



Cadets aboard a littoral combat ship under construction at the Austal USA shipyard overlooking the port city of Mobile, Alabama

JROTC AND CTE: USING STEM TO ENGAGE STUDENTS IN PROJECT-BASED LEARNING

By Robert F. Barrow

TODAY'S RAPIDLY EVOLVING GLOBAL ECONOMY IS DEPENDENT UPON A HIGHLY SKILLED,

well-motivated workforce to sustain its growth. Career and technical educators are often encouraged to “think outside the box” when developing new strategies to teach our curriculum, to ensure that today’s students are equipped with the necessary skills to graduate college- and career-ready. This is a story of how a Junior Reserve Officers’ Training Corps (JROTC) program in Alabama thought outside the box and successfully implemented a

STEM summer program for cadets in the Mobile County Public School System.

Science, technology, engineering and mathematics (STEM) are not what usually come to mind when you think of high school JROTC. But through the combined efforts of the district leadership, business and industry partners, and a dedicated team of JROTC instructors and staff, cadets in Mobile County have the unique opportunity to expand their knowledge through a weeklong summer program that challenges them to consider a career in

a STEM-related field. It is also important to note: JROTC in the state of Alabama comes under career and technical education (CTE), a critical link that assured successful implementation of the JROTC STEM Leadership Academy.

Background

In July of 2013, I had the unique opportunity to drive a busload of cadets to attend LEADERState, a weeklong STEM program hosted by Mississippi State University in Starkville, Mississippi. The program offered



Cadets celebrate their chance to fly with a flight instructor at Brookley Field.

cadets the opportunity to develop leadership skills through small group exercises; included tours of local industry sites to demonstrate real-world STEM knowledge application. LEADERState began as an initiative of my counterpart in Jackson, Mississippi, retired Col. Paul Willis, director of army instruction for the Jackson Public Schools District; and I left in awe of the learning that took place.

Upon our return I briefed Martha Peek, Mobile County Public Schools superintendent, and discussed my idea to replicate a similar camp experience for JROTC cadets in our district. Peek had a few simple words of encouragement: "Great idea! Now run with it as hard as you can and see where it leads!" And the resulting program has been a tremendous success for Mobile County students.

Industry is flourishing in southwest Alabama.

JROTC helps educate and train the talented workforce needed to support rapidly expanding career opportunities in:

- Aviation
- Shipbuilding
- Energy production
- Advanced manufacturing

JROTC STEM Advisory Committee

After getting the go-ahead from the superintendent, we recruited a network of key stakeholders in our community to form the JROTC STEM Advisory Committee. Members consisted of individuals from a variety of backgrounds and included leaders in business and industry, postsecondary institutions, philanthropic organizations, and government.

Special thanks

Among these, a few deserve special mention:

- Southwest Alabama Workforce Development Council
- Mobile Area Education Foundation
- Bedsole Foundation
- Community Foundation of South Alabama
- Mobile Area Chamber of Commerce
- Spring Hill College
- University of South Alabama

The major challenge the committee faced was to identify the critical resources necessary for implementation of this ambitious proposal, like finding a host institution and the funding needed to make the JROTC STEM Leadership Academy a reality. In addition, we needed to integrate a new STEM curriculum with the summer program requirements mandated by the U.S. Army Cadet Command. Participation in a JROTC Cadet Leadership Challenge (JCLC) is required for all Army JROTC programs and includes such activities as drown-proof training, rappelling, land-navigation exercises, physical fitness training, sports competitions, and small unit leadership opportunities for cadets. What we proposed was a hybrid JCLC, of which had never been done before.

As a JROTC senior army instructor for 11 years at a LeFlore High School in Mobile, Alabama, and as I was relatively new in my position as the director of army instruction, I had little experience in STEM and struggled to grasp the difficulty of implementing a first-of-its-kind camp like what

I envisioned. My first big break — it all started to come together when I met Julie Cwikla, Ph.D., a STEM researcher and current director of creativity and innovation in STEM at the University of Southern Mississippi. What was to be a thirty-minute meeting turned into a two-hour exploratory conversation; I left that meeting determined that we could make this a reality for our students!

Cwikla connected me with Susan Pruet, Ph.D., who had recently retired from the Mobile Area Education Foundation and founded STEMWorks LLC. Pruet was energized and excited to see this proposal become a reality. And I was amazed by her willingness to share expertise in grant writing and curriculum development as we worked to transform ideas into workable solutions.

Pilot

The first-ever JROTC STEM Leadership Academy took place on the campus of Spring Hill College in Mobile, Alabama, in the summer of 2015. With assistance from James Duke, an advanced placement math teacher from Davidson High School, Pruet devised an engineering project that demonstrated STEM content and technology in action as cadets interacted with scientists and engineers. Cadets were tasked with designing and developing a catapult that could accurately send a projectile a specific distance to a designated target.

Key learning objectives included the physics associated with kinetic energy and gravitational pull. Cadet teams had to create, test and improve their own solutions to the STEM-focused engineering design challenge during the five-day, four-night exercise. Several industry partners offered facility tours to cadets, where they learned about career opportunities in energy production and other related fields.

“Trial and error led them to new discoveries about science and the power of perseverance.”

JROTC STEM Leadership Academy

After a successful inaugural camp, the JROTC STEM Leadership Academy decision was expanded to include an extra day and night, and the number of participants was increased from 120 to 144. This was another ambitious step considering the high cost of the pilot year. With funding support from critical sources in our local, state and national communities, the second STEM Leadership Academy, held in 2016, emphasized the successful build of an electric generator that would light an LED bulb. When the first team successfully completed this challenging task, the room exploded with excitement! Trial and error led them to new discoveries about science and the power of perseverance.

By then, our academy had begun to attract attention from other JROTC programs across the region. Other instructors contacted us with interest about incorporating STEM into their own JCLC programs; a group of instructors located in Huntsville pursued a similar project-based learning program at the Space and Rocket Center. In the meantime, we were able to expand the STEM Leadership Academy in

Mobile, again, from 144 to 160 cadets in the summer of 2017.

We explored how we could best streamline our curriculum to the immediate needs of our regional industry partners. Airbus had recently opened a wide-body aircraft assembly plant at Brookley Field, a former U.S. Air Force base that was closed in the mid-1960s. The opening of this new facility resulted in a high demand for skilled labor in the aviation industry. The STEM Leadership Academy that year would focus on aviation. The result was extraordinary; the community reacted favorably to our decision and we secured many industry-related tour opportunities for cadets.

Planning for the Future

Having successfully conducted three STEM Leadership Academies, our team looked for opportunities to fund the program for the long term. Melissa Dean, a doctoral student at the University of South Alabama, teamed up with her academic advisor, Dr. Jim Van Haneghan, to submit a research grant proposal to the National Science Foundation (NSF) to study the lon-

gitudinal effects our camp was having on our students. Incredibly, we received notification in late March 2018 that our school district was awarded a three-year grant totaling nearly \$1 million! Susan Hinton, director of research and evaluation for Mobile County Public Schools, was named the principal investigator (PI) for the project. Pruet and I were named as co-PIs charged with implementing the grant.

Focus on Industry

A stable source of funds secured, we were ready to execute our 2018 summer program with yet another important industry focus in mind: maritime! Mobile has become a major shipbuilding and ship refurbishment port city and is ranked tenth in the nation in terms of cargo tonnage, according to the Army Corps of Engineers Waterborne Commerce Statistics Center (2018). One of our industry partners, Austal USA, employs more than 4,000 workers to build ships for the U.S. Navy, including the littoral combat ship and the Expeditionary Fast Transport vessel. Mobile is also home to a large number of firms involved in energy production, including deep sea oil exploration, natural gas production and oil refineries.

Hoping to encourage our cadets to consider careers in these important fields, we designed a challenging curriculum using water robotics kits. Our students had to master engineering design concepts, the effects of current and buoyancy, and maneuverability on a liquid surface. The hands-on learning opportunities were well received by the cadets and reinforced the classroom lessons taught by professors in the classroom.

As we plan our 2019 STEM Leadership Academy curriculum, we will focus on our third major area of emphasis in the region: advanced manufacturing. Using the funds made possible by the NSF grant, we are in the process of purchasing robotics kits, produced by VEX Robotics, that will allow our cadets to experiment with essential



Cadets test their engineering design with a water robotics kit during a practical exercise.



Cadets develop a functional electrical generator.

structures and basic object manipulators. They will also learn preprogrammed sensor functions and gain experience operating a robot via a controller as well as simple autonomous programming.

Conclusion

What are the lessons to be learned from our efforts to “think outside the box” and get involved in STEM? From my perspective there are six guiding principles that led to our success:

- 1) Think big. Be ambitious.
- 2) Network, network, network.
- 3) Link everything to career opportunities and the needs of your regional workforce.
- 4) If you don't ask (for funding), you shall not receive.
- 5) Assemble a team of like-minded professionals.
- 6) Be willing to take risks.

There were many times along this journey when it would have been easy to quit. The challenges can seem enormous at the beginning. However, when you garner the support of your school officials and your business and industry partners, when you convince them that your vision means ensuring a pipeline of highly skilled and motivated employees, you will be halfway to achieving your goal.

JROTC has evolved tremendously over the last two decades. Our instructors are educators first and foremost. We must be if we want the JROTC to be offered across the nation. We must contribute to the greater mission of our school district, to produce graduates who are ready to enter postsecondary education or the workforce. JROTC teaches the essential skills most sought after by business and industry



Cadets learn to rappel as part of the hybrid JROTC STEM Leadership Academy. Cadets also participate in down-proofing, land navigation and physical fitness training.



Cadets take a close-up look at local industry involved in energy production.

today: time management, teamwork, problem solving, decision-making and leadership!

If we combine these important skill sets with the critical aspects of STEM, we can produce outstanding graduates who are ready:

- To consider a career in the military
- To enter the Alabama workforce with in-demand skills
- To enroll in a postsecondary institution, for a degree in a STEM-related field

I know that the hard work we put into our JROTC STEM Leadership Academy is worth it. The impact is powerful and the program will make a lifetime of difference for our students. Perhaps two cadets, suc-

cessful completers of our 2016 academy, said it best. On the final day, during a group presentation, one student shared, “Failure happens in life. Y’all keep failing — but fail forward and learn from your mistakes.” Another cadet’s words, written in his journal, illustrate best why I believe so much in what we are doing: “The most valuable thing for me that I learned is that I actually am worth something. That I can and will grow to be something absolutely incredible.”

Isn't this what teaching is supposed to be about? ■

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