Supporting Veteran Students Transitioning to Engineering

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Abstract
As an engineering department in a historically military friendly state, and at a noted military friendly institution, we desire a broader understanding of our veteran population. We would like to develop this institutional understanding so that we may achieve a number of desired goals. These goals include attracting veterans as students to East Carolina University (ECU), increasing the veteran population within engineering, easing the transition from the structured military atmosphere to the freedom associated with the collegiate environment, and ensuring the success of veteran students both during school and after graduation. Anecdotally, veteran students have been strong contributors to the engineering program. The students excel in both classroom and extracurricular activities, including participating in undergraduate research experiences. Gaining a deeper understanding of the characteristics of the veteran population within the engineering department, as well as the ECU’s veteran population at large, will allow the faculty to be in tune to the needs of veterans. These characteristics may include information such as branch of service, length of service, military occupational specialty, and their last duty station. Data collection will occur by surveys and informal interviews. Ultimately, the aim of this work is to facilitate an increase in recruitment and retention from the veteran population into our engineering department. Often their military experience (i.e. perseverance, discipline) makes engineering a feasible and appropriate choice after their service. In general, we want to understand the potential barriers recently separated veterans have to overcome in choosing engineering as a profession and selecting ECU as their preferred school of choice. An increased veteran population within the engineering department at ECU is a win-win situation for both the student veterans and the department.

Introduction
The Engineering faculty at East Carolina University (ECU) have taken notice of the number of veterans in their engineering classes. This may range from one or two to several veterans in a class of 25, to a current course’s three veterans in a class of ten. This intrigued the faculty, and raised several pertinent questions. Could the faculty determine why the veteran students chose ECU from the fifteen public colleges and universities in North Carolina? Why did they choose Engineering as their major? It became apparent the faculty first needed to understand their state, and the military installations and 4-year schools within it a bit better.

ECU is located in North Carolina, a state known for its military ties. In fact, Camp Lejeune in Jacksonville, NC, is home to the largest concentration of sailors and marines (over 47,000) [1], [2]. In addition, Fort Bragg is considered one of the largest military bases [3] with nearly 54000 soldiers [4], and this number is expected to grow [5]. These are only two of nine military installations in North Carolina. The others are: US Coast Guard Air Station Elizabeth City, Marine Corps Air Station Cherry Point, US Coast Guard Sector North Carolina (Wilmington), US Army Corps of Engineers (Wilmington), Seymour Johnson Air Force Base (Goldsboro), Army Research Office (Durham), and NC National Guard Headquarters (Raleigh). Additionally, Naval Station Norfolk, Naval Air Station Oceana, and Naval Amphibious Base Little Creek are located in the Norfolk, Virginia, area and are only a two-hour drive from ECU.
The US Army Corps of Engineers in Wilmington, NC, is home to one of four companies of the 249th Engineer Battalion [6]. The remaining companies are in Hawaii, Virginia, and Rhode Island (Rhode Island’s battalion is comprised of Reservists) [6]. In the 249th Battalion are the soldiers who participate in Power School. Those who complete receive 38 college credits, including Physics I/II with lab, Electronics, and Math credits [7]. The prospective students are told that graduates typically perform tasks of “electrical or mechanical engineers” [8]. Camp Lejeune is home of the Marine Corps Engineering School [9]. While the Marines also go through training, specifics regarding that training and their ability for Marines to receive college credit for their training is information that is not as easily obtained as that for the Army [10], [11].

North Carolina has a university and community college system that reaches all ends of the state. There are sixteen 4-year schools [12] and 58 community colleges [13]. The 4-year state schools offer a wide range of majors, but only six offer Engineering degrees [14]. Of the fifteen 4-year state schools, Table 1 includes the nine institutions that were selected for the Military Times Best: Colleges, 2018 (4 year) list. This list of 4-year schools included 140 colleges and universities from across the United States [15]. Of the nine state schools, four offer Engineering, including East Carolina University. Surprisingly, none of the fifty-eight community colleges in the state are on the Military Times Best: Colleges, 2018 (2 year) list, although it should be noted that the list only contains 34 schools [16].

Table 1: State Schools from North Carolina included on the Military Times Best: Colleges, 2018 (4 year) [15]

<table>
<thead>
<tr>
<th>School</th>
<th>Ranking</th>
<th>Students</th>
<th>Veterans</th>
<th>% Veterans</th>
<th>Offers Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of North Carolina Wilmington</td>
<td>40</td>
<td>15740</td>
<td>6984</td>
<td>44.37</td>
<td>No*</td>
</tr>
<tr>
<td>East Carolina University</td>
<td>48</td>
<td>28962</td>
<td>1221</td>
<td>4.22</td>
<td>Yes</td>
</tr>
<tr>
<td>Elizabeth City State University</td>
<td>75</td>
<td>1357</td>
<td>150</td>
<td>11.05</td>
<td>No</td>
</tr>
<tr>
<td>North Carolina State University</td>
<td>77</td>
<td>33755</td>
<td>614</td>
<td>1.82</td>
<td>Yes</td>
</tr>
<tr>
<td>The University of North Carolina at Greensboro</td>
<td>79</td>
<td>19653</td>
<td>426</td>
<td>2.17</td>
<td>No</td>
</tr>
<tr>
<td>Western Carolina University</td>
<td>82</td>
<td>10803</td>
<td>211</td>
<td>1.95</td>
<td>Yes</td>
</tr>
<tr>
<td>University of North Carolina at Charlotte</td>
<td>83</td>
<td>28721</td>
<td>310</td>
<td>1.08</td>
<td>Yes</td>
</tr>
<tr>
<td>University of North Carolina at Pembroke</td>
<td>91</td>
<td>6277</td>
<td>416</td>
<td>6.63</td>
<td>No</td>
</tr>
<tr>
<td>Appalachian State University</td>
<td>122</td>
<td>18295</td>
<td>659</td>
<td>3.60</td>
<td>No</td>
</tr>
</tbody>
</table>

*Offers 2+2 engineering program with NC State University

So, is there something about proximity to the bases that results in a greater number of veterans attending one 4-year school over another? Figure 1 contains a layout of North Carolina with the locations of the 4-year schools (top panel) a layout of North Carolina with the locations of the military installations (bottom panel). From a quick glance, it seems that the dots in the top image that would benefit from being close to a base are Elizabeth City State University, Fayetteville State University, North Carolina Central University, and North Carolina State University. However, East Carolina University is not one of these schools! It is an hour drive from East Carolina University to the closest military base, and over 90 minutes to the next-closest military
base. So, it is something more than being a quick commute that attracted these students to the Engineering department at East Carolina University.

Figure 1: A comparison of the locations of the military installations (top panel) in North Carolina [17] and the 4-year state schools (bottom panel) [12]. Note that the bottom panel includes a public residential high school for gifted students with the 4-year schools (17. NC School of Science and Mathematics).

Methods
The authors created a simple survey that was advertised to the Engineering students via email. In addition, faculty of the department were encouraged to announce to students about the survey. The survey was created using Qualtrics, and all respondents’ responses were anonymous unless they chose to leave their email address for a follow-up interview. The authors have completed appropriate IRB training, and the protocol has been approved through the ECU IRB.

The list of questions presented to the students were:

- Are you a veteran?
  - Yes
  - No
- What was your branch of service?
  - Air Force
  - Army
  - Coast Guard
  - Marine Corps
  - Navy
- What was the duration of your active duty? (in years; if you have not been active please type 0) [open response]
- What was the duration of your reserve duty? (in years; if you have not served as a reservist please type 0) [open response]
- What was your Military Occupation Specialty (MOS)? If you provide a number/acronym, please provide a title/description. [open response]
- What was your highest rank achieved? (if you prefer not to answer, please skip to next question) [open response]
- Where was your last duty station? [open response]
- Where is your hometown? [open response]
- If your hometown is not in North Carolina, why did you choose to remain in NC after your obligated service time? [open response]
- Why did you pick ECU? [open response]
- Why did you pick Engineering as your major? [open response]
- Do you feel that your military service has impacted (either positively or negatively) your ability to perform as a student in a college setting? [open response]
- You may use this response to leave comments regarding anything that has not been addressed that you wish to share. Please note this is not required and you may choose to skip this question. [open response]
- If you are willing to participate in a one on one face to face interview with one of the investigators regarding your experiences, please leave your name and email address. Please note this is not required to fill out the survey and you may skip to the end of the survey. It is anticipated that these interviews will be audio recorded with the participant's consent, but there will be no personally identifiable information associated with the recordings. [open response]

After collecting the survey data, the in-person interviews were scheduled with the students and two of the researchers. In addition to taking notes, an audio recording was taken for each interview. While there was not a specific script used, the students were asked to acknowledge
that they understood the transcript was to be used to research purposes only, and some of the guiding questions were:

- When did the notion of earning an engineering degree strike you? (i.e. before active duty, during active duty, after active duty)
- What information about 4-year degrees did you get while serving?
- How do/did you think this degree will enhance your life/lifestyle?
- Has this perception changed now that you are enrolled in the program?
- How many semesters do you have until you graduate (not counting this one)?
- When you finish, how many semesters will you have spent on your engineering degree, and at how many institutions?
- May we analyze your transcript for the purpose of looking at time to graduate, geography, the NC tuition surcharge.
- What veteran-focused support services have you used, regardless of source, and what was the source? (i.e. GI Bill, Pirate Veterans group, VFW, local support groups)
- How is our department/college doing supporting veterans?
  - (Do you know which faculty are veterans? Faculty that have close military ties?)
  - (Have you communicated your veteran status to faculty? If yes, or if no, why?)
  - (Do you feel that faculty knowledge of your veteran status has affected how they interact with you?)
  - What could we (Engineering) do better?

Results
Of the 504 current Engineering undergraduate students, twenty-two responded to the survey. Of the twenty-two, five were not veterans. Four people checked that they were veterans, but did not continue the survey beyond that question. Thus, twelve student veterans completed the survey. Table 2 presents data from the survey. Of the twelve students, nine left their contact information. From the nine students, five have come in for face-to-face interviews.

Overall, records indicate that of the 504 currently enrolled students in Engineering at ECU, nineteen are self-identified as veterans. This is 3.77% of the Engineering undergraduate population. This also indicates that 63.2% of the undergraduate Engineering veteran population participated in completing the survey and 26.3% participated in the face to face interview.

With respect to the various branches of the armed forces, one respondent was from the Navy (8.3% of respondents), two were from the Air Force (16.7% of respondents), four were from the Army (33.3% respondents), and five were from the Marine Corps (41.7% of respondents). This is shown in Figure 2.
The veteran students spent an average of 7.1 years active duty, with a standard deviation of ±4.77 years (the range was 2.5 – 20 years). The veteran students spent an average of 1.8 years on reserve duty, with a standard deviation of ±2.93 years (the range was 0-10 years).

Of the twelve respondents, ten had their last duty station in North Carolina. Two of the respondents’ last duty station was Fort Bragg (16.7% of respondents), two were last stationed at Seymour Johnson Air Force Base (16.7% of respondents), three were stationed at MCAS Cherry Point (25%). For the remaining five students, one was last stationed in North Dakota (8.3% of respondents), one was last stationed at Camp Lejeune (8.3% of respondents), one was last stationed at Joint Force Headquarters with the North Carolina National Guard (8.3% of respondents), and one respondent simply listed “NC” as their last duty station (8.3% of respondents).

When looking at highest rank achieved, one veteran achieved E3 (8.3% of respondents), one achieved E4 (8.3% of respondents), seven achieved E5 (58.3% of respondents), and three achieved E6 (25% of respondents).

When considering the military occupation specialties (MOSes) of the students, ten appear to easily relate to engineering fields (83.3% of respondents). The two MOSes which do not appear to relate are infantry rifleman and medic.

The academic transcripts of selected individuals were analyzed to see how many institutions (in addition to ECU) the students had attended, and how many credits they had earned at each institution. This is of particular interest to students at public universities in North Carolina, where the students pay 150% per credit hour over 140 credit hours. Since the Engineering degree
requires 128 credits, there is not much wiggle room for the students to fall by the wayside. This analysis is shown in Figure 3.

Figure 3. The academic transcript of select interviewees were analyzed for the number of institutions attended, the number of credit hours at each institution, and the anticipated number of semesters needed to graduate. The green line indicates the 128 credit hours required for the ECU Engineering degree, and the red line indicates the 140 credit hours where the tuition surcharge is applied.

When asked why the students picked Engineering as their major the answers, the answers were varied. Note that grammar and spelling are retained from original responses.

- i love the idea of creative thinking and problem solving. I was also inspired by the engineers that worked on my jet when i needed help troubleshooting
- I started out as a physic major, and I felt that the department cared very little about their undergraduate students as a whole. Also, I would like to deepen my electronics knowledge.
- I've worked as an engineer for several years after leaving the military. Getting an engineering degree is the logical next career development step.
- I have always loved science, math and the human body. I had originally wanted to be a physical therapist to help veterans get better after injuries. I remembered seeing an Army ranger on my deployment who returned to combat with a prosthetic leg. I never got to meet him personally, but I thought it was amazing to see how he was able to continue to fight for his country despite having his leg amputated. Prosthesis allow people to attempt to have a normal life. I want to help improve those.Other fields of interest were skin grafts for burn patients and emergency medical devices that can be used in a combat or emergency setting.
- Math and science have always been easy for me and I feel like that is because I enjoy learning about them and they really make sense to me. I feel like engineering is the perfect combination of the two--a little more science than math, but lots of both, just how I prefer it.
- Engineering is the product of mathematics, physics, and real-life problem solving. I've always been good with math and loved to work with my hands.
• I've been around engines for the better part of 12 years professionally and as a hobby.
• I have always been mechanically inclined, and having a background in aviation maintenance made it an easy decision. Also, in high school, I enjoyed and did well in my math and science courses. Part of using the Vocational Rehabilitation program through the VA is an aptitude assessment. My scores on that test also determined that engineering was best suited for my skill set and understanding.
• I like breaking things to see how they work as well as building and creating new things and used to think math was fun.
• It seemed like a good route for being a pilot in the military.
• My associates degree was in engineering technology and I wanted to further that education.
• Wanted more than computer science offered. Better pay for jobs as well.

When asked why they picked ECU, the students’ responses could be grouped into several categories: close to home/desired geography (6); applied to NC State and ECU but State didn’t admit me (4); admitted to ECU and State, but chose ECU (2). Separate from this tally, there were three students who mentioned preferring a smaller school/program over a larger school/program.

Discussion
There are several discussion points to be considered. The Student Veterans of America have published several documents tracking veteran students’ success using the Post-9/11 GI Bill. Of interest is the high level of STEM (Science, Technology, and Engineering) degrees. STEM topics were the 2nd most popular majors (behind business), and over 51,000 STEM degrees have been earned by student veterans [18]. In particular, over 12,000 veterans (1.6% of those studied in [19]) earned an Engineering degree.

The current veteran population in Engineering at ECU (3.77%) is not far off from ECU’s student veteran population being 4.22% of the overall student body [15]. The Engineering program at ECU has 504 students in a population of 28962 (1.74% of overall student body). The proportion of students at ECU pursuing an Engineering degree is consistent with the proportion of post-9/11 GI Bill students pursuing an Engineering degree [19]. Further, ECU Engineering’s proportion of veterans is similar (3.77%) to the proportion of veterans for the university as a whole (4.22%).

Even though the number of veteran students pursuing STEM degrees is high (relatively speaking), and that engineering has been named one of the top ten jobs for veterans [20], there are still fewer veterans pursuing engineering degrees than one might expect, given the use of technology and/or electronics, high-level training, and leadership skills the veterans typically have when they depart the military [21].

Future Work
The next steps for this work are to expand the questionnaire to include additional questions, such as did family impact the choice of ECU. We would also like to include veterans at ECU who are not engineering students to see if they encountered barriers that kept them from entering the Engineering program. We are open to deploying the survey at other universities that are interested in gleaning similar information about their veteran population on campus.
We would like to reach out to several of the last duty stations in North Carolina to see how we can best connect with service members prior to separation to discuss their options regarding higher education.
References


