7-8-2018

Breaking Down Traditional Classroom Walls and Studying Spacesuits Abroad

Ryan L. Kobrick
Embry-Riddle Aeronautical University, kobrickr@erau.edu

Jessica McKee Ph.D.
Embry-Riddle Aeronautical University, jessica.mckee@erau.edu

Sue A. Macchiarella
Embry-Riddle Aeronautical University, macch18f@erau.edu

Angelica Gould
Embry-Riddle Aeronautical University, goulda1@my.erau.edu

 ICES-2018-312

Breaking Down Traditional Classroom Walls and Studying Spacesuits Abroad

Ryan L. Kobrick, Ph.D.[1], Jessica McKee, Ph.D.[2], Sue A. Macchiarella[3] and Angelica Gould[4]
Embry-Riddle Aeronautical University, Daytona Beach, FL, 32114. USA

The spacesuit curriculum under development by the Spacesuit Utilization of Innovative Technology Laboratory (S.U.I.T. Lab) in the Spaceflight Operations program of the Applied Aviation Sciences Department at Embry-Riddle Aeronautical University has the unique challenge of educating non-engineering students about extremely technical space systems, highlighted by spacesuits. CSO 399: "Spacesuits and Human Spaceflight Operations" course, taught in Greece each summer, introduces students to human spaceflight topics. This unique offering takes advantage of the clear water visibility in the Aegean Sea with practical underwater demonstrations of space operations. Students live in confined quarters on a sailboat for two weeks to simulate operations in a close-quarter space station, emulating astronaut living experiences. Hiking Mount Astráka in the Zagori region of Greece created an immersed environment to learn about spacewalk preparations for extravehicular activities. This course is innovative by taking students outside of the classroom to do hands-on, or gloves-on, learning. Students taking this course have a drive to obtain a career in the spaceflight industry. By taking this course, students developed an understanding of the design process of human-rated spacecraft and spacesuits required to aid humans in exploring the cosmos. Non-traditional learning was reinforced by the uniqueness of the program teaching "anywhere but a classroom" and included locales such as an amphitheater on the beach, catacombs, monasteries, a church courtyard, and as micro-lessons along the way, on sailboats, buses, hotels, and underwater. By changing the locations and having students constantly adapt to new learning environments they were able to grasp a feel for the constant changing pace of the space industry and the thrill of exploration.

Nomenclature

AAS	=	Applied Aviation Sciences
CSO	=	Commercial Space Operations (now Spaceflight Operations)
ERAU	=	Embry-Riddle Aeronautical University
EVA	=	extravehicular activity
IVA	=	intravehicular activity
NASA	=	National Aeronautics and Space Administration
OGE	=	Office of Global Engagement
S.U.I.T. Lab	=	Spacesuit Utilization of Innovative Technology Laboratory

[1] S.U.I.T. Lab Principal Investigator, Applied Aviation Sciences, 600 S Clyde Morris Blvd, Daytona Beach, FL 32114.
[2] Assistant Professor, Humanities and Communication, 600 S Clyde Morris Blvd, Daytona Beach, FL 32114.
[3] Director, Office of Global Engagement, 600 S Clyde Morris Blvd, Daytona Beach, FL 32114.
[4] S.U.I.T. Lab Research Assistant, Applied Aviation Sciences, 600 S Clyde Morris Blvd, Daytona Beach, FL 32114.

I. Introduction

The underlying strategy for developing new spacesuit curriculum in Embry-Riddle Aeronautical University's (ERAU) new Spaceflight Operations Program is incremental, beginning with the creation and execution of the 2017 summer course in Greece, Commercial Space Operations (CSO) 399: "Spacesuits and Human Spaceflight Operations." CSO 399 was designed by Spacesuit Utilization of Innovative Technology Laboratory (S.U.I.T. Lab) Principal Investigator and Assistant Professor of Spaceflight Operations in the ERAU Applied Aviation Sciences (AAS) Department, Dr. Ryan Kobrick, as a mechanism to expose students to an international experience and learn about spacesuits and human-centered design. Lessons learned from the experimental summer course are already being applied to designing a second summer aboard offering called Expedition Greece (Summer B 2018) as well as a full semester technical elective course working on the S.U.I.T. Lab projects (CSO 395B for Fall 2018). Eventually, curriculum packages for short courses could be designed with scuba instruction anywhere on the planet. The short course could be designed as an ERAU "domestic away" experience over Fall or Spring Break by visiting locations like Aquarius Reef Base in Key Largo, FL; could be offered directly to industry, or academic program locations. Eventually the full CSO 395B course will become a permanent offering that could connect with additional courses such as the CSO 490 Senior Space Ops Projects (Sr. Design Capstone), undergraduate and graduate independent projects, or thesis work.

The first stage of this approach, creating the summer course CSO 399, was approved by the ERAU Office of Global Engagement (OGE) for the 2017 Antikythera Mechanism program in Greece (Summer A). This course introduced students to human spaceflight topics including spacesuit history, design, human factors considerations, space life support systems, as well as Intravehicular Activity (IVA) and Extravehicular Activity (EVA) operations. These subjects can be critically addressed from a knowledge base of elementary mathematics, materials, and exploration history. This unique Summer A offering took advantage of the clear water visibility in the Aegean Sea of the Mediterranean Sea with practical demonstrations underwater of space operations. Through the Summer A course, the history of space exploration was linked to ancient navigation and technology while sailing around Greece, looking to unlock the mysteries of the Antikythera Mechanism (the headliner course offered by the Mechanical Engineering Department). The goal of the CSO 399 course was to provide an introduction to spacesuits and human spaceflight operations in order to build upon that knowledge that will provide students with an understanding of the design process of human-rated spacecraft and spacesuits required to aid us in exploring the cosmos. The knowledge base will be used to help solve problems for future spacesuit development across industry, government, and academia. Non-traditional learning was reinforced by the uniqueness of the program teaching "anywhere but a classroom" and included locales such as an amphitheater on the beach, catacombs, monasteries, a church courtyard (as seen in the collage in Figure 1), and as micro-lessons along the way on sailboats, buses, hotels, and underwater.

Figure 1: CSO 399 lectures occurring "anywhere but a classroom" in Greece [Kobrick photos].

II. Background

Even though we know that students learn best by doing, college professors continue to lecture at students with the expectation that the students will diligently take notes and listen carefully [Dalke, 2007; Hanford 2018]. This traditional model of learning, often referred to as the "transmittal model" [King 1995] or the "banking model" [Friere 1970] assumes that the student's brain is like an empty container into which the professor pours knowledge [King 1995]. While this "sage on the stage" mentality remains the dominant mode of instruction, especially within the sciences, it can often result in students merely memorizing and reciting information, rather than actually internalizing and applying the knowledge obtained. Riardo Nemirovsky characterizes this pedagogical model as "teleological" learning, which is learning for the sake of passing pre-defined tasks and goals [2018]. Rather than developing a deeper understanding of the information provided, teleological learning asks students to merely recite information. The NMC Horizon Report, however, identifies a growing trend in education that is moving from the traditional, lecture-based approach to a more hands-on teaching style [Becker, 2017]. This report identifies active learning as a "deeper learning approach" because it encourages students to make clear connections between their coursework and the real world. This type of learning can be achieved through project-based learning, challenge-based learning, and/or inquiry-based learning; no matter the approach, the end goal is to relate materials and assignments to real-life applications [Becker, 2017]. This final goal is especially recommended for teaching science [Zhang 2018].

This developing trend served as the theoretical point of departure for organizing a study abroad trip to Greece, which provided the unique challenge of educating non-engineering students about extremely technical space systems. The students in the Spaceflight Operations (formerly CSO) undergraduate major have chosen this ERAU interdisciplinary program, which was structured with the help of the commercial space industry and affiliated space agencies, to match the strengths of the graduates with industry needs. Studying abroad brings a new dimension in academic delivery and the potential for service learning, professional visits and hands-on experience in a way that creates a new excitement for students and faculty alike. Taking students abroad on what ERAU considers an "academic adventure" has helped double the numbers of students studying abroad during the summer. The ERAU OGE has fostered these programs by cutting tuition in half so that the necessary program fees balance expenses students would have paid if they stayed on campus to take courses in the summer. Including flights, food and assuming students do not have to pay rent for a vacant home in Florida, the cost to study abroad is equal (on average across 17 programs) to staying in hot and humid Daytona Beach in the summer. Unfortunately, at this time, the program does not get any additional funding from outside sources. For students who enroll in 6 credit hours over the summer, the only available funding is limited to Federal Direct Stafford loans, Federal /Direct Parent Plus loans, and private loans. ERAU currently provides zero institutional scholarships for study abroad programs of any kind. All summer abroad programs provide a 6 credit hour options so students may obtain financial assistance.

Between 2015 and 2016, the overall number of students studying abroad at ERAU more than doubled from 94 to 197 (out of 5,447 undergraduates in 2016 [ERAU Newsroom, 2018]). The two biggest catalysts for this change were the two newest programs to Greece introduced in 2016 (Aegean Airlines visit and the Antikythera Mechanism workshop). Both programs saw a participation record of 30 students each. The common thread between the two programs and what differentiated them amongst all the ERAU programs offered in Summer 2016 were the hands-on industry and training experience.

Both programs included an amazing and in-depth cultural piece but the differentiator was industry and research. One program worked directly with the aviation industry embedding students with the number one regional airlines in Europe, Aegean Airlines. Students worked side-by-side with directors and heads of departments to work on solutions for future programs and directions the airline wants to head. 2018 is the third year ERAU has been working with Aegean Airlines abroad and the collaboration continues to grow.

The second Greek program (Antikythera Mechanism Program) focused Mechanical Engineering coursework on the ancient Antikythera Mechanism (as seen in Figure 2) culminating with students working alongside researchers of the actual mechanism models in Thessaloniki, Greece. The students from those first two years were recently acknowledged in a research paper for their work in helping to unlock the secrets of this astrological anomaly dating between 205 and 100 BC.

Figure 2: fragments of the ancient Antikythera Mechanism. National Archaeological Museum in Athens [Kobrick photo].

After the first year, the Antikythera program was re-envisioned to continue with a focus on space studies and included ERAU's CSO 399 course. This was a phenomenal success with students being able to physically work and study in comparable or analogue environments. Whether it be underwater, or on the craggy barren landscape found on some Greek island, understanding spacesuits and the work environment surrounding the suit provided direct industry experience. For example, students are required to live on a sailboat with nine other students for two weeks. These tight living quarters mimic the close-quarter spaceflight vehicles and stations that astronauts inhabit. Hiking Mount Astráka in the Zagori region of Greece created an immersed environment to learn about spacewalk preparations for spacewalks and surface EVA on a terrestrial body. Scuba diving in the Aegean Seas provided students the opportunity to simulate space operations in low gravity environments, which is the same method NASA uses to train astronauts and to test real spacesuits. Moreover, the changing learning environments—from catacombs to monasteries—required students to constantly adapt; in turn this reinforced the changing pace of the space industry itself and the thrill of exploration. This experiential learning environment provided a platform for helping non-engineering students understand complicated theoretical modes, which were consistently reinforced through improvised micro-lessons that each experience generated.

More specifically, the course implemented "experiential learning theory," that was first developed by Kolb [1981; 2005]. Colin Beard defines experiential learning as more active than passive because it requires active engagement with the material taught [2016]. It is, as Bob Stremba points out, both a philosophy and a methodology. Through experimental learning, students must experience something, reflect on that experience, develop new knowledge from the experience, and apply this knowledge to a new situation [Stremba 2015]. This teaching style is well suited for study abroad courses because the entire class is an ever-changing environment that always requires students to experience new lessons.

A recent study by Christine Farrugia and Jodi Sanger [2017], states that Intrapersonal (intercultural skills, flexibility, tolerance for ambiguity, adaptability), cognitive (curiosity, problem solving, language skills) and interpersonal (communication, teamwork) competencies were strongly improved through the study abroad experiences. According to the same study, these soft skills, garnered through study abroad experiences, are a skill employers find valuable in their employees.

Regarding language, ERAU provides language programs for two critical languages, Arabic and Chinese, and the more common language of Spanish. Although a second language is a huge plus, the international language for many industries is English. International airline pilots all speak English, many international conferences and meetings are conducted in English, and international entrepreneurs generally have a working level of English. Essentially, English is the common language of professionals around the world. So, while the importance of a second language is not overlooked, it is not a focus for the spacesuits abroad program. More importantly, as a secondary result, a student's ability to successfully navigate in a culture where they do not speak or read the language is an important skillset for future employment.

ERAU Career Services conducted a survey after the 2018 Career/Industry Expo asking company representatives their perceptions of students' global experiences [OIR, 2018] and received 68 responses. 86% of the employers responded that they value students who have had global experiences (e.g. study abroad, exchange programs, etc.). Questioned if "all things being equal between two students, to what extent does having a global experience help set a candidate apart?" indicating that yes, the global experience does set students apart from each other. The best measure of a university's degree program is job placement or continued education. Continued work is needed to investigate the post-hiring side of the workforce to see how much global experiences actually did help companies so that success can be quantified. A few anonymous explanations are provided in this paper to reiterate the importance programs like study abroad.

"We value experiences that make employees better at working with different people with different background(s) and cultures."

"Having global experience is definitely an asset since diversity is part of our culture."

"Global company so we appreciate the global experience."

"I believe that companies would value employees that have been exposed to a global experience and would be better prepared to face the market and represent their companies abroad."

III. Course Development Methodology

A. Why Greece?

A major influence to early Greek culture was the creation of mythology. The telling of stories passed from generation to generation creating heroes to package life lessons and values in entertaining and easy to remember folklore. Spaceflight needs heroes. An example of embracing a human spaceflight hero was the creation of Yuri's Night[5] in 2001 to honor the first human to blast-off into space, Yuri Gagarin, on the 12th of April 1961. Every April 12th, over 300 events around the world and on all seven continents (sometimes even on the International Space Station (ISS) as seen in Figure 3) celebrate human spaceflight with the "World Space Party." Yuri's Night created an iconic logo of Yuri with his space helmet on, but without Soviet CCCP propaganda and nationalist pride writing that was painted on his head before his flight. The logo embodies that he was a hero for all of humanity, not just a milestone for one nation. Wherever we may explore, thousands of years from now humanity will always remember their first space ambassador. A truly global citizen, a hero of our modern time.

ISS027E011851

Figure 3: Expedition 27 on the ISS celebrates the 50th anniversary of human spaceflight by all wearing Yuri's Night t-shirts and enjoying a Russian dinner and a watching classic Russian movie, sharing the early culture of humanity's journey into space [NASA Photo ISS027-E-011851, 12 April 2011].

Fast forward to today. ERAU in Daytona Beach is less than an hour away from Kennedy Space Center in Florida where history continues to unfold with rockets launching and landing, and soon humans will return to space from American soil with multiple companies and spacecraft, and international crews. Storytelling is critical to the spaceflight industry. NASA's ~19 Billion US Dollar budget drives spaceflight research and development efforts and human exploration. Taxpayers are NASA's customer; therefore, NASA and all the companies and universities that fit under their financial umbrella are obligated to tell the public how and why funds are being spent. NASA has embraced social media as an important outlet to convey these messages, which are dominated by imagery and videos that

[5] Yuri's Night: http://yurisnight.net

highlight achievements. It goes without saying that storytelling and effective communication is an important skill within the spaceflight industry.

Submersing students in one of the birthplaces of storytelling emphasizes how to make a story impactful and last. Every stop along the way in Greece has some form of ancient connection with mystical ruins that act as a reminder to the heritage in that region. To link the ancient with the future, the CSO 399 students were tasked with creating a video about their study abroad semester in Greece.

B. S.U.I.T. Lab Integration

CSO 399 was designed by the S.U.I.T. Lab in ERAU's College of Aviation's AAS Department to introduce students to human spaceflight topics, specifically spacesuits. The S.U.I.T. Lab maintains a curriculum-based experiential focused goal of teaching ERAU students about the fundamentals of spacesuit operations in simulated environments, starting with IVAs in spacecraft cabins and extending to analogue research in simulations with EVAs. The S.U.I.T. Lab promoted the CSO 399 course inside and outside of the lab. Students that were working in the lab were encouraged to go on the trip to help facilitate the growing connection between the lab and the experimental course. This encouragement influenced Nick Lopac, now Lead S.U.I.T. Lab Technician, to participate in the trip.

Integrating student researchers from the S.U.I.T. Lab was critical during preparation for the summer. In an independent study, SP 425 (Select Topics in Space/Aerospace) an investigation on space analogues and spacesuit demonstrations for the classroom and in relevant environments, a student was able to help develop an underwater demonstration where students shifted their center of gravity to simulate walking in a lunar environment, essentially Moonwalking (as seen in Figure 4). The student also helped prepare an overview lecture on range of motion. This research assistance was a great way to get students involved in course development and to learn about creating operational checklists and test procedures. Lecture materials were continually shuffled to best link to the trip itinerary and covered spacesuit and spaceflight topics including: objectives and philosophies; storytelling; visualization of spacesuit systems; film and photography 101; requirements for human spaceflight; center of gravity and underwater demonstrations; spacesuit history; special highlight on the first spacewalk; life support baseline values; gas laws; hypoxia and hyperoxia; human factors; commercial companies and contractors; EVA hazards; spacesuit systems; science fiction and advanced concepts; design pressure of spacecraft and suits; analogue research; operations; and astronaut selection. The materials took an enormous effort to collect and prepare for 2017, which included previous design projects by Kobrick, materials from textbooks, online sources, and colleagues (such as film). Leading up to the 2018 program, students in the S.U.I.T. Lab provided assistance updating materials.

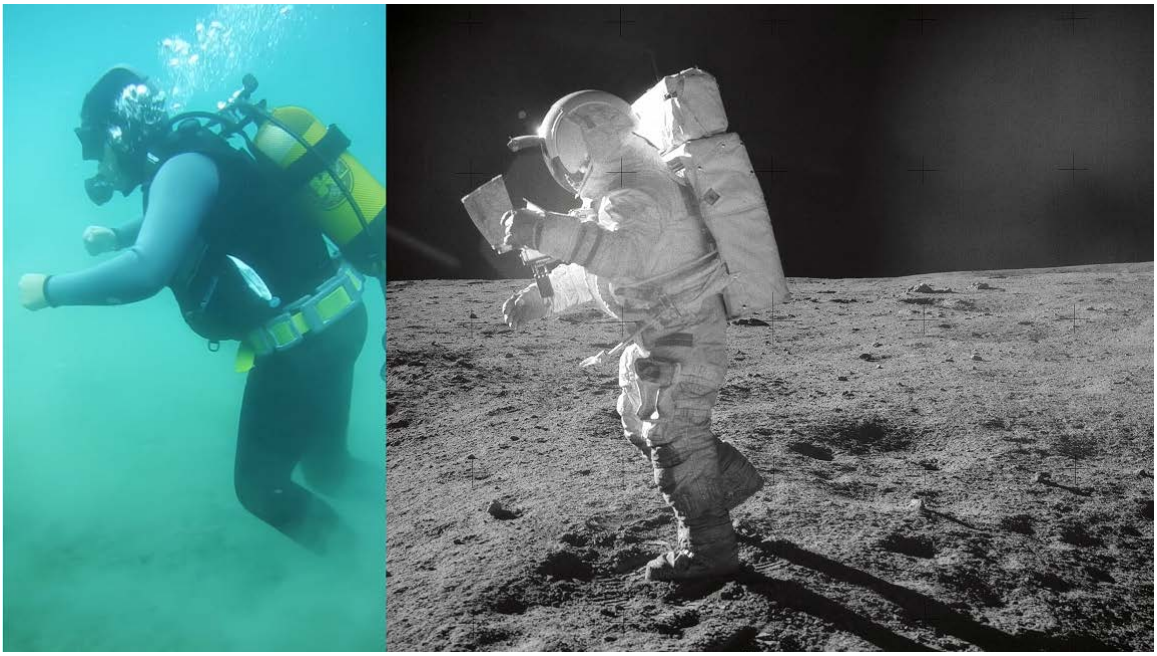

Figure 4: On the left, CSO 399 student participating in a scuba simulation of walking on the Moon. Students learned what it feels like to be on the Moon in 1/6th of Earth's gravity with the added mass of the Apollo portable life support system (backpack), as shown on the right [left: Kobrick photo; right: NASA image].

C. Experimental Learning Theory Applications

1. Demonstrations and hands-on activities

The summer program has pass / not-pass courses, but individual grades from homework and assignments were estimated to quantify the knowledge retention of students during the program. With nine students in CSO 399 (out of 18 on the trip), it was easy for the professor to gauge knowledge retention and effort since the group was traveling so closely together and constant engagement was promoted. The focus was not on memorization of data, but on the application of tools needed for understanding how humans can live in space or extreme environments.

This course boasts an underwater component with scuba demonstrations of "Moonwalking" that were very helpful for students to understand the difficulties of human spaceflight operations. Two demonstrations dives were conducted, with the first only including scuba certified divers. Others were given an opportunity to do an adventure dive with an instructor (covered by their dive shop waivers and additional insurance covering medical, dental, repatriation, and political and natural disaster evacuation through the ERAU agent for all summer programs).

For the second demonstration dive, the full class (as well as others on the trip) participated either as divers or they observed as snorkelers from the surface. Ideally, more or all students would be certified so they could take turns walking on the Aegean Sea floor. The briefings and debriefings of the demo dives were extremely helpful for the students to discuss and interpret what they experienced. Using feedback from the scuba demo debriefings showed that the demonstrations primarily benefited the students, but it will be tremendously important to document for future course offerings.

Hands on activities were prepared for the course to demonstrate the difficulties astronauts have faced in the past with design errors in spacesuit human factors. One student donned dishwashing gloves and was told to build a rocket out of Legos. Then again with a time limit. And a third time with heavy distraction and changes in the required design as they were rushing. Other students were able to observe the difficulty and frustration the student participating in the activity faced when under pressure. The activity simulated what astronauts face when trying to complete a task in a limited time frame while wearing a spacesuit and when things may go wrong. With these students being the future of the space industry, it is important that they understand the root causes of problems they are trying to fix before they can try to stabilize the problem.

Another highlighted demonstration that was using balloons to demonstrate the difficulty of spacesuit design and how pressure must be retained while providing mobility. This also triggered an active conversation on what layers and materials should be included in a spacesuit and for a variety of different space environments.

2. Assignments

The students were assigned a task to research a spacesuit company and then present the company to the rest of the group. The companies or recent spacesuit projects were divided out as an interactive draft-pick to ensure everyone was working on one of their top three picks. The students were invited to use photos, PowerPoint, or short verbal presentations. This assignment was completed with excellence as the students enthusiastically researched their topics and competently delivered information to the rest of the group. Noteworthy is that the students were able to present their topics as special guests within the courtyard of a monastery in the mountainous Zagori region of Greece. This type of activity is standard for a research group in the space industry and led to excellent question and answer sessions after each mini-presentation as the students were curious about the other companies. This divide and conquer method works effectively in the summer abroad architecture, but could only be used a few times as the intense schedule and reduced internet access does not leave many study hours.

One homework task was having the students seek out spacesuit images and references from across science fiction online and adding them to a gallery in Canvas (the online learning management system used by ERAU). However, the Canvas infrastructure did not allow the gallery to load properly on all devices or browsers. Some were collected but not as many as desired to facilitate a conversation. In the future, a "Pinterest" approach would be used and possibly a shared photo gallery on Facebook. The concept behind the activity was to seek sources of inspiration for design and interpret what the artists were trying to convey and how realistic they were using today's technology.

3. Team Project

As a final project, students were required to complete a team project video. The video was to feature all students, Greek culture, locations visited, topics covered in the course materials, and stock NASA (or other space agency open source) footage [Lopac, 2018] (as seen in Figure 5). The project forced students to constantly think about their final deliverable during the entire trip and what footage they may want to obtain. The importance of storytelling is critical for the spaceflight industry and experiencing other cultures is what brings the students together. The link between

Greek mythology and creating heroes to transfer knowledge from generation to generation can serve as a model for how we should package space exploration legends.

Additionally, a social media plan was established in advance of the Summer A course to target key hashtags like #SpacesuitUp and other affiliated ERAU tags (#GoGlobal, #GetLostInGreece, and #CSO399). This served as an indirect means of collecting photos, videos and emotional snapshots during the program. Students were encouraged to use social media in a professional manner, respecting their other classmates, staff, and faculty with the knowledge that they are sharing a very unique and privileged opportunity.

Figure 5: Screenshots from CSO 399 student directed and edited video for final team project [Lopac, 2018].

IV. Results

Given the innovative nature of this curriculum endeavor, an assessment of the summer program collected data from the students. Students were required to complete two final evaluations of the course. The first evaluation occurred on one of the final days of the program reflecting on highlights (positives and negatives), while they were still fresh memories. This feedback aimed to capture raw emotion and important details. Two weeks after the program was completed, students were asked to complete a survey with the goal of obtaining constructive feedback on the course content. Specific course evaluations for summer study abroad programs did not exist prior to this study abroad trip. This was the first step taken to collect official feedback on student satisfaction with the execution of the course and topics covered. Questions asked were related specifically to the experimental demonstrations and experiential components of the course as a way of seeking ways to improve the course for future offerings. The survey asked for suggestions on what should be kept for a semester long course, what needs to be changed, and what they should add. The feedback was generally positive and steps have been taken to ensure the 2018 program rises to the challenge of providing the same energetic content.

In a similar manner, the OGE sent out a survey to all students that participated in a summer study abroad trip for overall importance, satisfaction, and likeliness of participating in future study abroad programs. Data was collected for each specific study abroad and then analyzed to reveal overall study abroad satisfaction levels. Students were asked to rate their level of satisfaction on a scale from one to seven, with one indicating “Not satisfied at all” and seven being “Extremely satisfied.” For the specific Antikythera program, twelve of the eighteen students that completed the trip answered the survey. The results of the survey showed that 100% of students were satisfied with the courses offered and 75% of students were extremely satisfied. In addition to overall positive feedback on program execution and experience, 100% of students said they would participate in another study abroad program and that the program positively impacted their life.

Students that completed the course went on to seek their own research experiences. Two students were hired in the S.U.I.T. Lab and OGE following the trip, and two other students will be going on another summer study abroad program. One current S.U.I.T. Lab research assistant will be going on the 2018 trip, with others wanting to join in future trips. The success of this program can be sufficiently judged by the final accomplishments of the summer that occurred after the program, which included a presentation in front of an international audience, the final video project by the participating students that they are proud of, and an award nomination to the IIE Andrew Heiskell Awards for Innovation in International Education under the Study Abroad category.

An early initiated planning phase for the summer of 2018 was implemented to recruit the next wave of Greek explorers. The OGE summer abroad survey revealed that most students heard about the program through flyers and posters around campus, class presentations, and by word of mouth. With this in mind, professors participating in the Antikythera program posted flyers around campus, spoke to classes with related coursework, and even set up information sessions in the ERAU Student Union and within the Student Village at night. The S.U.I.T. Lab also advertised for the trip at ERAU's Astronomy Open House with their U-2 spy-plane pressure suit and videos from Greece (as seen in Figure 6). Students are used from past programs to help recruit at multiple ERAU events. The team spoke with several high school visitors that were accepted to ERAU and making their final university selections. Hopefully this outreach inspired them to become an ERAU Eagle that one day may soar in Greece, other locations abroad, and one day on to Mars.

Photos and testimonials from all ERAU programs are used in OGE social media posts including Facebook, Instagram, Twitter, ERAU's Yammer, and in the global engagement photography exhibit located in the university Starbucks to help get the word out and recruit for subsequent years. Since all global programs are promoted within OGE social media, it is not a single platform for one program and the S.U.I.T. Lab specifically focuses on CSO 399. High profile study abroad programs, such as the Greece programs, help with university enrollment and inspire student retention, which are both critical for ERAU's bottom line.

Figure 6: S.U.I.T. Lab technicians at Astronomy Open House showcasing the CSO 399 course and lab work at ERAU Astronomy Open House [Kobrick photo].

V. Conclusion

The Greece summer program, as well as many others offered from ERAU's OGE, will have a significant impact on all future university work, as it sets a different pace of how material can be efficiently delivered. Additionally, these programs not are only about spacesuits (or other topics) but about the internationalization of individual students and faculty. These programs challenge students, as well as the attending faculty, on a personal, social and global level. There is a twofold process happening: first, to promote student/faculty globalization abroad and, second, to provide an interesting and relevant venue to enhance student learning and retention through experiential activities, observations and creative problem solving both individually and collectively.

Students leave the four-walled classroom or familiar lab and conscientiously make the decision to step out of what is familiar and known into something new and different. Taking students and faculty away from the traditional learning venues encourages them to observe, plan, and execute differently than normal. Programs abroad open the door for a type of complex originative problem solving that you cannot find or create on campus.

The reduced stress environment of continual grading material will be difficult to integrate into campus courses. The experience has been helpful to see how much research activity can be integrated into a compact program, such as the scuba demonstrations. As these hands-on activities are further refined, there may be an opportunity to work with industry as several groups have agreed to host workshops relating to crew training and exploration. Globally experienced students are highly valued by most industries, but for the spaceflight industry, it is becoming a pre-requisite.

VI. Testimonials

Testimonials offer powerful short anecdotes of experience showcasing raw emotion of a significant experience in someone's life. These examples from ERAU students embody not just the voice of the students, but the shared opinion that the staff and faculty feel about the life changing programs and why we all continue to be motivated to push year after year to share these exploration and education experiences.

"By far the most maturing thing I've been through thus far in my life. I feel like I came back a new person, just because of the amount of growing up I did and the multitude of things I got to experience. If I could go back, I wouldn't hesitate."

Tori Hoff, Computation Math Major who studied at the University of New South Wales, Australia, Fall 2017.

"Studying abroad was easily the top 5 best decisions I made in college."

Lara McKowan, Aeronautics Major, Siena, Italy Summer Study Abroad Program, 2012.

Acknowledgments

The authors would like to acknowledge the Embry-Riddle Aeronautical University College of Aviation and Applied Aviation Sciences Department for their support in the establishment of the Spacesuit Utilization of Innovative Technology Laboratory (S.U.I.T. Lab). The authors also recognize the dedicated students of the S.U.I.T. Lab who helped support this vision and its ongoing development, including Nicholas Lopac, Peyton Schwartz, Chase Covello, Jenifer Schuman, Emily Parcell, and the lab alumni who fostered the inception. The authors would also like to thank the Greece 2017 trip students and faculty from ERAU and our hosts from Get Lost (https://www.getlost.gr).

Ryan L. Kobrick, Ph.D. acknowledges that this research was partially supported through Embry-Riddle Aeronautical University research funding.

This project was supported by the National Aeronautics and Space Administration through the University of Central Florida's NASA Florida Space Grant Consortium and Space Florida.

References

Adams Becker, S., Cummins, M., Davis, A., Freeman, A., Hall, Giesinger, C., & Ananthanarayanan, V. (2017): "NMC Horizon report: 2017 Higher education edition". Austin, Texas: The New Media Consortium.

Beard, C. (2010): "The experiential learning toolkit: Blending practice with concepts". Philadelphia: Kogan Page Limited.

Dalke, A.F., Cassidy, K., Grobstein, P., & Blank, D. (2007): "Emergent pedagogy: Learning to enjoy the uncontrollable—and make it productive". Journal of Educational Change, 8(2), 111-130.

ERAU Newsroom (2018): "Fall 2016 Residential Campus Enrollment by Undergraduate Degree Program". Retrieved from: https://news.erau.edu/media-resources/facts-and-figures/enrollment.

Farrugia, C., and Sanger, J. (2017): "Gaining an Employment Edge: The Impact of Study Abroad on 21st Century Skills and Career Prospects". New York: Institute of International Education (IIE).

Freire, P. (1972): "Pedagogy of the oppressed". New York: Herder and Herder.

Hanford, E. (2018): "Rethinking the way college students are taught". American Radio Works. Retrieved from: http://americanradioworks.publicradio.org/features/tomorrows-college/lectures/rethinking-teaching.html.

King, A. (1993): "From sage on the stage to guide on the side". College Teaching, 41(1), 30-35

Kolb, D.A. (1981): "Experiential learning theory and the learning style inventory: A reply to Freedman and Stumpf". The Academy of Management Review, 6(2), 289-296.

Kolb, D.A. (2015): "Experiential learning: Experience as the source of learning and development". New Jersey: Pearson Education.

Lopac, N., Consolo, R., Cowan, A., Franque, Z., Gould, A., Idy, R., Parcell, E., Williams, D., Williams, J., and Kobrick, R.L. (2018): "CSO 399: Spacesuit Up! Embry-Riddle Aeronautical University students final video project Greece 2017". Retrieved from https://commons.erau.edu/db-study-abroad/4. Video direct YouTube link: https://youtu.be/XG-v666f69w.

NASA Photo (12 April 2011): "ISS027-E-011851". International Space Station Imagery. Retrieved from https://spaceflight.nasa.gov/gallery/images/station/crew-27/html/iss027e011851.html.

Nemirovsky R. (2018): “Pedagogies of Emergent Learning”. In: Kaiser G., Forgasz H., Graven M., Kuzniak A., Simmt E., Xu B. (Eds.) Invited Lectures from the 13th International Congress on Mathematical Education. ICME-13 Monographs. Springer, Cham.
Office of Institutional Research (OIR) (2018): “Career Services Expo Exhibitor Satisfaction Survey”. Daytona Beach, FL: Embry-Riddle Aeronautical University.
Stremba, R., Bisson, C. (2009): “Teaching adventure education theory: Best practices”. Champaign, Ill. Human Kinetics.
Zhang, L. (2018)” “‘Hands-on’ plus ‘inquiry’? Effects of withholding answers coupled with physical manipulations on students’ learning of energy-related concepts”. Learning and Instruction. Retrieved from https://www.sciencedirect.com/science/article/pii/S0959475217305455.

ERAU References

ERAU Office of Global Engagement:

- Website: https://daytonabeach.erau.edu/international-student-services/study-abroad
- Instagram: https://www.instagram.com/eaglesabroad
- #GoGlobal

Spacesuit Utilization of Innovative Technology Laboratory (S.U.I.T. Lab) online assets:

- Website: http://sites.erau.edu/spacesuit (http://spacesuit.erau.edu or http://erau.edu/spacesuit)
- Instagram: https://www.instagram.com/spacesuitup
- YouTube: http://bit.ly/spacesuitvids (https://www.youtube.com/channel/UCpMzaNUJtAtLUM23LzpRuoA)
- Facebook: https://www.facebook.com/SpacesuitUp
- Twitter: https://twitter.com/spacesuitup
- #SpacesuitUp