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Brian J. Novoselich

Janice Leshay Hall

Keith A. Landry

Joyce B. Main

Anthony W. Dean

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Supporting Veteran Students Along Engineering Pathways: Faculty, Student, and Researcher Perspectives

Lt. Col. Brian J Novoselich P.E., U.S. Military Academy

Brian Novoselich is an active duty Army Lieutenant Colonel currently serving as an Assistant Professor in the Department of Civil and Mechanical Engineering at the United States Military Academy (West Point). He earned his Ph.D. in Engineering Education at Virginia Tech in 2016. He holds Master's and Bachelor's degrees in mechanical engineering from The University of Texas at Austin and West Point respectively. His research interests include capstone design teaching and assessment, undergraduate engineering student leadership development, and social network analysis. He is also a licensed professional engineer in the Commonwealth of Virginia.

Mrs. Janice Leshay Hall, Virginia Polytechnic Institute and State University

I am a doctoral student in Engineering Education at Virginia Tech. I am a proud military brat with a biomedical engineering background. My own experiences navigating the engineering curriculum as a first-generation college student as well as being a colleague to other military-connected students through my membership as a 2010 Tillman Military Scholar have sparked my passion for research on pathways to and through engineering with emphasis on the formation of engineering identity especially among veteran students.

Dr. Keith A. Landry, Georgia Southern University

Keith Landry, PhD, PE, F.ASCE Colonel (Retired), US Army Assistant Dean for Research Assistant Professor of Civil Engineering

College of Engineering & IT Civil Engineering & Construction Management Department Georgia Southern University Statesboro, GA

Dr. Joyce B. Main, Purdue University, West Lafayette (College of Engineering)

Joyce B. Main is Assistant Professor of Engineering Education at Purdue University. She holds a Ph.D. in Learning, Teaching, and Social Policy from Cornell University, and an Ed.M. in Administration, Planning, and Social Policy from the Harvard Graduate School of Education.

Dr. Anthony W Dean, Old Dominion University

Dr. Anthony W. Dean has had several roles in academia. His previous appointments include Associate Professor of Engineering Technology and as Associate Director of the Institute for Ship Repair, Maintenance, and Operations at Old Dominion University (ODU). He is currently on assignment with the Office of the Dean for Sponsored Programs and the Engineering Fundamentals Department, Batten College of Engineering and Technology (BCET) at ODU. His research has focused mostly on control systems (integration and testing) and the reliability and maintainability of complex systems. He has been selected as both a NASA and an ONR Faculty Fellow. He regularly teaches courses in Marine Engineering and in Maintained Systems. Most recently Dr. Dean was on the Headquarters Staff the American Society of Naval Engineers. He received his Ph.D. from the Department of Engineering Management and Systems Engineering, and a B.S. in Nuclear Engineering Technology, from the Batten College of Engineering and Technology at Old Dominion University. Additionally, Dr. Dean received an MBA from the College of William and Mary. Prior to his academic career Dr. Dean was Director of Operations and Business Development for Clark-Smith Associates, P.C., and served as an Electrician in the US Navy aboard the USS South Carolina and the USS Enterprise.

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Abstract

Student veterans, with their highly technical military training, may help remedy national level gaps in qualified science, technology, engineering, and mathematics (STEM) workers. Recent military education benefits and military end strength reductions have the potential to bolster the nation's engineering technician, engineering technologist, and engineer (ETETE) workforce. Recent work by the National Science Foundation indicates that supporting veteran students towards ETETE careers involves three key tasks for educators: 1) building early awareness of ETETE pathways; 2) ensuring academic recognition for prior military work experience; and 3) providing seamless support from government agencies, academic institutions, and industry. Many veterans experience an abrupt and unsupportive transition from military to civilian academic pursuits, which may negatively affect their retention and persistence in the field. Among other factors, delays in education benefits, a lack of academic credit for prior work experience, and less structured academic environments all may contribute to this negative perception. The growing number of veterans pursuing STEM degrees, and the diversity of this underserved group of students continues to garner the attention of faculty and administrators in an effort to mitigate these transition challenges.

The purpose of this paper is to examine the initiatives and challenges discussed by a diverse panel of military and veteran-related students, faculty, and researchers during the 2016 ASEE annual conference. The topics discussed during the panel are related to previous research regarding the challenges faced by veteran students beyond ETETE career paths to contrast similarities and differences between veteran ETETE students and their peers in other undergraduate programs. Results from this panel suggest that veteran students still struggle in navigating the transition from military to academic life and that a lack of constructive credit for military training and experience may exacerbate these challenges. A series of novel initiatives are presented that may assist faculty and administrators in adopting a fresh approach to veteran student support. Developing veteran student support programs that include on-going peer mentorship components akin to the engineering support programs being implemented for women and underrepresented minorities may play an important role in veteran student success.

Introduction

Recent military education benefits [1] and military end strength reductions [2] have the potential to bolster the nation's engineering technician, engineering technologist, and engineer (ETETE) workforce to close national level gaps in qualified science, technology, engineering, and mathematics (STEM) workers [3]. Recent work by the National Science Foundation (NSF) and the American Society for Engineering Education (ASEE) indicates that supporting veteran students towards ETETE careers involves three key tasks for educators: 1) building early awareness of ETETE pathways; 2) ensuring academic recognition for prior military work experience; and 3) providing seamless support from government agencies, academic institutions, and industry [4]. Many student veterans and service members (SVSM) experience an abrupt and unsupportive transition from military to civilian academic pursuits, which may negatively affect their retention and persistence in the field [4]. Among other factors, delays in education benefits, a lack of academic credit for prior work experience, and less structured academic environments all may contribute to this negative perception [5]. The growing number of veterans pursuing

STEM degrees and the diversity of this underserved group of students continues to garner the attention of faculty and administrators in an effort to mitigate these transition challenges [6] [7] [8] and bolster their ETETE career goal attainment.

Review of Literature

SVSMs face challenges when transitioning from their military service to higher education. Recent study of SVSMs' broad higher education experiences describe the cultural disconnects that exist between the military and higher education [5] broadly. In particular, Arminio et al. describe how the three salient areas of structure, collectivism, and masculinity differ between military and higher education cultures (Figure 1). As SVSMs transition from the highly structured, group oriented, and masculine culture of the military to the less structured, individualistic, and more gender equal culture of higher education, they may be challenged to reconcile these stark contrasts. Similar cultural differences related to structure and collectivism have been described in more recent work examining SVSMs in engineering specifically [9]. In addition to these acculturation challenges, Landry and Jackson [8] highlight the results from the Institute for Veterans & Military Families (IVMF) that list the top five challenges for SVSMs as: 1) Age differences, 2) Financial resources, 3) Working full time, 4) Family responsibilities, and 5) Few veteran resources on campus. These challenges may compound the cultural differences SVSMs must navigate as they transition from the military to higher education. An unsupportive environment may cause SVSMs to turn inward toward their military heritage, exacerbating the acculturation challenge [5] and inhibiting the accomplishment of education goals.

<u>Military Culture</u>		<u>Higher Education Culture</u>
	Structure	
Rigid Hierarchical Structures		Undefined Structures
	Collectivism	
Highly Collective		Individualistic
	Masculinity	
Disproportionately Male		Gender Equality

Figure 1: Military and Higher Education Cultural Differences.

Understanding the nuances of SVSM challenges may assist in developing an educational environment deemed supportive by SVSMs in ETETE pathways. To assist SVSMs, NSF and ASEE advocate a series of key tasks for the military and higher education communities (Figure 2) [4]. These key tasks were generated through a comprehensive meeting of military and civilian professionals from both academia and industry to assist SVSMs toward ETETE careers. These tasks cast a wide net around the many barriers to successful careers that may exist for SVSMs in ETETE pathways and align generally with the top five challenges for SVSMs mentioned previously. These tasks alone, however, may not fully inform faculty and administrators regarding the cultural difference that exist during the transition process.

The purpose of this paper is to examine the challenges and initiatives discussed by a diverse panel of military and veteran-related students, faculty, and researchers during the 2016 ASEE annual conference. The topics discussed during the panel are related to this previous research

regarding the SVSM experiences in higher education broadly and support within ETETE career pathways to better understand current alignment with previous research.

<u>ETETE Career Success Key Tasks</u>	
Military Service	Higher Education
<ul style="list-style-type: none"> • Early information about educational opportunities • Availability of math and science courses • Advice on aligning experience with course work • Early contact with academic institutions • Advice from vets who have successfully made the transition via social networking and other means 	<ul style="list-style-type: none"> • Guidance through the application process • Assistance with paying for higher education • Appropriate courses at all levels of higher education • Mentoring, advising, and support while in higher education • Relevant internship, coop, and research experiences

Figure 2: Key Tasks in support of SVSM ETETE Career Success

Methods

This paper synthesizes the perspectives expressed during the ASEE Military and Veterans Engineering Education Constituent Committee's inaugural veterans panel. The authors led this panel (Table 1), which occurred during the 2016 ASEE Annual Conference in New Orleans, Louisiana and was attended by about a dozen additional conference attendees. This synthesis particularly addresses two research questions:

- 1) *SVSM challenges*: What challenges do SVSMs face during their ETETE education experience?
- 2) *Ongoing Initiatives*: What initiatives are proposed or on-going to support SVSMs in their ETETE education experience?

The audio recordings and subsequent transcript of the panel session were analyzed to identify themes based on the duration and depth of conversation that occurred around a particular point. Detailed qualitative coding was not used in this work given the nature of the panel discussion and role of the panel moderator in shaping the conversation and moving the session forward. This work did not conform to a systematic process of qualitative inquiry and the results reported here may be considered anecdotal accounts provided by panel participants. This panel discussion focused largely on supporting SVSMs through their undergraduate education and into ETETE careers. Because some of the panel members also had graduate educational experiences to reflect upon, these experiences were also included in the discussion as they had relevance in developing the themes that emerged from the panel discussion.

Table 1: Summary of Panel Discussion Leaders

Name	Position	Institution	Military Experience
Brian Novoselich (Moderator)	Assistant Professor of Mechanical Engineering	USMA West Point	Army Lieutenant Colonel
Mel G. Williams Jr.	Executive Director of Strategic Research and Development	The University of California, Davis	Navy Vice Admiral (ret)
Keith Landry	Assistant Professor of Civil Engineering	Georgia Southern University	Army Colonel (ret)
Kerry Ratliff	Technician/ Undergraduate Student	Engineering Research and Development Center (ERDC)/ Mississippi Community College	Former Army Enlisted
Joyce B. Main	Assistant Professor of Engineering Education	Purdue University	None
Tony Dean	Associate Professor	Old Dominion University	Former Navy Enlisted

Results and Discussion:

SVSM Challenges

From the panel discussion, four themes emerged regarding SVSM challenges (Table 2). These themes demonstrate a breadth of challenges that may impede SVSM ETETE pathway goal attainment. Overall, these challenges showed remarkable alignment with previous research regarding SVSM experiences in higher education. These challenges failed to align with the masculinity cultural difference illuminated by previous research and the authors posit that this particular difference may stem from the over-representation of males in engineering programs in contrast to the greater gender parity of higher education broadly.

The first theme that emerged from the panel discussion were the concerns of SVSMs *fitting in* with the academic culture at their educational institutions. This challenge was consistent with their status as non-traditional students. The SVSM pathway to ETETE education is typically delayed from their civilian counterparts because of their years of military service. Correspondingly, the panelists describe SVSMs as older and with more life experiences than traditional students, often having additional life responsibilities such as supporting a family and full-time employment which may lead to different study habits and priorities than their younger civilian counterparts. Panelists also describe SVSMs as having stronger work ethic and discipline which they attribute to years of military service and the additional life experiences commensurate with that service. The theme of fitting in included descriptions of very early challenges integrating into the higher education culture which participants attributed to additional burdens navigating convoluted veteran registration, “paperwork” processes which seemed contrary to how, “the military flows”. Coming from a military academy undergraduate

education, one participant with graduate student experience also described a lack of understanding regarding a university's organizational structure as an additional contributor to not fitting in. This experience indicated that fitting in may be an issue for graduate students in addition to undergraduates. This lack of understanding created a sense of, "running and hunting" throughout his educational experience.

Table 2: Summary of SVSM Challenges

Challenges	Description
Fitting-In	<p>Veteran Students are non-traditional in the following areas:</p> <ul style="list-style-type: none"> • Delay in education due to national service • Level of life experiences • Additional life responsibilities (i.e. work and family) • Different educational experiences than traditional students. • Discipline • Additional self-confidence • Strong work ethic
Math and science skills	SVSM may have not taken required math and science in high school or these perishable skills have degraded due to time gap in education.
Funding	Post 9-11 GI Bill only covers 36 months of education while a typical undergraduate engineering education may take 4-6 years.
College Credit	Veteran engineering students are often challenged to receive constructive credit for technical educational experiences or transfer credits from other educational experiences.

Closely tied to the challenge of fitting in was a challenge in *math and science skills*. This challenge particularly emanated from one panelist. The challenge encompassed SVSM challenges either meeting the pre-requisite math and science requirements of ETETE education ("barriers to entry") or the perishing of those skills ("pitfalls") because of the delay in the student's educational experience. This challenge may prevent some SVSMs from pursuing ETETE education or may prolong the educational experience for others as they take refresher courses to ensure success along the educational pathway. This challenge was specifically mentioned as a key task for military services to address as mentioned previously.

Panelists also discussed a challenge related to *funding* the educational experience. This challenge seemed particular to an undergraduate experience and was attributed to a miss-match in funding timelines. The 36 months of funding provided by the post 9-11 GI Bill was considerably less time than the "5-6 year" degree completion time that one panel member attributed to an undergraduate engineering experience. This funding challenge was compounded by SVSMs' financial obligations associated with their additional life responsibilities. The overall conversation regarding this challenge created a sense that ETETE educational experiences should be streamlined to the greatest extent possible to lessen the financial burden of SVSMs. This discussion was directly linked to a proposed "firehose approach" to SVSM education which is further discussed in the supporting initiatives section of this paper.

The theme of funding was entangled with a theme of *college credit* as a seemingly compound problem. The college credit challenge described issues SVSMs have transferring their military service experiences or other educational experiences into credit at a degree granting institution. Multiple panel members discussed a lack of commonality across institutions regarding the translation of military service experiences to college credit. Multiple panelists described the American Council on Education (ACE) guidelines [10] as a source of providing this translation, but one panel member went on to describe how the ACE guidelines may not exactly match the requirements of various college courses and are also subject to interpretation. An inability to provide constructive credit for technical military experience may prolong the educational experience for SVSMs, increasing their financial burden. Similarly, some panelists describe SVSMs taking courses at a community college to lessen the financial burden but subsequently have challenges translating these credits to a four-year institution, which may also prolong the educational experience and financial burden. Finally, one panel member shared her research findings indicating a lack of transparency regarding college credit for SVSMs. She indicated that additional transparency of the progress would “go a long way” in decreasing this challenge.

SVSM Support Initiatives

From the panel discussion, five themes emerged regarding SVSM support initiatives (Table 3) to counter some of the challenges described in the previous section. These themes demonstrate a wide range of efforts focused on the success of SVSMs along their pathway to ETETE career goal attainment. With the exception of a firehose approach to education, these themes showed considerable alignment between the NSF and ASEE advocated key tasks (see [4]). All themes are discussed in detail below.

The most prominent topic discussed in support of SVSMs was *mentoring programs*. These programs took many forms but centered on the idea of more experienced veterans helping younger SVSMs navigate the challenges of ETETE educational opportunities. In all cases, these programs provided a sense of veterans helping other veterans succeed. Mentoring programs spanned the ETETE educational experience. One participant discussed the mentoring he received from his colleagues at his job, which helped him prepare for and succeed in his undergraduate education. This workplace mentoring idea was expanded upon by another panel member who had helped to implement a more structured veteran mentoring network at the Department of Energy to help ensure success of veterans once in the ETETE workplace. Within the higher education experience, another panel member discussed his experiences mentoring SVSMs as a faculty member. He focused the conversation on how military artifacts within his office helped SVSMs self-identify and enter into mentoring relationships. These veteran-to-veteran relationships were deemed safer by SVSMs than those established with more traditional faculty members. He described the initial mentoring relationships as a grassroots effort that has since expanded into a more structured veteran mentorship program that is still in development (see [8]). These mentoring experiences highlighted the importance and influence of an established veteran network taking a vested interest in the success of SVSMs. This idea was highlighted by one panel member who attributed his institution’s solution to registration,

“paperwork” processes mentioned previously by hiring a veteran to specifically address recurring issues and centralize the process.

Table 3: Summary of Initiatives for Supporting SVSMs.

Initiatives	Description
Mentoring Programs (veterans helping veterans)	Programs where more experienced individuals help inform and facilitate the actions of SVSMs either formally or informally.
Educating Educators	Efforts to inform civilian faculty and administrators regarding the details of military service.
College Credit Understanding	Systems used to better inform the college credit process for SVSMs.
Firehose Approach	A compressed approach to undergraduate education allowing SVSMs to expedite their education and better align with funding timelines.
Pathway Understanding	Research Efforts to better understand the entire pathway of SVSMs from High School to ETETE employment.

The prominence of the mentoring discussion provided parallels to current strategies for supporting the retention of women and underrepresented minorities. In a recent comprehensive study by the American Society for Engineering Education, both peer and faculty/graduate student mentoring were listed as best practices by the majority of programs involved in the study [11]. Lee and Matusovich [12] include both mentoring and informal advising as inputs to their co-curricular support for engineering students model. Outputs to their model included both faculty/staff proximity and faculty/staff relationships which panelists also discussed as a part of the mentoring theme described above. The similarities between current student retention best practices and the mentoring theme described previously provided some preliminary indications that those interventions used to bolster retention of women and underrepresented minorities through engineering students support centers may also be applicable to SVSM support systems.

To garner support for SVSMs at an institutional level, one panel participant highlighted his effort in *educating educators*. These efforts centered on de-mystifying military service for faculty and administrators in an effort to show how veterans may bring value to an organization. His effort included both advisory board meetings to provide information regarding educational experience inherent to military service as well as experiential trips for faculty and administrators. These experiential trips allowed participants to see and interact with service members in their daily technical duties, which helped change perceptions regarding what it meant to serve in an ETETE role in the military. This panel participant embarked on this educating educators initiative to better inform decision making regarding institutional policies to support SVSMs. These experiences may also allow faculty and administrators to better understand the difference in culture that exist between the military and ETETE education programs.

Multiple panel members discussed initiatives related to *college credit understanding*. Combined, these initiatives were designed to support SVSMs in either constructive credit for technical military experience or transfer credit from other educational institutions. One panel member discussed an initiative at his institution that consolidated all SVSM advising under himself (a fellow veteran) to help facilitate the interpretation of joint service transcripts and award college credit accordingly. Another panelist described how his institution created an articulation agreement with the Navy's nuclear program to provide 6 credits toward a Master of Science degree in engineering to help streamline the constructive credit process. A third panel member discussed how his institution created an articulation agreement with the local community colleges to help facilitate understanding of transfer credit policies for SVSMs. In total, the initiatives aimed at college credit understanding were institution specific and some panel members aspire to create a broader system of college credit for SVSMs. These aspirations were met with challenges however, as individual institutions maintain ownership of their degree processes. This theme also had natural parallels to the engineering student retention best practice of academic advising [11]. This additional parallel provided further evidence that current best practices for the retention of other student populations may also be useful for SVSMs.

A fourth initiative that gained traction throughout the panel discussion was the creation of a *firehose approach* to ETETE education for SVSMs. This proposed initiative grew throughout the panel discussion and became the subject of some debate near the end of the session. This approach synergized the challenges of fitting in and funding. The panel members constructed synergy between the discipline, additional self-confidence, and strong work ethic attributed to veteran students. The panel members proposed an ETETE educational experience marked by a greater than normal workload (like drinking from a firehose) that would enable SVSMs to complete their degree requirements in a shorter period of time. This proposed firehose approach would help to alleviate the challenge related to funding by allowing completion in the time covered by the Post 9-11 GI Bill and preventing SVSMs from requiring additional funding sources. This proposition was corroborated by another panel member whose research results indicated that SVSMs express a desire to fill perceived free time during the educational experience with additional workload to lessen the time to degree attainment. She suggested a focus on introductory or preparatory courses to help alleviate some of the math and science skills challenges discussed previously. She further recommended a summer 'boot camp' scenario that may help prepare students for future success but cautioned against a sustained four-year firehose approach to education as it might place an undue burden on the student.

A final set of initiatives highlighted within the panel was developing *pathway understanding* for ETETE SVSMs. One panel member highlighted her ongoing research efforts to support SVSMs in their ETETE pathways by developing a greater understanding of their pathways toward their post educational goals. Her ongoing research seeks to differentiate between SVSMs and other non-traditional students regarding factors that promote their persistence in ETETE pathways. Her efforts and those of this panel session may promote more informed policy decisions regarding how institutions may best support SVSMs along their pathway toward ETETE careers.

Conclusions

Results from this panel suggest that veteran students may still struggle in navigating the transition from military to academic life and that a lack of constructive credit for military training and experience may exacerbate these challenges. Overall, the challenges highlighted by this panel discussion were somewhat aligned with previous research regarding the challenges faced by SVSMs in higher education broadly and key tasks to support ETETE career success. The initiatives presented by this panel were largely consistent with the key tasks to support SVSMs in ETETE career pathways and may assist faculty and administrators in adopting a fresh approach to veteran student support. The results also suggest that faculty may look toward mentorship programs like those being adopted by women and underrepresented minority engineering support programs for supporting veteran student success. These programs may serve as models for supporting SVSMs considering the depth of conversation regarding mentoring within the panel session. Within the specific areas of math and science skills and college credit, continued emphasis within the military service and higher education may help alleviate these challenges through advising SVSMs early and often in the transition toward higher education.

The unique firehose approach to engineering education for SVSMs is an area worthy of further inquiry. The SVSM attributes of self-confidence, discipline, and strong work ethic may be under-appreciated or misaligned with current (traditional) higher education curriculum and practices. Faculty and administrator may consider intensive summer ‘boot camp’ programs. These programs could provide SVSMs with the additional educational experiences necessary to accomplish their educational goals within the funding constraints of current benefits. These types of programs may be better aligned with some of the unique attributes (i.e. self-discipline and strong work ethic) that the military imparts on SVSMs.

Overall, the results of this panel are a cause for cautious optimism. The degree of alignment between current initiatives discussed by the panel members and the key tasks advocated by NSF and ASEE demonstrate that positive change may be occurring on college campuses. Through continued outreach efforts, SVSM advocacy groups such as the Military Engineering and Veteran Constituent Committee may allow for greater SVSM support across a wider array of college campuses.

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