Military Veteran Students' Pathways in Engineering Education (Year 6)

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Susan M. Lord received a B.S. from Cornell University in Materials Science and Electrical Engineering (EE) and the M.S. and Ph.D. in EE from Stanford University. She is currently Professor and Chair of Integrated Engineering at the University of San Diego. Her research focuses on the study and promotion of diversity in engineering including student pathways and inclusive teaching. She is Co-Director of the National Effective Teaching Institute (NETI). Her research has been sponsored by the National Science Foundation (NSF). Dr. Lord is among the first to study Latinos in engineering and coauthored The Borderlands of Education: Latinas in Engineering. Dr. Lord is a Fellow of the IEEE and ASEE and is active in the engineering education community including serving as General Co-Chair of the Frontiers in Education Conference, President of the IEEE Education Society, and Associate Editor of the IEEE Transactions on Education (ToE) and the Journal of Engineering Education (JEE). She and her coauthors received the 2011 Wickenden Award for the best paper in JEE and the 2011 and 2015 Best Paper Awards for the IEEE ToE. In Spring 2012, Dr. Lord spent a sabbatical at Southeast University in Nanjing, China teaching and doing research. She is on the USD team implementing "Developing Changemaking Engineers", an NSF-sponsored Revolutionizing Engineering Education (RED) project. Dr. Lord is the 2018 recipient of the IEEE Undergraduate Teaching Award.

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Abstract

This National Science Foundation (NSF) Research in Engineering Education (REE)-funded project explores the experiences of student veterans in engineering (SVE) at four institutions across the US. Data collection included interviews with key informants in year one of this grant, focus groups with SVEs in year two, and in-depth SVE interviews in year three at each campus. Efforts since then have focused on analysis and dissemination. Here, we provide a summary and highlight some recent results from our work. This study has potential for broad impact by diversifying pathways to and through engineering programs.

Project Goals, Data Collection, and Analysis

In this research, we address the following research questions:

1. Why do veterans pursue a Bachelor's degree in engineering?
2. How do military experiences shape student veterans' educational experiences?
3. What are the experiences of student veterans in engineering education?
4. How do institutions support veterans in engineering education?

Data was collected at four campuses: University of San Diego (USD), North Carolina State University (NCSU), Purdue University, and Clemson University. We conducted interviews with key informants in year one of this project, focus groups with SVEs in year two, and in-depth SVE interviews in year three. Overall, we have data from 25 key informants, 21 focus group participants who were SVEs, and 60 interviews with SVEs, 13 of whom were also focus group participants. As part of the SVE interviews, we also used two innovative methods to obtain richer data: a key event timeline of important events in their lives since the age of 18 and an identity exercise articulating the extent to which various components of their identity were most central to their core self.

All recorded data were transcribed, checked, and entered into Atlas.ti, a qualitative data analysis software program used for in-depth analysis and coding. For focus groups, where possible, the speaker was identified to support textual analysis by variables such as branch of service and major. Speakers are coded with their salient characteristics that they reported on their pre-qualification surveys such as military branch, sex, race, and engineering major. For interview data, we generated episode profiles for a subset of the transcripts to gain a more holistic understanding of our participants and their experiences [1]. To analyze our data, we used constant comparison and thematic analysis to develop our initial categories as they emerged and were pertinent to our research goals.

Dissemination

During year six, we have continued with the dissemination of research results in a variety of venues for a range of audiences, including engineering educators in the US, engineering educators from across the world, student affairs administrators who work with veterans, the

Student Veterans Association (SVA), and the general public [2, 3]. In addition to this paper for the 2020 American Society for Engineering Education (ASEE) Annual Conference NSF Grantees Poster Session, this project has yielded three published journal articles [4, 5, 6] and seventeen published conference papers [7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23]. We did a presentation at the 2019 *Collaborative Network for Engineering and Computing Diversity* (CoNECD) conference in April 2019 [24], a poster [25] at a sociology meeting, two conference special sessions at engineering education conferences [26, 27] and three workshops for student affairs professionals and engineering educators [28, 29, 30]. We delivered an informal session at the 2018 SVA national conference and a presentation at the 2019 Annual Meeting of the Pacific Sociological Association [31]. We presented a paper in the inaugural ASEE Military and Veterans Division and received the Best Paper Award during the Division's second year [13]. In addition, one member of our team participated in a panel for this division [32]. One of our 2019 ASEE papers "Institutional Agents' Roles in Serving Student Veterans and Implications for Student Veterans in Engineering" was selected as the Best Diversity Paper in the ASEE Military and Veterans Division and a finalist for the 2019 Best Diversity Paper at the conference by the ASEE Committee on Diversity, Equity, and Inclusion (CDEI) [22]. We have a workshop accepted for presentation at the 2020 CoNECD conference [33] and a paper accepted for the ASEE conference in June 2020 [34]. We are currently working on several manuscripts for journals.

Findings

Throughout this project, we have focused our analysis on several areas including leadership, first-generation student veterans, Black student veterans, women student veterans, gay student veterans, campus allies and advocates, and how military branch may impact student veterans' choosing engineering. Several of these areas of exploration are being expanded into journal publications.

Based on our interview data, we are examining the experiences of Black student veterans in engineering (BSVE). A paper on this topic was presented at the 2019 *CoNECD Conference* [19]. We are continuing this analysis in more depth for a journal publication where a manuscript is in preparation that will extend the exploration of BSVEs' identity to include areas that were common to most of the participants, including the centrality of religion, socioeconomic class, age, and family relationships, in addition to engineering and veteran identities. We are targeting journals such as the *Journal of Women and Minorities in Science and Engineering* (JWMSE) or IJEE.

In addition, we are working on journal papers including one on "Transitions of student military veterans into higher education" targeted for the journal *Sociological Perspectives*, one summarizing findings for the overarching research questions for a special issue of the *Journal of Veterans Studies,* and one on institutional responses to SVE experiences, targeted for the *Journal of College Student Development.*

In year six, we began analysis of the experiences of engineering students who have served in the National Guard or Reserves and began developing a model of SVE pathways from high school to engineering education. More details are provided below.

Reserves or National Guard

One group that emerged from our data was students who were currently serving in the Reserves or National Guard. A paper on this topic will be presented at the 2020 ASEE *Conference* [34]. We are continuing this analysis in more depth for a journal publication.

From: C. Mobley, J. Murphy, J. B. Main, S. M. Lord, and C. E. Brawner, "The Engineering Education Experiences of Students Serving in the Reserves or National Guard," *2020 American Society for Engineering Education Annual Conference Proceedings*, Montreal, Canada, June 2020.

Much of the research on military-connected students focuses on former members of the military (i.e., "student veterans"), or those individuals who served in the military (i.e., were a part of the "active component"), then exited the military and moved on to pursue their college degrees. These students' educational experiences are often conflated with the experiences of those students who serve in the military while attending college (i.e., those students who are serving in the National Guard or in the Reserves, or the "Reserve Corps" - RC).

In this paper, we focus on students who are actively serving in the RC, either in the Reserves or National Guard, while pursuing their engineering degrees (i.e., Reserve and National Guard Engineering (RANGE) students). We examine RANGE students' motivations for joining the military and engineering and the extent to which these students experience benefits as a result of their simultaneous military service and educational pursuits.

Drawing on in-depth interviews of 15 RANGE students, we investigate the following questions:

(1) Why did RANGE students choose to join the military?
(2) Why did RANGE students choose to major in engineering?
(3) What are some opportunities and benefits to RANGE students of serving in the military while majoring in engineering?

Our analysis reveals that RANGE students joined the military primarily to receive financial assistance. The timing of this realization and reasoning varied across the RANGE students. Some students joined the military prior to college, knowing they needed the financial assistance. Others joined after attending school for a semester or two and realizing that college was more expensive than anticipated. A predominant theme for RANGE students was the perceived flexibility that participants felt they had in choosing their military occupational specialty due to their contemporaneous engineering and military experiences. This finding is in contrast to our prior research on student veterans who felt they had little flexibility in choosing their Military Occupational Specialty (MOS). In terms of benefits of their service, the RANGE students were also able to make direct, real-time connections between their engineering studies and their military service. Our prior research on SVEs found that SVEs may not have been able to make such direct connections due to the passage of time between their military service and their engineering studies.

Pathways from High School to Engineering Education

Drawing on all of our data, we are developing a model of the pathways followed by these SVEs from high school to engineering education. A paper on this topic was presented at the 2019 *SEFI Conference* [23]. We are continuing this analysis in more depth for a journal publication where a manuscript is in preparation. We are targeting the *International Journal of Engineering Education* (IJEE) or the new journal*, Studies in Engineering Education*.

From: J. B. Main, S. M. Lord, C. Mobley, C. E. Brawner, M. Camacho, and C. Pantoja, "Military veterans' pathways from high school to postsecondary engineering education," *European Society for Engineering Education (SEFI) Annual Conference,* Budapest, Hungary, September 2019.

This study examines the pathways of U.S. military veterans from high school to postsecondary engineering education. In the U.S., there is a growing demand for engineering professionals from diverse backgrounds. Given that many military veterans come from diverse backgrounds and some receive technical training while in the military, their participation in engineering education has great potential to contribute to expanding and diversifying the engineering workforce. This is a mixed methods case study that utilizes survey data and semi-structured interviews with 20 military veterans pursuing engineering degrees across four academic institutions in the U.S. Our analysis of the survey data reveals that student veterans in engineering (SVEs) take various paths as they embark upon their engineering studies. Thematic analysis of the in-depth interviews shows that SVEs pursue engineering based on numerous factors, including: early and life-long engineering interest, encouragement from veterans' centers, and the positive job outlook. This article presents four cases of participant pathways into engineering education. Research findings provide context and information regarding student veterans' pathways into engineering, revealing overlooked areas for promoting student veterans' participation in engineering as well as encouraging the development of new strategies to support student veterans' interest and success in engineering.

Overall Recommendations

Workshop

Drawing from all of the results and findings of our grant, we have prepared a workshop for engineering educators on welcoming student veterans to engineering. This will be presented at the 2020 CoNECD conference.

C. Brawner, C. Mobley, S. M. Lord, and J. B. Main, "Welcoming Student Veterans to Engineering: An Interactive Session for Faculty and Administrators," Workshop presented at the *Collaborative Network for Engineering and Computing Diversity (CoNECD) Conference,* Crystal City, VA, April 2020.

The goals of this session are to help faculty and administrators better understand the strengths and needs of student veterans in engineering. We

- Gave a profile of student veterans
- Explained the assets and range of skills and experiences that veterans bring to the engineering classroom
- Identified the challenges faced by student veterans as they transition to engineering classrooms.

- Gave faculty tools to engage and encourage veterans in their classes.
- Provided administrators with recommended actions to ease the transition of veterans to their campuses.

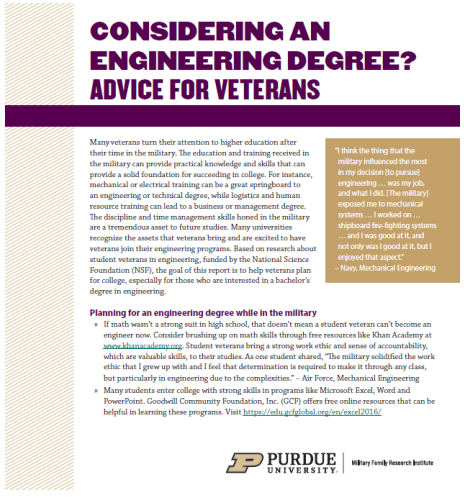
Participants are encouraged to think about the resources for veterans on campus and how veterans may be treated in their classrooms. In pair-share activities, participants discussed such questions as:

- What resources are on your campus for veterans? What may be missing?
- What encounters have you had with student veterans in your classrooms?
- How can veterans' experiences be developed as an asset in your classes?
- How can veterans' technical skills be an advantage in your classes?
- How can veteran students enact leadership skills in your classes?
- What can you do to encourage veterans to come forward with specific needs that they may have to optimize their learning environment?
- How can you accommodate hearing loss, PTSD, ADHD, and pain from combat injuries in your classroom?

The presenters will provide specific tips and feedback that can be immediately implemented by attendees when they return to their home campus.

Tip Sheets

To share the overall results of our grant with a wider audience, including veterans and those in the military, we drafted brief tip sheets for service members considering going to college, veterans interested in pursuing a bachelor's degree in engineering, and engineering faculty. We shared these with our External Advisory Board (EAB) at our meeting in June 2018. They provided feedback throughout 2018-2019 and encouraged us to find a partner to transform these tip sheets into visually appealing products that could be shared with a wider audience. In Spring 2019, we began working with the Military Family Research Institute (MFRI) at Purdue University on these tip sheets. We chose to work with MFRI based on the advice of our EAB and invitation from Dr. Shelley MacDermid Wadsworth (EAB member and MFRI Director). MFRI has experience developing such materials. We are currently working with MFRI staff on editing and style. MFRI has agreed to help with development and dissemination, largely to military audiences. MFRI's assistance will be very helpful for us as we strive to promulgate our research findings beyond academic settings and into the military. Figure 1 shows an example of the front page of one of these tip sheets for veterans considering engineering. Other tip sheets are available with advice for veterans considering college and for faculty and administrators


CONSIDERING AN ENGINEERING DEGREE? ADVICE FOR VETERANS

Many veterans turn their attention to higher education after their time in the military. The education and training received in the military can provide practical knowledge and skills that can provide a solid foundation for succeeding in college. For instance, mechanical or electrical training can be a great springboard to an engineering or technical degree, while logistics and human resource training can lead to a business or management degree. The discipline and time management skills honed in the military are a tremendous asset to future studies. Many universities recognize the assets that veterans bring and are excited to have veterans join their engineering programs. Based on research about student veterans in engineering, funded by the National Science Foundation (NSF), the goal of this report is to help veterans plan for college, especially for those who are interested in a bachelor's degree in engineering.

"I think the thing that the military influenced the most in my decision [to pursue] engineering … was my job, and what I did. [The military] exposed me to mechanical systems … I worked on … shipboard fire-fighting systems … and I was good at it, and not only was I good at it, but I enjoyed that aspect."
– Navy, Mechanical Engineering

Planning for an engineering degree while in the military

- If math wasn't a strong suit in high school, that doesn't mean a student veteran can't become an engineer now. Consider brushing up on math skills through free resources like Khan Academy at www.khanacademy.org. Student veterans bring a strong work ethic and sense of accountability, which are valuable skills, to their studies. As one student shared, "The military solidified the work ethic that I grew up with and I feel that determination is required to make it through any class, but particularly in engineering due to the complexities." – Air Force, Mechanical Engineering
- Many students enter college with strong skills in programs like Microsoft Excel, Word and PowerPoint. Goodwill Community Foundation, Inc. (GCF) offers free online resources that can be helpful in learning these programs. Visit https://edu.gcfglobal.org/en/excel2016/

PURDUE UNIVERSITY | Military Family Research Institute

Figure 1 Front page of sample tip sheet produced by Purdue Military Family Research Institute based upon findings from this grant.

interested in supporting student veterans. The three tip sheets are available at https://bit.ly/NSFMilitaryVeteranStudents

Mentoring

The research team has provided research mentorship to two graduate student and two undergraduate students as part of this project. Mentoring students to conduct research in the field of student veteran engineers not only broadens the impacts of our work, but also provides valuable training to future scholars.

Joseph Murphy graduated from Clemson University in May 2019 with a bachelor's degree in sociology. He is now a graduate student in Sociology at the University of California, Los Angeles (UCLA), one of the nation's premier graduate programs in sociology (ranking # 8 in Sociology graduate programs in 2018). Mr. Murphy collaborated on our research investigating the experiences of engineering students who have served in the National Guard or Reserves. He will present this work at the 2020 ASEE conference and is also collaborating on a journal publication.

Christina Pantoja is a PhD student in the School of Engineering Education at Purdue University. Ms. Pantoja is a co-author on the paper for the SEFI conference investigating pathways of SVEs.

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