. Dr. Giovanetti believes that it is critical for students have access to this technology.

Another significant contributor to the success of the course was the widespread energy and motivation from everyone involved. The faculty and staff at JMU were committed to making this course the best it could be. Nova Labs professionals were excited to partner with James Madison University and were motived to work within a short time frame to develop the course.

STUDENT FLOWN QUADCOPTERS

"ON THE SURFACE IT SEEMS LIKE A TRIVIAL TASK, BUT IT TOOK A BIT OF PRACTICE TO BECOME COMFORTABLE FLYING THE QUADS."
Brandon Fitzwater,
Mathematics Major

Photo Credit: *Dan Stein | The Breeze*

FUTURE WORK

All collaborators involved in the course agreed that it was an overwhelming success. With momentum around the collaboration building, a course for the fall 2015 semester has been developed. This course focuses on utilizing the quadcopters for individualized discipline based scenarios developed by interdisciplinary teams.

The 4-VA Director hopes to connect remote expertise from other Virginia universities for the advancement of interactive and applied STEM labs.

IN CONCLUSION

The technology supported interactive STEM lab provided critical robotics expertise from Nova Labs to students enrolled in the robotics minor at JMU.

The 4-VA Director was able to connect Physics faculty and Nova Labs members with a shared interest in robotics and drones. This relationship was cemented with funds made available by the 4-VA course sharing initiative.

The collaboration created a unique opportunity for students and increased access to industry experts.

Image credits
Presentation by Alex Kwa from the Noun Project, Reading by Loïc Alejandro from the Noun Project, Key by Madeleine Bennett from the Noun Project, Madison building photo by James Madison University.

Mission

4-VA's mission is to promote inter-university collaborations that leverage the strengths of each partner university in order to accomplish much more than any individual university could achieve alone.

www.4-va.org