

Veteran Students in Engineering Leadership Roles

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Veteran Students in Engineering Leadership Roles

There has been a growing emphasis on producing engineers that are technically proficient while having many professional skills such as organization, time management, communication, and leadership. Service academies and senior military colleges require a highly structured leadership curriculum and formal experience for all their cadet students. However, many veterans are not required to participate and cannot experience the leadership sequence at military colleges. Unless they are a cadet or midshipman, they simply are not allowed to register for these courses nor can they hold leadership positions in the cadet ranks. However, veteran students are well suited to assume leadership roles and responsibilities in and out of the classroom. Their military experience often fosters growth of these soft skills and make them effective and admired leaders, even at a military college where their academic peers have experienced a more structured and recent leadership curriculum. Faculty and traditional students at civilian or military colleges can benefit from these qualities if they are aware of their skills and experiences. The classroom experience and extracurricular activities can be enriched through these non-traditional students. This paper discusses some of the professional skills recognized in veterans. It then provides examples of veterans in leadership roles in three different programs and activities. One experience will be a project leader in the ASCE concrete canoe, another is the role of veteran leaders in a senior design project in electrical engineering. Finally, the last experience describes the veterans assuming leadership roles in the student chapter of ASME. Based upon the feedback and peer assessments, these veterans played significant roles in their organizations' and teams' activities and eventual success.

Introduction

The Citadel has a well-known and highly-ranked engineering program. Most recently, it has been rated as one of the top 13 engineering programs by US News and World Report for Universities that offer a Master's degree as the highest degree. Adapting to a growing student enrollment within any college is difficult, particularly when competing against colleges/ universities that receive more funding and a progressive campus climate. Veterans who are leaving the military and considering a second career as well as some active duty students who are enhancing their skillsets are a potential pool of students. These military and former military students can enhance the engineering education of traditional students as well. Colleges still desire to create a diverse student population and build an inclusive environment with all students to ensure they feel a part of the department/school culture.

The School of Engineering's six year strategic plan (LEAD 2018) includes objectives in retention and graduation numbers. The team established the following goals (which were a subset from the institution's strategic plan) that established the foundation for creating new initiatives to address the most pressing issues: 1) enhance student retention, 2) expand engineering student enrollment, 3) enhance the non-traditional student experience by transforming the delivery of student services, 4) expand veteran, reservists, and active duty enrollments, 5) expand diversity, and 6) recruit and retain a diverse faculty and staff. Armed with the new strategic plan, the leadership team began developing new programs and setting priorities to build a culture of inclusion and resilience to stay in engineering.

Student veterans possess maturity far beyond the traditional 18-22 year old students. In contrast, the entering student veteran ranges in age from 22-42. Some have completed courses either online or acquired as part of education and training courses obtained during military service. As a result, a fair number enter college classified as sophomores or even juniors and miss the bonding period of a freshman year.

Student veterans are also accustomed to a previous lifestyle of pressure, regimented routine, and goal orientation. Socializing with younger underclassmen is not appealing to these former military members. Consequently, this cultural divide often keeps student veterans from getting involved with other traditional students. Finding ways to unite this group of students both in and out of the classroom can be a challenge¹. Veteran and active duty students have persistence and mental toughness for academic work stemming from their goal oriented work ethic in the military. Some of these veterans and active duty students initially entered college after high school, performed poorly due to the lack of mental toughness and persistence, and then entered the military. As students who are now traditionally older and more cognitively developed, they are better equipped to scaffold more traditional students through complicated problems and interactions. In addition, their world experience provides a different and critically broad experience which is lacking from students who have not been out of the state. They have spent years working with diverse groups and have the skills and experiences to lead small teams.

Research shows involvement is the best way to help students succeed both in and out of the classroom². Examples include campus activities, socialization, recreation, leadership opportunities, service opportunities and engagement in academic activities with peers. This paper focuses on veteran and active duty students as they are part of the overall strategic plan for the School of Engineering. For a more detailed discussion of the strategic plan and initiatives, see Ref 3.

Veterans Center

The Citadel has attracted veteran students for a number of years, and subsequently expanded the college's services by opening the Office of Military and Veterans Services to veterans and their families and with the opening of a new Veterans Center on Veterans Day 2014. The new programs are part of The Citadel's Strategic LEAD Plan 2018. A part of the plan identifies the need for the expansion of veteran student services and programming for those wanting to further their education at an institution that appreciates and understands their sacrifices and educational needs. The Office of Military and Veterans Services is a part of the Office of Financial Aid and Scholarships and is dedicated to assisting service members, veterans, and their dependents in managing their Veteran educational benefits. The office is responsible to interpret, explain, and administer VA regulations.

The Veterans Center, which is open to all campus day and evening veterans, includes; kitchen, lounge, and study room equipped with WiFi. The space is designed to foster social interaction and community-building with the use of trending technology.

The campus also has a chapter of The Student Veterans Association which was created in order to facilitate a supportive environment for veterans transitioning into a student civilian

environment. The goal is to connect student veterans through social functions, intramural sports, academic support, and mentor leadership. The association was founded by veteran students, for veteran students, run by veteran students to assist fellow veteran students (Figure 1).

The Citadel is a member of the Yellow Ribbon Scholarship program and is ranked by U.S. News and World Report as the No. 3 Best College for Veterans in the South.



Figure 1: Veteran Students

Active Duty Military and Veteran Lounges in Department Areas

The traditional day students are part of a residential program with their dorms centrally located between the academic building extremes. However, each department has used limited available space to establish locations for veterans and active duty military to use as a base of operations: study, eat lunch, and visit between classes. These students in concert with the department head have added refrigerators, microwaves, and coffee pots to improve the availability of comfort items as they push to complete their undergraduate degrees in three years (time line for active duty military and many using their full GI Bill). One department worked with the campus soft drink contractor to move one of the dispensers being removed from campus into the designated space for active duty military and veterans. This relatively simple accommodation has had a significant effect on the quality of student life. These spaces are now being used by a number of the active duty military and veteran students who are part of the Supplemental Instructor team to tutor students throughout the day. This effort to meet basic needs and help the military student feel wanted has helped in the recruiting of additional students with a military background. Moreover, these spaces are almost a necessity for the active duty and veteran students who may have several hours between classes or may take an evening class due to scheduling conflicts. Again, the traditional students can easily return to their dorm rooms since the day student population is nearly 100% residence living.

Academic Support Programs³ – Supplemental Instruction

Veteran and active duty students are currently filling a critical role at The Citadel as tutors through the Supplemental Instruction Program. With high demands on traditional student time, veterans and active duty students fill approximately 20% of the instructor positions. These

individuals assist students often when the instructor is unavailable and can help traditional students who have missed classes due to athletics or other trips as well as those who are academically deficient in specific courses.

Revamping academic support programs has become a priority for the School of Engineering to engage and retain students in the engineering majors. In the fall 2012, the focus was on final grade reports for engineering, math, and science courses. The courses were 100 and 200 level engineering prerequisite courses with the majority of freshman and sophomore student-enrollments. It was evident there was a high trend of losing students that received a D, F, or Withdraw (DFW) as their final course grade in Mathematics and Chemistry courses.

The results shown in Figure 2 outline Math and Chemistry results with approximately 50 percent DFW rates, while Engineering was only at 13 percent DFW beginning in the fall 2012. The large gap that occurred between the subjects left many Engineering freshman and sophomore students wanting to change out of their current major into Business, Criminal Justice or another humanities major before taking significant engineering courses since they could not complete their required Mathematics and Chemistry courses and maintain progress toward graduation in four years.

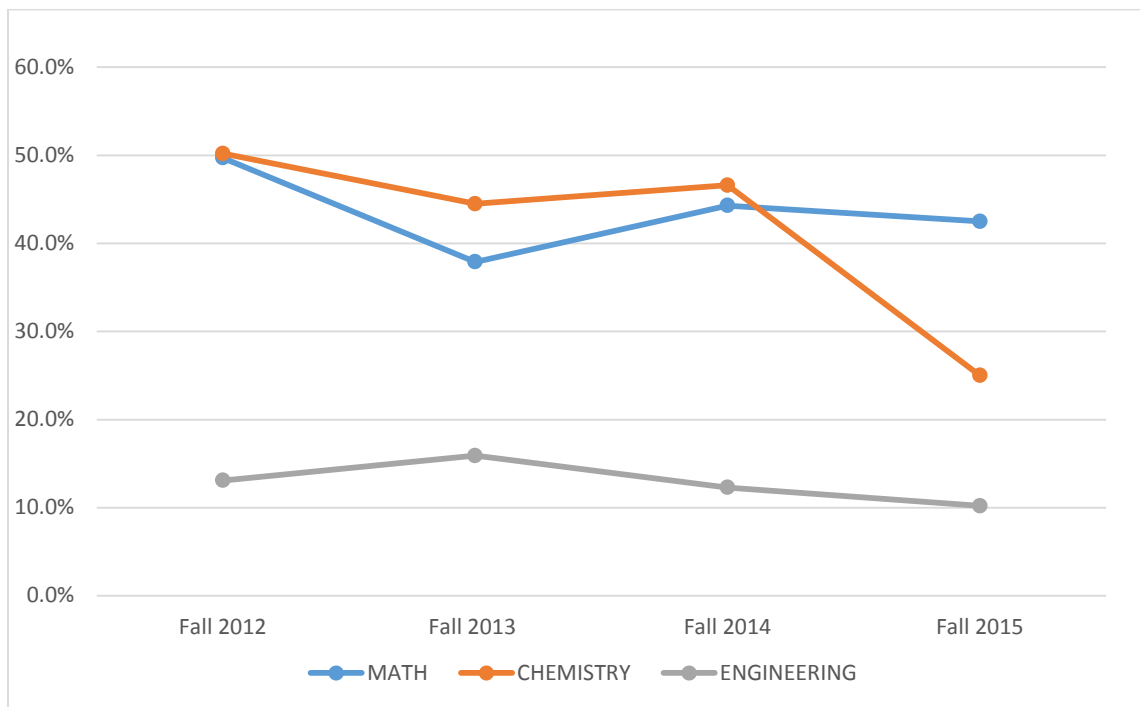


Figure 2: Percent DFW by Subject Area

It should be noted that in Figure 2, the significant decrease in Chemistry DFW rates from fall 2014 to fall 2015 could be the addition of a new course, Chemistry for Engineers as well as the assignment of a gifted teacher to that course. Previously, engineering students only had the option of taking General Chemistry for their chemistry course. The fall 2015 was the first time Chemistry for Engineers was offered for engineering majors. The Chemistry DFW rate went from 46.6 percent down to 25 percent between the semesters for engineering majors only.

To circumvent the high DFW rate shown in Mathematics and Chemistry, the School of Engineering turned toward the Supplemental Instruction (SI) program. The SI program was in place on campus; however, there was not a heavy emphasis on Science, Technology, Engineering, and Math (STEM) courses. Researchers have noted that some course instructors simply lecture but rarely help students make the connection between teaching and learning.⁴⁻⁵ The SI program is based on group sessions led twice a week for one hour by a peer leader who has already completed the course with a grade of an A or B. These group sessions include collaborative learning techniques. SI leaders were assigned to target courses based on prior semester DFW rates and professor willingness to have an SI leader. Whenever possible, the SI leader sits in class and gains firsthand knowledge of the areas in which students are struggling.

In order to examine the effectiveness of the SI sessions, we examined the number of SI sessions that students attended and the final grades that they received in their course. The SI program began in fall 2012 with two SI leaders assigned to only 2 courses. As of fall 2016, the program has an average 25 SI leaders supporting multiple sections in 32 courses. SI sessions are held twice a week for a total of 13 weeks or a total of 26 possible sessions that students can attend. The number of SI sessions was broken into three categories: 1) Attended five or more sessions, 2) Attended one to four sessions, and 3) Did not attend any sessions. This break-out of number of attendances was based on showing a trend of consistency in a student actively going to SI sessions, which would be five or more times.

The one to four sessions could be students going to get one or two homework questions answered and some may only attend before a test, midterm or final exam throughout the semester. We compared the students who attended five or more sessions to the students who never attended. For course grades, we looked at the percent of students who earned an A, B, or C in their course. These are the grades that are considered “passing” in many courses. We wanted to show that among the students who went to five or more SI sessions, a higher percentage of them passed their course (received an A, B, or C) than among the students who never went to an SI session.

Data collected by SI leaders provided a record account of two academic years and was compiled by the Academic Support Center. Table 1 data is solely based on the following STEM courses for those four semesters: Pre-Calculus, Calculus I, Calculus II, Calculus III, General Chemistry I and II, Statics, Dynamics, Circuits I and II, Computer Applications for Electrical Engineering, Signals & Systems, Electromagnetics, and Mechanics of Materials.

As shown in Table 1, 80.7 percent of the students who attended five or more SI sessions received an A, B, or C in their course, compared to only 67.0 percent of students who never attended. Additionally, students who did not attend had a higher DFW percentage of 33 percent when compared to 19.3 percent of those who attended 5 or more sessions. Therefore, there is sufficient evidence to support the claim that STEM students who regularly attend SI sessions (went to five or more sessions) have a higher pass rate than those who do not attend at all. These results definitely indicate that the SI program is meeting its goal of improving student success

(more students receiving A, B, or C grades in STEM courses) which leads to greater retention of engineering students. Furthermore, both Figure 2 and Table 1 show a continual decrease in the DFW rate since the SI program was introduced to STEM courses. In the paper “Using Supplemental Instruction to Increase Retention in Engineering” (based on the SI program at The Citadel, the change in grade from mid-term to final is compared to number of attendances.³ Students with more than five attendances received an average of 0.2 increase in their GPA.

Table 1: SI Attendance and Final Course Grade

	Course grade: A, B, C	Course grade: D, F	Course grade: W
Attended 5+ SI sessions n=249	80.7%	14.9%	4.4%
Attended 1-4 SI sessions n=689	66.9%	23.5%	9.6%
Did not attend any SI sessions n=1649	67.0%	20.3%	12.7%

The data collected for Figure 3 includes student attendance averages for fall (blue) and spring (red) semesters on the x-axis. In addition, the y-axis indicates grade point change. The dashed lines are a best fit linear trend line of each semester. Figure 3 below demonstrates that regardless of subject matter area students who attend five or more sessions show a significant improvement in grade point average (GPA) between midterm and final grades. Since session attendance has shown an increase in GPA, some faculty members are now including bonus points for students to attend SI sessions as a means to motivate them to get extra assistance in a course.

Beginning in the fall 2014 another resource was launched called “STEM Lab” to support courses that an SI leader was not assigned directly to cover. STEM Lab is run by senior level students who have demonstrated an ability to tutor students across multiple subject areas, and also possess a cumulative GPA of a 3.0 or higher. Advertisement for STEM Lab is primarily for freshman and sophomore students; however, junior students often attend when they have difficulty on homework problems. The STEM Lab is centrally located in the Academic Support Center³ on campus. Figure 4 below shows a gradual increase in attendance over the past three semesters.

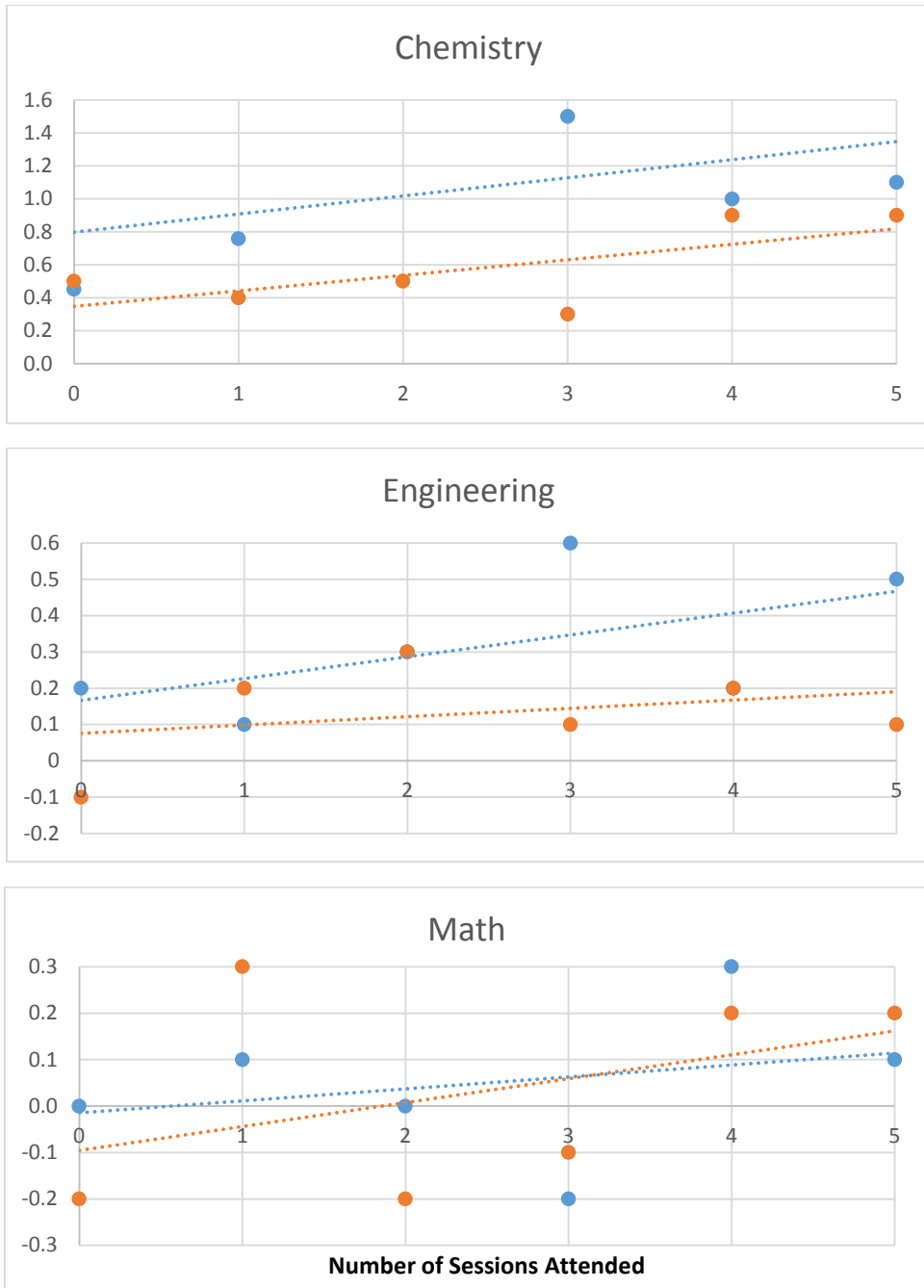


Figure 3: Grade Point Improvement by Subject Area & Number of Sessions Attended

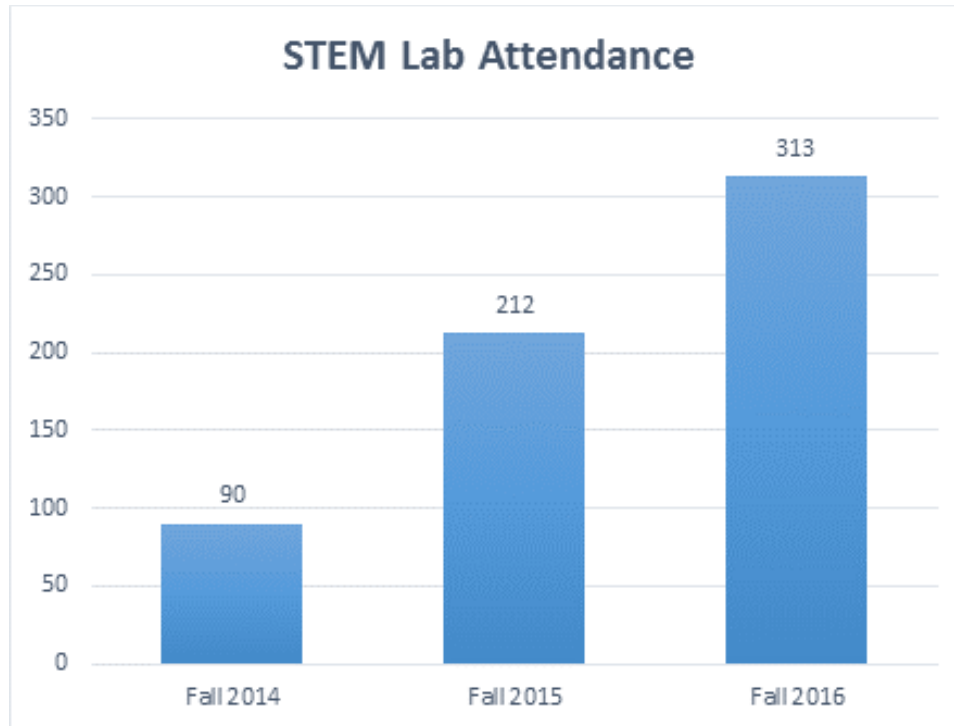


Figure 4: Overall attendance in STEM Lab by semester

The addition of STEM Lab has allowed students who may not have felt comfortable going directly to their professor an avenue of support from a peer. Also the scheduling of the STEM lab each night ensures a student has a resource four nights a week. Throughout the School of Engineering the primary mindset is for students to help other students within the engineering major. Many students received help during their first two years and often want to give back some of their time to assist new engineering majors; therefore, they seek to become SI leaders.

American Society of Civil Engineers' Annual Concrete Canoe Competition (CIVL)⁶

The ASCE Concrete Canoe Competition started in the late 1980s and has grown to be a challenging comprehensive design and development project which includes elements of material design and testing, project management, construction and fabrication, and marketing/ branding. New rules are released in August of each year and students typically have 6 – 8 months to execute the project. Veteran students and active duty military students play a key role in the successful completion of this project (Figure 5). Experience gained from their prior military training/ experience and the positive effect from their cognitive development and life skills maturity contribute in a variety of successful ways to the overall team. The Citadel has qualified for the national competition over the last few years. Here are some of the meaningful ways veteran students have contributed to that success.

Veteran and active military students provide a positive example to younger and more inexperienced students when dealing with:

Conflict Resolution - There are challenges which occur annually related to effective communication, sharing of workload, delegation of responsibilities and personal accountability. Veteran and active duty students typically have been exposed to more resolution skills and tend to handle these situations more calmly than traditional student.

Teamwork / Project Management – While goal setting, task planning, and deadline development are taught in the curriculum, the nuances of executing them to form a collaborative and inclusive environment are often modeled more effectively by veteran and active duty students. This addition to an outcome that is tied to a department's ABET accreditation adds to the program and can be used to illustrate other ways a department is working to aid in student development and obtainment of student outcomes.

Life Skills Mentoring – The Veteran and active military student will often have a family to support. The nature of the concrete canoe competition requires student to work in the evenings and weekends. This means the veteran and active duty students are bringing their families or at least interacting with their families in front of traditional students. This provides additional examples to traditional student on how to balance life with professional responsibilities.



Figure 5: Active Duty Student working on the Concrete Canoe Stand

Senior Capstone Projects (ELEC)

The electrical and computer engineering senior design project is a mandatory two semester sequence of lecture and laboratory work culminating in a working prototype. These design projects can cause anxiety and apprehension for students because of the numerous decisions and open ended nature of the requirements. Student veterans in engineering are well experienced to help the traditional students reduce their apprehensions. The military educates veterans to expect

ambiguities and solve problems out of necessity. Also, military experience in harsh operating conditions provides insight to product requirements and development and boosts interpretive and systematic skills. Due to their unique experiences, veterans usually understand their strengths and challenges very well and have had opportunities to minimize their own limitations.

Typically, veteran students are dispersed among several capstone senior design groups where their maturity, planning and conflict resolution skills can benefit multiple student projects. In contrast to the norm, in 2015, a team composed of two veteran and two active duty students was formed. In a truly impressive engineering effort, this team designed and constructed a prototype floatation delivery device to prevent drownings. The prototype consisted of a beacon worn by the passenger and an autonomous robotic boat designed to deliver the floatation device. This well thought out project included; wireless communication, an internet real-time display application, target acquisition algorithms using GPS technology, motor control, and chassis construction. It was by far the most complex and impressive design project of the academic year. This team demonstrated that not only can the veteran and active duty students help lead the less experienced traditional students, but they form cohesive teams capable of delivering far beyond the requirements.

IEEE Ethics Competition

Electrical and Computer Engineering veteran and active duty students also formed the core of the student ethics competition team in 2015. This team is formed with the sole purpose of competing in the annual regional ethics competition sponsor by the IEEE. Here the teams compete against dozens of other colleges to analyze a case study dilemma, presenting their solution to a panel of judges. The institution's team won first place. As cited by the competition judges; the maturity, professionalism, and poise demonstrated by this team was impressive (Figure 6).



Figure 6: IEEE Ethics Competition Students

Business Bowl Challenge

In 2015, an electrical and computer engineering team of one veteran, and two active duty students joined forces with a business student to compete in and win the college wide business bowl. This competition is aimed at students who have an idea for a new product or service. It is

open to the entire campus including both undergraduate students and graduate students. This veteran lead team impressed the judges and audience by producing a smart phone application to allow event attendees to order food and beverages from their seat during the event. The team not only designed the phone app, but also the business plan including marketing and sales projection. The team backed up their assertions by testing their design at a local minor league baseball game. The quality of the prototype product, the professionalism of the presentations, and the maturity and poise of the students set them far ahead of all the competing teams. Demonstrating that given a leadership role, a small group of veteran and active duty students can make a significant impact in campus wide events.

SAME Infrastructure Challenge

In 2015, SAME held its first 24 hour infrastructure challenge. The competition allows for each school to enter a five-person team where only two have to travel to the competition site. In 2015, the site was at a hotel near the Baltimore-Washington Airport. Once the team was formed (two veterans, one active duty (E-6), and two cadets) a discussion on school requirements led to the decision that one veteran and one active duty student would travel to the competition while the other three supported from campus. Even though the team competed against John Hopkins, VMI, the Naval Academy, etc., the judges noted the maturity, ability to handle stress, and confidence of the veteran and active duty person was clearly evident in the product and presentation.

So, in 2015 alone, a small group of veteran and active duty electrical engineering students provided un-paralleled leadership in four separate undertakings; a capstone senior design project, a campus wide business competition, a national infrastructure challenge, and a regional ethics competition.

ASME Student Chapter Leadership (MECH)

The Mechanical Engineering program is the newest of all the engineering degrees, first being offered in 2014. With a limited pool of upper level students during the initial growth, four seniors (two veteran and two traditional students) volunteered to move the ASME Student Chapter from its initial authorization by ASME into a chartered active club on campus. Student elections resulted in the veteran students as the president and the treasurer for 2016-2017.

The student president quickly set up an ASME student chapter page on Facebook that is similar to the student IEEE page. The social media site is a useful medium to pass along pertinent information to other students, as well as using it as a tool for industry information, and a place to put pictures and videos of events in which the department is involved. This site allows the student president to communicate with the mechanical engineering majors to coordinate campus wide STEM events, alert students to potential internships, and to notify students when there are scheduled speakers from the ASME and local companies to talk with all students. All mechanical engineering majors were invited to join the group.

During the annual E-Week competitions, the School of Engineering sponsors several events which include a water bottle rocket competition for local K-12 students. The student president organized the student volunteers to run a late registration booth and the competition. He

coordinated with the command tent for the firing window, had teams set up the area, run the launch sites, retrieve the fired rockets, measure and record distances, conduct crowd control, and break down the equipment.

The student president stated that his goal was “to help develop partnerships with people and companies in a broad spectrum of mechanical engineering disciplines to help guide us into a successful transition from classroom to jobsite.” When the local ASME chapter needed a meeting space in the spring, the student chapter quickly organized and worked the coordination for campus space. This allowed many local companies to come to campus for the first time and learn about the new ME program. ASME was able to engage and recruit students. Students had the opportunity to hear from professionals about how their ME education allowed them to advance their careers. There was time for small group mentoring and networking. During the fall, the student president coordinated two more outside speakers for the student chapter.

Study Abroad

In a recent summer study abroad for engineering students, one veteran student served as a translator for the group. The veteran student was already multi-lingual, but greatly assisted the collective student group in gathering and translating information. His military experience of travelling in foreign countries made him a valuable asset to the instructor and student group. Although most of the times the needed information seemed trivial, the collective time saved by having an immediate answer allowed the group to see and explore more than if the veteran were not part of this group.

Enrollment

As shown in Table 2, the programs that have been initiated have had the desired effect of improving recruiting and retention. Once a student makes it through the gateway courses at The Citadel, 82.5% (was 74%) graduate in 4 years and 92-95% (was 89%) graduate within six years. Every faculty member knows the key to overall retention is retaining the incoming students in significant numbers.

Most of the programs mentioned previously were initiated to help build a positive culture, build community between diverse groups of students, and provide focused activities for select underrepresented groups in engineering.

Table 2: Veteran Enrollment

Student Type	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17 Fall
Active Duty Students	10	16	24	22	19	14	10	13	9
Veteran Students (Day & Evening)	2	1	12	16	20	42	43	37	33
Total	12	17	36	38	39	56	53	50	42

Conclusions

Many of the activities and programs at The Citadel where veterans and active duty students are involved are successful due to direct or indirect involvement of the veteran and active duty students. The SI program with 20% veteran leaders can clearly show the connection between veterans and the program's success. In many of the aforementioned activities and student competitions, veteran leaders are making a difference and setting the example among traditional students. Their ability to organize, plan, and execute is a model for the cadet population which receives much more formal leadership training.

Each veteran student has individual needs and the faculty are obligated to seek a continuum of experiences that allows each student to maximize his or her potential. As the US, and the world, need more engineers, one way to narrow that gap is to recruit and retain veterans that matriculate on campuses wanting to be engineers. They are not always prepared mathematically, but faculty can provide the necessary assistance and mentorship to improve eventual success.

The Citadel has used a multi-prong integration approach that focuses on organizations, activities, assistance, and mentoring. Veteran students seek organizations (student chapters and even departments) to be a part of and experience speakers, conferences, and community service surrounding the group's basic needs. Some students look to socialize and begin to connect with like-minded peers within activities and focused study areas for our veterans and active duty military.

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